



**PRE-DESIGN INVESTIGATION WORK PLAN  
REVISION 3**

**REMEDIAL DESIGN SERVICES  
SWAN ISLAND BASIN PROJECT AREA  
CERCLA DOCKET NO. 10-2021-001**

**PORTLAND HARBOR SUPERFUND SITE  
PORTLAND, MULTNOMAH COUNTY, OREGON**

**Contract Number: DT2002**

*Prepared for:*

**Swan Island Basin Remedial Design Group**

*Prepared by:*



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**May 2022**

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**May 2022**

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**PRE-DESIGN INVESTIGATION WORK PLAN  
Swan Island Basin Project Area  
Portland Harbor Superfund Site**

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## LIST OF ACRONYMS AND ABBREVIATIONS

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3D	Three dimensional
ACM	active channel margin
ADCP	acoustic doppler current profiler
AIS	Automatic Information System
ARCS	Assessment and Remediation of Contaminated Sediments
ASAOC	Administrative Settlement Agreement and Order on Consent
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing Materials
BMP	best management practice
BODR	Basis of Design Report
Bridgewater	Bridgewater Group, Inc.
COC	contaminant of concern
CPT	cone penetration test
CSM	conceptual site model
CUL	cleanup level
CWA	Clean Water Act
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DDx	refers collectively to DDD, DDE, and DDT
DTNA	Daimler Trucks North America LLC
EC	electrocoagulation
ECSI	Environmental Cleanup Site Information
ENR	enhanced natural recovery
EPA	U.S. Environmental Protection Agency
ERP	Emergency Response Plan
ESD	Explanation of Significant Differences
FMD	future maintenance dredge
FS	Feasibility Study
FSP	Field Sampling Plan
ft	foot/feet
GIS	geographic information system
GPS	global positioning system

## LIST OF ACRONYMS AND ABBREVIATIONS (continued)

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HASP	Health and Safety Plan
HEA	Habitat Equivalency Analysis
HGL	HydroGeoLogic, Inc.
HVS	high-volume, time-weighted sampling
LiDAR	light detection and ranging
MNR	monitored natural recovery
MTLS	Mobile Terrestrial LiDAR Survey
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
ODEQ	Oregon Department of Environmental Quality
OHS	Oregon Historical Society
OHWM	ordinary high water mark
OU	operable unit
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
PDI	Pre-Design Investigation
PeCDD	1,2,3,7,8-pentachlorodibenzo-p-dioxin
PGG	Pacific Groundwater Group
PHSS	Portland Harbor Superfund Site
PIC	Principal-in-Charge
PM	Project Manager
PTW	principal threat waste
QAPP	Quality Assurance Project Plan
QC	quality control
RA	Remedial Action
RAL	Remedial Action Level
RAO	remedial action objective
RD	Remedial Design
RI	Remedial Investigation
RM	River Mile
ROD	Record of Decision
RPC	recontamination potential chemical
RPM	Remedial Project Manager

## LIST OF ACRONYMS AND ABBREVIATIONS (continued)

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SAR	Sufficiency Assessment Report
SCM	source control measures
SIB	Swan Island Basin
SMA	Sediment Management Area
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
Vigor	Vigor Industrial, LLC

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**PRE-DESIGN INVESTIGATION WORK PLAN  
SWAN ISLAND BASIN PROJECT AREA  
PORTLAND HARBOR SUPERFUND SITE  
PORTLAND, MULTNOMAH COUNTY, OREGON**

## **1.0 INTRODUCTION**

This Pre-Design Investigation (PDI) Work Plan proposes an approach to collecting additional data, conducting surveys, and performing analysis necessary to develop the Remedial Design (RD) for the Swan Island Basin (SIB) Project Area within the Portland Harbor Superfund Site (PHSS). Upon U.S. Environmental Protection Agency (EPA) approval, this plan will guide a focused data collection and analysis effort to supplement existing data and analysis and provide the technical basis for developing the RD to remediate contaminated sediments and riverbanks within the SIB.

On December 1, 2000, PHSS was listed on the National Priorities List due to concerns about contamination in the riverbed sediments and the potential risks to human health and the environment. The most widespread contaminants found at PHSS include polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and dioxins/furans. The vicinity and boundaries of the SIB Project Area are shown on Figure 1-1.

In January 2017, EPA issued a Record of Decision (ROD) that presents the selected remedy for the in-river portion of PHSS contamination. The selected remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act, and to the extent practicable, the National Contingency Plan.

EPA published an Explanation of Significant Differences (ESD) (EPA, 2019a) after completion of a sitewide PDI (AECOM and Geosyntec, 2019). The ESD identified changes to the selected remedy and the reasons for such changes. The changes did not fundamentally alter the remedy. The ESD documented changes to the sediment cleanup levels (CULs) and shellfish target tissue level for carcinogenic PAHs and updated the Remedial Action Level (RAL) for total PAHs for areas of PHSS outside of the federal navigation channel. These updates were incorporated with other errata to update ROD Table 17 in Errata #2 (EPA, 2020). These changes have minor implications for RD within the SIB Project Area by potentially affecting the Sediment Management Area (SMA) boundaries.

On January 20, 2021, certain Parties<sup>1</sup> and EPA voluntarily entered into an Administrative Settlement Agreement and Order on Consent (ASAOC) (EPA, 2021a), to perform 100% RD work within the PHSS SIB Project Area. This PDI Work Plan along with the source control Sufficiency Assessment Report (SAR) provide an early foundation for the development of the RD.

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<sup>1</sup> Parties to the Administrative Settlement Agreement and Order on Consent (ASAOC) are EPA and Daimler Trucks North America LLC, Vigor Industrial LLC, Cascade General, Inc., and Shipyard Commerce Center LLC (collectively, Respondent(s)); Maritime Administration, U.S. Coast Guard, U.S. General Services Administration, Bonneville Power Administration, and U.S. Department of Defense (collectively, Settling Federal Agencies); and the state of Oregon, acting by and through the Department of State Lands, the city of Portland, and the Port of Portland (collectively, Settling Public Entities).

## 1.1 PRE-DESIGN INVESTIGATION PURPOSE AND OBJECTIVES

The RD drives the data, survey, and analysis needs. The purpose of this PDI Work Plan is to:

- Determine what data and analysis are necessary to inform the RD;
- Identify and evaluate relevant, applicable, and existing data and analysis;
- Identify data gaps; and
- Propose an approach to collect the data and complete the analyses required to address those data gaps and design the remedy.

At this early phase, planning the PDI requires the design team to begin with a conceptual RD based on the remedial technology assignments for the selected remedy published in Appendix I of the PHSS ROD (EPA, 2017a) as illustrated on Figure 1-2. The preliminary design concepts provide an early basis to identify the specific data, surveys, and analysis needed to develop that design.

In addition to aligning with the specifications and requirements of the ROD, this PDI Work Plan must be developed according to the principles and recommended sampling techniques described in the *Remedial Design Guidelines and Considerations* document (EPA, 2021b). The PDI must provide the information necessary to select remedial technologies identified in the ROD as potentially applicable within the SIB Project Area. It also must include the information and analysis necessary to demonstrate that the remedy will be robust, sustainable, and effective in the context of the SIB including natural processes and human activities including vessel traffic, waterway maintenance, and activities on the shoreline and adjacent uplands. The elements of the RD concept and approach determine the data and analysis that is necessary. This work plan identifies and qualifies applicable existing data and analysis that may be reliably used to inform and support the design development. Data and analysis gaps are identified by comparing the applicable existing data and analysis to the list of data and analysis needs determined by the conceptual design. This PDI Work Plan identifies the scope of proposed data collection and analysis to fill those data gaps and the proposed approach for each component of the investigation.

The ASAOC (EPA, 2021a) specifically identifies three applications of the PDI results that support the development of the RD. Those specific applications are:

1. Refinement of SMAs.
2. Refinement of the conceptual site model (CSM).
3. Application of the technology application decision tree (Figure 1-3).

Each of these required applications aligns with and must be fulfilled by the approach presented in this PDI Work Plan.

As part of developing this PDI Work Plan, the RD team used available sediment characterization data collected since ROD publication in 2017 to prepare a preliminary refinement of the SIB SMA boundaries presented in the ROD. This exercise was an essential step in evaluating the data gaps and developing the proposed data collection plan for characterizing the spatial and vertical extent of contaminants of concern (COCs) within the SIB Project Area. That refinement is presented

within this PDI Work Plan. The same SMA boundary refinement exercise will be performed after completion of the PDI per this work plan using the new sediment characterization data collected in accordance with a Field Sampling Plan (FSP) (Appendix A) designed specifically for this purpose.

The CSM presented in ROD Figures 3, 4, and 5 applies to the entire PHSS. The CSM fulfills an essential purpose focused on identifying and describing, at a conceptual level, the critical elements of the site that are relevant to COC sources, release mechanisms, transport and exposure pathways, and ecological and human receptors. The CSM portrays these elements and how they relate and interact with one another in the context of the site considering physical, chemical, and ecological processes as well as human activities.

The SIB Project Area is physically distinct from the main river because most of the project area falls within a backwatered slip that is not subject to the higher flow velocities and resulting forces that transport sediments and COCs. These flows often substantially modify the physical configuration of the riverbed and riverbanks. The SIB Project Area is physically more stable in comparison to the main river. Refinements to the CSM as it specifically applies to the SIB Project Area are necessary to ensure that the remedy will be effective and sustainable in the context of the SIB and not subject to future recontamination. Section 2.2 of this PDI Work Plan presents initial refinements to the CSM specific to the SIB Project Area. Multiple data collection efforts and studies proposed for the PDI will provide the necessary information and analysis to further refine the CSM and provide a quantitative analytical basis for applying the CSM to developing and evaluating the RD in the applicable context. EPA's 7-step data quality objective process for each media will be utilized, as appropriate, throughout these efforts (EPA, 2006).

This PDI Work Plan will guide the collection of additional data and analysis necessary to apply the technology application decision tree to determine the location and extent of each remedial technology within the SIB Project Area. Figure 1-2 shows the delineated areas within the SIB Project Area for application of various remedial technologies (e.g., dredging, capping, monitored natural recovery [MNR], enhanced natural recovery [ENR], etc.). Figure 1-2 was generated by applying the decision tree using existing available data at the time the ROD was published in 2017. New data and analysis have become available since then, and this PDI Work Plan will guide additional data collection and analysis needed to fully inform the RD. The new data used in accordance with the decision tree will result in refinements to the technology applications with the SIB Project Area. Specific information needed to inform the use of the decision tree includes but is not limited to:

- Bathymetry and bank topography,
- Sediment chemistry (e.g., horizontal and vertical extent of COCs in sediments),
- Geotechnical characteristics of the riverbanks and sediments,
- Groundwater upwelling through sediments,
- Porewater chemistry,

- Navigation zones subject to maintenance dredging along with specified depth requirements, and
- Location and condition of shoreline and in-water structures.

This PDI Work Plan will guide new data collection and analysis that will include substantial updates to each of these information requirements necessary to apply the decision tree.

The overarching objective of this PDI Work Plan focuses on compiling a complete body of data and analysis to fully inform the development and evaluation of a RD for a sustainable and effective remedy for the SIB Project Area. Within that guiding objective, other specific objectives are used to guide the planning and implementation of the PDI to ensure this primary goal is met. Those objectives are listed below.

1. Define the specific data and analysis needs required to fully inform the design development and evaluation based on a conceptual design approach and strategy consistent with the ROD.
2. Ensure that the data and analysis needs are sufficient to support the three applications specifically required in the ASAOC for SMA refinement, CSM refinement, and effective use of the technology application decision tree (Figure 1-3).
3. Compile and evaluate existing available data and analysis relevant to the defined data and analysis needs as determined by the design and required applications.
4. Identify data gaps by comparing what is needed to what is available.
5. Develop a work plan to guide the collection of new data and the completion of new analyses to address the data gaps.

## **1.2 SWAN ISLAND BASIN PROJECT AREA DESCRIPTION**

The SIB Project Area is the active cleanup area between approximately River Mile (RM) 8.1 and RM 9.2 on the northeast side of the Willamette River (Figure 1-2). The SIB Project Area is approximately 1.1 miles in length, 117 acres in size, and includes riverbanks from top of the bank to the river.

The upland areas surrounding the SIB Project Area include approximately 588 acres of mostly impervious area with primarily light industrial uses (Figure 1-4). The SIB Project Area receives discharges from city of Portland outfall basins M-1, M-2, M-3, S-1, and S-2; six Port of Portland outfall basins; and multiple private outfalls at shoreline properties.

Section 2.0 includes a more detailed description of the project area, site conditions, and background. Additional information on the in-water and upland site characteristics in the SIB Project Area is included in the June 2021 SAR (Hydrogeologic, Inc. [HGL], 2021).

## **1.3 CONCEPTUAL REMEDIAL DESIGN ELEMENTS**

The application of the remediation technology process will demonstrate compliance with the EPA ROD technology application decision tree and the design requirements found in ROD Section

14.2.9. The application of the specific Remedial Actions (RAs) of dredging and capping will be based on the locations of RAL and principal threat waste (PTW) exceedances relative to river regions. The selected remedy identified in the ROD for the SIB Project Area designates approximately 117 acres for active remediation and approximately 6 acres of MNR technology (Figure 1-2). The final combination of active remedial technologies and MNR technology, and the sediment volumes and acreages associated with each remedial technology will be determined during the RD in coordination with EPA. Each remedial technology corresponds to an element of the RD. The following sections describe each RD element in the context of the SIB Project Area and identify the types of data and analysis necessary to support development and evaluation of the design. Section 3.0 summarizes existing applicable data and analysis and identifies data gaps based on what is needed to design the remedy. Section 4.0 proposes data collection and engineering studies that will address those data gaps. Each proposed data collection effort or study will be applied to one or more elements of the RD, and the linkages are mapped in the following discussions for each remedial technology. Information about future land uses is a necessary component when collecting data for the evaluation of the application of each technology.

### **1.3.1 Sediment Dredging via Future Maintenance Dredging in the Navigation Channel**

Sediment dredging via future maintenance dredging is proposed for the western (downstream) portion of the interior lagoon of the SIB Project Area. This remedial technology considers the future navigation depth requirement and specifies either dredging or dredging combined with capping to accommodate that future navigation depth and ensure sufficient depth to accommodate post-remedial maintenance dredging. The U.S. Army Corps of Engineers (USACE) designates and maintains the -50' Federal Navigation Channel and the channel does not extend into the SIB (Figure 1-1). However, it is acknowledged that the western portion of SIB is subject to coordination with both USACE and EPA to ensure that the slopes and depths are suitably compatible. The entirety of the SIB Project Area is located outside the Federal Navigation Channel and is therefore not subject to the specified future maintenance dredging depths associated with it. Navigation depth requirements within the SIB Project Area represent a critical data gap that will be addressed as part of the proposed PDI. Note that the western portion of the site adjacent to the navigation channel is anticipated to be remediated using ENR, so the remedy is unlikely to result in significant changes in slope or depth in this part of the project area.

Designing and evaluating this element of the RD will require the following data and analysis:

- Current and future navigational use of the waterway and associated depth requirements,
- Bathymetry,
- Sediment characterization of vertical and horizontal distribution of COCs,
- Condition assessment of adjacent shoreline structures,
- Geotechnical analysis of adjacent submerged slopes and bank slopes,
- Distribution of debris and utilities within and adjacent to the dredge area, and
- Hydrodynamics and sediment dynamics analysis.

### **1.3.2 Sediment Dredging**

The ROD specifies sediment dredging outside the future maintenance dredging zone for only a small portion of the SIB Project Area. The data needs for sediment dredging are the same as those listed for dredging via future maintenance dredging except for navigation depth requirements.

### **1.3.3 Sediment Dredging with Sediment Capping**

The ROD specifies sediment dredging with sediment capping together for limited portions of the SIB Project Area near the head of the lagoon and along the Mocks Bottom shoreline near the northeast end of the project area. Dredging with capping is applied where surface concentrations are too high for ENR to be protective and where contamination extends to a depth greater than what could be feasibly removed (for example, as limited by adjacent slopes, adjacent structures). Although sediment dredging is specified for limited portions of the SIB Project Area, application of the remedial technology decision tree (Figure 1-3) may result in applying this technology within portions of the zone slated for sediment dredging via future maintenance dredging in the navigation channel. That result will depend on the relation between required navigation depth and the vertical extent of contamination.

Designing and evaluating this element of the RD will require the following data and analysis:

- Current and future navigational use of the waterway and associated depth requirements,
- Bathymetry,
- Sediment characterization of vertical and horizontal distribution of COCs,
- Condition assessment of adjacent shoreline structures,
- Geotechnical analysis of adjacent submerged and bank slopes,
- Geotechnical analysis of bedded sediments to assess settlement under a cap,
- Distribution of debris and utilities within and adjacent to the dredge area,
- Hydrodynamics and sediment dynamics analysis,
- Evaluation of cap effectiveness,
- Porewater upwelling locations
- Porewater chemistry, and
- Evaluation of cap stability.

### **1.3.4 Sediment Capping**

The ROD specifies sediment capping within the SIB Project Area near portions of the shoreline along Mocks Bottom and Swan Island and around in-water structures at the end of the Swan Island peninsula. Sediment capping may be applied strategically to provide a protective remedy close to and under in-water structures where COC concentrations are too high for effective application of ENR and other active remedial technologies (e.g., dredging) would not be feasible or compatible with shoreline structures or adjacent slopes due to structural or geotechnical concerns.

Designing and evaluating this element of the RD will require the following data and analysis:

- Bathymetry and topography,
- Sediment characterization of horizontal distribution of COCs,
- Condition assessment of adjacent shoreline structures,
- Geotechnical analysis of adjacent submerged slopes and bank slopes,
- Geotechnical analysis of bedded sediments to assess settlement under a cap,
- Hydrodynamics and sediment dynamics analysis,
- Evaluation of cap effectiveness,
- Porewater upwelling locations,
- Porewater chemistry, and
- Evaluation of cap stability.

### **1.3.5 Enhanced Natural Recovery**

ENR is specified within portions of the SIB Project Area along the Mocks Bottom shoreline waterward and adjacent to MNR areas. ENR is also specified for an approximately 12-acre area at the mouth of the SIB lagoon within the transitional zone between the main river and the SIB. ENR is commonly applied where surface sediment COC concentrations are relatively low, but natural processes (e.g., sediment deposition and mixing) proceed too slowly to rely on MNR to meet remedial goals. ENR relies on placement of a specified thickness of clean, typically sandy material that effectively dilutes surface concentrations of COCs and reduces exposure for ecological and human receptors. Designing and evaluating this element of the RD will require the following data and analysis:

- Bathymetry,
- Sediment characterization of horizontal distribution of COCs, and
- Hydrodynamics and sediment dynamics analysis.

While the ROD technology application decision tree identifies ENR as the selected technology for areas within the project area that are outside of the SMA, the results of specific, approved sampling locations and parameters compared to applicable CULs will be the basis for determining which specific locations will be subject to ENR and which specific locations will be subject to MNR. Criteria that will be used to specify locations for ENR are summarized as follows:

- Located outside the SMA but within the project area;
- COC concentrations in surface sediments exceed CULs but are less than RALs; and
- Sediment deposition occurs at too slow a rate for MNR to be protective. Threshold rate will be determined as part of the sediment transport modeling analysis.

### **1.3.6 Monitored Natural Recovery**

MNR is specified within limited shallow areas along the head of the SIB lagoon and along the Mocks Bottom shoreline. MNR is a passive component of the remediation approach that relies on natural processes, generally related to sediment dynamics, to attenuate relatively low levels of COCs. MNR is often specified in areas where an active remedy could impact aquatic habitat as a means of minimizing such impacts. While MNR does not require design, there are data and

analysis requirements relevant to evaluating the effectiveness of MNR as a component of the remedy. Those data and analysis needs are:

- Sediment deposition rates;
- Analysis of sediment resuspension, transport, and deposition; and
- Habitat conditions survey.

#### **1.4 PDI WORK PLAN ORGANIZATIONAL OVERVIEW**

This section provides a brief overview of the organization of this PDI Work Plan.

Section 1.0 presents an overall introduction including a clear purpose statement for this work plan and a description of the approach and strategy for planning and conducting the PDI so that it results in the data and analysis necessary to develop an effective and sustainable RD.

Section 2.0 provides an overview of existing conditions including a discussion of the site background and history; a description of the present-day site layout, land use, and activities in and around the SIB waterway; and a discussion of the CSM and its application to the specific context in the SIB Project Area.

Section 3.0 documents the data gap analysis. Data gaps were determined by:

- Identifying the information necessary to support the RD,
- Assessing available data and analysis for applicability, and
- Comparing what is needed to what is available and applicable.

Where appropriate and helpful, summary tables are used to show side-by-side comparisons of these steps. The data gap analysis is organized by specific technical categories relevant to different elements of the design including both design development and design evaluation. Data gaps identified in the SAR (HGL, 2021a) are integrated with the data gaps identified for design.

Section 4.0 proposes the approach to addressing the identified data and analysis gaps. The proposed data and analysis work plan is organized by the same categories of data collection and analysis used in Section 3.0 so that the parallel structure allows for easy reference between those sections.

Section 5.0 presents the PDI Management Plan that proposes how the performing Parties and the RD team will manage implementation of the PDI and documentation of the results in coordination with EPA.

Section 6.0 proposes a preliminary schedule for the individual technical deliverables that will document the results of the PDI.

Section 7.0 documents the references cited throughout this PDI Work Plan.

## 1.5 SUPPORTING DOCUMENTS FOR THIS PDI WORK PLAN

The supporting planning documents, including the FSP, Quality Assurance Project Plan (QAPP), Health and Safety Plan (HASP), and Emergency Response Plan (ERP) are included as appendices.

This PDI Work Plan is supported by the essential planning documents listed below. These documents were developed according to EPA guidance and in compliance with the requirements specified in the ASAOC (EPA, 2021a).

- **Appendix A, Field Sampling Plan**—The FSP supports the PDI sampling within the SIB Project Area and the SIB Upland Area and provides details for field sampling locations and procedures for the planned PDI project tasks. The FSP also addresses the field data collection needs identified in the SAR (HGL, 2021a) to inform the evaluation of potential recontamination.
- **Appendix B, Quality Assurance Project Plan**—The QAPP provides quality control (QC) elements to satisfy the data quality objectives for each task specified in this PDI Work Plan. The protocols established in the QAPP are necessary to ensure the data generated is of a sufficient quality to support development of valid conclusions. EPA’s 7-step data quality objective process for each media will be applied, as appropriate, in this plan (EPA, 2006).
- **Appendix C, Health and Safety Plan**—The HASP identifies and describes physical, chemical, and biological hazards relevant to each planned field task, and provides hazard mitigation techniques to address these hazards.
- **Appendix D, Emergency Response Plan**—The ERP will be used in the event of an accident or emergency during PDI fieldwork.

## 1.6 IMPORTANT DEFINITIONS

The following important definitions are used in the PDI for PHSS SIB Project Area:

**Cleanup Levels (CULs)** are “the long-term contaminant concentrations that need to be achieved by the remedy to meet RAOs [remedial action objectives]” (EPA, 2017a). CULs were established in the ROD for multiple media and COCs based on human and ecological risk thresholds, applicable or relevant and appropriate requirements, and background concentrations (in sediment only). For riverbank soil or sediment, when risk-based CULs were less than background concentrations for a given contaminant, background concentrations were selected as the CUL. PHSS CULs are based on Errata #2 Table 17 of the PHSS ROD (EPA, 2020).

**Contaminants of Concern (COCs)** are contaminants that "contribute a significant amount of risk to the human and ecological receptors evaluated" (EPA, 2017a). The focused COCs are those of highest prevalence, toxicity, and significance at PHSS and consist of PCBs, PAHs, dioxin/furans, and DDx. The focused and additional COCs are listed in Table 21 of Appendix II of the PHSS ROD (EPA, 2017a), updated in the ESD (EPA, 2019a).

**Recontamination Potential Chemicals (RPCs)** are the chemicals that pose a risk of recontamination in the SIB Project Area and were identified by screening existing surface sediment data against PHSS CULs. RPCs will be determined by a screening process to be documented in the final SAR. RPCs will be based on an assessment of all available sediment, riverbank, groundwater, and stormwater data screened against the applicable ROD Table 17 CULs as modified by the 2019 ESD and the 2020 Errata #2 memorandum, and ROD Table 21 RALs and PTW thresholds.

**Remedial Action Levels (RALs)** are contaminant-specific sediment concentrations specified for the focused COCs in Table 21 of Appendix II of the PHSS ROD (EPA, 2017a). RALs are used to determine where active remediation is required. RALs in the SIB Project Area are higher than sitewide values for RALs in nearshore areas because the SIB Project Area is outside of the navigation channel. For the purposes of this document, RALs will refer specifically to those applicable to the SIB Project Area and these sitewide RALs in ROD Table 21 apply to the SIB Project Area.

**Principal Threat Waste (PTW)** is mobile and/or toxic source material containing hazardous substances. PTW thresholds are based on a 10<sup>-3</sup> risk level (highly toxic), except for not reliably contained PTW (chlorobenzene and naphthalene or the non-aqueous phase liquid PTW and may require treatment prior to disposal). PTW thresholds are listed in Table 21 of Appendix II of the PHSS ROD, updated in the ESD (EPA, 2017a; EPA, 2019a).

**Sediment Management Areas (SMAs)** are the regions of PHSS in which RAL and/or PTW threshold values are exceeded. The term is defined in the ROD as "areas where containment or removal technologies were considered to immediately reduce risks upon implementation [and] where natural recovery is not occurring or is not likely to be effective in reducing concentrations of COCs within a reasonable time frame ... the presence of PTW and in-situ treatment areas for PTW were used to delineate SMAs [and] the FS (Feasibility Study) alternatives were developed using focused COCs" (EPA, 2017a). Further, per EPA's *Remedial Design Guidance and Considerations* document, "a SMA will be delineated by surface and subsurface contamination above RALs and principal threat waste (PTW) thresholds" (EPA, 2021b).

## **2.0 EXISTING CONDITIONS OVERVIEW**

PHSS extends along 9.9 miles of the lower Willamette River in Portland, Oregon, from RM 1.9 to RM 11.8. EPA listed PHSS on the National Priorities List in December 2000. A Remedial Investigation (RI) and FS were performed between 2001 and 2016 (EPA, 2016a; EPA, 2016b). On January 3, 2017, EPA issued a ROD selecting a remedy to be implemented for long-term cleanup of PHSS (EPA, 2017a). However, because the data utilized to develop the RI/FS and ROD were up to 20 years old, the ROD explicitly called for a post-ROD sampling effort to evaluate and update conditions prior to the development of the RD. EPA has approved data collected since the ROD as part of the PHSS PDI and Baseline Sampling Study (AECOM and Geosyntec, 2019). The data from this Portland Harbor-wide PDI will be used in the development of the RD to refine SMAs, select appropriate remedial technologies, and identify uncontrolled sources of recontamination for the SIB. For all relevant media, a summary will be included that contains the nature and extent of COC contamination, contamination sources, and migration pathways.

Existing conditions within the SIB Project Area and its surroundings provide context for understanding and applying existing data and analysis and identifying additional data needs to support development of the RD. The SIB Project Area is described below with high-level descriptions of the waterway and riverbanks, in-water and shoreline activities, upland properties in the project area vicinity, and a brief overview of site development history. Preliminary refinements to the CSM are presented and discussed to anticipate and guide portions of this PDI Work Plan that will be applied to refining the CSM so the RD will be sustainable and effective within the context of natural processes and human activities in and around the SIB Project Area.

The Willamette River provides critical habitat for fish, wildlife, aquatic and terrestrial plants and birds, and supports several endangered salmon runs as stated in the ROD. The Willamette River is important to many Native American tribes. Six federally recognized tribes are party to the 2001 Memorandum of Understanding established by EPA after listing PHSS on the National Priority List as described in ROD Section 1 (EPA, 2017a). Tribes maintain rights through Treaties with the United States to hunting, fishing, and certain gathering activities. The history of tribal presence in the region and within the PHSS site indicates there may be cultural and archeological resources within the project area. The archaeological survey conducted during the RI/FS will be utilized to highlight areas of interest in the SIB for consideration when developing the RD.

### **2.1 SWAN ISLAND BASIN PROJECT AREA**

The SIB Project Area (Figure 1-2) is the active cleanup area between approximately RM 8.1 and RM 9.2 on the northeast side of the Willamette River in Portland, Oregon. The SIB Project Area is approximately 1.1 miles in length and 117 acres in size. Within the SIB Project Area boundaries, the RD will address contaminated sediments in the riverbed and contaminated soils on erosion-prone riverbanks extending to the top of the bank.

The SIB Project Area is bounded by uplands of Swan Island and Mocks Bottom to the southwest and northeast, respectively, and by dredge fill at the head of the basin. Except for slopes along the riverbanks, land surface within the SIB Project Area is generally flat, with elevations of about 30 to 40 feet (ft) NGVD29. Land uses within and adjacent to the SIB Project Area consist of light and heavy industrial uses and commercial uses (Figure 1-4). Mixed (residential/commercial) and

residential only land uses are located outside but in close vicinity to the SIB Project Area. The SIB is an active navigable industrial waterway, and the shoreline hosts many structures supporting light and heavy industrial activities.

### **2.1.1 Waterway and Riverbanks**

The SIB is a quiescent waterway that is backwatered from the main Willamette River Channel. Currents within the interior of the SIB move slowly in response to daily tidal cycles and during flooding events when rising river levels raise the water elevation with the SIB. The interior waterway is approximately 1 mile long and 650 ft wide. Typical water depths within the SIB range from 20 to 35 ft with shallowest depths in the interior of the lagoon and deepest areas located at the transition to the main river channel downstream of the end of the Swan Island Peninsula. The SIB is a freshwater waterbody, but it is influenced by daily tides that cause water surface elevation to vary typically over a 3- to 4-ft range with a maximum range of approximately 6 ft.

The riverbanks within the SIB are predominantly armored with riprap or protected from erosion by bulkheads or other shoreline structures. The SIB lagoon is roughly rectangular in shape, and the shoreline in its entirety was constructed by fill placement and other modification that occurred over several decades. The shoreline at the head of the lagoon includes a sandy beach with sparse vegetation, and there are vegetated and bare soil banks in a more natural condition along a larger portion of the Mocks Bottom shoreline.

### **2.1.2 In-water and Shoreline Activities**

The waterway within the SIB Project Area supports commercial/industrial, recreational, and government vessel traffic related to the ongoing uses of the shoreline. Shoreline facilities support light and heavy industrial uses, vessel mooring, U.S. Coast Guard operations, and public access.

### **2.1.3 Upland Properties**

Upland areas around the SIB Project Area that discharge stormwater runoff to the SIB include approximately 588 acres of mostly impervious area with primarily light industrial uses (Figure 1-4). Stormwater discharges from these upland areas to the SIB from five city of Portland municipal outfall basins (M-1, M-2, M-3, S-1, and S-2), six Port of Portland outfall basins, as well as multiple private outfalls (Figure 1-4).

### **2.1.4 Site Development History**

The SIB was historically part of the main channel of the Willamette River and Swan Island was not connected to the shoreline area known as Mocks Bottom. First explored by Lewis and Clark in 1806 and originally charted as Willow Island, Swan Island was awarded to Lemuel Hendrickson as one of four pioneer land claims in the Portland area in the 1840s (Oregon Department of Environmental Quality [ODEQ], 2016). A natural bar repeatedly formed at the island, which required maintenance dredging from the 1870s through 1920s to keep the ship channels open (Oregon Historical Society [OHS], 2014). The main river channel flowed east of the island adjacent to the marshy lowlands of Mocks Bottom, curving into the base of the high bluff, above which is Mock's Crest.

In 1922, the Port of Portland had acquired Swan Island (ODEQ, 2016) and received approval in 1927 to close the main navigation channel creating a lagoon or basin (OHS, 2014). The Port of Portland developed Swan Island beginning in 1923, when the main navigation channel of the Willamette River was relocated to the west side of the island. River sediments dredged as part of the project were deposited on Swan Island to raise the surface elevation and construct a causeway connecting the island to the eastern shore of the river. This allowed industrial development of the island as Portland's first municipal airport.

The Mocks Bottom area also was subsequently filled with dredge fill for industrial development. Figure 2-1 shows the fill history. By 1946, most of Swan Island had been developed and most of the Mocks Bottom area had been filled (Maul Foster and Alongi, Inc., 2009; Bridgewater Group, Inc. [Bridgewater], 2011). The Port of Portland estimated that more than 13 million cubic yards of dredged material was placed in the 1920s and 1930s to create commercial and industrial space from the former Mocks Bottom marshlands (Engineering World, 1920). Since initial development of Swan Island and Mocks Bottom, additional placement of dredge fill has periodically occurred, including between about late 1950s and 1960s in the Mocks Bottom area and to create the southwest part of Swan Island, and in 1984 when about 4.8 million cubic yards of dredge material was placed at the head of the basin.

By 1940, the airport outgrew the island and was relocated, and Henry Kaiser's ship building operations began and continued throughout World War II (OHS, 2014). Temporary housing for workers was built on Swan Island and in Mocks Bottom for the workforce that built T2 Tankers between 1942 and 1945 (ODEQ, 2016). Kaiser continued to perform work at the shipyard between the end of the war and 1947. Consolidated Builders reportedly conducted ship dismantling post-war between 1947 and 1949 (ODEQ, 2016).

After the war, the Port of Portland acquired the shipyard from the United States and made it available for use by local ship repair companies, increasing the industrial manufacturing, shipping, and transportation focus of the area in the 1950s (City of Portland, 2013b). Heavy industrial uses continue at the Portland Shipyard on Swan Island (Figure 1-4). The Mocks Bottom area was developed for light industrial and commercial use in the 1960s through the 1990s (City of Portland, 2013b).

## **2.2 SWAN ISLAND BASIN CONCEPTUAL SITE MODEL**

The CSM presented in ROD Figures 3, 4, and 5 applies to the entire PHSS. The CSM fulfills an essential purpose that centers on identifying and describing, at a conceptual level, the essential elements of the site that are relevant to COC sources, release mechanisms, transport and exposure pathways, and ecological and human receptors. The CSM portrays these elements and how they relate and interact with one another in the context of the site considering physical, chemical, and ecological processes as well as human activities. Refinements to the CSM as it specifically applies to the SIB Project Area are necessary to ensure that the remedy will be sustainable and effective in the context of the SIB and not subject to future recontamination.

The SIB Project Area is physically distinct from the main river because most of the project area is a backwatered slip that is not subject to the higher flow velocities and resulting forces that transport sediments and COCs and substantially modify the physical configuration of the riverbed and

riverbanks. The SIB Project Area is physically more stable in comparison to the main river. Sediment deposition and accumulation proceeds slowly, while currents and other physical processes are broadly too weak to physically alter the riverbed within most of the SIB Project Area. While the riverbed and riverbanks within the SIB Project Area are typically not subjected to scouring forces from river currents (Coast & Harbor Engineering, 2013), like those in the main river, waves generated by vessel traffic in the lagoon likely mobilize sediment and potentially cause erosion in riverbank locations not protected by structure or armoring. The majority of the lagoon is privately owned; however, there is public access via a beach and boat ramp at the head of the lagoon. The distinct physical attributes of the SIB affect the relations and relative effects of many elements of the CSM in comparison to the main river and other parts of PHSS.

Multiple data collection efforts and studies proposed as part of the PDI will provide the necessary information and analysis to further refine the CSM and provide a quantitative analytical basis for applying the CSM to developing and evaluating the RD in its applicable context. Initial refinements to the CSM specific to the SIB Project Area are identified and described below along with their implications for development of the RD.

### **2.2.1 Quiescent Backwater Conditions are Prevalent Within SIB**

During peak flow conditions in the river, as well as during periods of low flow that result in maximum tidal exchange, current velocities within the SIB interior are typically less than 0.1 ft per second. Current velocities are larger in the mouth of the SIB between the navigation channel and the shipyard, reaching up to roughly 1 ft per second, and can exceed 1 ft per second in the main channel (Coast & Harbor Engineering, 2013). The waterway is backwatered by the main river water surface elevations and subject to freshwater tidal influence and water surface elevations that rise and fall with variable flood stages. During flood stages, the SIB does not convey flood flows moving in the main river because it is a backwater channel. Even during large flood events, the interior of the SIB remains quiescent, with river flow-induced current velocities less than 0.1 ft per second (Coast & Harbor Engineering, 2013).

### **2.2.2 Natural River Sediment Deposition and River-Induced Scour are Limited by Low Energy Hydrodynamics in the SIB Interior**

Quiescent river flow conditions in the SIB interior result in low sediment deposition rates (neutral, between -2.5 to +2.5 centimeters per year), as demonstrated by comparison of hydrographic surveys from both 2002 to 2009 and from 2009 to 2018 (AECOM and Geosyntec, 2019). Riverbed scour due to river currents alone is likely negligible, based on observed small current velocities and modeled currents less than 0.1 ft per second (Coast & Harbor Engineering, 2013). While river-induced sediment mobilization is limited, some degree of localized sediment mobilization, resuspension, and scour likely result from vessel traffic within the SIB. However, transport of these sediments is also likely to be limited due to low ambient current speeds.

### **2.2.3 The Mouth of the SIB is a Physical Process Transition Zone**

With respect to both hydrodynamics and sediment dynamics, the mouth of the SIB is a transition zone between the higher flow velocities and sediment transport rates prevalent within the main river and the quiescent conditions typical of the interior of the lagoon. This transition zone is

limited to a discrete definable area, and it may be used to determine the extent to which sediment may be exchanged between the main river and the SIB Project Area. Comparison of bathymetric surveys showed that sediment deposition may be as much as 1.5 ft over 10 years within the transition zone (Geosyntec, 2019).

#### **2.2.4 Stormwater Outfalls are the Primary Connected Pathway from Upland Sources to SIB Sediments**

There are five city of Portland municipal stormwater system outfalls that discharge to the SIB Project Area. Those outfalls drain most of the surrounding upland area in Mocks Bottom and Swan Island. A much larger number of private outfalls with small drainage areas convey stormwater runoff from private properties along the margins of the waterway. The majority of the SIB upland is privately owned; however, there is public access via a beach and boat ramp at the head of the lagoon. The CSM published in the ROD (EPA, 2017a) identifies eight final release mechanisms that were evaluated as potential recontamination transport pathways between the upland source areas and SIB sediment in the SAR (HGL, 2021). That evaluation applied existing data to compare the relative magnitude of the potential future COC loading to SIB via each transport pathway. That analysis concluded that based on potential loading, stormwater discharges to SIB were the primary connected pathway between upland sources and SIB for potential recontamination of SIB sediments. This finding applies to future recontamination, and the relative importance of contaminant transport pathways under past conditions was likely different. The SAR determined that stormwater is not the only potential pathway for recontamination. The findings in the SAR are preliminary and based on existing data. This analysis will be revisited when the SAR is updated after the PDI data collection efforts address the data gaps identified in the SAR.

#### **2.2.5 Dredging History Informs Interpretation and Application of Sediment Characterization Data**

Understanding the history of dredging within the SIB Project Area is necessary to interpret sediment characterization data and apply it to the RD. In 1923, the Port of Portland began to relocate the main navigation channel of the Willamette River from the east side of Swan Island to the west side. In 1927, a causeway of filled land was built between Mocks Bottom and Swan Island, closing off the channel and creating a still-water basin. Following the closing of the SIB, dredging occurred as part of upland development. For example, in the early 1940s, shipways were dredged to create a dry dock basin. Major dredging occurred in the SIB in the 1940s through the 1970s.

The Lower Willamette Group compiled dredge information, including dredge areas, depths, date, and volume in the Lower Willamette from 1980 through 2001 as documented in Table 3-3 and Map 2-2 of the 2004 Programmatic Work Plan (Integral et. al., 2004) and GIS file metadata. The Lower Willamette Group reported the following dredging events in SIB:

- 1981, Dry Dock 3 maintenance;
- 1985, Berth 315 maintenance;
- 1985, Berths 301 to 305 maintenance;
- 1986, Berths 306 to 308 maintenance; and
- 1992, Dry Docks 1 and 4 maintenance.

Most recently, Vigor Industrial, LLC (Vigor) dredged and capped sediments at the dry dock basin north of Pier D in July 2015 to accommodate the Vigorous dry dock. Records for the shipyard from 1981 to present are well researched and documented in LWG work. However, specific dredging information is not available prior to the 1970s for the SIB and may not be complete for non-shipyard facilities.

### **2.2.6 Waterway Uses Determine Navigation Requirements**

The waterway within the SIB Project Area supports a wide range of vessel traffic related to the ongoing uses of the shoreline. The shoreline facilities support light and heavy industrial uses, vessel mooring, U.S. Coast Guard operations, and public access. The current and future navigational needs for the SIB waterway are not clearly specified or documented, but they are determined by the current and future uses of the waterway associated with the collective shoreline properties. Maintenance dredge depths are specified for the Federal Navigation Channel maintained by USACE. That Federal Navigation Channel is located within the main Willamette River channel throughout much of PHSS as depicted on Figure 1-1, and it does not extend into the SIB Project Area. Navigation depth requirements within the SIB lagoon are not specified as part of the Federal Navigation Channel, and the current and future navigation depth requirements for the SIB Project Area are a data gap.

### 3.0 DATA GAP ANALYSIS

The data gap analysis was completed following the approach outlined in Section 1.0:

- (1) Identify the data and analysis needed, based on the conceptual design approach and strategy, to inform the development and evaluation of a RD for a sustainable and effective remedy;
- (2) Compile and evaluate available applicable data and analysis aligned with the specified data and analysis needs; and
- (3) Identify data and analysis gaps based on the comparison of what is needed to what is available.

All collected data and technical information will be based upon the need for this data and technical information required to support the evaluation with the appropriate level remedy compliant with the *Remedial Design Guidance and Considerations* document (EPA, 2021b).

The data gap analysis is organized by categories of data and analysis needed to develop and evaluate the design. Each sub-section that follows contains a summary of the data required, data available at the time of this report, and data gaps that were identified as needing to be addressed as part of the PDI. The following types of data were considered for use on the project:

1. Surface/Subsurface Sediment Contaminant Concentrations
2. Porewater Upwelling Locations
3. Stormwater Discharge
4. Riverbank Characterization
5. Bathymetry and Topography
6. Geotechnical Site Characterization
7. Shoreline and Overwater Structures and Activities
8. Existing Utilities and Debris
9. Hydrodynamics and Sediment Dynamics
10. Flood Impact Evaluation
11. Habitat Conditions

#### 3.1 SURFACE/SUBSURFACE SEDIMENT CONTAMINANT CONCENTRATIONS

Surface and subsurface sediment RAL and PTW exceedances define SMAs in PHSS. For RM 8.5E overall, total PCBs, 2,3,7,8-tetrachlorodibenzo-p-dioxin, and 1,2,3,7,8-pentachlorodibenzo-p-dioxin (PeCDD) RAL exceedances define the ROD SMA in the SIB Project Area (EPA, 2017a). In addition to the 2017 ROD, additional surface and subsurface samples have been collected as part of the following investigations:

- Kleinfelder, 2015. Sediment Sampling Data Report, Portland Harbor, Portland, Oregon. Prepared for de maximis inc. 1 June.
- Geosyntec, 2016. Sediment Sampling Data Report, Swan Island Lagoon, Portland, Oregon. Prepared for The Marine Group, LLC and BAE Systems San Diego Ship Repair, Inc. August 12.
- AECOM and Geosyntec, 2019. PDI Evaluation Report, Portland Harbor Pre-Remedial Design Investigation and Baseline Sampling. Prepared for United States Environmental Protection Agency, Region 10.
- Pacific Groundwater Group, 2019. Surface and Subsurface Sediment Field Sampling and Data Report, Swan Island Lagoon, Portland Harbor Superfund Site. Prepared for Daimler Trucks North America LLC (DTNA).
- Pacific Groundwater Group, 2019. Surface and Subsurface Sediment Field Sampling and Data Report, Swan Island Lagoon, Portland Harbor Superfund Site. Prepared for de maximis, inc.

These samples are depicted on Figures 3-1a to 3-1d, except the Kleinfelder data, and show generally good surface spatial coverage within the ROD SMA boundary with less coverage at the mouth and along the northern Mocks Bottom boundary. EPA has not accepted the data set from the Kleinfelder investigation in 2015 and the RD will not rely on that data. All sediment sample locations shown on Figures 3-1a to 3-1d are presented in Table 3-1, including individual sample results for each COC, sample identifications, sample dates, sample depths, and data qualifiers. Note that future maintenance dredge (FMD) areas portrayed on Figures 3-1a to 3-1d differ from what was shown in the ROD, and EPA has not yet accepted these areas for use in the RD. Section 2.2.6 of this PDI Work Plan identifies current and future navigation depth requirements for the SIB Project Area as a data gap. The approximate FMD areas shown in Figures 3-1a to 3-1d are preliminary and based on preliminary information provided by a subset of the shoreline property users. The FMD areas that will be used to inform the RD will be mapped based on the results of the proposed facility owner/operator interviews, which will include a survey of waterway users (see Section 4.11.2 of this PDI Work Plan). Any revisions to the map of FMD areas will be reported to EPA in the PDI Evaluation Report and subject to EPA review and acceptance prior to using them to inform technology applications and RD development.

The data gap analysis method for both surface and subsurface sediment data gaps overlay a 150-by 150-ft grid with existing sediment data and identifies grid cells that lack data (Figures 3-2 and 3-3). The 150-ft spacing is consistent with the spacing described in *Remedial Design Guidelines and Considerations* (EPA, 2021b) and the grid spacing used in the RM9W and Willamette Cove project areas, and effective spacing in the Terminal 4 project area. Table 3-2 presents a summary of existing source documents for surface and subsurface sediment contamination concentrations and identifies data gaps.

Proposed sediment samples would address identified sediment data gaps to meet the following three goals:

- Update the horizontal and vertical extent of contamination within the SIB Project Area,
- Refine the SMA footprint and technology assignments in the SIB, and
- Delineate the extent of PTW.

In addition to characterizing the extent of sediment contamination, sediment chemistry must be characterized to evaluate the potential for short-term contaminant releases during dredging operations. That evaluation is typically informed by dredge elutriate testing, which would require bulk sediment samples.

### **3.1.1 Surface Sediment Contaminant Concentrations**

Additional data is required to define the SMA as the basis of RD. Surface sediment data gaps will be filled to delineate the SMA boundary in several locations where data is not complete. These “step out” data gaps are defined grid cells that overlap or border the SMA boundary but lack any existing surface sediment sample data. The FSP (Appendix A) provides additional detail regarding sample locations, collection procedures, and analysis.

Figure 3-2 presents surface samples that have been collected in the SIB SMA overlain by a 150-ft square grid. This figure shows that of the 70 grid cells that define the ROD SMA border, 47 (67 percent) have existing data. The 29 “step out” data gaps will be targeted for sampling to provide a basis for refining the SMA boundaries. The proposed surface samples are located within grid cells using judgement to achieve approximate 150-ft spacings.

The sampling plan shown on FSP Figures 4-3 and 4-4 will address COC-specific data gaps. The boundary of the ROD SMA including step-outs and targeted sampling where buried and post-RI/FS exceedances have been identified. The top interval of cores will be archived, and some of these may be necessary to fill in COC-specific data gaps. These potential data gaps are listed in Section 4.2.2 of the FSP and will be determined on a case-by-case basis after the initial round of sample results are received to meet 150-ft spacing along the SMA boundary for each COC. EPA may be consulted for review on the necessity of analyzing archived material in some cases. The proposed analytical schedule includes 3 weeks for lab analysis following sample receipt, followed by 3 weeks for data validation. Upon receipt of validated data, the data will be reviewed within 60 days and recommendations for further analysis of archived material will be sent to EPA.

Specific sampling methodologies are presented as part of the FSP (Appendix A). Conceptually, surface samples will be collected from the top foot of each grid cell lacking a surface sample. Target coordinates will be defined by randomly generating x and y coordinates within each cell, then manually adjusting the coordinates as necessary to better meet 150-ft spacing criteria and in some cases to move sample locations away from areas already heavily sampled. Final coordinates will be reported after fieldwork is complete. Where grid cells have data gaps in both surface and subsurface sediments, a single core will be collected for both surface and subsurface samples.

### **3.1.2 Subsurface Sediment Contaminant Concentrations**

Fewer subsurface or core samples have been collected within the SIB Project Area compared to the number of surface samples. Figure 3-3 shows the ROD subsurface sample locations and additional core locations sampled during the post-ROD investigations listed in Section 3.1. Thus,

data gaps exist for subsurface sediment, and additional subsurface samples are required to support RD in selecting and designing remedial technologies.

Data gaps are identified using the same grid approach and judgement for location within each grid cell applied for surface sediments to identify where grid cells lack subsurface data and additional cores are needed (Figure 3-3). In addition to targeting areas within and along the border of the ROD SMA, 17 grid cells are targeted for sampling outside the ROD SMA. These represent grid cells with buried or suspected subsurface contamination exceeding RAL or PTW criteria outside the ROD SMA and areas with large subsurface data gaps. Additionally, ten core locations within the ROD SMA are extended to target penetration depths of 20 ft in areas with subsurface RAL and PTW exceedances that do not have well-constrained depths of contamination.

The FSP (Appendix A) includes sampling details about number of samples, depths, and analytes. Conceptually, core locations are identified in each grid cell lacking existing subsurface data by randomly generating x, y coordinates for core collection within each cell. These random coordinates are then manually adjusted within grid cells, as necessary, to support a 150-ft spacing between existing and planned sample locations and in some cases to distance a random sample location away from nearby existing sample data in neighboring grid cells. Final coordinates will be reported after fieldwork is complete. Each collected core will be sampled at 1-ft intervals from the sediment surface to a depth of 10 ft, as described in the *Remedial Design Guidance and Considerations* document (EPA, 2021b). Surface and subsurface samples will be collected from the same location as required.

### **3.2 POREWATER UPWELLING LOCATIONS**

Identification and mapping of locations within the SIB Project Area where upward porewater migration occurs is necessary to inform the RD. More specifically, this information supports the evaluation and design of engineered sediment caps in areas where subsurface contaminated sediments may be left in place below an engineered sediment cap or other remedial technology that addresses the sediment surface. A map of porewater upwelling locations is needed to determine the locations where capping may not be effective or, alternatively, locations where a different engineered cap design may be required to prevent breakthrough of COCs through the cap due to upward migration of porewater. During the design phase, the porewater upwelling map will be layered with the proposed locations for engineered sediment capping to evaluate the need for additional data collection and/or analysis to determine the pressure gradients that drive porewater migration and the resulting porewater velocities and flow rates.

Porewater data was not available within the SIB Project Area to address these needs. The physical configuration of the waterway and surrounding landscape combined with the history of dredging and filling to form both the landscape and the waterway suggest that porewater migration is likely a limited process in this setting. That inference is not sufficient for RD, and field data and analysis are necessary to either confirm this or identify and characterize areas where porewater migration could affect RD.

### 3.3 STORMWATER DISCHARGE

There are five public, seven Port of Portland, and multiple private stormwater outfalls that discharge to the SIB Project Area from the surrounding upland areas. The status of discharges from some of the private outfalls is unknown and will need to be evaluated as part of the PDI to provide information necessary to complete the SAR (HGL, 2021a). ROD Table 17 COCs, including focused COCs, were detected in stormwater and stormwater solids in public and select private outfall basins at concentrations that exceed the surface water and/or sediment CULs and/or RALs. In addition, dioxins/furans have not been adequately characterized either within the stormwater conveyance systems, or at the many sites in the upland area around the SIB Project Area that are contributing runoff to these stormwater collection and conveyance systems.

For the reasons above, the collection of additional stormwater and solids data within city of Portland outfall basins M-1, M-2, M-3, S-1, and S-2, and select private outfall basins, is necessary, to provide updated analytical data representative of current conditions, determine source control sufficiency to complete the SAR, and for modeling to assess recontamination potential for SIB (HGL, 2021a). The specific data collection and analysis approach to evaluate inputs from upland sites, as well as current concentrations of ROD Table 17 COCs in stormwater for the outfall basins, is provided in Section 4.3. Completion of the ongoing source control and investigation activities at upland properties continues to be within the jurisdiction of ODEQ with coordination and input from EPA, except at two sites owned by the U.S. Government (U.S. Navy and Marine Reserve Center [Environmental Cleanup Site Information (ECSI) 5109] and adjacent U.S. Coast Guard Marine Safety Unit [ECSI 1338]), where EPA is the regulatory authority for source control.

### 3.4 RIVERBANK CHARACTERIZATION

Pursuant to the *Guidance for River Bank Characterizations and Evaluations at the Portland Harbor Superfund Site* (EPA, 2019b), EPA has assumed oversight of the riverbank erosion pathway from ODEQ. The ROD (EPA, 2017a) identified three riverbanks within the SIB Project Area as areas with known contamination that exceed RALs and/or CULs for various ROD COCs, including focused COCs, in the SIB Project Area. The locations of those riverbanks are shown on Figure 1-2 and described as follows:

- One riverbank along the Portland Shipyard property on Swan Island adjacent to the SIB Project Area (1,487 lineal feet of bulkheads, a historical wooden retaining wall, and/or riprap below ordinary high water mark (OHWM) and vegetated soil above OHWM) (ECSI 271);
- The riverbank along the Portland Shipyard property's Dry Dock Basin and Ballast Water Treatment Plant on the end of the Swan Island peninsula (224 lineal feet of engineered bank consisting of riprap below OHWM and vegetated soil above OHWM); and
- One 911-ft-long riverbank, armored with riprap below OHWM and vegetated soil above OHWM, along the U.S. Navy and Marine Reserve Center (ECSI 5109) in the Mocks Bottom portion of the SIB Upland Area.

Two non-ROD riverbanks were identified based on ROD CUL exceedances in soil during previous investigations: A 713-ft-long, unarmored, sand riverbank was identified at the head of SIB, and a

587-ft-long armored bank along the Port of Portland’s N. Lagoon Avenue property adjacent to SIB.

The SAR assigned an initial source control sufficiency status of “uncontrolled” to all shoreline properties because (1) few riverbanks adjacent to the SIB Project Area have been adequately characterized (SAR Figure 6-1 [HGL, 2021a]); (2) there is a potential need for RA on shorelines where COCs are present in soils; and (3) contaminated riverbanks are at risk of erosion and could be uncontrolled sources of recontamination. If an in-river sediment SMA does not extend to the toe of the riverbank in portions of the SIB shoreline (i.e., is not contiguous with the riverbank) and the riverbank materials are not erodible, the source control sufficiency status may be downgraded for the riverbank erosion pathway in those areas. Regardless of source control sufficiency status assigned to a particular riverbank, EPA guidance for riverbanks (EPA, 2019) requires that the entire lateral extent of COCs in the riverbank be characterized.

Data was not available to characterize riverbank stability and the presence of COCs in riverbank soil sufficiently to determine their source control sufficiency status, identify riverbank locations that would need to be addressed as part of the RD, or inform design development for riverbank remediation where required. Section 4.4 of this PDI Work Plan describes the objectives of the proposed field reconnaissance and data to be collected to fill riverbank data gaps.

The RD will include measures to remediate the three riverbanks and any other riverbanks within the SIB Project Area identified in the ROD as needing RA. According to the ROD, these riverbanks will be determined based on the combined results of the first and second phases of the riverbank evaluation. The selected remedy for riverbanks will minimize erosion and transport of riverbank materials contaminated above CULs, thereby minimizing recontamination potential through a riverbank erosion pathway. Alteration of any riverbank will be discussed and coordinated with shoreline property owners during the RD.

### **3.5 BATHYMETRY AND TOPOGRAPHY**

Table 3-3 summarizes the data gap analysis performed to ensure adequate information on bathymetry and topography data will be available during and after the PDI. The data gap analysis results for bathymetry and topography indicate that a new multibeam bathymetry survey of the SIB Project Area is required, but typical topographic surveying is not required for the PDI. Additional topographic surveying will be performed as part of design for selected areas that will be identified during development of the Basis of Design Report (BODR). This bathymetric surveying data collection effort must be completed to support various analyses on hydrodynamics and sediment dynamics, cap stability, riverbank stability, and overall RD. Additional topographic surveying will be performed later as part of the RD for selected areas if necessary.

### **3.6 GEOTECHNICAL SITE CHARACTERIZATION**

Table 3-4 summarizes the data gap analysis performed to ensure adequate geotechnical site characterization data will be available during and after the PDI. Results of the data gap analysis indicate that a project-specific geotechnical site investigation is required to adequately characterize the SIB Project Area. Specific data gaps identified include site soil stratigraphy, groundwater conditions, geotechnical design parameters, geologic hazards, and seismic design parameters.

Geotechnical site characterization field efforts are intended to support evaluation of recontamination, cap stability, and overall RD. Additional specific design applications of geotechnical information include assessment of shoreline stability, and evaluation of settlement in locations where engineered sediment capping may be specified.

### **3.7 SHORELINE AND OVERWATER STRUCTURES AND ACTIVITIES**

Table 3-5 summarizes the data gap analysis performed to confirm adequate information on shoreline and overwater structures will be available following the PDI. Results of the data gap analysis for overwater structures indicate that available as-built information for all the overwater structures, available existing recent condition assessment results, intended future use information, and repair history information should be collected. It is anticipated that not all this data will be available during the PDI; therefore, inspections, condition assessments, and structural evaluations are also recommended.

The priority for characterizing conditions of shoreline structures (revetments/bulkheads) to inform RD development is dictated by the nature and proximity of the remedial technology specified near or under each structure. The selected alternative in the ROD specifies active remediation (either sediment capping or dredging) along all the Swan Island shoreline on the southwest side of the lagoon. MNR or ENR are specified for the shoreline along the head of the lagoon and along about 80 percent of the Mocks Bottom shoreline on the northeast side of the lagoon. Sediment capping or dredge with capping is specified for about 20 percent of the Mocks Bottom shoreline at the northeast end of the lagoon. Complete and detailed information about shoreline structures (revetments/bulkheads) is most important along the shorelines where active remediation is specified. Along shorelines where MNR is specified, the need for detailed assessment of shoreline structures (revetments/bulkheads) will be determined by the distance from the structure to the edge of active remediation, and whether the specified active remediation has the potential to affect the structure.

The known overwater activities for the SIB shoreline are typical of large ports. The materials that are transferred to/from the structures are not known to contain SIB RPCs, except petroleum hydrocarbons used for fueling and maintenance of vessels. To the best of the Parties' knowledge, shoreline and upland facilities currently operate pursuant to best management practices (BMPs), and currently exhibit standard practices of care designed to reduce spills into the river. However, overwater activities along the SIB shoreline will be further evaluated as potential recontamination concerns during the RD.

The current and future navigational needs for the SIB waterway are not known. Maintenance dredge depths are specified for the Federal Navigation Channel maintained by USACE. That Federal Navigation Channel is located within the main Willamette River channel and does not extend into the SIB Project Area. Navigation depth requirements within the SIB lagoon are not specified as part of the Federal Navigation Channel, and the current and future navigation depth requirements for the SIB Project Area are a data gap.

Leaching or abrasion of the in-water structures are potential pathways for associated contaminants to reach nearby sediment. There has not been a comprehensive survey of in-water structures or debris in the SIB Project Area, and there is no facility-specific information regarding the presence

or absence of contaminants on these structures. A screening level visual inspection of readily accessible in-water structures will be conducted as part of shoreline and overwater structures data collection activities. To the extent that wooden and painted steel structures will remain in place as part of the remedy, they may need to be assessed during the RD.

Shoreline and overwater structures data collection is intended to support recontamination evaluation and detailed engineering studies for overall RD, including information necessary to evaluate functionality and condition of the structures. Precursors to overwater activities evaluation would be owner/operator interviews, incident reports, or BMP documentation.

### **3.8 EXISTING UTILITIES AND DEBRIS**

Table 3-6 summarizes the data gap analysis performed to ensure adequate information on existing utilities and debris will be available during and after the PDI. Sediment dredging design requires information characterizing the location and nature of debris. That information informs selection of dredge equipment, material handling requirements, and determination of whether large debris must be picked out in some areas before dredging proceeds. Utility locations within the project area must be clearly known to identify and either avoid or resolve conflicts between the RA and utility locations. Utility conflicts may need to be resolved by utility protection and/or relocation as part of RA. The data gap analysis results for existing utilities and debris indicate that a new survey program consisting of sub-bottom profiling, magnetometer survey, and side-scan sonar is required, in addition to desktop study to locate and document potential obstacles to be encountered and/or removed during RA. Utilities under consideration include power, communications, water/stormwater, or other similar systems.

### **3.9 HYDRODYNAMICS AND SEDIMENT DYNAMICS**

Table 3-7 summarizes the data gap analysis performed to ensure adequate information on hydrodynamics and sediment dynamics will be available during and after the PDI. The data gap analysis results for hydrodynamics and sediment dynamics indicate that a new program consisting of current, water level, suspended sediment, wind-wave, and vessel wake measurements is required, in addition to desktop studies and numerical modeling to evaluate sediment movements (recontamination potential, cap stability). Hydrodynamics and sediment dynamics data collection and PDI studies are necessary to support completion of the SAR (HGL, 2021a) with respect to in-water sources and pathways including sediment resuspension, transport and deposition of COCs in sediments delivered from upstream sources, and fate and transport of COCs discharged from outfalls. The same studies will be applied during the RD to support evaluation of sediment resuspension and scour, recontamination potential, sediment cap stability, riverbank stability, and other aspects of overall RD.

### **3.10 FLOOD IMPACT EVALUATION**

Flood impact evaluation is necessary to confirm that a selected remedial strategy does not result in exacerbated flooding in the surrounding area during heavy rain events. Data required for flood impact evaluation include hydrologic conditions (river discharges and downstream tidal elevations), updated bathymetry both with and without the proposed remedy included, and numerical modeling results for analysis of flooding impacts. No existing flood impact data is

available because the remedy has not been determined. Discharge and tidal elevation data is available from the network of U.S. Geological Survey (USGS) gages and National Oceanic and Atmospheric Administration (NOAA) tide gages, respectively. Federal Emergency Management Agency flood elevation data is available, which is critical for use as input to numerical modeling efforts. Sufficient field data is available during the PDI; however, numerical modeling must be performed during the PDI to provide flood impact evaluation conclusions.

### **3.11 HABITAT CONDITIONS**

EPA has authority to direct the evaluation of habitat impacts to meet the substantive requirements of Clean Water Act (CWA) Section 404. EPA has initiated programmatic consultation with National Marine Fisheries Service (NMFS) for the sitewide cleanup and will direct the project area-specific evaluations under the Endangered Species Act and CWA Section 404. Habitat Equivalency Analysis (HEA) is the tool that EPA will use to evaluate habitat pre-and post-remediation for the purposes of complying with CWA Section 404 and, in coordination with NMFS, in compliance with the Endangered Species Act. The purpose of the habitat conditions characterization would be to collect the data needed to inform an HEA-based approach to comparing pre- and post-remediation habitat conditions. EPA, as the decision maker, will ensure implementation of all reasonable NMFS requirements. Similarly, EPA will determine how CWA requirements will be implemented with input from ODEQ.

The study area for the habitat conditions characterization will include the riparian area on the riverbank extending into the shallow water area along the shoreline within the SIB Project Area. NMFS defines the shallow water area from 0 to -15 ft Columbia River Datum. This vertical extent of the habitat conditions study is divided into five zones:

- Riparian area – areas above ordinary high water and less than 400 ft from the active channel margin (ACM).
- ACM – the area between ordinary high water and ordinary low water.
- Shallow water – the area between 0 to -15 ft Columbia River Datum.
- Deep water – the area deeper than -15 ft Columbia River Datum.
- Off-channel areas – tributaries to the main waterway.

Data needs to characterize the riparian area include vegetation, substrate, location with respect to historical floodplain, slope, presence of buildings, structures, and riprap.

Data needs to characterize the ACM are depth, substrate, presence of riprap, sheetpile/seawall, pilings, and suspended and floating structures.

Data needs to characterize the shallow water area are depth, substrate, presence of riprap, sheetpile/seawall, pilings, and suspended and floating structures.

Data needs to characterize the deep water area are depth, substrate, presence of riprap, sheetpile/seawall, pilings, and suspended floating structures.

Data needs to characterize the off-channel areas are tributary water temperature and position relative to main channel substrate.

Habitat data collection would occur on transects spaced at 150 ft-intervals along the shoreline using photo documentation of habitat conditions at a frequency sufficient to fully describe habitat conditions for input into the HEA. HEA development will require the acreages and conditions of each habitat area where remedial activities will occur. This work overlaps extensively with the data needs for riverbank evaluation, and HGL intends to coordinate the habitat survey and riverbank characterization survey to ensure consistency and efficiency.

Available data exists to characterize both bank conditions and near shore shallow zone conditions to some extent, but there are zones where existing data is sparse or absent. Similarly with the riverbanks, there is data for portions of the shoreline, but there are sections of the riverbank that have sparse or no data.

There are no precursors to the habitat characterization work, but it would be most efficient to coordinate the work with any riverbank evaluation survey efforts. The riverbank survey, overwater and shoreline structure surveys, bathymetry surveys, and surface sediment sampling would all be potential sources of data to support completion of the habitat characterization.

## 4.0 PRE-DESIGN INVESTIGATION APPROACH

The data gap analysis identified data gaps to be filled during the PDI. This data is required to support development of the RD as described in Section 3.0 for each data and analysis need. In addition to informing RD development, components of the PDI will also support completion of the source control sufficiency assessment as documented in the SAR (HGL, 2021a), SMA delineation refinements, refinement of the CSM, and application of the Technology Application Decision Tree (Figure 1-3) to determine remedial technology assignments. Data gaps are summarized in Table 4-1 along with the proposed data collection and analysis recommended to address those gaps. Data gaps specifically identified in the SAR are called out within the table and a crosswalk is provided to identify the PDI Work Plan section that addresses each SAR data gap. Data gaps will be addressed using a combination of field data collection (e.g., sampling and surveying) and engineering analysis. This section describes the approach to both the field sampling efforts and engineering studies. Additional details on proposed field sampling are provided in the FSP (Appendix A).

### 4.1 SUBSURFACE/SURFACE SEDIMENT CONCENTRATIONS

Both surface and subsurface sediment sampling will be performed to refine the lateral and vertical extent of contamination as the basis of RD. As discussed in Section 3.1, Figures 3-2 and 3-3 identify the data gaps used to determine the proposed surface and subsurface sediment sampling locations.

Surface sediment data gaps will be filled with the analysis of 30 new samples, 29 of which represent “step out” samples used to refine the delineation of the SMA boundary. Of these 30 samples, 4 locations have existing subsurface data and therefore do not require core sampling. Those four surface samples will be collected to meet 150-ft spacing criteria, and a fifth surface sample will be collected targeting an outlier PAH exceedance from 2002 near the head of Swan Island Lagoon. In total, surface samples will be collected at 5 locations by grab sampler. The remaining 25 samples will be collected as the uppermost interval of proposed new cores, from 0 to 1 ft in depth below mudline. Proposed surface sample locations are shown on Figure 4-3 of the FSP (Appendix A).

Subsurface sediment data gaps are addressed with the analysis of 179 cores, with 2 additional cores collected and archived for a total of 181 cores. Core samples will be collected in 1-ft intervals from 1 to 6 ft in depth for 10-foot cores and 1 to 15 ft in depth of 20-foot cores, for a total of 985 Phase I samples. The uppermost interval (0 to 1 ft) for 156 of the cores will be frozen and archived for potential future analyses in case RD development identifies the need for additional surface sediment data. Analysis will most likely be triggered by the identification of COC-specific data gaps after the first phase of sample results are received, but additional archived material may be analyzed as necessary, and in consultation with EPA as needed, to support RD.

The uppermost interval for 25 of the cores, as previously noted, will be sampled and analyzed to fill surface sediment data gaps. Cores will also be sampled at 1-ft intervals from 6 to 10 ft, frozen, and archived for potential future analyses after updated preliminary technology assignments are identified. Ten locations are identified for targeting 20-foot core lengths, located in grid cells N0, J8, E18, C19, E20, E22, E27, E33, D35, and F35. These locations will aid in filling depth-of-contamination data gaps within the SMA boundary. The 20-foot core locations are selected to

target areas with PTW exceedances that are unbounded in depth near or exceeding 10 feet below mudline, and to a lesser extent areas with unbounded RAL exceedances. Locations were further selected to target areas where the expected remedial technologies are most uncertain, starting near Berth 305 and continuing to the Head of SIB. Eight 20-foot cores will be collected in and near this area, from grid cell columns 18 to 35. A ninth 20-foot core will be collected in the Dry Dock Basin near an unbounded PCB PTW exceedance in grid cell J8, and a tenth 20-foot core will be collected in grid cell N0 just outside the Swan Island Sediment Decision Unit near an unbounded PCB PTW exceedance in grid cell N1. The two archived cores will be collected from grid cells H0 and I0 and analyzed depending on any identified RAL and PTW exceedances in neighboring cells H1 and I1.

Analysis of archived subsurface sediment will most likely be triggered by the need to constrain the depth of contamination with two consecutive 1-ft intervals below the deepest CUL exceedance after the first phase of sample results are received. It may not be necessary to perform analysis on every core to constrain depth of contamination, and EPA will be consulted on any reductions to the analysis of archived samples. Additional archived material may be analyzed as necessary, and in consultation with EPA as needed, to support RD. For example, an anomalously high COC result may warrant analysis of nearby (horizontally and vertically) archived material.

Three samples for dredge elutriate testing shall be collected from grid cells F14, D5, and C20 to evaluate the potential for short-term contaminant releases during dredging operations. The samples will be collected in accordance with SOP 403.08 Sediment Sampling (FSP Appendix A) and tested for all ROD Table 17 Surface Water COCs. The results from dredge elutriate testing shall be evaluated against both chronic and acute water quality criteria as defined in FSP Section 4.2.5.

## **4.2 POREWATER UPWELLING LOCATION SURVEY**

This task proposes to conduct a vessel-mounted instrument survey to measure temperature and conductivity contrasts in porewater and overlying surface water using a Trident Probe along transects within the SIB Project Area. Identification and mapping of locations within the SIB Project Area where upward porewater migration occurs is needed to address data gaps identified in Section 3.2. A map of porewater upwelling locations is needed to determine the locations where capping may not be effective or, alternatively, locations where adjustments to engineered cap design may be required to prevent breakthrough of COCs through the cap due to upward migration of porewater through contaminated sediments below the cap.

The survey would collect temperature and conductance measurements in porewater and overlying surface water along the transects shown in Figure 4-1a. The standard operating procedure for the Trident Probe is in Appendix A of the FSP. For the temperature sensor, areas of groundwater seepage may appear either as warm or cold contrast to the surface water depending on the seasonal and site characteristics. For the conductivity sensor, groundwater conductivity is typically higher than that measured in surface water in rivers. The detection of upwelling zones between surface water and groundwater will be based primarily on measurements of conductivity contrast and secondarily on measurements of temperature contrast (Coastal Monitoring Associates, 2020).

The proposed stations are closer together for nearshore areas and further apart away from shore. Distances between stations were also adjusted for the presence of permanent or semi-permanent structures (Figure 4-1a). The proposed survey assumes station distances of no more than 50 ft near

the shore and no more than 100 ft away from the shore. Specifically, the proposed survey assumes fifteen 800-ft-wide transects across SIB (with up to 10 stations each where no permanent structures are present) and two 400-ft-wide transects at the head of SIB (8 stations) for a total of up to 158 stations.

Measurements may deviate from the transects, as needed, to map those areas with the largest temperature and conductance gradients between sediment and overlying surface water. Measurements may deviate from the proposed transect lines if a strong contrast in surface water and porewater conductivity measurements is recorded in one area along a transect to delineate the extent of that contrast on and around the transect line area and to quantify variability within the potential upwelling zone. The stronger the difference in measurements, the more measurements will be collected in that area to map the extent of the upwelling zone(s). These additional stations will be within 50 ft of the previous station. In addition, deviations from proposed station locations may occur if the substrate is too hard to manually drive the Trident Probe into the sediment or vessels or other over-water features are present during the survey.

The timing of the investigation will be planned during the time of the year when the river surface elevations are dropping, has less tidal fluctuations (neap tides), temperature contrasts between surface water and groundwater are greatest, and seasonal groundwater elevations are higher than river elevations. Figure 4-1b of this PDI Work Plan shows groundwater elevations relative to river elevations for those wells closest to the basin versus the river channel. Some groundwater elevations consistently plot close to river elevations, reflecting high connectivity with the river, and, as a result, are influenced by mean river level and potentially the tides. Groundwater elevations were higher than river elevations in December 2001, March 2002, July 2002, October 2002, March 2003, September 2003, December 2003, January 2005, October 2005, September 2006, October 2006, January 2007, and September 2007. In addition to a comparison of groundwater elevations relative to river elevations, the timeframe for discharge mapping is also related to a temperature signal difference between groundwater and surface water. This difference generally stronger during the winter (groundwater warmer than surface water) and summer (groundwater cooler than surface water) and weaker during transition periods of fall and spring based on Gravity Marine and Coastal Monitoring Associates professional experience on rivers in the Pacific Northwest. For example, in late February 2022, river temperatures were 6 to 7 degrees Celsius, and are expected to provide a good contrast with groundwater temperatures (estimated to be between 12 and 15 degrees Celsius [Bridgewater, 2020]). Also in late February 2022, discharge and gauge heights were low (below 25<sup>th</sup> percentile) with low river conditions (<https://waterdata.usgs.gov/nwis/uv?14211720>). The survey period was selected to correspond as closely as possible to neap tide conditions when tidal fluctuations are relatively small (~2 ft). The subsurface probe depth was also selected to be at 18 inches, deep enough to be minimally affected by tidal fluctuations. As a result, the upwelling survey is proposed for February and March 2022.

Limitations of the upwelling study are related to the screening-level nature of the measurements, and the limited temporal coverage of the data. While conductivity and temperature provide a good indicator of potential upwelling zones, they can be influenced by processes other than groundwater upwelling and thus need to be considered as a screening level indicator of potential upwelling zones only, and not a quantitative measure of upwelling rates. Quantification of upwelling rates generally requires different methodologies that are most effectively applied after the potential upwelling zones have been identified. The screening survey will be conducted during conditions

that are present in February – March 2022 and are thus primarily indicative of that time period. As discussed above, that period is expected to be a favorable time to detect upwelling using conductivity and temperature. However, the actual conditions that are present during the measurement period may vary from what is expected. In addition, seasonal and other temporal variations in river levels and groundwater levels may influence the nature and extent of upwelling zones. To the extent that uncertainty remains in identification of potential upwelling zones following the winter measurement event, some level of verification during the summer period may be considered.

The survey described above is the first phase of a two-phase approach to characterizing porewater chemistry and groundwater upwelling rates. Porewater sampling and analysis will be included in Phase 2 to characterize porewater chemistry. After the results of the Phase 1 porewater upwelling mapping effort are completed, HGL will use those results to prepare a sampling and analysis plan for characterizing porewater chemistry and migration rates in the areas where groundwater seepage occurs. That future porewater sampling and analysis plan will be provided to EPA for review as an addendum to the PDI Work Plan and FSP.

The upwelling survey results will be overlaid on proposed cap areas and used to identify future collection stations for quantitative measurements of seepage rates in proposed cap areas for cap modeling. Seepage rate data collection methods and locations will be described in a future porewater sampling and analysis plan that will be provided to EPA for review as an addendum to the PDI Work Plan and FSP.

A cap treatability study is tentatively planned as a component of the design and evaluation of sediment capping within the SIB Project Area. That cap treatability study is not included as part of the current PDI Work Plan. It will be developed on a parallel track with the PDI and documented in a draft Cap Treatability Study Work Plan that will be submitted to EPA for review tentatively October 2022 to allow consideration of the Phase 1 porewater survey results in developing that work plan. Preliminary concepts for the cap treatability study envision laboratory tests designed to compare alternatives for cap composition, chemical treatment amendments, and thickness.

### **4.3 STORMWATER OUTFALL AND CONVEYANCE SYSTEM SAMPLING**

This task includes the collection of stormwater and stormwater solids samples within municipal and private conveyance systems that drain to the SIB Project Area. Proposed sampling of municipal conveyance systems will include the city of Portland outfalls M-1, M-2, M-3 S-1, and S-2 conveyance systems. Some ROD Table 17 COCs in stormwater and stormwater solids were detected in city outfall basins at concentrations exceeding surface water and sediment CULs and/or RALs.<sup>2</sup> As further described in Section 6.1 of the SAR (HGL, 2021a), evaluation of available data indicates that additional sampling within city and private outfall basins is warranted for the following reasons:

- Data for stormwater solids collected before some source control measures (SCMs) were implemented in the city's outfall basins indicate that PCBs exceeded the surface water CUL in all SIB city outfall basins and the PCB RAL in stormwater solids in some locations.

- Determine whether these solids could recontaminate future remedial caps and ENR and MNR areas.
- Recent sampling of stormwater and stormwater solids COC concentrations in city and private systems at levels that, although similar to other PHSS heavy industrial sites, still exceed the applicable surface water and riverbank/sediment CULs.
  - o Stormwater or solids sampling data are not available for private outfalls adjacent to areas that have had ROD COC CUL and RAL concentration exceedances in surface sediment.
  - o In addition, dioxins and furans are present in surface sediment data in the vicinity of these city outfalls. However, dioxins/furans have not been adequately characterized either within the stormwater conveyance systems, or at the many sites in the SIB Upland Area that are contributing stormwater to these conveyance systems discharging into the SIB Project Area.

This PDI Work Plan includes a task to identify and address other data gaps for stormwater outfalls. Data will be used to evaluate the effects of stormwater with ROD CUL or RAL exceedances within the SIB Project Area. Figure 4-2 shows the proposed manhole sample locations within city outfall basins M-1, M-2, M-3, S-1, and S-2. Table 4-2 summarizes invert elevations of proposed sampling locations in the city's system as well as possible alternative sample locations representative of basin discharges, if access constraints or possible backflow are identified.

Most SIB outfalls are submerged at least part of the year, causing flow reversals within the pipe, that would confound stormwater loading evaluations. Therefore, the manhole access location closest to the target outfalls was selected as the representative "End of Pipe" sample location for the high-volume, time-weighted sampling (HVS) (i.e., manholes AAM107/AAM104, AAM165, AAQ003/AAQ004<sup>2</sup>). Table 4-2 identifies alternate HVS locations to use if the primary manholes are flooded because of a high tide or storm event and cannot be sampled (i.e., the SIB river stage elevation as measured via a water level probe installed in SIB and corrected to the Morrison Street Bridge Corrected Datum is predicted to be higher than a pipe invert elevation). Comparisons of pipe invert elevations to river elevations will be completed before mobilizing to the field so that the necessary preparations (e.g., traffic control, access notifications) can be completed in advance.

The HVS sampling methodology, which will be followed using the Gravity Marine PR2900 system, is a time-weighted sampling method that targets sample collection during qualifying storms that occur when the river stage is below the manhole sump elevation. This approach is expected to ensure that samples are representative of stormwater discharges and are not influenced by river water backing up into the pipe.

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<sup>2</sup> High-volume water samples are collected to quantify concentrations of targeted organic chemicals (e.g., dioxins/furans, PCBs, and pesticides) that could be present at levels too low to be detected using conventional sampling methods. This method also allows for quantification of hydrophobic organic chemicals in the suspended particle and dissolved phases of the water column. The HVS equipment system, the Gravity Marine PR2900, was approved by EPA for use on the PHSS PDI and baseline sampling surface water sampling event (AECOM and Geosyntec, 2019). This sampling methodology is a form of flow-weighted sampling.

HVS at these key locations will include the collection of time-weighted stormwater, stormwater solids, and storm flow data during three representative storm events over an approximate 9-month period and to add the data to the SEDCAM recontamination model to predict future total COC loading to the SIB Project Area. In addition, in-line sediment traps will be installed in the laterals to the manholes to collect solids that will be composited into samples representing two separate periods (wet season from December 2021 through June 2022 and dry season from July through October 2022) for comparison to the data collected during the three individual HVS storm events. The dry season deployment may be terminated early if wet weather before the end of October is predicted. In addition, flow meters will be installed prior to sampling and continuously log data during the sediment trap deployment period and during HVS events. Prior to deployment, HGL will confirm that manhole sampling will occur when river elevations are sufficiently below manhole elevations.

The proposed stormwater sampling plan also includes the collection of manual grab samples at the same locations as the in-line sediment traps (prior to deployment) and at manholes further up-pipe within the city conveyance system. The rationale for collecting manual grab samples from laterals in subbasins of each city outfall basin, prior to sediment deployment, is to collect materials present in the line in the unlikely event that no solids are collected in the sediment traps. These solids will be archived (frozen) for potential future analyses. Data from either the sediment traps or the grab samples will be added to the SEDCAM recontamination model to inform the relative Table 17 ROD COC load from each major sub-basin (i.e., each sub-basin of the outfall basins in the city conveyance system). The data will identify potential ongoing sources of contamination by evaluating stormwater solids data downstream of upland sites.

The sampling locations proposed for in-line and grab stormwater solids are shown on Figure 4-2, listed in Table 4-2, and include:

- Three laterals into manhole AAM104<sup>3</sup> from subbasins in the city outfall basin M-1 (map identification is OFM-1);
- Three laterals into manhole AAM169 from subbasins in the city outfall basin M-2 (OFM-2);
- Two laterals into AAQ004<sup>4</sup> from subbasins in the city outfall basin M-3 (OFM-3);
- Two laterals entering manhole AAM131 from two subbasins within the city outfall basin S-1 (OFS-1); and
- Two laterals entering manhole AAP957 from two subbasins within the city outfall basin S-2 (OFS-2).

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<sup>3</sup> In-line sediment trap deployment and collection of manual solids samples are not proposed at this location due to historical and likely future river backflow. If proposed field reconnaissance during high tide indicates that a sediment trap can be installed above the highest river elevation, then a sediment trap will be installed at this location with the inlet above the highest river elevation. The proposed HVS monitoring and solids sampling location may be adjusted to AAM104 where river backflow is less likely (i.e., pipe invert elevation of 13.01 ft MBDC versus 6.58 ft MBDC at AAM107).

<sup>4</sup> While manhole AAQ003 is closer to OFM-3, its pipe invert elevation is less than the river elevation range during the wet season (3.11 ft versus 4 to 10 ft MBDC). As a result, the proposed monitoring location was adjusted.

In addition to city conveyance system monitoring, private systems will be instrumented with autosamplers to collect grab samples and flow data during qualifying storm events to assess the need for upland source control (Figure 4-2). The private stormwater systems with direct discharges to SIB that will be sampled, and the rationale for sampling each system include:

- The U.S. Coast Guard Marine Safety Unit (historical pre-SCM CUL exceedances in stormwater and stormwater solids and adjacent to RAL and PTW threshold exceedances in sediment);
- ATC Leasing (historical CUL exceedances in stormwater and adjacent to RAL exceedances in sediment);
- Barge Eagle Inc./Swan Island Dock Company (historical CUL exceedances in stormwater and adjacent to CUL exceedances in sediment);
- North Basin Watumull LLC/Swan Island Dock Company (no stormwater or stormwater solids data, historical pesticide releases, and adjacent to RAL exceedances in sediment);
- DTNA Corp 5 Wind Tunnel property (no stormwater or solids data and adjacent to RAL exceedances in sediment); and
- Port of Portland property on North Lagoon Avenue (former Swan Island Upland Facility Operable Unit [OU] 3) (historical CUL exceedances in stormwater and stormwater solids, discharges to ROD riverbank, and adjacent to RAL exceedances in sediment).

While ROD CUL and RAL exceedances are present in surface sediment adjacent to the Portland Shipyard, Vigor is implementing SCMs under an ODEQ Consent Order and Tier 2 measures under its National Pollutant Discharge Elimination System (NPDES) 1200-Z stormwater permit to control CUL exceedances in its stormwater discharge. Vigor is also sampling stormwater for dioxin/furans pursuant to the ODEQ Consent Order (Floyd|Snider, 2020e). Figures E-5 and E-6 in Appendix E of the 2021 SAR show the Portland Shipyard's layout and stormwater drainage areas (HGL, 2021a). The Portland Shipyard outfalls that historically discharged to the basin in the SIB Project Area include 2 that were rerouted to a treatment facility in 2017 and 18 that will be rerouted for electrocoagulation (EC) treatment in 2021. Two additional outfalls that discharged to the Portland Shipyard's drydock area were rerouted for treatment in 2017. Treated effluent from the rerouted outfalls discharges to the main channel of the Willamette River at berth 313 (see Figure 3-1). All the outfall basins in the shipyard are treated, either through active treatment in the EC system (outfall basins Q, S, S1, E, and F) or through passive treatment, including the outfalls on Pier D and the scuppers on Pier C. The exact types of passive treatment (e.g., double rain barrels, custom catch basin inserts, and Grattix boxes) are described in Vigor's Tier II Corrective Action Report and its Monitoring and Performance Evaluation Reports (Floyd|Snider, 2020a and 2020b). Currently, five outfall basins (M1, G, Pier C, Q, and R) discharge treated stormwater to the SIB Project Area. Discharges are monitored as part of NPDES 1200-Z industrial stormwater permit requirements. One outfall basin (M) discharges stormwater to the city's S-1 conveyance system, which will be monitored as part of the PDI.

Additional data on the proposed sample locations, sampling methodology, analytical approach, and schedule is provided in the FSP (Appendix A) and QAPP (Appendix B).

#### 4.4 RIVERBANK CHARACTERIZATION

Riverbank characterization is needed to fulfill three purposes: (1) address data gaps necessary to complete the source control sufficiency assessment, (2) determine the full extent of contamination exceeding the ROD CULs, and (3) provide data necessary to support RD for remediation of contaminated riverbank soils (EPA, 2019b).

Riverbank characterization will be performed in two phases, with one field mobilization each, to identify and characterize the types of materials present in the riverbanks, locate, and delineate areas of potentially erodible sediments, sample grain sizes (through subsequent laboratory sieve analysis), and locate areas of geotechnical movement (slope rotational failure, settlement). This PDI Work Plan addresses only the first phase. The first phase will include an assessment survey of the entire riverbank within the SIB Project Area and completion of a bank stability analysis using the BANCS model, including Bank Erosion Hazard Index and near bank stress determinations. The first phase of the proposed riverbank characterization includes visually inspecting the riverbank and material types to determine input parameters for the BANCS evaluation. After completing this inspection, HGL will prepare a riverbank soil sampling plan as an addendum to this PDI Work Plan. The addendum will include the data quality objectives and proposed sampling locations. The first phase assessment survey will be performed when water levels are at their lowest in SIB (anticipated for Fall 2021 or early 2022). Chemical characterization will be used to meet the ROD objectives; identify the nature of contamination relative to CULs, RALs, and PTW thresholds; and inform the RD when contamination is present (EPA, 2019).

The proposed two-phased characterization will develop data required to determine which riverbank areas need further detailed erodibility/stability assessments by coastal and geotechnical engineers during the PDI. This data will also be used to delineate riverbank areas susceptible to erosion for future use in the RD. Coordinates of erodible and non-erodible areas will be mapped using hand-held GPS units, backed up with field notes on tablets. During the second phase of the riverbank characterization, riverbank soil sampling for chemical characterization will be performed at 126 riverbank transect locations (see Figure 3-2), including a surface soil sample and a subsurface soil sample at each sampling location along the transects (e.g., top, face, and toe of bank [mean low water]). Riverbank soil sampling will be deferred until the proposed first phase riverbank survey has been completed. EPA guidance for riverbanks (EPA, 2019) requires that the entire lateral extent of the riverbank be characterized.

The proposed two-phased approach to riverbank characterization includes the following sequential steps:

1. Assemble available topographic and nearshore bathymetric maps and light detection and ranging (LiDAR) maps to obtain topographic inputs for the BANCS analysis;
2. Conduct a riverbank assessment survey to characterize existing bank conditions, collect data sufficient to run a BANCS analysis for 126 transect locations to calculate bank erosion indices and near bank stress values, and identify locations where riverbank soil sampling is feasible based on material types;
3. Compile riverbank assessment data and perform a BANCS evaluation to calculate the degree of erodibility of the banks;

4. Identify riverbank soil sampling locations based on the results of the riverbank assessment survey, results of the BANCS evaluation, and review of existing riverbank soil data;
5. Prepare a riverbank soil sampling plan and provide it to EPA for review and approval prior to initiating sampling; and
6. Conduct riverbank soil sampling.

This PDI Work Plan includes only the first phase of the riverbank characterization. The first phase includes the Step 1 riverbank assessment survey, the Step 2 data collection to support the BANCS modeling analysis, and the Step 3 data compilation and runs of the BANCS model pursuant to the Stormwater and Riverbank Assessment and Sampling Plan (HGL, 2021a). For the second phase of the work, the specific approach for Steps 4 through 6, conducted during the second phase of the riverbank characterization, will be documented in the Final PDI Work Plan and in the riverbank soil sampling plan addendum, which will be prepared after the riverbank assessment survey and BANCS evaluation steps have been completed.

For riverbank areas with existing data and adjacent to sediment SMAs, the concentrations of ROD COCs at those areas will dictate how they are incorporated into the BODR as follows (after Section 4.1.2, Table 1 and Figure 4 of Appendix D of the *Remedial Design Guidelines and Considerations* document [EPA, 2021a]):

- If ROD Table 17 COC concentrations are less than the CULs, no action will be necessary.
- If ROD Table 17 COC concentrations are above the CULs, the vertical and lateral extent of the exceedances will be delineated, a BANCS analysis (or equivalent erodibility evaluation) will be performed to identify erodible and non-erodible conditions, and a lines of evidence approach will be presented to evaluate whether RAO 9<sup>5</sup> can be achieved by a planned action.
- If ROD Table 21 focused COC concentrations are between the CULs and the RALs, the vertical and lateral extent of the exceedances will be delineated, a BANCS analysis (or equivalent erodibility evaluation) will be performed to identify erodible and non-erodible conditions, and the need for RD for the riverbank will be assessed based on whether the materials exceeding CULs are erodible.
- If ROD Table 21 focused COC concentrations exceed the RALs but not the ROD Table 21 COC concentrations PTW thresholds, the vertical and lateral extent of the exceedances will be delineated, a BANCS analysis (or equivalent erodibility evaluation) will be performed to identify erodible and non-erodible conditions, as noted above, and the RD for the riverbank will be designed in accordance with the requirements of the ROD. Remedial technologies to address contaminated riverbank soils may include removal of contaminated soils and/or capping of contaminated soils, supplemented with bank stabilization to resist erosion (e.g., from stormwater runoff, tidal fluctuations, and propeller wash).

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<sup>5</sup> RAO 9 - River Banks: Reduce migration of COCs in river banks to sediment and surface water such that levels are acceptable in sediment and surface water for human health and ecological exposures (EPA, 2017a).

- If ROD Table 21 COC concentrations exceed the PTW thresholds, the vertical and lateral extent of the exceedances will be delineated, a BANCS analysis (or equivalent erodibility evaluation) will be performed to identify erodible and non-erodible conditions, as noted above, and the RD for the riverbank will be designed in accordance with the requirements of the ROD. Remedial technologies to address contaminated riverbank soils may include removal of contaminated soils and/or capping of contaminated soils, supplemented with bank stabilization to resist erosion (e.g., from stormwater runoff, tidal fluctuations, and propeller wash).

Characterization data was available for only three shoreline properties in the SIB Upland Area: city property with a public boat ramp at the head of SIB, and two former OUs of the Swan Island Upland Facility (Portland Shipyard [OU1] and Port property on N. Lagoon Avenue [OU3]). Sampling results for these three sites were evaluated in Section 6.0 and Appendix E of the SAR (HGL, 2021a). ROD CULs for riverbank soil and in-water sediment and PCB RAL exceedances were identified. Detected concentrations of metals, PCBs, and polycyclic hydrocarbons exceeded the ROD CULs at the Portland Shipyard, and PCBs exceeded the RAL and PTW threshold. Because the lateral extents of the exceedances were not defined and all ROD COCs were not analyzed, these conditions were identified as data gaps for the PDI, and additional characterization has been proposed.

Remediation of impacted riverbanks with adjacent SMAs will become part of the preferred remedial approach presented in the BODR so that the connections between riverbanks and adjacent sediment remediation are accounted for and addressed in an efficient overall design strategy.

#### **4.5 BATHYMETRIC AND TOPOGRAPHIC SURVEYS**

Bathymetric data collection will address the need for a new complete survey data set identified as a data gap in Section 3.5 and Table 3-2. The new bathymetry data will support hydrodynamics and sediment dynamics data collection, PDI engineering studies, and RD. Bathymetric data acquisition will result in a complete elevation surface in the areas of potential remedy using multibeam survey techniques. Reasonable bottom elevation approximations will be made in areas where data collection is not feasible (e.g., under permanently moored vessels or large pile-restrained floats), such as filling data gaps using interpolation based on observed slopes, or filling with previous data if analysis shows recent changes are minimal. Side-scan sonar and sub-bottom profiling being performed at different times may also be used to help address bottom elevation data gaps to the extent feasible. Extents of the proposed multibeam bathymetry survey are shown in Figure 4-3. Bathymetric data collection will be conducted in accordance with applicable requirements specified in the ROD, ASAOC, and *Remedial Design Guidelines and Considerations* document (EPA, 2021b). Further details are provided in the FSP (Appendix A).

Previously available topographic survey data will be used during the PDI for recontamination evaluation, cap/riverbank stability evaluation, and identification of debris. Data available from existing LiDAR (Oregon LiDAR Consortium, 2014) and the proposed laser scan (see Section 4.7) are deemed sufficient in coverage, resolution, and quality for these purposes during the PDI phase of the project. Later, during preliminary and final engineering design, a densely spaced topographic survey will be required at targeted locations. This approach provides the detailed survey data required for design and avoids sitewide topographic surveying that would be costly

and of insufficient value. Existing property line data from [www.portlandmaps.com](http://www.portlandmaps.com) can be used for the PDI phase of the project if required; therefore, no property line surveying is proposed.

Bathymetry data collection will not require specific permits or access agreements with property owners, nor does it rely on any other data collection efforts or PDI studies.

#### 4.6 GEOTECHNICAL SAMPLING

Geotechnical sampling will be performed both in water and in the uplands to identify and characterize the types of soil present at the site, develop estimates for relevant geotechnical engineering design parameters, identify geotechnical hazards, and assess overall ground conditions. Ground condition assessment results will inform structure condition assessments, as well as riverbank stability, cap stability, and cap settlement. Geotechnical sampling will address data gaps identified in Section 3.6 and Table 3-3, and will be based on the following:

- An evaluation of available geotechnical data, including:
  - Existing site-specific geotechnical data and reports;
  - Soil survey maps and data (e.g., Natural Resources Conservation Service);
  - Geologic maps and fault maps (e.g., USGS and Oregon Department of Geology and Mineral Industries); and
  - Historic topographic maps and aerial photographs (e.g., USGS and city of Portland).
- A geotechnical site investigation program, including in-water and upland soil borings and cone penetration tests (CPTs) (as shown in Figure 4-4). Further details are provided in the FSP (Appendix A).
- A geotechnical laboratory testing program to evaluate the physical and engineering characteristics of the soils encountered during the site investigation. Geotechnical laboratory testing will be performed in accordance with current American Society for Testing Materials (ASTM) standards and is anticipated to include:
  - Moisture Content and Unit Weight (ASTM, 2019; ASTM, 2021);
  - Grain Size Distribution (ASTM, 2017e);
  - Grain Size – Percent Passing No. 200 Sieve (ASTM, 2017c);
  - Organic Content (ASTM, 2020a);
  - Specific Gravity (ASTM, 2014);
  - Hydrometer Analysis (ASTM, 2017f);
  - Atterberg Liquid and Plastic Limits (ASTM, 2017d);
  - Consolidated Undrained Triaxial Compression Test (ASTM, 2020b); and
  - One-Dimensional Consolidation (ASTM, 2020c).

Geotechnical site characterization field efforts are required to provide site soil properties suitable for use in a wide range of geotechnical analysis and RD. The work will be performed in accordance with applicable requirements specified in the ROD, ASAOC, *Remedial Design Guidelines and Considerations* document (EPA, 2021b), as well as other applicable guidance documents (e.g.,

Oregon Department of Transportation, Federal Highway Administration). In accordance with Oregon Water Resources Department requirements (Oregon Administrative Rule 690-240-0035), a Geotechnical Hole Report will be prepared for each geotechnical hole advanced for the project. The work will also require site access agreements from property owners, and short-term access agreement with Department of State Lands. Additionally, over-water work will likely require permits from USACE, U.S. Coast Guard, and/or the port authority or harbor master with jurisdiction over the study area.

#### 4.7 SHORELINE AND OVERWATER STRUCTURE INSPECTIONS

Data collection for shoreline and overwater structures will include multiple field inspections and owner/operator interviews. The work is intended to support evaluation of the current condition and use of each structure within the project area and confirm as-built details, including overall structure dimensions, member sizes and spacing, and construction materials. In addition, the owner/operator interviews will be used to determine current and future navigation needs for the waterway within the SIB Project Area. The data collection will fill data gaps identified in Section 3.7 and Table 3-4. The data collection will include the following field inspections:

1. Topside structure inspection of main structural system components, by foot.
2. Under-structure inspection of main structural system components, by boat.
3. A dive inspection using a minimum of a 3-member dive team for 10 working days. This includes a visual and tactile inspection of selected structures based on the screening level inspections.
4. A Mobile Terrestrial LiDAR Survey (MTLS), or boat-mounted laser scan survey, will be performed to locate and document the shoreline, in-water emergent debris, and nearshore marine structures.

Structure inspection data collection will be conducted in accordance with applicable requirements specified in the ROD, ASAOC, and *Waterfront Facilities Inspection and Assessment Manual of Practice No. 130* (American Society of Civil Engineers [ASCE], 2015). A screening level visual inspection of readily accessible main structural systems components and fender piles will be conducted to be able to form an engineering opinion on the general condition of each structure (see Section 4.11.1). The screening inspection results will identify those structures that are recommended to receive a dive inspection and to make further inspection recommendations.

Proposed shoreline extents for performing the MTLS are shown in Figure 4-5. Further details are provided in the FSP (Appendix A). During final engineering design, repair-level inspections will be needed for structures that require structural modifications because of anticipated impacts from the RA.

Shoreline and overwater structure inspections will not require specific permits. The work will require access agreements with property owners. The work does not rely on other data collection efforts or PDI studies.

#### **4.8 EXISTING UTILITIES AND DEBRIS IDENTIFICATION SURVEYS**

Field activities to generate data on utilities and debris potentially affecting RD will include a combination of sub-bottom profiling, side-scan sonar, and magnetometer surveys for detection of debris and existing buried utilities. This data collection will address the data gap identified in Section 3.8 and Table 3-5. Sub-bottom profiling (low-frequency sonar) will assist in both geological characterization as well as debris/utility detection. Magnetometer readings are intended for magnetic object and/or utility detection. Side-scan sonar will cover wider areas and is intended to capture debris in shallower water where multibeam cannot be effectively collected. Side-scan sonar is being proposed as a supplement to multibeam along the entire shoreline in areas where required due to the presence of higher-elevation marine debris (e.g., broken timber piles) or other obstacles preventing safe vessel access and data capture in the multi-beam survey. Proposed utilities and debris detection surveying locations are shown in Figure 4-6. Further details are provided in the FSP (Appendix A).

Stormwater outfalls will also be identified, including private outfalls for which insufficient data exist for RD. Field activities performed for characterizing both riverbank and existing upland utilities will locate remaining outfalls and discern their functionality. In addition, owner/operator interviews will be performed during the PDI to locate and evaluate as-built information and functionality of private outfalls so they can be considered, and used if needed, during RD.

Desktop studies will include a review for the presence of buried utilities (water, sewer, electrical, communications, pipelines, etc.), and evaluation of how waterfront activities and uses may affect those existing utility systems. Research will also be performed on utilities and debris to inform geotechnical site characterization field efforts (i.e., to avoid drilling conflicts with buried objects). Historical documents, aerial photos, and other sources of existing data will be reviewed. Locations of piles and other debris will be delineated from these sources for use in the RD.

Existing utilities and debris identification field efforts will be conducted in accordance with applicable requirements specified in the ROD and ASAOC, if applicable. This data collection will not require specific permits. Only outfall location efforts will require access agreements with property owners. Field efforts do not rely on other data collection efforts or PDI studies; however, the desktop study relies on owner/operator interviews and data collected in the field.

#### **4.9 HYDRODYNAMICS AND SEDIMENT DYNAMICS MEASUREMENTS**

Field measurement efforts are proposed to fill hydrodynamics and sediment dynamics data gaps identified in Section 3.9 and Table 3-6. This data is required to support site characterization; provide input data for numerical modeling efforts (CSM refinement, recontamination, cap stability, climate change impacts); validate the numerical model(s); and assist in PDI engineering studies. Bottom-deployed Acoustic Doppler Current Profilers (ADCPs) will be deployed at two stations, with co-located sensors measuring suspended sediment concentrations. Suspended sediment measurements are a low-cost way to determine the amount of suspended solids moving in the water column over time which supports recontamination evaluation and understanding of general sediment dynamics. Suspended sediments data collection includes laboratory analysis for conversion of measured turbidity to total suspended solids. A mid-deployment recovery and re-deployment will be performed to ensure data is properly captured. Vessel-mounted ADCP

(transect) surveys will also be performed to characterize larger-scale hydrodynamic patterns. These surveys will be performed during the deployment or recovery of bottom-mounted systems at multiple transects across the interior of the SIB and immediately outside the SIB in the main river.

High-frequency free surface elevation measurements will be collected to characterize vessel wakes and wind-waves using four pile-mounted sensors deployed at the same time as the bottom-mounted sensors. These measurements will allow evaluation of potential resuspension/scour and cap and riverbank stability. Bottom-mounted ADCP current data collection, suspended sediments data collection, and wave/wake data collection are assumed to last approximately 2 months, with a retrieval and re-deployment after the first month. Proposed locations of measurement activities for currents, water levels, wind-waves, and boat wakes are shown in Figure 4-7.

The outer bottom-deployed ADCP location was chosen to characterize currents closer to the entrance where river flows enter SIB and recirculate (Coast & Harbor Engineering, 2013). The inner bottom-deployed ADCP location was chosen to characterize currents in the more quiescent area within the SIB where velocities are typically less than 0.1 ft per second (Coast & Harbor Engineering, 2013). At both locations, consideration was made to avoid potential conflicts with vessel traffic, as well as bottom slope to ensure instrument package stability during the deployment.

SedFlume (sediment) cores are proposed to be collected in the field and analyzed in the laboratory to provide data regarding the erodibility of native sediments. Samples are proposed on a regular pattern throughout the SIB Project Area as shown in Figure 4-8. Further details are provided in the FSP (Appendix A).

This data collection will be conducted in accordance with applicable requirements specified in the ROD and ASAOC. Data collection with vessel-mounted and pile-mounted instruments will not require specific permits but pile-mounted measurements will require access agreements with property owners. Data collection with bottom-mounted instruments and SedFlume coring will require specific permits as well as access agreements with property owners. There are no precursors to any of the measurement activities related to hydrodynamics and sediment dynamics.

#### **4.10 HABITAT CONDITIONS SURVEY**

A targeted habitat conditions survey is needed to address data gaps identified in Section 3.11 related to characterization of aquatic and riparian habitat conditions within the SIB Project Area. Although some relevant data exists, it is proposed to conduct a field survey of the entire shoreline included within the SIB Project Area to document both bank conditions and substrate conditions within the shallow area defined as the area from 0 to -15 ft Columbia River Datum. The proposed survey would document present-day conditions around the shoreline and riverbanks and provide consistency in the quality and applicability of the data. It is noted that CWA Section 404 and 401 permits do not limit EPA's interpretation of substantive permit requirements and that future deliverables will incorporate Portland Harbor-specific examples as provided in the forthcoming Programmatic Biological Opinion.

The habitat survey will be performed in accordance with EPA’s National Rivers and Streams Assessment project non-wadeable field protocols for physical habitat characterizations (EPA, 2017b). Habitat data will be collected on transects spaced at 150-ft intervals along the shoreline using photo documentation of habitat conditions at a frequency sufficient to fully describe habitat conditions for input into the HEA. Data will be used to establish the acreages and conditions of each habitat area where remedial activities will occur. Habitat characterization will cover five zones as follows:

- Riparian area – areas above ordinary high water and less than 400 ft from the ACM.
- ACM – the area between ordinary high water and ordinary low water.
- Shallow water – the area between 0 to -15 ft Columbia River Datum.
- Deep water – the area deeper than -15 ft Columbia River Datum.
- Off-channel areas – tributaries to the main waterway.

The following data will be collected to characterize habitat conditions within each of these zones:

- Riparian area – vegetation, substrate, location with respect to historical floodplain, slope, presence of buildings, structures, and riprap.
- ACM – depth, substrate, presence of riprap, sheetpile/seawall, pilings, and suspended and floating structures.
- Shallow water – depth, substrate, presence of riprap, sheetpile/seawall, pilings, and suspended and floating structures.
- Deep water – depth, substrate, presence of riprap, sheetpile/seawall, pilings, and suspended floating structures.
- Off-channel areas – tributary water temperature and position relative to main channel substrate.

The habitat conditions survey will require access agreements for the portion of work conducted in the riparian zone on the riverbanks. The habitat conditions survey will incorporate information from the surface sediment sampling (Section 4.1), the riverbank conditions survey (Section 4.4), bathymetric and topographic surveys (Section 4.5), and the shoreline and overwater structure inspections (Section 4.7).

#### **4.11 ENGINEERING STUDIES**

Engineering studies are required to inform application of the technology application decision tree (Figure 1-3). Initial engineering studies are intended to identify critical impacts to structures, shorelines, the nearshore environment, and facility operations. Further detailed engineering analysis and design activities related to specific structures will also occur during the RD. This section describes the engineering studies considered to be required during the PDI. These studies are proposed to address data gaps identified in multiple subsections of Section 3.0, and to prepare for the RD. Studies will be conducted in accordance with applicable requirements specified in the

ROD, ASAOC, *Remedial Design Guidance and Considerations* document (EPA, 2021b), and *Waterfront Facilities Inspection and Assessment Manual of Practice No. 130* (ASCE, 2015).

#### **4.11.1 Structure Condition Assessments**

Screening-level condition assessments will be performed for each of the identified structures based on the results of field inspections in Section 4.7. Condition assessments are required information to support functional structure determinations according to the technology application decision tree (Figure 1-3). These assessments will identify major visually observable deficiencies that may affect the ability of the structures to carry future design loads and those most likely to be negatively impacted by the RA. Assessments will follow *Waterfront Facilities Inspection and Assessment Manual of Practice No. 130* (ASCE, 2015). The condition assessments will include an evaluation of the structure general condition, design loads, age and past repair history, geotechnical conditions, and likely capacity. Condition assessments themselves will not require specific permits or access agreements with property owners. This analysis relies on field inspection efforts described in Section 4.7.

#### **4.11.2 Facility Owner/Operator Interviews**

Owners and operators of waterfront facilities with structures will be interviewed for the following purposes:

- Improve understanding of site history,
- Obtain additional as-built data and repair history,
- Obtain past condition assessment reports,
- Determine current and future use requirements and anticipated design criteria, and
- Determine the current and future navigation depth requirements for the SIB Project Area.

These interviews are intended to supplement the field inspections described in Section 4.7 and to facilitate the functional structure evaluation. No known guidelines or requirements are applicable to this effort. Owner/operator interviews will not require specific access agreements but will require coordination with property owners. This effort does not rely on any other data collection efforts or PDI studies.

#### **4.11.3 Facility Future Use and RA Impact Evaluation**

Engineering evaluations will be performed to characterize the anticipated future use of the shoreline and overwater structures in the SIB and potential impacts of the RA. Structural analysis will be performed to evaluate capacities and capabilities to support design loads post-RA. RA impacts on shoreline and overwater structures will be evaluated with the following tasks:

- Estimate current structural system capacity based on condition assessment, as-built drawings, and past repair history;
- Perform a functional structures determination, including an estimate of the structures' remaining service life;

- Perform structural analysis using two dimensional finite element analysis (or similar) to determine impacts of RA on structural system capacity;
- Perform a more detailed (three dimensional [3D] finite element) analysis on a limited number of complex or sensitive structures either during the PDI or during the RD;
- Determine the relative decrease in structural system capacity compared to the as-built condition and relative to applicable building codes; and
- Modify the RD iteratively, where feasible, to avoid negative impacts to permanent, functional structures.

No known requirements are applicable to this effort. These studies will not require specific permits or access agreements with property owners. This effort relies upon the results of many field efforts and PDI studies, including bathymetric survey, utility and debris identification, geotechnical site characterization, slope stability and seismic evaluation, and riverbank characterization.

#### **4.11.4 Facility Operations and Construction Phasing Assessment**

Analysis will be performed to evaluate potential disruption to facility operations caused by the RA. Sequencing/planning schemes will be evaluated to identify impacts, identify both synergies and conflicts, develop conflict mitigation measures, and plan additional temporary operations scenarios, or other. Construction planning efforts will consider both existing and future use of facilities affected by RA on an annual and/or seasonal basis. This study does not address a specific data gap but represents an optimization effort to mitigate disruption impacts. Mitigation measures may consist of altering the proposed RA, altering the timing and/or sequencing of RA activities, or providing alternative operational scenarios for tenants. This study will be conducted in accordance with applicable requirements specified in the ROD, ASAOC, and *Remedial Design Guidelines and Considerations* document (EPA, 2021b). This study will not require specific permits or access agreements with property owners. This effort relies upon the results of many PDI studies, including application of the technology application decision tree (Figure 1-3) (which is also based on many other efforts), and the dredging study discussed in Section 4.11.5.

#### **4.11.5 Dredging Study**

A dredging study will be performed to evaluate critical elements of dredging in the SIB and streamline construction, and is anticipated to include the following elements:

- Anticipated equipment (mechanical, hydraulic, land-based vs. water-based, etc.);
- Equipment capabilities and limitations;
- Lateral and vertical extents of dredging;
- Over-dredging (construction tolerance) requirements;
- Site configuration considerations (sediments, bed slope, hydrodynamics, etc.);
- Geotechnical evaluation, for the purposes of evaluating potential dredging production rates, slope stability, side slope design, structural offsets, dewatering, and disposal considerations;

- Existing debris removal and existing structure considerations;
- Dredging production rates;
- Transloading, rehandling, and logistics for disposal; and
- BMPs and engineered recontamination control measures.

This study does not address a specific data gap but represents an optimization effort to reduce costs and environmental impacts during construction. This study will be conducted in accordance with applicable requirements specified in the ROD, ASAOC, and *Technical Guidelines for Environmental Dredging of Contaminated Sediments* (USACE, 2008). This study will not require specific permits or access agreements with property owners. This effort relies upon the results of many PDI studies, including application of the technology application decision tree (Figure 1-3) (which is also based on many other efforts).

#### **4.11.6 Constructability Assessment**

The purpose of the constructability assessment is to evaluate feasibility of implementing the proposed remediation concepts. Remediation concepts will be evaluated using field data collected during the PDI and the results of desktop engineering studies. Remediation concepts will likely consist of miscellaneous combinations of capping, dredging, dredging/capping, bank stabilization, habitat development, debris and non-functional structure removal, potential replacement of functional marine structures, and other elements to be determined. The assessment will be conducted by reviewing the construction process from start to finish and determining potential impacts of constructions on facility operations and whether proposed construction methods are likely to be practical and successful. Construction elements will include dredging, capping, demolition, bank stabilization, and rehabilitation or reconstruction of shoreline and overwater structures. The process is intended to:

- Integrate construction expertise into the planning and design process;
- Evaluate whether the RA concepts are buildable and maintainable;
- Provide insight into construction activities;
- Identify potential project construction risks;
- Reduce or prevent errors, delays, and cost overruns;
- Evaluate impacts to existing facilities;
- Evaluate traffic control (surface and maritime);
- Identify potential sources of aggregate materials (capping, shoreline protection, etc.);
- Evaluate anticipated site logistics and constraints, including utility conflicts within the work areas;
- Review potential environmental impacts for the proposed construction methods; and
- Establish general construction sequencing necessary to complete the project.

The constructability assessment will be conducted in coordination with the dredging study. The constructability assessment will also include a discussion on potential construction monitoring suitable to protect existing functional structures. This study does not address a specific data gap but represents an optimization effort to reduce overall risk and construction costs. This study will be conducted in accordance with applicable requirements specified in the ROD and ASAOC. This study will not require specific permits or access agreements with property owners. This effort relies upon the results of many PDI studies, including application of the technology application decision tree (Figure 1-3) (which is also based on many other efforts).

#### **4.11.7 Recontamination Potential Evaluation**

Sediment transport studies will be performed to evaluate recontamination potential in the SIB post-RA. Recontamination potential evaluations in this section include analysis of sediment movements which, when combined with contaminant concentrations from areas of sediment origin, provide input of contaminants from different sources for use in the SEDCAM modeling described in SAR Section 8.6. The hydrodynamic and sediment transport modeling results will be used to develop inputs for SEDCAM. SEDCAM will be applied to multiple locations spatially distributed within the SIB Project Area, and the hydrodynamic and sediment transport modeling results will inform key parameter values at each SEDCAM location. Those parameters will include local sediment deposition rates, scour rates, mixing depth, and COC loading. Recontamination will be considered from upland pathways, in-water pathways, and local pathways (e.g., local resuspension/scour). In addition, recontamination will be considered from both natural forces (e.g., river currents) and anthropogenic forces (e.g., propeller wash). The SAR (HGL, 2021a) determined that all the recontamination pathways discussed in this section are Status “C”, Uncontrolled, and require additional characterization and/or source control.

- Upland Pathways – Direct Discharges (Outfalls) Recontamination Potential: The purpose of this analysis is to evaluate the fate and relative contribution of contaminated sediments discharged to the SIB Project Area from outfalls. Existing numerical models of the SIB that include the river and outfall jets will be utilized, in combination with stormwater and hydrology information. Sediment footprints from simulated outfall discharges will be assigned contaminant concentrations based on contaminant concentrations measured during stormwater sampling. Work will consist of the following tasks:
  - o Hydrology evaluation – upland drainage and stormwater flows;
  - o Outfall discharge evaluations (flows, sediments, etc.);
  - o 3D hydrodynamic modeling of outfall discharges – extreme events;
  - o 3D hydrodynamic modeling of outfall discharges – typical conditions; and
  - o Generate sediment deposition footprint from simulated outfalls and rates of sediment deposition to be used as input to SEDCAM modeling for recontamination potential evaluation.
- Upland Pathways – Overwater Sources (Particulates) Recontamination Potential: The purpose of this analysis is to evaluate the fate and relative contribution of contaminated particulates (to be determined) discharged to the SIB Project Area from overwater activities. Existing hydrodynamic numerical models of the SIB will be utilized, in

combination with approximated behavior of overwater materials (to be determined). Data used to characterize over-water contributions will include any available measured concentrations within discharged particulates or estimates based on desktop study, and particulate physical properties relevant to in-water transport (density, diameter, and shape). Particulate material to be considered will include abrasive blasting material, paint chips, and solids components of stormwater runoff from over-water surfaces. Data sources may include existing stormwater monitoring data and published literature characterizing abrasive blasting material and marine paints. Transport and deposition will be simulated using hydrodynamic modeling combined with particle tracking (Lagrangian) or similar transport simulations. Work will consist of the following tasks:

- o Evaluate discharged material types (particulates, others), likely source locations, and contaminant concentrations;
  - o Perform 3D hydrodynamic modeling of hydrodynamics near over-water inputs;
  - o Simulate transport and deposition of over-water discharged particulates; and
  - o Characterize recontamination (dilution) from over-water sources.
- In-Water Pathways – River Sediment Transport Recontamination Potential: The purpose of this analysis is to evaluate the fate and relative contribution of contaminated sediments entering the SIB Project Area from other areas. Existing numerical models of the SIB that include the river will be utilized, in combination with river sediment information. Upstream river sediments will be incorporated into the modeling through sediment tracking analysis with multi-fraction sediment sources within the river upstream of the SIB. Work will consist of the following tasks:
    - o Redevelop existing mass-based river-wide model (coarsen);
    - o Re-validate coarse hydrodynamic model;
    - o Perform longer-term simulations – hydrodynamics (e.g., seasonal);
    - o Perform longer-term simulations – sediments (e.g., seasonal);
    - o Perform sediment tracking simulations from distinct river locations into the SIB;
    - o Perform sediment tracking simulations from distinct SIB locations into various remediation areas; and
    - o Characterize recontamination (dilution) from river source areas to the SIB.
  - Resuspension/Scour Pathways – Natural Forces: The purpose of this analysis is to evaluate the fate and relative contribution of contaminated sediments resuspended/scoured from un-remediated areas within the SIB Project Area. Existing natural hydrodynamics numerical models of the SIB will be utilized. Work will consist of the following tasks:
    - o Perform river conditions analysis - river flows, winds, outfall discharges;
    - o Evaluate wind-wave generation and transformation;
    - o Perform bathymetry change analysis;
    - o Incorporate SedFlume data into sediment transport model;

- o Perform 3D hydrodynamic (mass-based) model refinement;
- o Perform 3D hydrodynamic model calibration/validation using previously collected and newly collected data in the SIB;
- o Perform 3D hydrodynamic modeling of natural conditions – extreme events;
- o Perform 3D hydrodynamic modeling of natural conditions – typical conditions;
- o Perform climate change impact evaluation (temperatures, water levels, discharges);
- o Extrapolate 3D hydrodynamic modeling results to long-term conditions (sediment resuspension climate);
- o Map sediment resuspension zones;
- o Evaluate potential for natural scour based on erosion rate/duration; and
- o Perform natural forces scour calculations.
- Resuspension/Scour Pathways – Anthropogenic Forces from Vessels and Dry Docks: The purpose of this analysis is to evaluate the fate and relative contribution of contaminated sediments resuspended/scoured from un-remediated areas within the SIB Project Area, due to anthropogenic hydrodynamic forces. A suite of numerical models simulating these processes will be utilized. Work will consist of the following tasks:
  - o Purchase and process Automatic Information System (AIS) data;
  - o Analyze AIS data and select relevant vessel traffic;
  - o Evaluate ship positions, speeds, and power utilization;
  - o Compute propeller-wash bottom velocities;
  - o Perform conceptual fluid design modeling of drydock lowering/raising and related vessel movement;
  - o Estimate boat wakes (short-period Kelvin wakes) using empirical formulations;
  - o Perform boat wake transformation simulation using spectra in wind-wave model;
  - o Perform vessel hydrodynamic simulations for pressure field effects;
  - o Evaluate pressure field effects on sediment resuspension;
  - o Map sediment resuspension zones;
  - o Evaluate overlap of anthropogenic resuspension zones;
  - o Evaluate potential for anthropogenic scour depths based on erosion rate/duration; and
  - o Perform anthropogenic forces scour assessment.
- Resuspension/Scour Pathways – Sediment Releases During Dredging: The purpose of this analysis is to evaluate the fate and relative contribution of contaminated sediments resuspended during dredging. Existing river/SIB hydrodynamic numerical models will be utilized. Work will consist of the following tasks:

- o Analyze sediment characteristics from SedFlume results;
  - o Evaluate likely dredging equipment and methodology;
  - o Evaluate releases from both hydraulic and mechanical dredging, in coordination with the Dredging Study;
  - o Prepare dredging source inputs to 3D hydrodynamic model;
  - o Simulate sediment movements at various river flows;
  - o Map thickness/concentrations of materials spread during dredging;
  - o Analyze recontamination potential (dilution); and
  - o Evaluate benefits of various BMPs intended to limit resuspension and/or spreading.
- Future Climate Change Effects on Recontamination Potential: The purpose of this analysis is to evaluate the fate and relative contribution of contaminated sediments during future climate change conditions, for forces evaluated in other tasks (natural and anthropogenic). Previously constructed river and anthropogenic hydrodynamic numerical models will be utilized. Work will consist of the following tasks:
    - o Summarize potential changes in future conditions;
    - o Develop future conditions – natural conditions, outfall flows;
    - o Develop future conditions from changes in use – overwater sources, direct discharges, vessels/drydocks;
    - o Evaluate climate change impacts on groundwater recontamination; and
    - o Evaluate climate change impacts on riverbank erosion/slope stability.

These recontamination analyses address data gaps regarding potential for recontamination of the SIB post-RA from multiple sources. This study will be conducted in accordance with applicable requirements specified in the ROD, ASAOC, and *Remedial Design Guidelines and Considerations* (EPA, 2021b). This study will not require specific permits or access agreements with property owners. This effort relies upon the results of many field efforts and PDI studies.

#### **4.11.8 Cap Stability Evaluations**

Cap stability will be evaluated under both natural and anthropogenic erosive hydrodynamic forces, as well as slope stability, settlement, and seismic forces. The cap stability analyses are required to support application of the technology application decision tree (Figure 1-3) and overall RD. Analysis will include assessments for both post-RA conditions and future climate change (also post-RA) conditions. Future climate change conditions are anticipated to include increased rainfall and rainfall intensity, changes in temperatures and winds, and sea level change considering both eustatic sea level rise and local subsidence.

- Cap Stability Evaluation (Erosion) – Natural Conditions Post-Remedial Action: The purpose of this analysis is to evaluate stability of capping materials under natural erosive forces. Previously constructed river hydrodynamic numerical models will be updated for use in the analyses. Work will consist of the following tasks:

- o Incorporate capping materials (RD concept) into numerical models;
- o Perform 3D hydrodynamic modeling of natural conditions – extreme events;
- o Perform 3D hydrodynamic modeling of natural conditions – typical conditions; and
- o Evaluate cap mobility/stability under natural forces.
- Cap Stability Evaluation (Erosion) – Anthropogenic Conditions Post-Remedial Action: The purpose of this analysis is to evaluate stability of capping materials as part of RA alternatives evaluation, for anthropogenic conditions. Previously constructed anthropogenic hydrodynamic numerical models will be updated for use in the analysis. Work will consist of the following tasks:
  - o Evaluate new propeller-wash bottom velocities post-RA, and changes from pre-project conditions;
  - o Evaluate new pressure field (large vessel movement) bottom velocities post-RA, and changes from pre-project conditions;
  - o Evaluate post-RA maximum expected vessel-generated waves;
  - o Evaluate new drydock-induced bottom velocities post-RA, and changes from pre-project conditions; and
  - o Perform post-RA cap mobility and erosion assessment.
- Future Climate Change Effects on Cap Stability (Erosion): The purpose of this analysis is to evaluate stability of capping materials under future climate change scenarios for natural erosive forces. Previously constructed river hydrodynamic numerical models will be updated and utilized. Work will consist of the following tasks:
  - o Summarize updated projections by the Intergovernmental Panel on Climate Change and Climate Impacts Group at the University of Washington;
  - o Update future design conditions for flow rate from hydrologic projections developed by Climate Impacts Group for the selected emissions scenario corresponding to the remedy design condition (100-year storm);
  - o Update sea level rise projections based on the same emissions scenario considered for the hydrologic projections (obtained from either USACE or NOAA); and
  - o Evaluate climate change impacts on riverbank erosion/slope stability.
- Geotechnical Cap Stability: Geotechnical engineering analyses will be performed based on the results of the site characterization and support the following assessments:
  - o Evaluation of potential liquefaction susceptibility (Youd et. al., 2001; Boulanger and Idriss, 2014);
  - o Evaluation of static stability of moderately to steeply sloping ground by limit-equilibrium based slope stability analysis;
  - o Evaluation of seismic stability of non-liquefied, moderately to steeply sloping ground during earthquake-induced ground shaking events by limit-equilibrium based pseudo-static slope stability analysis;

- o Evaluation of bearing capacity failure mode and filter design, in general accordance with EPA’s Assessment and Remediation of Contaminated Sediments (ARCS) Program Guidance for In-Situ Subaqueous Capping of Contaminated Sediments (EPA, 1998);
- o Representative section development and identification of risks and failure modes;
- o Seismic stability analysis, per Section 5.2.5 of Remedial Design Guidelines and Considerations (EPA, 2021b);
- o Local subsidence evaluation based on existing data; and
- o Settlement analysis.

These cap stability analyses address the feasibility and longevity of the proposed RA. These studies will be conducted in accordance with applicable requirements specified in the ROD, ASAOC, *Remedial Design Guidance and Considerations* document (EPA, 2021b), and *Guidance for River Bank Characterizations and Evaluations at the Portland Harbor Superfund Site* (EPA, 2019b). These studies will not require specific permits or access agreements with property owners. These studies rely upon the results of many field efforts and other PDI studies.

#### **4.11.9 Green Remediation Practice Evaluation**

Green remediation practices will be evaluated according to Section 14.2.12 of the ROD for the initial RA concepts. The evaluation will consider the following construction elements:

- Use of renewable energy and energy conservation and efficiency approaches;
- Water conservation and efficiency approaches including water sense products;
- Use of cleaner fuels and reused or recycled materials;
- Limiting transportation, limiting idling of trucks/equipment, checking that vehicles are full prior to transport, and routing transport efficiently; and
- Implementing on-site BMPs (dust and noise control, reducing air pollutant and greenhouse gas emissions).

The green remediation practice evaluation will address ROD requirements related to construction, such as minimizing transportation of materials and using rail rather than truck transport to the extent practicable. During the design phase of the project, a Green Remediation Plan will be developed in accordance with the *Remedial Design Guidance and Considerations* document (EPA, 2021b). This analysis is proposed to reduce the environmental impact of construction activities. The Green Remediation Plan will include a discussion on how baseline versus reductions in energy and water usage, particulate emissions, waste generation and handling, and other improvements will be tracked and reported during construction. EPA Region 10 guidance to be considered will include the 11 primary elements listed in the EPA Region 10 Clean and Green Policy (EPA, 2009a), with a focus on reducing the anticipated environmental footprint of construction activities.

Per discussion with EPA on August 19, 2021, the green remediation practice evaluation will not need to include design investigations, and the Green Remediation Plan will be developed after the

PDI. The design team is committed to using BMPs during the design investigations to minimize their environmental footprint to the extent feasible. These studies will be conducted in accordance with applicable requirements specified in the ROD, ASAOC, *Clean and Green Policy* (EPA, 2009a), *Principles for Greener Cleanups* (EPA, 2009b), and the *Superfund Green Remediation Strategy* (EPA, 2010). These studies will not require specific permits or access agreements with property owners. This effort relies upon the results of many field efforts and other PDI studies.

#### **4.11.10 Flood Impact Evaluation**

Flood impact evaluation will be performed using a hydrodynamic model of the Willamette River and surrounding Columbia River. Modeling will be performed using HEC-RAS or other tools to be reviewed and approved by EPA (e.g., existing hydrodynamic models of the Willamette River system). The flood impact evaluation will include the following tasks:

- Incorporate a conservative RD concept (greatest potential to produce a net water level rise) into full river hydrodynamic model.
- Develop appropriate hydrologic inputs (Federal Emergency Management Agency 500-year data).
- Simulate a conservative set (maximum three) of extreme flood events.
- Evaluate uncertainties associated with potential climate change effects on future hydrologic conditions that affect the flood rise evaluation, using a modeling sensitivity analysis.
- Document changes in water levels in the river system.
- Generate Flood Impact Evaluation memo (draft and final).

The remedy will include activities at the mouth of the SIB that are close to the main river where changes to riverbed elevation may affect hydraulics. The proposed analysis will identify constraints on the RA in this area necessary to ensure no net rise in the 500-year floodplain elevation will be caused by RA. Post-remedy 500-year floodplain maps are not intended to be developed. The flood impact evaluation will be performed in accordance with Section 5.2.11 of *Remedial Design Guidance and Considerations* (EPA, 2021b). The evaluation will not require specific permits or access agreements with property owners. This effort relies upon the results of hydrodynamics and sediment dynamics field efforts, numerical model development as part of recontamination studies, and application of the technology application decision tree (Figure 1-3).

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## 5.0 PDI MANAGEMENT PLAN

This PDI Work Plan proposes a plan to address data and analysis gaps by conducting field investigations and analyses needed to develop the BODR and RD Work Plan. This plan proposes a comprehensive multi-disciplinary field data collection program safely and efficiently using appropriate regulatory and industry-standard performance practices. EPA will approve fieldwork prior to implementation. At all times, this work will adhere to industry prescribed health and safety practices in the field and in the water. This also includes any current national, state, or local COVID-19 guidelines. The PDI will provide the information necessary to complete the SAR (HGL, 2021a) and develop the RD. The PDI will also include the information necessary to analyze the RD and demonstrate that the remedy will be effective and sustainable in the context of the SIB. Following implementation of the EPA-approved PDI, the Parties will submit a Draft PDI Evaluation Report for EPA comment and approval.

The Parties will follow the *Remedial Design Guidance and Considerations* document, which was developed consistent with the ROD to facilitate efficient and timely design work throughout PHSS. The *Remedial Design Guidance and Considerations* document was developed in coordination and collaboration with designers already performing RD at PHSS and the Portland Harbor Technical Coordinating Team. EPA will update the *Remedial Design Guidance and Considerations* document as needed through collaborative meetings and discussion with designers and the Portland Harbor Technical Coordinating Team. Section 1.4 of the *Remedial Design Guidance and Considerations* document provides clarification on determination of SMAs, how buried contamination is considered in design, where data replacement might be considered during design, technology assignment, equivalence analysis, and how PeCDD RALs will be addressed in design.

While the approved data, including baseline data will be considered, final decisions regarding RD activities including PDIs at the SIB Project Area, including delineation of SMAs, implementation of sampling necessary for design, and application of the ROD's technology matrix, will be made pursuant to the ASAOC and the scope of work incorporated therein.

### 5.1 SWAN ISLAND BASIN REMEDIAL DESIGN GROUP

The SIB RD Group consists of the following parties named in the ASAOC executed between the Parties (collectively known as the Respondents) and EPA effective January 20, 2021. The Respondents are:

- DTNA;
- Vigor;
- Cascade General, Inc.; and
- Shipyard Commerce Center LLC.

Additional Parties to the ASAOC are the Settling Federal Agencies, which consist of:

- Maritime Administration, U.S. Coast Guard;
- U.S. General Services Administration;
- Bonneville Power Administration; and
- U.S. Department of Defense.

Additional Settling Public Entities consist of:

- State of Oregon, acting by and through the Department of State Lands;
- City of Portland; and
- Port of Portland.

DTNA is represented by law firm Ogden Murphy Wallace P.L.L.C. from Seattle, Washington. Philip Spadaro of The Intelligence Group is the Respondents' project coordinator. The EPA Remedial Project Manager (RPM) is Madi Novak.

## **5.2 PROJECT ORGANIZATION CHART**

The project management team mirrors the project management team and structure identified for the overall RD and documented in the ASAOC and associated scope of work. Figure 5-1 illustrates HGL's management and reporting structure for the SIB Project Area including lines of communication with the clients, Project Coordinator Philip Spadaro, and EPA.

HGL Principal-In-Charge (PIC), Bob Overfelt, is responsible for contract performance, and he ensures that HGL meets its performance objectives and contractual requirements.

HGL Project Manager (PM) Jeff Hodge reports to Mr. Overfelt and is responsible for providing direction to the project staff and managing project activities including cost and schedule accountability. Mr. Hodge provides a point of contact for the clients, project coordinator, subcontractors, and suppliers. Primary roles and responsibilities of the PM include coordinating with the PIC and technical director to select project staff and assign responsibilities; communicating with the clients and project coordinator; developing, monitoring, and complying with project budgets, schedules, and deliverables; coordinating technical efforts; anticipating and managing changed conditions; and implementing project QC and health and safety procedures.

HGL Technical Director Shane Cherry reports to the PIC and is responsible for providing technical direction to the project staff. Mr. Cherry communicates with the clients, project coordinator, subcontractors, and suppliers, as necessary. Other responsibilities of the technical director include reviewing deliverables and directing technical efforts.

Mott MacDonald is a subcontractor to HGL, providing multi-disciplinary engineering analysis and design services. Mott MacDonald's responsibilities in the PDI include oversight of field sampling for engineering-related data; and coastal, hydraulic, geotechnical, civil, and structural engineering studies to support future RD.

Pacific Groundwater Group is a subcontractor to HGL, providing sediment chemical characterization including data gaps analysis and supporting SEDCAM modeling to evaluate recontamination. Pacific Groundwater Group is also responsible for data management as well as database statistics and maintenance.

The Bridgewater Group is a subcontractor to HGL specializing in environmental site assessments and multi-media investigations including upland source control investigations, RD, implementation oversight, permitting, environmental management, and compliance assistance.

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## **6.0 DELIVERABLES/SCHEDULE**

The PDI will be documented in the PDI Evaluation Report as specified in the ASAOC, Appendix A “Remedial Design Statement of Work.” The ASAOC specifies that the PDI Evaluation Report must include:

1. Summary of the investigations performed;
2. Summary of investigation results;
3. Summary of validated data (i.e., tables and graphics);
4. Data validation reports and laboratory data reports;
5. Narrative interpretation of data and results;
6. Results of statistical and modeling analyses, if applicable;
7. Photographs documenting the work conducted; and
8. Conclusions and recommendations on whether the data is sufficient to complete the BODR.

Appendix A “Remedial Design Statement of Work” in the ASAOC (Section 6.2 “Schedule”) specifies that the deadline for the Draft PDI Evaluation Report is “As set forth in the approved PDI Work Plan.” This PDI Work Plan proposes June 26, 2023, as the deliverable date for the Draft PDI Evaluation Report. The rationale for that proposed date is summarized below as an overview of the timeline for completing sequentially dependent data collection efforts and analyses proposed in this PDI Work Plan.

The period for conducting the field data collection begins with EPA approval of this PDI Work Plan anticipated late Fall 2021. The proposed schedule for the work is shown in Table 6-1. Certain sampling efforts, such as stormwater event sampling that target winter season rainfall events, would benefit from EPA approval in time to allow mobilization by late 2021. Most other field efforts are seasonal or weather dependent, and the bulk of the PDI field data collection effort is planned to occur between April and August 2022. Field sample collection feeds into laboratory analysis followed by data validation and reporting. Field sampling efforts will be staggered to account for required test durations or capacity limitations at certain process steps. For example, geotechnical sampling will occur as early as possible to allow up to 3 months for sample analysis. The proposed delivery date of June 26, 2023, for the Draft PDI Evaluation Report allows for field sampling to occur through August 2022 and provides enough time for the subsequent steps of analysis, validation, reporting, and review.

The work elements proposed in this PDI Work Plan fall into three categories:

- Field sample collection and laboratory analysis,
- Field surveys and other field measurements/observations, and
- Engineering analysis studies.

HGL proposes to report on all components of the proposed PDI in the draft PDI Evaluation Report. Where appropriate, engineering analysis reporting will be expanded upon within the BODR. HGL believes it is necessary and constructive to describe the engineering studies while planning the PDI to transparently present and discuss with EPA the anticipated application of the field data to the RD as early as possible. The overall schedule for the RD will be optimized by beginning to develop the BODR concurrently with PDI performance and reporting. The specific work elements proposed as part of this PDI Work Plan are summarized below.

## **6.1 FIELD DATA COLLECTION ELEMENTS OF THE PDI**

The field data collection elements of the PDI are summarized in the following list. These PDI elements include field sample collection and laboratory analysis, field surveys, and other field measurements/observations. HGL proposes to report all these results in the Draft PDI Evaluation Report to be delivered to EPA on June 26, 2023.

1. Surface and subsurface sediment contaminant concentrations
2. Porewater upwelling area survey
3. Stormwater outfall and conveyance system sampling
4. Riverbank characterization survey
5. Bathymetry and topographic surveys
6. Geotechnical sampling
7. Shoreline and overwater structure inspections
8. Existing utilities and debris identification surveys
9. Hydrodynamics and sediment dynamics field measurements
10. Habitat conditions survey results

## **6.2 ENGINEERING STUDY ELEMENTS OF THE PDI**

The engineering study elements of the PDI are summarized in the following list. These PDI elements include engineering analysis that relies on a combination of existing data and new data that will be collected as part of the PDI. HGL proposes to report the results of engineering studies in the Draft PDI Evaluation Report to be delivered to EPA on June 26, 2023. This is not a fully inclusive list of all engineering evaluations required for RD. Additional engineering evaluations will be identified and documented in the Basis of Design Report, the RD Work Plan, and subsequent design submittals.

1. Shoreline and overwater structure condition assessments
2. Facility owner/operator interviews
3. Facility future use and RA impact evaluation
4. Facility operations and construction phasing assessment
5. Dredging study
6. Constructability assessment
7. Recontamination potential evaluation
8. Cap stability evaluations
9. Green remediation practice evaluation
10. Flood impact evaluation

## 7.0 REFERENCES

- AECOM and Geosyntec, 2019. PDI Evaluation Report, Portland Harbor Pre-Remedial Design Investigation and Baseline Sampling. Prepared for United States Environmental Protection Agency, Region 10.
- American Society of Civil Engineers (ASCE), 2015. *ASCE Manuals and Reports on Engineering Practice No. 130 Waterfront Facilities Inspection and Assessment*. American Society of Civil Engineers.
- ASTM, 2014. ASTM D854-14, *Standard Test Methods for Specific Gravity of Soil Solids by Water Pycnometer*, ASTM International, West Conshohocken, PA, 2014, at URL [www.astm.org](http://www.astm.org).
- ASTM, 2017a. ASTM D2487-17e1, *Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)*, ASTM International, West Conshohocken, PA, 2017, at URL [www.astm.org](http://www.astm.org).
- ASTM, 2017b. ASTM D2488-17e1, *Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)*, ASTM International, West Conshohocken, PA, 2017, at URL [www.astm.org](http://www.astm.org).
- ASTM, 2017c. ASTM D1140-17, *Standard Test Methods for Determining the Amount of Material Finer than 75- $\mu$ m (No. 200) Sieve in Soils by Washing*, ASTM International, West Conshohocken, PA, 2017, at URL [www.astm.org](http://www.astm.org).
- ASTM, 2017d. ASTM D4318-17e1, *Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils*, ASTM International, West Conshohocken, PA, 2017, at URL [www.astm.org](http://www.astm.org).
- ASTM, 2017e. ASTM D6913 / D6913M-17, *Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis*, ASTM International, West Conshohocken, PA, 2017, at URL [www.astm.org](http://www.astm.org).
- ASTM, 2017f. ASTM D7928-17, *Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis*, ASTM International, West Conshohocken, PA, 2017, at URL [www.astm.org](http://www.astm.org).
- ASTM, 2019. ASTM D2216-19, *Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass*, ASTM International, West Conshohocken, PA, 2019, at URL [www.astm.org](http://www.astm.org).
- ASTM, 2020a. ASTM D2974-20e1, *Standard Test Methods for Determining the Water (Moisture) Content, Ash Content, and Organic Material of Peat and Other Organic Soils*, ASTM International, West Conshohocken, PA, 2020, at URL [www.astm.org](http://www.astm.org).

- ASTM, 2020b. ASTM D4767-11(2020), *Standard Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils*, ASTM International, West Conshohocken, PA, 2020, at URL [www.astm.org](http://www.astm.org).
- ASTM, 2020c. ASTM D2435 / D2435M-11(2020), *Standard Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading*, ASTM International, West Conshohocken, PA, 2020, at URL [www.astm.org](http://www.astm.org).
- ASTM, 2021. ASTM D7263-21, *Standard Test Methods for Laboratory Determination of Density and Unit Weight of Soil Specimens*, ASTM International, West Conshohocken, PA, 2021, at URL [www.astm.org](http://www.astm.org).
- Boulanger, R. W. and Idriss, I. M., 2014. *CPT and SPT Based Liquefaction Triggering Procedures*, Report UCD/CGM- 14/01, Department of Civil and Environmental Engineering, University of California, Davis, CA, 138 pp.
- Bridgewater, 2011. Remedial Investigation and Risk Assessment, Daimler Trucks North America, LLC Facility (formerly Freightliner LLC Parts Manufacturing Plant). June.
- Bridgewater, 2013. Addendum to Source Control Evaluation Report Regarding Stormwater Pathway, Including results of 2021 Catch Basin Sampling and Analyses and Source Evaluation, Corp. 10 (formerly Freightliner Parts Manufacturing Plant), 5400 N. Basin Avenue, Portland, Oregon (DEQ ECSI No. 1500). April.
- Bridgewater, 2020. Interim Report for Source Control Evaluation: Updated Final Groundwater Monitoring Well Installation and Development, 2017 – 2018 Sampling and Analyses, and Proposed Transition Zone Water Sampling and Analyses. Revised August 13.
- City of Portland, 2013. Municipal Stormwater Source Control Report for Portland Harbor. Amended February 2014, at URL <http://www.portlandoregon.gov/bes/64448>.
- Coast and Harbor Engineering, 2013. Sediment Transport Modeling and Fate Analysis, Swan Island Basin, Portland Harbor, Oregon. Technical Report prepared for Daimler Trucks North America LLC, San Francisco, California. September.
- Coastal Monitoring Associates, 2020. Data Report [for] Trident Probe Transition Water Zone Screening [for] Tube Forgings of America / Front Avenue LLCs, 4950, 5034, and 5200 NW Front Avenue, Portland, OR (ODEQ ECSI # 1236). July.
- Engineering World, 1920 Volume 17. Issue Number 1. Page 92. July, at URL [http://books.google.com/books?id=OwU0AQAAMAAJ&pg=PA92&lpg=PA92&dq=swan+island+mocks+bottom&source=bl&ots=ouTrtb\\_478&sig=ZE4zYZs\\_jOvyRsH6QscQ5SKmnMA&hl=en&sa=X&ei=mB8GVJWsKeKCjAKtm4H4Dw&ved=0CEAQ6AEwAzgK#v=onepage&q=swan%20island%20mocks%20bottom&f=false](http://books.google.com/books?id=OwU0AQAAMAAJ&pg=PA92&lpg=PA92&dq=swan+island+mocks+bottom&source=bl&ots=ouTrtb_478&sig=ZE4zYZs_jOvyRsH6QscQ5SKmnMA&hl=en&sa=X&ei=mB8GVJWsKeKCjAKtm4H4Dw&ved=0CEAQ6AEwAzgK#v=onepage&q=swan%20island%20mocks%20bottom&f=false).

- Floyd|Snider, 2020a. Vigor Shipyards – Swan Island Revised 2019 1200-Z Permit Year Tier II Corrective Action Report. February.
- Floyd|Snider, 2020b. Vigor Shipyards – Swan Island Revised Monitoring and Performance Report. March.
- Floyd|Snider, 2020c. Memorandum (re: Vigor Industrial LLC – Dioxins / Furans Sampling Work Plan), to R. Hoy, Oregon Department of Environmental Quality (NW Region Cleanup), from C. Wilson, Floyd|Snider. November 18.
- Hydrogeologic, Inc (HGL), 2021a. *Sufficiency Assessment Report, Swan Island Basin Project Area, CERCLA Docket No. 10-2021-001*. Prepared for the Swan Island Remedial Design Group. Overland Park, Kansas. June.
- HGL, 2021b. *Stormwater and Riverbank Assessment and Sampling Plan, CERCLA Docket No. 10-2021-001*. Prepared for the Swan Island Remedial Design Group. Overland Park, Kansas. November.
- Maul Foster and Alongi, Inc., 2009. *Draft remedial investigation and risk assessment for soil and groundwater, Truck Manufacturing Plant, Western Star Truck Plant Portland LLC*. December 18.
- Oregon Department of Environmental Quality (ODEQ), 2016. Portland Harbor Upland Source Control Summary Report. Portland, Oregon, at URL <https://www.oregon.gov/deq/FilterDocs/ph-scSumRepUp.pdf>
- Oregon Historical Society (OHS), 2014. Oregon Encyclopedia webpage, at URL [http://oregonencyclopedia.org/articles/swan\\_island/#.VAYgqMVdXTo](http://oregonencyclopedia.org/articles/swan_island/#.VAYgqMVdXTo).
- Pacific Groundwater Group (PGG), 2019a. *Surface and Subsurface Sediment Field Sampling and Data Report, Swan Island Lagoon, Portland Harbor Superfund Site*. Prepared for Daimler Trucks North America LLC.
- PGG. 2019b. *Surface and Subsurface Sediment Field Sampling and Data Report, Swan Island Lagoon, Portland Harbor Superfund Site*. Prepared for de maximis, inc.
- U.S. Army Corps of Engineers (USACE), 2008. *Technical Guidelines for Environmental Dredging of Contaminated Sediments*. ERDC/EL TR-08-29.
- U.S. Environmental Protection Agency (EPA), 1998. *Assessment and Remediation of Contaminated Sediments (ARCS) Program Guidance for In-Situ Subaqueous Capping of Contaminated Sediment*, at URL <https://nepis.epa.gov/Exe/tiff2png.exe/2000CQL3.PNG?-r+75+g+7+D%3A%5CZYFILES%5CINDEX%20DATA%5C95THRU99%5CTIFF%5C0000521%5C2000CQL3.TIF>.

- EPA, 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process*. EPA/240/B-06/001, at URL [https://www.epa.gov/sites/default/files/documents/guidance\\_systematic\\_planning\\_dqo\\_process.pdf](https://www.epa.gov/sites/default/files/documents/guidance_systematic_planning_dqo_process.pdf).
- EPA, 2009a. *Clean and Green Policy, Region 10 Superfund, RCRA, LUST, and Brownfields*, at URL [https://www.epa.gov/sites/production/files/2015-12/documents/r10\\_clean\\_and\\_green\\_policy\\_aug\\_13\\_2009.pdf](https://www.epa.gov/sites/production/files/2015-12/documents/r10_clean_and_green_policy_aug_13_2009.pdf)
- EPA, 2009b. *Principles for Greener Cleanups*, at URL <https://www.epa.gov/greenercleanups/epa-principles-greener-cleanups>.
- EPA, 2010. *Superfund Green Remediation Strategy*, at URL <https://www.epa.gov/greenercleanups/superfund-green-remediation-strategy-2010>.
- EPA, 2016a. *Portland Harbor RI/FS, Final Remedial Investigation Report, Portland Oregon*. United States Environmental Protection Agency Region 10, Seattle, Washington. 8 February.
- EPA, 2016b. *Portland Harbor RI/FS, Final Feasibility Study, Portland Oregon*. United States Environmental Protection Agency Region 10, Seattle, Washington. June.
- EPA, 2017a. *Record of Decision, Portland Harbor Superfund Site*, Portland, Oregon
- EPA, 2017b. National Rivers and Streams Assessment 2018/19: Field Operations Manual – Non-Wadeable. EPA-841-B-17-003b. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.
- EPA, 2019a. *Explanation of Significant Differences, Portland Harbor Superfund Site Portland, Oregon*. December 9.
- EPA, 2019b. *Guidance for River Bank Characterizations and Evaluations at the Portland Harbor Superfund Site*. September 10.
- EPA, 2020. *Errata #2 for Portland Harbor Superfund Site Record of Decision ROD Table 17*. Memorandum from Sean Sheldrake to Portland Harbor Site File. January 14.
- EPA, 2021a. *Administrative Settlement Agreement and Order on Consent for Remedial Design, Swan Island Basin Project Area*, CERCLA Docket No. 10-2021-001 - 7, Region 10. January 20.
- EPA, 2021b. *Remedial Design Guidelines and Considerations, Portland Harbor Superfund Site, Portland, Oregon*. April 23.
- U.S. Geological Survey (USGS), 2021. *National Water Information System: Web Interface, Water-Year Summary for Site USGS 452827122382402*, at URL: [USGS Water-Year Summary for Site 452827122382402](https://www.water.usgs.gov/nwis/water-year-summary-for-site-452827122382402/).

Youd, T. L., et al., 2001. *Liquefaction resistance of soils: Summary report from the 1996 NCEER and 1998 NCEER/NSF workshops on evaluation of liquefaction resistance of soils*. *J. Geotech. Geoenviron. Eng.*, 127(10), 817–833, doi:10.1061/(ASCE)1090-0241(2001)127:10(817)].

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## **TABLES**

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**Table 3-1  
COC Sediment Chemistry Data in Vicinity of SIB  
Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID					07B023	08B032	08R003	08R040	09B028	09R001
Sample ID					LWG0107B023SDS015C00	LWG0108B032SDS015C00	LWG0108R003SDS015C00	LWG0108R040SDS015C00	LWG0109B028SDS015C00	LWG0109R001SDS015C10
Sample Date					2002/10/10	2002/10/10	2002/10/22	2002/10/28	2002/10/10	2002/10/24
Sample Depth					0 to 15 cm					
COC	Units	CUL	RAL	PTW						
Total PCBs	µg/kg	9	75	200	25 UT	28.5 JT	92.6 JT	435 T	17.3 JT	31 UT
TCDDeq	µg/kg	0.01								
HxCDF	µg/kg	0.0004		0.04			0.00127 NJ			
PeCDD	µg/kg	0.0002	0.0008	0.01			0.000322 NJ			
PeCDF	µg/kg	0.0003	0.2	0.2			0.000373 NJ			
TCDD	µg/kg	0.0002	0.0006	0.01			0.000135 UJ			
TCDF	µg/kg	0.0040658		0.6			0.000431			
Aldrin	µg/kg	2			0.19 U	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U
Dieldrin	µg/kg	0.07			1.3 U	0.39 U	0.4 U	9.7 U	0.39 U	1.1 U
DDD	µg/kg	114			36 T	0.39 UT	1.8 UJT	3.4 UT	0.39 UT	1.8 UJT
DDE	µg/kg	50			21.15 T	0.76 UT	2.1 UT	23 UT	0.39 UT	4 UJT
DDT	µg/kg	246			61 T	1.1 UT	2.3 UJT	0.39 UT	0.39 UT	3 UJT
DDx	µg/kg	6.1	160	7050	118.15 T	1.1 UT	2.3 UJT	23 UT	0.39 UT	4 UJT
Lindane	µg/kg	5			0.19 U	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U
Chlordanes	µg/kg	0.51			0.56 UT	0.39 UT	0.4 UT	6 UT	0.39 UT	11 UT
Arsenic	mg/kg	3			0.7	2.2	2.4	4.8	1.3	8.55 T
Cadmium	mg/kg	0.51			0.09	0.07	0.14	0.54	0.03	0.235 T
Copper	mg/kg	359			69.6	23.9	113	101	18.9	69.2 T
Lead	mg/kg	196			15	10.2	27 J	45 J	12	42.5 JT
Mercury	mg/kg	0.085			0.05 U	0.06 U	0.15 J	0.18	0.05 U	0.16 T
Zinc	mg/kg	459			97	71.7	149	267	78	163 T
TBT	µg/kg	3080								
Total cPAHs	µg/kg	774		106000						
Total PAHs	µg/kg	23000	30000		121.5 T	124.5 T	536 JT	3590 T	96 T	6360 T
TPH-Diesel	mg/kg	91								
Chlorobenzene	µg/kg									
Naphthalene	µg/kg				19 U	19 U	20 U	66	19 U	230
BEHP	µg/kg	135			69	45	1200	1300	68	1000

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID					09R001-2	09R001-3	A1	A2	A3	A4	A5	A6
Sample ID					LWG0109R001SDS015C20	LWG0109R001SDS015C31	A1-0to30-102018	a2-0to26-100818	a3-0to31-100818	a4-0to25-100818	a5-0to25-100818	a6-0to23-100818
Sample Date					2002/10/24	2002/10/24	2018/10/20	2018/10/08	2018/10/08	2018/10/08	2018/10/08	2018/10/08
Sample Depth					0 to 15 cm	0 to 15 cm	0 to 30 cm	0 to 26 cm	0 to 30 cm	0 to 25 cm	0 to 25 cm	0 to 23 cm
COC	Units	CUL	RAL	PTW								
Total PCBs	µg/kg	9	75	200	47.2 T		0.7283	107.413475	389.716295	1404.570085	815.986035	429.43554
TCDDeq	µg/kg	0.01					0.000299 JT	0.023 JT	0.0218 JT	0.0184 JT	0.0217 JT	0.0147 JT
HxCDF	µg/kg	0.0004		0.04			0.000082 U	0.009	0.0084	0.013	0.015	0.0076
PeCDD	µg/kg	0.0002	0.0008	0.01			0.00025 U*	0.0018 J*	0.0015 J*	0.0017 J*q	0.00088 U*	0.00096 J*q
PeCDF	µg/kg	0.0003	0.2	0.2			0.00016 U*	0.0021 J*	0.0018 J*	0.0028 J*	0.0031 J*	0.0016 J*
TCDD	µg/kg	0.0002	0.0006	0.01			0.00016 U*	0.00058 J*q	0.0008 J*	0.00086 J*q	0.00082 J*	0.00045 J*q
TCDF	µg/kg	0.0040658		0.6			0.00011 U	0.0021	0.002	0.0047	0.0035	0.0017
Aldrin	µg/kg	2			0.2 U	1.4 UT	67.675 T	0.084 U	0.088 U	0.079 U	0.082 U	0.089 U
Dieldrin	µg/kg	0.07			1.1 U	2.2 UT	16051	0.082 U	0.086 U	0.077 U	0.08 U	0.087 U
DDD	µg/kg	114			1.6 UJT		0.12	1.0335	1.335	1.7315	2.84	3.69
DDE	µg/kg	50			9.2 UJT		43 D	1.342	1.844	2.94	2.588	1.0145
DDT	µg/kg	246			3.3 UJT		59	0.1	0.11	0.094	0.779	0.11
DDx	µg/kg	6.1	160	7050	9.2 UJT		12365	2.4505	3.2605	4.742	6.207	4.786
Lindane	µg/kg	5			0.2 U	0.2 UT	16887	0.033 U	0.035 U	0.031 U	0.033 U	0.035 U
Chlordanes	µg/kg	0.51			1.1 UT		0.0197 JT	0.505	0.48	0.5435	0.545	0.321
Arsenic	mg/kg	3			8.9	7.2 T	4	7.7	8.1	9.2	9.7	9.1
Cadmium	mg/kg	0.51			0.39	0.63 T	0.074 J	0.34	0.41	0.64	0.48	0.41
Copper	mg/kg	359			90.6	103 T	46	95	110	170	130	160
Lead	mg/kg	196			39 J	51 JT	12	26	31	68 B	38 B	31 B
Mercury	mg/kg	0.085			0.15	0.385 T	0.059 HF1	0.14 H	0.16 H	0.28 H	0.18 H	0.16 H
Zinc	mg/kg	459			192	303 T	65	210	220	360	270	240
TBT	µg/kg	3080					21688	98	120	780	120	180
Total cPAHs	µg/kg	774		106000			0.36307, iIJT	339.48 T	145.55 T	274.12 T	64.008 T	33.062 T
Total PAHs	µg/kg	23000	30000		1161 T		2.9625, iIJXT	2957 T	1294.1 T	2267 T	533.3 T	254.3 JT
TPH-Diesel	mg/kg	91					20 U	76 J	54 J	110 J	93 J	22 U
Chlorobenzene	µg/kg											
Naphthalene	µg/kg				26	78 UT	20424	17	2	29	4.2	1.8
BEHP	µg/kg	135			640	2550 T	0.094	59 J	240	2000	260	26 J

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID Sample ID Sample Date Sample Depth					A7 a7-0to26-100918 2018/10/09 0 to 26 cm	A-9.03 A-9.03-0to26-102418 2018/10/24 0 to 26 cm	B020 LW2-B020 2004/07/30 0 to 15 cm	B1 B1-0to20-101418 2018/10/14 0 to 20 cm	B247 PDI-SG-B247-BL1 2018/04/22 0 to 30 cm	B248 PDI-SG-B248-BL1 2018/04/22 0 to 30 cm	B249 PDI-SG-B249-BL1 2018/04/22 0 to 30 cm	B252 PDI-SG-B252-BL1 2018/04/22 0 to 26 cm	B254 PDI-SG-B254-BL1 2018/04/22 0 to 30 cm
COC	Units	CUL	RAL	PTW									
Total PCBs	µg/kg	9	75	200	1224.3335	97.43517	40.35 T	17.20059	14.603857	64.1281	121.588385	25.0023225	52.882915
TCDDeq	µg/kg	0.01			0.0189 JT	0.0442 JT	0.000808 JT	14307	0.00325 +JNT	0.00696 +JNT	0.00274 +JNT	0.00321 +JNT	0.0148 JNT
HxCDF	µg/kg	0.0004		0.04	0.011	0.02	0.000638 J	0.0021 JB	0.0014 J	0.0021 J	0.0011 J	0.0012 J	0.005 J
PeCDD	µg/kg	0.0002	0.0008	0.01	0.00093 U*	0.0047 J	0.000083 U	0.0014 U	0.00065 J	0.0019 J	0.00032 Jq	0.00044 J	0.0017 J
PeCDF	µg/kg	0.0003	0.2	0.2	0.0026 J*	0.0063 J	0.000157 J	0.0018 B	0.00046 J	0.00064 Jq	0.00031 J	0.00038 J	0.0016 J
TCDD	µg/kg	0.0002	0.0006	0.01	0.00047 J*q	0.001 Jq	0.000022 U	290	0.0003 Jq	0.00076 Jq	0.00026 Jq	0.00035 J	0.00059 Jq
TCDF	µg/kg	0.0040658		0.6	0.0027	0.0045 B	0.000053 U	1.7	0.0008 J	0.004	0.00052 J	0.00073 J	0.0014
Aldrin	µg/kg	2			0.079 U		0.0312 U	0.079 U	0.63 U,*	0.57 U	0.48 U	0.4 U	0.69 U
Dieldrin	µg/kg	0.07			0.077 U		0.051 U	0.077 U	1.3 U,*	1.1 U	1 U	1 U	1.4 U
DDD	µg/kg	114			2.97	4.65	1.075 JNT		1.225		0.84	1.63	1.65
DDE	µg/kg	50			1.8395	7.6	0.52805 JT	0.1695	2.315	3.285	1.34	1.8	2.745
DDT	µg/kg	246			0.094	1.7	0.742 JT	0.094	0.655	1.165	0.68	0.975	1.315
DDx	µg/kg	6.1	160	7050	4.88	13.505	2.34505 JNT	0.654	4.195	6.54	2.86	4.405	5.71
Lindane	µg/kg	5			0.031 U		0.0761 U	0.031 U	0.63 U,*	0.43 J	0.48 U	0.39 U	0.69 U
Chlordanes	µg/kg	0.51			0.5935		0.2122 JNT	1.2135					
Arsenic	mg/kg	3			9.5		1.77	5.3	4.9	6.8	4.6	4.1	6.8
Cadmium	mg/kg	0.51			0.32		0.116	0.089 J	0.25 JF2	0.33 J	0.23 J	0.3	0.31 J
Copper	mg/kg	359			150		14.5	25	64 F1	140	63	54	100
Lead	mg/kg	196			30 B		8.91	11	11	25	12	19	23
Mercury	mg/kg	0.085			0.14 H		0.046	0.042	0.069	0.099	0.053	0.059	0.11
Zinc	mg/kg	459			240		74.1	90	110	200	110	130	170
TBT	µg/kg	3080			130			28	77	3300	67	47	160
Total cPAHs	µg/kg	774		106000	27.543 T	398.23 DT	21.59 JT	168.97 DT	34.03 XT	239.89 T	34.626 T	72.185 T	166.27 T
Total PAHs	µg/kg	23000	30000		221.63 JT	4635.1 DJT	183.4 JT	1395 DT	295.3 XT	1971.7 DT	290.8 T	511.5 T	1950 DT
TPH-Diesel	mg/kg	91			73 J			21 J	35 J	110	29 J	35 J	49 J
Chlorobenzene	µg/kg												
Naphthalene	µg/kg				2.2	14 JD	7.5	12 D	3.7	31	2.9	6.6	38
BEHP	µg/kg	135			230		12 U	37 J	130 J	870	120	73 J	300

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			B255	B258	B258	B259	B260	B263	B264	B265
		Sample ID			PDI-SG-B255-BL1	PDI-SG-B258-BL1	PDI-SG-B258-BL1-D	PDI-SG-B259-BL1	PDI-SG-B260-BL1	PDI-SG-B263-BL1	PDI-SG-B264-BL1	PDI-SG-B265-BL1
		Sample Date			2018/06/03	2018/07/20	2018/07/20	2018/06/22	2018/04/23	2018/04/22	2018/06/25	2018/04/23
		Sample Depth			0 to 30 cm	0 to 28 cm	0 to 28 cm	0 to 30 cm	0 to 27 cm	0 to 29 cm	0 to 30 cm	0 to 28 cm
COC	Units	CUL	RAL	PTW								
Total PCBs	µg/kg	9	75	200	68.89321	9.680915	6.486595	164.851635	157.4081	141.72112	46.57	1154.57559
TCDDeq	µg/kg	0.01			0.00779 +JNT	0.00153 +JNT	0.00209 +JNT	0.00457 +JNT	0.00801 +JNT	0.02 JT	0.0028 +JNT	0.0162 +JNT
HxCDF	µg/kg	0.0004		0.04	0.0031 JB	0.0007 JB	0.0007 JB	0.0017 J	0.0036 JB	0.0058 J	0.00098 J	0.0063 B
PeCDD	µg/kg	0.0002	0.0008	0.01	0.0012 J	0.00027 JB	0.00038 JB	0.00073 J	0.0011 JB	0.0018 J	0.00063 J	0.002 JB
PeCDF	µg/kg	0.0003	0.2	0.2	0.00066 Jq	0.000049 U	0.00021 JBq	0.00063 J	0.00099 JqB	0.0016 J	0.0003 J	0.0019 JB
TCDD	µg/kg	0.0002	0.0006	0.01	0.00062 Jq	0.00016 Jq	0.00024 Jq	0.00046 Jq	0.00054 JqB	0.0007 J	0.0003 Jq	0.0017 B
TCDF	µg/kg	0.0040658		0.6	0.0032 B	0.0004 JB	0.0005 JB	0.0048	0.0023 B	0.0023	0.00058 J	0.0037 B
Aldrin	µg/kg	2			1.7 U	0.35 U	0.35 U	0.36 U	1 U,*	0.64 U,*	0.47 U	1.1 U,*
Dieldrin	µg/kg	0.07			3.5 U	0.71 U	0.7 U	0.72 U	2.1 U,*	1.3 U,*	0.94 U	2.1 U,*
DDD	µg/kg	114			2.35	0.975	0.905		6.3	2.91	1.095	4
DDE	µg/kg	50			4.35	1.475	1.575	3.28	6.5	3.72	2.135	8.05
DDT	µg/kg	246			1.7	0.355	0.375	0.84	2	1.32	0.755	3.35
DDx	µg/kg	6.1	160	7050	8.4	2.805	2.855	5.74	14.8	7.95	3.985	15.4
Lindane	µg/kg	5			1.7 U	0.35 U	0.35 U	0.36 U	1 U,*	0.64 U,*	0.47 U	1.1 U,*
Chlordanes	µg/kg	0.51										
Arsenic	mg/kg	3			6.4	6.8	6.6	11	7.1	6.8	5.7	8.1
Cadmium	mg/kg	0.51			0.27	0.23 J	0.26 J	0.3	0.38	0.41 J	0.17 J	0.61
Copper	mg/kg	359			210	58	54	510	190	94	130	130
Lead	mg/kg	196			24	13	12	38	31	26	13	79
Mercury	mg/kg	0.085			0.13	0.067 H	0.063 H	0.13	0.3	0.13	0.078	0.31
Zinc	mg/kg	459			210	120	110	340	190	180	130	270
TBT	µg/kg	3080			2300	49 J	48 J	7500	1100	200	270	960
Total cPAHs	µg/kg	774		106000	221.92 T	50.428 JT	21.204 JT	671.94 T	187.5 DT	317.2 DT	88.385 JT	333.19 DT
Total PAHs	µg/kg	23000	30000		1892.5 DT	452.3 *JT	114.2 *JT	7263 T	1736 DT	2870 DT	952.4 BJT	2877 DT
TPH-Diesel	mg/kg	91			170	64 J	67 J	310	180	65 J	110	350
Chlorobenzene	µg/kg											
Naphthalene	µg/kg				15	8.1 J	16 U	130	45 D	31	19 B	54 D
BEHP	µg/kg	135			750	100 JB	150 JF1B	840 B	320	340	230 JB	860

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		B266	B271	B272	B273	B279	B280	B284	B288	B294			
Sample ID		PDI-SG-B266-BL1	PDI-SG-B271-BL1	PDI-SG-B272-BL1	PDI-SG-B273-BL1	PDI-SG-B279-BL1	PDI-SG-B280-BL1	PDI-SG-B284-BL1	PDI-SG-B288-BL1	PDI-SG-B294-BL1			
Sample Date		2018/07/20	2018/04/23	2018/06/24	2018/04/23	2018/04/23	2018/04/23	2018/04/24	2018/04/24	2018/04/24			
Sample Depth		0 to 29 cm	0 to 30 cm	0 to 27 cm	0 to 27 cm	0 to 30 cm	0 to 29 cm	0 to 30 cm	0 to 29 cm	0 to 29 cm			
COC	Units	CUL	RAL	PTW									
Total PCBs	µg/kg	9	75	200	18.27511	156.1026	10.054289	320.40865	273.2646	287.53305	521.49899	159.36905	88.90206
TCDDeq	µg/kg	0.01			0.00189 +JNT	0.0129 +JNT	0.00154 +JNT	0.0158 +JNT	0.0141 +JNT	0.0193 JNT	0.021 JT	0.0196 JNT	0.0114 +JT
HxCDF	µg/kg	0.0004		0.04	0.0017 J	0.006 JB	0.001 J	0.007 B	0.012 B	0.017 B	0.023	0.025	0.0083
PeCDD	µg/kg	0.0002	0.0008	0.01	0.00021 JB	0.0011 JqB	0.00027 J	0.0014 JB	0.0011 JqB	0.0018 JB	0.0018 J	0.0015 Jq	0.0017 J
PeCDF	µg/kg	0.0003	0.2	0.2	0.00039 J	0.0013 JB	0.00017 Jq	0.0015 JB	0.0018 JB	0.0037 JB	0.0025 J	0.0032 J	0.0017 J
TCDD	µg/kg	0.0002	0.0006	0.01	0.00012 Jq	0.00082 JB	0.00017 Jq	0.00068 JB	0.00053 JB	0.00051 JqB	0.0007 J	0.00058 J	0.00051 J
TCDF	µg/kg	0.0040658		0.6	0.00052 JB	0.0014 JB	0.00042 J	0.0019 B	0.0016 B	0.0016 B	0.0016	0.0017	0.0015
Aldrin	µg/kg	2			0.31 U	1.4 U,*	0.34 U	1.3 U,*	1.3 U,*	1.5 U,*	0.58 U	0.77 U	0.7 U
Dieldrin	µg/kg	0.07			0.63 U	2.8 U,*	0.67 U	2.7 U,*	2.6 U,*	3 U,*	1.2 U	1.5 U	1.4 U
DDD	µg/kg	114			0.675	2.5	0.76	2.55	3.55	2.55		2.55	3.76
DDE	µg/kg	50			1.255	5.7	1.87	5.65	5.05	6.05	6.19	5.585	4.75
DDT	µg/kg	246			0.31	6.9	0.37	1.3	1.3	1.49	0.87	1.075	0.94
DDx	µg/kg	6.1	160	7050	2.24	15.1	3	9.5	9.9	10.09	10.38	9.21	9.45
Lindane	µg/kg	5			0.31 U	1.4 U,*	0.34 U	1.3 U,*	1.3 U,*	1.5 U,*	0.58 U	0.77 U	0.7 U
Chlordanes	µg/kg	0.51											
Arsenic	mg/kg	3			6.2	8.2	4.4	7.9	7.9	8.7	8.8	8.5	7.1
Cadmium	mg/kg	0.51			0.22	0.31 J	0.15 J	0.36	0.51	0.39 J	0.37 J	0.45 F2	0.32 J
Copper	mg/kg	359			150	120	72	100	89	100	110	100 F1	76
Lead	mg/kg	196			14	27	10	28	31	32	31	35	24
Mercury	mg/kg	0.085			0.056	0.15	0.053	0.15	0.15	0.16	0.16	0.12 F1F2	0.13
Zinc	mg/kg	459			170	220	110	210	230	240	260	250	190
TBT	µg/kg	3080			200	230	120 U	300	120	130	220	86	35
Total cPAHs	µg/kg	774		106000	33.572 *BJT	169.81 DT	25.115 JT	210.98 DT	322.55 DT	200.95 DT	293.41 DT	162.3 DT	149.64 DT
Total PAHs	µg/kg	23000	30000		423 *BJT	1502.6 DT	302.3 BJT	1999.5 DT	2972 DT	1902.6 DT	2649 DT	1445.9 DT	1465.5 DJT
TPH-Diesel	mg/kg	91			85	81 J	76	400 U	110 J	87 J	110 J	130 J	54 J
Chlorobenzene	µg/kg												
Naphthalene	µg/kg				11 JB	14 D	12 B	27 D	21 D	16 D	25 D	11 D	11 D
BEHP	µg/kg	135			200 B	390	140 JB	750	1600	720	1100	620	450

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		B296	B3	B302	B303	B308	B313	B313	B315			
Sample ID		PDI-SG-B296-BL1	B3-0to21-100818	PDI-SG-B302-BL1	PDI-SG-B303-BL1	PDI-SG-B308-BL1	PDI-SG-B313-BL1	PDI-SG-B313-BL1-D	PDI-SG-B315-BL1			
Sample Date		2018/04/24	2018/10/08	2018/04/24	2018/04/24	2018/04/26	2018/04/26	2018/04/26	2018/05/22			
Sample Depth		0 to 26 cm	0 to 21 cm	0 to 27 cm	0 to 28 cm	0 to 30 cm	0 to 27 cm	0 to 27 cm	0 to 25 cm			
COC	Units	CUL	RAL	PTW								
Total PCBs	µg/kg	9	75	200	169.52568	115.8787	182.36642	134.9881	85.093995	116.80325	118.13145	23.375931
TCDDeq	µg/kg	0.01			0.018 JNT	0.0124 JT	0.0142 JNT	0.0152 JNT	0.0204 JT	0.0228 JT	0.0203 JT	0.00329 +JNT
HxCDF	µg/kg	0.0004		0.04	0.022	0.0064 q	0.0094	0.007 J	0.013 B	0.011 B	0.012 B	0.0021 J
PeCDD	µg/kg	0.0002	0.0008	0.01	0.0021 J	0.00053 U	0.002 J	0.002 Jq	0.0013 U	0.0024 U	0.0019 U	0.00049 JBq
PeCDF	µg/kg	0.0003	0.2	0.2	0.0032 J	0.0014 Jq	0.0024 J	0.002 J	0.0029 JB	0.0014 U	0.0029 JB	0.00058 J
TCDD	µg/kg	0.0002	0.0006	0.01	0.00059 Jq	0.0007 JB	0.0008 J	0.00096 J	0.0011 J	0.0017	0.001 J	0.00013 U
TCDF	µg/kg	0.0040658		0.6	0.002	0.0012	0.0033	0.0037	0.0027	0.0029	0.0028	0.00075
Aldrin	µg/kg	2			0.7 U	0.09 U	0.66 U	0.71 U	0.88 U,*	0.75 U,*	0.75 U,*	0.79 U
Dieldrin	µg/kg	0.07			1.4 U	0.088 U	1.3 U	1.4 U	1.8 U,*	1.5 U,*	1.5 U,*	2 U
DDD	µg/kg	114			2.97	2.16	2.72	3.75	2.24	2.94	3.04	0.87
DDE	µg/kg	50			6.65	1.145	6.73	8.055	4.64	4.875	4.875	1.205
DDT	µg/kg	246			1.04	0.11	1	0.875	0.89	1.185	0.905	0.94
DDx	µg/kg	6.1	160	7050	10.66	3.387	10.45	12.68	7.77	9	8.82	2.895
Lindane	µg/kg	5			0.24 J	0.036 U	0.66 U	0.3 J	0.88 U,*	0.75 U,*	0.3 J,*	0.7 U
Chlordanes	µg/kg	0.51				0.485						
Arsenic	mg/kg	3			8.9	5.2	9.3	8.6	9.2	9.4	8.8	5.4
Cadmium	mg/kg	0.51			0.39	0.25 J	0.58	0.28 J	0.4 J	0.62	0.62	0.21
Copper	mg/kg	359			110	63	100	95	100	110	100	30
Lead	mg/kg	196			33	24	39	33	30	42	43	14
Mercury	mg/kg	0.085			0.21	0.12	0.45	0.18	0.17	0.21	0.2	0.039
Zinc	mg/kg	459			250	140	280	240	250	270	270	110
TBT	µg/kg	3080			190	75	400	220	120	210	180	50
Total cPAHs	µg/kg	774		106000	336.66 DT	211.83 DT	237.02 DT	216.79 T	188.95 DT	395.79 DT	317.48 DT	73.215 T
Total PAHs	µg/kg	23000	30000		3378 DT	2196 DT	2113 DT	1987 DT	1774.5 DJT	3542 DJT	2709 DJT	640.3 T
TPH-Diesel	mg/kg	91			110 J	88 J	150	120 J	44 J	66 J	69 J	40 J
Chlorobenzene	µg/kg											
Naphthalene	µg/kg				23 D	27 D	32 D	37	14 D	26 D	25 D	16
BEHP	µg/kg	135			720	300	640	430	640	1300	2500	230

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		B315	B5	B7	B-9.00	B-9.00	B-9.15	BT022	BT023	BT026			
Sample ID		PDI-SG-B315-BL1-D	B5-0to26-100818	B7-0to30-100918	512-0to29-102418	B-9.00-0to29-102418	B-9.15-0to30-102418	LW2-GBT022	LW2-GBT023	LW2-GBT026			
Sample Date		2018/05/22	2018/10/08	2018/10/09	2018/10/24	2018/10/24	2018/10/24	2005/12/08	2005/12/20	2005/12/12			
Sample Depth		0 to 25 cm	0 to 26 cm	0 to 30 cm	0 to 29 cm	0 to 29 cm	0 to 30 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm			
COC	Units	CUL	RAL	PTW									
Total PCBs	µg/kg	9	75	200	19.473684	344.1463	420.6278	72.1769	76.22861	105.785815	218 T	81.8 JT	596 JT
TCDDeq	µg/kg	0.01			0.00367 JNT	14313	0.0256 JT	0.0205 JT		0.012 JT	0.003 JT	0.000239 JT	0.00204 JT
HxCDF	µg/kg	0.0004		0.04	0.0021 J	0.0087	0.011	0.018		0.0034 J	0.001339 J	0.00017 U	0.003691
PeCDD	µg/kg	0.0002	0.0008	0.01	0.0006 JBq	0.00013 U	0.0015 Jq	0.0027 J	0.0028 JqB	0.002 J	0.000216 U	0.00002 U	0.00008 J
PeCDF	µg/kg	0.0003	0.2	0.2	0.00018 U	0.00076 B	0.0023 J	0.0034 J	0.0029 Jq	0.0017 J	0.000307 J	0.000011 U	0.000258 J
TCDD	µg/kg	0.0002	0.0006	0.01	0.00075 q	7.14	0.00034 U	0.00074 J	0.00073 U	0.00068 J	0.000066 U	0.000012 U	0.000008 U
TCDF	µg/kg	0.0040658		0.6	0.00084	0.098	0.0017	0.0025 B		0.0031 B	0.000368 J	0.0002 U	0.000125 U
Aldrin	µg/kg	2			0.79 U	0.12 U	0.11 U				0.101 J	0.112 J	0.027 J
Dieldrin	µg/kg	0.07			2 U	0.11 U	0.098 U				0.0904 J	0.0989 J	0.0378 J
DDD	µg/kg	114			0.84	1.93	1.9	2.05	2.05	3.5	2.619 T	2.361 T	1.11 T
DDE	µg/kg	50			1.115	1.96	1.455	4.2	4.3	4.14	2.2063 JT	2.9277 JT	0.8076 JT
DDT	µg/kg	246			0.94	0.14	1.52	1.9	1.9	0.1885	0.847 JT	1.846 T	0.2313 JT
DDx	µg/kg	6.1	160	7050	2.775	3.9935	4.875	7.66	7.755	7.8285	5.6723 JT	7.1347 JT	2.1489 JT
Lindane	µg/kg	5			0.7 U	0.044 U	0.04 U				0.00995 J	0.00735 U	0.0173 U
Chlordanes	µg/kg	0.51				0.665	0.57				0.7455 JT	0.728275 JT	0.43455 JT
Arsenic	mg/kg	3			6.4	6.8	6.9				5.25	6.76	6.7
Cadmium	mg/kg	0.51			0.18 J	0.41 J	0.26				0.537	0.257	0.697
Copper	mg/kg	359			23	98	84				113	235	110
Lead	mg/kg	196			11	25	25				41.2	22.9 J	49.8 J
Mercury	mg/kg	0.085			0.047	0.15	0.12				0.142	0.152	0.127
Zinc	mg/kg	459			100	410	210				219	220	301
TBT	µg/kg	3080			43	170	160				170	1400	150
Total cPAHs	µg/kg	774		106000	67.675 T	209 DT	162.35 DT	159.12 DT	172.57 DT	247.99 DT	26.678 JT	122.248 T	258.99 T
Total PAHs	µg/kg	23000	30000		607.6 T	1737.8 DT	1233.4 DJT	1534.5 DJT	1628 DJT	2280 DT	223 JT	944 JT	2214.4 T
TPH-Diesel	mg/kg	91			39 J	110 J	120 J				180 J	130 J	320 J
Chlorobenzene	µg/kg										0.24 U	0.2 U	0.19 U
Naphthalene	µg/kg				14	15 D	7.7 D	10 D	11 D	38 D	1.2 UJ	0.99 U	11
BEHP	µg/kg	135			230	560	330				57 U	460	1600 J

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			BT029	C364	C364	C364	C372	C372	C372	C379	C379	C379	C379
		Sample ID			LW2-GBT029	LW2-C364-B	LW2-C364-C	LW2-C364-D	LW2-C372-B	LW2-C372-C	LW2-C372-E	LW2-C379-A	LW2-C379-B	LW2-C379-C	LW2-C379-D
		Sample Date			2005/12/09	2004/10/26	2004/10/26	2004/10/26	2004/10/07	2004/10/07	2004/10/07	2004/10/07	2004/10/07	2004/10/07	2004/10/07
		Sample Depth			0 to 10 cm	30 to 75 cm	75 to 183 cm	183 to 225 cm	30 to 94 cm	94 to 141 cm	263 to 363 cm	0 to 30 cm	30 to 152 cm	152 to 196 cm	196 to 318 cm
COC	Units	CUL	RAL	PTW											
Total PCBs	µg/kg	9	75	200	52.6 JT	395.805 JT	2.93 UT		182.335 JT	43.06 T	2.8 UT		937.505 JT	443.76 JT	2.68 UT
TCDDeq	µg/kg	0.01			0.00144 JT				0.000625 JT	0.00037 JT					
HxCDF	µg/kg	0.0004		0.04	0.001154 J				0.000721 U	0.000234 U					
PeCDD	µg/kg	0.0002	0.0008	0.01	0.000255 J				0.000063 U	0.000035 U					
PeCDF	µg/kg	0.0003	0.2	0.2	0.000256 J				0.000231 J	0.000093 J					
TCDD	µg/kg	0.0002	0.0006	0.01	0.000084 U				0.000047 U	0.000011 U					
TCDF	µg/kg	0.0040658		0.6	0.000164 U				0.000126 U	0.000165 U					
Aldrin	µg/kg	2			0.0887 J	0.173 UJ	0.195 UJ		0.199 UJ	0.175 UJ			0.247 UJ	0.217 UJ	0.0356 UJ
Dieldrin	µg/kg	0.07			0.12 J	0.283 U	0.319 U		0.325 U	0.287 U			0.405 UJ	0.355 UJ	0.0582 UJ
DDD	µg/kg	114			2.336 T	47.71 JNT	1.02 JNT		1.666 JNT	0.27 UT			5.29 JNT	7.31 JNT	0.0548 UT
DDE	µg/kg	50			1.5779 JT	11.48 JNT	0.282 UT		2.2885 T	0.253 UT			8.205 JNT	5.597 JNT	0.1227 JT
DDT	µg/kg	246			0.2713 JT	1.605 JNT	0.737 JT		0.354 UJT	0.312 UJT			4.58 JT	17.877 JT	0.0633 UJT
DDx	µg/kg	6.1	160	7050	4.1852 JT	60.795 JNT	2.0045 JNT		4.275 JNT	0.312 UJT			18.075 JNT	30.784 JNT	0.22575 JT
Lindane	µg/kg	5			0.0353 J	0.422 U	0.476 U		0.485 U	0.428 U			0.604 UJ	0.53 UJ	0.0868 UJ
Chlordanes	µg/kg	0.51			2.11105 JT	3.0185 JNT	0.26 UT		0.5605 JNT	0.234 UJT			5.141 JNT	0.289 UJT	0.0474 UJT
Arsenic	mg/kg	3			3.26	2.98 J	3.43 J		3.74	2.62			4.25 JT	3.7 J	1.9 J
Cadmium	mg/kg	0.51			0.315	0.234	0.223		0.411	0.16			0.512 JT	0.434 J	0.08 J
Copper	mg/kg	359			35.3	27.3	32.4		57.3	24.4			95.7 T	61.1	27.9
Lead	mg/kg	196			17.6	29.9	28.6		29.4 J	12.3 J			68 T	48.6	4.38
Mercury	mg/kg	0.085			0.092	0.198	0.358	0.16 J	0.437	0.084			0.32 T	0.467	0.037
Zinc	mg/kg	459			141	98.7	89.2		127	81			283 T	209	54.5
TBT	µg/kg	3080			24	0.23 U	0.27 U		0.25 U	0.23 U			86	1.5 J	2.1
Total cPAHs	µg/kg	774		106000	36.532 T	219.33 T	646.72 T	188.78 T	96.039 T	64.621 T	107.998 T		64.381 T	62.511 T	1.501 JT
Total PAHs	µg/kg	23000	30000		322.2 JT	2367 T	5933 T	2058.1 T	1103.3 T	917.5 T	1201.2 T		591 T	742.5 T	6.755 JT
TPH-Diesel	mg/kg	91			82 JT				440 J	150 J		300 J	590 J		5 U
Chlorobenzene	µg/kg				0.13 U										
Naphthalene	µg/kg				6.2	74	200	110	39	61	90		15 U	45	3.4 U
BEHP	µg/kg	135			260 J	59 J	24 U	2.5 U	17 U	4.9 U	15 U		130 U	17 U	11 J

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID					C380	C380	C380	C380	C382	C382	C382	C383	C383	C383	C384
Sample ID					LW2-C380-A	LW2-C380-B	LW2-C380-C	LW2-C380-E	LW2-C382-B	LW2-C382-C	LW2-C382-D	LW2-C383-B	LW2-C383-C	LW2-C383-D	LW2-C384-B
Sample Date					2004/11/10	2004/11/10	2004/11/10	2004/11/10	2004/10/21	2004/10/21	2004/10/21	2004/10/21	2004/10/21	2004/10/21	2004/10/07
Sample Depth					0 to 30 cm	30 to 153 cm	153 to 275 cm	398 to 549 cm	30 to 153 cm	153 to 284 cm	284 to 390 cm	30 to 63 cm	63 to 160 cm	160 to 266 cm	30 to 128 cm
COC	Units	CUL	RAL	PTW											
Total PCBs	µg/kg	9	75	200		2.96 UT	2.93 UT		291 JT	2.72 UT		231.81 T	2.81 UT		10800 JT
TCDDeq	µg/kg	0.01							0.00161 JT						
HxCDF	µg/kg	0.0004		0.04					0.000647 J						
PeCDD	µg/kg	0.0002	0.0008	0.01					0.000093 J						
PeCDF	µg/kg	0.0003	0.2	0.2					0.00018 J						
TCDD	µg/kg	0.0002	0.0006	0.01					0.000008 U						
TCDF	µg/kg	0.0040658		0.6					0.000127 U						
Aldrin	µg/kg	2				0.188 J	0.0389 UJ		0.199 UJ	0.0359 UJ	0.14 U	0.0299 UJ	0.0382 UJ		0.461 UJ
Dieldrin	µg/kg	0.07				0.0674 U	0.0636 UJ		0.326 U	0.0587 U	0.12 U	0.0489 UJ	0.0626 U		0.755 UJ
DDD	µg/kg	114				0.0634 UT	0.0599 UJT		275.6 JNT	13.71 JT	0.2595 JT	1.526 JNT	0.0589 UT		17.29 JNT
DDE	µg/kg	50				0.0595 UT	0.0562 UJT		23.01 JNT	1.1096 T	0.081 UT	0.436 JNT	0.0552 UT		9.422 JNT
DDT	µg/kg	246				0.0733 UJT	0.0692 UJT		6.65 JNT	0.0639 UJT	0.23 UT	0.67255 JNT	0.2016 JT		23.77 JT
DDx	µg/kg	6.1	160	7050		0.0733 UJT	0.0692 UJT		305.26 JNT	14.87745 JT	0.551 JT	2.63455 JNT	0.2992 JT		50.482 JNT
Lindane	µg/kg	5				0.1 U	0.0949 UJ		6.65 NJ	0.0876 UJ	0.14 U	0.0729 UJ	0.0933 UJ		1.13 UJ
Chlordanes	µg/kg	0.51				0.0549 UT	0.0518 UJT		14.02 JNT	0.5442 JNT	0.17 UJT	0.8306 JNT	0.0509 UT		2.771 JNT
Arsenic	mg/kg	3				2.3 J	2.06 J		5.42	2.9		1.52	2.14	2.37	44.5 J
Cadmium	mg/kg	0.51				0.156	0.144		0.518	0.139		0.178	0.128	0.156 U	3.25 J
Copper	mg/kg	359				31.2	29.9		121	33.1		16.2	27.2	26.4	3290
Lead	mg/kg	196				5.97 J	5.86 J		98.4	5.66		15.3	5.4	4.67	329
Mercury	mg/kg	0.085				0.039 J	0.038 J		0.458	0.033		0.046	0.036		1.24
Zinc	mg/kg	459				68.6	64.4		241	66.4		82.8	61.8	57.4	1930
TBT	µg/kg	3080				0.27 U	0.26 U		51	0.38 J					36000 J
Total cPAHs	µg/kg	774		106000		2.0251 JT	1.624 JT		82.918 T	1.501 JT		38.222 T	1.527 JT		2816.2 T
Total PAHs	µg/kg	23000	30000			19.355 JT	8.1 JT		960 T	10.86 JT		575.2 T	7 JT		33234 T
TPH-Diesel	mg/kg	91				38 J	5.5 UT	5.2 U	520 J	14 U		120 J	11 U		880 J
Chlorobenzene	µg/kg														
Naphthalene	µg/kg					5.3 U	4.9 U		16	2.2 U		13	1.8 U		590
BEHP	µg/kg	135				7.5 U	21 U		72	4.5 U		290 U	15 U		6800

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID Sample ID Sample Date Sample Depth					C384 LW2-C384-C 2004/10/07 128 to 207 cm	C384 LW2-C384-E 2004/10/07 274 to 334 cm	C384 LW2-C384-F 2004/10/07 334 to 357 cm	C388 LW2-C388-B 2004/10/07 30 to 154 cm	C388 LW2-C388-C 2004/10/07 154 to 276 cm	C392 LW2-C392-B 2004/10/21 30 to 76 cm	C392 LW2-C392-C 2004/10/21 76 to 199 cm	C392 LW2-C392-D 2004/10/21 199 to 337 cm	C393 LW2-C393-B 2004/10/25 30 to 152 cm	C393 LW2-C393-C 2004/10/25 152 to 282 cm	C396 LW2-C396-B 2004/10/21 30 to 153 cm
COC	Units	CUL	RAL	PTW											
Total PCBs	µg/kg	9	75	200	99.7 JT	0.835 JT		2.91 UT	3 UT	888.5 JT	60.225 JT	25.05 T	310 JT	2.28 UT	2.75 UT
TCDDeq	µg/kg	0.01													
HxCDF	µg/kg	0.0004		0.04											
PeCDD	µg/kg	0.0002	0.0008	0.01											
PeCDF	µg/kg	0.0003	0.2	0.2											
TCDD	µg/kg	0.0002	0.0006	0.01											
TCDF	µg/kg	0.0040658		0.6											
Aldrin	µg/kg	2			0.0304 UJ					0.0533 UJ	0.0327 UJ		0.183 UJ	0.03 UJ	0.0381 UJ
Dieldrin	µg/kg	0.07			0.0498 UJ					0.0873 U	0.0534 U		0.299 U	0.0492 U	0.0623 U
DDD	µg/kg	114			1.666 JNT					2.76 JNT	5.257 JNT		2.8 JNT	0.0463 UT	1.839 JNT
DDE	µg/kg	50			0.3036 JNT					5.71 JT	1.923 JNT		1.582 JNT	0.0434 UT	0.2748 JT
DDT	µg/kg	246			0.53 JT					1.391 JNT	1.206 JNT		1.723 JT	0.0535 UJT	3.1 JNT
DDx	µg/kg	6.1	160	7050	2.4996 JNT					9.861 JNT	8.386 JNT		6.105 JNT	0.0535 UJT	5.2138 JNT
Lindane	µg/kg	5			0.0742 UJ					0.13 UJ	0.0797 UJ		0.445 U	0.0733 U	0.0929 UJ
Chlordanes	µg/kg	0.51			0.0405 UJT					1.2323 JNT	0.81135 JNT		0.243 UJT	0.04 UJT	0.0507 UT
Arsenic	mg/kg	3			2.3 J		2.62	2.27	2.36	6.7	1.71 T		9.28	2	1.89
Cadmium	mg/kg	0.51			0.073 J		0.139 U	0.126	0.138	0.403	0.116 T		0.35	0.09	0.095
Copper	mg/kg	359			47		26.1	26.2	29.2	705	22.1 T		201	19.8	30.3
Lead	mg/kg	196			8.52		4.05	4.93 J	5.04 J	52.5	7.31 T		103 J	3.34 J	4.64 J
Mercury	mg/kg	0.085			0.215			0.0425 T	0.032	0.111	0.125		0.146	0.059	0.028
Zinc	mg/kg	459			72.9		61.2	60.7	64.2	383	60.4 T		368	53.3	68.2
TBT	µg/kg	3080			190 J			0.24 U	0.26 U	30000 J	30		2100	0.22 U	0.24 U
Total cPAHs	µg/kg	774		106000	95.563 T		0.65 UT	0.72 UT	0.77 UT	789.05 T	50.497 T		230.88 T	1.349 JT	1.5371 JT
Total PAHs	µg/kg	23000	30000		898.75 T		4.515 JT	3.6 UT	3.4 UT	7157 T	543 T		2249 T	6.035 JT	10.535 JT
TPH-Diesel	mg/kg	91			21 J					210 J	94.5 JT				
Chlorobenzene	µg/kg														
Naphthalene	µg/kg				6.4 U		2.4 U	3.6 U	3.4 U	48	23		22	2 U	2.2 U
BEHP	µg/kg	135			24 U			7.1 J	2.8 U	6500	33 U		1000	14 U	37 U

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		C396	C397	C397	C397	C4	C402	C402	C405	C405	C405	C409			
Sample ID		LW2-C396-C	LW2-C397-B	LW2-C397-C	LW2-C397-D	c4-0to27-100918	LW2-C402-B	LW2-C402-C	LW2-C405-B	LW2-C405-C	LW2-C405-E	LW2-C409-A			
Sample Date		2004/10/21	2004/10/07	2004/10/07	2004/10/07	2018/10/09	2004/10/07	2004/10/07	2004/10/26	2004/10/26	2004/10/26	2004/10/26			
Sample Depth		153 to 277 cm	30 to 153 cm	153 to 271 cm	271 to 341 cm	0 to 27 cm	30 to 65 cm	65 to 183 cm	30 to 134 cm	134 to 171 cm	292 to 328 cm	0 to 30 cm			
COC	Units	CUL	RAL	PTW											
Total PCBs	µg/kg	9	75	200	3.09 UT	583.415 JT	571 JT	408.18 T	345.17085	424.895 JT	11.951 JT	494.75 JT	74.5685 JT	1.7 UT	
TCDDeq	µg/kg	0.01				0.00325 JT	0.00464 JT	0.000948 JT	0.017 JT			0.00125 JT			
HxCDF	µg/kg	0.0004		0.04		0.002613	0.003368	0.000614 J	0.0085			0.00064 J			
PeCDD	µg/kg	0.0002	0.0008	0.01		0.000341 J	0.000575 J	0.000126 J	0.0015 J*			0.000201 J			
PeCDF	µg/kg	0.0003	0.2	0.2		0.000475 J	0.000687 J	0.00017 U	0.0016 J*			0.000233 J			
TCDD	µg/kg	0.0002	0.0006	0.01		0.000166 J	0.000367	0.000061 U	0.00047 J*q			0.000049 U			
TCDF	µg/kg	0.0040658		0.6		0.000749	0.000691 U	0.000227 U	0.0018			0.000326			
Aldrin	µg/kg	2				0.0409 UJ	0.591 NJ	0.048 UJ	0.0471 UJ			0.175 UJ			
Dieldrin	µg/kg	0.07				0.067 U	0.0868 UJ	0.0785 U	0.0771 UJ			0.286 U	0.255 U		
DDD	µg/kg	114				0.18605 JNT	5.25 JNT	4.699 JNT	7.46 JNT			8.41 JNT	5.25 JNT		
DDE	µg/kg	50				0.0591 UT	6.235 JNT	5.364 JNT	5.619 JNT			2.981 JT	1.345 JNT		
DDT	µg/kg	246				0.30355 JT	1.708 JNT	2.09465 JT	1.21405 JNT			4.72 JT	1.242 JNT		
DDx	µg/kg	6.1	160	7050		0.5415 JNT	13.193 JNT	12.15765 JNT	14.29305 JNT			16.111 JNT	7.837 JNT		
Lindane	µg/kg	5				0.0999 UJ	3.27 NJ	0.117 UJ	0.115 UJ			0.427 U	0.788 J		
Chlordanes	µg/kg	0.51				0.0545 UT	2.027 JNT	1.63465 JNT	3.5869 JNT			4.9765 JNT	0.74245 JNT		
Arsenic	mg/kg	3				1.73 T	5.3 J	4.82	4.47	16.1 J	1.9 J	4.51	3.44 T	3.31	
Cadmium	mg/kg	0.51				0.099 T	0.497 J	0.472	0.582	0.194 J	0.056 J	0.363	0.54 T	0.218	
Copper	mg/kg	359				28.5 T	88.2	79.9	62	309	19.2	22	34.2 T	30.6	
Lead	mg/kg	196				4.49 JT	52.4	52.3 J	42.8 J	70.4	7.04	16.3	36.3 T	7.43	
Mercury	mg/kg	0.085				0.035	0.271	0.36	0.638	0.138	0.122	0.03 J	0.111 J		
Zinc	mg/kg	459				64.7 T	269	289	197	366	53.5	96.8	139 T	70.4	
TBT	µg/kg	3080				0.25 U	130	16 J	0.29 UJ	100	120 J	0.9 U		88	
Total cPAHs	µg/kg	774		106000		0.73 UT	84.703 T	69.188 JT	48.971 JT	1222.2 T	99.47 T	16.762 JT	83.88 T	179.84 T	1.2936 JT
Total PAHs	µg/kg	23000	30000			2 UT	749.9 T	699 JT	622.4 JT	8551.7 JT	2031.45 JT	269.33 JT	811.5 JT	1919 T	16.62 JT
TPH-Diesel	mg/kg	91					490 J	555 JT	760 J	140	180 J	13 JT	210 JT	510 J	
Chlorobenzene	µg/kg														
Naphthalene	µg/kg					2 U	20 U	19 J	31 J	4.3 J	5.7 U	6 U	3.6 U	29	7.6 U
BEHP	µg/kg	135				41 U	150 U	120 U	60 U	420	180	9 J	310	790	5.8 U

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		C409	C409	C409	C415	C415	C415	C415	C417	C417	C417	C421	
Sample ID		LW2-C409-B	LW2-C409-C	LW2-C409-D	LW2-C415-B	LW2-C415-C	LW2-C415-D	LW2-C415-E	LW2-C417-B	LW2-C417-C	LW2-C417-D	LW2-C421-A	
Sample Date		2004/10/26	2004/10/26	2004/10/26	2004/11/10	2004/11/10	2004/11/10	2004/11/10	2004/10/26	2004/09/22	2004/10/26	2004/10/07	
Sample Depth		30 to 72 cm	72 to 192 cm	192 to 306 cm	23 to 175 cm	175 to 262 cm	262 to 337 cm	337 to 424 cm	30 to 152 cm	152 to 298 cm	298 to 353 cm	0 to 30 cm	
COC	Units	CUL	RAL	PTW									
Total PCBs	µg/kg	9	75	200	190.475 JT	237 JT	15.9 JNT	27.645 JT	2.34 UT	2.42 UT	206.37 JT	172.96 JT	
TCDDeq	µg/kg	0.01									0.00353 JT		
HxCDF	µg/kg	0.0004		0.04							0.00285		
PeCDD	µg/kg	0.0002	0.0008	0.01							0.000375 J		
PeCDF	µg/kg	0.0003	0.2	0.2							0.000437 J		
TCDD	µg/kg	0.0002	0.0006	0.01							0.000191 J		
TCDF	µg/kg	0.0040658		0.6							0.00048		
Aldrin	µg/kg	2			0.0397 UJ	0.0318 UJ	0.12 U	0.0317 UJ	0.031 UJ	0.0325 UJ	0.0525 UJ	0.0325 UJ	0.22 U
Dieldrin	µg/kg	0.07			0.303 NJ	0.0521 U	0.1 U	0.0519 U	0.0508 U	0.0531 U	0.0859 U	0.0532 U	4.2 NJ
DDD	µg/kg	114			3.65 JNT	5.71 JNT	1.02 JNT	1.736 JNT	0.0478 UT	0.05 UT	5.37 JNT	5.72 JNT	3.25 T
DDE	µg/kg	50			2.2617 JT	1.7174 T	0.315 JNT	0.5363 T	0.0448 UT	0.0469 UT	5.31865 JNT	1.86775 JNT	2.51 JNT
DDT	µg/kg	246			1.418 JT	2.028 JT	1.01 JT	0.0565 UJT	0.0552 UJT	0.0578 UJT	2.167 JNT	1.801 JNT	25 T
DDx	µg/kg	6.1	160	7050	7.3297 JNT	9.4554 JNT	2.345 JNT	2.32345 JNT	0.0552 UJT	0.0578 UJT	12.85565 JNT	9.38875 JNT	30.76 JNT
Lindane	µg/kg	5			0.951 NJ	0.0777 U	0.12 U	0.0774 U	0.0757 U	0.0792 U	0.128 U	2.77 NJ	0.17 U
Chlordanes	µg/kg	0.51			1.96905 JNT	0.81185 JNT	0.477 JT	0.0422 UT	0.0413 UT	0.0432 UT	2.29355 JNT	16.18935 JNT	7.0395 T
Arsenic	mg/kg	3			7.86	2.38	1.93	3.01 J	1.95 J	2.57 J	1.69	4.47 J	2.15 J
Cadmium	mg/kg	0.51			0.349	0.117	0.091 U	0.15	0.075	0.109	0.017 U	0.507 J	0.206 J
Copper	mg/kg	359			191	70.6	17.7	23.9	15.9	24.4	18.8	72.4	24.7
Lead	mg/kg	196			44.6	62.4	3.11	44.4 J	3.83 J	4.26 J	3	51.2	19
Mercury	mg/kg	0.085			0.089 J	0.165 J		0.056 J	0.009 J	0.025 J		0.275	0.093
Zinc	mg/kg	459			283	94.3	49.3	74.4	50.4	61	48.4	236	107
TBT	µg/kg	3080			2300			4.8	0.22 U	0.23 U			
Total cPAHs	µg/kg	774		106000	111.763 T	177.94 T	8.139 JT	119.207 T	1.35 JT	1.466 JT	92.331 T	316.17 T	
Total PAHs	µg/kg	23000	30000		2056.8 T	3394 T	74.07 JT	815.3 JT	5.58 JT	18.4 JT	725.5 T	2766 T	
TPH-Diesel	mg/kg	91						25 J		4.6 U			
Chlorobenzene	µg/kg												
Naphthalene	µg/kg				29	46	2.3 U	14 U	3.7 U	5 U	17	23	
BEHP	µg/kg	135			850	29 U	8.6 U	22 U	6 U	20 U	220	82	

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		C421	C421	C421	C421	C421	C425	C425	C425	C425	C425-2	C425-2			
Sample ID		LW2-C421-B	LW2-C421-C	LW2-C421-D	LW2-C421-E	LW2-C421-F	LW2-C425-B1	LW2-C425-C1	LW2-C425-E1	LW2-C425-F1	LW2-C425-B2	LW2-C425-C2			
Sample Date		2004/10/07	2004/10/07	2004/10/07	2004/10/07	2004/10/07	2004/10/26	2004/10/26	2004/10/26	2004/10/26	2004/10/26	2004/10/26			
Sample Depth		30 to 61 cm	61 to 123 cm	123 to 240 cm	240 to 318 cm	318 to 362 cm	30 to 165 cm	165 to 217 cm	257 to 295 cm	295 to 324 cm	30 to 102 cm	102 to 253 cm			
COC	Units	CUL	RAL	PTW											
Total PCBs	µg/kg	9	75	200	1281.95 JT	335.925 JT		2.3 UT		40.8 JT	64.5 JT	73.9 JT	2.8 UT	93.445 JT	42.02 JT
TCDDeq	µg/kg	0.01													
HxCDF	µg/kg	0.0004		0.04											
PeCDD	µg/kg	0.0002	0.0008	0.01											
PeCDF	µg/kg	0.0003	0.2	0.2											
TCDD	µg/kg	0.0002	0.0006	0.01											
TCDF	µg/kg	0.0040658		0.6											
Aldrin	µg/kg	2			0.18 U			0.14 U		0.251 NJT	0.193 NJ				
Dieldrin	µg/kg	0.07			5.1 U			0.12 U		0.0499 UT	0.0517 UT	0.0508 UT		0.275 U	0.0513 U
DDD	µg/kg	114			5.1 JT			1.27 T						2.195 JNT	1.043 JNT
DDE	µg/kg	50			4.6 UT			0.17 JT						2.85 JNT	0.58515 JT
DDT	µg/kg	246			84 T			0.335 JNT						0.8695 JNT	0.282 JT
DDx	µg/kg	6.1	160	7050	91.845 JT			1.775 JNT						5.9145 JNT	1.91015 JNT
Lindane	µg/kg	5			0.53 NJ			0.14 U		0.0744 UT	0.0771 UT	0.0781 UT		0.41 U	0.0765 U
Chlordanes	µg/kg	0.51			12.3105 T			0.2725 JNT						2.3794 JNT	3.48405 JT
Arsenic	mg/kg	3			6.02	3.71	1.79		1.8	3.45 T	2.18 T	2.75 T		4.36	1.94
Cadmium	mg/kg	0.51			0.64	0.343	0.12 U		0.114 U	0.35 T	0.289 T	0.394 T		0.537	0.201
Copper	mg/kg	359			109	47.4	25.6		20.9	30.7 T	26.9 T	26.8 T		52.7	24.9
Lead	mg/kg	196			106 J	46.2 J	4.48		3.15	25.9 JT	25.2 T	27.5 T		31.2	17
Mercury	mg/kg	0.085			0.489	0.318				0.183 T	0.1 JT	0.0745 JT		0.078 J	0.058 J
Zinc	mg/kg	459			314	164	58		54.3	152 T	150 T	111 T		207	91.6
TBT	µg/kg	3080			20	0.44 J									
Total cPAHs	µg/kg	774		106000	381.66 T	82.075 T								55.717 T	30.705 T
Total PAHs	µg/kg	23000	30000		7749.5 T	781.8 T								628.05 T	282.6 JT
TPH-Diesel	mg/kg	91								150 JT	175 JT	255 JT		240 J	110 J
Chlorobenzene	µg/kg														
Naphthalene	µg/kg				35 U	16 U				15 T	34 T	18 T		9.7 U	9.4 U
BEHP	µg/kg	135			300	39 J				570 T	180 T	880 T	6.1 U	1200	66 U

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		C425-2	C426	C426	C426	C430	C430	C430	C430	C702	C702	C702			
Sample ID		LW2-C425-D2	LW2-C426-A	LW2-C426-B	LW2-C426-C	LW2-C430-A	LW2-C430-B	LW2-C430-C	LW2-C430-E	LW3-C702-B	LW3-C702-C	LW3-C702-D			
Sample Date		2004/10/26	2004/09/22	2004/10/25	2004/10/25	2004/11/10	2004/11/10	2004/11/10	2004/11/10	2008/01/15	2008/01/15	2008/01/15			
Sample Depth		253 to 300 cm	0 to 30 cm	30 to 132 cm	135 to 220 cm	0 to 30 cm	30 to 155 cm	155 to 278 cm	400 to 520 cm	30 to 152 cm	152 to 275 cm	275 to 344 cm			
COC	Units	CUL	RAL	PTW											
Total PCBs	µg/kg	9	75	200	114.575 JT		202.725 JT	2.45 UT	181 JT	100 JT	198 JT	335 JT	168 T	255 T	44.3 JT
TCDDeq	µg/kg	0.01				0.00342 JT	0.00128 JT			0.00538 JT					
HxCDF	µg/kg	0.0004		0.04		0.00121 J	0.000711 J	0.000031 UT		0.00236					
PeCDD	µg/kg	0.0002	0.0008	0.01		0.000344 J	0.000129 J	0.000042 UT		0.000345 J					
PeCDF	µg/kg	0.0003	0.2	0.2		0.000349 J	0.000176 U	0.000028 UT		0.000676 J					
TCDD	µg/kg	0.0002	0.0006	0.01		0.000168 J	0.00009 U	0.000039 UT		0.000179 U					
TCDF	µg/kg	0.0040658		0.6		0.00088	0.000275	0.000031 UT		0.000847					
Aldrin	µg/kg	2					0.0471 UJ		0.044 UJ	0.0437 UJ	0.196 UJ	0.13 U	0.32 U	0.12 U	
Dieldrin	µg/kg	0.07			0.0604 U		0.077 UJ	0.0553 U	0.0719 U	0.0714 U	0.321 U	0.67 NJ	0.32 U	0.03 U	
DDD	µg/kg	114			3.895 JNT		2.657 JNT	0.0521 UT	3.611 JNT	7.31 JNT	15.72 JNT	3.4 JT	7.9 JT	6.9 JT	
DDE	µg/kg	50			0.73315 JNT		2.94 JNT	0.0488 UT	2.784 JT	5.477 JNT	9.457 T	8.8 JNT	13.175 JNT	2.035 JNT	
DDT	µg/kg	246			0.374 JNT		0.373 JT	0.0602 UJT	0.59575 JT	1.103 JT	2.1815 JT	16.7 T	23.9 JT	3.8 JT	
DDx	µg/kg	6.1	160	7050	5.00215 JNT		5.97 JNT	0.0602 UJT	6.99075 JNT	13.89 JNT	27.3585 JNT	28.9 JNT	44.975 JNT	12.735 JNT	
Lindane	µg/kg	5			0.0901 U		0.115 UJ	1.28 NJ	5.69 NJ	0.107 U	0.479 U	0.21 U	0.062 U	0.16 U	
Chlordanes	µg/kg	0.51			8.67165 JT		0.5792 JNT	0.0451 UT	1.44265 JNT	2.07295 JNT	3.211 JNT	6.3265 JT	9.135 JT	1.282 JT	
Arsenic	mg/kg	3			2.5		4.97	1.3	4.25	4.27 J	5.36 J	5.69 J	5.51	4.18	2.41
Cadmium	mg/kg	0.51			0.32		0.47	0.07	0.45	0.367	0.528	0.555	0.351	0.354	0.13
Copper	mg/kg	359			57.2		55.8	14.9	71.3	50.3	53.7	107	198	69.6	27.3
Lead	mg/kg	196			25.8		53.1 J	2.75 J	38.2	41.2 J	42 J	85.2 J	40.2	43.6	11.9
Mercury	mg/kg	0.085			0.078 J		0.233	0.009 U	0.195 JT	0.314 J	0.626 J	0.137	0.459	0.113	
Zinc	mg/kg	459			95.8		189	46.2	215	166	207	237	253	249	80.1
TBT	µg/kg	3080					120	0.21 U							
Total cPAHs	µg/kg	774		106000	252.92 T	53.329 T	63.127 T	1.58587 JT	159.49 T	34.716 T	141.858 T	161.25 T	206.79 T	113.24 T	42.546 T
Total PAHs	µg/kg	23000	30000		1931 T	513.85 JT	644.8 T	15.215 JT	1381.2 T	295.7 T	1625 T	1760 T	1881.4 T	1134.9 T	518.4 T
TPH-Diesel	mg/kg	91			360 J		330 J	11 UT	204 JT	430 J	510 J	280 J	270 J	65 J	
Chlorobenzene	µg/kg														
Naphthalene	µg/kg				18	7.3 U	27	2.1 U	13	16 U	94	380	23	16	31
BEHP	µg/kg	135			470		63 U	8.4 U	200 U	79 U	190 U	780	72 J	14 U	

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		C702	C703	C703	C703	C706	C706	C706	C706	C708	C708	C708			
Sample ID		LW3-C702-F	LW3-C703-B	LW3-C703-C	LW3-C703-D	LW3-C706-B	LW3-C706-C	LW3-C706-D	LW3-C706-E	LW3-C708-B	LW3-C708-C	LW3-C708-D			
Sample Date		2008/01/15	2008/01/16	2008/01/16	2008/01/16	2008/01/16	2008/01/16	2008/01/16	2008/01/16	2008/01/16	2008/01/16	2008/01/16			
Sample Depth		402 to 485 cm	30 to 152 cm	152 to 240 cm	240 to 303 cm	30 to 152 cm	152 to 253 cm	253 to 333 cm	333 to 402 cm	30 to 150 cm	150 to 236 cm	236 to 305 cm			
COC	Units	CUL	RAL	PTW											
Total PCBs	µg/kg	9	75	200	0.441 JT	122 T	74.1 JT	0.418 JT	9.34 JT	10.09 T	66.3 JT	3.815 JT	7050 JT	6950 JT	203 JT
TCDDeq	µg/kg	0.01													
HxCDF	µg/kg	0.0004		0.04											
PeCDD	µg/kg	0.0002	0.0008	0.01											
PeCDF	µg/kg	0.0003	0.2	0.2											
TCDD	µg/kg	0.0002	0.0006	0.01											
TCDF	µg/kg	0.0040658		0.6											
Aldrin	µg/kg	2			0.12 U	0.12 U	0.19 J	0.12 U	0.24 NJ	0.24 J	0.12 U	0.12 U	6.7 U	6 U	0.12 U
Dieldrin	µg/kg	0.07			0.03 U	0.03 U	0.03 U	0.038 NJ	0.26 U	0.03 U	0.2 U	0.03 U	1.7 U	1.5 U	0.03 U
DDD	µg/kg	114			0.16 UT	12.7 JT	3.6 JT	0.16 UT	1.7 JT	5.1 JT	2 T	0.29 JNT	345 T	235 T	7.85 T
DDE	µg/kg	50			0.046 UT	11.75 JT	4.145 JNT	0.046 UT	2.91 T	4.923 T	3.05 JT	0.046 UT	401.5 JNT	20 UT	2.4 UT
DDT	µg/kg	246			0.18 UT	7 JNT	6.5 JT	0.18 UT	0.83 UT	1.095 JT	8.5 T	0.174 JT	1410 JNT	1110 JT	15.6 JT
DDx	µg/kg	6.1	160	7050	0.18 UT	31.45 JNT	14.245 JNT	0.18 UT	5.365 JT	11.118 JT	13.55 JT	0.5005 JNT	2156.5 JNT	1365 JT	25.05 JT
Lindane	µg/kg	5			0.062 U	0.36 U	0.34 U	0.14 U	0.22 U	0.062 U	0.64 U	0.062 U	6.7 J	7.2 J	0.062 U
Chlordanes	µg/kg	0.51			0.087 UT	6.6655 JNT	3.9 UT	0.087 UT	0.9605 JNT	2.4505 T	2.4 UT	0.11 UT	390.6 JT	381.2 JNT	7.68 JNT
Arsenic	mg/kg	3			1.85	6.22	5.45	2.12 T	4.29	4.55	14.9	1.62	13.3	51.4	8.57
Cadmium	mg/kg	0.51			0.056	0.483	0.363	0.09 T	0.197	0.259	0.431	0.048	0.764	1.25	0.175
Copper	mg/kg	359			17.5	76.1	51.9	20 T	92.7	81.8	531	14.9	1570	2510	103
Lead	mg/kg	196			3.09	38.4	30.6	11.9 T	14.5	18.5	56.9	3	633	711	39.1
Mercury	mg/kg	0.085			0.015	0.489 T	0.354	0.06	0.061	0.061	0.078	0.015	4.88	16.8	0.938
Zinc	mg/kg	459			51.9	165	134	70 T	141	126	505	58.5	986	1100	118
TBT	µg/kg	3080													
Total cPAHs	µg/kg	774		106000	0.48 UT	109.948 T	107.457 T	150.02 T	20 JT	43.584 T	558.12 T	3.6672 JT	4799.8 T	4989.6 T	177.55 T
Total PAHs	µg/kg	23000	30000		0.75 UT	1261.1 T	1202.8 T	1202.1 T	174.4 JT	420.1 T	5395 T	29.23 JT	48760 T	54670 T	1918.1 T
TPH-Diesel	mg/kg	91			1.6 JT	320 J	360 J	62 J	76 J	89 J	410 J	1.8 JT	1000 J	6800 J	210 J
Chlorobenzene	µg/kg														
Naphthalene	µg/kg				0.51 U	52	53	17	5.9	8.5	53	0.77 J	130	150	12
BEHP	µg/kg	135			7 U	140 U	140 U	7 U	120	640	3500	7 U	2000	700 U	40

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		C708	C708	C-8.94	D2	D3	D5	D5	D6-SC			
Sample ID		LW3-C708-F	LW3-C708-G	C-8.94-0to27-	d2-0to19-101018	D3-0to26-101018	511-0to28-100918	D5-0to28-100918	411-sc1b-50to60-			
Sample Date		2008/01/16	2008/01/16	102418	2018/10/10	2018/10/10	2018/10/09	2018/10/09	82619			
Sample Depth		380 to 496 cm	496 to 544 cm	0 to 27 cm	0 to 19 cm	0 to 26 cm	0 to 28 cm	0 to 28 cm	2019/08/26			
Sample Depth		152 to 183 cm										
COC	Units	CUL	RAL	PTW								
Total PCBs	µg/kg	9	75	200	1.4 JT	0.88 JT	95.7294	25.08446	244.7809	660.672	570.595	486.7
TCDDeq	µg/kg	0.01						0.00349 JT	0.00996 JT	0.0167 JT	0.0149 JT	0.00371 JT
HxCDF	µg/kg	0.0004		0.04				0.003 J	0.0064	0.0095	0.0088	0.00225 J
PeCDD	µg/kg	0.0002	0.0008	0.01			0.002 JBq	0.0002 U*	0.0011 Jq	0.0016 J	0.00093 U	0.000338 J
PeCDF	µg/kg	0.0003	0.2	0.2			0.0031 J	0.00048 J*	0.00065 U	0.0025 J	0.0019 Jq	0.0011 J
TCDD	µg/kg	0.0002	0.0006	0.01			0.00061 Jq	0.00013 U*	0.00051 U	0.00095 JB	0.00098 JqB	0.000938 U
TCDF	µg/kg	0.0040658		0.6				0.00045 J	0.0019	0.0025	0.0026	0.000501 BJ
Aldrin	µg/kg	2			0.12 U	0.12 U		0.079 U		0.11 U	0.11 U	
Dieldrin	µg/kg	0.07			0.03 U	0.03 U		0.077 U	0.096 U	0.11 U	0.11 U	
DDD	µg/kg	114			0.16 UT	1.07 T	2.55	2.71		1.842	1.742	
DDE	µg/kg	50			0.2335 T	0.5095 JNT	3.85	0.4795		2.33	2.34	6.295
DDT	µg/kg	246			0.18 UT	0.83 JT	3.5	0.094	0.12	0.13	2.1315	0.94
DDx	µg/kg	6.1	160	7050	0.4705 T	2.4095 JNT	9.9	3.26	8.3895	4.2685	6.2135	11.28
Lindane	µg/kg	5			0.15 U	0.31 U		0.031 U	0.039 U	0.042 U	0.042 U	
Chlordanes	µg/kg	0.51			0.659 JNT	0.14 UT		0.6535	0.645	0.785	0.725	
Arsenic	mg/kg	3			3.13	1.89		5.9	7.1	7.2	6.8	
Cadmium	mg/kg	0.51			0.082	0.052		0.18	0.4	0.41	0.39	
Copper	mg/kg	359			29.8	17.3		95	100	100	100 F1	
Lead	mg/kg	196			4.87	3.04		24 B	36	31	34	
Mercury	mg/kg	0.085			0.034	0.011 J		0.028 H	0.2	0.15	0.23	
Zinc	mg/kg	459			74.3	64.5		150	220	230	230	
TBT	µg/kg	3080						23	160	230	250	
Total cPAHs	µg/kg	774		106000	2.1693 JT	2.7596 JT	184.78 DT	133.82 T	224.99 T	277.27 DT	208.98 DT	125.453 T
Total PAHs	µg/kg	23000	30000		22.515 JT	25.95 JT	1744.9 DJT	1431.4 T	2026 DT	2369 DT	1936 DJT	1230 T
TPH-Diesel	mg/kg	91			2.6 J	1.7 U		56 J	180 J	130 J	150 J	
Chlorobenzene	µg/kg											
Naphthalene	µg/kg				0.78 J	1.3 J	17 D	5.4	19	28 D	23 D	33
BEHP	µg/kg	135			7.6 J	7 U		120 J	270	730	720	

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			D6-SC	D6-SC	D6-SC	D6-SC	D6-SC	D6-SC
		Sample ID			D6-SC-0to1-102118	D6-SC-108to123-102118	d6-sc1b-100to110-82619	d6-sc1b-10to20-82619	d6-sc1b-110to120-82619	d6-sc1b-20to30-82619
		Sample Date			2018/10/21	2018/10/21	2019/08/26	2019/08/26	2019/08/26	2019/08/26
		Sample Depth			0 to 30 cm	329 to 375 cm	305 to 335 cm	30 to 61 cm	335 to 366 cm	61 to 91 cm
COC	Units	CUL	RAL	PTW						
Total PCBs	µg/kg	9	75	200	19533		1.6	1748.8	1.6	1056.5
TCDDeq	µg/kg	0.01			0.0166 JT	14331	0.0053 JT		0.00545 JT	0.0138 JT
HxCDF	µg/kg	0.0004		0.04	0.014	0.005 J	0.00471 U		0.00484 U	0.00619
PeCDD	µg/kg	0.0002	0.0008	0.01	0.0012 J	0.002 J	0.00471 U		0.00484 U	0.00122 J
PeCDF	µg/kg	0.0003	0.2	0.2	0.0019 J	0.0017	0.00471 U		0.00484 U	0.0024 J
TCDD	µg/kg	0.0002	0.0006	0.01	0.00071 J	2100	0.000941 U		0.000969 U	0.000451 JK
TCDF	µg/kg	0.0040658		0.6	0.0026 B	0.6	0.000232 BJK		0.000207 BJ	0.00154 B
Aldrin	µg/kg	2			0.092 U	0.079 U				
Dieldrin	µg/kg	0.07			0.089 U	0.077 U				
DDD	µg/kg	114			1.8365	0.063	0.63		0.63	2.915
DDE	µg/kg	50				0.079	0.79		0.79	5.895
DDT	µg/kg	246			0.11	0.094	0.94		0.94	5.27
DDx	µg/kg	6.1	160	7050	4.869	0.094	0.94		0.94	14.08
Lindane	µg/kg	5			0.036 U	0.031 U				
Chlordanes	µg/kg	0.51			0.81	0.13				
Arsenic	mg/kg	3			10	4.2				
Cadmium	mg/kg	0.51			0.5	0.087 J				
Copper	mg/kg	359			210	32				
Lead	mg/kg	196			45	5.1				
Mercury	mg/kg	0.085			0.64	0.29 F1				
Zinc	mg/kg	459			330	64				
TBT	µg/kg	3080			210	0.61 U				
Total cPAHs	µg/kg	774		106000	188.89 DT	0.73378 JT	0.7605 JT		0.26215 JT	101.38 T
Total PAHs	µg/kg	23000	30000		1695.9 DT	6.855 JXT	6.087 JT		2.474 JT	772.2 T
TPH-Diesel	mg/kg	91			270 J	17 U				
Chlorobenzene	µg/kg									
Naphthalene	µg/kg				17 D	0.32 J	0.23 J		0.15 U	7.3
BEHP	µg/kg	135			580	8.9 U				

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		Sample ID			Sample Date		Sample Depth		D6-SC	D6-SC	D6-SC	D6-SC	D6-SC	D6-SC
COC		Units	CUL	RAL	PTW			d6-sc1b-20to30-82619r1	d6-sc1b-30to40-82619	d6-sc1b-40to50-82619	d6-sc1b-50to60-82619	d6-sc1b-60to70-82619	d6-sc1b-70to80-82619	
								2019/08/26	2019/08/26	2019/08/26	2019/08/26	2019/08/26	2019/08/26	
								61 to 91 cm	91 to 122 cm	122 to 152 cm	152 to 183 cm	183 to 213 cm	213 to 244 cm	
Total PCBs	µg/kg	9	75	200					1435.1	287	419.9	375.2	54	
TCDDeq	µg/kg	0.01							0.00457 JT	0.00732 JT	0.00182 JT	0.0013 JT	0.00153 JT	
HxCDF	µg/kg	0.0004		0.04					0.00214 J	0.00402 J	0.000966 J	0.000554 BJ	0.000823 BJ	
PeCDD	µg/kg	0.0002	0.0008	0.01					0.00499 U	0.000998 J	0.000279 J	0.000146 J	0.000237 J	
PeCDF	µg/kg	0.0003	0.2	0.2					0.000405 J	0.00169 J	0.000513 BJ	0.00027 BJ	0.000384 BJ	
TCDD	µg/kg	0.0002	0.0006	0.01					0.000999 U	0.00053 JK	0.0000976 J	0.0000848 J	0.0000955 J	
TCDF	µg/kg	0.0040658		0.6				0.0018 B	0.000517 BJ	0.000808 BJ	0.000425 BJ	0.00026 BJ	0.000327 BJ	
Aldrin	µg/kg	2												
Dieldrin	µg/kg	0.07												
DDD	µg/kg	114							4.615	1.615	3.415	1.8	0.63	
DDE	µg/kg	50							7.795	4.895	5.695	3.095	0.79	
DDT	µg/kg	246							4.27	0.94	0.94	0.94	0.94	
DDx	µg/kg	6.1	160	7050					16.68	7.215	9.815	5.015	0.94	
Lindane	µg/kg	5												
Chlordanes	µg/kg	0.51												
Arsenic	mg/kg	3												
Cadmium	mg/kg	0.51												
Copper	mg/kg	359												
Lead	mg/kg	196												
Mercury	mg/kg	0.085												
Zinc	mg/kg	459												
TBT	µg/kg	3080												
Total cPAHs	µg/kg	774		106000					119.737 T	118.55 T	120.712 T	76.97 T	8.9906 T	
Total PAHs	µg/kg	23000	30000						917.8 T	1041 T	1144 T	665.6 T	79.66 T	
TPH-Diesel	mg/kg	91												
Chlorobenzene	µg/kg													
Naphthalene	µg/kg								6.1	11	25	11	1.6	
BEHP	µg/kg	135												

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			D6-SC	D6-SC	D6-SC	D6-SC	D6-SC	D6-SC	D6-SC
		Sample ID			d6-sc1b-80to90-82619	d6-sc1b-90to100-82619	D6-SC-1to2-102118	D6-SC-2to4-102118	D6-SC-40to64-102118	D6-SC-64to88-102118	D6-SC-88to108-102118
		Sample Date			2019/08/26	2019/08/26	2018/10/21	2018/10/21	2018/10/21	2018/10/21	2018/10/21
		Sample Depth			244 to 274 cm	274 to 305 cm	30 to 61 cm	61 to 122 cm	122 to 195 cm	195 to 268 cm	268 to 329 cm
COC	Units	CUL	RAL	PTW							
Total PCBs	µg/kg	9	75	200	22.9	10					
TCDDeq	µg/kg	0.01			0.00408 JT	0.00496 JT	0.0264 JT	14337	0.0152 JT	0.00102 JT	0.000373 JT
HxCDF	µg/kg	0.0004		0.04	0.000127 BJ	0.0000919 BJK	0.014 B	0.00214 J	0.0092 B	0.00012 U	0.0002 JBq
PeCDD	µg/kg	0.0002	0.0008	0.01	0.00468 U	0.0046 U	0.002 Jq	0.0032 J	0.0017 J	0.00014 J	0.000056 Jq
PeCDF	µg/kg	0.0003	0.2	0.2	0.0000599 BJK	0.0046 U	0.0031 J	0.0019	0.0016 J	0.00013 J	0.000042 U
TCDD	µg/kg	0.0002	0.0006	0.01	0.000935 U	0.000919 U	0.0015 B	100	0.0014 Bq	0.00012 JBq	0.00011 JBq
TCDF	µg/kg	0.0040658		0.6	0.000166 BJ	0.000186 BJ	0.007 B	0.094	0.00094 JB	0.00019 JB	0.000085 JBq
Aldrin	µg/kg	2					0.086 U	0.081 U	0.079 U	0.079 U	0.079 U
Dieldrin	µg/kg	0.07					0.084 U	0.079 U	0.077 U	0.077 U	0.077 U
DDD	µg/kg	114			0.63	0.63	1.8345	5.032	4.1315	0.4915	0.0745
DDE	µg/kg	50			0.79	0.79					0.1495
DDT	µg/kg	246			0.94	0.94	0.11	2.948	0.094	0.094	0.094
DDx	µg/kg	6.1	160	7050	0.94	0.94	6.945	19.18	14.302	1.39	0.2945
Lindane	µg/kg	5					0.13	0.095 J	0.031 U	0.031 U	0.031 U
Chlordanes	µg/kg	0.51					1.105	1.94	0.7425	0.13	0.13
Arsenic	mg/kg	3					14	12	8.3	4.3	4
Cadmium	mg/kg	0.51					0.78	0.72	0.62	0.16 J	0.092 J
Copper	mg/kg	359					280	160	87	41	32
Lead	mg/kg	196					120	140	91	13	6.7
Mercury	mg/kg	0.085					0.39	1.1	0.82	0.13	0.1
Zinc	mg/kg	459					480	490	280	85	71
TBT	µg/kg	3080					1200	170	29	1.2 J	0.59 JP
Total cPAHs	µg/kg	774		106000	7.946 T	1.18223 JT	412.53 DT	264.77 DT	204.7 DT	20.942 T	2.84 JT
Total PAHs	µg/kg	23000	30000		70.33 T	10.95 JT	3662 DT	2367 DT	1881 DT	172.7 T	25.9 JT
TPH-Diesel	mg/kg	91					760	690	620	68 J	22 J
Chlorobenzene	µg/kg										
Naphthalene	µg/kg				1.6	0.35 J	46 D	37 D	29 D	2.7	0.71
BEHP	µg/kg	135					5800 *	390	760	10 J	8.9 U

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		Sample ID			D7	D-8.83	D-8.90	D-8.90-SC	D-8.90-SC	D-8.90-SC
Sample Date		Sample Date			D7-0to28-100918	D-8.83-0to25-102418	D-8.90-0to27-102418	D-8.90-SC-00to10-102318	D-8.90-SC-103to120-102318	D-8.90-SC-10to20-102318
Sample Depth		Sample Depth			2018/10/09	2018/10/24	2018/10/24	2018/10/23	2018/10/23	2018/10/23
Sample Depth		Sample Depth			0 to 28 cm	0 to 25 cm	0 to 27 cm	0 to 30 cm	314 to 366 cm	30 to 61 cm
COC	Units	CUL	RAL	PTW						
Total PCBs	µg/kg	9	75	200	714.813	135.6715	97.29775	219.5791	269.48028	618.74043
TCDDeq	µg/kg	0.01			0.0419 JT					
HxCDF	µg/kg	0.0004		0.04	0.017					
PeCDD	µg/kg	0.0002	0.0008	0.01	0.0023 J	0.0024 JB	0.0022 JBq	0.0027 JB	0.0027 JB	0.0022 JB
PeCDF	µg/kg	0.0003	0.2	0.2	0.0037 J	0.0045 J	0.0031 J	0.0024 Jq	0.0027 J	0.0039 J
TCDD	µg/kg	0.0002	0.0006	0.01	0.001 JB	0.00076 Jq	0.0013 J	0.0012	0.0016	0.0011 q
TCDF	µg/kg	0.0040658		0.6	0.003					
Aldrin	µg/kg	2			0.13 U					
Dieldrin	µg/kg	0.07			0.13 U					
DDD	µg/kg	114			2.5	2.13	2.3	2.5355	3.39	5.2
DDE	µg/kg	50			1.765	3.85	4.53	5.41	9.8	6.395
DDT	µg/kg	246			0.317	1.3	0.14	0.11	0.94	0.94
DDx	µg/kg	6.1	160	7050	4.582	6.95	6.933	8.027	13.895	12.3
Lindane	µg/kg	5			0.049 U					
Chlordanes	µg/kg	0.51			0.745					
Arsenic	mg/kg	3			8.7					
Cadmium	mg/kg	0.51			0.37					
Copper	mg/kg	359			130					
Lead	mg/kg	196			79					
Mercury	mg/kg	0.085			0.18					
Zinc	mg/kg	459			360					
TBT	µg/kg	3080			140					
Total cPAHs	µg/kg	774		106000	129.61 DT	215.09 DT	223.05 DT	96.842 DT	125.652 DT	261.77 DT
Total PAHs	µg/kg	23000	30000		1184.2 DJT	1900.5 DT	1900.8 DT	779.5 DT	1228 DT	2251 DT
TPH-Diesel	mg/kg	91			150 J					
Chlorobenzene	µg/kg									
Naphthalene	µg/kg				11 D	16 D	17 D	18 D	28 D	51 D
BEHP	µg/kg	135			390					

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			D-8.90-SC	D-8.90-SC	D-8.90-SC	D-8.90-SC	D-8.90-SC
		Sample ID			D-8.90-SC-120to140-102318	D-8.90-SC-140to160-102318	D-8.90-SC-20to40-102318	D-8.90-SC-40to62-102318	D-8.90-SC-62to80-102318
		Sample Date			2018/10/23	2018/10/23	2018/10/23	2018/10/23	2018/10/23
		Sample Depth			366 to 427 cm	427 to 488 cm	61 to 122 cm	122 to 189 cm	189 to 244 cm
COC	Units	CUL	RAL	PTW					
Total PCBs	µg/kg	9	75	200	195.324125	258.1129	347.58349	322.629375	280.16373
TCDDeq	µg/kg	0.01							
HxCDF	µg/kg	0.0004		0.04					
PeCDD	µg/kg	0.0002	0.0008	0.01	0.0039 JB	0.0028 JB	0.0022 JB	0.0024 JB	0.0024 J
PeCDF	µg/kg	0.0003	0.2	0.2	0.0029 J	0.0023 JB	0.0026 J	0.0022 J	0.0023 J
TCDD	µg/kg	0.0002	0.0006	0.01	0.0019	0.0014	0.0015 q	0.0014	0.0014
TCDF	µg/kg	0.0040658		0.6		0.0015 B			
Aldrin	µg/kg	2							
Dieldrin	µg/kg	0.07							
DDD	µg/kg	114			4.8315	4.815	6.9	4.54	3.815
DDE	µg/kg	50			7.07	11.1	8.295	7.995	8.195
DDT	µg/kg	246			0.094	2.07	0.94	0.94	0.94
DDx	µg/kg	6.1	160	7050	11.972	17.985	15.9	13.24	12.715
Lindane	µg/kg	5							
Chlordanes	µg/kg	0.51							
Arsenic	mg/kg	3							
Cadmium	mg/kg	0.51							
Copper	mg/kg	359							
Lead	mg/kg	196							
Mercury	mg/kg	0.085							
Zinc	mg/kg	459							
TBT	µg/kg	3080							
Total cPAHs	µg/kg	774		106000	117.297 DT	113.397 DT	154.755 DT	115.725 DT	78.885 DT
Total PAHs	µg/kg	23000	30000		1147 DT	1103 DT	1406 DT	1142 DT	706.5 DT
TPH-Diesel	mg/kg	91							
Chlorobenzene	µg/kg								
Naphthalene	µg/kg				34 D	33 D	43 D	36 D	15 D
BEHP	µg/kg	135							

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		D-8.90-SC			D-9.09	D-9.09-SC	D-9.09-SC	D-9.09-SC	D-9.09-SC	D-9.09-SC
Sample ID		D-8.90-SC-80to103-102318			D-9.09-0to29-102418	511-20to40-102318	D-9.09-SC-00to10-102318	D-9.09-SC-100to117-102318	D-9.09-SC-10to20-102318	D-9.09-SC-10to20-102318
Sample Date		2018/10/23			2018/10/24	2018/10/23	2018/10/23	2018/10/23	2018/10/23	2018/10/23
Sample Depth		244 to 314 cm			0 to 29 cm	61 to 122 cm	0 to 30 cm	305 to 357 cm	30 to 61 cm	30 to 61 cm
COC	Units	CUL	RAL	PTW						
Total PCBs	µg/kg	9	75	200	462.109725	91.87681	158.462	144.626715	241.50115	149.77219
TCDDeq	µg/kg	0.01				0.0181 JT				
HxCDF	µg/kg	0.0004		0.04		0.0096				
PeCDD	µg/kg	0.0002	0.0008	0.01	0.0029 JB	0.0028 J	0.0024 JBq	0.0022 JB	0.0017 JBq	0.0026 JB
PeCDF	µg/kg	0.0003	0.2	0.2	0.0029 J	0.0027 J	0.0022 J	0.0022 J	0.0018 J	0.0022 J
TCDD	µg/kg	0.0002	0.0006	0.01	0.0016	0.0011 J	0.0013	0.00067 Jq	0.0013	0.0014
TCDF	µg/kg	0.0040658		0.6		0.0041 B				
Aldrin	µg/kg	2								
Dieldrin	µg/kg	0.07								
DDD	µg/kg	114			7.1	2.18	2.7315	2.45	5.2	2.175
DDE	µg/kg	50			8.795	4.15	5.2	4.68	6.77	4.645
DDT	µg/kg	246			0.94	1.5	0.094	0.099	0.094	0.82
DDx	µg/kg	6.1	160	7050	16.6	7.44	8.002	7.2045	12.0405	7.435
Lindane	µg/kg	5								
Chlordanes	µg/kg	0.51								
Arsenic	mg/kg	3								
Cadmium	mg/kg	0.51								
Copper	mg/kg	359								
Lead	mg/kg	196								
Mercury	mg/kg	0.085								
Zinc	mg/kg	459								
TBT	µg/kg	3080								
Total cPAHs	µg/kg	774		106000	108.409 DT	200.7 DT	114.738 DT	81.378 DT	138.266 DT	100.066 DT
Total PAHs	µg/kg	23000	30000		965.4 DT	1690 DT	1099 DT	676.7 DT	1545 DT	1013 DT
TPH-Diesel	mg/kg	91								
Chlorobenzene	µg/kg									
Naphthalene	µg/kg				22 D	18 D	52 D	18 D	88 D	42 D
BEHP	µg/kg	135								

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			D-9.09-SC	D-9.09-SC	D-9.09-SC	D-9.09-SC	DM16	DM18
		Sample ID			D-9.09-SC-20to40-102318	D-9.09-SC-40to60-102318	D-9.09-SC-60to80-102318	D-9.09-SC-80to100-102318	PSYD&M97DM16DM16	PSYD&M97DM18DM18
		Sample Date			2018/10/23	2018/10/23	2018/10/23	2018/10/23	1997/11/26	1997/11/26
		Sample Depth			61 to 122 cm	122 to 183 cm	183 to 244 cm	244 to 305 cm	0 to 10 cm	0 to 10 cm
COC	Units	CUL	RAL	PTW						
Total PCBs	µg/kg	9	75	200	163.2785	211.74404	439.5912	225.838365	140.1 T	
TCDDeq	µg/kg	0.01								
HxCDF	µg/kg	0.0004		0.04						
PeCDD	µg/kg	0.0002	0.0008	0.01	0.0029 JB	0.0023 JB	0.0025 JB	0.0024 JB		
PeCDF	µg/kg	0.0003	0.2	0.2	0.002 J	0.0021 J	0.0033 J	0.0023 J		
TCDD	µg/kg	0.0002	0.0006	0.01	0.0013	0.0015 q	0.0014	0.0014		
TCDF	µg/kg	0.0040658		0.6						
Aldrin	µg/kg	2								
Dieldrin	µg/kg	0.07								
DDD	µg/kg	114			2.67	7.5	3.25	5		
DDE	µg/kg	50			4.34	8.02	3.68	6.2		
DDT	µg/kg	246			0.81	0.094	0.427	0.094		
DDx	µg/kg	6.1	160	7050	7.62	15.5905	7.357	11.2705		
Lindane	µg/kg	5								
Chlordanes	µg/kg	0.51								
Arsenic	mg/kg	3								
Cadmium	mg/kg	0.51								
Copper	mg/kg	359								
Lead	mg/kg	196								
Mercury	mg/kg	0.085								
Zinc	mg/kg	459								
TBT	µg/kg	3080								
Total cPAHs	µg/kg	774		106000	112.019 DT	247.8 DT	320.04 DT	134.436 DT	294.026 T	
Total PAHs	µg/kg	23000	30000		991 DT	2472 DT	2516 DT	1274 DT	2599.1 T	
TPH-Diesel	mg/kg	91								
Chlorobenzene	µg/kg									
Naphthalene	µg/kg				39	96 D	64 D	44 D	33.6	
BEHP	µg/kg	135							1810	

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID Sample ID Sample Date Sample Depth					DM20C PSYD&M97DM20DM20C 1998/01/22 106 to 137 cm	DM22 PSYD&M97DM22DM22 1998/01/19 0 to 10 cm	DM24C PSYD&M97DM24DM24C1 1998/01/21 121 to 152 cm	DM24C PSYD&M97DM24DM24C2 1998/01/21 167 to 198 cm	E-8.99 E-8.99-0to28-102418 2018/10/24 0 to 28 cm	E-9.02 E-9.02-0to26-102418 2018/10/24 0 to 26 cm
COC	Units	CUL	RAL	PTW						
Total PCBs	µg/kg	9	75	200	220 T	40 UT	40 UT	40 UT	83.071555	126.485565
TCDDeq	µg/kg	0.01								0.0159 JT
HxCDF	µg/kg	0.0004		0.04						0.0086
PeCDD	µg/kg	0.0002	0.0008	0.01					0.003 JB	0.0024 J
PeCDF	µg/kg	0.0003	0.2	0.2					0.003 Jq	0.0026 J
TCDD	µg/kg	0.0002	0.0006	0.01					0.00095 J	0.0011 J
TCDF	µg/kg	0.0040658		0.6						0.0055 B
Aldrin	µg/kg	2								
Dieldrin	µg/kg	0.07								
DDD	µg/kg	114							1.95	3.76
DDE	µg/kg	50							4	6.15
DDT	µg/kg	246							2.5	1.1
DDx	µg/kg	6.1	160	7050					8.45	10.73
Lindane	µg/kg	5								
Chlordanes	µg/kg	0.51								
Arsenic	mg/kg	3			4.6	4.49	3.16	3.46		
Cadmium	mg/kg	0.51			1.98 J	1.48	1.29 J	1.38 J		
Copper	mg/kg	359			55.8	38.1	27.8	31.1		
Lead	mg/kg	196			28.9	12.3	14.5	10 U		
Mercury	mg/kg	0.085			0.397	0.27	0.05 U	0.73		
Zinc	mg/kg	459			141	71.3	70.6	69.2		
TBT	µg/kg	3080				92				
Total cPAHs	µg/kg	774		106000	238.476 T	43.7625 T	6.7 UT	6.7 UT	171.86 DT	176.56 DT
Total PAHs	µg/kg	23000	30000		2055.65 T	363.9 JT	6.7 UT	6.7 UT	1799.5 DJT	1625 DT
TPH-Diesel	mg/kg	91								
Chlorobenzene	µg/kg									
Naphthalene	µg/kg				58.7	6.7 U	6.7 U	6.7 U	17 D	41 D
BEHP	µg/kg	135			425 J	1920 J	319 J	13 UJ		

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			E-9.02-SC	E-9.02-SC	E-9.02-SC	E-9.02-SC	E-9.02-SC	E-9.02-SC
		Sample ID			E-9.02-SC-00to10-102318	E-9.02-SC-100to115-102318	E-9.02-SC-10to20-102318	E-9.02-SC-115to130-102318	E-9.02-SC-20to40-102318	E-9.02-SC-40to60-102318
		Sample Date			2018/10/23	2018/10/23	2018/10/23	2018/10/23	2018/10/23	2018/10/23
		Sample Depth			0 to 30 cm	305 to 351 cm	30 to 61 cm	351 to 396 cm	61 to 122 cm	122 to 183 cm
COC	Units	CUL	RAL	PTW						
Total PCBs	µg/kg	9	75	200	197.474275	272.36893	152.83904	234.6114	438.618645	240.559955
TCDDeq	µg/kg	0.01								
HxCDF	µg/kg	0.0004		0.04						
PeCDD	µg/kg	0.0002	0.0008	0.01	0.0032 J	0.0021 J	0.0029 JB	0.002 JB	0.0033 J	0.0028 JB
PeCDF	µg/kg	0.0003	0.2	0.2	0.00089 U	0.002 J	0.002 J	0.0021 J	0.0042 J	0.0022 Jq
TCDD	µg/kg	0.0002	0.0006	0.01	0.00041 U	0.0015	0.0013	0.0012	0.0016	0.0014
TCDF	µg/kg	0.0040658		0.6						
Aldrin	µg/kg	2								
Dieldrin	µg/kg	0.07								
DDD	µg/kg	114			3.3365	3.85	3.4315	3.95	5.3	5.1
DDE	µg/kg	50			7.99	7.2	5.64	6.95	6.23	8.45
DDT	µg/kg	246			0.11	1.7	4.447	2.5	0.79	1.8
DDx	µg/kg	6.1	160	7050	11.4085	12.305	13.5185	13.4	12.125	14.895
Lindane	µg/kg	5								
Chlordanes	µg/kg	0.51								
Arsenic	mg/kg	3								
Cadmium	mg/kg	0.51								
Copper	mg/kg	359								
Lead	mg/kg	196								
Mercury	mg/kg	0.085								
Zinc	mg/kg	459								
TBT	µg/kg	3080								
Total cPAHs	µg/kg	774		106000	64.513 DT	114.24 DT	99.948 DT	104.904 DT	1638.3 DT	122.177 DT
Total PAHs	µg/kg	23000	30000		527.7 DT	1013 DT	1002 DT	937 DT	11679 DT	1160 DT
TPH-Diesel	mg/kg	91								
Chlorobenzene	µg/kg									
Naphthalene	µg/kg				19 D	22 D	52 D	23 D	81 D	45 D
BEHP	µg/kg	135								

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID Sample ID Sample Date Sample Depth					E-9.02-SC E-9.02-SC-60to80- 102318 2018/10/23 183 to 244 cm	E-9.02-SC E-9.02-SC-80to100- 102318 2018/10/23 244 to 305 cm	F1 F1-0to23-101418 2018/10/14 0 to 23 cm	F2 f2-0to19-101018 2018/10/10 0 to 19 cm	F3 F3-0to27-101118 2018/10/11 0 to 27 cm	F5 512-0to28-101118 2018/10/11 0 to 28 cm	F5 F5-0to28-101118 2018/10/11 0 to 28 cm	F7 F7-0to27-101118 2018/10/11 0 to 27 cm
COC	Units	CUL	RAL	PTW								
Total PCBs	µg/kg	9	75	200	250.862235	333.40588	23.9291	42.475295	426.317	437.657	9158.331	1608.896
TCDDeq	µg/kg	0.01					14371	0.00345 JT	0.0126 JT	0.0234 JT	0.0167 JT	0.0517 JT
HxCDF	µg/kg	0.0004		0.04			0.0021 JB	0.0016 J	0.011 B	0.023 B	0.013 B	0.08 B
PeCDD	µg/kg	0.0002	0.0008	0.01	0.002 J	0.0026 JB	0.0014 U	0.00024 U*	0.0017 J	0.0021 J	0.0016 J	0.002 J
PeCDF	µg/kg	0.0003	0.2	0.2	0.0015 Jq	0.0026 J	0.0018 B	0.00038 J*	0.0017 Jq	0.0032 J	0.0021 Jq	0.0055 J
TCDD	µg/kg	0.0002	0.0006	0.01	0.001	0.0018	290	0.00039 J*	0.00047 Jq	0.00079 Jq	0.00048 Jq	0.00077 J
TCDF	µg/kg	0.0040658		0.6			2.07	0.00053 J	0.0013 B	0.0017 B	0.0015 B	0.0025 B
Aldrin	µg/kg	2					0.079 U	0.079 U			0.12 U	
Dieldrin	µg/kg	0.07					0.077 U	0.077 U	0.092 U	0.11 U	0.12 U	0.099 U
DDD	µg/kg	114			4.35	5.7	0.7415	4.24	1.5375	2.0445	2.0455	2.5405
DDE	µg/kg	50			7.3	7.29	0.2595	1.22	2.21		2.66	
DDT	µg/kg	246			1.7	0.17	0.094	0.094	0.12	0.58	3	0.12
DDx	µg/kg	6.1	160	7050	12.91	13.116	1.0715	5.5305	3.8355	5.5845	7.7055	5.2905
Lindane	µg/kg	5					0.031 U	0.031 U	0.037 U	0.044 U	0.045 U	0.04 U
Chlordanes	µg/kg	0.51					0.13	0.3455	0.59	0.775	0.715	0.72
Arsenic	mg/kg	3					11	3.6	7.3	8.3	8	16
Cadmium	mg/kg	0.51					0.16 J	0.17 J	0.43	0.45	0.42 J	0.67
Copper	mg/kg	359					180	46	72 B	110	110	370
Lead	mg/kg	196					16	12 B	22	34	35	82
Mercury	mg/kg	0.085					0.036	0.07 H	0.14	0.2	0.19 F1	0.23
Zinc	mg/kg	459					200	130	210	250	240 F1	460
TBT	µg/kg	3080					11	12	96	110	52	140
Total cPAHs	µg/kg	774		106000	136.294 DT	161.67 DT	242.01 DT	54.356 T	102.16 T	197.18 T	143.71 T	470.81 DT
Total PAHs	µg/kg	23000	30000		1424 DT	1767 DT	2248.2 DT	473.4 T	919 T	1568.2 T	1199.9 T	3713.5 DT
TPH-Diesel	mg/kg	91					51 J	54	140	180	160	200
Chlorobenzene	µg/kg											
Naphthalene	µg/kg				59 D	58 D	9.7 D	6.8	6.7	9	8.7	16 D
BEHP	µg/kg	135					210	70	280	610	490 J	1100

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			G364	G367	G372	G372-2	G376	G379	G380	G382	G383	G384	G384-2	G385
		Sample ID			LW2-G364	LW2-G367	LW2-G372-1	LW2-G372-2	LW2-G376	LW2-G379	LW2-G380	LW2-G382	LW2-G383	LW2-G384-1	LW2-G384-2	LW2-G385
		Sample Date			2004/10/08	2004/10/29	2004/08/24	2004/08/24	2004/10/29	2004/09/09	2004/10/22	2004/10/08	2004/10/08	2004/08/23	2004/08/23	2004/10/29
		Sample Depth			0 to 27 cm	0 to 26 cm	0 to 29 cm	0 to 30 cm	0 to 29 cm	0 to 28 cm	0 to 22 cm	0 to 29 cm	0 to 20 cm	0 to 27 cm	0 to 29 cm	0 to 29 cm
COC	Units	CUL	RAL	PTW												
Total PCBs	µg/kg	9	75	200	97.2 JT	1015.815 T	23.6 T	121.2 JT	224.805 T	422.205 T	131 JT	466 T	39.956 JT		103.85 JT	1021.5 T
TCDDeq	µg/kg	0.01						0.00118 JT								
HxCDF	µg/kg	0.0004		0.04			0.000398 JT	0.000436 J								
PeCDD	µg/kg	0.0002	0.0008	0.01			0.000154 UT	0.000131 U								
PeCDF	µg/kg	0.0003	0.2	0.2			0.000119 UT	0.00009 U								
TCDD	µg/kg	0.0002	0.0006	0.01			0.000092 UT	0.000105 U								
TCDF	µg/kg	0.0040658		0.6			0.000136 UT	0.000299 U								
Aldrin	µg/kg	2			0.0377 UJ	0.0351 UJ	0.202 UJT	0.212 UJ	0.0577 UJ	0.359 UJ	0.154 UJ	0.0623 UJ	0.306 UJ	0.0686 UJT	0.076 UJ	0.0669 UJ
Dieldrin	µg/kg	0.07			0.0617 U	0.0573 U	0.202 UT	0.212 U	0.0944 U	0.587 U	0.252 U	0.102 U	0.501 U	0.112 UT	0.124 U	0.109 U
DDD	µg/kg	114			4.97 JNT	11.58 JNT		1.788 JT	5.12 JNT	3.421 JNT	1.83 JNT	6.01 JNT	1.259 JNT		1.787 JNT	5.43 JNT
DDE	µg/kg	50			6.054 T	4.95 JNT		1.706 T	3.915 JNT	3 JT	2.416 JNT	1.504 JNT	0.442 UT		3.296 JNT	0.9155 JNT
DDT	µg/kg	246			0.807 JT	4.74 JNT		0.747 JT	3.51 JNT	3.119 JNT	2.322 JNT	2.308 JT	3.281 JNT		0.135 UT	0.0965 UJT
DDx	µg/kg	6.1	160	7050	11.831 JNT	21.27 JNT		4.241 JT	12.545 JNT	9.54 JNT	6.568 JNT	9.822 JNT	4.928 JNT		5.2055 JNT	6.39375 JNT
Lindane	µg/kg	5			0.092 U	0.0855 U	10.9 JT	0.212 U	4.69 NJ	0.876 U	0.375 U	0.152 U	0.747 U	0.168 UT	0.185 U	4.02 NJ
Chlordanes	µg/kg	0.51			0.1384 JT	2.8131 JNT		2.002 JT	0.6051 JNT	0.478 UT	0.205 UJT	0.85485 JNT	0.9715 JNT		6.1086 JNT	2.1643 JT
Arsenic	mg/kg	3			3.5 J	6.7	4.89 T	4.78	7.27	5.91 J	8.44	13.8 J	1.52 J	6.22 T	5.36	8.01
Cadmium	mg/kg	0.51			0.283	0.548	0.362 JT	0.358 J	0.489	0.473	0.422	0.533	0.422	0.313 T	0.29	0.714
Copper	mg/kg	359			54.9	96.9	97 T	101	223	101	170	230	33.8	349 T	480	105
Lead	mg/kg	196			31.3 J	69 J	25.1 T	26	47.8 J	32	22.7	76.3 J	10.3 J	20.2 T	22.2	46.8 J
Mercury	mg/kg	0.085			0.446	0.155	0.122 T	0.101	0.204	0.124	0.049	0.137	0.032	0.072 JT	0.066 J	0.128
Zinc	mg/kg	459			136	262	168 T	174	299	242	203	362	173	241 T	260	275
TBT	µg/kg	3080			3.2		180 T	170		210	430	640		2750 T	510	180
Total cPAHs	µg/kg	774		106000	114.814 T	351.07 T		57.729 T	123.26 T	169.79 T	615.74 T	257.03 T	62.006 T		76.901 T	85.871 T
Total PAHs	µg/kg	23000	30000		1020 T	5620 T		415.3 JT	937.2 T	1522.5 T	9333 T	2081 T	532.9 JT		676.3 JT	723.7 JT
TPH-Diesel	mg/kg	91				140 J	99.5 JT	110 J	180 J			200 J	310 JT	160 JT	150 J	310 J
Chlorobenzene	µg/kg															
Naphthalene	µg/kg				37	23	9 T	5.2	5.5	22	32	32	4.8 U	6.6 T	11	8.2
BEHP	µg/kg	135			56 J	440000 J	190 T	150	220	660 J	1700	2400 J	2000 J	395 T	550	510 J

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			G387	G388	G390	G392	G393	G395	G396	G397	G398	G402	G405	G406	G408
		Sample ID			LW2-G387	LW2-G388	LW2-G390	LW2-G392	LW2-G393	LW2-G395	LW2-G396	LW2-G397	LW2-G398	LW2-G402	LW2-G405	LW2-G406	LW2-G408
		Sample Date			2004/08/23	2004/09/09	2004/08/23	2004/10/08	2004/10/22	2004/08/27	2004/10/11	2004/08/24	2004/08/24	2004/09/09	2004/10/11	2004/08/27	2004/10/29
		Sample Depth			0 to 28 cm	0 to 26 cm	0 to 28 cm	0 to 30 cm	0 to 26 cm	0 to 26 cm	0 to 23 cm	0 to 29 cm	0 to 29 cm	0 to 30 cm	0 to 25 cm	0 to 25 cm	0 to 24 cm
COC	Units	CUL	RAL	PTW													
Total PCBs	µg/kg	9	75	200	32.65 JT	124.31 JT	725 T	40.5 JT	12500 JT	28.955 JT	2.82 UT	434 JT	5.2 UJT	656 T	20.0675 T	21.775 JT	133.585 JT
TCDDeq	µg/kg	0.01										0.00336 JT					
HxCDF	µg/kg	0.0004		0.04								0.008124					
PeCDD	µg/kg	0.0002	0.0008	0.01								0.000151 J					
PeCDF	µg/kg	0.0003	0.2	0.2								0.000805 J					
TCDD	µg/kg	0.0002	0.0006	0.01								0.00007 U					
TCDF	µg/kg	0.0040658		0.6								0.000355 U					
Aldrin	µg/kg	2			0.0696 UJ		0.327 UJ	0.367 J	5.51 UJ	0.0432 UJ	0.0389 UJ	0.23 UJ	0.204 UJ		0.153 UJ	0.0432 U	0.0672 UJ
Dieldrin	µg/kg	0.07			0.114 U		0.535 UJ	0.0776 U	9.02 U	0.207 J	0.0636 U	0.23 U	0.204 U		0.25 U	0.184	0.11 U
DDD	µg/kg	114			1.063 JNT		29.11 JT	3.77 JNT	17.645 JNT	0.951 JNT	0.0599 UT	2.542 JT	0.419 JT		0.235 UT	1.493 JNT	6.83 JNT
DDE	µg/kg	50			1.718 T		8.4785 JNT	2.1059 T	7.96 UT	0.8496 JT	0.0562 UT	1.915 T	0.887 JT		0.22 UT	1.5436 JT	3.1967 JNT
DDT	µg/kg	246			1.4305 JT		24.56 JT	0.37 JNT	19.28 JT	0.49 JT	0.0692 UJT	3.22 JT	0.204 UT		0.272 UJT	2.756 JNT	3.457 JNT
DDx	µg/kg	6.1	160	7050	4.2115 JNT		62.1485 JNT	6.2459 JNT	43.915 JNT	2.2906 JNT	0.0692 UJT	7.677 JT	1.51 JT		0.272 UJT	5.7926 JNT	13.4837 JNT
Lindane	µg/kg	5			0.17 U		1.31 J	0.351	13.4 U	0.105 UJ	0.0949 U	0.23 U	4.62 J		0.372 U	0.971 NJ	7.33 NJ
Chlordanes	µg/kg	0.51			0.26715 JT		25.866 JNT	1.28765 JNT	7.34 UJT	0.67325 JNT	0.0518 UT	0.629 JT	0.204 UT		0.203 UT	0.80925 JNT	0.8019 JT
Arsenic	mg/kg	3			4.9	1.77 J	16.5	5.99 J	15.6	3.71 T	2.1 J	6.03	5.25	9.4 J	3.4 J	2.86	8.9
Cadmium	mg/kg	0.51			0.253	0.229	0.663	0.246	0.997	0.212 T	0.09 J	0.55 J	0.237 J	0.558	0.34 J	0.197	0.569
Copper	mg/kg	359			52.6	20.4	1080	360	330	87.9 JT	28.9	97.5	203	155	30.7	56.8 J	354
Lead	mg/kg	196			11.7	23.3	102	25.9 J	94.9	11.5 T	4.91	36	13.9	67.4	12.8	11.5	54.7 J
Mercury	mg/kg	0.085			0.069 J	0.057	0.308 J	0.136	0.163	0.04 T	0.038 J	0.112	0.057	0.122	0.06 J	0.08	0.122
Zinc	mg/kg	459			117	95.3	731	218	597	119 T	66.2	266	162	326	133	103	477
TBT	µg/kg	3080				89		9300	460		0.45 J	190		280			
Total cPAHs	µg/kg	774		106000	14.36 JT	36.348 T	1707.2 T	506.83 T	1967.9 T	51.04 T	2.981 JT	204.96 T	37.255 T	286.21 T	58.925 T	26.39 T	134.93 T
Total PAHs	µg/kg	23000	30000		113.15 JT	325.15 JT	15728 T	4710 T	17301.5 JT	404.1 JT	42.41 JT	1873.1 T	430.8 T	2524.5 T	525.7 T	189.4 JT	1343 T
TPH-Diesel	mg/kg	91			93 J		406 JT	150 J				240 J	84 J	260 J	69.5 JT		550 J
Chlorobenzene	µg/kg																
Naphthalene	µg/kg				7.7 U	6.9 U	62	64	23 U	10 U	2 U	23	35	14	7.2 U	9.2 U	8.9
BEHP	µg/kg	135			130	180 UJ	3000	3100 J	8600	1100 J	13 U	1700 J	320	3900 J	710 J	180	2400 J

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		G409	G411	G415	G416	G417	G421	G425	G426	G430	G6	G696	G697			
Sample ID		LW2-G409	LW2-G411	LW2-G415	LW2-G416	LW2-G417	LW2-G421	LW2-G425	LW2-G426	LW2-G430	g6-0to27-101818	LW3-G696	LW3-G697			
Sample Date		2004/10/08	2004/10/08	2004/10/22	2004/10/29	2004/10/22	2004/09/09	2004/10/07	2004/10/11	2004/10/22	2018/10/18	2007/11/30	2007/11/30			
Sample Depth		0 to 30 cm	0 to 30 cm	0 to 25 cm	0 to 29 cm	0 to 26 cm	0 to 30 cm	0 to 24 cm	0 to 27 cm	0 to 25 cm	0 to 27 cm	0 to 30 cm	0 to 30 cm			
COC	Units	CUL	RAL	PTW												
Total PCBs	µg/kg	9	75	200	21.015 JT	21.3355 JT	902.17 JT	124 T	90.2 JT	595.24 JT	10.7 JT	256 JT	8.535 JT	486.872065	20 UT	28 UT
TCDDeq	µg/kg	0.01									0.0405 JT			0.0287 JT		
HxCDF	µg/kg	0.0004		0.04							0.016019 J			0.03		
PeCDD	µg/kg	0.0002	0.0008	0.01							0.001096 J			0.00077 U*		
PeCDF	µg/kg	0.0003	0.2	0.2							0.00417			0.0039 J*		
TCDD	µg/kg	0.0002	0.0006	0.01							0.000185 U			0.00053 J*q		
TCDF	µg/kg	0.0040658		0.6							0.001617			0.0036		
Aldrin	µg/kg	2			0.0468 UJ	0.0312 UJ	0.249 UJ	0.0682 UJ	0.491 J		0.0325 UJ	0.345 UJ	0.0328 UJ	0.079 U	0.3 U	0.46 U
Dieldrin	µg/kg	0.07			0.0766 U	0.051 U	0.407 U	0.112 U	0.0548 U		0.0532 U	0.564 UJ	0.0537 U	0.077 U	0.34	0.44
DDD	µg/kg	114			1.005 JNT	0.269 JNT	10.13 JNT	6.03 JNT	3.84 JT		0.365 JNT	4.19 JNT	0.16585 JT	1.1315	1.61 JT	0.925 T
DDE	µg/kg	50			1.65555 T	0.116 JNT	6.35 JNT	4.68725 JNT	0.657 JNT		0.15875 JT	3.8485 JT	0.0474 UT	1.5395	1.93 T	1.627 T
DDT	µg/kg	246			0.459 JNT	0.384 JT	13.79 JT	0.50725 JT	0.4412 JT		0.18795 JT	1.056 JT	0.0584 UJT	0.094	3.33 T	0.59 UT
DDx	µg/kg	6.1	160	7050	3.11955 JNT	0.769 JNT	30.27 JNT	11.2245 JNT	4.9382 JNT		0.7117 JNT	9.0945 JNT	0.26035 JT	2.7415	6.87 JT	3.072 T
Lindane	µg/kg	5			0.114 U	0.49 NJ	0.608 U	7.16 NJ	0.0818 U		0.0793 U	4.79 NJ	0.0801 U	0.031 U	0.26 U	0.24 U
Chlordanes	µg/kg	0.51			0.8087 JNT	0.26735 JT	3.0275 JNT	0.6015 JT	5.84765 JT		1.36935 JT	0.459 UJT	0.0437 UJT	0.5135	1.06 JNT	0.7335 JT
Arsenic	mg/kg	3			3.31 J	2 J	8.44	7.56	2.57	13.8 J	2 J	6.5 J	3.46	14	5.3	4.85 T
Cadmium	mg/kg	0.51			0.167	0.12	0.651	0.631	0.265	0.688	0.19	0.82 J	0.133	1.1	0.267 J	0.215 JT
Copper	mg/kg	359			52.4	25.6	242	94.4	22.9	128	19.2	128	21.1	260	80.8	61.2 T
Lead	mg/kg	196			11.9 J	12.7 J	86.1	53.5 J	14	63.1	12.7 J	54.8	8.47	64 B	16	11.2 T
Mercury	mg/kg	0.085			0.05	0.03	0.325	0.182	0.183	0.274	0.053	0.219 J	0.034	0.3 H	0.073	0.061 T
Zinc	mg/kg	459			111	80.1	469	302	103	338	127	420	88.6	570	136	120 T
TBT	µg/kg	3080				6.7	1900		16	46000		320 J		460		
Total cPAHs	µg/kg	774		106000	25.085 T	34.034 T	1212.1 T	305.2 T	18.341 JT	648.19 T	22.792 T	1195.9 T	138.1 T	97.52 T	38.981 T	14.229 JT
Total PAHs	µg/kg	23000	30000		252 JT	272.45 JT	12353 T	4968.2 T	195.9 JT	6442 T	253.4 JT	17023 T	1150.63 JT	871 T	367.7 JT	122.95 JT
TPH-Diesel	mg/kg	91					480 J	310 J			55 J	490 J	19 JT	140	94 J	66 JT
Chlorobenzene	µg/kg															
Naphthalene	µg/kg				30	3.3 U	30	20	20	28	5.2 U	41	2.9 U	5.9	11	4.8
BEHP	µg/kg	135			260 J	39 UJ	2700	310	140	960 UJ	660 J	4600 J	62	770	230	96

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			G700	G705	G706	G-9.15	GSP08E	H1	H2	H3	H3-SC
		Sample ID			LW3-G700	LW3-G705	LW3-G706	G-9.15-0to18-102418	LW3-GSP08E	H1-0to24-101418	h2-0to30-101218	H3-0to28-101118	H3-SC-0to1-102118
		Sample Date			2007/11/16	2007/11/30	2007/11/30	2018/10/24	2007/10/15	2018/10/14	2018/10/12	2018/10/11	2018/10/21
		Sample Depth			0 to 30 cm	0 to 28 cm	0 to 30 cm	0 to 18 cm	0 to 12 cm	0 to 24 cm	0 to 30 cm	0 to 28 cm	0 to 30 cm
COC	Units	CUL	RAL	PTW									
Total PCBs	µg/kg	9	75	200	24.1 T	11 UT	69 UT	16.265875	9.42 JT	73.4714	299.447555	202.0962	
TCDDeq	µg/kg	0.01						0.00155 JT	0.000976 JT	0.00414 JT	0.00925 JT	0.0175 JT	0.025 JT
HxCDF	µg/kg	0.0004		0.04				0.00083 J	0.00104 J	0.0034 JB	0.0086	0.015 B	0.018
PeCDD	µg/kg	0.0002	0.0008	0.01				0.00032 J	0.0000743 J	0.00061 Jq	0.00071 J*q	0.0019 Jq	0.0025 Jq
PeCDF	µg/kg	0.0003	0.2	0.2				0.00018 Jq	0.0002 J	0.0011 J	0.0014 J*	0.0026 J	0.0034 J
TCDD	µg/kg	0.0002	0.0006	0.01				0.00018 Jq	0.0000366 U	0.00029 Jq	0.00043 J*q	0.00099 J	0.0013
TCDF	µg/kg	0.0040658		0.6				0.00038 JB	0.0000347 U	0.00088 B	0.0013	0.0017 B	0.0029 B
Aldrin	µg/kg	2			0.44 U	0.37	0.5 U		0.12 U	0.079 U	0.079 U		0.082 U
Dieldrin	µg/kg	0.07			0.11 U	0.34 J	0.037 U		0.03 U	0.12 J	0.077 U	0.12 U	0.08 U
DDD	µg/kg	114			0.9 T	1.35 T	1.96 JT	1.315	0.49 JT	0.6615	1.3315	1.847	14.0325
DDE	µg/kg	50			2.02 JT	1.623 T	1.828 T	0.79	0.1995 JT	0.5895	1.1395	2.83	
DDT	µg/kg	246			2.32 JNT	0.51 UT	3.78 JNT	1.47	0.58 T	0.094	0.094	0.595	
DDx	µg/kg	6.1	160	7050	5.24 JNT	3.458 T	7.568 JNT	3.53	1.2695 JT	1.3215	2.5415	5.272	30.9325
Lindane	µg/kg	5			0.24 U	0.062 U	0.25 U		0.062 U	0.031 U	0.031 U	0.047 U	0.032 U
Chlordanes	µg/kg	0.51			0.905 T	1.1505 JT	1.045 T		0.2065 JT	0.5545	0.4935	0.815	0.14
Arsenic	mg/kg	3			3.46 J	4.15	4.52		2.64 T	5.5	7.9	8.7	11
Cadmium	mg/kg	0.51			0.185	0.154 J	0.18 J		0.0855 T	0.26	0.62	0.48	0.99
Copper	mg/kg	359			68.7	42.2	180		14.6 T	39	100	100 B	110
Lead	mg/kg	196			11	9.97	10.5		6.07 T	25	32 B	35	120
Mercury	mg/kg	0.085			0.062	0.071	0.058		0.036	0.088	0.16 H	0.19	1.1
Zinc	mg/kg	459			120	100	165		61.3 T	120	270	250	400
TBT	µg/kg	3080							0.46 J	28	100	100	140
Total cPAHs	µg/kg	774		106000	23.496 JT	18.862 JT	26.505 JT	43.744 DJT	438 JT	168.22 DT	393.76 T	350.86 DT	297.94 DT
Total PAHs	µg/kg	23000	30000		232.4 JT	198.8 JT	267.6 JT	410.3 DJXT	7588.6 JT	2019 DT	3534 T	3072.7 DT	3740 DT
TPH-Diesel	mg/kg	91			57 J	57 J	82 J			110	80 J	210	690
Chlorobenzene	µg/kg												
Naphthalene	µg/kg				8.7	5.7	11	3.2 JD	8	59	28	14 D	54 D
BEHP	µg/kg	135			170	110	330		44 U	250	3700	520	380

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			H3-SC	H3-SC	H3-SC	H3-SC	H3-SC	H3-SC
		Sample ID			h3-sc1b-00to10-82919	h3-sc1b-100to110-82919	h3-sc1b-10-20-82919	h3-sc1b-110to114-82919	h3-sc1b-20to30-82819	h3-sc1b-20to30-82819r1
		Sample Date			2019/08/28	2019/08/29	2019/08/28	2019/08/29	2019/08/28	2019/08/28
		Sample Depth			0 to 30 cm	305 to 335 cm	30 to 61 cm	335 to 347 cm	61 to 91 cm	61 to 91 cm
COC	Units	CUL	RAL	PTW						
Total PCBs	µg/kg	9	75	200	1521.8	1.5	1588.3	7.25	765.4	
TCDDeq	µg/kg	0.01				0.00499 JT			0.0177 JT	
HxCDF	µg/kg	0.0004		0.04		0.0047 U			0.0104	
PeCDD	µg/kg	0.0002	0.0008	0.01		0.0047 U			0.00184 JK	
PeCDF	µg/kg	0.0003	0.2	0.2		0.0047 U			0.0107	
TCDD	µg/kg	0.0002	0.0006	0.01		0.00094 U			0.000761 J	
TCDF	µg/kg	0.0040658		0.6		0.000352 BJ			0.00166 B	0.00162 B
Aldrin	µg/kg	2								
Dieldrin	µg/kg	0.07								
DDD	µg/kg	114				0.63			4.015	
DDE	µg/kg	50				0.79				
DDT	µg/kg	246				0.94			0.94	
DDx	µg/kg	6.1	160	7050		0.94			16.02	
Lindane	µg/kg	5								
Chlordanes	µg/kg	0.51								
Arsenic	mg/kg	3								
Cadmium	mg/kg	0.51								
Copper	mg/kg	359								
Lead	mg/kg	196								
Mercury	mg/kg	0.085								
Zinc	mg/kg	459								
TBT	µg/kg	3080								
Total cPAHs	µg/kg	774		106000		2.2236 JT			162.29 T	
Total PAHs	µg/kg	23000	30000			24.11 JT			1764 T	
TPH-Diesel	mg/kg	91								
Chlorobenzene	µg/kg									
Naphthalene	µg/kg					1 J			38	
BEHP	µg/kg	135								

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			H3-SC	H3-SC	H3-SC	H3-SC	H3-SC	H3-SC
		Sample ID			h3-sc1b-30to40-82919	h3-sc1b-40to50-82919	h3-sc1b-50to60-82919	h3-sc1b-60to70-82919	h3-sc1b-70to80-82919	h3-sc1b-80to90-82919
		Sample Date			2019/08/29	2019/08/29	2019/08/29	2019/08/29	2019/08/29	2019/08/29
		Sample Depth			91 to 122 cm	122 to 152 cm	152 to 183 cm	183 to 213 cm	213 to 244 cm	244 to 274 cm
COC	Units	CUL	RAL	PTW						
Total PCBs	µg/kg	9	75	200	61	49.2	79.2	19.4	7.3	1.5
TCDDeq	µg/kg	0.01			0.00432 JT	0.00421 JT	0.0038 JT	0.00252 JT	0.00157 JT	0.00387 JT
HxCDF	µg/kg	0.0004		0.04	0.000316 BJK	0.00172 J	0.000202 BJ	0.000862 BJ	0.000563 BJK	0.000141 BJK
PeCDD	µg/kg	0.0002	0.0008	0.01	0.00484 U	0.000325 JK	0.00464 U	0.000271 J	0.000234 JK	0.00471 U
PeCDF	µg/kg	0.0003	0.2	0.2	0.000378 BJK	0.0021 J	0.000213 BJ	0.00113 J	0.000614 BJK	0.000111 BJK
TCDD	µg/kg	0.0002	0.0006	0.01	0.000969 U	0.000934 U	0.000927 U	0.000949 U	0.000974 U	0.000943 U
TCDF	µg/kg	0.0040658		0.6	0.000475 BJ	0.000803 BJ	0.000282 BJ	0.000389 BJK	0.000732 BJK	0.000413 BJ
Aldrin	µg/kg	2								
Dieldrin	µg/kg	0.07								
DDD	µg/kg	114			2.715	1.415	1.165	0.63	0.63	0.63
DDE	µg/kg	50			1.195	0.79	0.79	0.79	0.79	0.79
DDT	µg/kg	246			0.94	0.94	0.94	0.94	0.94	0.94
DDx	µg/kg	6.1	160	7050	4.615	2.865	2.615	0.94	0.94	0.94
Lindane	µg/kg	5								
Chlordanes	µg/kg	0.51								
Arsenic	mg/kg	3								
Cadmium	mg/kg	0.51								
Copper	mg/kg	359								
Lead	mg/kg	196								
Mercury	mg/kg	0.085								
Zinc	mg/kg	459								
TBT	µg/kg	3080								
Total cPAHs	µg/kg	774		106000	39.321 T	48.645 T	98.575 T	123.049 T	97.698 T	38.108 T
Total PAHs	µg/kg	23000	30000		423.8 T	503.8 T	743.8 T	1162.5 T	577.4 T	323.3 T
TPH-Diesel	mg/kg	91								
Chlorobenzene	µg/kg									
Naphthalene	µg/kg				15	16	13	32	10	9.6
BEHP	µg/kg	135								

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			H3-SC	H3-SC	H3-SC	H3-SC	H3-SC	H3-SC	H3-SC
		Sample ID			h3-sc1b-90to100-82919	H3-SC-1to2-102118	H3-SC-29to46-102118	H3-SC-2to29-102118	H3-SC-46to63-102118	H3-SC-63to85-102118	H3-SC-85to99-102118
		Sample Date			2019/08/29	2018/10/21	2018/10/21	2018/10/21	2018/10/21	2018/10/21	2018/10/21
		Sample Depth			274 to 305 cm	30 to 61 cm	88 to 140 cm	61 to 88 cm	140 to 192 cm	192 to 259 cm	259 to 302 cm
COC	Units	CUL	RAL	PTW							
Total PCBs	µg/kg	9	75	200	1.5						
TCDDeq	µg/kg	0.01			0.00472 JT	0.0404 JT	0.00259 JT	0.00719 JT	0.00366 JT	0.00364 JT	0.000247 JT
HxCDF	µg/kg	0.0004		0.04	0.0000485 BJ	0.033	0.0013 J	0.0036 J	0.00059 U	0.0016 J	0.00009 J
PeCDD	µg/kg	0.0002	0.0008	0.01	0.00466 U	0.0044 J	0.00024 J	0.001 J	0.0004 J	0.0005 J	0.000092 J
PeCDF	µg/kg	0.0003	0.2	0.2	0.00466 U	0.0054	0.0005 J	0.0015 J	0.00052 J	0.00071 J	0.00005 Jq
TCDD	µg/kg	0.0002	0.0006	0.01	0.000933 U	0.0016	0.000088 Jq	0.00062 Jq	0.000092 Jq	0.00026 Jq	0.000051 Jq
TCDF	µg/kg	0.0040658		0.6	0.000405 BJ	0.0027 B	0.00051 JB	0.0014 B	0.0005 JB	0.00048 JB	0.00022 JB
Aldrin	µg/kg	2				0.079 U	0.079 U	0.079 U	0.079 U	0.25	0.079 U
Dieldrin	µg/kg	0.07				0.077 U	0.077 U	0.077 U	0.077 U	0.077 U	0.077 U
DDD	µg/kg	114			0.63	13.0315	1.1315	14.0175	0.59	0.063	0.063
DDE	µg/kg	50			0.79				0.1695	0.079	0.079
DDT	µg/kg	246			0.94	2.047	0.094		0.094	0.094	0.094
DDx	µg/kg	6.1	160	7050	0.94	36.4785	1.885	42.5175	0.5665	0.094	0.094
Lindane	µg/kg	5				0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U
Chlordanes	µg/kg	0.51				1.715	0.13	0.6625	0.13	0.13	0.13
Arsenic	mg/kg	3				13	3	7.2	3.7	5.7	4.8
Cadmium	mg/kg	0.51				0.99	0.2	0.87	0.18 J	0.39	0.17 J
Copper	mg/kg	359				110	28	91	30	54	48
Lead	mg/kg	196				180	18	110	16	32	17
Mercury	mg/kg	0.085				1.5	0.44	1.6	0.35 F1	0.38	0.21
Zinc	mg/kg	459				410	91	280	86 F1	140	93
TBT	µg/kg	3080				1.2 J	1.5	2.8	1.1 J	0.8 U	0.7 U
Total cPAHs	µg/kg	774		106000	23.777 T	438.66 DT	49.758 DT	188.975 DT	137.069 DT	215.9 DT	45.23 DXT
Total PAHs	µg/kg	23000	30000		205.5 T	4043 DT	531.8 DT	2078.115 DT	1109.9 DT	2059 DT	426.5 DXT
TPH-Diesel	mg/kg	91				1000	330	1200	200	310	170
Chlorobenzene	µg/kg										
Naphthalene	µg/kg				8.4	81 D	15 D	46 D	18	66 D	21
BEHP	µg/kg	135				120	390	610	29 J	14 J	8.9 U

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID Sample ID Sample Date Sample Depth			H3-SC H3-SC-99to114-102118 2018/10/21 302 to 335 cm	H5 H5-0to29-101118 2018/10/11 0 to 29 cm	H7 H7-0to24-101218 2018/10/12 0 to 24 cm	J1 J1-0to20-101318 2018/10/13 0 to 20 cm	J2 j2a3-0to18-101218 2018/10/12 0 to 18 cm	J3 J3-0to26-101318 2018/10/13 0 to 26 cm	J3-SC 412-sc1b-80to90-82719 2019/08/27 244 to 274 cm	J3-SC J3-SC-00to10-102218 2018/10/22 0 to 30 cm
COC	Units	CUL	RAL	PTW								
Total PCBs	µg/kg	9	75	200		298.117	6861.8	13.6668	24.692185	277.139	17.6	29313
TCDDeq	µg/kg	0.01			0.000467 JT	0.0305 JT	0.0528 JT	0.00106 JT	0.00115 JT	0.0235 JT	0.004 JT	0.00575 JT
HxCDF	µg/kg	0.0004		0.04	0.000075 U	0.05 B	0.13 B	0.0008 JB	0.0011 Jq	0.031 B	0.00129 J	0.0071 B
PeCDD	µg/kg	0.0002	0.0008	0.01	0.00016 Jq	0.0023 J	0.0026 U	0.00019 Jq	0.00031 J*q	0.0019 J	0.000451 J	0.00057 JB
PeCDF	µg/kg	0.0003	0.2	0.2	0.00011 Jq	0.006 J	0.0074	0.00018 Jq	0.00011 U*	0.0029 J	0.00137 J	0.00074 J
TCDD	µg/kg	0.0002	0.0006	0.01	0.00014 Jq	0.00048 Jq	0.00073 Jq	0.000036 U	0.00011 U*	0.00052 Jq	0.000989 U	0.00022 Jq
TCDF	µg/kg	0.0040658		0.6	0.00011 JB	0.0025 B	0.0023 B	0.0002 JqB	0.0004 J	0.0014 B	0.000289 BJ	0.00066 J
Aldrin	µg/kg	2			0.079 U			0.079 U	0.079 U	0.091 U		
Dieldrin	µg/kg	0.07			0.077 U	0.12 U	0.09 U	0.077 U	0.077 U	0.089 U		0.077 U
DDD	µg/kg	114			0.063	1.5485	2.337	0.2315	1.0115	2.3365	0.63	1.36
DDE	µg/kg	50			0.079	2.665		0.1995	0.4195		0.79	
DDT	µg/kg	246			0.094	0.615	0.705	0.094	0.094	0.11	0.94	0.094
DDx	µg/kg	6.1	160	7050	0.094	4.8285	6.452	0.5015	1.5015	4.9585	0.94	3.3705
Lindane	µg/kg	5			0.031 U	0.048 U	0.036 U	0.031 U	0.031 U	0.036 U		0.031 U
Chlordanes	µg/kg	0.51			0.13	0.735	0.96	0.4255	0.8335	1.095		0.4195
Arsenic	mg/kg	3			5.8	9	9.1	5.3	4.1	8.4		3.7
Cadmium	mg/kg	0.51			0.14 J	0.43	0.43	0.32	0.73	1.1		0.29
Copper	mg/kg	359			40	130	150	35	34	120		32
Lead	mg/kg	196			8.3	38	48	14	19 B	44		25
Mercury	mg/kg	0.085			0.16	0.17	0.33	0.018 J	0.024 H	0.13		0.18
Zinc	mg/kg	459			77	270	310	180	190	360		120
TBT	µg/kg	3080			0.61 U	83	230	13	16	87		26
Total cPAHs	µg/kg	774		106000	2.1935 JXT	114.86 T	195.72 DT	43.523 T	164.14 T	510.1 DT	80.233 T	71.986 DT
Total PAHs	µg/kg	23000	30000		22.81 JXT	1000.8 T	1701.6 DT	418.48 T	1264.4 JT	5515 DJT	580.2 T	680.8 DT
TPH-Diesel	mg/kg	91			24 J	170	300	46 J	16 J	280		180 J
Chlorobenzene	µg/kg											
Naphthalene	µg/kg				2	8.6	11 D	1.8	4.3	17 D	8.4	9.4 D
BEHP	µg/kg	135			8.9 U	2900	900	190	720	2100		250

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			J3-SC	J3-SC	J3-SC	J3-SC	J3-SC	J3-SC	J3-SC
		Sample ID			J3-SC-10to20-102218	j3-sc1b-10to20-82719	j3-sc1b-20to30-82719	j3-sc1b-30to40-82719	j3-sc1b-30to40-82719r1	j3-sc1b-40to50-82719	j3-sc1b-50to60-82719
		Sample Date			2018/10/22	2019/08/27	2019/08/27	2019/08/27	2019/08/27	2019/08/27	2019/08/27
		Sample Depth			30 to 61 cm	30 to 61 cm	61 to 91 cm	91 to 122 cm	91 to 122 cm	122 to 152 cm	152 to 183 cm
COC	Units	CUL	RAL	PTW							
Total PCBs	µg/kg	9	75	200	47.1	14.8	237.7	515.4		140.2	30.8
TCDDeq	µg/kg	0.01			0.00136 JT	0.00388 JT	0.00327 JT	0.0138 JT		0.00264 JT	0.00244 JT
HxCDF	µg/kg	0.0004		0.04	0.0011 JB	0.000672 BJ	0.00233 J	0.0114		0.00087 J	0.00103 J
PeCDD	µg/kg	0.0002	0.0008	0.01	0.00024 JB	0.00461 U	0.00039 J	0.00174 J		0.000262 J	0.000241 J
PeCDF	µg/kg	0.0003	0.2	0.2	0.00027 J	0.000397 BJ	0.000857 J	0.00364 J		0.00137 J	0.000816 J
TCDD	µg/kg	0.0002	0.0006	0.01	0.00014 Jq	0.000923 U	0.000907 U	0.000499 J		0.000924 U	0.000893 U
TCDF	µg/kg	0.0040658		0.6	0.00035 Jq	0.000251 BJ	0.000907 U	0.000987 BJ	0.00104 B	0.000347 BJK	0.000893 U
Aldrin	µg/kg	2									
Dieldrin	µg/kg	0.07			0.21						
DDD	µg/kg	114			0.2915	0.695	4.615	5.915		3.315	0.63
DDE	µg/kg	50			0.4095	0.79					0.79
DDT	µg/kg	246			0.094	0.94	0.94	0.94		0.94	0.94
DDx	µg/kg	6.1	160	7050	0.7715	2.145	16.12	24.52		15.32	0.94
Lindane	µg/kg	5			0.031 U						
Chlordanes	µg/kg	0.51			0.2405						
Arsenic	mg/kg	3			2.7						
Cadmium	mg/kg	0.51			0.24						
Copper	mg/kg	359			27						
Lead	mg/kg	196			11						
Mercury	mg/kg	0.085			0.056						
Zinc	mg/kg	459			91						
TBT	µg/kg	3080			14						
Total cPAHs	µg/kg	774		106000	19.05 T	6.5173 T	90.735 T	162.02 T		55.78 T	38.625 T
Total PAHs	µg/kg	23000	30000		164.74 XT	60.56 JT	947.5 T	2024 T		672.8 T	405.5 T
TPH-Diesel	mg/kg	91			34 J						
Chlorobenzene	µg/kg										
Naphthalene	µg/kg				1.3	0.95	19	32		19	16
BEHP	µg/kg	135									

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			J3-SC	J3-SC	J3-SC	J3-SC	J3-SC	J3-SC	J3-SC
		Sample ID			j3-sc1b-60to70-82719	j3-sc1b-70to80-82719	j3-sc1b-80to90-82719	j3-sc1b-90to100-82719	J3-SC-20to36-102218	J3-SC-36to45-102218	J3-SC-45to55-102218
		Sample Date			2019/08/27	2019/08/27	2019/08/27	2019/08/27	2018/10/22	2018/10/22	2018/10/22
		Sample Depth			183 to 213 cm	213 to 244 cm	244 to 274 cm	274 to 305 cm	61 to 110 cm	110 to 137 cm	137 to 168 cm
COC	Units	CUL	RAL	PTW							
Total PCBs	µg/kg	9	75	200	1.6	1.6	15.7	1.6	474		77
TCDDeq	µg/kg	0.01			0.00524 JT	0.00531 JT	0.00226 JT	0.0039 JT	0.0244 JT	0.00958 JT	0.00553 JT
HxCDF	µg/kg	0.0004		0.04	0.00485 U	0.00467 U	0.000972 J	0.000219 BJK	0.02 B	0.0057 B	0.0032 J
PeCDD	µg/kg	0.0002	0.0008	0.01	0.00485 U	0.00467 U	0.000213 JK	0.00473 U	0.0034 JB	0.0016 JB	0.00045 J
PeCDF	µg/kg	0.0003	0.2	0.2	0.00485 U	0.00467 U	0.000877 J	0.000246 BJ	0.0032 J	0.0019 J	0.001 J
TCDD	µg/kg	0.0002	0.0006	0.01	0.00097 U	0.000933 U	0.000951 U	0.000945 U	0.0011 q	0.00068 J	0.0002 Jq
TCDF	µg/kg	0.0040658		0.6	0.000217 BJ	0.000933 U	0.000226 BJK	0.000204 BJK	0.0019	0.0012	0.0015 B
Aldrin	µg/kg	2							0.079 U		
Dieldrin	µg/kg	0.07							0.077 U	0.077 U	0.077 U
DDD	µg/kg	114			0.63	0.63	0.63	0.63	6	7.7315	0.063
DDE	µg/kg	50			0.79	0.79	0.79	0.79			
DDT	µg/kg	246			0.94	0.94	0.94	0.94	0.047	0.267	0.094
DDx	µg/kg	6.1	160	7050	0.94	0.94	0.94	0.94	18.3235	22.9985	1.3895
Lindane	µg/kg	5							0.031 U	0.031 U	0.031 U
Chlordanes	µg/kg	0.51							0.8015	0.7425	0.13
Arsenic	mg/kg	3							8.5	6.9	5.6
Cadmium	mg/kg	0.51							0.66	0.72	0.35
Copper	mg/kg	359							76	69	37
Lead	mg/kg	196							98	74	38
Mercury	mg/kg	0.085							0.94	1.2	0.61
Zinc	mg/kg	459							270	230	120
TBT	µg/kg	3080							3.1	0.9 J	0.66 J
Total cPAHs	µg/kg	774		106000	29.282 T	4.6236 T	62.788 T	40.528 T	246.85 DT	155.435 DXT	74.744 DT
Total PAHs	µg/kg	23000	30000		233.59 T	46.7 JT	488.1 T	333.4 T	2383 DT	1634.115 DXT	860.2 DT
TPH-Diesel	mg/kg	91							680	880	490
Chlorobenzene	µg/kg										
Naphthalene	µg/kg				7.7	1.2	7.7	6.1	38 D	37 D	23 D
BEHP	µg/kg	135							270	130	71 J

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			J3-SC	J3-SC	J5	J5-SC	J5-SC	J5-SC	J5-SC
		Sample ID			J3-SC-55to76-102218	J3-SC-76to98-102218	J5-0to29-101318	J5-SC-00to10-102218	J5-SC-10to20-102218	j5-sc1b-00to10-82719	j5-sc1b-100to110-82719
		Sample Date			2018/10/22	2018/10/22	2018/10/13	2018/10/22	2018/10/22	2019/08/27	2019/08/27
		Sample Depth			168 to 232 cm	232 to 299 cm	0 to 29 cm	0 to 30 cm	30 to 61 cm	0 to 30 cm	305 to 335 cm
COC	Units	CUL	RAL	PTW							
Total PCBs	µg/kg	9	75	200	12	13	325.9951		1063	19525	1.08364
TCDDeq	µg/kg	0.01			0.000675 JT	0.0017 JT	0.0274 JT	14475	0.0218 JT		0.00562 JT
HxCDF	µg/kg	0.0004		0.04	0.000043 U	0.00089 J	0.032 B	0.018 B	0.017		0.00496 U
PeCDD	µg/kg	0.0002	0.0008	0.01	0.00016 J	0.0002 J	0.0023 J	0.0023 JB	0.0023 J		0.00496 U
PeCDF	µg/kg	0.0003	0.2	0.2	0.00004 J	0.00027 J	0.0039 J	0.0028 J	0.0032 J		0.00496 U
TCDD	µg/kg	0.0002	0.0006	0.01	0.00011 Jq	0.000051 U	0.00087 J	0.00068 J	0.00088 Jq		0.000992 U
TCDF	µg/kg	0.0040658		0.6	0.00005 JB	0.00021 JBq	0.0015 JqB	0.0023	0.005 B		0.000464 BJ
Aldrin	µg/kg	2					0.14 U	0.1 U			
Dieldrin	µg/kg	0.07			0.077 U	0.077 U	0.13 U	0.097 U	0.084 U		
DDD	µg/kg	114			0.063	0.063		1.94	1.5345		0.63
DDE	µg/kg	50			0.079	0.079	2.67				0.79
DDT	µg/kg	246			0.094	0.094	0.16	0.12	0.365		0.94
DDx	µg/kg	6.1	160	7050	0.094	0.094	4.7995	4.69	4.2995		0.94
Lindane	µg/kg	5			0.031 U	0.031 U	0.052 U	0.04 U	0.034 U		
Chlordanes	µg/kg	0.51			0.13	0.13	0.835	0.83	0.5195		
Arsenic	mg/kg	3			2.3	3.3	10	9.7	8.8		
Cadmium	mg/kg	0.51			0.042 J	0.12 J	0.51	0.71	0.96		
Copper	mg/kg	359			13	19	140	130	130		
Lead	mg/kg	196			5.8	16	45	63	86		
Mercury	mg/kg	0.085			0.058	0.065	0.16	0.35	0.44		
Zinc	mg/kg	459			44	63	320	410	360		
TBT	µg/kg	3080			0.51 U	0.59 U	100	520	1200		
Total cPAHs	µg/kg	774		106000	2.989 JT	36.405 T	142.88 T	1.4 U	261.02 DT		0.26566 JT
Total PAHs	µg/kg	23000	30000		31.69 JT	272.58 T	1337 T	13291	2401 DT		2.2165 JT
TPH-Diesel	mg/kg	91			14 J	82	170	250	620		
Chlorobenzene	µg/kg										
Naphthalene	µg/kg				2.6	5.3	8.8	16 D	39 D		0.15 U
BEHP	µg/kg	135			8.9 U	8.9 U	530	720	1200		

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		Sample ID			J5-SC	J5-SC	J5-SC	J5-SC	J5-SC	J5-SC	J5-SC
Sample Date		Sample Depth			j5-sc1b-10to20-82719	j5-sc1b-20to30-82719	j5-sc1b-20to30-82719r1	j5-sc1b-30to40-82719	j5-sc1b-40to50-82719	j5-sc1b-50to60-82719	j5-sc1b-50to60-82719r1
Sample Date		Sample Depth			2019/08/27	2019/08/27	2019/08/27	2019/08/27	2019/08/27	2019/08/27	2019/08/27
Sample Depth		Sample Depth			30 to 61 cm	61 to 91 cm	61 to 91 cm	91 to 122 cm	122 to 152 cm	152 to 183 cm	152 to 183 cm
COC	Units	CUL	RAL	PTW							
Total PCBs	µg/kg	9	75	200	19514	871.52436		212.65629	479.19056	1127.83803	
TCDDeq	µg/kg	0.01				0.00594 JT		0.00304 JT	0.00522 JT	0.00748 JT	
HxCDF	µg/kg	0.0004		0.04		0.00309 J		0.00113 BJ	0.0033 J	0.00543	
PeCDD	µg/kg	0.0002	0.0008	0.01		0.000954 BJ		0.000595 BJ	0.000779 BJ	0.000858 BJ	
PeCDF	µg/kg	0.0003	0.2	0.2		0.00165 J		0.000777 BJ	0.00133 J	0.00165 JQ	
TCDD	µg/kg	0.0002	0.0006	0.01		0.000358 JK		0.000213 JK	0.000225 JK	0.000308 J	
TCDF	µg/kg	0.0040658		0.6		0.00107 B	0.000841 BJ	0.000733 BJ	0.000841 BJ	0.0011 B	0.00101 B
Aldrin	µg/kg	2									
Dieldrin	µg/kg	0.07									
DDD	µg/kg	114				3.65		2.915	2.315	2.215	
DDE	µg/kg	50				4.895		4.895	4.095		
DDT	µg/kg	246				0.94		0.94	2.17	3.47	
DDx	µg/kg	6.1	160	7050		9.25		8.515	8.58	19.285	
Lindane	µg/kg	5									
Chlordanes	µg/kg	0.51									
Arsenic	mg/kg	3									
Cadmium	mg/kg	0.51									
Copper	mg/kg	359									
Lead	mg/kg	196									
Mercury	mg/kg	0.085									
Zinc	mg/kg	459									
TBT	µg/kg	3080									
Total cPAHs	µg/kg	774		106000		88.593 T		57.387 T	143.48 T	164.37 T	
Total PAHs	µg/kg	23000	30000			897.6 T		493.6 T	1353 T	1651 T	
TPH-Diesel	mg/kg	91									
Chlorobenzene	µg/kg										
Naphthalene	µg/kg					36		20	31	21	
BEHP	µg/kg	135									

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			J5-SC	J5-SC	J5-SC	J5-SC	J5-SC	J5-SC	J5-SC
		Sample ID			j5-sc1b-60to70-82719	j5-sc1b-70to80-82719	j5-sc1b-80to90-82719	j5-sc1b-90to100-82719	J5-SC-20to40-102218	J5-SC-40to60-102218	J5-SC-60to80-102218
		Sample Date			2019/08/27	2019/08/27	2019/08/27	2019/08/27	2018/10/22	2018/10/22	2018/10/22
		Sample Depth			183 to 213 cm	213 to 244 cm	244 to 274 cm	274 to 305 cm	61 to 122 cm	122 to 183 cm	183 to 244 cm
COC	Units	CUL	RAL	PTW							
Total PCBs	µg/kg	9	75	200	409.82125	341.40145	2.67749	17.423835	190	211	427
TCDDeq	µg/kg	0.01			0.00229 JT	0.00355 JT	0.0051 JT	0.00382 JT	0.0194 JT	0.0124 JT	14485
HxCDF	µg/kg	0.0004		0.04	0.00131 BJ	0.0023 J	0.0000476 BJK	0.0000887 BJ	0.0088 B	0.006	0.000234 U
PeCDD	µg/kg	0.0002	0.0008	0.01	0.000385 BJ	0.000464 BJ	0.00496 U	0.00493 U	0.0029 JB	0.0016 J	0.0011 JB
PeCDF	µg/kg	0.0003	0.2	0.2	0.000576 BJ	0.00141 JK	0.00496 U	0.0000493 BJ	0.0026 J	0.0015 J	0.0022
TCDD	µg/kg	0.0002	0.0006	0.01	0.000158 J	0.000191 J	0.000991 U	0.0000532 JK	0.0016	0.0011 q	900
TCDF	µg/kg	0.0040658		0.6	0.000541 BJ	0.000629 BJ	0.000325 BJ	0.00028 BJ	0.0026	0.0011 B	0.094
Aldrin	µg/kg	2							0.08 U		
Dieldrin	µg/kg	0.07							0.078 U	0.077 U	0.077 U
DDD	µg/kg	114			2.615	2.715	0.63	0.63	3.232	3.6315	3.2315
DDE	µg/kg	50			6.995	4.295	0.79	0.79			
DDT	µg/kg	246			0.94	0.94	0.94	0.94	0.095	0.094	1.547
DDx	µg/kg	6.1	160	7050	10.315	7.715	0.94	0.94	7.6535	9.832	13.7785
Lindane	µg/kg	5							0.11	0.031 U	0.031 U
Chlordanes	µg/kg	0.51							0.77	0.5385	1.345
Arsenic	mg/kg	3							6.9	6.2	7.2
Cadmium	mg/kg	0.51							0.48	0.5	0.66
Copper	mg/kg	359							66	64	93
Lead	mg/kg	196							58	69	190
Mercury	mg/kg	0.085							0.38	0.7	0.68
Zinc	mg/kg	459							250	210	340
TBT	µg/kg	3080							39	2.8	73
Total cPAHs	µg/kg	774		106000	71.454 T	72.647 T	1.03002 JT	0.87943 JT	104.799 DT	129.557 DT	161.8 DT
Total PAHs	µg/kg	23000	30000		640.7 T	691.2 T	9.62 JT	8.254 JT	1074 DT	1261 DT	1598 DXT
TPH-Diesel	mg/kg	91							430 J	520	690
Chlorobenzene	µg/kg										
Naphthalene	µg/kg				11	17	0.23 J	0.29 J	49 D	20 D	22 D
BEHP	µg/kg	135							54 J	70 J	240

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		Sample ID			J5-SC	J5-SC	J6-SC	J6-SC	J6-SC	J6-SC	J6-SC
Sample Date		Sample Date			J5-SC-80to95-102218	J5-SC-95to110-102218	413-sc1b-40to50-82819	J6-SC-00to10-102218	J6-SC-10to20-102218	J6-SC-111to121-102218	J6-SC
Sample Depth		Sample Depth			2018/10/22	2018/10/22	2019/08/28	2018/10/22	2018/10/22	2018/10/22	2019/08/27
Sample Depth		Sample Depth			244 to 290 cm	290 to 335 cm	122 to 152 cm	0 to 30 cm	30 to 61 cm	338 to 369 cm	0 to 30 cm
COC	Units	CUL	RAL	PTW							
Total PCBs	µg/kg	9	75	200	107	15	838.5			12	1208.9
TCDDeq	µg/kg	0.01			0.00223 JT	0.000334 JT	0.00179 JT	0.0292 JT	0.0241 JT	0.000192 JT	
HxCDF	µg/kg	0.0004		0.04	0.0018 JB	0.000094 U	0.000852 BJ	0.029	0.017	0.00012 JBq	
PeCDD	µg/kg	0.0002	0.0008	0.01	0.000097 U	0.0001 JBq	0.000251 JK	0.0023 Jq	0.00052 U	0.000055 U	
PeCDF	µg/kg	0.0003	0.2	0.2	0.00031 J	0.000079 U	0.000431 J	0.0046 Jq	0.0042 J	0.000071 U	
TCDD	µg/kg	0.0002	0.0006	0.01	0.00049 J	0.000079 U	0.000998 U	0.0016	0.0014	0.000087 U	
TCDF	µg/kg	0.0040658		0.6	0.00026 Jq	0.00008 J	0.000519 BJ	0.0048 B	0.0036 B	0.000035 U	
Aldrin	µg/kg	2			0.079 U	0.079 U					
Dieldrin	µg/kg	0.07			0.077 U	0.077 U		0.091 U	0.082 U	0.077 U	
DDD	µg/kg	114			0.3515	0.0845	1.915	1.437	2.6335	0.063	
DDE	µg/kg	50				0.1495	3.795	1.62		0.079	
DDT	µg/kg	246			0.094	0.094	1.97	0.33	0.1	0.094	
DDx	µg/kg	6.1	160	7050	1.153	0.3045	7.68	3.387	6.4185	0.094	
Lindane	µg/kg	5			0.031 U	0.031 U		0.037 U	0.038 J	0.031 U	
Chlordanes	µg/kg	0.51			0.13	0.13		0.526	0.719	0.13	
Arsenic	mg/kg	3			4.1	4.1		11	7.9	3.2	
Cadmium	mg/kg	0.51			0.15 J	0.098 J		0.74	0.48	0.067 J	
Copper	mg/kg	359			34	32		290	95	25	
Lead	mg/kg	196			15	8.5		120	67	5	
Mercury	mg/kg	0.085			0.17	0.057		0.4	0.48	0.046	
Zinc	mg/kg	459			82	68		410	270	55	
TBT	µg/kg	3080			0.62 U	0.61 U		1100	88	1.6	
Total cPAHs	µg/kg	774		106000	19.382 T	3.9351 T	46.568 T	576.49 DT	182.92 DT	0.49921 JT	
Total PAHs	µg/kg	23000	30000		167.9 T	36.94 XT	314.6 T	4706 DT	1710 DT	5.3085 JT	
TPH-Diesel	mg/kg	91			91	26 J		360	350	14 U	
Chlorobenzene	µg/kg										
Naphthalene	µg/kg				4.9	1.9	4.1	36 D	43 D	0.54 J	
BEHP	µg/kg	135			8.9 U	8.9 U		1100	170	8.9 U	

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			J6-SC	J6-SC	J6-SC	J6-SC	J6-SC	J6-SC
		Sample ID			j6-sc1b-100to110-82819	j6-sc1b-10to20-82719	j6-sc1b-110to120-82819	j6-sc1b-20to30-82819	j6-sc1b-20to30-82819r1	j6-sc1b-30to40-82819
		Sample Date			2019/08/28	2019/08/27	2019/08/28	2019/08/28	2019/08/28	2019/08/28
		Sample Depth			305 to 335 cm	30 to 61 cm	335 to 366 cm	61 to 91 cm	61 to 91 cm	91 to 122 cm
COC	Units	CUL	RAL	PTW						
Total PCBs	µg/kg	9	75	200	1.6	442	1.6	190.2		371.1
TCDDeq	µg/kg	0.01			0.00521 UT		0.00501 UT	0.00761 JT		0.00436 JT
HxCDF	µg/kg	0.0004		0.04	0.00462 U		0.00444 U	0.00301 J		0.00232 J
PeCDD	µg/kg	0.0002	0.0008	0.01	0.00462 U		0.00444 U	0.00127 J		0.000622 J
PeCDF	µg/kg	0.0003	0.2	0.2	0.00462 U		0.00444 U	0.00173 J		0.00103 J
TCDD	µg/kg	0.0002	0.0006	0.01	0.000924 U		0.000889 U	0.000527 J		0.000303 J
TCDF	µg/kg	0.0040658		0.6	0.000301 BJ		0.000245 BJ	0.00157 B	0.00141 B	0.000894 BJ
Aldrin	µg/kg	2								
Dieldrin	µg/kg	0.07								
DDD	µg/kg	114			0.63		0.63	1.615		1.915
DDE	µg/kg	50			0.79		0.79	2.595		3.295
DDT	µg/kg	246			0.94		0.94	0.94		0.94
DDx	µg/kg	6.1	160	7050	0.94		0.94	4.915		5.915
Lindane	µg/kg	5								
Chlordanes	µg/kg	0.51								
Arsenic	mg/kg	3								
Cadmium	mg/kg	0.51								
Copper	mg/kg	359								
Lead	mg/kg	196								
Mercury	mg/kg	0.085								
Zinc	mg/kg	459								
TBT	µg/kg	3080								
Total cPAHs	µg/kg	774		106000	0.168898 JT		0.175562 JT	48.059 T		55.396 T
Total PAHs	µg/kg	23000	30000		1.3915 JT		1.0545 JT	387.9 T		418.2 T
TPH-Diesel	mg/kg	91								
Chlorobenzene	µg/kg									
Naphthalene	µg/kg				0.15 U		0.15 U	14		8.3
BEHP	µg/kg	135								

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID Sample ID Sample Date Sample Depth					J6-SC j6-sc1b-40to50-82819 2019/08/28 122 to 152 cm	J6-SC j6-sc1b-50to60-82819 2019/08/28 152 to 183 cm	J6-SC j6-sc1b-50to60-82819r1 2019/08/28 152 to 183 cm	J6-SC j6-sc1b-60to70-82819 2019/08/28 183 to 213 cm	J6-SC j6-sc1b-60to70-82819r1 2019/08/28 183 to 213 cm	J6-SC j6-sc1b-70to80-82819 2019/08/28 213 to 244 cm	J6-SC j6-sc1b-80to90-82819 2019/08/28 244 to 274 cm
COC	Units	CUL	RAL	PTW							
Total PCBs	µg/kg	9	75	200	481.7	755.5		475.8		63.3	17
TCDDeq	µg/kg	0.01			0.00358 JT	0.00697 JT		0.00875 JT		0.00532 T	0.00548 JT
HxCDF	µg/kg	0.0004		0.04	0.00203 J	0.00579		0.00598		0.00472 U	0.00482 U
PeCDD	µg/kg	0.0002	0.0008	0.01	0.000533 J	0.000982 J		0.00117 J		0.00472 U	0.00482 U
PeCDF	µg/kg	0.0003	0.2	0.2	0.00103 JK	0.00176 J		0.00173 J		0.00472 U	0.00482 U
TCDD	µg/kg	0.0002	0.0006	0.01	0.000297 JK	0.000439 JK		0.000507 J		0.000945 U	0.000965 U
TCDF	µg/kg	0.0040658		0.6	0.000746 BJ	0.00162 B	0.00128 B	0.000937 B	0.000754 BJ	0.000367 BJ	0.000293 BJ
Aldrin	µg/kg	2									
Dieldrin	µg/kg	0.07									
DDD	µg/kg	114			2.115	1.915		2.915		0.775	0.63
DDE	µg/kg	50			3.995					0.79	0.79
DDT	µg/kg	246			1.09	0.94		0.94		0.94	0.94
DDx	µg/kg	6.1	160	7050	7.2	11.34		18.62		2.225	0.94
Lindane	µg/kg	5									
Chlordanes	µg/kg	0.51									
Arsenic	mg/kg	3									
Cadmium	mg/kg	0.51									
Copper	mg/kg	359									
Lead	mg/kg	196									
Mercury	mg/kg	0.085									
Zinc	mg/kg	459									
TBT	µg/kg	3080									
Total cPAHs	µg/kg	774		106000	58.92 T	64.138 T		57.313 T		12.3302 T	2.6288 T
Total PAHs	µg/kg	23000	30000		435.2 T	517 T		489.8 T		95.6 T	20.58 JT
TPH-Diesel	mg/kg	91									
Chlorobenzene	µg/kg										
Naphthalene	µg/kg				6.2	5.1		9		2.1	0.39 J
BEHP	µg/kg	135									

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

COC		Units	CUL	RAL	PTW	J6-SC j6-sc1b-90to100-82819 2019/08/28 274 to 305 cm	J6-SC J6-SC-20to40-102218 2018/10/22 61 to 122 cm	J6-SC J6-SC-40to60-102218 2018/10/22 122 to 183 cm	J6-SC J6-SC-60to80-102218 2018/10/22 183 to 244 cm	J6-SC J6-SC-80to96-102218 2018/10/22 244 to 293 cm	J6-SC J6-SC-96to111-102218 2018/10/22 293 to 338 cm	J7 J7-0to26-101218 2018/10/12 0 to 26 cm
Total PCBs	µg/kg	9	75	200	1.6	163	511	228	74	14	2751.477	
TCDDeq	µg/kg	0.01			0.00558 UT	0.0151 JT	14519	0.00872 JT	0.000795 JT	0.000215 JT	14549	
HxCDF	µg/kg	0.0004		0.04	0.00489 U	0.0089	0.00121 J	0.0057	0.00071 JBq	0.0002 JBq	0.0013 JB	
PeCDD	µg/kg	0.0002	0.0008	0.01	0.00489 U	0.0019 J	0.0018 JB	0.0011 Jq	0.000079 U	0.000059 U	0.00007 J	
PeCDF	µg/kg	0.0003	0.2	0.2	0.00489 U	0.0023 J	0.0015 B	0.0011 J	0.000082 U	0.000052 U	0.000808 BJ	
TCDD	µg/kg	0.0002	0.0006	0.01	0.000977 U	0.0012	19 J	0.00084	0.000087 U	0.00007 U	690	
TCDF	µg/kg	0.0040658		0.6	0.000977 U	0.0024 B	0.227	0.00087 B	0.00018 J	0.000089 J	0.82	
Aldrin	µg/kg	2					0.079 U					
Dieldrin	µg/kg	0.07				0.082 U	0.077 U	0.077 U	0.077 U	0.077 U	0.094 U	
DDD	µg/kg	114			0.63	2.5335	3.6315	1.4315	0.2015	0.0755	6.3385	
DDE	µg/kg	50			0.79				0.3395	0.1395		
DDT	µg/kg	246			0.94	0.47	1.047	0.094	0.094	0.094	1.16	
DDx	µg/kg	6.1	160	7050	0.94	7.0135	14.1785	8.402	0.6115	0.2855	11.0585	
Lindane	µg/kg	5				0.085 J	0.031 U	0.031 U	0.031 U	0.031 U	0.038 U	
Chlordanes	µg/kg	0.51				0.701	1.395	0.7135	0.13	0.13	1.5	
Arsenic	mg/kg	3				7	6.7	5.9	4.2	3.8	19	
Cadmium	mg/kg	0.51				0.5	0.55	0.32	0.11 J	0.084 J	0.51	
Copper	mg/kg	359				73	81	74	34	29	450	
Lead	mg/kg	196				120	68	62	12	6.2	160	
Mercury	mg/kg	0.085				0.37	0.58	0.34	0.081	0.049	0.43	
Zinc	mg/kg	459				280	290	200	76	62	480	
TBT	µg/kg	3080				29	31	4.9	0.63 U	0.63 U	750	
Total cPAHs	µg/kg	774		106000	0.21961 JT	155.47 DT	149.01 DT	77.095 DT	7.788 T	1.09921 JT	324.48 DT	
Total PAHs	µg/kg	23000	30000		1.73 JT	1457 DT	1425 DT	719.6 DT	63.44 XT	13.52 JXT	2638.2 DJT	
TPH-Diesel	mg/kg	91				290	560	340 J	37 J	17 J	220	
Chlorobenzene	µg/kg											
Naphthalene	µg/kg				0.15 U	38 D	21 D	8.4 D	2.1	1.3	12 JD	
BEHP	µg/kg	135				92 J	190	60 J	8.9 U	8.9 U	920	

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID Sample ID Sample Date Sample Depth					K6 K6-0to28-101918 2018/10/19 0 to 28 cm	L1 L1-0to30-101518 2018/10/15 0 to 30 cm	L3 L3-0to20-101318 2018/10/13 0 to 20 cm	L3-SC L3-SC-00to10-102218 2018/10/22 0 to 30 cm	L3-SC L3-SC-10to20-102218 2018/10/22 30 to 61 cm	L3-SC l3-sc1b-00to10-82619 2019/08/26 0 to 30 cm	L3-SC l3-sc1b-10to20-82619 2019/08/26 30 to 61 cm
COC	Units	CUL	RAL	PTW							
Total PCBs	µg/kg	9	75	200		5.31206	121.0942		60	32.6	32.9
TCDDeq	µg/kg	0.01				0.00218 JT	0.00301 JT	14557	0.000847 JT		
HxCDF	µg/kg	0.0004		0.04		0.0018 JB	0.0043 B	0.00017 U	0.0009 J		
PeCDD	µg/kg	0.0002	0.0008	0.01		0.00032 JB	0.00021 Jq	0.0025 JB	0.00013 U		
PeCDF	µg/kg	0.0003	0.2	0.2		0.00049 JB	0.00059 J	0.0033 B	0.0002 J		
TCDD	µg/kg	0.0002	0.0006	0.01		0.00011 Jq	0.00028 J	12 J	0.000062 U		
TCDF	µg/kg	0.0040658		0.6		0.00043 JB	0.00026 JB	0.14	0.00029 JB		
Aldrin	µg/kg	2				0.079 U	0.079 U				
Dieldrin	µg/kg	0.07				0.077 U	0.077 U	0.077 U	0.077 U		
DDD	µg/kg	114					0.2915	2.48	0.87		
DDE	µg/kg	50				0.3395	0.2795				
DDT	µg/kg	246					0.094	0.457	0.227		
DDx	µg/kg	6.1	160	7050		4.6665	0.6415	4.197	1.776		
Lindane	µg/kg	5				0.031 U	0.031 U	0.031 U	0.031 U		
Chlordanes	µg/kg	0.51				0.3765	0.13	0.2835	0.13		
Arsenic	mg/kg	3				1.6	3.9	3.9	3.1		
Cadmium	mg/kg	0.51				0.1 J	0.24	0.2	0.13 J		
Copper	mg/kg	359				19 B	33	29	18		
Lead	mg/kg	196				10	12	21	27		
Mercury	mg/kg	0.085				0.038	0.036	0.13	0.083		
Zinc	mg/kg	459				56	110	120	88		
TBT	µg/kg	3080			220	6.5	13	15	1.3 J		
Total cPAHs	µg/kg	774		106000		20.273 DT	117.98 T	46.909 DT	14.207 T		
Total PAHs	µg/kg	23000	30000			153.78 DJT	1326.7 DT	461.6 DXT	120.85 XT		
TPH-Diesel	mg/kg	91				13 U	33 J	85	38 J		
Chlorobenzene	µg/kg										
Naphthalene	µg/kg					0.65 JD	8.6	5.7 D	1.7		
BEHP	µg/kg	135				30 J	100	90	13 J		

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID Sample ID Sample Date Sample Depth		L3-SC l3-sc1b-20to30-82619 2019/08/26 61 to 91 cm	L3-SC l3-sc1b-30to40-82619 2019/08/26 91 to 122 cm	L3-SC L3-SC-20to40-102218 2018/10/22 61 to 122 cm	L5 513-0to26-101318 2018/10/13 0 to 26 cm	L5 L5-0to26-101318 2018/10/13 0 to 26 cm	L7 L7-0to29-101318 2018/10/13 0 to 29 cm	M01 PSYD&M97DM01DM01 1997/11/26 0 to 10 cm			
COC	Units	CUL	RAL	PTW							
Total PCBs	µg/kg	9	75	200	25.8	17.8	49	256.279	452.05	836.284	238 T
TCDDeq	µg/kg	0.01			0.00648 JT	0.00384 JT	0.00149 JT	0.0195 JT	0.0196 JT	0.0159 JT	
HxCDF	µg/kg	0.0004		0.04	0.00914	0.000819 BJ	0.0012 J	0.024 B	0.026 B	0.026 B	
PeCDD	µg/kg	0.0002	0.0008	0.01	0.00493 U	0.00475 U	0.00014 U	0.0017 J	0.0019 J	0.0014 J	
PeCDF	µg/kg	0.0003	0.2	0.2	0.00118 J	0.000317 BJK	0.00033 J	0.0031 J	0.0033 J	0.0028 J	
TCDD	µg/kg	0.0002	0.0006	0.01	0.000985 U	0.00095 U	0.000065 U	0.00094 J	0.00062 Jq	0.0006 Jq	
TCDF	µg/kg	0.0040658		0.6	0.000501 BJ	0.000482 BJ	0.00042 JB	0.0017 B	0.0017 B	0.0012 JB	
Aldrin	µg/kg	2						0.12 U	0.12	0.12 U	
Dieldrin	µg/kg	0.07					0.077 U	0.12 U	0.12 U	0.12 U	
DDD	µg/kg	114			1.055	0.995	0.94	1.947	1.5465	1.948	
DDE	µg/kg	50			0.79	0.79	0.4995	3.35	2.82		
DDT	µg/kg	246			0.94	0.94	0.337	0.14	0.14	0.15	
DDx	µg/kg	6.1	160	7050	2.505	2.445	1.7765	5.402	4.471	5.3185	
Lindane	µg/kg	5					0.031 U	0.047 U	0.046 U	0.047 U	
Chlordanes	µg/kg	0.51					0.13	0.845	0.775	0.925	
Arsenic	mg/kg	3					2.9	10	10	11	6.43
Cadmium	mg/kg	0.51					0.13	0.6	0.54	0.47	1.26
Copper	mg/kg	359					19	130	130	200	109
Lead	mg/kg	196					12	41	53	110	31
Mercury	mg/kg	0.085					0.07	0.19	0.18	0.18	0.131
Zinc	mg/kg	459					87	310	310 F1	440	242
TBT	µg/kg	3080					3.5	80	58	230	336
Total cPAHs	µg/kg	774		106000	21.978 T	13.1498 T	19.437 T	182.85 DT	212.05 DT	241.03 DT	209.749 T
Total PAHs	µg/kg	23000	30000		163.87 T	97.59 T	164.4 XT	1608.8 DJT	2298.3 DT	2021 DJT	1922.03 T
TPH-Diesel	mg/kg	91					34 J	200	180	180	
Chlorobenzene	µg/kg										50 U
Naphthalene	µg/kg				1.4	1.1	2.7	9 D	12 D	9.9 D	14.4
BEHP	µg/kg	135					22 J	900	890	770	1680

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID					M09T	M101	M103	M104	M105	M106
Sample ID					PSYD&M97DM09DM09T	WLCOFH02M101M101	WLCOFH02M103M103	WLCOFH02M104M104	WLCOFH02M105M105	WLCOFH02M106M106
Sample Date					1997/11/26	2002/08/22	2002/08/22	2002/08/22	2002/08/22	2002/08/22
Sample Depth					0 to 10 cm	0 to 15 cm	0 to 15 cm	0 to 15 cm	0 to 15 cm	0 to 15 cm
COC	Units	CUL	RAL	PTW						
Total PCBs	µg/kg	9	75	200	40 UT		138.12 T	6.8 UT	347.07 T	47.4 T
TCDDeq	µg/kg	0.01								
HxCDF	µg/kg	0.0004		0.04						
PeCDD	µg/kg	0.0002	0.0008	0.01						
PeCDF	µg/kg	0.0003	0.2	0.2						
TCDD	µg/kg	0.0002	0.0006	0.01						
TCDF	µg/kg	0.0040658		0.6						
Aldrin	µg/kg	2				1.23 UT	1.42 U	1.11 U	1.28 U	1.06 U
Dieldrin	µg/kg	0.07				0.936 UT	1.08 U	0.845 U	0.974 U	0.804 U
DDD	µg/kg	114					5.785 JT	5.15 UT	5.94 UT	4.9 UT
DDE	µg/kg	50					5.195 JT	5.15 UT	4 JT	4.9 UT
DDT	µg/kg	246					6.59 UT	5.15 UT	5.94 UT	4.9 UT
DDx	µg/kg	6.1	160	7050			14.702 JT	5.15 UT	10.614 JT	4.9 UT
Lindane	µg/kg	5				1.09 UT	1.26 U	0.984 U	1.14 U	0.937 U
Chlordanes	µg/kg	0.51					14.85 JT	5.15 UT	14.87 JT	4.9 UT
Arsenic	mg/kg	3			5.59	5.93 T	5.81	3.86	4.11	4.1
Cadmium	mg/kg	0.51			0.5 U	1.58 T	1.31	0.348 J	1.89	1.26
Copper	mg/kg	359			146	79.5 JT	79.9 J	25.6 J	73.6 J	49.5 J
Lead	mg/kg	196			20.2	81.1 JT	43.4 J	34 J	57.6 J	38.6 J
Mercury	mg/kg	0.085			0.0885	0.125 T	0.131	0.0104 U	0.108	0.0102 U
Zinc	mg/kg	459			169	490 JT	318 J	359 J	362 J	357 J
TBT	µg/kg	3080			104					
Total cPAHs	µg/kg	774		106000	151.1 T		126 UJT	14.2152 T	148.969 JT	120.95 JT
Total PAHs	µg/kg	23000	30000		1282.35 T		2654.8 JT	190.715 JT	3116.65 JT	2825.1 JT
TPH-Diesel	mg/kg	91				966 JT	777 J	54	345 J	261 J
Chlorobenzene	µg/kg				50 U					
Naphthalene	µg/kg				12.1	89.7 UJT	96.8 UJ	12.8 J	83.4 UJ	79.8 UJ
BEHP	µg/kg	135			779	23200 JT	32500 J	163 J	2250 J	2260 J

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID					M107	M108	M109	M110	M2010	M2020
Sample ID					WLCOFH02M107M107	WLCOFH02M108M108	WLCOFH02M109M109	WLCOFH02M110M110	WLCOFJ02M0201M2010	WLCOFJ02M0202M2020
Sample Date					2002/08/22	2002/08/22	2002/08/22	2002/08/22	2002/10/15	2002/10/15
Sample Depth					0 to 15 cm	0 to 5 cm	0 to 10 cm			
COC	Units	CUL	RAL	PTW						
Total PCBs	µg/kg	9	75	200	6.18 UT	29.165 T	202.835 T	23.65 T		
TCDDeq	µg/kg	0.01								
HxCDF	µg/kg	0.0004		0.04						
PeCDD	µg/kg	0.0002	0.0008	0.01						
PeCDF	µg/kg	0.0003	0.2	0.2						
TCDD	µg/kg	0.0002	0.0006	0.01						
TCDF	µg/kg	0.0040658		0.6						
Aldrin	µg/kg	2			1.1 U	1.25 U	1.28 U	1.07 U	2.36 U	1.07 U
Dieldrin	µg/kg	0.07			0.84 U	0.949 U	0.973 U	0.815 U	22.3	0.811 U
DDD	µg/kg	114			5.12 UT	5.78 UT	5.93 UT	4.97 UT	4.72 UT	2.47 UT
DDE	µg/kg	50			5.12 UT	5.78 UT	4.025 JT	4.97 UT	4.72 UT	2.47 UT
DDT	µg/kg	246			3.89 JT	5.78 UT	5.93 UT	4.97 UT	4.72 UT	2.47 UT
DDx	µg/kg	6.1	160	7050	9.5535 JT	5.78 UT	10.6275 JT	4.97 UT	4.72 UT	2.47 UT
Lindane	µg/kg	5			0.979 U	1.11 U	1.13 U	0.95 U	2.36 U	0.945 U
Chlordanes	µg/kg	0.51			5.12 UT	5.78 UT	5.93 UT	4.97 UT	23.6 UT	3.48 UT
Arsenic	mg/kg	3			2.81	8.98	4.84	3.65	4.11 J	4.15 J
Cadmium	mg/kg	0.51			0.00927 U	0.00947 U	0.488 J	0.18 J	0.0989 J	0.0441 J
Copper	mg/kg	359			15 J	34.4 J	63.8 J	36 J	27.3 J	22 J
Lead	mg/kg	196			5.45 J	14.6 J	24.6 J	10.8 J	12.1 J	8.73 J
Mercury	mg/kg	0.085			0.0103 U	0.0118 U	0.0124 U	0.0111 U	0.00978 U	0.00943 U
Zinc	mg/kg	459			57 J	145 J	193 J	123 J	169 J	89.7 J
TBT	µg/kg	3080								
Total cPAHs	µg/kg	774		106000	10.2 UT	165.96 T	138.827 T	14.1888 T	20.668 JT	27.6116 JT
Total PAHs	µg/kg	23000	30000		117.005 JT	1950.62 JT	1212.295 JT	440.015 JT	506.3 JT	515.4 JT
TPH-Diesel	mg/kg	91			26.1 J	44.1 J	204 J	83.7 J	59	36.1
Chlorobenzene	µg/kg									
Naphthalene	µg/kg				7.81 U	14.4 J	19.2 J	13.7 J	15.4 U	17.2 U
BEHP	µg/kg	135			68.4 U	226	994	377	565	468

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID Sample ID Sample Date Sample Depth					M2030 WLCOFJ02M0203M2030 2002/10/15 0 to 15 cm	M2031 WLCOFJ02M02031M2031 2002/10/15 0 to 15 cm	M2040 WLCOFJ02M0204M2040 2002/10/15 0 to 5 cm	M2050 WLCOFJ02M0205M2050 2002/10/16 0 to 8 cm	M3020 WLCOFJ02M0302M3020 2002/10/14 0 to 6 cm	M3030 WLCOFJ02M0303M3030 2002/10/14 0 to 12 cm
COC	Units	CUL	RAL	PTW						
Total PCBs	µg/kg	9	75	200						
TCDDeq	µg/kg	0.01								
HxCDF	µg/kg	0.0004		0.04						
PeCDD	µg/kg	0.0002	0.0008	0.01						
PeCDF	µg/kg	0.0003	0.2	0.2						
TCDD	µg/kg	0.0002	0.0006	0.01						
TCDF	µg/kg	0.0040658		0.6						
Aldrin	µg/kg	2			0.96 U	1.05 U	1.03 U	1.35 U	1.09 U	11.2 UJ
Dieldrin	µg/kg	0.07			0.73 U	0.801 U	0.784 U	1.03 U	0.83 U	8.51 UJ
DDD	µg/kg	114			4.33 JT	2.44 UT	2.39 UT	3.14 UT	2.53 UT	25.9 UJT
DDE	µg/kg	50			2.22 UT	2.44 UT	2.39 UT	3.14 UT	2.53 UT	25.9 UJT
DDT	µg/kg	246			2.22 UT	2.44 UT	2.39 UT	3.14 UT	2.53 UT	25.9 UJT
DDx	µg/kg	6.1	160	7050	7.094 JT	2.44 UT	2.39 UT	3.14 UT	2.53 UT	25.9 UJT
Lindane	µg/kg	5			0.85 U	0.934 U	0.914 U	1.2 U	0.967 U	9.91 UJ
Chlordanes	µg/kg	0.51			3.13 UT	3.44 UT	3.37 UT	4.42 UT	3.56 UT	36.5 UJT
Arsenic	mg/kg	3			2.68 J	2.9 J	2.79 J	2.93	2.21	4.04
Cadmium	mg/kg	0.51			0.00171 U	0.00176 U	0.00226 U	0.00203 U	0.00172 U	0.0883 J
Copper	mg/kg	359			18.9 J	21.5 J	36.2 J	34.2 J	21.2	72
Lead	mg/kg	196			9.26 J	9.3 J	7.88 J	6.11 J	14.6	31.9
Mercury	mg/kg	0.085			0.0373	0.0263	0.0363	0.0355	0.0225 J	0.0398
Zinc	mg/kg	459			80.6 J	79.7 J	59.9 J	58 J	80.1	236
TBT	µg/kg	3080								
Total cPAHs	µg/kg	774		106000	51.916 T	40.9434 T	4.30314 JT	2.08 UT	16.3635 T	113.6866 T
Total PAHs	µg/kg	23000	30000		3202.115 T	2219.75 T	25 JT	20.25 JT	168.735 JT	966.8 JT
TPH-Diesel	mg/kg	91			14.7	16.9	6.62	3.92	10.4	83.2
Chlorobenzene	µg/kg									
Naphthalene	µg/kg				33.2	5.85	2.15 U	2.08 U	2.13 J	19 U
BEHP	µg/kg	135			169	147	21.5 UJ	20.8 UJ	71.4	1940



**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			N4	N5	N7	NA-4A	NA-4A	NA-4A	NA-4A	NA-4A	NA-4A	NA-4A	
		Sample ID			N4-0to29-101418	N5-0to28-101418	N7-0to27-101418	NA-4A-0005	NA-4A-0508	NA-4A-0812	NA-4A-1216	NA-4A-1620	NA-4A-2024	NA-4A-2428	NA-4A-2832
		Sample Date			2018/10/14	2018/10/14	2018/10/14	2004/10/21	2004/10/21	2004/10/21	2004/10/21	2004/10/21	2004/10/21	2004/10/21	2004/10/21
		Sample Depth			0 to 29 cm	0 to 28 cm	0 to 27 cm	0 to 5 cm	5 to 8 cm	8 to 12 cm	12 to 16 cm	16 to 20 cm	20 to 24 cm	24 to 28 cm	28 to 32 cm
COC	Units	CUL	RAL	PTW											
Total PCBs	µg/kg	9	75	200		592.82888	272.317005								
TCDDeq	µg/kg	0.01				0.0159 JT	0.0301 JT								
HxCDF	µg/kg	0.0004		0.04		0.02	0.069								
PeCDD	µg/kg	0.0002	0.0008	0.01		0.00099 Jq	0.0016 J								
PeCDF	µg/kg	0.0003	0.2	0.2		0.0021 J	0.006 J								
TCDD	µg/kg	0.0002	0.0006	0.01		0.00056 J	0.00062 J								
TCDF	µg/kg	0.0040658		0.6		0.0017	0.0015								
Aldrin	µg/kg	2				0.12 U	0.11 U								
Dieldrin	µg/kg	0.07				0.12 U	0.12 J								
DDD	µg/kg	114				2.0475	3.944								
DDE	µg/kg	50													
DDT	µg/kg	246				0.15	0.14								
DDx	µg/kg	6.1	160	7050		5.538	11.627								
Lindane	µg/kg	5				0.047 U	0.044 U								
Chlordanes	µg/kg	0.51				0.795	1.075								
Arsenic	mg/kg	3				10	13	5.6 J	5.2 J	4.6 J	4.4 J	4 J	4.7 J	4.9 J	4.5 J
Cadmium	mg/kg	0.51				0.53	0.53	0.52	0.52	0.5	0.45	0.44	0.49	0.51	0.49
Copper	mg/kg	359				140	230	92.2	64.9	73.4	57.7	66.1	59.4	63.7	60.2
Lead	mg/kg	196				44 B	45 B	44.7	47.8	45.5	40.7	39.3	42.3	42.3	42.5
Mercury	mg/kg	0.085				0.22 H	0.18 H								
Zinc	mg/kg	459				310	360	270	286	281	251	243	261	275	255
TBT	µg/kg	3080				170	270								
Total cPAHs	µg/kg	774		106000	157.84 DT	186.8 DT	303.25 DT								
Total PAHs	µg/kg	23000	30000		1363.8 DT	1625.6 DJT	2311.7 DT								
TPH-Diesel	mg/kg	91				88 J	120								
Chlorobenzene	µg/kg														
Naphthalene	µg/kg				9.4 D	13 D	10 D								
BEHP	µg/kg	135				890	810								

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			NA-4A	NA-4B	NA-4B	NA-4B	O7						
		Sample ID			NA-4A-3238	NA-4A-3844	NA-4A-4448	NA-4A-5864	NA-4A-6874	NA-4A-7884	NA-4A-8894	NA-4B-0024	NA-4B-2450	NA-4B-5094	O7-0to27-101918
		Sample Date			2004/10/21	2004/10/21	2004/10/21	2004/10/21	2004/10/21	2004/10/21	2004/10/21	2004/10/21	2004/10/21	2004/10/21	2018/10/19
		Sample Depth			32 to 38 cm	38 to 44 cm	44 to 48 cm	58 to 64 cm	68 to 74 cm	78 to 84 cm	88 to 94 cm	0 to 24 cm	24 to 50 cm	50 to 94 cm	0 to 27 cm
COC	Units	CUL	RAL	PTW											
Total PCBs	µg/kg	9	75	200								167.48 JT	185.415 JT	131.8 JT	213.08664
TCDDeq	µg/kg	0.01													0.0326 JT
HxCDF	µg/kg	0.0004		0.04											0.065
PeCDD	µg/kg	0.0002	0.0008	0.01											0.0019 J
PeCDF	µg/kg	0.0003	0.2	0.2											0.0062 J
TCDD	µg/kg	0.0002	0.0006	0.01											0.00066 Jq
TCDF	µg/kg	0.0040658		0.6											0.0023
Aldrin	µg/kg	2										0.0601 UJ	0.0538 UJ	0.257 NJ	0.11 U
Dieldrin	µg/kg	0.07										0.0984 U	0.088 U	0.0843 U	0.099 U
DDD	µg/kg	114										3.632 JNT	4.538 JNT	5.61 JNT	
DDE	µg/kg	50										5.161 JNT	5.5794 T	6.231 JNT	
DDT	µg/kg	246										0.971 JNT	0.696 JT	0.921 T	0.735
DDx	µg/kg	6.1	160	7050								9.764 JNT	10.8134 JNT	12.762 JNT	8.415
Lindane	µg/kg	5										0.147 U	0.131 U	2.38 NJ	0.04 U
Chlordanes	µg/kg	0.51										2.2733 JNT	2.4745 JNT	3.12285 JNT	0.95
Arsenic	mg/kg	3			4.2 J	4.1 J	3.8 J	4.4 J	4.1 J	4.1 J	4.45 JT				12
Cadmium	mg/kg	0.51			0.49	0.47	0.45	0.52	0.46	0.49	0.5 T				0.44
Copper	mg/kg	359			57.7	72.5	68.4	86.6	73.5	61.1	80 T				150
Lead	mg/kg	196			42.2	40.4	38.9	46	39.6	44	48 T				42 B
Mercury	mg/kg	0.085													0.2 H
Zinc	mg/kg	459			258	245	251	262	198	218	244 T				300
TBT	µg/kg	3080													670
Total cPAHs	µg/kg	774		106000								77.305 T	40.628 T	50.263 T	27.298 T
Total PAHs	µg/kg	23000	30000									692.9 T	402.9 T	410 T	159.39 JT
TPH-Diesel	mg/kg	91										250 J	310 J	390 J	95 J
Chlorobenzene	µg/kg											0.19 U	0.17 U	0.16 U	
Naphthalene	µg/kg											25	31	16	0.44 J
BEHP	µg/kg	135										250 U	110 U	110 U	88 J

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		P1	P3	P5	PSY01A	PSY01B	PSY01S	PSY03S			
Sample ID		P1-0to30-101518	P3-0to29-101618	P5-0to26-101618	PSYSEA98PSY01CPSY01A	PSYSEA98PSY01CPSY01B	PSYSEA98PSY01PSY01S	PSYSEA98PSY03PSY03S			
Sample Date		2018/10/15	2018/10/16	2018/10/16	1998/04/15	1998/04/15	1998/04/05	1998/04/05			
Sample Depth		0 to 30 cm	0 to 29 cm	0 to 26 cm	0 to 121 cm	121 to 219 cm	0 to 10 cm	0 to 10 cm			
COC	Units	CUL	RAL	PTW							
Total PCBs	µg/kg	9	75	200	8.6881	114.3707	371.7946	176 T	428 T	137 T	10 UT
TCDDeq	µg/kg	0.01			0.00109 JT	0.0159 JT	0.0372 JT				
HxCDF	µg/kg	0.0004		0.04	0.00064 JB	0.028 B	0.084 B				
PeCDD	µg/kg	0.0002	0.0008	0.01	0.00013 JB	0.0013 JB	0.0021 JB				
PeCDF	µg/kg	0.0003	0.2	0.2	0.00015 JB	0.0029 JB	0.0065 JB				
TCDD	µg/kg	0.0002	0.0006	0.01	0.000055 U	0.00035 Jq	0.00063 Jq				
TCDF	µg/kg	0.0040658		0.6	0.00015 JB	0.0012 JB	0.0024 B				
Aldrin	µg/kg	2			0.079 U	0.081 U	0.12 U			6	
Dieldrin	µg/kg	0.07			0.077 U	0.079 U	0.11 U			6	
DDD	µg/kg	114				1.432	1.7445			6 UT	
DDE	µg/kg	50			0.2495					8 T	
DDT	µg/kg	246				0.096	0.14			10 T	
DDx	µg/kg	6.1	160	7050	1.7695	3.924	5.3375			21 T	
Lindane	µg/kg	5			0.031 U	0.032 U	0.044 U			6	
Chlordanes	µg/kg	0.51			0.13	0.6295	0.925			13 T	
Arsenic	mg/kg	3			1.9	6.6	9	5	5	5	4
Cadmium	mg/kg	0.51			0.071 J	0.3	0.61	0.4	0.6	1.1	0.4
Copper	mg/kg	359			19 B	75	130	47.8 J	99.7 J	71.1	38.5
Lead	mg/kg	196			15	24	54	43.8 J	81.2 J	68.1 J	25.6 J
Mercury	mg/kg	0.085			0.041	0.12	0.25	0.17	0.57	0.1	0.05
Zinc	mg/kg	459			79	190	310	199	243	435 J	133 J
TBT	µg/kg	3080			4.3	100	580				
Total cPAHs	µg/kg	774		106000	145.36 DT	187.93 DT	118.52 T	109.289 T	277.48 T	538.442 T	541.565 T
Total PAHs	µg/kg	23000	30000		1434.99 DJT	1859.7 DJT	915.5 T	1478 T	2718 T	6717 T	4655 T
TPH-Diesel	mg/kg	91			17 U	120 J	82 J				
Chlorobenzene	µg/kg										
Naphthalene	µg/kg				1.1 JD	9.9 D	5	54	80	65	19
BEHP	µg/kg	135			19 J	390	800	440	572	33300	913

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		PSY04S			PSY05S		PSY06S		PSY07		PSY07		PSY07S	
Sample ID		PSYSEA98PSY04PSY04S			PSYSEA98PSY05PSY05S		PSYSEA98PSY06PSY06S		PSYSEA98PSY07CPSY07A		PSYSEA98PSY07CPSY07B		PSYSEA98PSY07PSY07S	
Sample Date		1998/04/05			1998/04/05		1998/04/05		1998/04/15		1998/04/15		1998/04/07	
Sample Depth		0 to 10 cm			0 to 10 cm		0 to 10 cm		0 to 121 cm		121 to 222 cm		0 to 10 cm	
COC	Units	CUL	RAL	PTW										
Total PCBs	µg/kg	9	75	200	141 T	78 T	10 UT	331 T	376 T	141 T				
TCDDeq	µg/kg	0.01												
HxCDF	µg/kg	0.0004		0.04										
PeCDD	µg/kg	0.0002	0.0008	0.01										
PeCDF	µg/kg	0.0003	0.2	0.2										
TCDD	µg/kg	0.0002	0.0006	0.01										
TCDF	µg/kg	0.0040658		0.6										
Aldrin	µg/kg	2												
Dieldrin	µg/kg	0.07												
DDD	µg/kg	114												
DDE	µg/kg	50												
DDT	µg/kg	246												
DDx	µg/kg	6.1	160	7050										
Lindane	µg/kg	5												
Chlordanes	µg/kg	0.51												
Arsenic	mg/kg	3			7	6	2	6	5	6				
Cadmium	mg/kg	0.51			0.6	0.5	0.1 U	0.4	0.4	0.5				
Copper	mg/kg	359			90.9	106	15.6	64.6 J	52.1 J	94.3				
Lead	mg/kg	196			41.9 J	33.6 J	10.5 J	48.7 J	47.2 J	36.2 J				
Mercury	mg/kg	0.085			0.16	0.13	0.05 U	0.25	0.21	0.13				
Zinc	mg/kg	459			281 J	254 J	66 J	222	225	262 J				
TBT	µg/kg	3080												
Total cPAHs	µg/kg	774		106000	205.452 T	182.372 T	25.327 T	243.14 T	114.566 T	173.91 T				
Total PAHs	µg/kg	23000	30000		2096 T	1946 T	287 T	2679 T	1343 T	1834 T				
TPH-Diesel	mg/kg	91												
Chlorobenzene	µg/kg													
Naphthalene	µg/kg				14	15	10 U	53	24	11				
BEHP	µg/kg	135			1800	1380	94 J	290	123	1440 J				

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID					PSY08S	PSY08S	PSY08S	PSY10S	PSY11	PSY11
Sample ID					PSYSEA98PSY08PSY08S	PSYSEA98PSY08PSY52S	PSYSEA98PSY08PSY53S	PSYSEA98PSY10PSY10S	PSYSEA98PSY11CPSY11A	PSYSEA98PSY11CPSY11B
Sample Date					1998/04/07	1998/04/07	1998/04/07	1998/04/05	1998/04/15	1998/04/15
Sample Depth					0 to 10 cm	0 to 121 cm	121 to 243 cm			
COC	Units	CUL	RAL	PTW						
Total PCBs	µg/kg	9	75	200		256 T	126 T	154 T	105 T	10 UT
TCDDeq	µg/kg	0.01								
HxCDF	µg/kg	0.0004		0.04						
PeCDD	µg/kg	0.0002	0.0008	0.01						
PeCDF	µg/kg	0.0003	0.2	0.2						
TCDD	µg/kg	0.0002	0.0006	0.01						
TCDF	µg/kg	0.0040658		0.6						
Aldrin	µg/kg	2			6 UT	6 U	6 U			
Dieldrin	µg/kg	0.07			4.5 T	6 U	6 U			
DDD	µg/kg	114				2 UT	2 UT			
DDE	µg/kg	50				5 T	2 T			
DDT	µg/kg	246				8 T	3 T			
DDx	µg/kg	6.1	160	7050		14 T	6 T			
Lindane	µg/kg	5			6 UT	6 U	6 U			
Chlordanes	µg/kg	0.51				6 JT	3 UJT			
Arsenic	mg/kg	3			6.5 T	6	5	15	4	4
Cadmium	mg/kg	0.51			2.25 T	2.8	1.5	0.6	0.4	0.1
Copper	mg/kg	359			82 T	42.6	66.6	188	38.5 J	33.2 J
Lead	mg/kg	196			48.4 JT	55.8 J	36.6 J	50.2 J	116 J	5.9 J
Mercury	mg/kg	0.085			0.11 T	0.12	0.08	0.15	0.4	0.07
Zinc	mg/kg	459			332 JT	424 J	322 J	683 J	113	61
TBT	µg/kg	3080								
Total cPAHs	µg/kg	774		106000		569.456 T	317.388 T	266.328 T	85.38 T	10 UT
Total PAHs	µg/kg	23000	30000			7261 T	3387 T	4274 T	930 T	10 UT
TPH-Diesel	mg/kg	91								
Chlorobenzene	µg/kg									
Naphthalene	µg/kg				55.5 T	53	38	148	21	10 U
BEHP	µg/kg	135			7180 JT	11400 J	11600 J	1930	97 J	18 J

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		PSY11			PSY11		PSY11S		PSY12S		PSY14S		PSY15S	
Sample ID		PSYSEA98PSY11CPSY11C			PSYSEA98PSY11CPSY11D		PSYSEA98PSY11PSY11S		PSYSEA98PSY12PSY12S		PSYSEA98PSY14PSY14S		PSYSEA98PSY15PSY15S	
Sample Date		1998/04/15			1998/04/15		1998/04/05		1998/04/04		1998/04/04		1998/04/04	
Sample Depth		243 to 365 cm			365 to 423 cm		0 to 10 cm		0 to 10 cm		0 to 10 cm		0 to 10 cm	
COC	Units	CUL	RAL	PTW										
Total PCBs	µg/kg	9	75	200	10 UT	10 UT	379 T	82 T	2525 AT	141 T				
TCDDeq	µg/kg	0.01												
HxCDF	µg/kg	0.0004		0.04										
PeCDD	µg/kg	0.0002	0.0008	0.01										
PeCDF	µg/kg	0.0003	0.2	0.2										
TCDD	µg/kg	0.0002	0.0006	0.01										
TCDF	µg/kg	0.0040658		0.6										
Aldrin	µg/kg	2						2 U						
Dieldrin	µg/kg	0.07						2 U						
DDD	µg/kg	114						2 UT						
DDE	µg/kg	50						2 UT						
DDT	µg/kg	246						2 UT						
DDx	µg/kg	6.1	160	7050				2 UT						
Lindane	µg/kg	5						2 U						
Chlordanes	µg/kg	0.51						3 UJT						
Arsenic	mg/kg	3			3	3	8	17	9	8				
Cadmium	mg/kg	0.51			0.1 U	0.1 U	1.2	0.4	0.6	0.5				
Copper	mg/kg	359			30.1 J	28.1 J	119	119	140	130				
Lead	mg/kg	196			6.4 J	5.4 J	54.4 J	26.6	62.5	38.9				
Mercury	mg/kg	0.085			0.07	0.05 U	0.17	0.05 U	0.14	0.15				
Zinc	mg/kg	459			60	59	337 J	264	443	271				
TBT	µg/kg	3080												
Total cPAHs	µg/kg	774		106000	10 UT	10 UT	311.202 T	2120.24 T	172.021 T	295.952 T				
Total PAHs	µg/kg	23000	30000		10 UT	10 UT	3026 T	19755 T	1966 T	3078 T				
TPH-Diesel	mg/kg	91												
Chlorobenzene	µg/kg													
Naphthalene	µg/kg				10 U	10 U	27	34	24	15				
BEHP	µg/kg	135			18 J	17 J	3510	440	2220	1020				

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID					PSY16	PSY16	PSY16	PSY16S	PSY17S	PSY18
Sample ID					PSYSEA98PSY16CPSY16A	PSYSEA98PSY16CPSY16B	PSYSEA98PSY16CPSY16C	PSYSEA98PSY16PSY16S	PSYSEA98PSY17PSY17S	PSYSEA98PSY18CPSY18A
Sample Date					1998/04/16	1998/04/16	1998/04/16	1998/04/04	1998/04/04	1998/04/15
Sample Depth					0 to 121 cm	121 to 243 cm	243 to 323 cm	0 to 10 cm	0 to 10 cm	0 to 121 cm
COC	Units	CUL	RAL	PTW						
Total PCBs	µg/kg	9	75	200	824 T	133 T	10 UT	133 T	419 T	660 T
TCDDeq	µg/kg	0.01								
HxCDF	µg/kg	0.0004		0.04						
PeCDD	µg/kg	0.0002	0.0008	0.01						
PeCDF	µg/kg	0.0003	0.2	0.2						
TCDD	µg/kg	0.0002	0.0006	0.01						
TCDF	µg/kg	0.0040658		0.6						
Aldrin	µg/kg	2								
Dieldrin	µg/kg	0.07								
DDD	µg/kg	114								
DDE	µg/kg	50								
DDT	µg/kg	246								
DDx	µg/kg	6.1	160	7050						
Lindane	µg/kg	5								
Chlordanes	µg/kg	0.51								
Arsenic	mg/kg	3			6	3	3	7	9	4
Cadmium	mg/kg	0.51			0.6	0.3	0.1 U	0.3	0.4	0.5
Copper	mg/kg	359			102	28.8	27.2	96.7	154	65.1 J
Lead	mg/kg	196			80.3	23.9	5.6	30.2	56	57.2 J
Mercury	mg/kg	0.085			0.33	0.23	0.05 U	0.12	0.16	0.37
Zinc	mg/kg	459			284	99	55	227	374	159
TBT	µg/kg	3080								
Total cPAHs	µg/kg	774		106000	330.996 T	76.958 T	10 UT	169.797 T	169.917 T	378.609 T
Total PAHs	µg/kg	23000	30000		2906 T	889 T	10 UT	1585 T	1987 T	4368 T
TPH-Diesel	mg/kg	91								
Chlorobenzene	µg/kg								25 U	
Naphthalene	µg/kg				31	40	10 U	13	19	115
BEHP	µg/kg	135			973	23	10 U	867	1370	715

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID					PSY18	PSY18	PSY18S	PSY19S	PSY20	PSY20
Sample ID					PSYSEA98PSY18CPSY18B	PSYSEA98PSY18CPSY18C	PSYSEA98PSY18PSY18S	PSYSEA98PSY19PSY19S	PSYSEA98PSY20CPSY20A	PSYSEA98PSY20CPSY20B
Sample Date					1998/04/15	1998/04/15	1998/04/04	1998/04/04	1998/04/16	1998/04/16
Sample Depth					121 to 243 cm	243 to 344 cm	0 to 10 cm	0 to 10 cm	0 to 121 cm	121 to 243 cm
COC	Units	CUL	RAL	PTW						
Total PCBs	µg/kg	9	75	200	110 UJT	10 UT	278 T	107 T	2315 T	10 UT
TCDDeq	µg/kg	0.01								
HxCDF	µg/kg	0.0004		0.04						
PeCDD	µg/kg	0.0002	0.0008	0.01						
PeCDF	µg/kg	0.0003	0.2	0.2						
TCDD	µg/kg	0.0002	0.0006	0.01						
TCDF	µg/kg	0.0040658		0.6						
Aldrin	µg/kg	2								
Dieldrin	µg/kg	0.07								
DDD	µg/kg	114								
DDE	µg/kg	50								
DDT	µg/kg	246								
DDx	µg/kg	6.1	160	7050						
Lindane	µg/kg	5								
Chlordanes	µg/kg	0.51								
Arsenic	mg/kg	3			3	2	7	7	6	2 U
Cadmium	mg/kg	0.51			0.3	0.1 U	0.7	0.3	0.5	0.1 U
Copper	mg/kg	359			38.3 J	21.4 J	163	100	233	32.1
Lead	mg/kg	196			123 J	4.1 J	52.2	27.5	121	6.2
Mercury	mg/kg	0.085			0.37	0.05 U	0.16	0.1	0.46	0.06
Zinc	mg/kg	459			121	49	375	212	347 J	52 J
TBT	µg/kg	3080								
Total cPAHs	µg/kg	774		106000	213.383 T	10 UT	473.749 T	125.588 T	375.156 T	10 UT
Total PAHs	µg/kg	23000	30000		2923 T	10 UT	4558 T	1437 T	3803 T	10 UT
TPH-Diesel	mg/kg	91								
Chlorobenzene	µg/kg									
Naphthalene	µg/kg				116	10 U	31	10 U	23	10 U
BEHP	µg/kg	135			107	16 J	1390 J	774	680 J	66 J

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		Sample ID			Sample Date		Sample Depth		PSY20	PSY20	PSY20S	PSY21S	PSY22S	PSY23
COC		Units	CUL	RAL	PTW	PSYSEA98PSY20CPSY20C	PSYSEA98PSY20CPSY20D	PSYSEA98PSY20PSY20S	PSYSEA98PSY21PSY21S	PSYSEA98PSY22PSY22S	PSYSEA98PSY23CPSY23A			
						1998/04/16	1998/04/16	1998/04/04	1998/04/03	1998/04/03	1998/04/15			
						243 to 365 cm	365 to 487 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 121 cm			
Total PCBs	µg/kg	9	75	200	10 UT	10 UT	282 T	94 T	133 T	1665 T				
TCDDeq	µg/kg	0.01		0.04										
HxCDF	µg/kg	0.0004		0.01										
PeCDD	µg/kg	0.0002	0.0008	0.01										
PeCDF	µg/kg	0.0003	0.2	0.2										
TCDD	µg/kg	0.0002	0.0006	0.01										
TCDF	µg/kg	0.0040658		0.6										
Aldrin	µg/kg	2												
Dieldrin	µg/kg	0.07												
DDD	µg/kg	114												
DDE	µg/kg	50												
DDT	µg/kg	246												
DDx	µg/kg	6.1	160	7050										
Lindane	µg/kg	5												
Chlordanes	µg/kg	0.51												
Arsenic	mg/kg	3		2	2	13	6	8	6					
Cadmium	mg/kg	0.51		0.1 U	0.1 U	0.4	0.3	0.3	0.3					
Copper	mg/kg	359		28.7	23.5	209	96.6	146	297					
Lead	mg/kg	196		5.6	4.8	44.8	96.6	26.1	91.3					
Mercury	mg/kg	0.085		0.06	0.05	0.13	0.1	0.11	0.55					
Zinc	mg/kg	459		50 J	47 J	359	190	203	257 J					
TBT	µg/kg	3080												
Total cPAHs	µg/kg	774		106000	10 UT	10 UT	189.01 T	288.501 T	94.548 T	568.61 T				
Total PAHs	µg/kg	23000	30000		10 UT	10 UT	1861 T	2400 T	1240 T	5849 T				
TPH-Diesel	mg/kg	91												
Chlorobenzene	µg/kg													
Naphthalene	µg/kg			10 U	10 U	15	33	10 U	12					
BEHP	µg/kg	135		16 J	18 J	1050	1110	550	950					

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		Sample ID			PSY23	PSY23	PSY23	PSY23S	PSY24	PSY24
Sample Date		Sample Depth			PSYSEA98PSY23CPSY23B	PSYSEA98PSY23CPSY23C	PSYSEA98PSY23CPSY23D	PSYSEA98PSY23PSY23S	PSYSEA98PSY24CPSY24A	PSYSEA98PSY24CPSY24B
Sample Date		Sample Depth			1998/04/15	1998/04/15	1998/04/15	1998/04/05	1998/04/16	1998/04/16
Sample Depth		Sample Depth			121 to 243 cm	243 to 365 cm	365 to 490 cm	0 to 10 cm	0 to 121 cm	121 to 204 cm
COC	Units	CUL	RAL	PTW						
Total PCBs	µg/kg	9	75	200	10 UT	10 UT	10 UT	68 T	421 T	105 T
TCDDeq	µg/kg	0.01								
HxCDF	µg/kg	0.0004		0.04						
PeCDD	µg/kg	0.0002	0.0008	0.01						
PeCDF	µg/kg	0.0003	0.2	0.2						
TCDD	µg/kg	0.0002	0.0006	0.01						
TCDF	µg/kg	0.0040658		0.6						
Aldrin	µg/kg	2								
Dieldrin	µg/kg	0.07								
DDD	µg/kg	114								
DDE	µg/kg	50								
DDT	µg/kg	246								
DDx	µg/kg	6.1	160	7050						
Lindane	µg/kg	5								
Chlordanes	µg/kg	0.51								
Arsenic	mg/kg	3			2 U	3	2 U	6	6	3
Cadmium	mg/kg	0.51			0.1 U	0.1 U	0.1 U	0.2	0.5	0.2
Copper	mg/kg	359			26.3	23.1	15	136	162	24.3
Lead	mg/kg	196			4.9	4.2	2.7	22.4	71.4	13.1
Mercury	mg/kg	0.085			0.05	0.05 U	0.05 U	0.11	0.27	0.15
Zinc	mg/kg	459			44 J	44 J	35 J	173	314	68
TBT	µg/kg	3080								
Total cPAHs	µg/kg	774		106000	10 UT	10 UT	10 UT	104.323 T	278.092 T	45.889 T
Total PAHs	µg/kg	23000	30000		10 UT	10 UT	10 UT	1188 T	2323 T	401 T
TPH-Diesel	mg/kg	91								
Chlorobenzene	µg/kg									
Naphthalene	µg/kg				10 U	10 U	10 U	10 U	23	10 U
BEHP	µg/kg	135			37 J	14 J	10 J	778	691	35

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		Sample ID			Sample Date		Sample Depth		PSY24S	PSY25S	PSY26S	PSY27	PSY27	PSY27
COC		Units	CUL	RAL	PTW	PSYSEA98PSY24PSY24S	PSYSEA98PSY25PSY25S	PSYSEA98PSY26PSY26S	PSYSEA98PSY27CPSY27A	PSYSEA98PSY27CPSY27B	PSYSEA98PSY27CPSY27C	PSYSEA98PSY27CPSY27C	PSYSEA98PSY27CPSY27C	PSYSEA98PSY27CPSY27C
						1998/04/03	1998/04/03	1998/04/03	1998/04/16	1998/04/16	1998/04/16	1998/04/16	1998/04/16	1998/04/16
						0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 121 cm	121 to 243 cm	121 to 243 cm	121 to 243 cm	243 to 338 cm	243 to 338 cm
Total PCBs	µg/kg	9	75	200	41 T	10 UT	404 T	10 UT	10 UT	10 UT	10 UT	10 UT	10 UT	10 UT
TCDDeq	µg/kg	0.01												
HxCDF	µg/kg	0.0004		0.04										
PeCDD	µg/kg	0.0002	0.0008	0.01										
PeCDF	µg/kg	0.0003	0.2	0.2										
TCDD	µg/kg	0.0002	0.0006	0.01										
TCDF	µg/kg	0.0040658		0.6										
Aldrin	µg/kg	2												
Dieldrin	µg/kg	0.07												
DDD	µg/kg	114												
DDE	µg/kg	50												
DDT	µg/kg	246												
DDx	µg/kg	6.1	160	7050										
Lindane	µg/kg	5												
Chlordanes	µg/kg	0.51												
Arsenic	mg/kg	3			6	6	6	2	3	2	3	2	2	2
Cadmium	mg/kg	0.51			0.2	0.2	0.6	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Copper	mg/kg	359			81.2	86	267	25	18.3	18.2	18.3	18.2	18.2	18.2
Lead	mg/kg	196			20.8	18.1	79.1	4.9	4.1	3.9	4.1	3.9	3.9	3.9
Mercury	mg/kg	0.085			0.08	0.07	0.13	0.72	0.05 U					
Zinc	mg/kg	459			145	137	314	42 J	43 J	45	43 J	45	45	45
TBT	µg/kg	3080												
Total cPAHs	µg/kg	774		106000	125.204 T	68.051 T	682.84 T	10 UT	10 UT	10 UT	10 UT	10 UT	10 UT	10 UT
Total PAHs	µg/kg	23000	30000		1521 T	725 T	9968 T	10 UT	10 UT	10 UT	10 UT	10 UT	10 UT	10 UT
TPH-Diesel	mg/kg	91												
Chlorobenzene	µg/kg						5 U							
Naphthalene	µg/kg				10 U	10 U	48 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BEHP	µg/kg	135			546	547	1920	15 J	10 U	13	10 U	13	13	13

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		Sample ID			PSY27	PSY27	PSY27	PSY27	PSY27	PSY27
Sample Date		Sample Depth			PSYSEA98PSY27CY27A01	PSYSEA98PSY27CY27A02	PSYSEA98PSY27CY27A03	PSYSEA98PSY27CY27A04	PSYSEA98PSY27CY27B05	PSYSEA98PSY27CY27B06
Sample Date		Sample Depth			1998/04/16	1998/04/16	1998/04/16	1998/04/16	1998/04/16	1998/04/16
Sample Depth		Sample Depth			0 to 30 cm	30 to 60 cm	60 to 91 cm	91 to 121 cm	121 to 152 cm	152 to 182 cm
COC	Units	CUL	RAL	PTW						
Total PCBs	µg/kg	9	75	200						
TCDDeq	µg/kg	0.01								
HxCDF	µg/kg	0.0004		0.04						
PeCDD	µg/kg	0.0002	0.0008	0.01						
PeCDF	µg/kg	0.0003	0.2	0.2						
TCDD	µg/kg	0.0002	0.0006	0.01						
TCDF	µg/kg	0.0040658		0.6						
Aldrin	µg/kg	2								
Dieldrin	µg/kg	0.07								
DDD	µg/kg	114								
DDE	µg/kg	50								
DDT	µg/kg	246								
DDx	µg/kg	6.1	160	7050						
Lindane	µg/kg	5								
Chlordanes	µg/kg	0.51								
Arsenic	mg/kg	3			3	2	2	2	3	3
Cadmium	mg/kg	0.51			0.1 U					
Copper	mg/kg	359			115	25.2	18.4	23.7	21.5	22.9
Lead	mg/kg	196			22.7	5.2	4.3	4.7	4.3	4.5
Mercury	mg/kg	0.085			0.05 U	0.05 U	0.05 U	0.05 U	0.12	0.05
Zinc	mg/kg	459			68 J	41 J	38 J	52	49	47
TBT	µg/kg	3080			1300	28	16	5	1 U	2
Total cPAHs	µg/kg	774		106000	10 UT	10 UT	224.42 T	63.768 T		
Total PAHs	µg/kg	23000	30000		10 UT	10 UT	2091 T	725 T		
TPH-Diesel	mg/kg	91								
Chlorobenzene	µg/kg									
Naphthalene	µg/kg				10 U	10 U	15	10 U		
BEHP	µg/kg	135								

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID Sample ID Sample Date Sample Depth					PSY27 PSYSEA98PSY27CY27B07 1998/04/16 182 to 213 cm	PSY27 PSYSEA98PSY27CY27B08 1998/04/16 213 to 243 cm	PSY27 PSYSEA98PSY27CY27C09 1998/04/16 243 to 274 cm	PSY27 PSYSEA98PSY27CY27C10 1998/04/16 274 to 304 cm	PSY27 PSYSEA98PSY27CY27C11 1998/04/16 304 to 338 cm	PSY27S PSYSEA98PSY27PSY27S 1998/04/03 0 to 10 cm
COC	Units	CUL	RAL	PTW						
Total PCBs	µg/kg	9	75	200						309 T
TCDDeq	µg/kg	0.01								
HxCDF	µg/kg	0.0004		0.04						
PeCDD	µg/kg	0.0002	0.0008	0.01						
PeCDF	µg/kg	0.0003	0.2	0.2						
TCDD	µg/kg	0.0002	0.0006	0.01						
TCDF	µg/kg	0.0040658		0.6						
Aldrin	µg/kg	2								2 U
Dieldrin	µg/kg	0.07								10
DDD	µg/kg	114								7 T
DDE	µg/kg	50								6 T
DDT	µg/kg	246								140 T
DDx	µg/kg	6.1	160	7050						153 T
Lindane	µg/kg	5								2 U
Chlordanes	µg/kg	0.51								6 T
Arsenic	mg/kg	3			3	3	2 U	2	3	17
Cadmium	mg/kg	0.51			0.1 U	0.7				
Copper	mg/kg	359			21.9	16	10.5	15.9	23.1	655
Lead	mg/kg	196			4.5	3.7	2.3	3.2	5.2	94.6
Mercury	mg/kg	0.085			0.05 U	0.21				
Zinc	mg/kg	459			51	52	35	43	53	593
TBT	µg/kg	3080			1 U	1 U	1	1 U	1 U	
Total cPAHs	µg/kg	774		106000						492.781 T
Total PAHs	µg/kg	23000	30000							6134 T
TPH-Diesel	mg/kg	91								
Chlorobenzene	µg/kg									5 U
Naphthalene	µg/kg									48
BEHP	µg/kg	135								2140

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		Sample ID			Sample Date		Sample Depth		PSY28S	PSY29S	PSY30	PSY30	PSY30	PSY30
COC		Units	CUL	RAL	PTW	PSYSEA98PSY28PSY28S	PSYSEA98PSY29PSY29S	PSYSEA98PSY30CPSY30A	PSYSEA98PSY30CPSY30B	PSYSEA98PSY30CY30A01	PSYSEA98PSY30CY30A02			
						1998/04/04	1998/04/03	1998/04/16	1998/04/16	1998/04/16	1998/04/16			
						0 to 10 cm	0 to 10 cm	0 to 121 cm	121 to 243 cm	0 to 30 cm	30 to 60 cm			
Total PCBs	µg/kg	9	75	200	87 T	325 T	52 T	10 UT						
TCDDeq	µg/kg	0.01		0.04										
HxCDF	µg/kg	0.0004		0.01										
PeCDD	µg/kg	0.0002	0.0008	0.01										
PeCDF	µg/kg	0.0003	0.2	0.2										
TCDD	µg/kg	0.0002	0.0006	0.01										
TCDF	µg/kg	0.0040658		0.6										
Aldrin	µg/kg	2												
Dieldrin	µg/kg	0.07												
DDD	µg/kg	114												
DDE	µg/kg	50												
DDT	µg/kg	246												
DDx	µg/kg	6.1	160	7050										
Lindane	µg/kg	5												
Chlordanes	µg/kg	0.51												
Arsenic	mg/kg	3			4	8	6	5	6	6	6			
Cadmium	mg/kg	0.51			0.1	0.4	0.4	0.1 U	0.3	0.3	0.3			
Copper	mg/kg	359			28.6	314	301	50	264	277				
Lead	mg/kg	196			14.8	48.8	36.1	8.5	25.3	24.2				
Mercury	mg/kg	0.085			0.06	0.23	0.1	0.05 U	0.13	0.1				
Zinc	mg/kg	459			101	296	327	91	183	222				
TBT	µg/kg	3080							5900	4900				
Total cPAHs	µg/kg	774		106000	23.805 T	512.14 T								
Total PAHs	µg/kg	23000	30000		221 T	4459 T								
TPH-Diesel	mg/kg	91												
Chlorobenzene	µg/kg					25 U								
Naphthalene	µg/kg				10 U	27								
BEHP	µg/kg	135			135 J	1740	1780	409						

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID Sample ID Sample Date Sample Depth					PSY30 PSYSEA98PSY30CY30A03 1998/04/16 60 to 91 cm	PSY30 PSYSEA98PSY30CY30A04 1998/04/16 91 to 121 cm	PSY30 PSYSEA98PSY30CY30B05 1998/04/16 121 to 152 cm	PSY30 PSYSEA98PSY30CY30B06 1998/04/16 152 to 182 cm	PSY30 PSYSEA98PSY30CY30B07 1998/04/16 182 to 213 cm	PSY30 PSYSEA98PSY30CY30B08 1998/04/16 213 to 243 cm
COC	Units	CUL	RAL	PTW						
Total PCBs	µg/kg	9	75	200						
TCDDeq	µg/kg	0.01								
HxCDF	µg/kg	0.0004		0.04						
PeCDD	µg/kg	0.0002	0.0008	0.01						
PeCDF	µg/kg	0.0003	0.2	0.2						
TCDD	µg/kg	0.0002	0.0006	0.01						
TCDF	µg/kg	0.0040658		0.6						
Aldrin	µg/kg	2								
Dieldrin	µg/kg	0.07								
DDD	µg/kg	114								
DDE	µg/kg	50								
DDT	µg/kg	246								
DDx	µg/kg	6.1	160	7050						
Lindane	µg/kg	5								
Chlordanes	µg/kg	0.51								
Arsenic	mg/kg	3			5	7	21	4	2 U	2 U
Cadmium	mg/kg	0.51			0.4	1.6	0.8	0.1 U	0.1 U	0.1 U
Copper	mg/kg	359			284	602	1580	85.8	17.9	10.8
Lead	mg/kg	196			27.3	146	107	9.7	3.1	2.1
Mercury	mg/kg	0.085			0.08	0.11	0.09	0.02	0.05 U	0.05 U
Zinc	mg/kg	459			251	1340	872	85	35	26
TBT	µg/kg	3080			12000	17000	90000	1700 J	570	13
Total cPAHs	µg/kg	774		106000						
Total PAHs	µg/kg	23000	30000							
TPH-Diesel	mg/kg	91								
Chlorobenzene	µg/kg									
Naphthalene	µg/kg									
BEHP	µg/kg	135								

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID					PSY30S	PSY31S	PSY32S	PSY33S	PSY34	PSY34
Sample ID					PSYSEA98PSY30PSY30S	PSYSEA98PSY31PSY31S	PSYSEA98PSY32PSY32S	PSYSEA98PSY33PSY33S	PSYSEA98PSY34CPSY34A	PSYSEA98PSY34CPSY34B
Sample Date					1998/04/02	1998/04/02	1998/04/02	1998/04/02	1998/04/16	1998/04/16
Sample Depth					0 to 10 cm	0 to 121 cm	121 to 243 cm			
COC	Units	CUL	RAL	PTW						
Total PCBs	µg/kg	9	75	200	46 T	10 UT	10 UT	10 UT	40 T	256 T
TCDDeq	µg/kg	0.01								
HxCDF	µg/kg	0.0004		0.04						
PeCDD	µg/kg	0.0002	0.0008	0.01						
PeCDF	µg/kg	0.0003	0.2	0.2						
TCDD	µg/kg	0.0002	0.0006	0.01						
TCDF	µg/kg	0.0040658		0.6						
Aldrin	µg/kg	2								
Dieldrin	µg/kg	0.07								
DDD	µg/kg	114								
DDE	µg/kg	50								
DDT	µg/kg	246								
DDx	µg/kg	6.1	160	7050						
Lindane	µg/kg	5								
Chlordanes	µg/kg	0.51								
Arsenic	mg/kg	3			5	5	5	5	4	4
Cadmium	mg/kg	0.51			0.2	0.2	0.2	0.2	0.3	0.3
Copper	mg/kg	359			397 J	94.4 J	84.5 J	61.8 J	76.3	62.5
Lead	mg/kg	196			25.9	18.6	15.3	14.7	19.4	37.6
Mercury	mg/kg	0.085			0.07	0.06	0.06	0.05	0.08	0.2
Zinc	mg/kg	459			238 J	145 J	113 J	106 J	123	154
TBT	µg/kg	3080								
Total cPAHs	µg/kg	774		106000	179.09 T	84.44 T	73.638 T	47.419 T	56.677 T	135.473 T
Total PAHs	µg/kg	23000	30000		1813 T	880 T	753 T	504 T	544 T	1423 T
TPH-Diesel	mg/kg	91								
Chlorobenzene	µg/kg				5 U					
Naphthalene	µg/kg				16	10 U	10 U	10 U	10 U	11
BEHP	µg/kg	135			1400	1000	800	660	384	296

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID					PSY34	PSY34S	PSY35S	PSY41S	PSY42S	PSY43
Sample ID					PSYSEA98PSY34CPSY34C	PSYSEA98PSY34PSY34S	PSYSEA98PSY35PSY35S	PSYSEA98PSY41PSY41S	PSYSEA98PSY42PSY42S	PSYSEA98PSY43CPSY43A
Sample Date					1998/04/16	1998/04/03	1998/04/02	1998/04/01	1998/04/01	1998/04/14
Sample Depth					243 to 329 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 121 cm
COC	Units	CUL	RAL	PTW						
Total PCBs	µg/kg	9	75	200	164 T	10 UT	10 UT	10 UT	73 T	285 T
TCDDeq	µg/kg	0.01								
HxCDF	µg/kg	0.0004		0.04						
PeCDD	µg/kg	0.0002	0.0008	0.01						
PeCDF	µg/kg	0.0003	0.2	0.2						
TCDD	µg/kg	0.0002	0.0006	0.01						
TCDF	µg/kg	0.0040658		0.6						
Aldrin	µg/kg	2								
Dieldrin	µg/kg	0.07								
DDD	µg/kg	114								
DDE	µg/kg	50								
DDT	µg/kg	246								
DDx	µg/kg	6.1	160	7050						
Lindane	µg/kg	5								
Chlordanes	µg/kg	0.51								
Arsenic	mg/kg	3			3	5	5	4	3	8
Cadmium	mg/kg	0.51			0.3	0.2	0.1	0.2	0.1	0.2
Copper	mg/kg	359			42	76.7	61 J	43.4 J	26.6 J	166 J
Lead	mg/kg	196			30.3	15.2	13.4	13.3	11.1	37.5 J
Mercury	mg/kg	0.085			0.33	0.06	0.05 U	0.05 U	0.05 U	0.14
Zinc	mg/kg	459			131	122	98 J	87 J	73 J	24
TBT	µg/kg	3080								
Total cPAHs	µg/kg	774		106000	139.689 T	55.331 T	41.753 T	40.232 T	122.795 T	240.31 T
Total PAHs	µg/kg	23000	30000		1386 T	624 T	434 T	388 T	1345 T	3522 T
TPH-Diesel	mg/kg	91								
Chlorobenzene	µg/kg									
Naphthalene	µg/kg				31	10 U	10 U	10 U	24	27
BEHP	µg/kg	135			49	575	480	370	200 J	1520

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		PSY43	PSY43S	PSY44S	Q2	Q6	R1	R3			
Sample ID		PSYSEA98PSY43CPSY43B	PSYSEA98PSY43PSY43S	PSYSEA98PSY44PSY44S	q2-0to13-101818	q6-0to27-102018	R1-0to30-101518	R3-0to33-101718			
Sample Date		1998/04/14	1998/04/01	1998/04/01	2018/10/18	2018/10/20	2018/10/15	2018/10/17			
Sample Depth		121 to 213 cm	0 to 10 cm	0 to 10 cm	0 to 13 cm	0 to 27 cm	0 to 30 cm	0 to 30 cm			
COC	Units	CUL	RAL	PTW							
Total PCBs	µg/kg	9	75	200	119 T	10 UT	10 UT	4.499415	158.1676	7.22048	144.115
TCDDeq	µg/kg	0.01						0.000379 JT	0.0302 JT	14951	0.0175 JT
HxCDF	µg/kg	0.0004		0.04				0.00014 Jq	0.043	0.012 B	0.017 B
PeCDD	µg/kg	0.0002	0.0008	0.01				0.00025 U	0.0011 U	0.00002 U	0.0018 JB
PeCDF	µg/kg	0.0003	0.2	0.2				0.00015 U	0.0047 J	0.0023 B	0.0029 JB
TCDD	µg/kg	0.0002	0.0006	0.01				0.00015 U	0.001 Jq	560	0.0016
TCDF	µg/kg	0.0040658		0.6				0.00012 U	0.0024	0.094	0.003 B
Aldrin	µg/kg	2						0.079 U	0.11 U	0.079 U	0.11 U
Dieldrin	µg/kg	0.07						0.077 U	0.11 U	0.077 U	0.11 U
DDD	µg/kg	114						0.6415	0.54		1.943
DDE	µg/kg	50						0.2595	0.725	0.1295	
DDT	µg/kg	246						3.53	0.215	0.094	0.13
DDx	µg/kg	6.1	160	7050				4.431	1.48	0.638	4.62
Lindane	µg/kg	5						0.031 U	0.043 U	0.031 U	0.043 U
Chlordanes	µg/kg	0.51						0.13	0.18	0.13	0.71
Arsenic	mg/kg	3			2	4	3	4.7	9.4	3.1	8.2
Cadmium	mg/kg	0.51			0.1 U	0.1	0.1	0.12 J	0.44	0.066 J	0.36 J
Copper	mg/kg	359			28 J	53.2 J	32.9 J	33	120	17	90
Lead	mg/kg	196			13.7 J	12.5	12.2	14 B	36 B	15	32
Mercury	mg/kg	0.085			0.08	0.05 U	0.05	0.043 H	0.16 H	0.03	0.19
Zinc	mg/kg	459			54	96 J	77 J	110	280	75	220
TBT	µg/kg	3080						1.7	130	0.82 J	450
Total cPAHs	µg/kg	774		106000	45.346 T	33.497 T	30.684 T	12.2687 T	8.0943 T	48.102 DT	177.68 T
Total PAHs	µg/kg	23000	30000		524 T	316 T	308 T	101.33 JT	64.835 JT	480.8 DT	1355.3 T
TPH-Diesel	mg/kg	91						16 J	120	41 J	200
Chlorobenzene	µg/kg										
Naphthalene	µg/kg				10 U	10 U	10 U	0.23 J	0.33 J	5.4 D	9.8
BEHP	µg/kg	135			26 J	510	250 J	160	67 J	27 J	380

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			R4-SC	R4-SC	R4-SC	R4-SC	R4-SC	R4-SC
		Sample ID			R4-SC-0to1-102118	R4-SC-10to12-102118	R4-SC-120to138-102118	R4-SC-138to147-102118	r4-sc1b-100to110-82819	R4-SC
		Sample Date			2018/10/21	2018/10/21	2018/10/21	2018/10/21	2019/08/28	2019/08/28
		Sample Depth			0 to 30 cm	305 to 366 cm	366 to 421 cm	421 to 448 cm	305 to 335 cm	30 to 61 cm
COC	Units	CUL	RAL	PTW						
Total PCBs	µg/kg	9	75	200	19537				160.8	420.3
TCDDeq	µg/kg	0.01			0.0262 JT	0.00883 JT	14961	0.000656 JT	0.00402 JT	
HxCDF	µg/kg	0.0004		0.04	0.033 B	0.0013 U	0.000638 J	0.00011 U	0.000361 BJ	
PeCDD	µg/kg	0.0002	0.0008	0.01	0.0024 Jq	0.0011 J	0.0029 J	0.000071 Jq	0.00496 U	
PeCDF	µg/kg	0.0003	0.2	0.2	0.0044 J	0.0021 J	0.0013 B	0.00011 J	0.000446 J	
TCDD	µg/kg	0.0002	0.0006	0.01	0.0012 B	0.00061 JB	2900	0.00016 JBq	0.000992 U	
TCDF	µg/kg	0.0040658		0.6	0.0045 B	0.00075 JB	0.14	0.00015 JB	0.000367 BJ	
Aldrin	µg/kg	2			0.095 U	1.7	1.6	0.079 U		
Dieldrin	µg/kg	0.07			0.093 U	0.077 U	0.077 U	0.077 U		
DDD	µg/kg	114			3.038		5.1315	0.063		
DDE	µg/kg	50						0.1895	2.695	
DDT	µg/kg	246			0.12	0.094	0.094	0.094	5.335	
DDx	µg/kg	6.1	160	7050	7.6965	12.8805	9.922	0.309	13.23	
Lindane	µg/kg	5			0.038 U	0.031 U	0.031 U	0.031 U		
Chlordanes	µg/kg	0.51			1.08	0.4485	0.3235	0.13		
Arsenic	mg/kg	3			8.9	6.6	4.9	2.4		
Cadmium	mg/kg	0.51			0.54	0.6	0.34	0.061 J		
Copper	mg/kg	359			110	61	49	19		
Lead	mg/kg	196			47	33	24	4.3		
Mercury	mg/kg	0.085			0.25	0.98	0.77	0.045		
Zinc	mg/kg	459			310	160	120	51		
TBT	µg/kg	3080			260	0.79 U	0.75 U			
Total cPAHs	µg/kg	774		106000	246.97 DT	166.77 DT	93.304 DT		65.391 T	
Total PAHs	µg/kg	23000	30000		2181 DT	2109 DT	917.3 DT		693.4 T	
TPH-Diesel	mg/kg	91			420 J	570	360	32 J		
Chlorobenzene	µg/kg									
Naphthalene	µg/kg				44 D	110 D	26 D		34	
BEHP	µg/kg	135			690	13 J	16 J			

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			R4-SC	R4-SC	R4-SC	R4-SC	R4-SC	R4-SC
		Sample ID			r4-sc1b-110to120-82819	r4-sc1b-120to130-82819	r4-sc1b-130to140-82819	r4-sc1b-140to150-82819	r4-sc1b-20to30-82819	r4-sc1b-30to40-82819
		Sample Date			2019/08/28	2019/08/28	2019/08/28	2019/08/28	2019/08/28	2019/08/28
		Sample Depth			335 to 366 cm	366 to 396 cm	396 to 427 cm	427 to 457 cm	61 to 91 cm	91 to 122 cm
COC	Units	CUL	RAL	PTW						
Total PCBs	µg/kg	9	75	200	170.3	200.8	26.3	13.7	224.6	425.1
TCDDeq	µg/kg	0.01			0.00152 JT	0.00151 JT	0.00468 JT	0.00405 JT	0.00168 JT	0.0011 JT
HxCDF	µg/kg	0.0004		0.04	0.00036 BJ	0.000474 BJ	0.000174 BJK	0.000263 BJ	0.000796 BJ	0.00063 BJ
PeCDD	µg/kg	0.0002	0.0008	0.01	0.00013 J	0.000169 J	0.0049 U	0.0049 U	0.000358 JK	0.000237 J
PeCDF	µg/kg	0.0003	0.2	0.2	0.000484 J	0.000533 JK	0.0049 U	0.000194 J	0.000432 J	0.000385 J
TCDD	µg/kg	0.0002	0.0006	0.01	0.001 U	0.000995 U	0.00098 U	0.00098 U	0.000157 JK	0.000107 JK
TCDF	µg/kg	0.0040658		0.6	0.000288 BJ	0.000446 BJ	0.000374 BJ	0.000263 BJ	0.000416 BJ	0.000324 BJK
Aldrin	µg/kg	2								
Dieldrin	µg/kg	0.07								
DDD	µg/kg	114			3.36		0.865	0.63	2.415	2.615
DDE	µg/kg	50			2.295	4.395	1.185	0.79	3.995	4.595
DDT	µg/kg	246			3.335	5.035	0.94	0.94	0.94	1.03
DDx	µg/kg	6.1	160	7050	8.99	14.83	2.755	0.94	7.115	8.24
Lindane	µg/kg	5								
Chlordanes	µg/kg	0.51								
Arsenic	mg/kg	3								
Cadmium	mg/kg	0.51								
Copper	mg/kg	359								
Lead	mg/kg	196								
Mercury	mg/kg	0.085								
Zinc	mg/kg	459								
TBT	µg/kg	3080								
Total cPAHs	µg/kg	774		106000	41.627 T	39.317 T	18.182 T	5.0161 T	119.268 T	50.372 T
Total PAHs	µg/kg	23000	30000		514.1 T	387.2 T	136.59 T	44.4 T	763.7 T	388.7 T
TPH-Diesel	mg/kg	91								
Chlorobenzene	µg/kg									
Naphthalene	µg/kg				38	17	3.3	1.6	14	8.5
BEHP	µg/kg	135								

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			R4-SC	R4-SC	R4-SC	R4-SC	R4-SC	R4-SC	R4-SC
		Sample ID			r4-sc1b-40to50-82819	r4-sc1b-40to50-82819r1	r4-sc1b-50to60-82819	r4-sc1b-60to70-82819	r4-sc1b-70to80-82819	r4-sc1b-80to90-82819	r4-sc1b-90to100-82819
		Sample Date			2019/08/28	2019/08/28	2019/08/28	2019/08/28	2019/08/28	2019/08/28	2019/08/28
		Sample Depth			122 to 152 cm	122 to 152 cm	152 to 183 cm	183 to 213 cm	213 to 244 cm	244 to 274 cm	274 to 305 cm
COC	Units	CUL	RAL	PTW							
Total PCBs	µg/kg	9	75	200	599.5		201.5	423.5	323.7	238.6	322.4
TCDDeq	µg/kg	0.01			0.00831 JT		0.00259 JT	0.00237 JT	0.00431 JT	0.00352 JT	0.00391 JT
HxCDF	µg/kg	0.0004		0.04	0.00537		0.00136 J	0.00127 J	0.000575 BJ	0.000455 BJ	0.000248 BJK
PeCDD	µg/kg	0.0002	0.0008	0.01	0.00128 J		0.000443 J	0.000228 J	0.00494 U	0.00497 U	0.00497 U
PeCDF	µg/kg	0.0003	0.2	0.2	0.00206 J		0.000634 JK	0.000483 J	0.000605 J	0.000517 JK	0.000308 J
TCDD	µg/kg	0.0002	0.0006	0.01	0.000503 J		0.000201 JK	0.000985 U	0.000989 U	0.0000776 JK	0.000993 U
TCDF	µg/kg	0.0040658		0.6	0.00116 B	0.00141 B	0.000437 BJ	0.000575 BJK	0.000409 BJ	0.000533 BJK	0.000395 BJ
Aldrin	µg/kg	2									
Dieldrin	µg/kg	0.07									
DDD	µg/kg	114			2.415		1.615	4.215	3.54		3.95
DDE	µg/kg	50					3.695	7.295	3.495	4.495	3.895
DDT	µg/kg	246			2.17		0.94	0.94	0.94	0.94	0.94
DDx	µg/kg	6.1	160	7050	13.765		6.015	12.215	7.74	9.4	8.55
Lindane	µg/kg	5									
Chlordanes	µg/kg	0.51									
Arsenic	mg/kg	3									
Cadmium	mg/kg	0.51									
Copper	mg/kg	359									
Lead	mg/kg	196									
Mercury	mg/kg	0.085									
Zinc	mg/kg	459									
TBT	µg/kg	3080									
Total cPAHs	µg/kg	774		106000	77.479 T		32.906 T	80.378 T	70.952 T	71.926 T	49.054 T
Total PAHs	µg/kg	23000	30000		638 T		260.4 T	713.3 T	613.6 T	698.4 T	547.4 T
TPH-Diesel	mg/kg	91									
Chlorobenzene	µg/kg										
Naphthalene	µg/kg				8.3		5.9	14	17	30	25
BEHP	µg/kg	135									

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		Sample ID			Sample Date			Sample Depth			R4-SC		R4-SC		R4-SC		R4-SC		R4-SC		R5		R6		S167															
R4-SC-1to2-102118		R4-SC-2to4-102118			R4-SC-4to6-102118			R4-SC-6to8-102118			R4-SC-8to10-102118		R5-0to25-101618		514-0to29-101618		PDI-SG-S167		2018/10/16		2018/10/16		2018/08/16																	
2018/10/21		2018/10/21			2018/10/21			2018/10/21			2018/10/21		2018/10/16		0 to 29 cm		0 to 30 cm		0 to 25 cm		0 to 29 cm		0 to 30 cm																	
Sample Depth		30 to 61 cm			61 to 122 cm			122 to 183 cm			183 to 244 cm		244 to 305 cm		0 to 25 cm		0 to 29 cm		0 to 25 cm		0 to 29 cm		0 to 30 cm																	
COC	Units	CUL	RAL	PTW																																				
Total PCBs	µg/kg	9	75	200																																				
TCDDeq	µg/kg	0.01			0.0168 JT	0.0175 JT	0.0192 JT	0.0141 JT	14975	0.0189 JT		0.00267 +JNT																												
HxCDF	µg/kg	0.0004		0.04	0.017 B	0.0098 B	0.015 B	0.011 B	0.017	0.028 B		0.00095 JB																												
PeCDD	µg/kg	0.0002	0.0008	0.01	0.0021 J	0.0024 J	0.0025 J	0.0019 J	0.0057 J	0.0017 JB		0.00033 Jq																												
PeCDF	µg/kg	0.0003	0.2	0.2	0.0038 J	0.0025 J	0.0028 J	0.0023 J	0.0011 B	0.0035 JB		0.00025 Jq																												
TCDD	µg/kg	0.0002	0.0006	0.01	0.0014 B	0.0014 B	0.0014 B	0.00098 B	520	0.00072 Jq		0.00034 Jq																												
TCDF	µg/kg	0.0040658		0.6	0.0061 B	0.0028 B	0.0026 B	0.0014 B	0.13	0.0023 B		0.00066 JB																												
Aldrin	µg/kg	2			0.08 U	0.079 U	0.079 U	0.079 U	0.079 U	0.085 U	0.098 U																													
Dieldrin	µg/kg	0.07			0.55	0.077 U	0.077 U	0.077 U	0.077 U	0.084 J	0.095 U																													
DDD	µg/kg	114				4.3315	3.5315	9.0315		1.834	1.639	0.96																												
DDE	µg/kg	50										2.31																												
DDT	µg/kg	246			0.4075	0.094	0.094	0.094	0.094	0.785	0.56	0.49																												
DDx	µg/kg	6.1	160	7050	14.4975	11.232	14.202	18.702	22.7705	6.209	5.159	3.76																												
Lindane	µg/kg	5			0.032 U	0.093 J	0.031 U	0.031 U	0.031 U	0.034 U	0.039 U																													
Chlordanes	µg/kg	0.51			1.21	1.395	1.195	0.863	0.9195	0.785	0.735																													
Arsenic	mg/kg	3			7.7	7	6.7	7.4	6.3	9.5																														
Cadmium	mg/kg	0.51			0.56	0.44	0.54	0.65	0.68	0.57																														
Copper	mg/kg	359			88	84	92	77	63	120 B																														
Lead	mg/kg	196			55	47	68	63	44	37																														
Mercury	mg/kg	0.085			0.54	0.35	0.5	0.83	0.98	0.19																														
Zinc	mg/kg	459			280	250	300	230	190	280																														
TBT	µg/kg	3080			420	78	15	8.7	0.79 U	700	180																													
Total cPAHs	µg/kg	774		106000	302.98 DT	171.8 DT	133.74 DT	169.25 DT	171.245 DXT	212.95 DT	150.19 DT	55.62 JT																												
Total PAHs	µg/kg	23000	30000		2790 DT	1666 DT	1282 DT	1806 DT	1918.115 DXT	1693.7 DT	1220.3 DJT	686.4 *JT																												
TPH-Diesel	mg/kg	91			520	400	630	590	660	51 J																														
Chlorobenzene	µg/kg																																							
Naphthalene	µg/kg				79 D	37 D	21 D	47 D	70 D	12 D	8.3 D	20 J																												
BEHP	µg/kg	135			290	110	140	43 J	21 J	620	470																													

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			S168	S169	S170	S171	S172	S173	S174	S175	S176	S177	S178
		Sample ID			PDI-SG-S168	PDI-SG-S169	PDI-SG-S170	PDI-SG-S171	PDI-SG-S172	PDI-SG-S173	PDI-SG-S174	PDI-SG-S175	PDI-SG-S176	PDI-SG-S177	PDI-SG-S178
		Sample Date			2018/06/24	2018/05/04	2018/05/04	2018/06/22	2018/05/03	2018/05/04	2018/06/22	2018/06/25	2018/06/02	2018/05/04	2018/05/04
		Sample Depth			0 to 30 cm	0 to 30 cm	0 to 30 cm	0 to 30 cm	0 to 30 cm	0 to 30 cm	0 to 30 cm	0 to 30 cm	0 to 26 cm	0 to 30 cm	0 to 30 cm
COC	Units	CUL	RAL	PTW											
Total PCBs	µg/kg	9	75	200	12.47073	77.04155	462.5920445	39.169885	55.02305	156.9433	68.05142	8.596665	2233.29185	156.355305	326.281165
TCDDeq	µg/kg	0.01			0.00256 +JNT	0.0053 +JNT	0.00832 +JNT	0.00308 +JT	0.00506 +JNT	0.00949 +JNT	0.00547 JNT	0.0019 +JNT	0.0111 +JNT	0.0106 +JT	0.0094 +JNT
HxCDF	µg/kg	0.0004		0.04	0.001 J	0.0025 J	0.0043 J	0.0014 J	0.0023 JB	0.0045 J	0.0023 J	0.00053 Jq	0.0059 B	0.0046 J	0.0047 J
PeCDD	µg/kg	0.0002	0.0008	0.01	0.00043 Jq	0.00095 J	0.0011 J	0.00057 J	0.00057 JB	0.0011 Jq	0.00069 J	0.00033 J	0.00041 U	0.0003 U	0.00097 Jq
PeCDF	µg/kg	0.0003	0.2	0.2	0.00026 J	0.00069 J	0.0012 J	0.00036 J	0.00071 JBq	0.00019 U	0.00056 J	0.00023 J	0.0017 J	0.0014 J	0.0013 J
TCDD	µg/kg	0.0002	0.0006	0.01	0.00029 Jq	0.00021 J	0.00062 Jq	0.0002 U	0.000075 U	0.00067 J	0.00044 Jq	0.0002 Jq	0.00096	0.00064 J	0.00055 Jq
TCDF	µg/kg	0.0040658		0.6	0.00046 J	0.0022 B	0.0018 B	0.00067 J	0.00063 JB	0.0018 B	0.00091 J	0.0004 J	0.0025 B	0.0033 B	0.0018 B
Aldrin	µg/kg	2													
Dieldrin	µg/kg	0.07													
DDD	µg/kg	114			1.325	1.8	3.6	1.41		2.2	1.89	2.1		2.4	2.05
DDE	µg/kg	50			1.825	5.1	8.4	2.01	1.6	4.5	2.205	3.2	14.45	5.4	4.75
DDT	µg/kg	246			0.995	1.2	6.6	1.11	2.17	3		2	19.9	1.45	1.52
DDx	µg/kg	6.1	160	7050	4.145	8.1	18.6	4.53	7.3	9.7	7.115	7.3	46.45	9.25	8.32
Lindane	µg/kg	5													
Chlordanes	µg/kg	0.51													
Arsenic	mg/kg	3													
Cadmium	mg/kg	0.51													
Copper	mg/kg	359													
Lead	mg/kg	196													
Mercury	mg/kg	0.085													
Zinc	mg/kg	459													
TBT	µg/kg	3080													
Total cPAHs	µg/kg	774		106000	34.568 JT	311.16 DT	316.07 DT	98.275 JT	160.77 DT	145.54 T	310.42 T	39.259 JT	746.99 DT	286.24 DT	164.96 T
Total PAHs	µg/kg	23000	30000		374.3 BJT	2490.5 DT	2516 DT	981.4 BJT	1584 DT	1282.6 T	3190 BT	470.3 BJT	5881 DT	2591 DT	1363.2 T
TPH-Diesel	mg/kg	91													
Chlorobenzene	µg/kg														
Naphthalene	µg/kg				12 B	18	39	20 B	51 D	16	89 B	15 B	38 D	47	21
BEHP	µg/kg	135													

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		S179	S180	S181	S182	S183	S184	S186	S187	S191	S193	S194	S198			
Sample ID		PDI-SG-S179	PDI-SG-S180	PDI-SG-S181	PDI-SG-S182	PDI-SG-S183	PDI-SG-S184	PDI-SG-S186	PDI-SG-S187	PDI-SG-S191	PDI-SG-S193	PDI-SG-S194	PDI-SG-S198			
Sample Date		2018/06/21	2018/05/04	2018/07/21	2018/06/22	2018/06/22	2018/06/21	2018/05/03	2018/06/19	2018/06/22	2018/05/03	2018/05/03	2018/05/03			
Sample Depth		0 to 30 cm	0 to 27 cm	0 to 28 cm	0 to 30 cm	0 to 28 cm	0 to 26 cm	0 to 30 cm	0 to 30 cm	0 to 30 cm						
COC	Units	CUL	RAL	PTW												
Total PCBs	µg/kg	9	75	200	247.79622	135.7528935	10.1284	238.82373	866.65175	2958.18	213.03697	114.444525	3904.4585	140.17605	154.815	366.811565
TCDDeq	µg/kg	0.01			0.0117 +JNT	0.0126 +JNT	0.00208 +JNT	0.0109 JNT	0.011 JNT	0.0677 JNT	0.0624 +JT	0.0134 JNT	0.0248 JT	0.0175 JNT	0.0235 JT	0.0153 JT
HxCDF	µg/kg	0.0004		0.04	0.0032 J	0.0057 J	0.00089 JB	0.0037 J	0.0048 J	0.021	0.0059 J	0.0058 J	0.0095	0.0057 J	0.007 J	0.0051 J
PeCDD	µg/kg	0.0002	0.0008	0.01	0.002 J	0.0012 J	0.00031 JB	0.0051 U	0.00078 Jq	0.0035 Jq	0.0027 J	0.00031 U	0.0012 U	0.0019 J	0.0021 J	0.0014 J
PeCDF	µg/kg	0.0003	0.2	0.2	0.00072 J	0.0013 J	0.00026 JB	0.0034 U	0.001 J	0.0057	0.0024 JB	0.0014 J	0.0034 J	0.0014 JB	0.0018 JB	0.0015 JB
TCDD	µg/kg	0.0002	0.0006	0.01	0.00042 Jq	0.00039 Jq	0.00014 Jq	0.0029 U	0.00057 Jq	0.0027	0.0011 J	0.00062 Jq	0.0023	0.00079 Jq	0.00091 J	0.00075 J
TCDF	µg/kg	0.0040658		0.6	0.0015	0.002 B	0.00056 JB	0.0016	0.0021	0.013	0.0022 B	0.0019	0.0062	0.0014 JB	0.0016 B	0.0017 B
Aldrin	µg/kg	2														
Dieldrin	µg/kg	0.07														
DDD	µg/kg	114				2.05	0.86				2.94	1.94		16.6	7.4	2.3
DDE	µg/kg	50			5.225	4.35	1.27	5.04	3.79	252.05	3.63	4.015	11.43	9.25	5.4	4.9
DDT	µg/kg	246				3.05	0.35	1.6			0.84	1.415	27.6	7	1.7	1.4
DDx	µg/kg	6.1	160	7050	18.125	9.45	2.48	21.105	16.39	989.05	7.41	7.37	58.73	32.85	14.5	8.6
Lindane	µg/kg	5														
Chlordanes	µg/kg	0.51														
Arsenic	mg/kg	3														
Cadmium	mg/kg	0.51														
Copper	mg/kg	359														
Lead	mg/kg	196														
Mercury	mg/kg	0.085														
Zinc	mg/kg	459														
TBT	µg/kg	3080														
Total cPAHs	µg/kg	774		106000	454.54 *T	154.01 T	33.421 JT	1093.76 T	877.79 T	5732.1 T	697.3 DT	132.22 *T	2031.7 12FT	331.83 DT	180.07 DT	267.25 DT
Total PAHs	µg/kg	23000	30000		4393 *BT	1496.8 T	327.5 *JT	10522 BT	9022 BT	58420 T	6603 DT	1433 *BJT	26134 12BFT	2886 DJT	1784.5 DJT	2547 DT
TPH-Diesel	mg/kg	91														
Chlorobenzene	µg/kg															
Naphthalene	µg/kg				50 B	20	31	220 B	65 B	320	30 D	33 B	420 F1B	24 D	19 D	26 D
BEHP	µg/kg	135														

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		S199	S200	S201	S2010	S2020	S203	S203	S2030	S204			
Sample ID		PDI-SG-S199	PDI-SG-S200	PDI-SG-S201	WLCOFJ02S0201S2010	WLCOFJ02S0202S2020	PDI-SG-S203	PDI-SG-S203-D	WLCOFJ02S0203S2030	PDI-SG-S204			
Sample Date		2018/06/17	2018/05/03	2018/05/03	2002/10/14	2002/10/14	2018/06/02	2018/06/02	2002/10/14	2018/05/03			
Sample Depth		0 to 18 cm	0 to 30 cm	0 to 30 cm	0 to 15 cm	0 to 15 cm	0 to 30 cm	0 to 30 cm	0 to 15 cm	0 to 17 cm			
COC	Units	CUL	RAL	PTW									
Total PCBs	µg/kg	9	75	200	21.87284	234.12762	421.1607		484.73205	871.8215	92.838675		
TCDDeq	µg/kg	0.01			0.00271 +JNT	0.0173 +JNT	0.0261 JNT		0.0383 +JNT	0.0469 +JNT	0.0145 +JNT		
HxCDF	µg/kg	0.0004		0.04	0.0016 J	0.0089	0.017		0.05 B	0.052 B	0.0037 B		
PeCDD	µg/kg	0.0002	0.0008	0.01	0.00021 J	0.0017 J	0.0013 Jq		0.0021 J	0.0021 J	0.00057 J		
PeCDF	µg/kg	0.0003	0.2	0.2	0.00034 J	0.0018 JB	0.0026 JB		0.0053 J	0.0052 J	0.00073 JB		
TCDD	µg/kg	0.0002	0.0006	0.01	0.000076 U	0.00075 Jq	0.0012 J		0.00089 J	0.0008 Jq	0.00022 JBq		
TCDF	µg/kg	0.0040658		0.6	0.00039 Jq	0.0013 B	0.0015 B		0.0021 B	0.003 B	0.00067 JB		
Aldrin	µg/kg	2					1.11 U		1.08 U		0.92 U		
Dieldrin	µg/kg	0.07					0.841 U		0.817 U		0.699 U		
DDD	µg/kg	114			2.7	2.82	2.5	2.56 UT	2.49 UT	4.9	3.8	2.13 UT	1.27
DDE	µg/kg	50			2.7	3.32	4.5	2.56 UT	2.49 UT	6.2	4.8	2.13 UT	1.21
DDT	µg/kg	246			2.7	0.76	1.8	2.56 UT	2.49 UT	2.2	1.6	2.13 UT	0.66
DDx	µg/kg	6.1	160	7050	2.7	6.9	8.8	2.56 UT	2.49 UT	13.3	10.2	2.13 UT	3.14
Lindane	µg/kg	5						0.979 U	0.952 U			0.815 U	
Chlordanes	µg/kg	0.51						3.61 UT	3.51 UT			3 UT	
Arsenic	mg/kg	3						1.49	1.97			3.52	
Cadmium	mg/kg	0.51						0.00194 U	0.00161 U			0.00168 U	
Copper	mg/kg	359						21.5	26.7			24.5	
Lead	mg/kg	196						12.2	8.76			8.46	
Mercury	mg/kg	0.085						0.0873	0.0218 J			0.0376	
Zinc	mg/kg	459						65.2	63.5			66.5	
TBT	µg/kg	3080											
Total cPAHs	µg/kg	774		106000	182.56 *T	224.13 DT	318.5 DT	21.0177 T	10.4442 T	1373.56 DT	311.48 DT	17.5145 T	89.746 DT
Total PAHs	µg/kg	23000	30000		2497 *BT	2071.9 DT	2462 DJT	263.665 JT	92.935 T	7468 DT	2575 DT	153.4 JT	989.3 DJT
TPH-Diesel	mg/kg	91						19.3	16.3			10.5	
Chlorobenzene	µg/kg												
Naphthalene	µg/kg				29 B	21 D	20 D	3.52	1.53 U	24 D	28 D	1.63 U	7.9 JD
BEHP	µg/kg	135						321	66.7			94	

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID					S2040	S2050	S208	S211	S213	S214	S215	S216	S220	S223
Sample ID					WLCOFJ02S0204S2040	WLCOFJ02S0205S2050	PDI-SG-S208	PDI-SG-S211	PDI-SG-S213	PDI-SG-S214	PDI-SG-S215	PDI-SG-S216	PDI-SG-S220	PDI-SG-S223
Sample Date					2002/10/14	2002/10/14	2018/04/29	2018/04/30	2018/04/30	2018/05/30	2018/04/30	2018/04/29	2018/04/30	2018/05/01
Sample Depth					0 to 15 cm	0 to 15 cm	0 to 30 cm	0 to 30 cm	0 to 30 cm	0 to 15 cm	0 to 30 cm	0 to 30 cm	0 to 30 cm	0 to 23 cm
COC	Units	CUL	RAL	PTW										
Total PCBs	µg/kg	9	75	200			259.14754	128.3907	193.20325	0.63805	135.3629615	147.803545	80.55901	154.933335
TCDDeq	µg/kg	0.01					0.0256 JNT	0.0205 JNT	0.0189 +JNT	0.00126 +JT	0.0244 JNT	0.0179 JNT	0.0121 JNT	0.0189 JNT
HxCDF	µg/kg	0.0004		0.04			0.037 B	0.025	0.02 q	0.00011 JB	0.034	0.02 B	0.009	0.018
PeCDD	µg/kg	0.0002	0.0008	0.01			0.0018 J	0.0004 U	0.002 J	0.000063 JB	0.0026 J	0.0019 Jq	0.0019 J	0.0027 J
PeCDF	µg/kg	0.0003	0.2	0.2			0.0045 JB	0.0043 J	0.0034 J	0.000044 JB	0.0057 J	0.004 JB	0.0025 J	0.0056 J
TCDD	µg/kg	0.0002	0.0006	0.01			0.00062 Jq	0.00071 Jq	0.00058 Jq	0.0011 B	0.00056 Jq	0.00074 Jq	0.00046 Jq	0.0007 Jq
TCDF	µg/kg	0.0040658		0.6			0.002 B	0.0019	0.0019	0.00013 JB	0.0022	0.0026 B	0.0019	0.0038
Aldrin	µg/kg	2			1.14 UJ	0.991 UJ								
Dieldrin	µg/kg	0.07			0.869 UJ	0.754 UJ								
DDD	µg/kg	114			2.65 UJT	2.3 UJT	2.74	2.67	2.51	0.75	3.2	2.33	2.65	3
DDE	µg/kg	50			2.65 UJT	2.3 UJT	4.17	4.48	5.01	0.79	5.92	4.635	3.955	5.195
DDT	µg/kg	246			2.65 UJT	2.3 UJT	0.89	1.19	1.41	0.94	1.39	0.985	0.755	0.865
DDx	µg/kg	6.1	160	7050	2.65 UJT	2.3 UJT	7.8	8.34	8.93	0.94	10.51	7.95	7.36	9.06
Lindane	µg/kg	5			1.01 UJ	0.878 UJ								
Chlordanes	µg/kg	0.51			3.73 UJT	3.23 UJT								
Arsenic	mg/kg	3			2.19	2.41								
Cadmium	mg/kg	0.51			0.00177 U	0.0017 U								
Copper	mg/kg	359			31.2	12.8								
Lead	mg/kg	196			18	4.59								
Mercury	mg/kg	0.085			0.213	0.0313								
Zinc	mg/kg	459			79.7	45.6								
TBT	µg/kg	3080												
Total cPAHs	µg/kg	774		106000	127.1362 T	15.001 T	280.24 DT	227.02 DT	255.08 DT	1.2593 JT	216.02 DT	219.02 DT	216.03 DT	273.18 DT
Total PAHs	µg/kg	23000	30000		840.22 T	141.22 JT	2428.1 DT	1882.2 DJT	2084.6 DT	14.265 JT	1972.4 DT	1883.2 DT	2158.5 DT	2658 DT
TPH-Diesel	mg/kg	91			22.9	5.61								
Chlorobenzene	µg/kg													
Naphthalene	µg/kg				5.48	1.73 J	12 D	16 D	19 D	0.44 J	17 D	17 D	17 D	38 D
BEHP	µg/kg	135			108	45.7								

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		S224	S225	S229	S230	S231	S233	S234	S235	S236	S238	S239	S240			
Sample ID		PDI-SG-S224	PDI-SG-S225	PDI-SG-S229	PDI-SG-S230	PDI-SG-S231	PDI-SG-S233	PDI-SG-S234	PDI-SG-S235	PDI-SG-S236	PDI-SG-S238	PDI-SG-S239	PDI-SG-S240			
Sample Date		2018/06/20	2018/05/01	2018/06/20	2018/05/01	2018/05/01	2018/05/02	2018/05/01	2018/05/01	2018/05/02	2018/05/01	2018/05/02	2018/05/22			
Sample Depth		0 to 24 cm	0 to 25 cm	0 to 28 cm	0 to 27 cm	0 to 28 cm	0 to 24 cm	0 to 29 cm	0 to 29 cm	0 to 30 cm	0 to 28 cm	0 to 28 cm	0 to 16 cm			
COC	Units	CUL	RAL	PTW												
Total PCBs	µg/kg	9	75	200	24.08863	115.897615	75.22735	82.36226	86.985414	84.81165	79.2646985	92.75185	37.167395	92.060395	104.91091	0.4235595
TCDDeq	µg/kg	0.01			0.00787 JNT	0.0146 +JNT	0.0222 JT	0.0155 +JNT	0.0151 JNT	0.0181 JNT	0.0171 JNT	0.0179 +JNT	0.00603 +JNT	0.0222 +JNT	0.0168 JNT	0.00455 +JT
HxCDF	µg/kg	0.0004		0.04	0.0048	0.0039 Jq	0.016	0.0092	0.0093	0.0084	0.0087	0.01	0.0036 J	0.012	0.0072 J	0.0016 JB
PeCDD	µg/kg	0.0002	0.0008	0.01	0.0011 J	0.0022 J	0.0027 J	0.0025 J	0.0023 J	0.0028 J	0.0027 J	0.003 J	0.0012 J	0.0036 J	0.0035 J	0.0003 JB
PeCDF	µg/kg	0.0003	0.2	0.2	0.00087 J	0.0029 J	0.0034 J	0.0028 J	0.0027 J	0.0025 JB	0.0028 J	0.0029 J	0.0011 JB	0.0032 J	0.0025 JB	0.00052 JB
TCDD	µg/kg	0.0002	0.0006	0.01	0.00035 Jq	0.00058 Jq	0.0013 J	0.00075 Jq	0.00074 J	0.00092 Jq	0.00064 Jq	0.00072 Jq	0.00033 Jq	0.0009 Jq	0.00089 J	0.0032 B
TCDF	µg/kg	0.0040658		0.6	0.00081 J	0.0026	0.003	0.0031	0.0025	0.002 B	0.0025	0.0027	0.0011 B	0.0029	0.0026 B	0.00024 JB
Aldrin	µg/kg	2														
Dieldrin	µg/kg	0.07														
DDD	µg/kg	114			0.88	3.13	1.54	2.51	2.81	2.75	2.26	2.52	1.48	2.95	3.45	0.64
DDE	µg/kg	50			1.39	5.85	4.44	4.69	5.4	4.75	4.525	4.485	2.35	5.68	5.55	0.79
DDT	µg/kg	246			0.38	0.88	0.75	1	1.06	1.5	0.955	0.765	1.1	0.92	1.5	0.94
DDx	µg/kg	6.1	160	7050	2.65	9.86	6.73	8.2	9.27	9	7.74	7.77	4.93	9.55	10.5	0.94
Lindane	µg/kg	5														
Chlordanes	µg/kg	0.51														
Arsenic	mg/kg	3														
Cadmium	mg/kg	0.51														
Copper	mg/kg	359														
Lead	mg/kg	196														
Mercury	mg/kg	0.085														
Zinc	mg/kg	459														
TBT	µg/kg	3080														
Total cPAHs	µg/kg	774		106000	223.31 *T	247.11 DT	257.28 *T	184.86 DT	217.04 DT	223.92 DT	203.96 DT	212.97 DT	126.81 T	244.06 DT	270.24 DT	20.517 T
Total PAHs	µg/kg	23000	30000		5631 *BT	2204 DT	3184 *BJT	1786.2 DT	2225.9 DT	2260 DT	1852.7 DJT	1862 DT	1296 DT	2062 DT	2304 DT	169.77 JT
TPH-Diesel	mg/kg	91														
Chlorobenzene	µg/kg															
Naphthalene	µg/kg				11 B	30 D	44 B	23 D	50 D	19 D	20 D	29 D	15	24 D	24 D	0.54 J
BEHP	µg/kg	135														

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID				S240	S241	S242	SC-S172	SC-S172	SC-S172	SC-S172	SC-S172	SC-S176	
Sample ID				PDI-SG-S240-D	PDI-SG-S241	PDI-SG-S242	PDI-SC-S172-0to2	PDI-SC-S172-2to4	PDI-SC-S172-2to4D	PDI-SC-S172-4to6	PDI-SC-S172-6to8.1	PDI-SC-S176-0to2	
Sample Date				2018/05/22	2018/05/01	2018/05/02	2018/08/02	2018/08/02	2018/08/02	2018/08/02	2018/08/02	2018/08/08	
Sample Depth				0 to 16 cm	0 to 28 cm	0 to 21 cm	0 to 61 cm	61 to 122 cm	61 to 122 cm	122 to 183 cm	183 to 247 cm	0 to 61 cm	
COC	Units	CUL	RAL	PTW									
Total PCBs	µg/kg	9	75	200	0.342769	84.323025	4.114675	178.8	171.1	151.4	37.4	16.4	26.3
TCDDeq	µg/kg	0.01			0.000936 +JNT	0.0112 JNT	0.00528 +JT	0.0119 JNT	0.0149 JNT	0.0118 JNT	0.00229 +JT	0.00216 +JNT	0.0034 JNT
HxCDF	µg/kg	0.0004		0.04	0.0011 JB	0.0056 J	0.0044	0.0057 J	0.0071	0.0061	0.0013 J	0.0012 J	0.0013 Jq
PeCDD	µg/kg	0.0002	0.0008	0.01	0.00016 JB	0.0019 J	0.00044 J	0.0005 U	0.0012 Jq	0.0013 J	0.00027 J	0.00031 J	0.00041 J
PeCDF	µg/kg	0.0003	0.2	0.2	0.00034 JB	0.0021 J	0.0011 JB	0.0013 Jq	0.0024 J	0.0021 J	0.00043 J	0.00028 Jq	0.00057 J
TCDD	µg/kg	0.0002	0.0006	0.01	0.00013 JBq	0.00078 Jq	0.00021 J	0.00046 Jq	0.0011 q	0.00052 Jq	0.00026 J	0.00014 Jq	0.00018 Jq
TCDF	µg/kg	0.0040658		0.6	0.00016 JB	0.0027	0.0013 B	0.0046 G	0.0028	0.0026	0.00052 J	0.00055 J	0.00051 JB
Aldrin	µg/kg	2											
Dieldrin	µg/kg	0.07											
DDD	µg/kg	114			0.64	4.5	0.67					3.97	3.78
DDE	µg/kg	50			0.79	5.31	0.79	4.886	10.514	10.903	2.995	1.706	4.555
DDT	µg/kg	246			0.94	0.67	0.94	0.707			4.3725	1.146	0.1505
DDx	µg/kg	6.1	160	7050	0.94	10.48	0.94	12.983	38.174	37.503	22.1375	6.822	8.4855
Lindane	µg/kg	5											
Chlordanes	µg/kg	0.51											
Arsenic	mg/kg	3											
Cadmium	mg/kg	0.51											
Copper	mg/kg	359											
Lead	mg/kg	196											
Mercury	mg/kg	0.085											
Zinc	mg/kg	459											
TBT	µg/kg	3080											
Total cPAHs	µg/kg	774		106000	17.722 T	221.89 DT	38.987 T	321.82 HJT	1097.78 BT	367.48 BJT	520.6 BT	569.58 BT	184.66 BJT
Total PAHs	µg/kg	23000	30000		136.11 JT	2160 DT	421.2 T	3985 BHJT	10770 BT	5508 BJT	7102 BT	8383 BT	3050 BJT
TPH-Diesel	mg/kg	91											
Chlorobenzene	µg/kg												
Naphthalene	µg/kg				0.44 J	140 D	2.2	220 JHB	310 B	440 B	620 B	550 B	250 B
BEHP	µg/kg	135											

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			SC-S176	SC-S176	SC-S176	SC-S176	SC-S178	SC-S178	SC-S178
		Sample ID			PDI-SC-S176-2to4	PDI-SC-S176-4to5.5	PDI-SC-S176-5.5to7.5	PDI-SC-S176-7.5to9.6	PDI-SC-S178-0to2	PDI-SC-S178-10.7to12.7	PDI-SC-S178-12.7to14
		Sample Date			2018/08/08	2018/08/08	2018/08/08	2018/08/08	2018/08/02	2018/08/02	2018/08/02
		Sample Depth			61 to 122 cm	122 to 168 cm	168 to 229 cm	229 to 293 cm	0 to 61 cm	326 to 387 cm	387 to 427 cm
COC	Units	CUL	RAL	PTW							
Total PCBs	µg/kg	9	75	200	42.9	18.7	8.77	2.8	332	2.9	2.9
TCDDeq	µg/kg	0.01			0.00456 JNT	0.00124 +JNT	0.000266 +JNT	0.00012 +JNT	0.0182 JNT	0.0000955 JT	0.000125 +JT
HxCDF	µg/kg	0.0004		0.04	0.00091 U	0.0002 U	0.00025 J	0.0001 J	0.01	0.000066 U	0.00009 U
PeCDD	µg/kg	0.0002	0.0008	0.01	0.00061 J	0.00017 J	0.000032 Jq	0.000023 U	0.002 Jq	0.000065 U	0.000077 U
PeCDF	µg/kg	0.0003	0.2	0.2	0.0012 J	0.00013 U	0.000052 Jq	0.000019 U	0.0026 J	0.000032 U	0.000038 U
TCDD	µg/kg	0.0002	0.0006	0.01	0.00026 Jq	0.000023 U	0.000015 U	0.000015 U	0.002	0.000056 U	0.000055 U
TCDF	µg/kg	0.0040658		0.6	0.0012 B	0.00063 JB	0.0001 JBq	0.000046 JB	0.0039	0.000026 U	0.000026 U
Aldrin	µg/kg	2									
Dieldrin	µg/kg	0.07									
DDD	µg/kg	114				0.396	0.2288	0.038	5.31	0.043	0.05
DDE	µg/kg	50			5.042	0.3114	0.1296	0.0988	12.41	0.031	0.056
DDT	µg/kg	246			0.5505	0.11	0.084	0.272		0.08	0.195
DDx	µg/kg	6.1	160	7050	15.5325	0.7724	0.4109	0.4023	27.9	0.08	0.195
Lindane	µg/kg	5									
Chlordanes	µg/kg	0.51									
Arsenic	mg/kg	3									
Cadmium	mg/kg	0.51									
Copper	mg/kg	359									
Lead	mg/kg	196									
Mercury	mg/kg	0.085									
Zinc	mg/kg	459									
TBT	µg/kg	3080									
Total cPAHs	µg/kg	774		106000	338.32 BJT	127.18 BJT	23.274 *JT	20.169 *JT	554.99 BT	1.693 JT	1.4049 JT
Total PAHs	µg/kg	23000	30000		5523 1BFJT	1945 BJT	418.2 *BJT	361.8 *BJT	6333 BT	13.71 BJT	17.3 BJT
TPH-Diesel	mg/kg	91									
Chlorobenzene	µg/kg										
Naphthalene	µg/kg				280 B	100 B	64 B	65 B	140 B	0.75 JB	0.78 JB
BEHP	µg/kg	135									

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			SC-S178	SC-S178	SC-S178	SC-S178	SC-S178	SC-S185	SC-S185
		Sample ID			PDI-SC-S178-2to3.7	PDI-SC-S178-3.7to4.7	PDI-SC-S178-4.7to6.7	PDI-SC-S178-6.7to8.7	PDI-SC-S178-8.7to10.7	PDI-SC-S185-0to2	PDI-SC-S185-2to4
		Sample Date			2018/08/02	2018/08/02	2018/08/02	2018/08/02	2018/08/02	2018/07/26	2018/07/26
		Sample Depth			61 to 113 cm	113 to 143 cm	143 to 204 cm	204 to 265 cm	265 to 326 cm	0 to 61 cm	61 to 122 cm
COC	Units	CUL	RAL	PTW							
Total PCBs	µg/kg	9	75	200	121.4	44.6	9.92	2.9	2.9	9.5	9.7
TCDDeq	µg/kg	0.01			0.0111 JNT	0.00664 JNT	0.000146 JNT	0.000218 JNT	0.00022 JNT	0.000549 JNT	0.00045 JNT
HxCDF	µg/kg	0.0004		0.04	0.0055	0.0034 J	0.000078 U	0.000043 U	0.000028 U	0.00015 U	0.00018 Jq
PeCDD	µg/kg	0.0002	0.0008	0.01	0.0014 J	0.00075 J	0.000056 U	0.000041 U	0.000034 U	0.00009 J	0.000071 U
PeCDF	µg/kg	0.0003	0.2	0.2	0.0015 J	0.00092 J	0.000052 U	0.000029 U	0.000021 U	0.000044 U	0.000049 U
TCDD	µg/kg	0.0002	0.0006	0.01	0.00073 Jq	0.00042 Jq	0.000031 U	0.00012 Jq	0.00016 Jq	0.00011 Jq	0.0002 Jq
TCDF	µg/kg	0.0040658		0.6	0.0013	0.00074 J	0.000028 U	0.000011 U	0.0000095 U	0.000067 Jq	0.000063 Jq
Aldrin	µg/kg	2									
Dieldrin	µg/kg	0.07									
DDD	µg/kg	114				3.86	0.131	0.052	0.022	4.895	0.711
DDE	µg/kg	50			11.42	4.816	0.2205	0.0779	0.016	0.5925	0.2712
DDT	µg/kg	246				1.207	0.041	0.193	0.055	0.716	0.33
DDx	µg/kg	6.1	160	7050	98	9.883	0.3505	0.193	0.055	6.2035	1.3122
Lindane	µg/kg	5									
Chlordanes	µg/kg	0.51									
Arsenic	mg/kg	3									
Cadmium	mg/kg	0.51									
Copper	mg/kg	359									
Lead	mg/kg	196									
Mercury	mg/kg	0.085									
Zinc	mg/kg	459									
TBT	µg/kg	3080									
Total cPAHs	µg/kg	774		106000	355.22 BT	122.64 BJT	8.6409 BJT	2.4093 JT	11.2352 JT	19.902 JT	11.9636 JT
Total PAHs	µg/kg	23000	30000		4371 BT	1850 BJT	116.1 BJT	16.37 BJT	30.18 BJT	227.8 BJT	125.6 BJT
TPH-Diesel	mg/kg	91									
Chlorobenzene	µg/kg										
Naphthalene	µg/kg				190 B	100 B	5.7 JB	0.79 JB	1 JB	8.6 J	5.7 J
BEHP	µg/kg	135									

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID Sample ID Sample Date Sample Depth					SC-S185 PDI-SC-S185-4to5.5 2018/07/26 122 to 168 cm	SC-S185 PDI-SC-S185-5.5to6.5 2018/07/26 168 to 198 cm	SC-S188 PDI-SC-S188-0to1.5 2018/08/08 0 to 46 cm	SC-S191 PDI-SC-S191-0to2 2018/08/08 0 to 61 cm	SC-S191 PDI-SC-S191-2to4 2018/08/08 61 to 122 cm	SC-S191 PDI-SC-S191-4to6 2018/08/08 122 to 183 cm	SC-S191 PDI-SC-S191-6to8.1 2018/08/08 183 to 247 cm	SC-S192 PDI-SC-S192-0to1.5 2018/08/08 0 to 46 cm
COC	Units	CUL	RAL	PTW								
Total PCBs	µg/kg	9	75	200	9.9	9.8	550	304.4	1810	819	288.4	1998
TCDDeq	µg/kg	0.01			0.000189 JNT	0.000334 +JNT	0.0118 +JNT	0.0122 JNT	0.0195 JNT	0.0231 JNT	0.00798 JNT	0.285 JT
HxCDF	µg/kg	0.0004		0.04	0.00014 J	0.000054 U	0.0052 J	0.0065	0.0092	0.012	0.0038	0.17 G
PeCDD	µg/kg	0.0002	0.0008	0.01	0.000044 U	0.000046 Jq	0.0015 J	0.0014 Jq	0.0016 Jq	0.0032 J	0.0008 Jq	0.03
PeCDF	µg/kg	0.0003	0.2	0.2	0.000038 U	0.00007 J	0.0017 J	0.0014 J	0.0033 J	0.0032 J	0.00094 J	0.019
TCDD	µg/kg	0.0002	0.0006	0.01	0.000029 U	0.00017 Jq	0.00095 J	0.00077 Jq	0.0013	0.0026	0.0011	0.0057
TCDF	µg/kg	0.0040658		0.6	0.000049 J	0.00012 JB	0.013 B	0.0073 B	0.0067 B	0.005 B	0.00076 B	0.032 B
Aldrin	µg/kg	2										
Dieldrin	µg/kg	0.07										
DDD	µg/kg	114			0.59	0.21	2.038	5.41	24.88	16.13	15.75	13
DDE	µg/kg	50			0.3147	0.1	7.696	7.474	19.237	18.76	3.468	17.084
DDT	µg/kg	246			0.3395	0.27	2.033	5.51	55.2	13.99	1.1	8.88
DDx	µg/kg	6.1	160	7050	1.2442	0.27	11.767	18.394	99.317	48.88	20.318	38.964
Lindane	µg/kg	5										
Chlordanes	µg/kg	0.51										
Arsenic	mg/kg	3										
Cadmium	mg/kg	0.51										
Copper	mg/kg	359										
Lead	mg/kg	196										
Mercury	mg/kg	0.085										
Zinc	mg/kg	459										
TBT	µg/kg	3080										
Total cPAHs	µg/kg	774		106000	130.83 T	7.175 JT	4808.6 *T	1561.9 *T	1807.8 *T	1958.6 *T	502.99 *T	12975.6 *T
Total PAHs	µg/kg	23000	30000		6746.1 BJT	51.35 BJT	50470 *BT	16667 *BT	17823 *BT	17969 *BT	4525 *BT	124090 *BT
TPH-Diesel	mg/kg	91										
Chlorobenzene	µg/kg											
Naphthalene	µg/kg				4.3 J	3.6 JB	280 B	200 B	75 B	180 B	100 B	540 B
BEHP	µg/kg	135										

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID Sample ID Sample Date Sample Depth					SC-S192 PDI-SC-S192-1.5to3 2018/08/08 46 to 91 cm	SC-S192 PDI-SC-S192-3to4.2 2018/08/08 91 to 128 cm	SC-S198 PDI-SC-S198-0to2 2018/08/08 0 to 61 cm	SC-S198 PDI-SC-S198-10to11.8 2018/08/08 305 to 360 cm	SC-S198 PDI-SC-S198-2to4 2018/08/08 61 to 122 cm	SC-S198 PDI-SC-S198-2TO4D 2018/08/08 61 to 122 cm	SC-S198 PDI-SC-S198-4to6 2018/08/08 122 to 183 cm	SC-S198 PDI-SC-S198-6to8 2018/08/08 183 to 244 cm
COC	Units	CUL	RAL	PTW								
Total PCBs	µg/kg	9	75	200	1643	198	542.9	2.7	171.4	180.8	102.3	19.4
TCDDeq	µg/kg	0.01			0.184 JT	0.0138 JNT	0.0178 +JNT	0.00009 +JNT	0.0114 +JNT	0.0101 JNT	0.00494 JNT	0.000546 +JNT
HxCDF	µg/kg	0.0004		0.04	0.12 G	0.008	0.011	0.000045 U	0.0063	0.0059	0.0029 J	0.000094 U
PeCDD	µg/kg	0.0002	0.0008	0.01	0.019	0.0012 J	0.0016 Jq	0.000032 U	0.0012 Jq	0.001 Jq	0.00043 Jq	0.000095 J
PeCDF	µg/kg	0.0003	0.2	0.2	0.011	0.00088 J	0.0029 J	0.000023 U	0.0014 J	0.0015 J	0.00052 J	0.000035 U
TCDD	µg/kg	0.0002	0.0006	0.01	0.0036	0.0003 Jq	0.0011	0.000035 U	0.0008 Jq	0.00071 Jq	0.0003 Jq	0.000046 U
TCDF	µg/kg	0.0040658		0.6	0.018 B	0.0015 B	0.0043 B	0.000017 U	0.0015 B	0.0017 B	0.00078 JB	0.00011 JB
Aldrin	µg/kg	2										
Dieldrin	µg/kg	0.07										
DDD	µg/kg	114			6.43	1.556	3.011	0.0632	2.772	2.835	1.2	0.193
DDE	µg/kg	50			9.314	1.6066	10.955	0.0582	10.283	10.72	2.907	0.3538
DDT	µg/kg	246			8.15	1.103	2.965	0.16	0.569	0.41	1.183	0.284
DDx	µg/kg	6.1	160	7050	23.894	4.2656	16.931	0.2043	13.624	13.845	5.29	0.7033
Lindane	µg/kg	5										
Chlordanes	µg/kg	0.51										
Arsenic	mg/kg	3										
Cadmium	mg/kg	0.51										
Copper	mg/kg	359										
Lead	mg/kg	196										
Mercury	mg/kg	0.085										
Zinc	mg/kg	459										
TBT	µg/kg	3080										
Total cPAHs	µg/kg	774		106000	9269.2 *T	971.93 *T	319.42 *T	3.621 *JT	164.84 *JT	167.84 *JT	89.448 *T	4.8102 *JT
Total PAHs	µg/kg	23000	30000		91160 *BT	9417 *BT	3193 *BT	9.49 *BJT	2335 *BJT	2295 *BJT	1104.9 *BT	65.72 *BJT
TPH-Diesel	mg/kg	91										
Chlorobenzene	µg/kg											
Naphthalene	µg/kg				450 B	12 U	51 B	1.2 JB	97 B	130 B	35 B	2.9 B
BEHP	µg/kg	135										

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			SC-S198	SC-S203	SC-S203	SC-S203	SC-S203	SC-S203	SC-S203	SC-S203
		Sample ID			PDI-SC-S198-8to10	PDI-SC-S203-0to2	PDI-SC-S203-10to12	PDI-SC-S203-12to13.8	PDI-SC-S203-2to4	PDI-SC-S203-4to6	PDI-SC-S203-6to8	PDI-SC-S203-8to10
		Sample Date			2018/08/08	2018/08/03	2018/08/03	2018/08/03	2018/08/03	2018/08/03	2018/08/03	2018/08/03
		Sample Depth			244 to 305 cm	0 to 61 cm	305 to 366 cm	366 to 421 cm	61 to 122 cm	122 to 183 cm	183 to 244 cm	244 to 305 cm
COC	Units	CUL	RAL	PTW								
Total PCBs	µg/kg	9	75	200	3	4450	2.9	2.7	6040	178.4	11.8	11.6
TCDDeq	µg/kg	0.01			0.000153 +JNT	0.0358 JT	0.0000873 JNT	0.0000726 JNT	0.0429 JNT	0.00214 +JT	0.000192 JNT	0.000097 JNT
HxCDF	µg/kg	0.0004		0.04	0.000063 J	0.048	0.00006 U	0.000057 U	0.055 G	0.0029 J	0.0002 U	0.000074 U
PeCDD	µg/kg	0.0002	0.0008	0.01	0.00002 U	0.0021 J	0.000038 U	0.000031 U	0.0011 U	0.00011 U	0.00011 U	0.000037 U
PeCDF	µg/kg	0.0003	0.2	0.2	0.000018 U	0.0057	0.00002 U	0.000024 U	0.0057	0.00037 J	0.00007 U	0.000019 U
TCDD	µg/kg	0.0002	0.0006	0.01	0.000063 U	0.0013	0.00002 U	0.000013 U	0.0025	0.000022 U	0.0001 U	0.000033 U
TCDF	µg/kg	0.0040658		0.6	0.000016 JB	0.0066	0.0000095 U	0.00001 U	0.0045	0.00049 J	0.000055 U	0.000011 U
Aldrin	µg/kg	2										
Dieldrin	µg/kg	0.07										
DDD	µg/kg	114			0.0458	5.47	0.053	0.049		2.407	0.0944	0.216
DDE	µg/kg	50			0.0576	10.24	0.0511	0.0402		1.5435	0.0782	0.1526
DDT	µg/kg	246			0.12	2.097	0.152	0.051	6.52	0.16	0.115	0.439
DDx	µg/kg	6.1	160	7050	0.12	17.807	0.2561	0.051	56.57	4.065	0.2876	0.8076
Lindane	µg/kg	5										
Chlordanes	µg/kg	0.51										
Arsenic	mg/kg	3										
Cadmium	mg/kg	0.51										
Copper	mg/kg	359										
Lead	mg/kg	196										
Mercury	mg/kg	0.085										
Zinc	mg/kg	459										
TBT	µg/kg	3080										
Total cPAHs	µg/kg	774		106000	2.47012 *JT	544.33 BT	1.8394 BJT	12.2274 2BFJT	800.96 BT	102.27 BT	7.4524 BJT	2.5715 BJT
Total PAHs	µg/kg	23000	30000		14.56 *BJT	7514 BT	18.73 BJT	39.28 2BFJT	9919 BT	1555 BT	55.05 BJT	28.54 BJT
TPH-Diesel	mg/kg	91										
Chlorobenzene	µg/kg											
Naphthalene	µg/kg				1.5 JB	160 B	0.69 J	1.2 JF2B	210	24 B	2.1 JB	0.87 J
BEHP	µg/kg	135										

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			SC-S213	SC-S213	SC-S213	SC-S213	SC-S213	SC-S213	SC-S213	SC-S219
		Sample ID			PDI-SC-S213-0to2	PDI-SC-S213-10to11.8	PDI-SC-S213-11.8to12.8	PDI-SC-S213-2to4	PDI-SC-S213-4to6	PDI-SC-S213-6to8	PDI-SC-S213-8to10	PDI-SC-S219-0to2
		Sample Date			2018/08/09	2018/08/09	2018/08/09	2018/08/09	2018/08/09	2018/08/09	2018/08/09	2018/08/07
		Sample Depth			0 to 61 cm	305 to 360 cm	360 to 390 cm	61 to 122 cm	122 to 183 cm	183 to 244 cm	244 to 305 cm	0 to 61 cm
COC	Units	CUL	RAL	PTW								
Total PCBs	µg/kg	9	75	200	100.4	251.7	97.1	335.6	243.5	192	318.5	44.6
TCDDeq	µg/kg	0.01			0.0168 +JT	0.0122 JNT	0.0138 JNT	0.0203 +JNT	0.0237 JT	0.0199 JNT	0.0146 JNT	0.013 +JNT
HxCDF	µg/kg	0.0004		0.04	0.023	0.007	0.011	0.045	0.031	0.017	0.021	0.017
PeCDD	µg/kg	0.0002	0.0008	0.01	0.0016 J	0.0015 J	0.0014 J	0.0015 J	0.0024 J	0.0025 J	0.0015 J	0.0015 J
PeCDF	µg/kg	0.0003	0.2	0.2	0.0035 J	0.0021 J	0.0022 J	0.004 J	0.0038 J	0.0029 J	0.0025 J	0.0028 J
TCDD	µg/kg	0.0002	0.0006	0.01	0.00035 U	0.0011	0.00056 Jq	0.00061 Jq	0.0012	0.0013 q	0.00078 J	0.0005 Jq
TCDF	µg/kg	0.0040658		0.6	0.0037 B	0.0014	0.0012 G	0.0026 B	0.008 B	0.005 G	0.0013 q	0.0029
Aldrin	µg/kg	2										
Dieldrin	µg/kg	0.07										
DDD	µg/kg	114			1.838	9.32	6.87	1.563	2.833	6.34	8.01	
DDE	µg/kg	50			4.044	11.22	5.222	3.839	6.626	9.943	14.6	5.923
DDT	µg/kg	246			0.835	0.588	0.258	1.36	1	1.134	0.62	0.607
DDx	µg/kg	6.1	160	7050	6.717	21.128	12.2415	6.762	10.459	17.417	23.23	16.39
Lindane	µg/kg	5										
Chlordanes	µg/kg	0.51										
Arsenic	mg/kg	3										
Cadmium	mg/kg	0.51										
Copper	mg/kg	359										
Lead	mg/kg	196										
Mercury	mg/kg	0.085										
Zinc	mg/kg	459										
TBT	µg/kg	3080										
Total cPAHs	µg/kg	774		106000	270.45 JT	264.11 JT	301.1 JT	281.37 JT	415.2 JT	323.3 JT	358.63 JT	399.53 BJT
Total PAHs	µg/kg	23000	30000		2615 BJT	4579 BJT	4912 BJT	3007 BJT	5219 BJT	4869 BJT	5657 BJT	7751 BJT
TPH-Diesel	mg/kg	91										
Chlorobenzene	µg/kg											
Naphthalene	µg/kg				54 JB	280 B	310 B	53 JB	190 B	220 B	130 B	610 B
BEHP	µg/kg	135										

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			SC-S219	SC-S219	SC-S229	SC-S229	SC-S229	SC-S229	SC-S229	SC-S229
		Sample ID			PDI-SC-S219-2to4	PDI-SC-S219-4to5.2	PDI-SC-S229-0to2	PDI-SC-S229-2to4	PDI-SC-S229-4to6	PDI-SC-S229-6to8	PDI-SC-S229-8to9.9	PDI-SC-S229-9.9to12.5
		Sample Date			2018/08/07	2018/08/07	2018/08/09	2018/08/09	2018/08/09	2018/08/09	2018/08/09	2018/08/09
		Sample Depth			61 to 122 cm	122 to 158 cm	0 to 61 cm	61 to 122 cm	122 to 183 cm	183 to 244 cm	244 to 302 cm	302 to 381 cm
COC	Units	CUL	RAL	PTW								
Total PCBs	µg/kg	9	75	200	2.7	9.7	143.5	33.6	10.2	2.7	2.6	2.7
TCDDeq	µg/kg	0.01			0.000274 JNT	0.000114 +JNT	0.0166 JNT	0.00495 JNT	0.000882 JNT	0.000345 JNT	0.000319 JNT	0.000383 JT
HxCDF	µg/kg	0.0004		0.04	0.00017 U	0.000024 U	0.012	0.0027 J	0.00045 J	0.00024 U	0.00015 U	0.00023 U
PeCDD	µg/kg	0.0002	0.0008	0.01	0.00017 U	0.00002 U	0.0023 J	0.00042 U	0.00021 U	0.00026 U	0.00029 U	0.00034 U
PeCDF	µg/kg	0.0003	0.2	0.2	0.00011 U	0.000014 U	0.0027 J	0.00057 Jq	0.00015 U	0.00024 U	0.00018 U	0.00021 U
TCDD	µg/kg	0.0002	0.0006	0.01	0.000094 U	0.000038 Jq	0.0011 q	0.00034 Jq	0.00014 U	0.00016 U	0.00015 U	0.00016 U
TCDF	µg/kg	0.0040658		0.6	0.000062 U	0.000036 JB	0.0047	0.00061 J	0.00011 U	0.0001 U	0.00008 U	0.000097 U
Aldrin	µg/kg	2										
Dieldrin	µg/kg	0.07										
DDD	µg/kg	114			0.057	0.728	2.553	6.8	0.236	0.022	0.029	0.082
DDE	µg/kg	50			0.0689	3.7084	7.338	4.145	0.1808	0.016	0.0493	0.1105
DDT	µg/kg	246			0.1765	0.2105	0.643	0.41	0.097	0.027	0.047	0.082
DDx	µg/kg	6.1	160	7050	0.2879	4.6469	10.534	11.177	0.4778	0.027	0.1158	0.23
Lindane	µg/kg	5										
Chlordanes	µg/kg	0.51										
Arsenic	mg/kg	3										
Cadmium	mg/kg	0.51										
Copper	mg/kg	359										
Lead	mg/kg	196										
Mercury	mg/kg	0.085										
Zinc	mg/kg	459										
TBT	µg/kg	3080										
Total cPAHs	µg/kg	774		106000	1.2 UBJT	4.4597 BJT	264.99 JT	121.5 JT	7.4992 JT	2.25823 JT	2.508 JT	4.221 JT
Total PAHs	µg/kg	23000	30000		16.75 BJT	40.44 BJT	2815 BJT	1578 BJT	100.69 BJT	11.37 BJT	9.36 BJT	11.05 BJT
TPH-Diesel	mg/kg	91										
Chlorobenzene	µg/kg											
Naphthalene	µg/kg				2.2 B	3.1 JB	110 B	65 B	6.8 B	1.4 JB	1.2 JB	1.4 JB
BEHP	µg/kg	135										

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

		Map Station ID			SC-S230	SC-S230	SC-S230	SC-S230	SC-S230	SC-S230	SC-S238	SC-S238
		Sample ID			PDI-SC-S230-0to2	PDI-SC-S230-10to11.4	PDI-SC-S230-2to4	PDI-SC-S230-4to6	PDI-SC-S230-6to8	PDI-SC-S230-8to10	PDI-SC-S238-0to2	PDI-SC-S238-10to12.4
		Sample Date			2018/08/10	2018/08/08	2018/08/10	2018/08/10	2018/08/10	2018/08/08	2018/08/09	2018/08/09
		Sample Depth			0 to 61 cm	305 to 347 cm	61 to 122 cm	122 to 183 cm	183 to 244 cm	244 to 305 cm	0 to 61 cm	305 to 378 cm
COC	Units	CUL	RAL	PTW								
Total PCBs	µg/kg	9	75	200	26.8	65.5	39.3	42.8	55.5	45.8	65	294
TCDDeq	µg/kg	0.01			0.0139 +JT	0.0176 JT	0.0209 JT	0.0129 +JT	0.0155 JNT	0.0161 +JT	0.0133 JNT	0.0205 JNT
HxCDF	µg/kg	0.0004		0.04	0.005 J	0.006	0.01	0.0046 J	0.0049	0.0051	0.0055	0.0093
PeCDD	µg/kg	0.0002	0.0008	0.01	0.0023 J	0.002 J	0.0025 J	0.0018 J	0.0018 J	0.0018 J	0.0019 J	0.0022 Jq
PeCDF	µg/kg	0.0003	0.2	0.2	0.0015 J	0.0023 J	0.0034 J	0.0016 J	0.0019 J	0.0019 J	0.0018 J	0.0027 J
TCDD	µg/kg	0.0002	0.0006	0.01	0.0012	0.0013	0.0013	0.00093 J	0.0014	0.0012	0.0015	0.0032
TCDF	µg/kg	0.0040658		0.6	0.0053 B	0.0028 B	0.0044 B	0.0023 B	0.0022 qB	0.0025 B	0.0042	0.0029
Aldrin	µg/kg	2										
Dieldrin	µg/kg	0.07										
DDD	µg/kg	114			2.206	5.9	4.26	2.929	2.76	3.75	3.267	4.24
DDE	µg/kg	50			4.099	8.833	6.846	4.564	5.544	7.024	5.408	10.516
DDT	µg/kg	246			0.21	0.692	0.66	0.361	0.263	0.493	0.22	0.994
DDx	µg/kg	6.1	160	7050	6.515	15.425	11.766	7.854	8.567	11.267	8.8105	15.75
Lindane	µg/kg	5										
Chlordanes	µg/kg	0.51										
Arsenic	mg/kg	3										
Cadmium	mg/kg	0.51										
Copper	mg/kg	359										
Lead	mg/kg	196										
Mercury	mg/kg	0.085										
Zinc	mg/kg	459										
TBT	µg/kg	3080										
Total cPAHs	µg/kg	774		106000	128.93 JT	196.84 JT	301.37 T	146.47 T	193.84 JT	132.12 JT	242.07 JT	297.47 JT
Total PAHs	µg/kg	23000	30000		2211.5 BJT	2655 BJT	4144 BJT	2354 BT	2827 BJT	1868 BJT	3160 BJT	4384 BJT
TPH-Diesel	mg/kg	91										
Chlorobenzene	µg/kg											
Naphthalene	µg/kg				170 B	100 B	210 B	150 B	110 B	77 B	190 B	180 B
BEHP	µg/kg	135										

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID					SC-S238	SC-S238	SC-S238	SC-S238	SC-S238	SC-S238	SD126	SD127
Sample ID					PDI-SC-S238-12.4to13.4	PDI-SC-S238-2to4	PDI-SC-S238-2TO4D	PDI-SC-S238-4to6	PDI-SC-S238-6to8	PDI-SC-S238-8to10	WR-WSI98SD1260	WR-WSI98SD1270
Sample Date					2018/08/09	2018/08/09	2018/08/09	2018/08/09	2018/08/09	2018/08/09	1997/09/23	1997/09/23
Sample Depth					378 to 408 cm	61 to 122 cm	61 to 122 cm	122 to 183 cm	183 to 244 cm	244 to 305 cm	0 to 10 cm	0 to 10 cm
COC	Units	CUL	RAL	PTW								
Total PCBs	µg/kg	9	75	200	102.5	73.4	79	191.7	51.9	120.5		38 UT
TCDDeq	µg/kg	0.01			0.0219 JNT	0.0176 JNT	0.0153 JT	0.024 JNT	0.0122 JNT	0.0213 JNT		
HxCDF	µg/kg	0.0004		0.04	0.012	0.0075	0.0097	0.012	0.0051	0.013		
PeCDD	µg/kg	0.0002	0.0008	0.01	0.0025 J	0.0024 J	0.00073 U	0.0024 J	0.0016 J	0.0029 J		
PeCDF	µg/kg	0.0003	0.2	0.2	0.0022 J	0.0014 U	0.0021 J	0.0032 J	0.0016 J	0.0028 J		
TCDD	µg/kg	0.0002	0.0006	0.01	0.0013 q	0.0013 q	0.0017	0.0016	0.00091 q	0.0016		
TCDF	µg/kg	0.0040658		0.6	0.0019	0.0024	0.002	0.0036 q	0.0024	0.0034 G		
Aldrin	µg/kg	2										
Dieldrin	µg/kg	0.07										
DDD	µg/kg	114			2.987	6.77	6.16	6.81	1.71	3.616		
DDE	µg/kg	50			7.898	8.197	7.612	9.77	3.075	5.65		
DDT	µg/kg	246			0.11	0.41	0.324	1.082	0.17	0.65		
DDx	µg/kg	6.1	160	7050	10.962	15.377	14.096	17.662	4.92	9.916		
Lindane	µg/kg	5										
Chlordanes	µg/kg	0.51										
Arsenic	mg/kg	3									6 U	5 U
Cadmium	mg/kg	0.51									0.4	0.3
Copper	mg/kg	359									71.2	56.4
Lead	mg/kg	196									16	12
Mercury	mg/kg	0.085									0.1	0.06
Zinc	mg/kg	459									129	96.7
TBT	µg/kg	3080										710
Total cPAHs	µg/kg	774		106000	223.04 JT	319.26 JT	336.58 JT	361.39 JT	117.91 JT	260.07 JT	61.015 T	40.371 T
Total PAHs	µg/kg	23000	30000		3039 BJT	4954 BJT	5559 BJT	4373 BJT	1852 BJT	4601 BJT	585 T	339 T
TPH-Diesel	mg/kg	91										
Chlorobenzene	µg/kg											
Naphthalene	µg/kg				130 B	350 B	390 B	190 B	120 B	420 B	20 U	19 U
BEHP	µg/kg	135									120	160

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		SD127	SD128	SD129	SD130	SD132	SD133	SD133	SD134			
Sample ID		WR-WSI98SD1270000A	WR-WSI98SD1280	WR-WSI98SD1290	WR-WSI98SD1300	WR-WSI98SD1320	WR-WSI98SD1330	WR-WSI98SD1330000A	WR-WSI98SD1340			
Sample Date		1997/10/16	1997/09/23	1997/09/22	1997/09/23	1997/09/23	1997/09/23	1997/10/16	1997/09/22			
Sample Depth		0 to 90 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 10 cm	0 to 90 cm	0 to 10 cm			
COC	Units	CUL	RAL	PTW								
Total PCBs	µg/kg	9	75	200	94.5 JT	1080 T		39 UT	1245 T	2426.5 JT		
TCDDeq	µg/kg	0.01										
HxCDF	µg/kg	0.0004		0.04								
PeCDD	µg/kg	0.0002	0.0008	0.01								
PeCDF	µg/kg	0.0003	0.2	0.2								
TCDD	µg/kg	0.0002	0.0006	0.01								
TCDF	µg/kg	0.0040658		0.6								
Aldrin	µg/kg	2										
Dieldrin	µg/kg	0.07										
DDD	µg/kg	114										
DDE	µg/kg	50										
DDT	µg/kg	246										
DDx	µg/kg	6.1	160	7050								
Lindane	µg/kg	5										
Chlordanes	µg/kg	0.51										
Arsenic	mg/kg	3			5 U	8	6 U	5 U	4 U	16	14	7 U
Cadmium	mg/kg	0.51			0.5	0.6	0.7	0.4	0.3	0.6	0.7	0.7
Copper	mg/kg	359			162	404	131	74.5	64.1	543	729	169
Lead	mg/kg	196			24	110	38	12	12	70	178	40
Mercury	mg/kg	0.085			0.07	0.86	0.16	0.06	0.05	0.3	0.8	0.12
Zinc	mg/kg	459			195	361	279	106	102	539	598	335
TBT	µg/kg	3080			7100	5000 J		420		3300	15000	
Total cPAHs	µg/kg	774		106000	166.17 T	1169.02 T	298.12 T	46.335 T	57.394 T	519.38 T	1766.1 T	200.9 T
Total PAHs	µg/kg	23000	30000		1931 T	9952 T	2942.5 T	392.5 T	418 T	4652.5 T	16588 T	1874 T
TPH-Diesel	mg/kg	91										
Chlorobenzene	µg/kg											
Naphthalene	µg/kg				58	57	62	19 U	20 U	29	110	23
BEHP	µg/kg	135			770	970	760	400	490	650	1200	1300

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID		SD136	SD136	SD139	SD141	SD141	SD148	SIL-00	SIL-01
Sample ID		WR-WSI98SD1360	WR-WSI98SD1360000A	WR-WSI98SD1390	WR-WSI98SD1410000A	WR-WSI98SD1410000CC	WR-WSI98SD1480	SIL-00-RSM	SIL-01-RSM
Sample Date		1997/09/22	1997/10/14	1997/09/22	1997/10/14	1997/09/22	1997/09/22	2016/03/04	2016/03/04
Sample Depth		0 to 10 cm	0 to 90 cm	0 to 10 cm	0 to 90 cm	0 to 10 cm	0 to 10 cm	0 to 30 cm	0 to 30 cm
COC	Units	CUL	RAL	PTW					
Total PCBs	µg/kg	9	75	200		197.5 JT		990 JT	1000 JT
TCDDeq	µg/kg	0.01							
HxCDF	µg/kg	0.0004		0.04					
PeCDD	µg/kg	0.0002	0.0008	0.01					
PeCDF	µg/kg	0.0003	0.2	0.2					
TCDD	µg/kg	0.0002	0.0006	0.01					
TCDF	µg/kg	0.0040658		0.6					
Aldrin	µg/kg	2				0.96 UJ	0.98 UT		
Dieldrin	µg/kg	0.07				1.9 UJ	2 UT		
DDD	µg/kg	114				3.3 JT			
DDE	µg/kg	50				2.6 UJT			
DDT	µg/kg	246				3.1 UJT			
DDx	µg/kg	6.1	160	7050		6.15 JT			
Lindane	µg/kg	5				0.96 UJ	0.98 UT		
Chlordanes	µg/kg	0.51				1.5 UJT			
Arsenic	mg/kg	3		7 U	4 U	7 U	5 U	7 UT	5 U
Cadmium	mg/kg	0.51		1	0.8	0.8	0.6	0.8 T	0.6
Copper	mg/kg	359		81.5	43.4	133	68.9	96 T	65.4
Lead	mg/kg	196		24	27	44	42	35.5 T	27
Mercury	mg/kg	0.085		0.06	0.04	0.16	0.18	0.15 T	0.16
Zinc	mg/kg	459		178	116	465	236	279 T	199
TBT	µg/kg	3080				720			
Total cPAHs	µg/kg	774		106000	118.07 T	69.88 T	208.47 T	306.65 T	159.2 T
Total PAHs	µg/kg	23000	30000		1211 T	704.5 T	1988 JT	3350 T	1731 T
TPH-Diesel	mg/kg	91							
Chlorobenzene	µg/kg								
Naphthalene	µg/kg			19 U	19 U	22	120	31 T	110
BEHP	µg/kg	135		2100	370	1200	200	895 T	640

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID				SIL-02	SIL-03	SIL-04	SIL-05	SIL-06	SIL-07	SIL-08	SIL-09	SIL-10	SIL-11	SIL-12	SIL-13	SIL-13	
Sample ID				SIL-02-RSM	SIL-03-RSM	SIL-04-RSM	SIL-05-RSM	SIL-06-RSM	SIL-07-RSM	SIL-08-RSM	SIL-09-RSM	SIL-10-RSM	SIL-11-RSM	SIL-12-RSM	SIL-13-RSM	SIL-21-RSM	
Sample Date				2016/03/04	2016/03/04	2016/03/04	2016/03/04	2016/03/04	2016/03/04	2016/03/04	2016/03/04	2016/03/04	2016/03/04	2016/03/04	2016/03/04	2016/03/04	
Sample Depth				0 to 30 cm													
COC	Units	CUL	RAL	PTW													
Total PCBs	µg/kg	9	75	200	300 JT	140 JT	36 JT	51 JT	54 JT	84 JT	160 JT	110 JT	310 JT	240 JT	450 JT	150 JT	200 JT
TCDDeq	µg/kg	0.01															
HxCDF	µg/kg	0.0004		0.04													
PeCDD	µg/kg	0.0002	0.0008	0.01													
PeCDF	µg/kg	0.0003	0.2	0.2													
TCDD	µg/kg	0.0002	0.0006	0.01													
TCDF	µg/kg	0.0040658		0.6													
Aldrin	µg/kg	2															
Dieldrin	µg/kg	0.07															
DDD	µg/kg	114															
DDE	µg/kg	50															
DDT	µg/kg	246															
DDx	µg/kg	6.1	160	7050													
Lindane	µg/kg	5															
Chlordanes	µg/kg	0.51															
Arsenic	mg/kg	3															
Cadmium	mg/kg	0.51															
Copper	mg/kg	359															
Lead	mg/kg	196															
Mercury	mg/kg	0.085															
Zinc	mg/kg	459															
TBT	µg/kg	3080															
Total cPAHs	µg/kg	774		106000													
Total PAHs	µg/kg	23000	30000														
TPH-Diesel	mg/kg	91															
Chlorobenzene	µg/kg																
Naphthalene	µg/kg																
BEHP	µg/kg	135															

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID					SIL-14	SIL-15	SIL-16	SIL-17	SIL-17	SIL-18	SIL-19	T1	T3	T5	T6
Sample ID					SIL-14-RSM	SIL-15-RSM	SIL-16-RSM	SIL-17-RSM	SIL-20-RSM	SIL-18-RSM	SIL-19-RSM	T1-0to30-101518	T3-0to28-101618	T5-0to26-101618	T6-0to29-101618
Sample Date					2016/03/04	2016/03/04	2016/03/04	2016/03/04	2016/03/04	2016/03/04	2016/03/04	2018/10/15	2018/10/16	2018/10/16	2018/10/16
Sample Depth					0 to 30 cm	0 to 28 cm	0 to 26 cm	0 to 29 cm							
COC	Units	CUL	RAL	PTW											
Total PCBs	µg/kg	9	75	200	75 JT	68 JT	72 JT	65 JT	68 JT	67 JT	55 JT	0.77526	90.4599	211.7484	150.06896
TCDDeq	µg/kg	0.01										0.000139 JT	0.0125 JT	0.0147 JT	0.0133 JT
HxCDF	µg/kg	0.0004		0.04								0.00014 JB	0.014 B	0.018 B	0.017
PeCDD	µg/kg	0.0002	0.0008	0.01								0.000071 JBq	0.0015 JB	0.0015 JB	0.0014 J
PeCDF	µg/kg	0.0003	0.2	0.2								0.000051 JBq	0.0021 JB	0.0029 JB	0.0025 J
TCDD	µg/kg	0.0002	0.0006	0.01								0.000022 U	0.00065 J	0.00062 Jq	0.0004 Jq
TCDF	µg/kg	0.0040658		0.6								0.00003 JBq	0.0015 JB	0.0026 B	0.002
Aldrin	µg/kg	2										0.079 U	0.09 U	0.082 U	0.11 U
Dieldrin	µg/kg	0.07										0.077 U	0.087 U	0.098 J	0.1 U
DDD	µg/kg	114										0.1615	1.336	2.433	0.641
DDE	µg/kg	50										0.079	2.41		1.045
DDT	µg/kg	246										0.094	0.11	0.098	0.13
DDx	µg/kg	6.1	160	7050								0.3065	3.828	6.3565	1.7815
Lindane	µg/kg	5										0.031 U	0.035 U	0.065 J	0.041 U
Chlordanes	µg/kg	0.51										0.13	0.68	0.96	0.17
Arsenic	mg/kg	3										2.9	9.3	9.3	10
Cadmium	mg/kg	0.51										0.076 J	0.4 J	0.56	0.46
Copper	mg/kg	359										32	100 B	120 B	150
Lead	mg/kg	196										6.5	32	41	39 B
Mercury	mg/kg	0.085										0.045	0.93	0.24	0.25 H
Zinc	mg/kg	459										58	260	310	310
TBT	µg/kg	3080										0.68 U	100	450	230
Total cPAHs	µg/kg	774		106000								0.81696 JT	110.84 DT	166.35 DT	9.1865 T
Total PAHs	µg/kg	23000	30000									6.177 JXT	993.8 DT	1334.5 DT	77.17 JT
TPH-Diesel	mg/kg	91										20 U	42 J	96 J	140
Chlorobenzene	µg/kg														
Naphthalene	µg/kg											0.18 J	17 D	13 D	0.3 J
BEHP	µg/kg	135										8.9 U	340	690	30 J

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID Sample ID Sample Date Sample Depth					T7 T7-0to31-101618 2018/10/16 0 to 30 cm	TCLPC23 LWM-TCLPC23 2008/08/21 0 to 384 cm	WLCPSK091 WLCPSK091-A 2009/11/12 0 to 176 cm	WLCPSK091 WLCPSK091-Z 2009/11/12 207 to 327 cm	WLCPSK092 WLCPSK092-A 2009/11/11 0 to 128 cm	WLCPSK092 WLCPSK092-B 2009/11/11 128 to 280 cm	WLCPSK092 WLCPSK092-Z 2009/11/11 280 to 375 cm	WLCPSK093 WLCPSK093-A Not specified 0 to 117.7 cm	WLCPSK093 WLCPSK093-B Not specified 117.7 to 270.1 cm	WLCPSK093 WLCPSK093-Z Not specified 270.1 to 382.2 cm
COC	Units	CUL	RAL	PTW										
Total PCBs	µg/kg	9	75	200	158.3236		385.25 T	266.3 T	6.7 UT	19 T	19.15 JT	9 UT	20 JT	27 T
TCDDeq	µg/kg	0.01			0.0262 JT									
HxCDF	µg/kg	0.0004		0.04	0.043 B									
PeCDD	µg/kg	0.0002	0.0008	0.01	0.0021 JB									
PeCDF	µg/kg	0.0003	0.2	0.2	0.0066 JB									
TCDD	µg/kg	0.0002	0.0006	0.01	0.0006 Jq									
TCDF	µg/kg	0.0040658		0.6	0.0019 B									
Aldrin	µg/kg	2			0.11 U		0.77 U	0.8 U	0.19 U	0.16 U	0.16 U	0.24 U	0.23 U	0.29 U
Dieldrin	µg/kg	0.07			0.098 U		0.77 U	0.7 U	0.2 U	0.17 U	0.15 U	0.15 U	0.15 U	0.22 U
DDD	µg/kg	114			1.64		1.6 T	9.6 T	0.13 UT	1.8 T	2.5 T	0.64 JT	2.1 T	2.2 T
DDE	µg/kg	50					1.4 UT	3.2 UT	1.8 T	3 T	3 T	1.6 T	2.6 T	2.9 T
DDT	µg/kg	246			0.12		1.6 T	44 T	0.19 UT	0.17 UT	0.17 UT	0.18 UT	0.17 UT	0.92 UT
DDx	µg/kg	6.1	160	7050	4.64		3.9 T	55.2 T	1.96 T	4.885 T	5.585 T	2.3 JT	4.8 T	5.6 T
Lindane	µg/kg	5			0.04 U	1.5 U	0.8	0.4 U	0.085 U	0.08 U	0.08 U	1.1 U	0.79 J	0.48 J
Chlordanes	µg/kg	0.51			0.68	1.5 UT	0.1 UT	0.5 UT	0.11 UT	0.64 JT	0.78 JT	0.11 UT	0.57 JT	0.82 JT
Arsenic	mg/kg	3			9	7 U	8.95	5.61	3.4	3.48	4.47	4.59	3.96	4.34
Cadmium	mg/kg	0.51			0.37 J	0.3 U	0.338	0.1	0.169	0.166	0.207	0.194	0.188	0.226
Copper	mg/kg	359			110		593	94.6	82.5	109	76.1	153	54.3	90.8
Lead	mg/kg	196			32	3 U	118	77.7	9.85	11.6	15.3	11.5	11.6	17.8
Mercury	mg/kg	0.085			0.18	0.07 U	0.293	0.279	0.077	0.069	0.095	0.062	0.065	0.104
Zinc	mg/kg	459			250		354	101	89.6	93.5	103	148	86	136
TBT	µg/kg	3080			170		3300	41	48	220	890	50	89	2200
Total cPAHs	µg/kg	774		106000	167.57 DT		3604.2 T	997.3 T	19.478 JT	34.124 JT	38.433 JT			
Total PAHs	µg/kg	23000	30000		1441.4 DJT		42741 T	15318.7 JT	170.4 JT	309.9 JT	309.3 JT			
TPH-Diesel	mg/kg	91			130 J									
Chlorobenzene	µg/kg					1.2 U								
Naphthalene	µg/kg				7.7 D		130	4.9 J	6.8 J	5.7 J	4.7 J	15	5.4 J	10
BEHP	µg/kg	135			340		1800	40 J	130	76 J	210	360	88 J	430

**Table 3-1 (continued)**  
**COC Sediment Chemistry Data in Vicinity of SIB**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Map Station ID Sample ID Sample Date Sample Depth		WLCPSK094 WLCPSK094-A 2009/11/16 0 to 88 cm	WLCPSK094 WLCPSK094-B 2009/11/16 88 to 240 cm	WLCPSK094 WLCPSK094-Z 2009/11/16 240 to 375 cm	WLCPSK095 WLCPSK095-A 2009/11/16 0 to 59 cm	WLCPSK095 WLCPSK095-B 2009/11/16 59 to 213 cm	WLCPSK095 WLCPSK095-Z 2009/11/16 213 to 354 cm		
COC	Units	CUL	RAL	PTW					
Total PCBs	µg/kg	9	75	200	4.7 UT		5.3 UT	5.4 UT	38.3 T
TCDDeq	µg/kg	0.01							
HxCDF	µg/kg	0.0004		0.04					
PeCDD	µg/kg	0.0002	0.0008	0.01					
PeCDF	µg/kg	0.0003	0.2	0.2					
TCDD	µg/kg	0.0002	0.0006	0.01					
TCDF	µg/kg	0.0040658		0.6					
Aldrin	µg/kg	2			0.17 U	0.16 UT	0.16 UT	0.18 U	0.16 U
Dieldrin	µg/kg	0.07			0.21 U	0.14 UT	0.14 UT	0.23 U	0.3 U
DDD	µg/kg	114			0.27 JT			0.35 JT	0.88 JT
DDE	µg/kg	50			1.3 T			1.3 T	1.9 T
DDT	µg/kg	246			0.38 UT			1.6 T	0.17 UT
DDx	µg/kg	6.1	160	7050	1.76 JT			3.25 JT	2.865 JT
Lindane	µg/kg	5			0.084 U	0.08 UT	0.13 JT	0.15 J	0.08 U
Chlordanes	µg/kg	0.51			0.11 UT			0.24 UT	0.18 JT
Arsenic	mg/kg	3			4.98	3.92 T	4.57 T	5.5	3.61
Cadmium	mg/kg	0.51			0.193	0.192 T	0.26 T	0.19	0.185
Copper	mg/kg	359			452	213 T	165 T	596	156
Lead	mg/kg	196			11.6	11.9 T	22.8 T	11.7	11.6
Mercury	mg/kg	0.085			0.061	0.0705 T	0.102 T	0.057	0.06
Zinc	mg/kg	459			223	129 T	184 T	262	137
TBT	µg/kg	3080			100	425 T	3500 T	77	270
Total cPAHs	µg/kg	774		106000	79.923 T			180.19 T	38.138 JT
Total PAHs	µg/kg	23000	30000		915.8 JT			2030.1 JT	311.3 JT
TPH-Diesel	mg/kg	91							
Chlorobenzene	µg/kg								
Naphthalene	µg/kg				30	7.5 JT	13.5 T	32	6.5 J
BEHP	µg/kg	135			220	295 T	890 T	1400	240

Notes:

For sample locations with Total PCBs results calculated from both congeners and aroclors, the concentration associated with congeners is shown here.

Sample duplicates are included with a unique Sample ID and a shared Map Station ID.

Dataset includes sediment samples within 200 feet of the SIB Project Area boundary.

Data Sources:

Remedial Investigation Database and Feasibility Study Database

Pre-RD Investigation and Baseline Sampling data

Pacific Groundwater Group, 2019. Surface and Subsurface Sediment Field Sampling and Data Report, Swan Island Lagoon, Portland Harbor Superfund Site. Prepared for Daimler Trucks North America LLC (DTNA). Data in review by EPA

Pacific Groundwater Group, 2019. Surface and Subsurface Sediment Field Sampling and Data Report, Swan Island Lagoon, Portland Harbor Superfund Site. Prepared for de maximis, inc. Data in review by EPA

Geosyntec. 2016. Sediment Sampling Data Report, Swan Island Lagoon, Portland, Oregon. Prepared for The Marine Group, LLC and BAE Systems San Diego Ship Repair, Inc.

Focused COC

CUL - Clean Up Level, Table 17 ROD, 2020 Errata #2

RAL - Remedial Action Level, Table 21, 2019 Explanation of Significant Differences

PTW - Principal Threat Waste, Table 21, 2019 Explanation of Significant Differences

U - concentration non-detect at shown detection limit

J - concentration estimated

JN - tentatively identified compound

T - reported concentration below quantitation limit

Other data qualifiers included as reported by data each source

**Table 3-2  
Data Gap Analysis – Sediment Chemistry  
Pre-Design Investigation Work Plan; Sufficiency Assessment Report, Swan Island Basin Project Area, Portland, Oregon**

Data Requirement	Existing Data Summary	Data Gap to be Filled
<p>Characterization and delineation of Portland Harbor COCs in surface sediments. To be used to refine the SMA boundary.</p>	<ul style="list-style-type: none"> <li>• Surface sediment chemistry provided in the Portland Harbor RI/FS database (EPA, 2019), with additional studies including:                             <ul style="list-style-type: none"> <li>o Geosyntec 2016 sediment sampling for Swan Island Lagoon, prepared for The Marine Group, LLC and BAE Systems San Diego Ship Repair Inc.</li> <li>o Portland Harbor PDI Evaluation Report and Baseline Sampling (AECOM and Geosyntec, 2019)</li> <li>o Pacific Groundwater Group 2019a sediment sampling for Swan Island Lagoon, prepared for Daimler Trucks North America LLC</li> <li>o Pacific Groundwater Group 2019b sediment sampling for Swan Island Lagoon, prepared for de maximis, inc.</li> <li>o Pacific Groundwater Group 2021 sediment sampling Phase 1b data report, prepared for Daimler Trucks North America LLC</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Data gaps were identified by overlaying a 150-foot grid on the Swan Island Basin SMA. Grid cells that either entirely or partially overlap the SMA and which lack existing data will be targeted for sampling. Additionally, some grid cells outside the SMA but near known contamination will be sampled, and one historical concentration outlier location will be resampled.</li> <li>• Preliminary numbers include 30 sample locations for surface-sediment samples. Of these, five will be collected by boat-mounted power grab sampler, and 25 will be collected as the top 0 to 1 foot interval of sampled cores.</li> </ul>
<p>Characterization and delineation of Portland Harbor COCs in subsurface sediments. To be used to identify the depth of contamination.</p>	<ul style="list-style-type: none"> <li>• Subsurface sediment chemistry provided in the Portland Harbor RI/FS database (EPA, 2019), with additional studies including:                             <ul style="list-style-type: none"> <li>o Portland Harbor PDI Evaluation Report and Baseline Sampling (AECOM and Geosyntec, 2019)</li> <li>o Pacific Groundwater Group 2019a sediment sampling for Swan Island Lagoon, prepared for Daimler Trucks North America LLC</li> <li>o Pacific Groundwater Group 2019b sediment sampling for Swan Island Lagoon, prepared for de maximis, inc.</li> <li>o Pacific Groundwater Group 2021 sediment sampling Phase 1b data report, prepared for Daimler Trucks North America LLC</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Data gaps were identified by overlaying a 150-foot grid on the Swan Island Basin SMA. Grid cells that either entirely or partially overlap the SMA and which lack existing data will be targeted for sampling.</li> <li>• Preliminary numbers include 181 sample locations for cores, to be collected by boat-mounted vibracore.</li> <li>• Samples will be analyzed in a phased approach. If the earlier phases of analysis are sufficient to close data gaps, it may not be necessary to analyze later phases.</li> </ul>

**References:**

AECOM and Geosyntec Consultants, Inc. (Geosyntec), 2019. *PDI Evaluation Report*, Portland Harbor Pre-Remedial Design Investigation and Baseline Sampling. Portland Harbor Superfund Site. Portland, Oregon. June 17.

Geosyntec, 2016. *Sediment Sampling Data Report*, Swan Island Lagoon, Portland, Oregon. Prepared for The Marine Group, LLC and BAE Systems San Diego Ship Repair, Inc. August.

Kleinfelder, 2015. *Sediment Sampling Data Report*, Portland Harbor, Portland, Oregon. Prepared for de maximis, inc.

Pacific Groundwater Group (PGG), 2019a. 2019a. *Surface and Subsurface Sediment Field Sampling and Data Report*, Swan Island Lagoon, Portland Harbor Superfund Site. Prepared for Daimler Trucks North America LLC.

PGG, 2019b. *Surface and Subsurface Sediment Field Sampling and Data Report*, Swan Island Lagoon, Portland Harbor Superfund Site. Prepared for de maximis, inc.

PGG, 2021. *Surface and Subsurface Sediment Phase 1B Data Report*, Swan Island Lagoon, Portland Harbor Superfund Site. Prepared for Daimler Trucks North America LLC.

U.S. Environmental Protection Agency (EPA), 2019. Portland Harbor Environmental Data Portal, 2018-2019 Pre-Design Investigation/Baseline Sample Data Database, at URL [http://ph-public-data.com/document/PHRD\\_2019/](http://ph-public-data.com/document/PHRD_2019/)

**Table 3-3  
Data Gap Analysis – Bathymetry and Topography  
Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Data Requirement	Existing Data Summary	Data Gap to be Filled
Present-day multibeam bathymetry data for entire Swan Island Basin (SIB) Project Area	<ul style="list-style-type: none"> <li>• Latest multi-beam bathymetry survey was collected in 2018 (David Evans Associates [DEA], 2018).</li> <li>• Up-to-date information is required for accurate design elevations and analysis input.</li> </ul>	<ul style="list-style-type: none"> <li>• New multi-beam bathymetry survey of entire SIB Project Area is required. Every attempt will be made to obtain complete coverage regardless of vessels moored in the basin.</li> </ul>
Semi-recent (past 20 years) multi-beam or single-beam bathymetry data, for evaluation of erosion and deposition	<ul style="list-style-type: none"> <li>• Bathymetry data is available from public sources and entities operating within the SIB Project Area. Relevant and publicly available recent data includes:                             <ul style="list-style-type: none"> <li>o 2008-2009 National Ocean Service (NOS, 2009) high-resolution multi-beam bathymetry survey.</li> <li>o Recent (2015-2019) bathymetry surveys from Vigor Industrial LLC (Vigor) for the areas surrounding the shipyard only (Vigor, 2020).</li> </ul> </li> <li>• 2001-2004, 2009, and 2018 multi-beam surveys covering the interior of the basin (DEA, 2001, 2002, 2003a, 2003b, 2004, 2018).</li> </ul>	<ul style="list-style-type: none"> <li>• No data gap identified. Existing data is sufficient for the Pre-Design Investigation (PDI).</li> </ul>
Historical bathymetry data, for evaluation of large-scale SIB modifications	<ul style="list-style-type: none"> <li>• Chart-based bathymetry data for the entire basin is available from the U.S. Army Corps of Engineers and includes many surveys beginning in 1927.</li> </ul>	<ul style="list-style-type: none"> <li>• No data gap identified. Existing data is sufficient for the PDI.</li> </ul>
Present-day topography data for entire SIB project area	<ul style="list-style-type: none"> <li>• Topography data is available in 2014 LiDAR OR LiDAR Consortium Metro (OLC, 2014). Ground cover is well described; however, the data is not likely accurate enough for some elements of potential Remedial Design (RD).</li> </ul>	<ul style="list-style-type: none"> <li>• Topographic survey data collection is not required for the PDI, but it will be performed prior to preliminary RD to ensure dense coverage in specific locations where required.</li> </ul>
Historical topography data	<ul style="list-style-type: none"> <li>• 2014 LiDAR OR LiDAR Consortium Metro (OLC, 2014) data is available for the entire SIB Project Area; data is sufficient for PDI efforts but not preliminary/final RD.</li> <li>• 2012 LiDAR OR LiDAR Consortium Metro (OLC, 2012), Columbia Digital Elevation Model (USACE, 2010), 2009 LiDAR OR LiDAR Consortium: Hood to Coast (OLC, 2009) and 2005 Puget Sound LiDAR Consortium (PSLC) Lower Columbia (PSLC, 2005) are all superseded by the 2014 OLC Metro dataset.</li> </ul>	<ul style="list-style-type: none"> <li>• No data gap identified. Existing data is sufficient for the PDI.</li> </ul>
Property line data	<ul style="list-style-type: none"> <li>• <a href="http://www.portlandmaps.com">www.portlandmaps.com</a> provides property line GIS data for all properties surrounding the SIB.</li> </ul>	<ul style="list-style-type: none"> <li>• No data gap identified. Existing data is sufficient for the PDI.</li> </ul>

**References:**

DEA, 2001. *Multibeam Bathymetric Survey of the Lower Willamette River Work Plan*. Prepared for Lower Willamette Group. David Evans and Associates, Inc., Portland, Oregon. July.

DEA, 2002. *Lower Willamette River Multibeam Bathymetric Survey Report*, December 2001/January 2002. Draft. April 26.

DEA, 2003a. *Lower Willamette River Summer 2002 Multibeam Bathymetric Survey Report*.

DEA, 2003b. *Lower Willamette River Multibeam Bathymetric Survey Report*. May.

DEA, 2004. *Lower Willamette River Multibeam Bathymetric Survey Report*, February.

DEA, 2018. *Willamette River, Oregon River Mile 1.9 to 11.8 Hydrographic Survey Report*. Prepared for the Pre-RD AOC Group on behalf of AECOM and Geosyntec Consultants.

National Ocean Service (NOS), 2009. *National Oceanic and Atmospheric Administration (NOAA), Registry No. H11859*. Surveyed by: David Evans and associates, Inc. Survey Report: [https://data.ngdc.noaa.gov/platforms/ocean/nos/coast/H10001-H12000/H11859/DR/H11859\\_DR.pdf](https://data.ngdc.noaa.gov/platforms/ocean/nos/coast/H10001-H12000/H11859/DR/H11859_DR.pdf).

Oregon LiDAR Consortium Metro (OLC), 2009. *2007 - 2009 OLC Lidar DEM: Hood to Coast, OR from 2010-06-15 to 2010-08-15*. NOAA National Centers for Environmental Information, <https://www.fisheries.noaa.gov/inport/item/57763>.

OLC, 2012. *2012 OLC Lidar DEM: West Metro, Oregon from 2010-06-15 to 2010-08-15*. NOAA National Centers for Environmental Information, <https://www.fisheries.noaa.gov/inport/item/49449>.

OLC, 2014. *2014 Oregon Department of Geology and Mineral Industries (DOGAMI) Oregon Lidar: Metro Portland, OR from 2010-06-15 to 2010-08-15*. NOAA National Centers for Environmental Information, <https://www.fisheries.noaa.gov/inport/item/49939>.

Puget Sound LiDAR Consortium (PSLC), 2005. *2005 Puget Sound LiDAR Consortium (PSLC) Topographic LiDAR: Lower Columbia River from 2010-06-15 to 2010-08-15*. NOAA National Centers for Environmental Information, at URL <https://www.fisheries.noaa.gov/inport/item/50147>.

U.S. Army Corps of Engineers (USACE), 2010. *2010 USACE Lidar: Columbia River (OR, WA, ID, MT) from 2010-06-15 to 2010-08-15*. NOAA National Centers for Environmental Information, <https://www.fisheries.noaa.gov/inport/item/49920>.

Vigor Industrial LLC (Vigor), 2020. *Utilities and Structures Swan Island Shipyard, General Technical Memorandum by Cascade General, Inc.* Attachment B: 2015 – 2019 Bathymetric Surveys.

**Table 3-4  
Data Gap Analysis – Geotechnical Site Characterization  
Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Data Requirement	Existing Data Summary	Data Gap to be Filled
Site Stratigraphy	<ul style="list-style-type: none"> <li>Geotechnical data and reports prepared for previous development in and around the project area. Limited data, including permit records, is available through the City of Portland Bureau of Development Services.</li> <li>Regional geologic maps and reports are available through both the U.S. Geological Survey (USGS) and the Oregon Department of Geology and Mineral Industries (DOGAMI).</li> </ul>	<ul style="list-style-type: none"> <li>Gather and evaluate existing geotechnical site information, including:                             <ul style="list-style-type: none"> <li>Historical records from prior site investigations,</li> <li>Geologic reports and publications, and</li> <li>Geologic and soil survey maps.</li> </ul> </li> <li>Perform a geotechnical site investigation to characterize the existing geotechnical site conditions and to aid in the development of geologic cross-sections that describe the soil stratigraphy across the site. Proposed data collection methods, preliminary investigation locations, and planned geotechnical laboratory testing are further described in the Field Sampling Plan.</li> </ul>
Groundwater Elevations	<ul style="list-style-type: none"> <li>Limited groundwater data and permit records information is contained in historical geotechnical reports available through City of Portland Bureau of Development Services.</li> </ul>	<ul style="list-style-type: none"> <li>Groundwater conditions for engineering analyses will be assessed as part of the geotechnical site investigation.</li> </ul>
Site-Specific Geotechnical Design Parameters	<ul style="list-style-type: none"> <li>None.</li> </ul>	<ul style="list-style-type: none"> <li>Geotechnical design parameters required for engineering analyses will be developed based on the results of the geotechnical site investigation and laboratory testing program. Planned engineering analyses include:                             <ul style="list-style-type: none"> <li>Static and seismic riverbank slope stability,</li> <li>Shoreline and overwater structure stability,</li> <li>Evaluation of the cap bearing capacity failure mode,</li> <li>Cap differential and total settlement, and</li> <li>Potential cap deformation during seismic events.</li> </ul> </li> </ul>
Geologic Hazard Identification	<ul style="list-style-type: none"> <li>Regional geologic hazard maps and reports are available through both USGS and DOGAMI.</li> </ul>	<ul style="list-style-type: none"> <li>Site-specific geologic hazards will be identified based on a review of available data and the results of the geotechnical site investigation.</li> </ul>
Seismic Design Parameters	<ul style="list-style-type: none"> <li>None.</li> </ul>	<ul style="list-style-type: none"> <li>Site-specific seismic design parameters will be developed based on the results of the geotechnical site investigation and available ground motion data.</li> </ul>

**Table 3-5  
Data Gap Analysis – Shoreline and Overwater Structures  
Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Data Requirement	Existing Data Summary	Data Gap to be Filled
Existing structure layout, structural system component sizes and strengths, and original structure design criteria	<ul style="list-style-type: none"> <li>Some as-built design plans are available for various fixed structures within the shipyard.</li> </ul>	<ul style="list-style-type: none"> <li>Structural information for all potentially affected shoreline and over-water structures, including piers, wharves, dolphins, floating docks, retaining walls/bulkheads, boat launch, dry docks, and other structures. Information to be compiled includes as-built structure dimensions and layout, material types, material strengths, design loads, environmental loads, pile embedment depths and capacities, and fill material used in cellular structures.</li> <li>Mobile Terrestrial LiDAR Survey (laser scan) data to document the locations and elevations of existing structures.</li> <li>Land- and water-based inspections of marine structures, to be photo-documented and geo-referenced.</li> </ul>
Current and future use and design criteria	<ul style="list-style-type: none"> <li>None</li> </ul>	<ul style="list-style-type: none"> <li>Data on vehicles, equipment, vessels, and other loads that the structures need to support and are planning to support in the future (if different than the original design).</li> <li>Interviews with owners/operators to understand facility operations and current/future use.</li> </ul>
History of past repairs	<ul style="list-style-type: none"> <li>As-built design plans are available for various fixed structures within the shipyard.</li> </ul>	<ul style="list-style-type: none"> <li>As-built plans of repairs or remodels for all affected shoreline and over-water structures, including design criteria.</li> </ul>
Current above- and below-water structural member condition	<ul style="list-style-type: none"> <li>The latest condition assessment report available is from 2014 and covers Berths 301-305, 309-310, 312-314, associated finger pier, and sheet piles cell walls of Pier A.</li> </ul>	<ul style="list-style-type: none"> <li>Current condition inspections and assessments (within 3 years) of all over-water facilities affected. Condition assessments will include pile and sheet pile foundations, decks, and other support structure members.</li> </ul>
Functional structures evaluation	<ul style="list-style-type: none"> <li>Some as-built design plans are available for various fixed structures within the shipyard, but no remaining service life information is available</li> </ul>	<ul style="list-style-type: none"> <li>Current condition assessments of shoreline and over-water structures, and structural evaluation to estimate remaining service life.</li> </ul>
Impacts of Remedial Action (RA) on structures	<ul style="list-style-type: none"> <li>Information is available on impacts of berth deepening on the sheet pile walls of Pier A.</li> </ul>	<ul style="list-style-type: none"> <li>Structural analysis to confirm impacts of the RA on a given structure.</li> <li>Previous navigation channel studies, dredging studies, or berth deepening studies for all affected structures</li> </ul>

**Table 3-6  
Data Gap Analysis – Existing Utilities and Debris  
Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Data Requirement	Existing Data Summary	Data Gap to be Filled
Stormwater system outfall locations	<ul style="list-style-type: none"> <li>Existing as-builts are available for the city of Portland’s five (5) outfalls in the basin.</li> <li>No as-built drawings are presently available for private outfalls.</li> <li><a href="http://www.portlandmaps.com">www.portlandmaps.com</a> provides the locations of the city of Portland’s stormwater system in GIS layers.</li> <li>Some private outfalls have been located and documented but level of detail (e.g., invert elevations, functionality) is unknown.</li> </ul>	<ul style="list-style-type: none"> <li>City of Portland’s outfalls will be evaluated to ensure that the Remedial Design (RD) does not affect their functionality, and/or to plan for relocation or removal.</li> <li>Private outfalls will be located and evaluated to ensure that the RD does not affect their functionality, and/or to plan for relocation or removal.</li> </ul>
Existing underground utilities, pipeline and conduit locations, water utilities, and other pipelines	<ul style="list-style-type: none"> <li>No data is presently available.</li> </ul>	<ul style="list-style-type: none"> <li>Coordination and communication with the Oregon Utility Notification Center to identify member utilities with facilities in the Swan Island Basin (SIB) Project Area. Specific locations of existing underground utilities will be coordinated through direct communication with the facility owner.</li> <li>Research to be performed using <a href="http://www.portlandmaps.com">www.portlandmaps.com</a> to identify potential locations of buried electrical system, gas, water, telecommunication, stormwater, sewer, and other existing utilities (e.g., power cables) in the SIB Project Area.</li> <li>Sub-bottom profiling (low-frequency sonar) and magnetometer survey will be performed in specific areas to confirm location of any utilities identified in research, as well as general single-beam transects covering the SIB Project Area and additional surveying as needed around detected objects.</li> </ul>
Derelict marine structures and other in-water debris	<ul style="list-style-type: none"> <li>Aerial photos show much of the derelict structures in the basin, including earlier time periods that indicate where underwater structures may now be located.</li> <li>Nautical Charts published by National Oceanic and Atmospheric Administration (NOAA) identify areas within the Swan Island Basin project area as “abandoned cables” (NOAA, 2016).</li> <li>No existing side-scan sonar or laser-scan data is presently available.</li> </ul>	<ul style="list-style-type: none"> <li>Delineation of debris will be performed using historical and recent aerial photos, historical design drawings, historical topographic maps, etc.</li> <li>Locations of debris will be documented using a combination of side-scan sonar and multi-beam bathymetry for submerged debris, and Mobile Terrestrial LiDAR Scan data for emergent debris.</li> </ul>

**References:**

NOAA, 2016. Booklet Chart, Willamette River – Swan Island Basin, NOAA Chart 18527 at URL: [https://www.charts.noaa.gov/BookletChart/18527\\_BookletChart.pdf](https://www.charts.noaa.gov/BookletChart/18527_BookletChart.pdf)

**Table 3-7  
Data Gap Analysis – Hydrodynamics and Sediment Dynamics  
Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Data Requirement	Existing Data Summary	Data Gap to be Filled
Currents and water levels	<ul style="list-style-type: none"> <li>• Acoustic Doppler Current Profiler (ADCP) transect-based current velocity data near Dry Dock 6 (Stillwater Sciences, 2014). Data has short duration and minimal coverage.</li> <li>• ADCP transect-based current velocity data in the main river (David Evans Associates [DEA], 2002-2004). This data does not cover the Swan Island Basis (SIB) Project Area.</li> <li>• National Oceanic and Atmospheric Administration (NOAA) and United States Geological Survey (USGS) provide freely available hydrologic data (flows and water levels) at various locations on the river.</li> </ul>	<ul style="list-style-type: none"> <li>• Current and water level measurements will be collected at multiple locations over 2 months using bottom-mounted instruments.</li> <li>• Current and water level measurements will be collected along transects by boat throughout the project site during deployment or recovery of bottom-mounted sensors.</li> <li>• Utilize DEA wider river velocity measurements taken from 2002 to 2004 for validating numerical models. No upstream/downstream river velocity data gap has been identified.</li> <li>• Numerical modeling results will be generated using a river-wide 3D hydrodynamic model.</li> </ul>
Winds	<ul style="list-style-type: none"> <li>• Long-term measurements (1976-2021) are available at Portland International Airport from the National Climatic Data Center. Historical measurements (1961-1990) are also available from Meteorological Resource Center (See details in U.S. Environmental Protection Agency [EPA], 2016).</li> <li>• Extremal analysis of winds was performed for the Remedial Investigation (RI)/Feasibility Study (FS) (EPA, 2016).</li> </ul>	<ul style="list-style-type: none"> <li>• No data gap has been identified.</li> </ul>
Climate change	<ul style="list-style-type: none"> <li>• Guidance documents from EPA and others, including Climate Change Adaptation Technical Fact Sheet: Contaminated Sediment Remedies (EPA, 2015), and Adaptation Strategies for Resilient Cleanup Remedies (2017).</li> </ul>	<ul style="list-style-type: none"> <li>• Literature review to determine potential changes in precipitation, temperatures, winds, and other factors potentially affecting the flood rise evaluation and future cap and riverbank stability.</li> </ul>
Wind-waves and boat wakes	<ul style="list-style-type: none"> <li>• No measurements are available.</li> <li>• No wind-wave modeling results or boat wake estimates are available inside the SIB.</li> </ul>	<ul style="list-style-type: none"> <li>• Wind-wave and boat wake measurements will be collected at multiple locations over 2 months using pile-mounted sensors. Sensors will record high-frequency, free-surface elevations to be later analyzed to characterize wind-waves and boat wakes.</li> </ul>
Sediment dynamics	<ul style="list-style-type: none"> <li>• RI/FS (EPA, 2016) and pre-Remedial Design sediment investigation give grain size and specific gravity at multiple locations.</li> <li>• RI/FS (EPA, 2016) included a river-wide 2006 SedFlume campaign with two relevant samples with significant variability, and age of the previous sampling is a concern (&gt;15 years). New SedFlume data is required.</li> <li>• Total suspended solids measurements from November 2005 to April 2006 are available at multiple locations between river mile (RM) 2 and RM 21 (WEST Consultants, Inc., 2006). The data was collected over a range of flows and over a tidal cycle. However, no measurements inside the basin are available.</li> <li>• Short-duration sediment release modeling results are available from evaluation of impacts during maintenance dredging (ERM-West, Inc., 2014). This data may be instructive to dredging studies.</li> </ul>	<ul style="list-style-type: none"> <li>• SedFlume data (cores and laboratory analysis) will be collected around the project site in accordance with details in the Field Sampling Plan.</li> <li>• Suspended sediment measurements will be taken at multiple locations over 2months using bottom-mounted instruments, to be co-located with ADCPs.</li> <li>• Numerical modeling results will be generated using a river-wide 2D hydrodynamic model, with local 3D hydrodynamic modeling performed on a limited basis as needed.</li> <li>• Short-duration sediment release modeling results for past maintenance dredging (ERM-West, Inc., 2014) will be used to assist dredging release studies.</li> <li>• No sediment release modeling data gap has been identified.</li> </ul>
Propeller wash	<ul style="list-style-type: none"> <li>• No measurements or modeling results are available.</li> <li>• EPA guidance, including Guidance for Subaqueous Dredged Material Capping (Palermo et al., 1998).</li> </ul>	<ul style="list-style-type: none"> <li>• Empirical analysis of vessel particulars and movements.</li> <li>• Vessel particulars to be obtained from Automatic Information System data.</li> <li>• Conceptual fluid design (CFD) modeling of propeller wash based on vessel traffic evaluation.</li> </ul>
Vessel positions, both recent (satellite data) and historical (other data)	<ul style="list-style-type: none"> <li>• Freely available data (Bureau of Ocean Energy Management [BOEM] and NOAA, 2019) for download and processing.</li> <li>• Data from January 2021 to present requires purchase.</li> <li>• Historical data not presently available.</li> </ul>	<ul style="list-style-type: none"> <li>• Download freely available data.</li> <li>• Purchase recent data.</li> <li>• Owner/operator interviews to obtain historical data.</li> </ul>
Dry dock operations and hydrodynamics	<ul style="list-style-type: none"> <li>• No information on operations or dry dock particulars is presently available.</li> <li>• No modeling results are presently available.</li> </ul>	<ul style="list-style-type: none"> <li>• Dry dock information (drawings, design reports).</li> <li>• Typical operations - raising and lowering protocols and tracking vessel movements.</li> <li>• CFD modeling of dry dock and vessel movements.</li> </ul>

**Table 3-7 (Continued)**  
**Data Gap Analysis – Hydrodynamics and Sediment Dynamics**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

**References:**

- BOEM and NOAA, 2019. Marine Cadaster, at URL: <https://marine.cadastre.gov/viewers/>
- DEA, 2002. *Willamette River Acoustic Doppler Current Profiler Survey Results*, April 2002. Prepared for Striplin Environmental Associates, Inc., Olympia, WA. David Evans and Associates, Inc., Portland, Oregon. April.
- DEA, 2003. *Willamette River Acoustic Doppler Current Profiler Survey Results*, May 2003. Submitted to Striplin Environmental Associates, Inc., Olympia, WA. David Evans and Associates, Inc., Portland, Oregon. May.
- DEA, 2004. *Willamette River Acoustic Doppler Current Profiler Survey Results*, January 2004. Prepared for Integral Consulting Inc., Mercer Island, WA. David Evans and Associates, Inc., Portland, OR. January.
- EPA, 2016. *Portland Harbor RI/FS, Final Feasibility Study, Portland Oregon*. United States Environmental Protection Agency Region 10, Seattle, Washington. June.
- EPA, 2019. Climate Change Adaptation Technical Fact Sheet: Contaminated Sediment Remedies. October 2019 Update.
- ERM-West, Inc., 2014. *Sediment Release Modeling Report*. Prepared for: Vigor Industrial LLC, Portland, Oregon.
- Palermo, M, Clausner, J, Rollings, M, Williams, G, Myers, T, Fredette, T, and R. Randall, 1998. Guidance for Subaqueous Dredged Material Capping. Technical Report DOER-1.
- Stillwater Sciences, 2014. *Turbidity Monitoring During Pile Driving for Dry Dock Installation*, Technical Memorandum, September 2014.
- Washington State Department of Ecology, 2017. Adaptation Strategies for Resilient Cleanup Remedies. Publication 17-09-052.
- West Consultants, Inc. 2006. *Portland Harbor RI/FS Round 2 Hydrodynamic/sediment Transport Modeling Data Collection Field Sampling Report*. Prepared for: The Lower Willamette Group.

**Table 4-1  
Summary of Data Gaps and Proposed Data Collection  
Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Data/Analysis Type	Data Gaps	Proposed Data Collection
Surface Sediment Contaminant Concentrations	<ul style="list-style-type: none"> <li>• Minor gaps in spatial coverage to characterize horizontal extent of contamination within Sediment Management Area (SMA).</li> <li>• Data needed to support analysis of short-term water quality effects during dredging activities.</li> <li>• Data needed to delineate areas for technology applications including enhanced natural recovery (ENR), dredging, and capping.</li> <li>• Physical and chemical characterization in areas under docks and other structures.</li> </ul>	<ul style="list-style-type: none"> <li>• 29 "step out" surface samples to refine delineation of SMA boundary (4 surface grabs, 25 samples collected from 0 to 1-foot interval of selected cores). One additional surface grab sample targeting historical PAH outlier for a total of 30 surface sediment samples.</li> <li>• 3 bulk sediment samples to support dredge elutriate testing (DRET).</li> </ul>
Subsurface Sediment Contaminant Concentrations	<p>Insufficient core data to characterize vertical extent of contamination within SMA.</p>	<ul style="list-style-type: none"> <li>• 171 cores to 10-foot depth (including 2 archived cores), 10 cores to 20-foot depth</li> <li>• Core locations are based on a 150-foot grid for coverage</li> <li>• 10-foot cores are sampled at 1-foot intervals from 1- to 6-foot depth (total 845 samples), and core intervals 6- to 10-ft depth are archived. 20-foot cores are samples at 1-foot intervals from 1- to 15-foot depth (total 140 samples), and core intervals 15- to 20-ft depth are archived.</li> </ul>
Sediment Pore Water Characterization	<p>No available data to map upward porewater migration within areas of potential sediment capping. Data needed to identify and delineate areas where sediment capping would be potentially feasible, to design sediment caps and evaluate sediment cap effectiveness.</p>	<p>Transect survey using vessel mounted or towed instrument for thermal profiling at sediment/water interface within SMA</p>
Riverbank Characterization	<p>Riverbanks within Swan Island Basin (SIB) Project Area not adequately characterized to assess source control sufficiency and inform stabilization as part of Remedial Design (RD).</p>	<ul style="list-style-type: none"> <li>• Visual survey of physical bank conditions to evaluate erosion potential and delineate areas of potentially erodible sediments.</li> <li>• Coordinate with geotechnical sampling program to evaluate geotechnical failure potential and characterize soil conditions (e.g., grain size, soil erodibility).</li> </ul>

**Table 4-1 (Continued)**  
**Summary of Data Gaps and Proposed Data Collection**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Data/Analysis Type	Data Gaps	Proposed Data Collection
Stormwater Discharge	Lack of adequate data on recontamination potential chemical (RPC) loading from municipal and private outfalls to determine source control sufficiency and complete the source control sufficiency assessment.	<ul style="list-style-type: none"> <li>• Inventory of the current status of discharges from private outfalls RPC exceedances in sediments.</li> <li>• Conduct high-volume, flow-weighted sampling to support RPC load calculations at five municipal stormwater (SW) outfalls.</li> <li>• Collect SW grab samples and SW solids samples using in-line traps at 12 locations.</li> <li>• Conduct reconnaissance of 7 private outfalls to determine if additional sampling is necessary.</li> </ul>
Bathymetric and Topographic Surveys	Complete recent multi-beam survey of the Swan Island Basin (SIB) Project Area for use in analysis and RD. New bathymetry will address data gaps related to technology application decisions and provide essential model geometry information for hydrodynamic and sediment transport modeling to address sufficiency assessment data gaps related to recontamination analysis.	Site-wide multibeam bathymetric survey with complete coverage
Geotechnical Sampling	Site stratigraphy and geotechnical design parameters.	<ul style="list-style-type: none"> <li>• Historical geological and geotechnical records and survey maps.</li> <li>• New program of in-water borings, upland borings, cone penetration tests (CPTs), and groundwater elevation observations.</li> <li>• Total of 31 borings and 15 CPTs</li> </ul>
Shoreline and Overwater Structures Inspections	Structural information required to make a functional structures determination and evaluate Remedial Action (RA) impacts on existing structures, and overwater activities to determine recontamination.	<ul style="list-style-type: none"> <li>• Structural information for all potentially affected shoreline and over-water structures.</li> <li>• Mobile Terrestrial LiDAR Survey</li> <li>• Land-based and water-based inspections</li> <li>• Owner/operator interviews to evaluate activities and future use</li> <li>• Owner/operator interviews to determine current and future navigation requirements and identify future maintenance dredge areas</li> </ul>
Existing Utilities and Debris Identification	Locations and elevations of existing utilities and marine debris affecting RA.	<ul style="list-style-type: none"> <li>• Sub-bottom profile survey along transects</li> <li>• Magnetometer survey along transects</li> <li>• Side-scan sonar with complete coverage</li> </ul>

**Table 4-1 (Continued)**  
**Summary of Data Gaps and Proposed Data Collection**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Data/Analysis Type	Data Gaps	Proposed Data Collection
Hydrodynamics and Sediment Dynamics Measurements	Hydrodynamic/transport processes for conceptual site model refinement, data for model validation, and data for direct use in RD. Data supports hydrodynamic and sediment transport modeling to address source control sufficiency assessment by evaluating recontamination potential for multiple pathways.	Measurement of: <ul style="list-style-type: none"> <li>• Currents from vessel-mounted instruments</li> <li>• Currents from bottom-mounted instruments</li> <li>• Suspended sediments, wind-waves, and boat wakes</li> <li>• Sediment erodibility (SedFlume cores) at 30 locations</li> </ul>
Flood Impact Evaluation	Understanding of potential RA impacts on 500-year flood elevations	Flood impact modeling to evaluate potential net rise due to RA
Habitat Conditions Survey	Aquatic and terrestrial habitat conditions in shallow nearshore zone and on riverbanks not adequately documented to support analysis of RD impacts to aquatic resources within waters of the U.S. Habitat data are needed to inform a Habitat Equivalency Analysis (HEA) that will be used by EPA for decision making regarding compliance with Clean Water Act and Endangered Species Act.	<ul style="list-style-type: none"> <li>• Conduct a habitat conditions survey to document habitat conditions within the SIB project area.</li> <li>• Coordinate habitat survey with riverbank characterization for efficiency based on overlapping information needs.</li> </ul>
Sufficiency Assessment Report (SAR) - Source Control Status	HGL assigned source control sufficiency status of “B” (conditionally controlled) to three upland source areas and “C” (uncontrolled) to 15 upland sources summarized on SAR Table 4-1.	<ul style="list-style-type: none"> <li>• Stormwater monitoring and sampling program described in PDI Work Plan Section 4.3</li> </ul>
SAR – Riverbanks	<ul style="list-style-type: none"> <li>• Existing riverbank conditions (e.g., vegetation, armoring, evidence of erosion, erodibility assessment, and potential for overland flow to the river) based on visual assessment survey.</li> <li>• Geotechnical evaluation to assess potential for bank slope failure.</li> <li>• Chemical characterization of riverbank soils in locations subject to bank erosion or instability.</li> </ul>	<ul style="list-style-type: none"> <li>• Riverbank characterization survey described in PDIWP Section 4.4</li> </ul>

**Table 4-1 (Continued)**  
**Summary of Data Gaps and Proposed Data Collection**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Data/Analysis Type	Data Gaps	Proposed Data Collection
SAR Direct Discharges	<ul style="list-style-type: none"> <li>• Status (active, inactive, removed) of private outfalls adjacent to SMAs.</li> <li>• Lack of current SIB RPC stormwater data at city outfalls M-1, M-2, M-3, S-1, and S-2 for evaluating RPCs using proposed SEDCAM modeling.</li> <li>• Lack of current SIB RPC stormwater data at USCG MSU and Port SIUF OU3 to assess the sufficiency of conveyance system cleanings with CUL or RAL exceedances in sediment.</li> <li>• Lack of SIB RPC stormwater data from outfalls near CUL or RAL exceedances in sediment (Port of Portland Dredge Base, ATC Leasing Co LLC, Barge Eagle Inc, North Basin Watumull, and DTNA Corp-5 Wind Tunnel).</li> <li>• Possible off-site tracking of PCB-impacted soil from an upland site in the M-3 outfall basin and entrainment in road runoff to the city’s conveyance system.</li> </ul>	<ul style="list-style-type: none"> <li>• Stormwater monitoring and sampling program described in PDI Work Plan Section 4.3</li> <li>• Riverbank characterization survey described in PDIWP Section 4.4</li> </ul>
SAR – Overwater Pathway	<ul style="list-style-type: none"> <li>• Inventory of shoreline structures.</li> <li>• Physical survey of select shoreline structures, including material types and coatings.</li> <li>• Assessment of structural integrity of select shoreline structures.</li> <li>• Description of overwater operations, chemical usage, releases, and BMPs associated with shoreline and overwater activities.</li> </ul>	<ul style="list-style-type: none"> <li>• Interviews with property owners/operators and state and federal agencies as described in PDI WP Section 4.11.2</li> <li>• Shoreline and overwater structure inspections as described in PDI Work Plan Section 4.7.</li> <li>• Structure condition assessments as described in PDI Work Plan Section 4.11.1.</li> </ul>
SAR – In-water Pathways	<ul style="list-style-type: none"> <li>• Resuspension of bedded sediments.</li> <li>• Advection of Groundwater through Contaminated Sediment.</li> <li>• Leaching or Abrasion from Existing Structures.</li> <li>• Loading derived from upstream sources.</li> </ul>	<ul style="list-style-type: none"> <li>• Recontamination potential evaluation, including hydrodynamic and sediment transport modeling, as described in PDI Work Plan Section 4.11.7.</li> <li>• Hydrodynamics and sediment dynamics measurements as described in PDI Work Plan Section 4.9.</li> <li>• Porewater upwelling location survey as described in PDI Work Plan Section 4.2.</li> </ul>

**Table 4-2  
Summary of Stormwater System Sampling Activities and Locations  
Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Basin ID	Primary Sample Location Manhole ID	Sample Media and Proposed Analytical Suite						Proposed Sample Location Info				Alternate Sample Location Manhole ID	Sample Media and Proposed Analytical Suite						Alternate Sample Location Information			
		Stormwater			Stormwater Solids			Depth (Portland Maps ft)	Pipe Diameter (Portland Maps inches)	Pipe Invert Elevation (COP)	Pipe Invert Elevation (MBDC)		Stormwater			Stormwater Solids			Depth (Portland Maps ft)	Pipe Elevation (COP)	Pipe Elevation (MBDC)	
		Analyte List	Sample Frequency	Collection Method	Analyte List	Sample Frequency	Collection Method						Analyte List	Sample Frequency	Collection Method	Analyte List	Sample Frequency	Collection Method				
<b>City of Portland Stormwater Conveyance System</b>																						
M-1	AAM107	ROD Table 17 COCs minus ROD Table 21 focused COCs, TSS, TOC	3 Events (2 wet season, 1 dry season)	HVS (Whole Water Carboy)	ROD Table 21 focused COCs	3 Events (2 wet season, 1 dry season)	HVS (Filter)	26.3	inlets 60 (AAM107-APX575) & outlet 60 (OFM-1)	9.5	6.58	AAM104	ROD Table 17 COCs minus ROD Table 21 focused COCs, TSS, TOC	3 Events (2 wet season, 1 dry season)	HVS (Whole Water Carboy)	ROD Table 21 focused COCs	3 Events (2 wet season, 1 dry season)	HVS (Filter)	25	15.93	13.01	
					ROD Table 17 COCs, or only ROD Table 21 focused COCs, if limited volume	2 wet season samples from lateral from basin, 2 dry season samples from lateral from basin	ILS										ROD Table 17, or only ROD Table 21 focused COCs, if limited volume	1 wet season sample from sub-basins, 1 dry season sample from sub-basins				ILS
					ROD Table 17 COCs, or only ROD Table 21 focused COCs, if limited volume	1 sample, from upstream side of AMM107 before equipment deployment	MSG										ROD Table 17, or only ROD Table 21 focused COCs, if limited volume	1 sample in each of three laterals to AAM104 before equipment deployment				MSG
												AAJ935 (north subbasin)				ROD Table 17, or only ROD Table 21 focused COCs, if limited volume	1 wet season sample from manhole, 1 dry season sample from manhole	ILS	16.5	14.88	11.96	
																ROD Table 17, or only ROD Table 21 focused COCs, if limited volume	1 sample in AAJ935 before equipment deployment	MSG				

**Table 4-2 (continued)**  
**Summary of Stormwater System Sampling Activities and Locations**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Basin ID	Primary Sample Location Manhole ID	Sample Media and Proposed Analytical Suite						Proposed Sample Location Info				Alternate Sample Location Manhole ID	Sample Media and Proposed Analytical Suite						Alternate Sample Location Information		
		Stormwater			Stormwater Solids			Depth (Portland Maps ft)	Pipe Diameter (Portland Maps inches)	Pipe Invert Elevation (COP)	Pipe Invert Elevation (MBDC)		Stormwater			Stormwater Solids			Depth (Portland Maps ft)	Pipe Elevation (COP)	Pipe Elevation (MBDC)
		Analyte List	Sample Frequency	Collection Method	Analyte List	Sample Frequency	Collection Method						Analyte List	Sample Frequency	Collection Method	Analyte List	Sample Frequency	Collection Method			
M-1	AAM107 <sup>a</sup>											AAJ810 (northwest subbasin)					1 wet season sample from sub-basin, 1 dry season sample from sub-basin	ILS	16.5	15.93	13.01
													ROD Table 17, or only ROD Table 21 focused COCs, if limited volume				1 sample in AAJ810 before equipment deployment	MSG			
												AAJ105 (southeast subbasin)					1 wet season sample from sub-basin, 1 dry season sample from sub-basins	ILS	20.6	16.5	13.58
																	1 sample in AAM105 before equipment deployment	MSG			
M-2	AAM169	ROD Table 17 COCs minus ROD Table 21 focused COCs, TSS, TOC	3 Events (2 wet season, 1 dry season)	HVS (Whole Water Carboy)	ROD Table 21 focused COCs	3 Events (2 wet season, 1 dry season)	HVS (Filter)	20.6	inlets 21 (AAM169-AAM165), 60 (AAM169-AAM170), 27 (AAM169-AAM192) and outlet 60 (OFM-2)	10.57	7.65	AAM170 (north subbasin)	ROD Table 17 COCs minus ROD Table 21 focused COCs, TSS, TOC	3 Events (2 wet season, 1 dry season)	HVS (Whole Water Carboy)	ROD Table 21 focused COCs	3 Events (2 wet season, 1 dry season)	HVS (Filter)	20.9	10.93	8.01
					ROD Table 17, or only ROD Table 21 focused COCs, if limited volume	3 wet season samples from laterals to sub-basins, 3 dry season samples from laterals to sub-basins	ILS										ROD Table 17, or only ROD Table 21 focused COCs, if limited volume	1 wet season sample from sub-basin, 1 dry season sample from sub-basins	ILS		

**Table 4-2 (continued)**  
**Summary of Stormwater System Sampling Activities and Locations**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Basin ID	Primary Sample Location Manhole ID	Sample Media and Proposed Analytical Suite						Proposed Sample Location Info				Alternate Sample Location Manhole ID	Sample Media and Proposed Analytical Suite						Alternate Sample Location Information			
		Stormwater			Stormwater Solids			Depth (Portland Maps ft)	Pipe Diameter (Portland Maps inches)	Pipe Invert Elevation (COP)	Pipe Invert Elevation (MBDC)		Stormwater			Stormwater Solids			Depth (Portland Maps ft)	Pipe Elevation (COP)	Pipe Elevation (MBDC)	
		Analyte List	Sample Frequency	Collection Method	Analyte List	Sample Frequency	Collection Method						Analyte List	Sample Frequency	Collection Method	Analyte List	Sample Frequency	Collection Method				
M-2	AAM169				ROD Table 17, or only ROD Table 21 focused COCs, if limited volume	3 samples one per lateral in AMM169 before equipment deployment	MSG										1 sample in AAJ935 before equipment deployment	MSG				
																	ROD Table 17, or only ROD Table 21 focused COCs, if limited volume	1 wet season sample from sub-basin, 1 dry season sample from sub-basins	ILS	18	14.97	12.05
																		1 sample in AAJ810 before equipment deployment	MSG			
																		1 wet season sample from sub-basin, 1 dry season sample from sub-basins	ILS	18	14.06	11.14
																	1 sample in AAJ810 before equipment deployment	MSG				
M-3	AAQ004 <sup>b</sup>	ROD Table 17 COCs minus ROD Table 21 focused COCs, TSS, TOC	3 Events (2 wet season, 1 dry season)	HVS (Whole Water Carboy)	ROD Table 21 focused COCs	3 Events (2 wet season, 1 dry season)	HVS (Filter)	24.6	inlets 18 (AAQ004-AAP976) and 48 (AAQ004-AAQ-005)	6.03 (AAQ004-AAQ003)	3.11	AAQ005	ROD Table 17 COCs minus ROD Table 21 focused COCs, TSS, TOC	3 Events (2 wet season, 1 dry season)	HVS (Whole Water Carboy)	ROD Table 21 focused COCs	3 Events (2 wet season, 1 dry season)	HVS (Filter)	22.6	9.89	6.97	

**Table 4-2 (continued)**  
**Summary of Stormwater System Sampling Activities and Locations**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Basin ID	Primary Sample Location Manhole ID	Sample Media and Proposed Analytical Suite						Proposed Sample Location Info				Alternate Sample Location Manhole ID	Sample Media and Proposed Analytical Suite						Alternate Sample Location Information						
		Stormwater			Stormwater Solids			Depth (Portland Maps ft)	Pipe Diameter (Portland Maps inches)	Pipe Invert Elevation (COP)	Pipe Invert Elevation (MBDC)		Stormwater			Stormwater Solids			Depth (Portland Maps ft)	Pipe Elevation (COP)	Pipe Elevation (MBDC)				
		Analyte List	Sample Frequency	Collection Method	Analyte List	Sample Frequency	Collection Method						Analyte List	Sample Frequency	Collection Method	Analyte List	Sample Frequency	Collection Method							
M-3	AAQ004 <sup>b</sup>				ROD Table 17, or only ROD Table 21 focused COCs, if limited volume	3 wet season samples from laterals to sub-basins, 3 dry season samples from laterals to sub-basins	ILS					AAQ005				ROD Table 17, or only ROD Table 21 focused COCs, if limited volume	3 wet season samples from laterals to sub-basins, 3 dry season samples from laterals to sub-basins	ILS							
					ROD Table 17, or only ROD Table 21 focused COCs, if limited volume	3 samples one per lateral in AMM104 before equipment deployment	MSG									ROD Table 17, or only ROD Table 21 focused COCs, if limited volume	3 samples one per lateral in AMM104 before equipment deployment	MSG							
S-1	AAM131	ROD Table 17 COCs minus ROD Table 21 focused COCs, TSS, TOC	3 Events (2 wet season, 1 dry season)	HVS (Whole Water Carboy)	ROD Table 21 focused COCs	3 Events (2 wet season, 1 dry season)	HVS (Filter)	21.7	inlets 27 (AAM131-AAM128), 18 (AAM131-AAM133)outlet 36 (OFS-1)	14.76	11.83		None proposed												
					ROD Table 17, or only ROD Table 21 focused COCs, if limited volume	2 wet season samples from laterals to sub-basins, 2 dry season samples from laterals to sub-basins	ILS																		
					ROD Table 17, or only ROD Table 21 focused COCs, if limited volume	2 samples, one per lateral, from AMM107 before equipment deployment	MSG																		

**Table 4-2 (continued)**  
**Summary of Stormwater System Sampling Activities and Locations**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Basin ID	Primary Sample Location Manhole ID	Sample Media and Proposed Analytical Suite						Proposed Sample Location Info				Alternate Sample Location Manhole ID	Sample Media and Proposed Analytical Suite						Alternate Sample Location Information			
		Stormwater			Stormwater Solids			Depth (Portland Maps ft)	Pipe Diameter (Portland Maps inches)	Pipe Invert Elevation (COP)	Pipe Invert Elevation (MBDC)		Stormwater			Stormwater Solids			Depth (Portland Maps ft)	Pipe Elevation (COP)	Pipe Elevation (MBDC)	
		Analyte List	Sample Frequency	Collection Method	Analyte List	Sample Frequency	Collection Method						Analyte List	Sample Frequency	Collection Method	Analyte List	Sample Frequency	Collection Method				
S-2	AAP957	ROD Table 17 COCs minus ROD Table 21 focused COCs, TSS, TOC	3 Events (2 wet season, 1 dry season)	HVS (Whole Water Carboy)	ROD Table 21 focused COCs	3 Events (2 wet season, 1 dry season)	HVS (Filter)	22.1	inlets 30 (AAP957-AAP955), 21 (AAP957-AAP970) outlet 36 (OFS-2)	14.71	11.79		None proposed									
					ROD Table 17, or only ROD Table 21 focused COCs, if limited volume	2 wet season samples from laterals to sub-basins, 2 dry season samples from laterals to sub-basins	ILS															
					ROD Table 17, or only ROD Table 21 focused COCs, if limited volume	2 samples, one per lateral, from AMM107 before equipment deployment	MSG															
<b>Private Conveyance System</b>																						
USCG Marine Safety Unit (WR-198, WR-199, WR-200 or WR-201)	ATC Leasing / Auto Truck Transport (WR-69, WR-71 or WR-289) Barge Eagle (WR-68, WR-185, or WR-186) NW Paperbox Manufacturing (WR-15)	ROD Table 17 COCs, TSS, TOC	3 Events (2 wet season, 1 dry season)	SWC	ROD Table 17, or only ROD Table 21 focused COCs, if limited volume	One sample from stormwater feature prior to equipment deployment	MSG		Not available												None proposed	

**Table 4-2 (continued)**  
**Summary of Stormwater System Sampling Activities and Locations**  
**Pre-Design Investigation Work Plan; Swan Island Basin Project Area, Portland, Oregon**

Basin ID	Primary Sample Location Manhole ID	Sample Media and Proposed Analytical Suite						Proposed Sample Location Info				Alternate Sample Location Manhole ID	Sample Media and Proposed Analytical Suite						Alternate Sample Location Information			
		Stormwater			Stormwater Solids			Depth (Portland Maps ft)	Pipe Diameter (Portland Maps inches)	Pipe Invert Elevation (COP)	Pipe Invert Elevation (MBDC)		Stormwater			Stormwater Solids			Depth (Portland Maps ft)	Pipe Elevation (COP)	Pipe Elevation (MBDC)	
		Analyte List	Sample Frequency	Collection Method	Analyte List	Sample Frequency	Collection Method						Analyte List	Sample Frequency	Collection Method	Analyte List	Sample Frequency	Collection Method				
Daimler Trucks North America Wind Tunnel / Corp 5 (WR-429) Port of Portland Lagoon Avenue Property (WR-30, WR-31, WR-32, WR-33, WR-34, or WR-35)		ROD Table 17 COCs, TSS, TOC	3 Events (2 wet season, 1 dry season)	SWC	ROD Table 17, or only ROD Table 21 focused COCs, if limited volume	One sample from stormwater feature prior to equipment deployment	MSG		Not available										None proposed			

**Footnotes:**  
a) In-line sediment trap deployment and collection of manual solids samples are not proposed at this location due to historical and likely future river backflow. If proposed field reconnaissance during high tide indicates that a sediment trap can be installed above the highest river elevation, then a sediment trap will be installed at this location with the inlet above the highest river elevation. The proposed HVS monitoring and solids sampling location may be adjusted to AAM104 where river backflow is less likely (i.e., pipe invert elevation of 13.01 feet MBDC versus 6.58 feet MBDC at AAM107).  
b) While manhole AAQ003 is closer to OFM-3, its pipe invert elevation is less than the river elevation range during the wet season (3.11 feet versus 4 to 10 feet MBDC). As a result, the proposed monitoring location was adjusted.

**Acronyms**

- BES = Bureau of Environmental Services
- COC = contaminant of concern
- COP = City of Portland
- ft = feet
- HVS = high-volume, time-weighted sample
- ID = identification
- ILS = in-line solids (confined space entry)
- MBDC = Morrison Bridge Datum Conversion. The City of Portland datum is converted to Morrison Bridge Datum (USGS gaging station 14211720, gage height of 1.55 feet above National Geodetic Vertical Datum of 1929) by subtracting 2.92  
<https://www.portlandoregon.gov/transportation/article/70676>
- MSG = manual solids grab (confined space entry)
- NA = not applicable
- ROD = Record of Decision for Portland Harbor Superfund Site (EPA, 2017 and 2020)
- SWC = flow-weighted, composite stormwater sample collected using Teledyne ISCO 6712C autosamplers equipped with flow meter
- TOC = total organic carbon
- TSS = total suspended solids
- USCG = U.S. Coast Guard
- VIS = visual system inspection

Current River Level (MBDC): [https://nwis.waterdata.usgs.gov/usa/nwis/uv/?cb\\_00065=on&format=gif\\_stats&site\\_no=14211720&period=&begin\\_date=2021-01-26&end\\_date=2021-02-02](https://nwis.waterdata.usgs.gov/usa/nwis/uv/?cb_00065=on&format=gif_stats&site_no=14211720&period=&begin_date=2021-01-26&end_date=2021-02-02)  
Projected River Level (MBDC): <https://waterdata.usgs.gov/monitoring-location/14211720/#parameterCode=00065&period=P7D&compare=true>  
<https://water.weather.gov/ahps2/hydrograph.php?gage=prto3&wfo=pqr>

**Table 6-1  
Proposed PDI Field Schedule  
Pre-Design Investigation Work Plan; Swan Island Basin Project Area,  
Portland, Oregon**

PDI Task Description	Planned Start Date	Planned Completion Date
Surface/Subsurface Sediment Contaminant Concentrations	6/6/22	2/7/23
Porewater Upwelling Location Survey	3/14/22	6/10/22
Stormwater Sampling	1/24/22	11/7/22
Riverbank Characterization	1/31/22	10/13/22
Bathymetric and Topographic Surveys	3/2/22	4/1/22
Geotechnical Sampling	3/2/22	9/28/22
Shoreline and Overwater Structure Inspections	3/2/22	6/16/22
Existing Utilities and Debris Identification Surveys	3/2/22	6/30/22
Hydrodynamics and Sediment Dynamics Measurements	2/22/22	5/23/22
Habitat Conditions Survey	6/30/22	8/26/22
Engineering Studies	1/3/22	6/9/23
Structure Condition Assessments	5/16/22	9/13/22
Facility Owner/Operator Interviews	1/3/22	4/1/22
Facility Future Use and RA Impact Evaluation	10/14/22	6/9/23
Construction Sequencing and Phasing Assessment	2/13/23	5/12/23
Dredging Study	10/28/22	2/24/23
Constructability Assessment	3/13/23	6/9/23
Recontamination Potential Evaluation	1/3/22	12/27/22
Resuspension/Scour (1) - Natural Forces	3/2/22	10/28/22
Resuspension/Scour (2) - Anthropogenic Forces	1/3/22	10/28/22
Resuspension/Scour Pathways – Sediment Releases During Dredging	5/23/22	10/20/22
Future Climate Change Effects on Recontamination Potential	8/29/22	12/27/22
Cap Stability Evaluations	5/31/22	2/24/23
Green Remediation Practice Evaluation	11/28/22	3/27/23
Flood Impact Evaluation	8/29/22	3/27/23

## **FIGURES**

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## PDI WP FIGURES LIST OF ACRONYMS

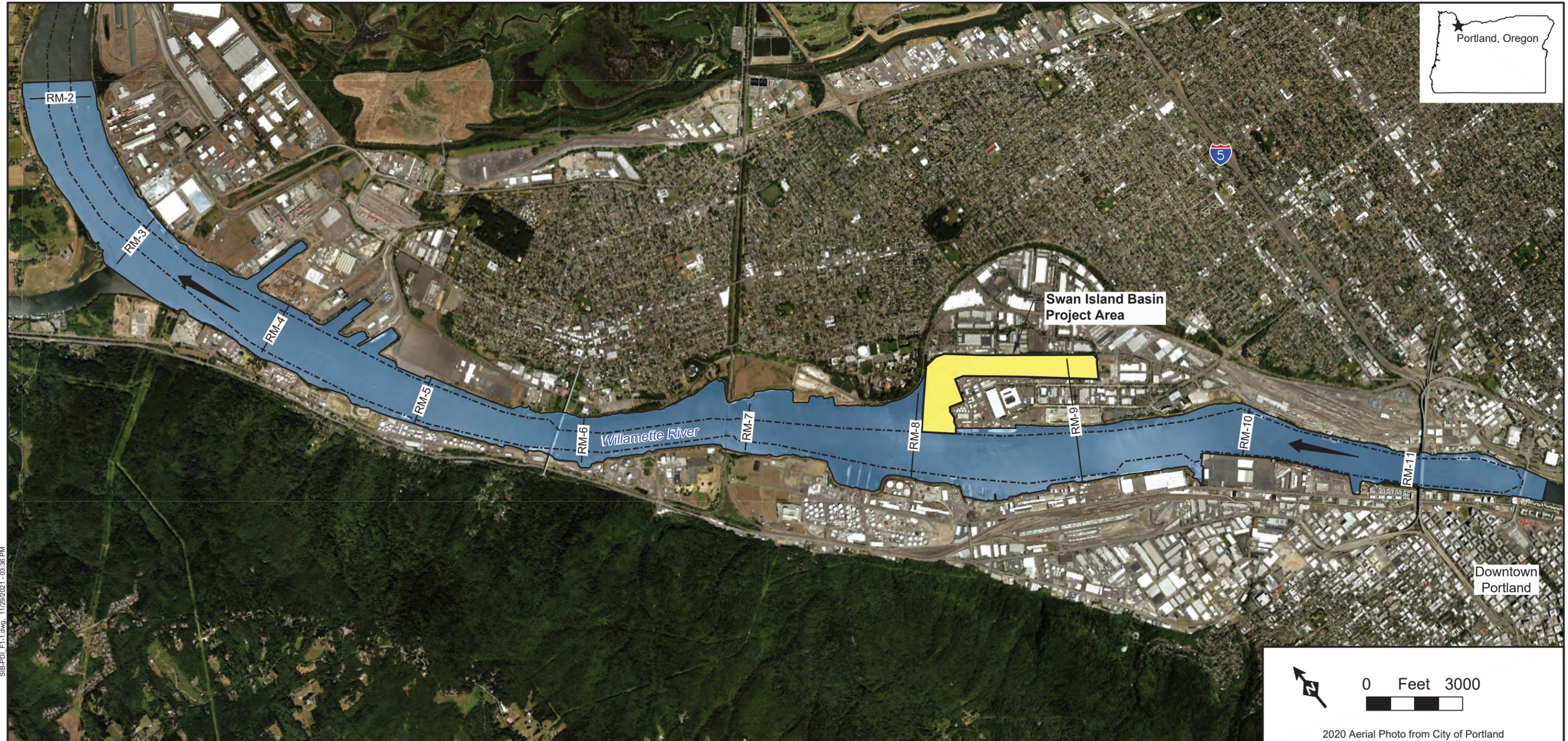
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ADCP	acoustic doppler current profiler
AICP	American Institute of Certified Planners
BWTP	Ballast Wastewater Treatment Plant
CHMM	Certified Hazardous Materials Manager
CIH	Certified Industrial Hygienist
CQMC	Core Quality Measures Collaborative
COP	City of Portland
CPG	Certified Professional Geologist
CPT	Cone Penetration test
CQA	certified quality auditor
DTNA	Diamler Trucks North America
EMNR	Enhanced Monitored Natural Recovery
EPA	U.S. Environmental Protection Agency
HGL	HydroGeologic Inc.
HVS	in-line solids and stormwater
IH	heavy industrial
IL S	in-line solids
IL SS	in-line solids and stormwater
LG	licensed geologist
LI	light industrial
LiDAR	light detection and ranging
FMD	Future Maintenance Dredge
MNR	Monitored Natural Recovery
MSG	manual solids grab
MU	mixed-use residential
NAPL	Non-aqueous pollutant liquid
Nav	navigational channel
NEC	no exposure certification
NPDES	National Pollution Discharge Elimination System
NRC	not reliably contained
OHW	Ordinary High Water
PE	professional engineers

## PDI WP FIGURES LIST OF ACRONYMS (Continued)

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PhD	Doctor of Philosophy
PHSS	Portland Harbor Superfund Site
PMP	project management professional
PTW	principal threat waste
RAL	Remedial Action Level
RI/FS	Remedial Investigation Feasibility Study
RG	Regional Geologist
RLIS	Oregon Metro Regional Land Information System
RM	River Mile
ROD	Record of Decision
SDU	Sediment Decision Unit
SIB	Swan Island Basin
SF	single family residential
SIB	Swan Island Basin
SMA	sediment management area
SWG	stormwater grab
TIG	The Intelligence Group
USACE	U.S. Army Corps of Engineers
VIS	visual inspection
VP	Vice President



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- Federal Navigation Channel (USACE 2020)
- ← River Flow Direction
- Swan Island Basin Project Area
- Portland Harbor Superfund Site Boundary (River Mile 1.9 to 11.8)

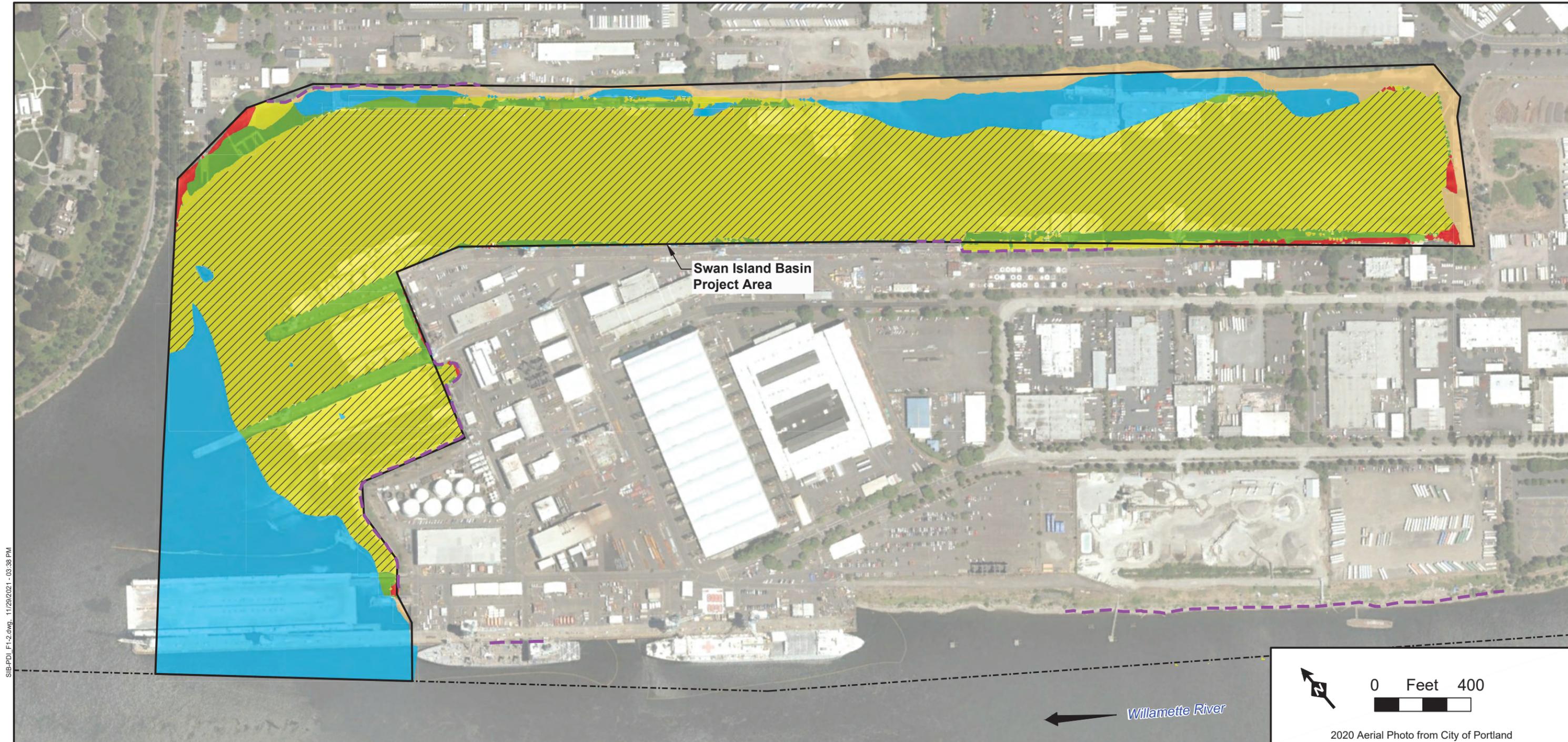
Notes:  
 NOAA - National Oceanic and Atmospheric Administration  
 RM - River Mile  
 SIB - Swan Island Basin  
 USACE - U.S. Army Corps of Engineers

Source:  
 NOAA, 2016. Booklet Chart, Willamette River – Swan Island Basin, NOAA Chart 18527 at URL:  
[https://www.charts.noaa.gov/BookletChart/18527\\_BookletChart.pdf](https://www.charts.noaa.gov/BookletChart/18527_BookletChart.pdf)  
 - Navigation Channel

**Figure 1-1**  
**SIB Project Area Location Map**

Prepared on 11/29/2021  
 Pre-Design Investigation Work Plan  
 Swan Island Basin





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- Known Contaminated Riverbanks
  - Federal Navigation Channel (USACE 2020)
  - River Flow Direction
- Technology Assignments**
- Monitored Natural Recovery
  - Enhanced Monitored Natural Recovery
  - Cap
  - Dredge
  - Future Maintenance Dredging in Navigation Channel
  - Dredge with Cap

Notes:  
 EPA - U.S. Environmental Protection Agency  
 NOAA - National Oceanic and Atmospheric Administration  
 PHSS - Portland Harbor Superfund Site  
 ROD - Record of Decision  
 SIB - Swan Island Basin  
 USACE - U.S. Army Corps of Engineers

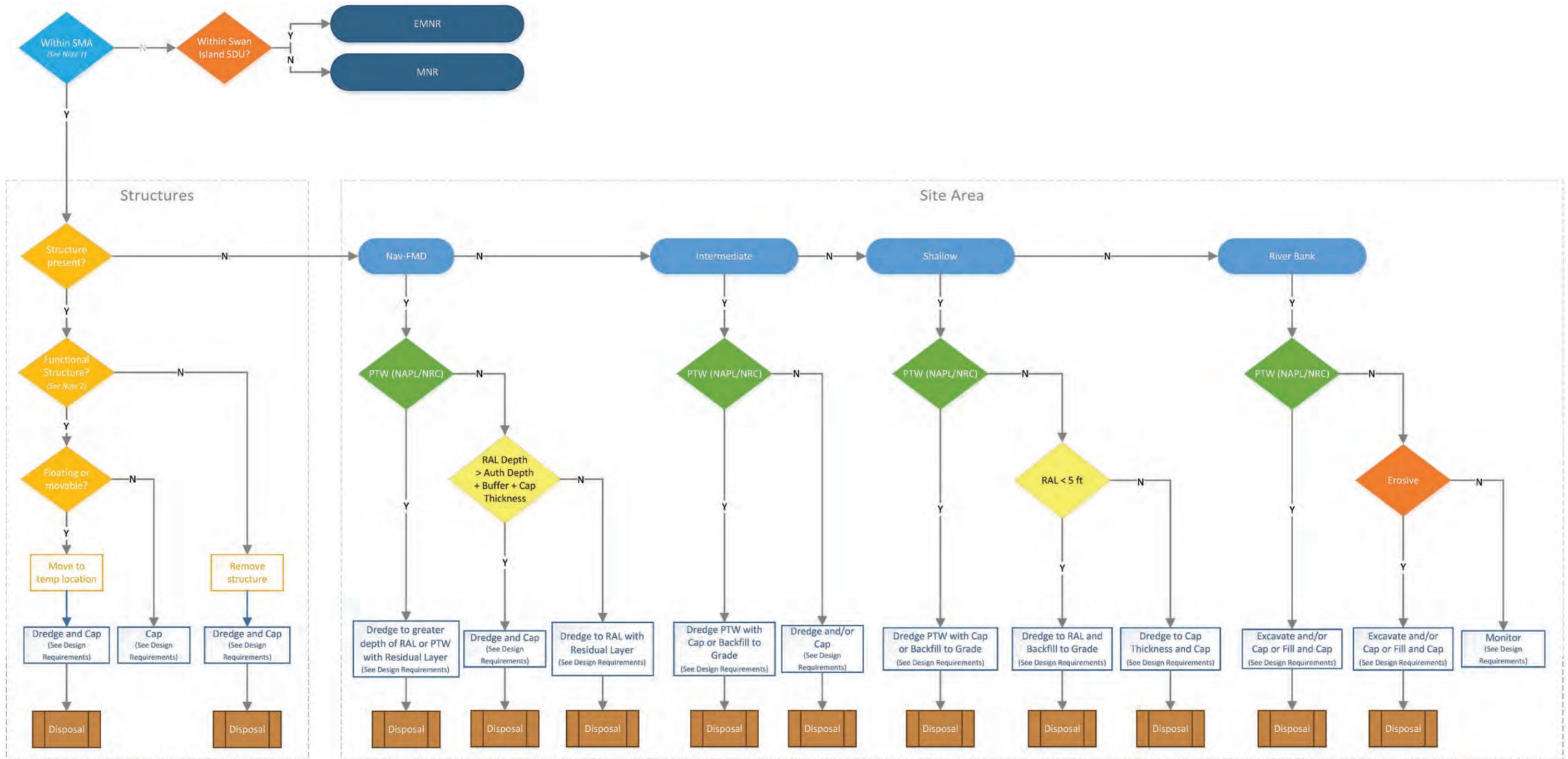
Sources:  
 (1) Adapted from: Figure 31d from EPA, 2017. ROD, PHSS, Portland, Oregon.  
 - Technology Assignments  
 - Known Contaminated Riverbanks  
 (2) NOAA, 2016. Booklet Chart, Willamette River – Swan Island Basin, NOAA Chart 18527 at URL:  
[https://www.charts.noaa.gov/BookletChart/18527\\_BookletChart.pdf](https://www.charts.noaa.gov/BookletChart/18527_BookletChart.pdf)  
 - Navigation Channel

**Figure 1-2**  
**SIB Project Area**  
**Technology Assignments per the PHSS ROD**

Prepared on 11/29/2021  
 Pre-Design Investigation Work Plan  
 Swan Island Basin



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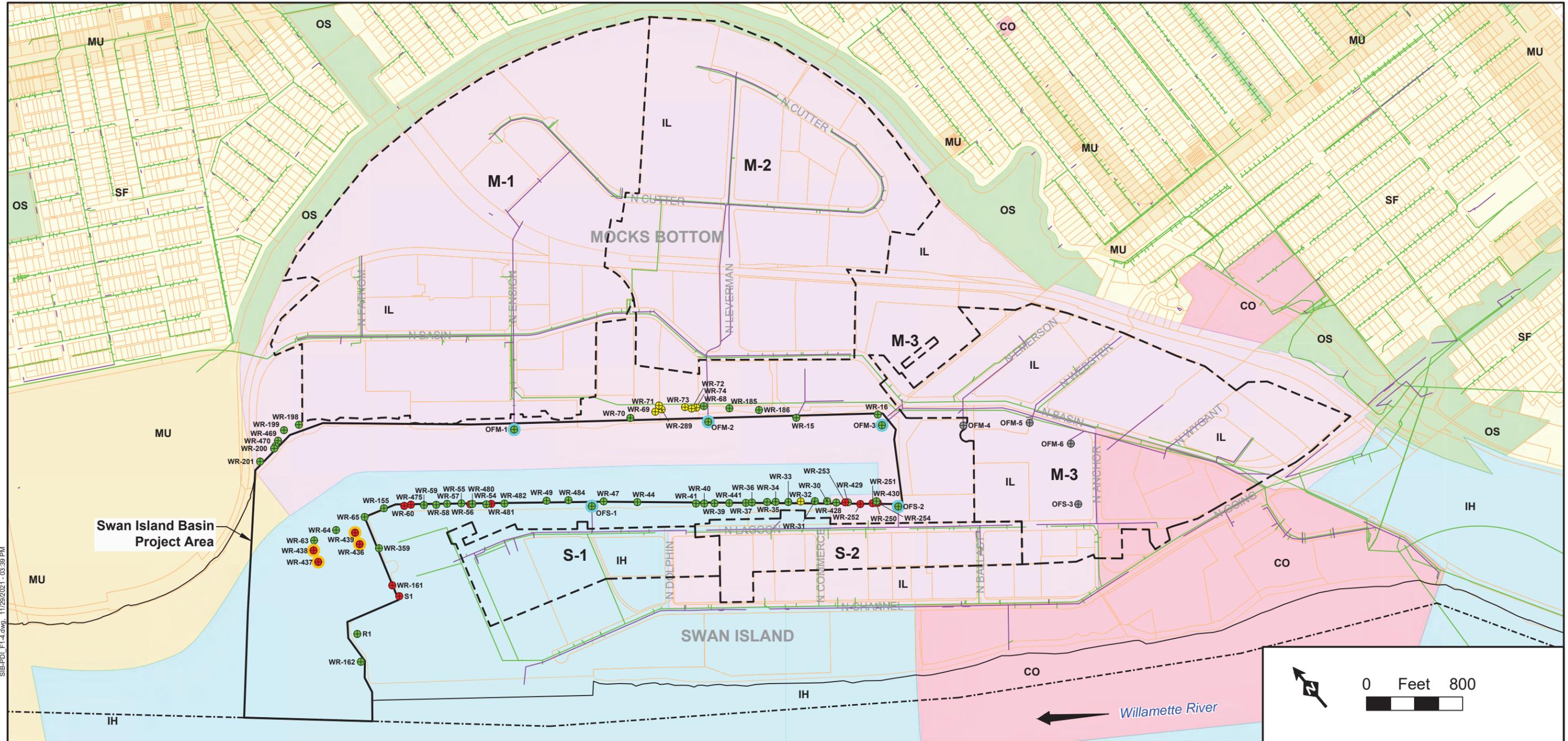
Notes:  
 EMNR - Enhanced Monitored Natural Recovery  
 MNR - Monitored Natural Recovery  
 NAPL - Non-Aqueous Phase Liquid  
 Nav-FMD - Navigation Channel - Future Maintenance Dredge Area  
 NRC - Not Reliably Contained  
 PHSS - Portland Harbor Superfund Site  
 PTW - Principal Threat Waste  
 RAL - Remedial Action Level  
 ROD - Record of Decision  
 SDU - Sediment Decision Unit  
 SMA - Sediment Management Area  
 USEPA - United States Environmental Protection Agency

Source:  
 PHSS ROD, USEPA, January 2017, Figure 28

(1) Contamination is defined in three dimensions.  
 (2) Currently operating or used to stabilize bank. Service life > 50 yrs.

**Figure 1-3**  
**Technology Application**  
**Decision Tree**

Prepared on 9/3/2021  
 Pre-Design Investigation Work Plan  
 Swan Island Basin



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- - - - - Drainage Basin      - - - - - Federal Navigation Channel (USACE 2020)      ← River Flow Direction  
 Zoning      Tax Lot Boundary

<b>IH</b> Heavy Industrial	<b>MU</b> Mixed Use Residential
<b>IL</b> Light Industrial	<b>SF</b> Single Family Residential
<b>CO</b> Commercial	<b>OS</b> Parks and Open Space

**Collection Lines**  
 — Stormwater Line      — Sewer Line

**Outfalls**  
 ● Active      ● Inactive      ⊕ Abandoned      ⊕ Unknown  
 ⊕ Active - City of Portland Municipal Outfalls (M-1, M-2, M-3, S-1 and S-2)  
 ⊕ Inactive - Former Non-Contact Cooling Water Discharge Points (WR-436 through WR-439)

**Notes:**  
 NOAA - National Oceanic and Atmospheric Administration  
 SIB - Swan Island Basin  
 USACE - U.S. Army Corps of Engineers

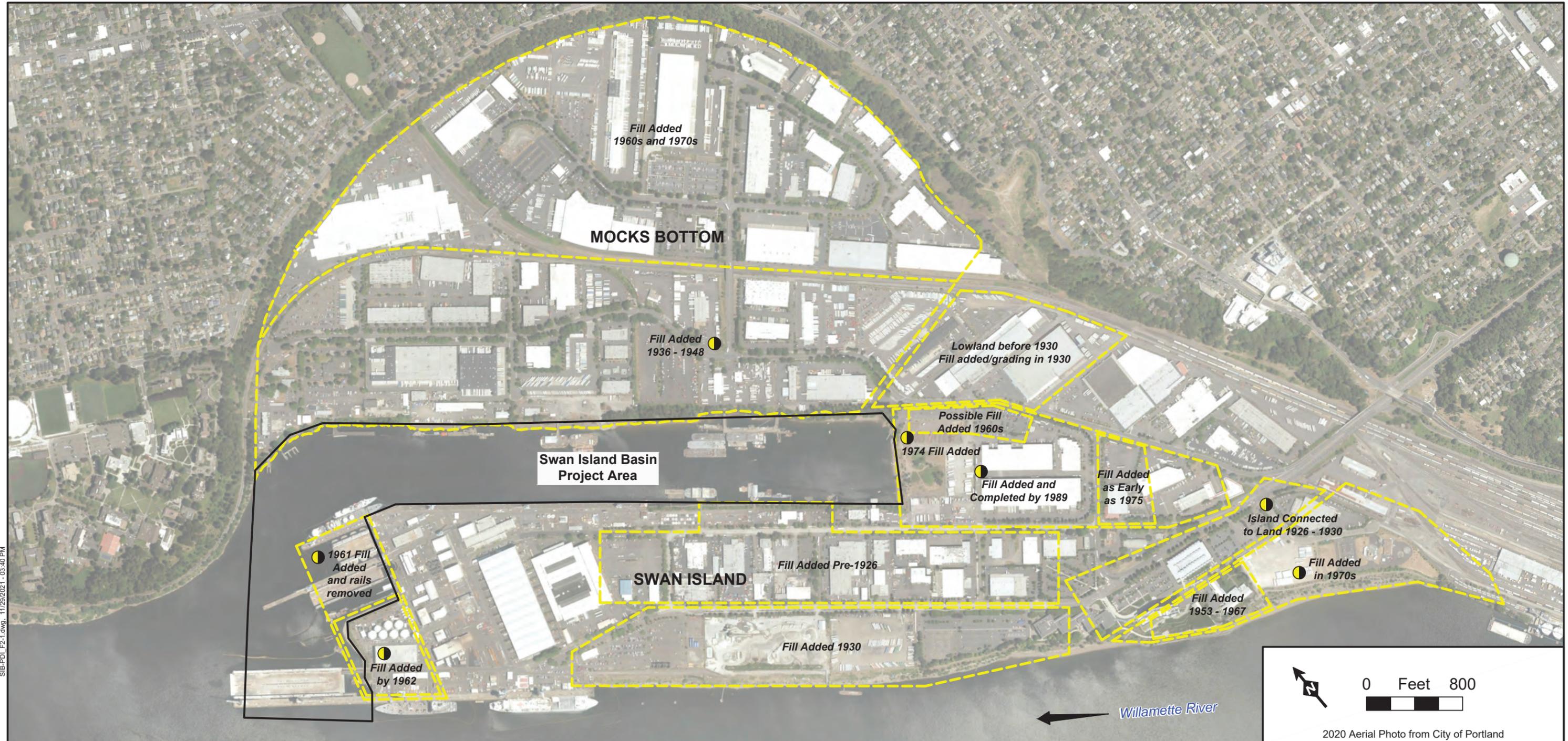
**Sources:**  
 (1) City of Portland Bureau of Environmental Services  
 - Outfalls  
 - Drainage Basins (except S-1)  
 - Collection Lines  
 (2) Vigor Stormwater Program Staff  
 - Portland Shipyard Outfalls (June 21, 2021)  
 - Drainage Basin S-1  
 (3) Oregon Metro Regional Land Information System  
 - Zoning (January 26, 2021)  
 - Tax Lots (July 23, 2020)  
 (4) NOAA, 2016. Booklet Chart, Willamette River – Swan Island Basin, NOAA Chart 18527 at URL: [https://www.charts.noaa.gov/BookletChart/18527\\_BookletChart.pdf](https://www.charts.noaa.gov/BookletChart/18527_BookletChart.pdf)  
 - Navigation Channel

## Figure 1-4 SIB Upland Area Zoning and Drainage Basins

Prepared on 11/29/2021

Pre-Design Investigation Work Plan  
Swan Island Basin Project Area

PACIFIC groundwater GROUP  
**HGL** M M  
 HydroGeoLogic, Inc. MOTT MACDONALD  
 BRIDGEWATER GROUP



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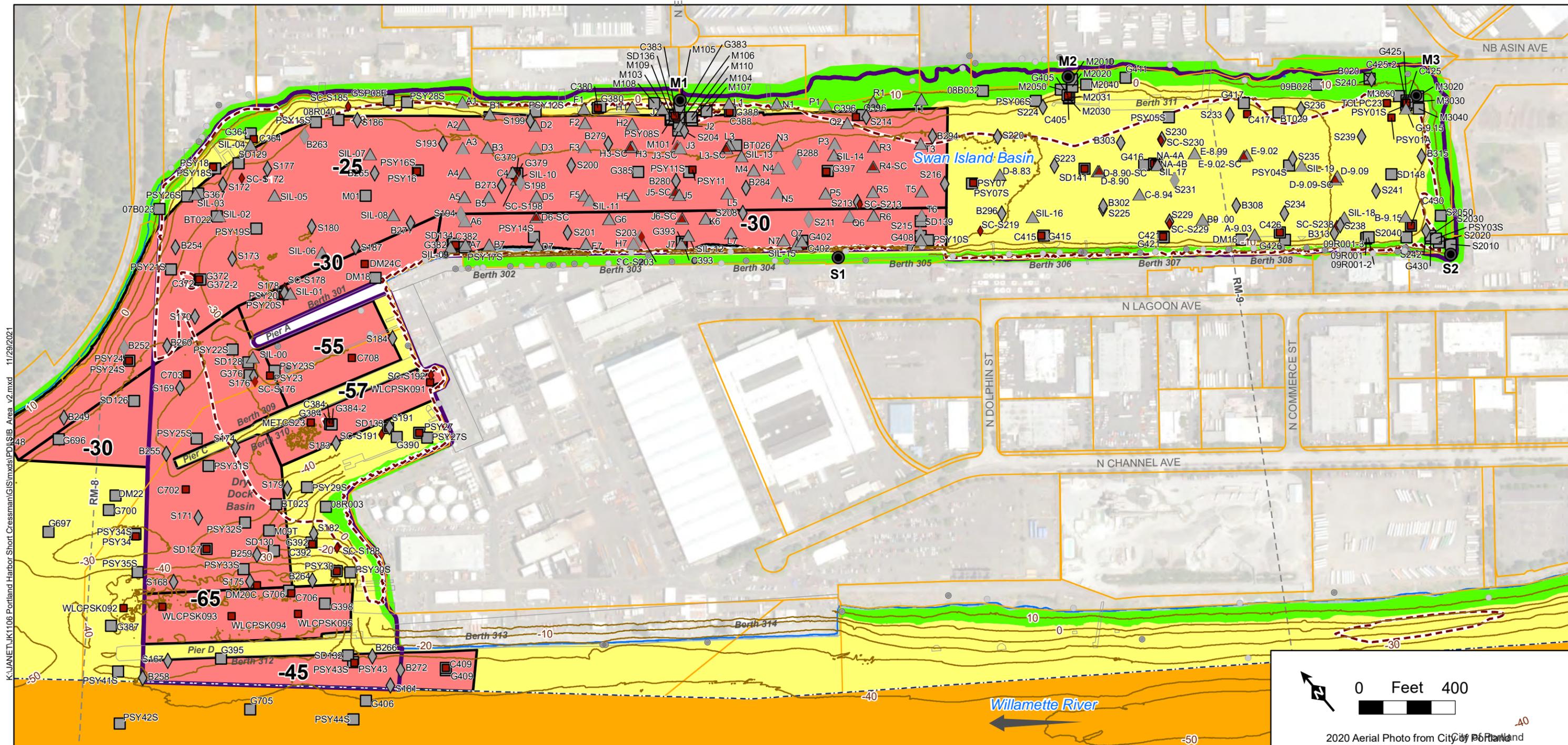
- Fill Placement (Approximate)
- Areas of Change (Approximate)
- River Flow Direction

Note:  
SIB - Swan Island Basin

Source:  
Figure 3-1, Historical Fill Placement in Swan Island/Mocks Bottom Georegion, Maul Foster Alongi (citing Integral et al., 2011), November 2011.

**Figure 2-1**  
**SIB Fill History**

Prepared on 11/29/2021  
Pre-Design Investigation Work Plan  
Swan Island Basin



K:\JANET\UK1106 Portland Harbor Short Crossman\GIS\mxd\SI\_B Area v2.mxd 11/29/2021

**Surface Sample Locations**

- RI/FS
- ▲ Post-ROD
- ◆ PDI

**Subsurface Sample Locations**

- RI/FS
- ▲ Post-ROD
- ◆ PDI

**Revised Portland Harbor Site Regions**

- Shallow
- Intermediate
- Navigation Channel
- Revised Future Maintenance Dredge (FMD) with Depths in feet. (Swan Island Group, 2016)

- City of Portland Stormwater Outfall
- Non-City Outfall
- River Mile (RM)
- Swan Island Sediment Decision Unit (SDU)
- Federal Navigation Channel (USACE, 2020)
- Docks and Structures
- Tax Lot Boundary
- Ordinary High Water (City of Portland, 2013)
- ROD Sediment Management Area (SMA)
- 10-ft Bathymetric Contours (DEA, 2018) NAVD88

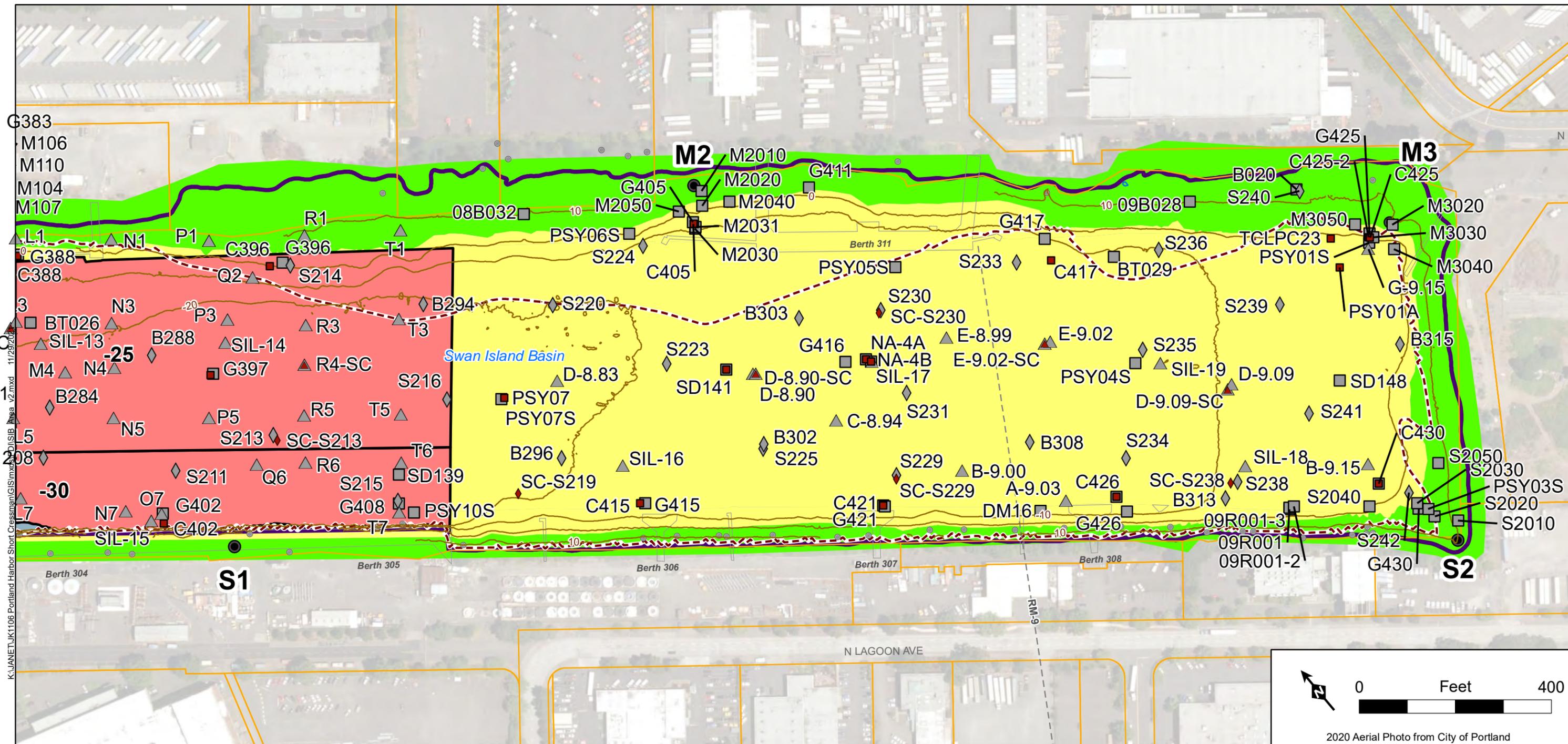
Notes:  
 CRD – Columbia River Datum (0' CRD = 5.28' NAVD)  
 DEA – David Evans and Associates, Inc  
 PDI - Pre-Design Investigation  
 RI/FS - Remedial Investigation/Feasibility Study  
 ROD – Record of Decision  
 USACE – United States Army Corps of Engineers  
 NAVD88 – North American Vertical Datum of 1988 (0' NAVD = -5.28' CRD)

Source:  
 Bathymetry data from David Evans and Associates, Inc.. 2018  
 Portland Harbor RI/FS. Feasibility Study Report. June 2016

← River Flow Direction

**Figure 3-1a**  
**Existing Surface and Subsurface**  
**Samples in SIB Project Area**

Pre-Design Investigation Work Plan  
 Swan Island Basin



<p><b>Surface Sample Locations</b></p> <ul style="list-style-type: none"> <li>■ RI/FS</li> <li>▲ Post-ROD</li> <li>◆ PDI</li> </ul>	<p><b>Subsurface Sample Locations</b></p> <ul style="list-style-type: none"> <li>■ RI/FS</li> <li>▲ Post-ROD</li> <li>◆ PDI</li> </ul>	<ul style="list-style-type: none"> <li>● City of Portland Stormwater Outfall</li> <li>○ Non-City Outfall</li> <li>--- River Mile (RM)</li> <li>▭ Swan Island Sediment Decision Unit (SDU)</li> <li>▭ Federal Navigation Channel (USACE, 2020)</li> <li>▭ Docks and Structures</li> <li>▭ Tax Lot Boundary</li> <li>▭ Ordinary High Water (City of Portland, 2013)</li> <li>▭ ROD Sediment Management Area (SMA)</li> <li>— 10-ft Bathymetric Contours (DEA, 2018) NAVD88</li> </ul>	<p><b>Notes:</b></p> <p>CRD – Columbia River Datum (0' CRD = 5.28' NAVD)          DEA – David Evans and Associates, Inc          PDI - Pre-Design Investigation          RI/FS - Remedial Investigation/Feasibility Study          ROD – Record of Decision          USACE – United States Army Corps of Engineers          NAVD88 – North American Vertical Datum of 1988 (0' NAVD = -5.28' CRD)</p> <p><b>Source:</b></p> <p>Bathymetry data from David Evans and Associates, Inc.. 2018          Portland Harbor RI/FS. Feasibility Study Report. June 2016</p>
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Revised Portland Harbor Site Regions

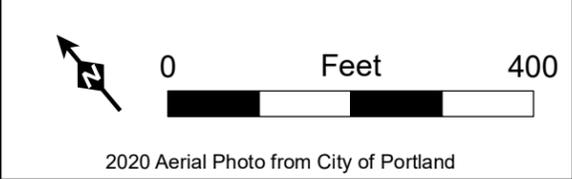
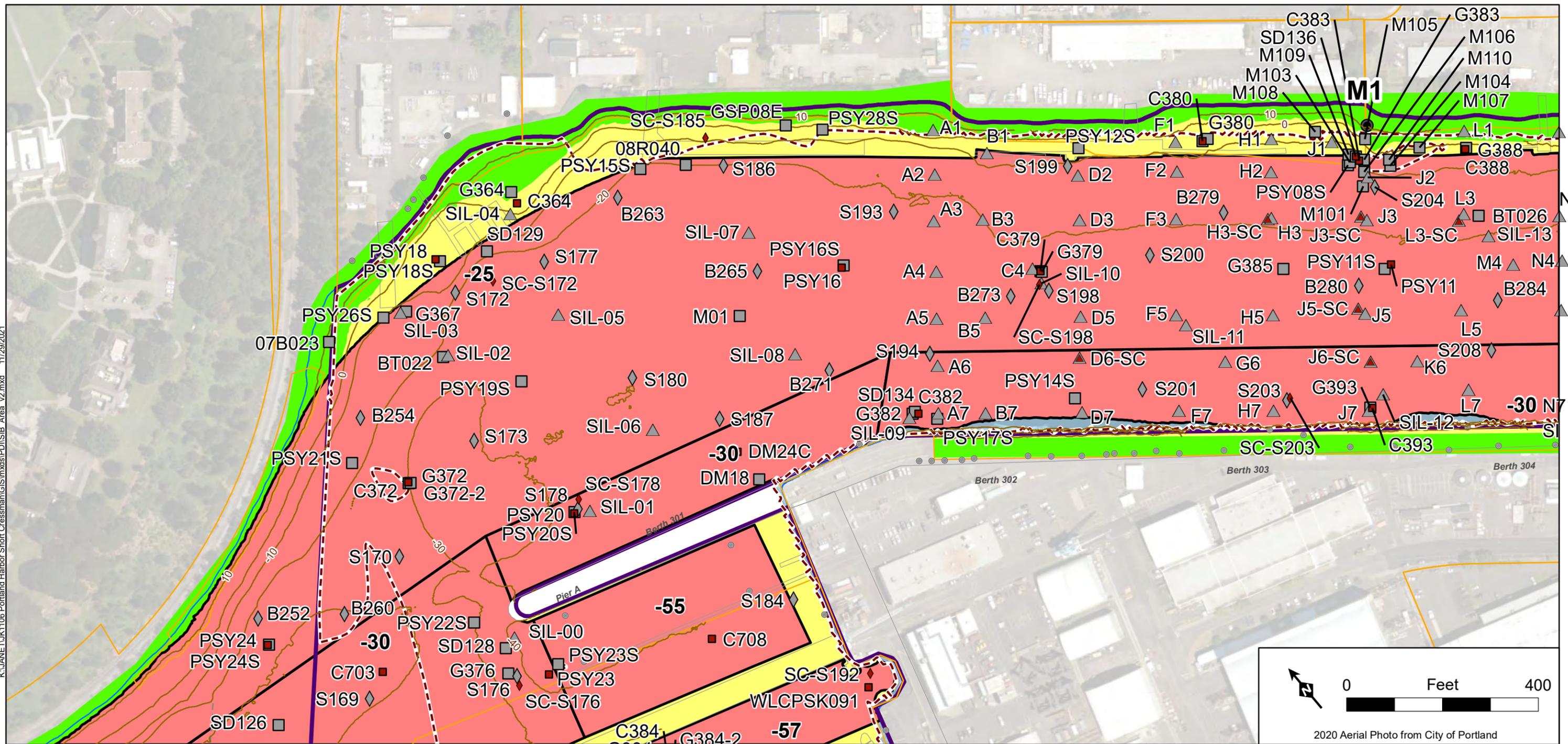
- Shallow
- Intermediate
- Navigation Channel
- Revised Future Maintenance Dredge (FMD) with Depths in feet. (Swan Island Group, 2016)

← River Flow Direction

**Figure 3-1b**  
**Existing Surface and Subsurface Samples in SIB Project Area - Head of SIB**

Pre-Design Investigation Work Plan  
 Swan Island Basin

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**Surface Sample Locations**

- RI/FS
- ▲ Post-ROD
- ◆ PDI

**Subsurface Sample Locations**

- RI/FS
- ▲ Post-ROD
- ◆ PDI

**Revised Portland Harbor Site Regions**

- Shallow
- Intermediate
- Navigation Channel
- Revised Future Maintenance Dredge (FMD) with Depths in feet. (Swan Island Group, 2016)

- Non-City Outfall
- River Mile (RM)
- Swan Island Sediment Decision Unit (SDU)
- Federal Navigation Channel (USACE, 2020)
- Docks and Structures
- Tax Lot Boundary
- Ordinary High Water (City of Portland, 2013)
- ROD Sediment Management Area (SMA)
- 10-ft Bathymetric Contours (DEA, 2018) NAVD88

**Notes:**

CRD – Columbia River Datum (0' CRD = 5.28' NAVD)  
 DEA – David Evans and Associates, Inc  
 PDI - Pre-Design Investigation  
 RI/FS - Remedial Investigation/Feasibility Study  
 ROD – Record of Decision  
 USACE – United States Army Corps of Engineers  
 NAVD88 – North American Vertical Datum of 1988 (0' NAVD = -5.28' CRD)

**Source:**

Bathymetry data from David Evans and Associates, Inc.. 2018  
 Portland Harbor RI/FS. Feasibility Study Report. June 2016

← River Flow Direction

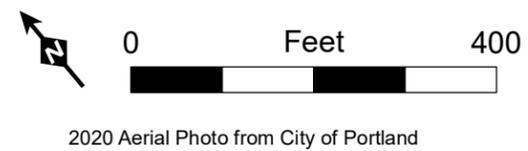
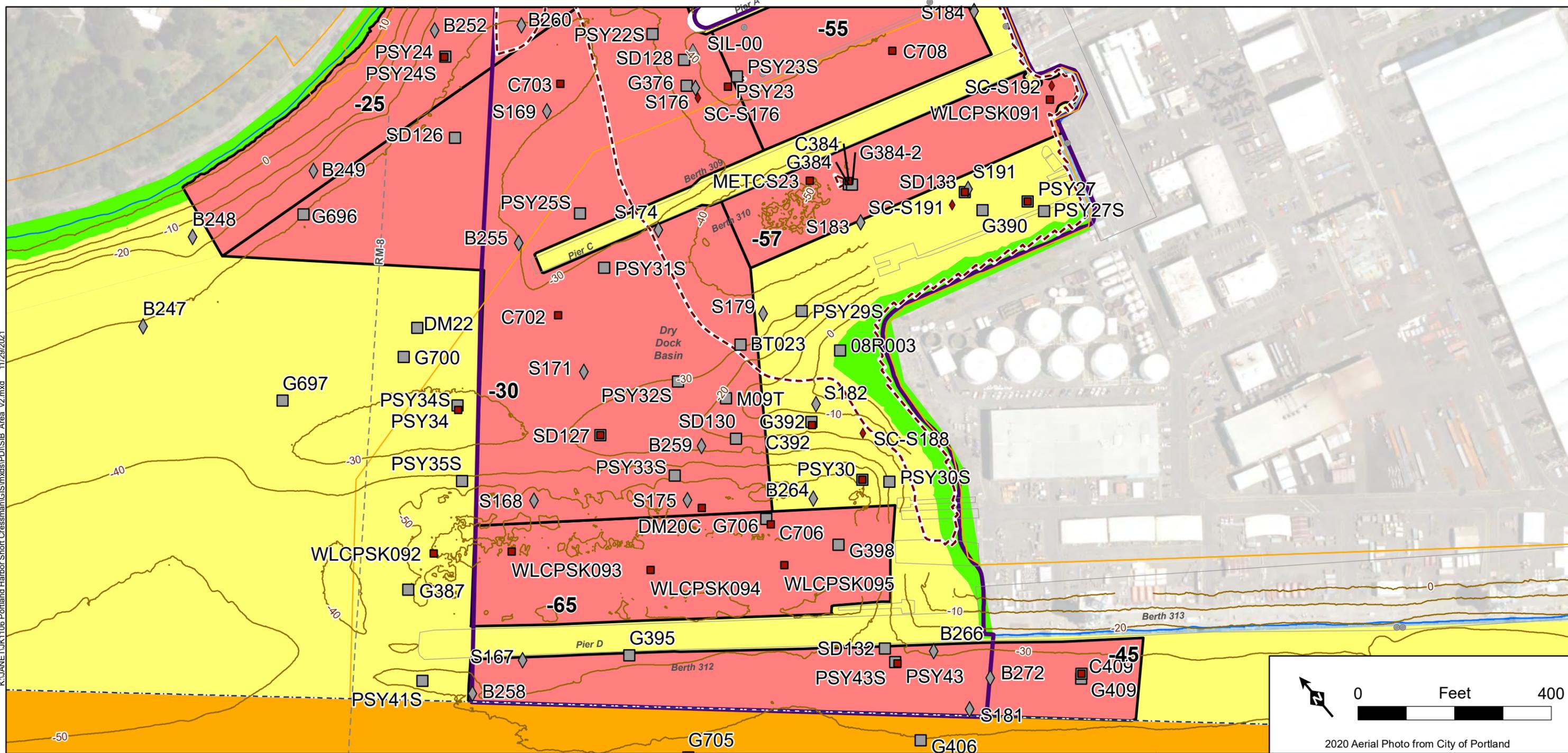
**Figure 3-1c**

**Existing Surface and Subsurface Samples in SIB Project Area - Center of SIB**

Pre-Design Investigation Work Plan  
 Swan Island Basin



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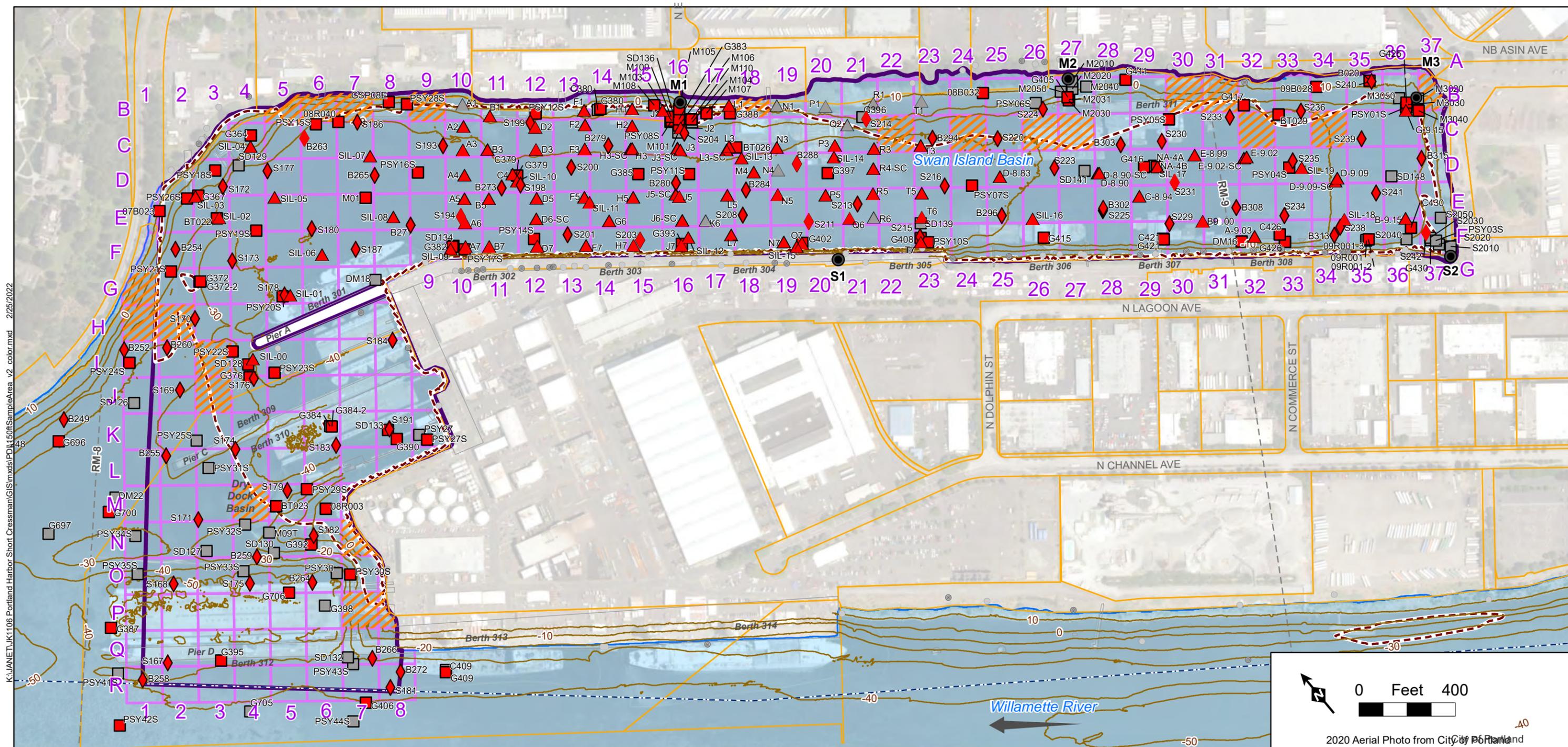


<p><b>Surface Sample Locations</b></p> <ul style="list-style-type: none"> <li>■ RI/FS</li> <li>▲ Post-ROD</li> <li>◆ PDI</li> </ul>	<p><b>Subsurface Sample Locations</b></p> <ul style="list-style-type: none"> <li>■ RI/FS</li> <li>▲ Post-ROD</li> <li>◆ PDI</li> </ul>	<ul style="list-style-type: none"> <li>● Non-City Outfall</li> <li>- - - River Mile (RM)</li> <li>▭ Swan Island Sediment Decision Unit (SDU)</li> <li>▭ Federal Navigation Channel (USACE, 2020)</li> <li>▭ Docks and Structures</li> <li>▭ Tax Lot Boundary</li> <li>▭ Ordinary High Water (City of Portland, 2013)</li> <li>▭ ROD Sediment Management Area (SMA)</li> <li>▭ 10-ft Bathymetric Contours (DEA, 2018) NAVD88</li> </ul>	<p><b>Notes:</b></p> <p>CRD – Columbia River Datum (0' CRD = 5.28' NAVD)          DEA – David Evans and Associates, Inc          PDI - Pre-Design Investigation          RI/FS - Remedial Investigation/Feasibility Study          ROD – Record of Decision          USACE – United States Army Corps of Engineers          NAVD88 – North American Vertical Datum of 1988 (0' NAVD = - 5.28' CRD)</p> <p><b>Source:</b></p> <p>Bathymetry data from David Evans and Associates, Inc.. 2018          Portland Harbor RI/FS. Feasibility Study Report. June 2016</p>
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← River Flow Direction

**Figure 3-1d**  
**Existing Surface and Subsurface**  
**Samples in SIB Project Area**  
**- Mouth of SIB**

Pre-Design Investigation Work Plan  
 Swan Island Basin



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**Surface Sample Locations**

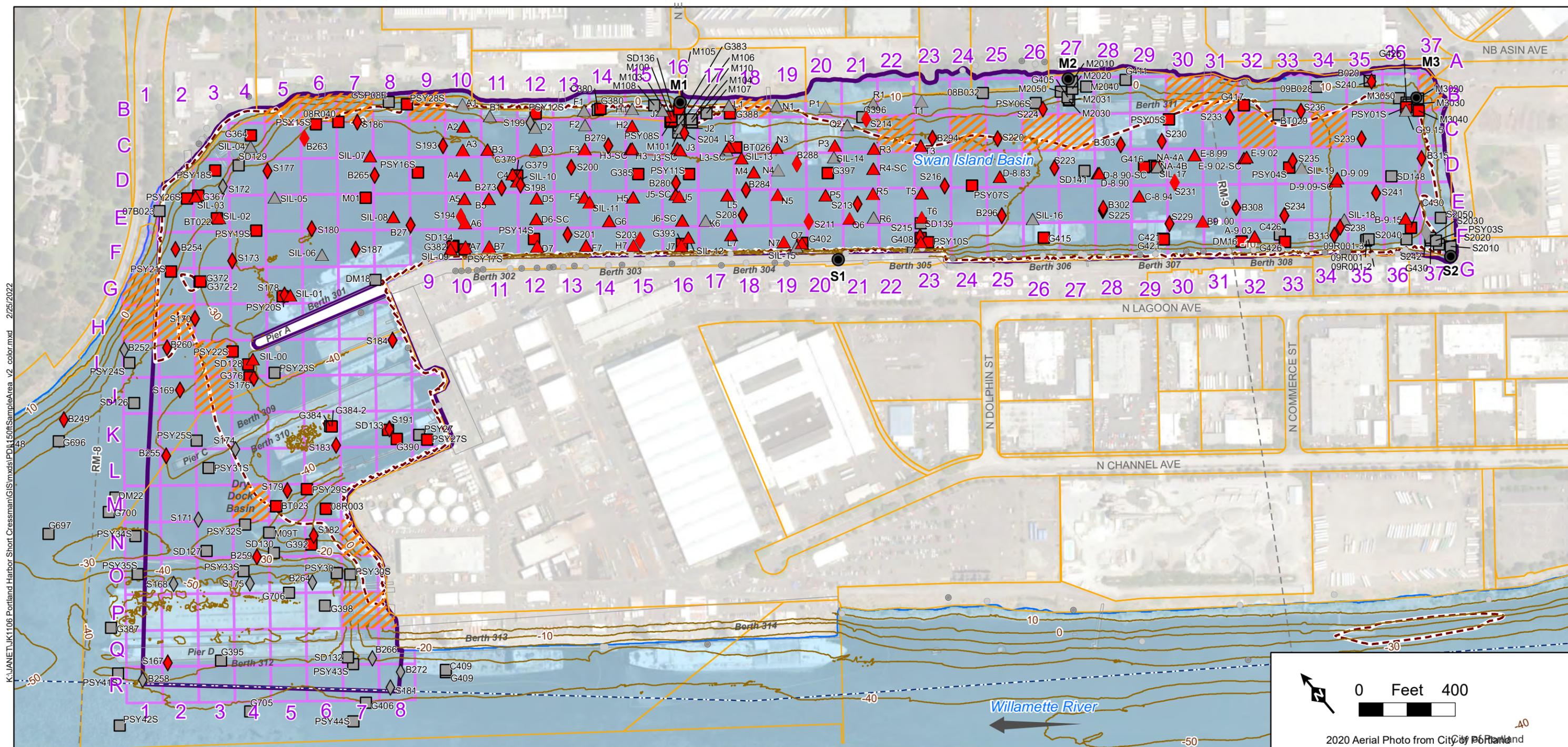
- RI/FS
  - ◆ PDI
  - ▲ Other Studies
- Sample Above Clean Up Level (CUL)**
- RI/FS
  - ◆ PDI
  - ▲ Other Studies
- ▨ Grid Cell Without Existing Data on Border of SMA (Step-Out)
  - 150-ft Sample Grid
  - ▤ ROD Sediment Management Area (SMA)

- City of Portland Stormwater Outfall
- Non-City Outfall
- River Mile (RM)
- ▭ Swan Island Sediment Decision Unit (SDU)
- ▭ Federal Navigation Channel (USACE, 2020)
- ▭ Docks and Structures
- ▭ Tax Lot Boundary
- ▭ Ordinary High Water (City of Portland, 2013)
- ▭ 10-ft Bathymetric Contours (DEA, 2018) NAVD88
- ➔ River Flow Direction

**Notes:**  
 CRD – Columbia River Datum (0' CRD = 5.28' NAVD)  
 DEA – David Evans and Associates, Inc.  
 ROD – Record of Decision  
 USACE – United States Army Corps of Engineers  
 NAVD88 – North American Vertical Datum of 1988 (0' NAVD = -5.28' CRD)

**Source:**  
 Bathymetry data from David Evans and Associates, Inc., 2018  
 Portland Harbor RI/FS. Feasibility Study Report. June 2016

**Figure 3-2a**  
**Surface Samples**  
**on a 150-foot Grid**  
**- CUL Exceedances**



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2020 Aerial Photo from City of Portland

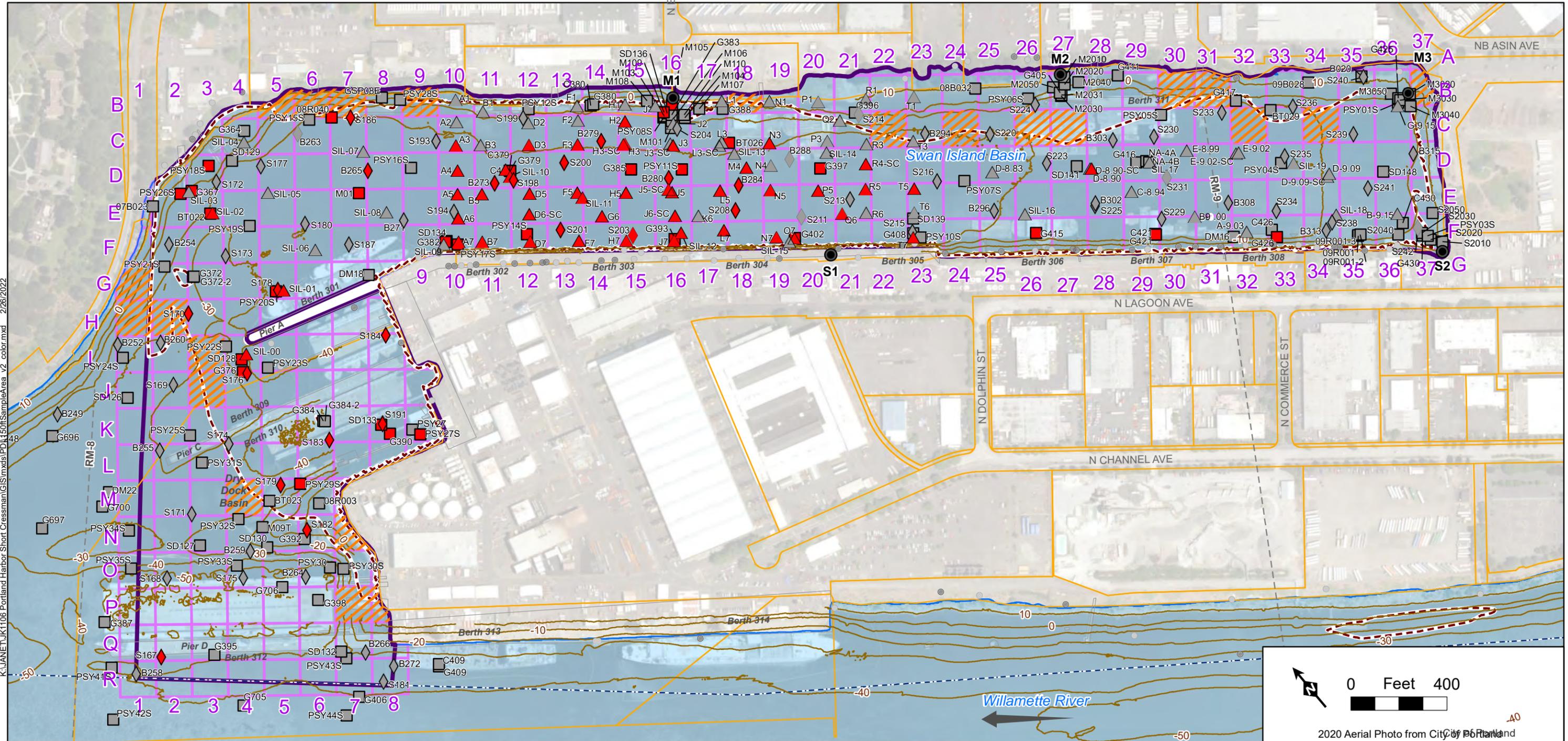
- |   |   |
|---|---|
| <p><b>Surface Sample Locations</b></p> <ul style="list-style-type: none"> <li>■ RI/FS</li> <li>◆ PDI</li> <li>▲ Other Studies</li> </ul> <p><b>Sample Above Remedial Action Level (RAL)</b></p> <ul style="list-style-type: none"> <li>■ RI/FS</li> <li>◆ PDI</li> <li>▲ Other Studies</li> </ul> <ul style="list-style-type: none"> <li>▨ Grid Cell Without Existing Data on Border of SMA (Step-Out)</li> <li>□ 150-ft Sample Grid</li> <li>▤ ROD Sediment Management Area (SMA)</li> </ul> | <ul style="list-style-type: none"> <li>● City of Portland Stormwater Outfall</li> <li>● Non-City Outfall</li> <li>--- River Mile (RM)</li> <li>▭ Swan Island Sediment Decision Unit (SDU)</li> <li>▭ Federal Navigation Channel (USACE, 2020)</li> <li>▭ Docks and Structures</li> <li>▭ Tax Lot Boundary</li> <li>▭ Ordinary High Water (City of Portland, 2013)</li> <li>▭ 10-ft Bathymetric Contours (DEA, 2018) NAVD88</li> <li>➔ River Flow Direction</li> </ul> |
|---|---|

**Notes:**  
 CRD – Columbia River Datum (0' CRD = 5.28' NAVD)  
 DEA – David Evans and Associates, Inc.  
 ROD – Record of Decision  
 USACE – United States Army Corps of Engineers  
 NAVD88 – North American Vertical Datum of 1988 (0' NAVD = -5.28' CRD)

**Source:**  
 Bathymetry data from David Evans and Associates, Inc., 2018  
 Portland Harbor RI/FS. Feasibility Study Report. June 2016

**Figure 3-2b**  
 Surface Samples  
 on a 150-foot Grid  
 - RAL Exceedances

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**Surface Sample Locations**

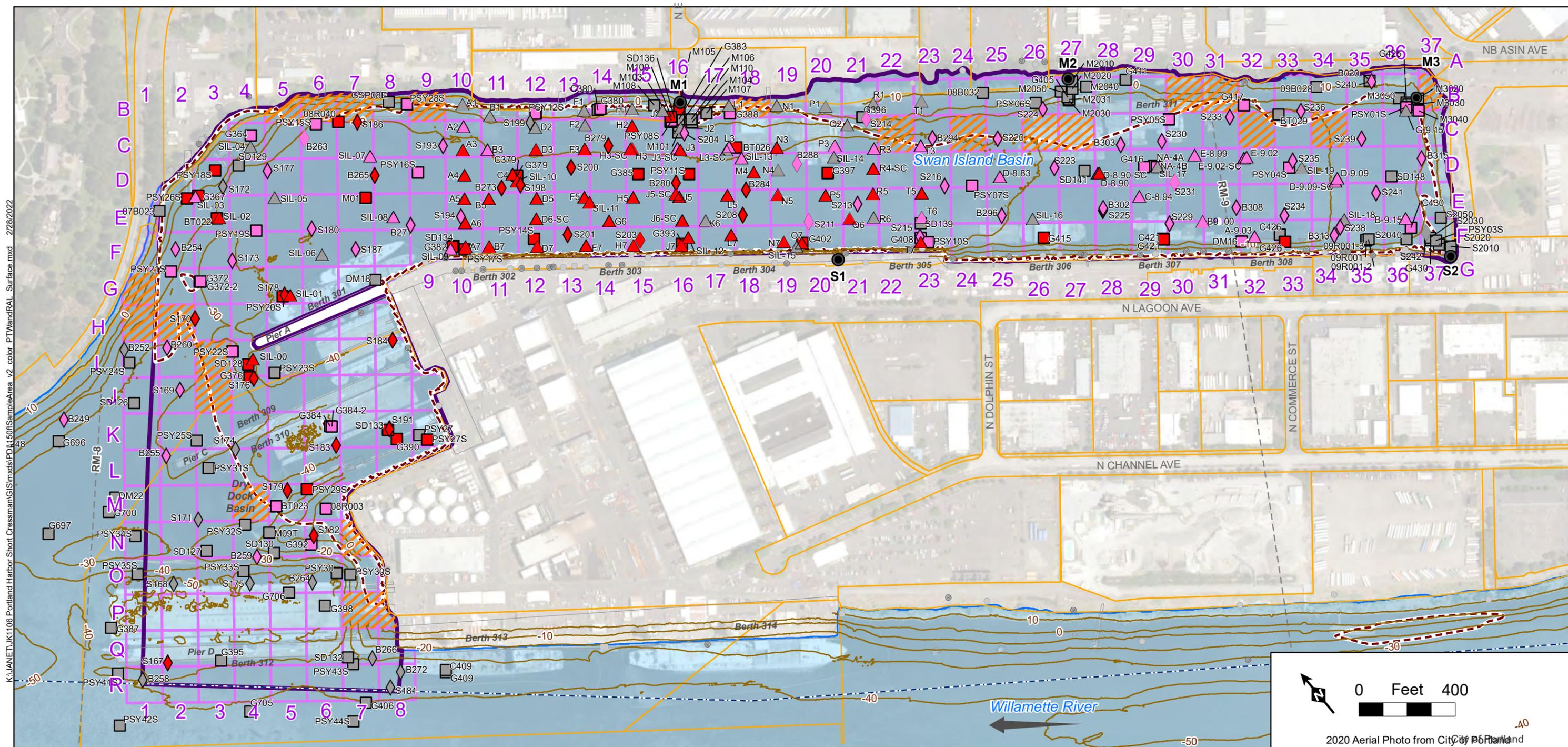
- RI/FS
- ◆ PDI
- ▲ Other Studies
- Sample Above Principal Threat Waste (PTW)**
- RI/FS
- ◆ PDI
- ▲ Other Studies
- ▨ Grid Cell Without Existing Data on Border of SMA (Step-Out)
- 150-ft Sample Grid
- ▤ ROD Sediment Management Area (SMA)

- City of Portland Stormwater Outfall
- Non-City Outfall
- River Mile (RM)
- ▭ Swan Island Sediment Decision Unit (SDU)
- ▭ Federal Navigation Channel (USACE, 2020)
- ▭ Docks and Structures
- ▭ Tax Lot Boundary
- ▭ Ordinary High Water (City of Portland, 2013)
- ▭ 10-ft Bathymetric Contours (DEA, 2018) NAVD88
- ➔ River Flow Direction

**Notes:**  
 CRD – Columbia River Datum (0' CRD = 5.28' NAVD)  
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 ROD – Record of Decision  
 USACE – United States Army Corps of Engineers  
 NAVD88 – North American Vertical Datum of 1988 (0' NAVD = -5.28' CRD)

**Source:**  
 Bathymetry data from David Evans and Associates, Inc.. 2018  
 Portland Harbor RI/FS. Feasibility Study Report. June 2016

**Figure 3-2c**  
**Surface Samples**  
**on a 150-foot Grid**  
**- PTW Exceedances**



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- ▲ ◆ Sample Above Principal Threat Waste (PTW)
- ◆ ▲ Sample Above Remedial Action Level (RAL)
- Surface Sample Locations**
- RI/FS
- ◆ PDI
- ▲ Other Studies
- Grid Cell Without Existing Data on Border of SMA (Step-Out)
- 150-ft Sample Grid
- ROD Sediment Management Area (SMA)

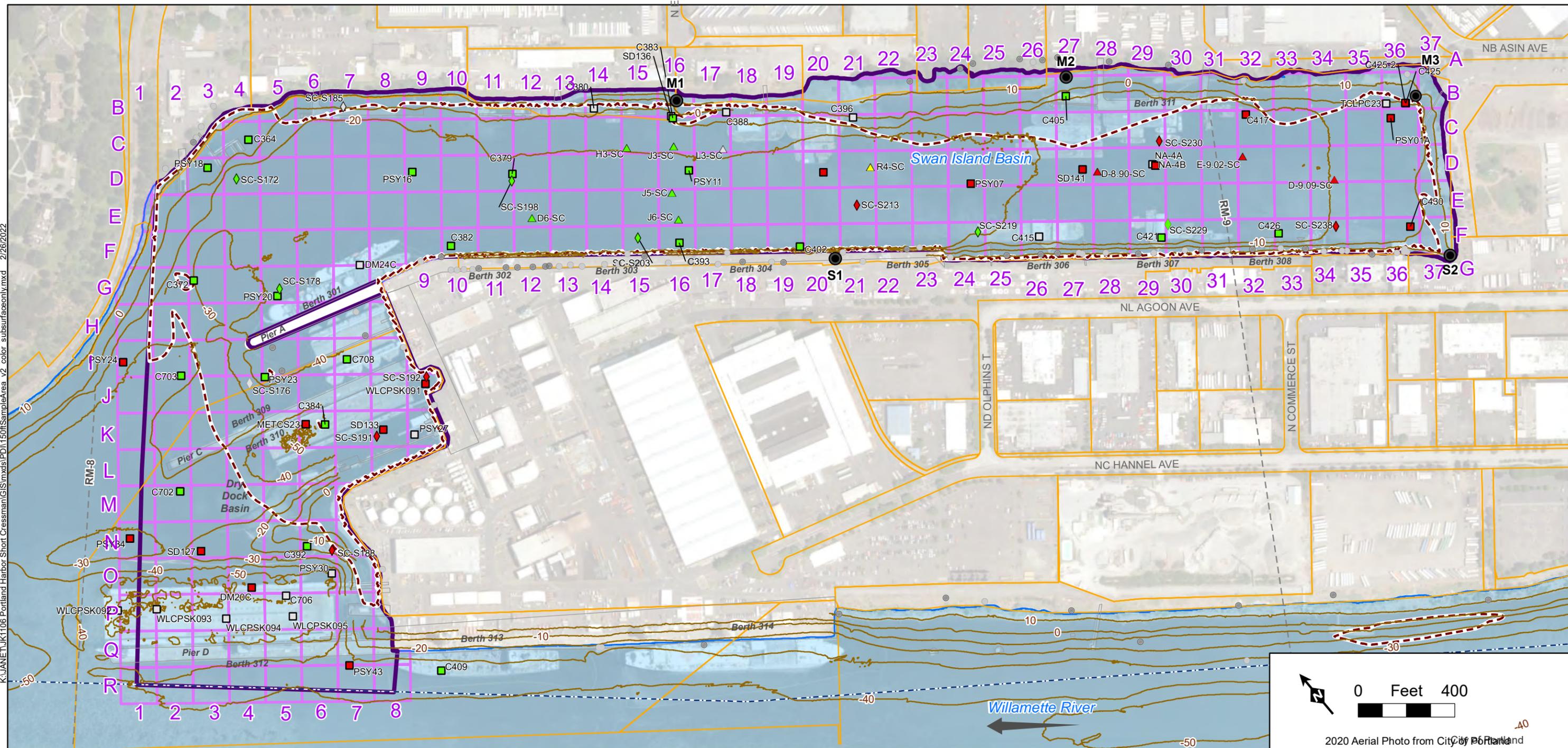
- City of Portland Stormwater Outfall
- Non-City Outfall
- River Mile (RM)
- Swan Island Sediment Decision Unit (SDU)
- Federal Navigation Channel (USACE, 2020)
- Docks and Structures
- Tax Lot Boundary
- Ordinary High Water (City of Portland, 2013)
- 10-ft Bathymetric Contours (DEA, 2018) NAVD88
- ➔ River Flow Direction

**Notes:**  
 CRD – Columbia River Datum (0' CRD = 5.28' NAVD)  
 DEA – David Evans and Associates, Inc  
 ROD – Record of Decision  
 USACE – United States Army Corps of Engineers  
 NAVD88 – North American Vertical Datum of 1988 (0' NAVD = -5.28' CRD)

**Source:**  
 Bathymetry data from David Evans and Associates, Inc.. 2018  
 Portland Harbor RI/FS. Feasibility Study Report. June 2016

**Figure 3-2d**  
**Surface Samples**  
**on a 150-foot Grid**  
**- PTW and RAL Exceedances**

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**Subsurface Sample Locations**

- RI/FS
- ◇ PDI
- △ Other Studies
- ◆ Sample Above RAL (reaches clean (>2-ft clean at bottom of core))
- ◇ Sample Above RAL (reaches clean (<2-ft clean at bottom of core))
- ◆ Sample Above RAL (doesn't reach clean)

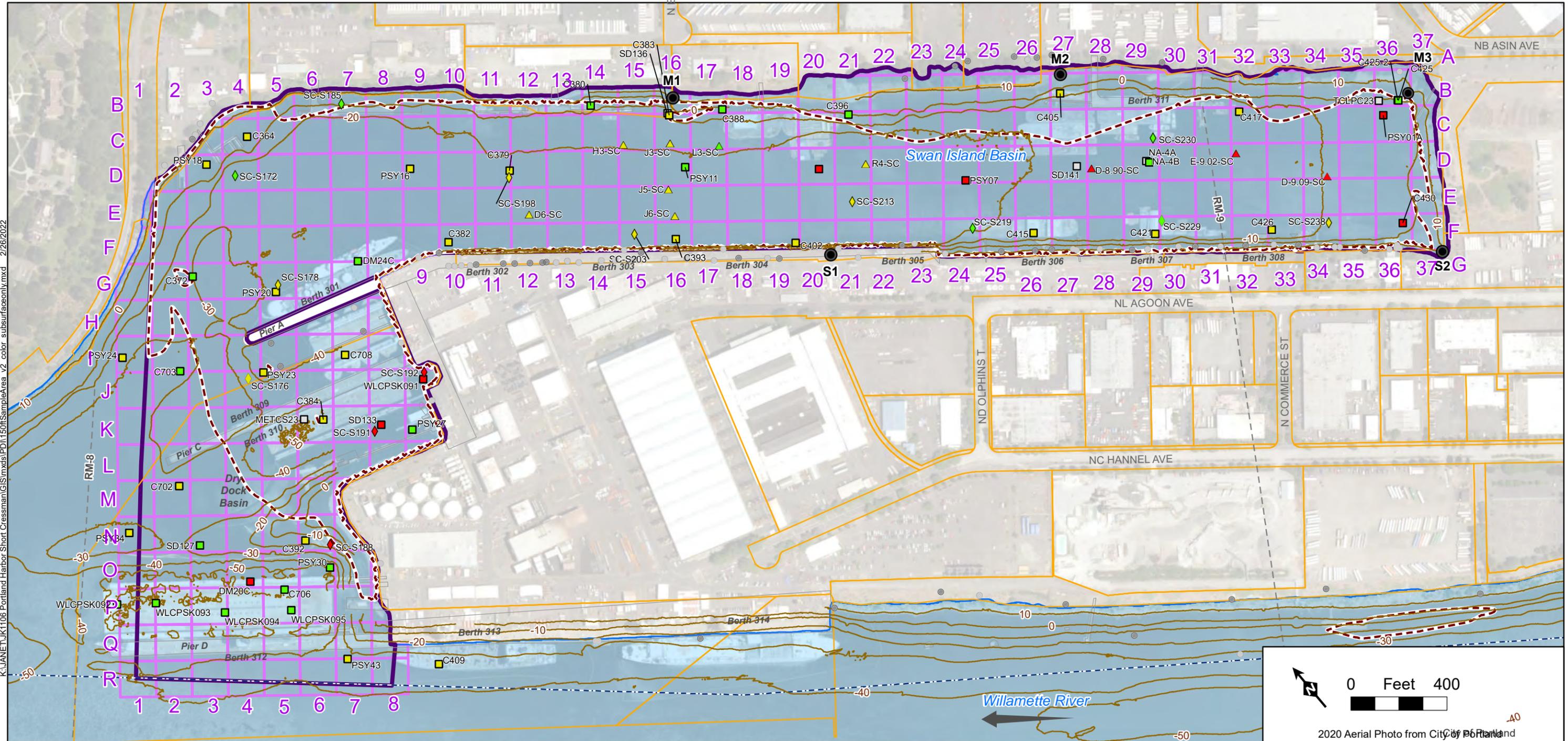
- 150-ft Sample Grid
- ▭ ROD Sediment Management Area (SMA)
- City of Portland Stormwater Outfall
- Non-City Outfall
- River Mile (RM)
- ▭ Swan Island Sediment Decision Unit (SDU)
- ▭ Federal Navigation Channel (USACE, 2020)
- ▭ Docks and Structures
- ▭ Tax Lot Boundary
- ▭ Ordinary High Water (City of Portland, 2013)
- ▭ 10-ft Bathymetric Contours (DEA, 2018) NAVD88
- ← River Flow Direction

Notes:  
 CRD – Columbia River Datum (0' CRD = 5.28' NAVD)  
 DEA – David Evans and Associates, Inc  
 ROD – Record of Decision  
 USACE – United States Army Corps of Engineers  
 NAVD88 – North American Vertical Datum of 1988 (0' NAVD = -5.28' CRD)

Source:  
 Bathymetry data from David Evans and Associates, Inc., 2018  
 Portland Harbor RI/FS. Feasibility Study Report. June 2016

**Figure 3-3a**  
**Subsurface Samples**  
**on a 150-foot Grid**  
**- RAL Exceedances**

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**Subsurface Sample Locations**

- RI/FS
- ◇ PDI
- △ Other Studies
- ◆ PTW Not Present
- ◆ PTW Present, Clean Confirmation (>2-ft clean at bottom of core)
- ◆ PTW Present, No Clean Confirmation (<2-ft clean at bottom of core)

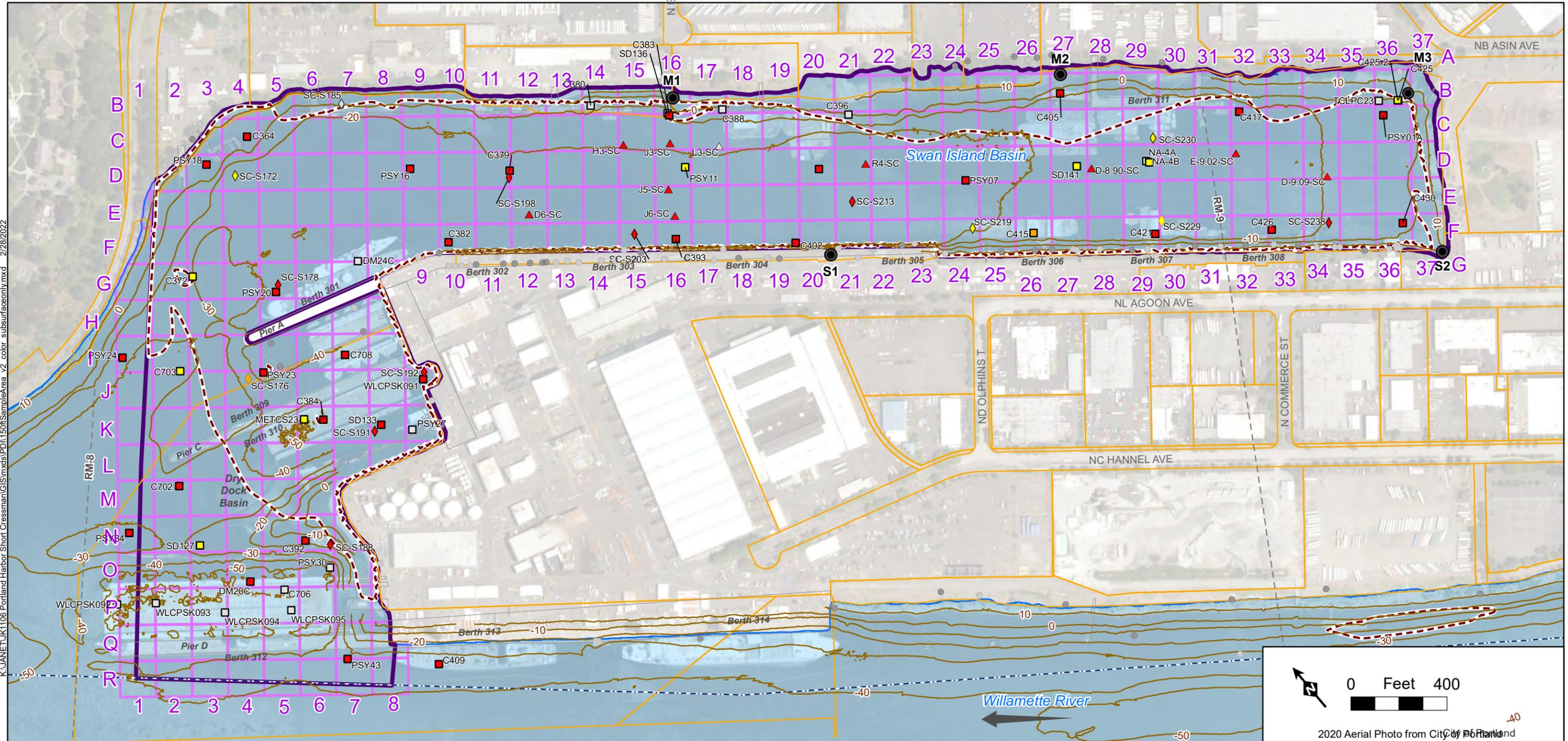
- 150-ft Sample Grid
- ROD Sediment Management Area (SMA)
- City of Portland Stormwater Outfall
- Non-City Outfall
- River Mile (RM)
- Swan Island Sediment Decision Unit (SDU)
- Federal Navigation Channel (USACE, 2020)
- Docks and Structures
- Tax Lot Boundary
- Ordinary High Water (City of Portland, 2013)
- 10-ft Bathymetric Contours (DEA, 2018) NAVD88
- ← River Flow Direction

Notes:  
 CRD – Columbia River Datum (0' CRD = 5.28' NAVD)  
 DEA – David Evans and Associates, Inc  
 ROD – Record of Decision  
 USACE – United States Army Corps of Engineers  
 NAVD88 – North American Vertical Datum of 1988 (0' NAVD = -5.28' CRD)

Source:  
 Bathymetry data from David Evans and Associates, Inc., 2018  
 Portland Harbor RI/FS. Feasibility Study Report. June 2016

**Figure 3-3b**  
**Subsurface Samples**  
**on a 150-foot Grid**  
**- PTW Exceedances**

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- Subsurface Sample Locations - No RAL or PTW exceedance**
- RI/FS
  - ◇ PDI
  - △ Other Studies
  - ◆ ≥1 RAL Exceedance Anywhere in Core
  - ♦ ≥1 PTW Exceedance Anywhere in Core
  - ◆♦ ≥1 RAL and ≥1 PTW Exceedance Anywhere in Core

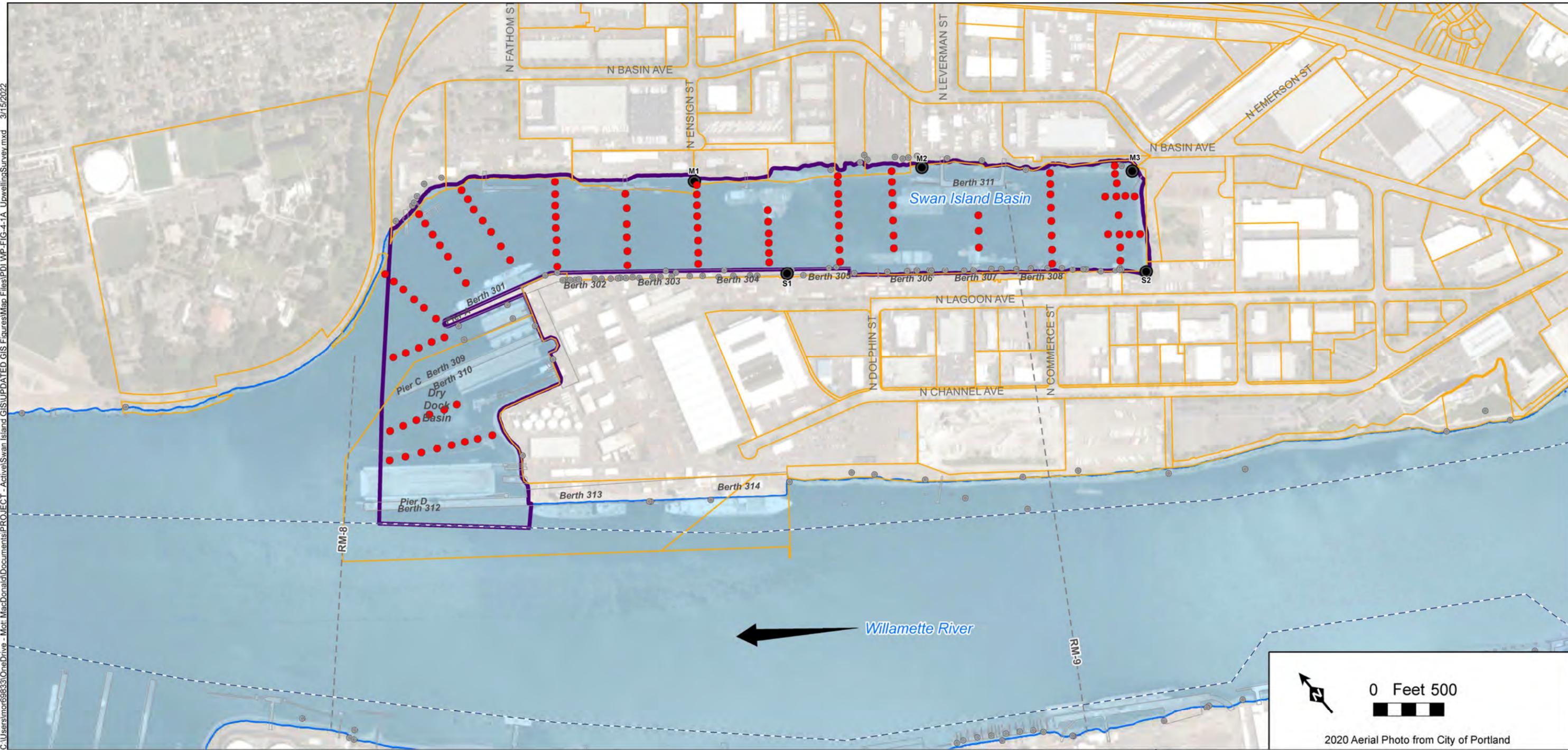
- 150-ft Sample Grid
- ▭ ROD Sediment Management Area (SMA)
- City of Portland Stormwater Outfall
- Non-City Outfall
- River Mile (RM)
- ▭ Swan Island Sediment Decision Unit (SDU)
- ▭ Federal Navigation Channel (USACE, 2020)
- ▭ Docks and Structures
- ▭ Tax Lot Boundary
- ▭ Ordinary High Water (City of Portland, 2013)
- ▭ 10-ft Bathymetric Contours (DEA, 2018) NAVD88
- ← River Flow Direction

**Notes:**  
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 DEA – David Evans and Associates, Inc.  
 ROD – Record of Decision  
 USACE – United States Army Corps of Engineers  
 NAVD88 – North American Vertical Datum of 1988 (0' NAVD = -5.28' CRD)

**Source:**  
 Bathymetry data from David Evans and Associates, Inc., 2018  
 Portland Harbor RI/FS. Feasibility Study Report. June 2016

**Figure 3-3c**  
**Subsurface Samples**  
**on a 150-foot Grid**  
**- RAL or PTW Exceedances**

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- City of Portland Stormwater Outfall
- Non-City Outfall
- Dock Drain
- River Mile (RM)
- ▭ Swan Island Sediment Decision Unit (SDU)
- ▭ Federal Navigation Channel (USACE, 2020)
- ▭ Docks and Structures
- ▭ Tax Lot Boundary
- ▭ Ordinary High Water (City of Portland, 2013)
- ← River Flow Direction
- Upwelling Survey Locations

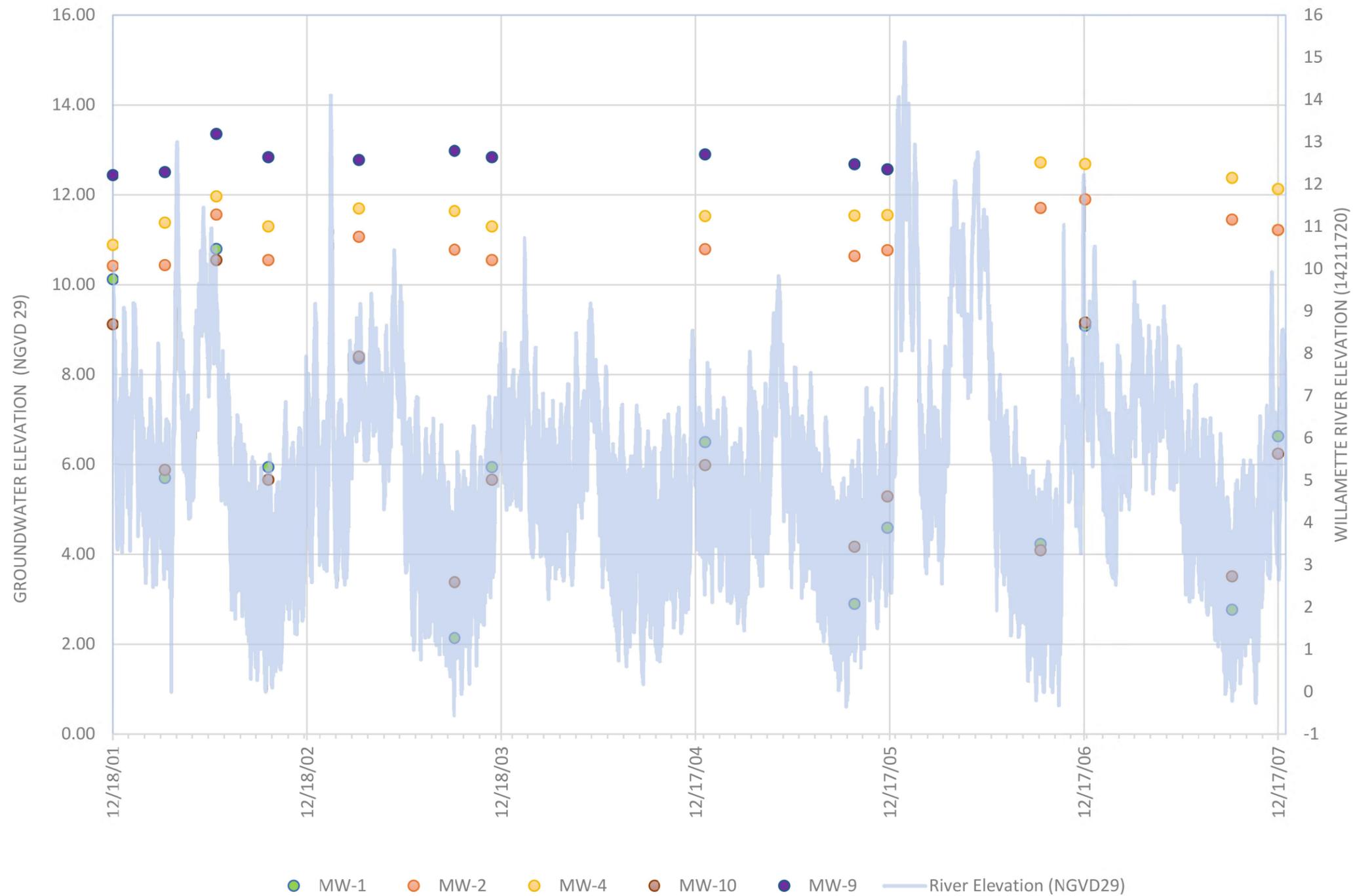
USACE: U.S. Army Corps of Engineers

Figure 4-1a  
Proposed Upwelling Survey Transects

Prepared on 3/15/2022  
Pre-Design Investigation Work Plan  
Swan Island Basin



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Notes:  
 ECSI - Environmental Cleanup Site Information  
 ODEQ - Oregon Department of Environmental Quality  
 NGVD29 - National Geodetic Vertical Datum of 1929  
 USGS - United States Geological Survey

Sources:  
 (1) Surface Water: USGS Oregon Water Science Center, Willamette River at Portland, Oregon, Morrison Bridge Gage Station (USGS ID: 14211720), (feet NGVD29)  
 (2) Groundwater: November 24, 2014. ODEQ. Operable Unit 1 – Swan Island Upland Facility File ECSI #271 Final Source Control Decision, Appendix C, Table 1 Summary of Water Level Measurements and Elevations.

**Figure 4-1b**  
 Surface Water and Groundwater  
 Elevation Evaluation for  
 Proposed Upwelling Survey

Prepared on 3/2/2022  
 Pre-Design Investigation Work Plan  
 Swan Island Basin





- Sources:
- (1) City of Portland Bureau of Environmental Services
    - Outfalls
    - Drainage Basins (except S-1)
    - Collection Lines
    - Manholes
  - (2) Vigor Stormwater Program Staff
    - Portland Shipyard Outfalls (June 21, 2021)
    - Drainage Basin S-1
  - (3) Oregon Metro Regional Land Information System
    - Tax Lots (July 23, 2020)
  - (4) NOAA, 2016. Booklet Chart, Willamette River – Swan Island Basin, NOAA Chart 18527 at URL: [https://www.charts.noaa.gov/BookletChart/18527\\_BookletChart.pdf](https://www.charts.noaa.gov/BookletChart/18527_BookletChart.pdf)
    - Navigation Channel

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Stormwater Line	Drainage Basin
2006 Stormwater Line Cleaning	Federal Navigation Channel (USACE 2020)
AAP951 Manhole	River Flow Direction
Tax Lot Boundary	

**Proposed Sampling Methods**

SWG Stormwater Grab	ILS In-Line Solids
HVS In-Line Solids and Stormwater	MSG Manual Solids Grab

Symbols repeated for sampling of multiple laterals at indicated manhole

**Outfalls**

Active	Inactive	Abandoned	Unknown
Active - City of Portland Municipal Outfalls (M-1, M-2, M-3, S-1 and S-2)			
Inactive - Former Non-Contact Cooling Water Discharge Points (WR-436 through WR-439)			

Notes:

EPA - U.S. Environmental Protection Agency  
 HVS - High Volume Sampling  
 NOAA - National Oceanic and Atmospheric Administration  
 RI/FS - Remedial Investigation/Feasibility Study  
 ROD - Record of Decision  
 USACE - U.S. Army Corps of Engineers

(1) The high volume sampling system methodology includes pumping stormwater at a consistent rate over the duration of the storm and running high volumes of water through the HVS system to distinguish between the dissolved and solids fractions and obtain ROD Cleanup Levels for focused contaminants of concern.

(2) The in-line sediment trap design is similar to that utilized in the EPA-approved Round 3A Stormwater Field Sampling Plan, Portland Harbor RI/FS (LWG, 2007). If possible, one trap will be installed in each lateral.

(3) Manual stormwater solid grab samples will be collected at time of manhole entry if a minimum of 8-oz of solids are present in manhole/lateral. If less than 8-oz of solids are present, then the manual grab sample locations shall be abandoned and alternative upstream locations will be inspected and selected.

(4) Stormwater grab samples will be collected using ISCO auto-samplers.

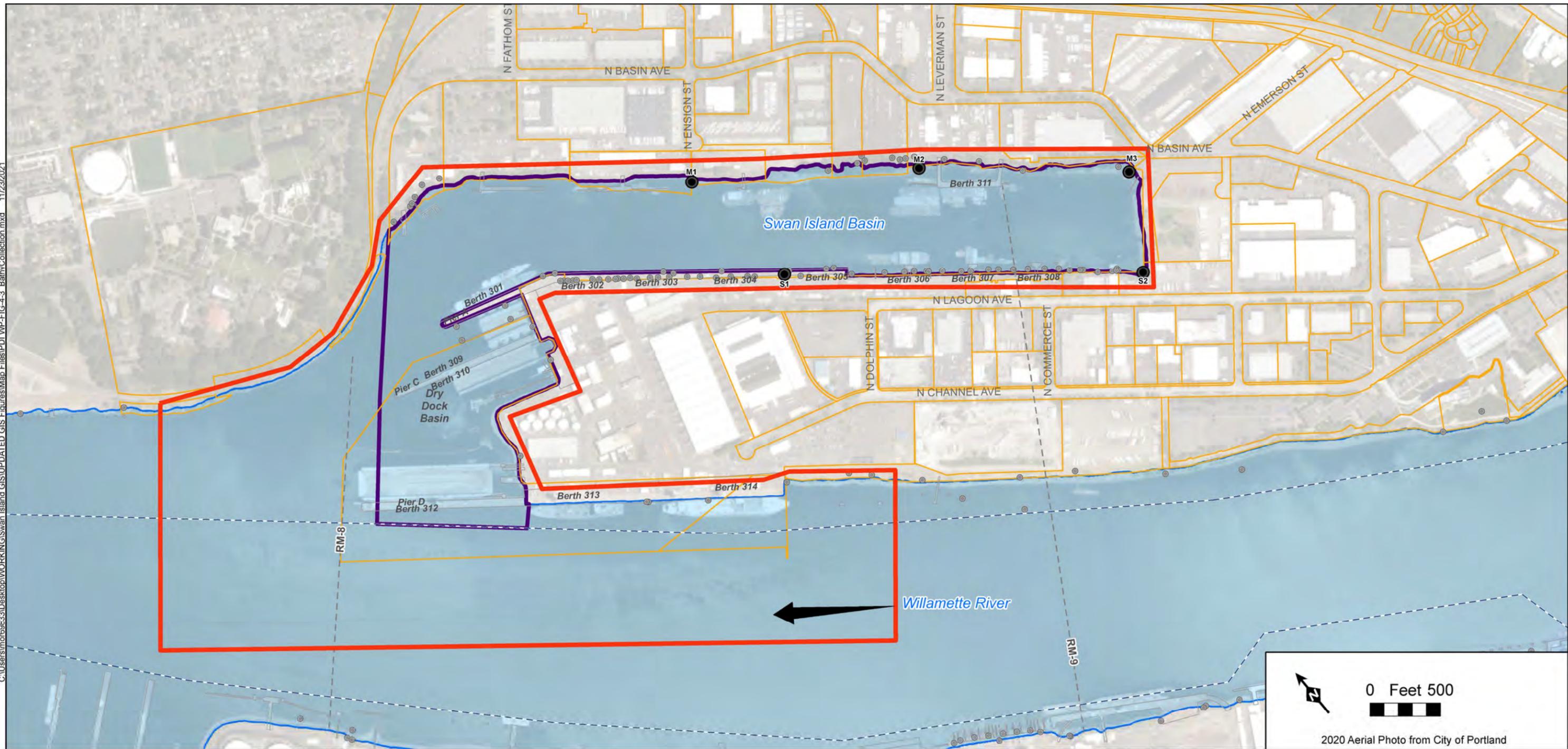
(5) Where visual outfall inspections reveal the presence of solids, a single composite manual grab sample will be collected from all outfalls on the property.

**Figure 4-2**  
**Proposed Stormwater Sampling Locations**

Prepared on 11/29/2021  
 Pre-Design Investigation Work Plan  
 Swan Island Basin Project Area



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0 Feet 500

2020 Aerial Photo from City of Portland

- City of Portland Stormwater Outfall
- Non-City Outfall
- Dock Drain
- - - River Mile (RM)
- Swan Island Sediment Decision Unit (SDU)
- - - Federal Navigation Channel (USACE, 2020)
- Docks and Structures
- Tax Lot Boundary
- Ordinary High Water (City of Portland, 2013)
- ← River Flow Direction

— Proposed Multibeam Bathymetry Data Collection Area

Figure 4-3  
Bathymetry Data Collection Plan

USACE: U.S. Army Corps of Engineers

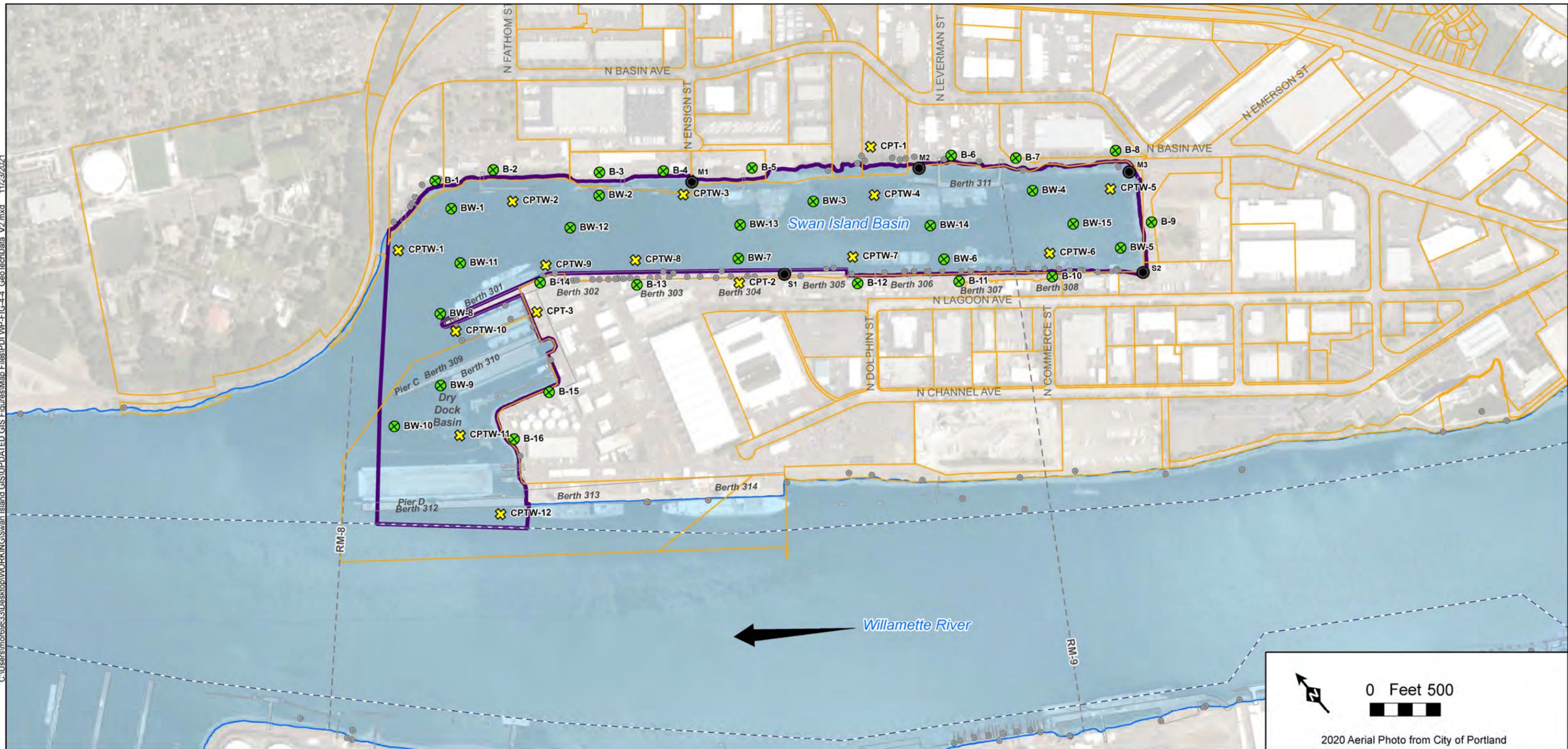
Prepared on 11/23/2021  
Pre-Design Investigation Work Plan  
Swan Island Basin

PACIFIC groundwater GROUP

**HGL** M M  
HydroGeologic, Inc. MOTT MACDONALD

BRIDGEWATER GROUP

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- City of Portland Stormwater Outfall
- Non-City Outfall
- Dock Drain
- - - River Mile (RM)
- ▭ Swan Island Sediment Decision Unit (SDU)
- - - Federal Navigation Channel (USACE, 2020)
- ▭ Docks and Structures
- ▭ Tax Lot Boundary
- ▭ Ordinary High Water (City of Portland, 2013)
- ← River Flow Direction
- ⊕ Geotechnical Boring
- ⊕ Cone Penetration Test (CPT)

USACE: U.S. Army Corps of Engineers

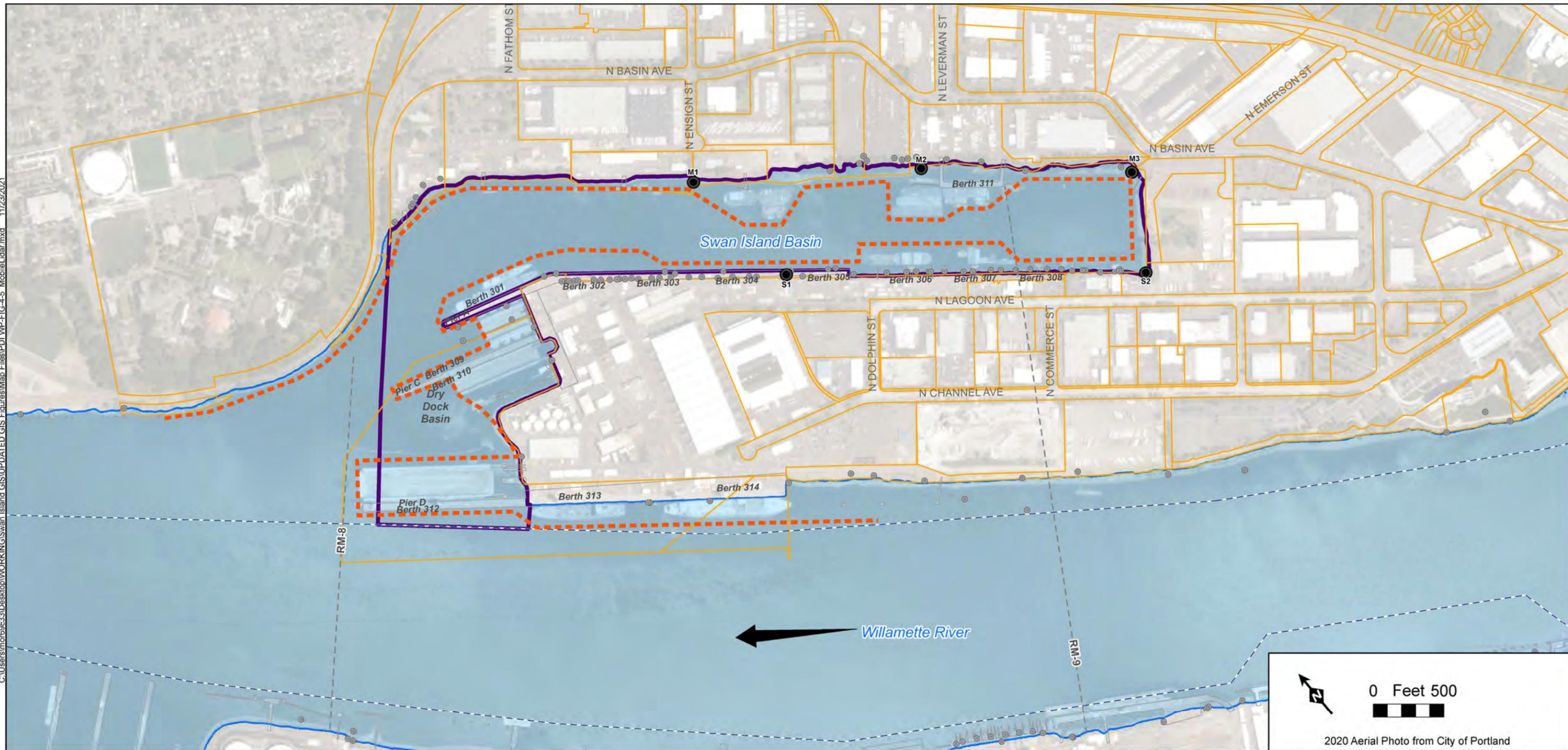
### Figure 4-4 Geotechnical Sampling Locations

Prepared on 11/23/2021

Pre-Design Investigation Work Plan  
Swan Island Basin



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 2020 Aerial Photo from City of Portland

- City of Portland Stormwater Outfall
- Non-City Outfall
- Dock Drain
- River Mile (RM)
- Swan Island Sediment Decision Unit (SDU)
- Federal Navigation Channel (USACE, 2020)
- Docks and Structures
- Tax Lot Boundary
- Ordinary High Water (City of Portland, 2013)
- ← River Flow Direction
- Laser Scan

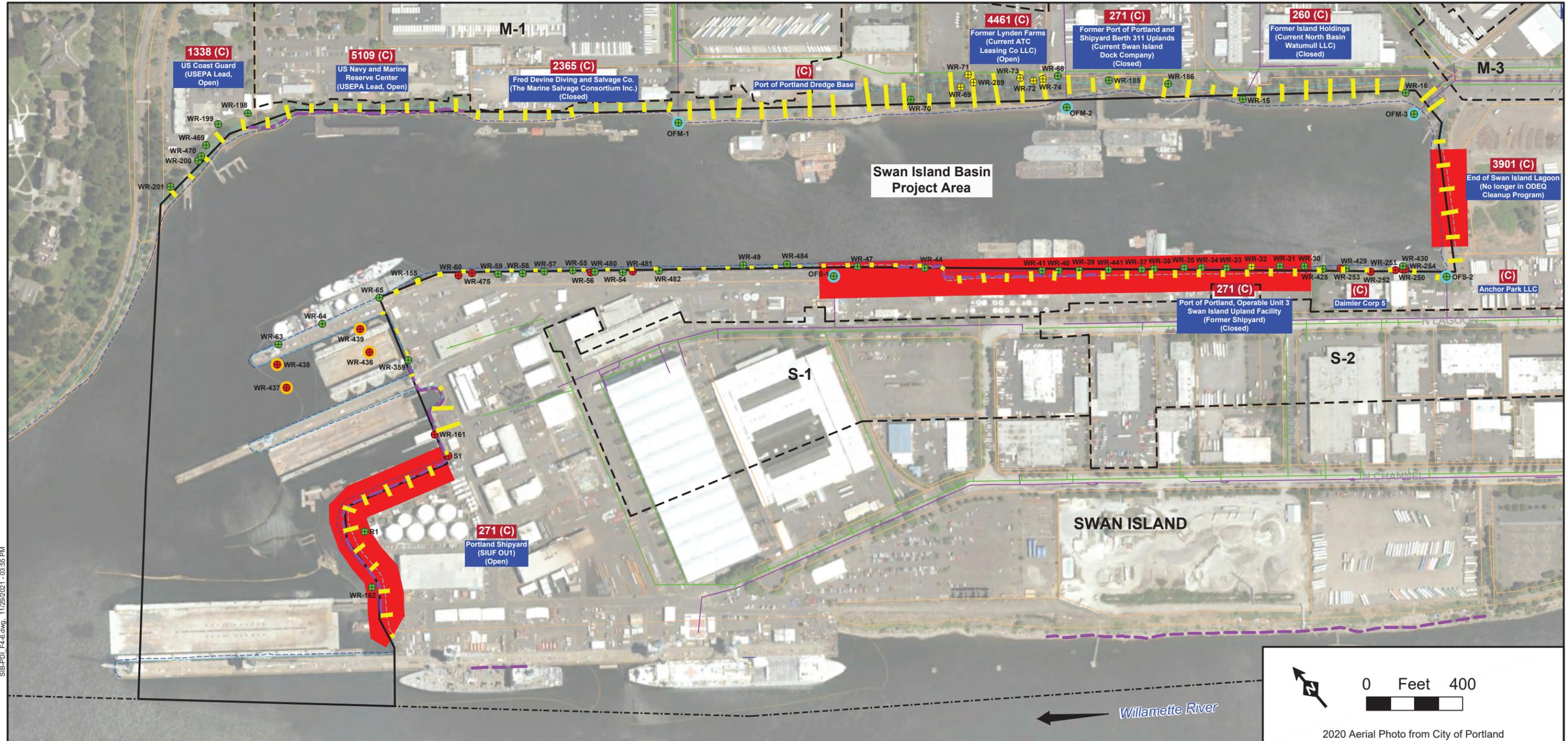
USACE: U.S. Army Corps of Engineers

Figure 4-5  
Mobile Terrestrial LiDAR Data  
Collection Plan

Prepared on 11/23/2021  
Pre-Design Investigation Work Plan  
Swan Island Basin

PACIFICgroundwaterGROUP  

  
 BRIDGEWATERGROUP



SIB-PDI\_F4-6.dwg, 11/29/2021 - 03:55 PM

- - - - - Drainage Basin      - - - - - Federal Navigation Channel (USACE 2020)      ← River Flow Direction  
 - - - - - Tax Lot Boundary

**Riverbank Investigations**

- Riverbank Sampling Transect (proposed)
- Known Contaminated Riverbanks
- Previous Riverbank Investigation Areas Exceeding Cleanup Levels

**Collection Lines**

- Stormwater Line
- Sewer Line

**Outfalls**

- Active
- Inactive
- ⊕ Abandoned
- ⊕ Unknown
- ⊕ Active - City of Portland Municipal Outfalls (M-1, M-2, M-3, S-1 and S-2)
- ⊕ Inactive - Former Non-Contact Cooling Water Discharge Points (WR-436 through WR-439)

**Notes:**

- EPA - U.S. Environmental Protection Agency
- ODEQ - Oregon Department of Environmental Quality
- OU - Operable Unit
- NAVD88 - North American Vertical Datum of 1988
- NOAA - National Oceanic and Atmospheric Administration
- PHSS - Portland Harbor Superfund Site
- ROD - Record of Decision
- SIUF - Swan Island Upland Facility
- USACE - U.S. Army Corps of Engineers

**Sources:**

- (1) PHSS ROD, EPA, January 2017
  - Known Contaminated Riverbanks
- (2) Ash Creek Associates, 2012a and b
  - Previous Riverbank Investigation Areas Exceeding Cleanup Levels (Shipyards)
- (3) Groundwater Solutions Inc., 2013
  - Previous Riverbank Investigation Areas Exceeding

**Cleanup Levels (End of Lagoon)**

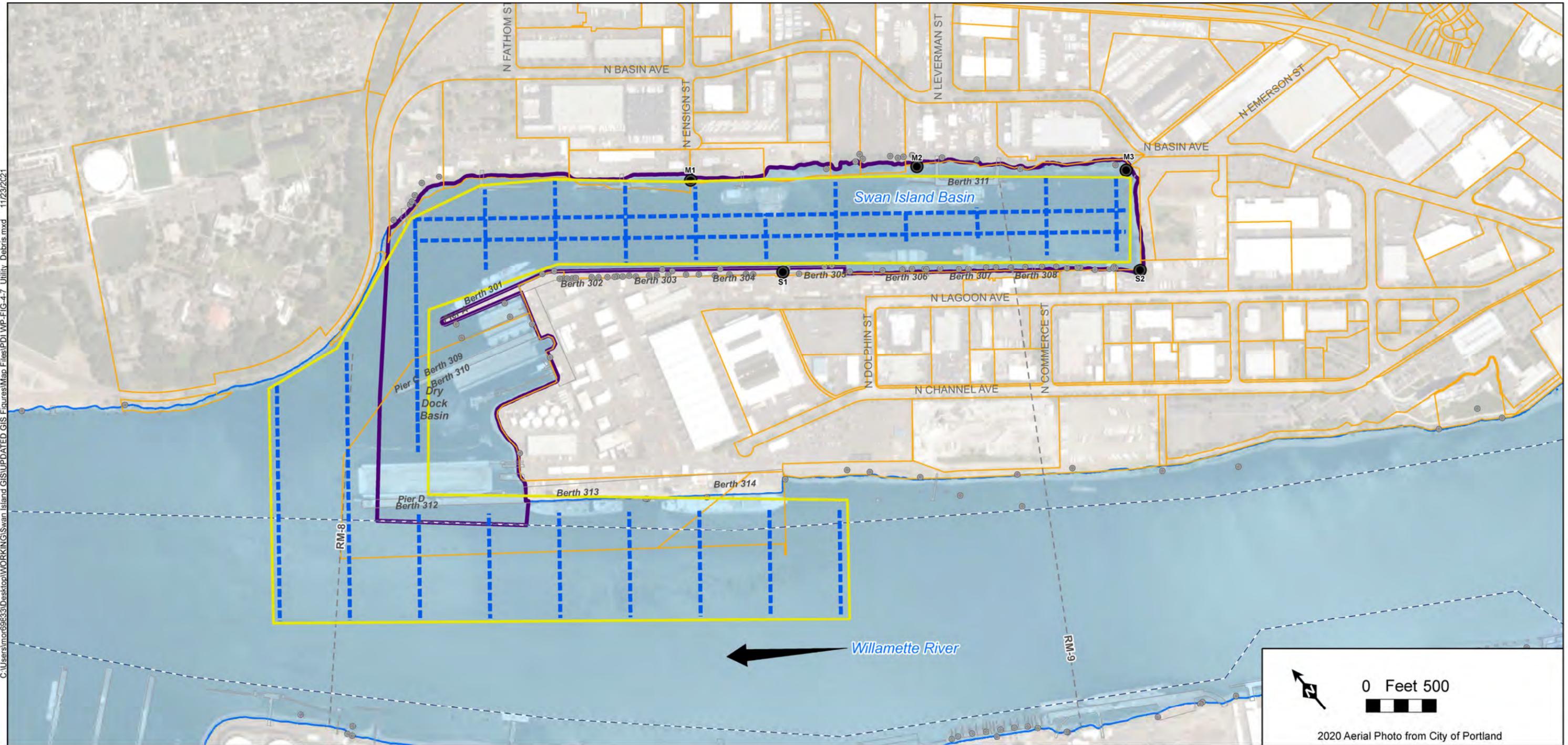
- (4) City of Portland Bureau of Environmental Services
  - Outfalls
  - Drainage Basins (except S-1)
  - Collection Lines
- (5) Vigor Stormwater Program Staff
  - Portland Shipyards Outfalls (June 21, 2021)
  - Drainage Basin S-1
- (6) NOAA, 2016. Booklet Chart, Willamette River – Swan Island Basin, NOAA Chart 18527 at URL: [https://www.charts.noaa.gov/BookletChart/18527\\_BookletChart.pdf](https://www.charts.noaa.gov/BookletChart/18527_BookletChart.pdf)
  - Navigation Channel
- (7) Oregon Metro Regional Land Information System
  - Tax Lots (July 23, 2020)
- (8) EPA Riverbank Guidance, Figure 3 RB Conceptual Diagrams, December 2019
  - Mean Low Water
  - Ordinary High Water

## Figure 4-6 Proposed Riverbank Characterization Transects

Prepared on 11/29/2021

Pre-Design Investigation Work Plan  
Swan Island Basin Project Area

C:\Users\m069633\Desktop\WORKING\Swan Island GIS\UPDATED GIS Figures\Map Files\PDI\WP-FIG-4.7 Utility Debris.mxd 11/23/2021



- City of Portland Stormwater Outfall
- Non-City Outfall
- Dock Drain
- - - River Mile (RM)
- ▭ Swan Island Sediment Decision Unit (SDU)
- - - Federal Navigation Channel (USACE, 2020)
- ▭ Docks and Structures
- ▭ Tax Lot Boundary
- ▭ Ordinary High Water (City of Portland, 2013)
- ← River Flow Direction

- - - Sub-Bottom Profile and Magnetometer Survey Transects
- ▭ Side-Scan Sonar Coverage

USACE: U.S. Army Corps of Engineers

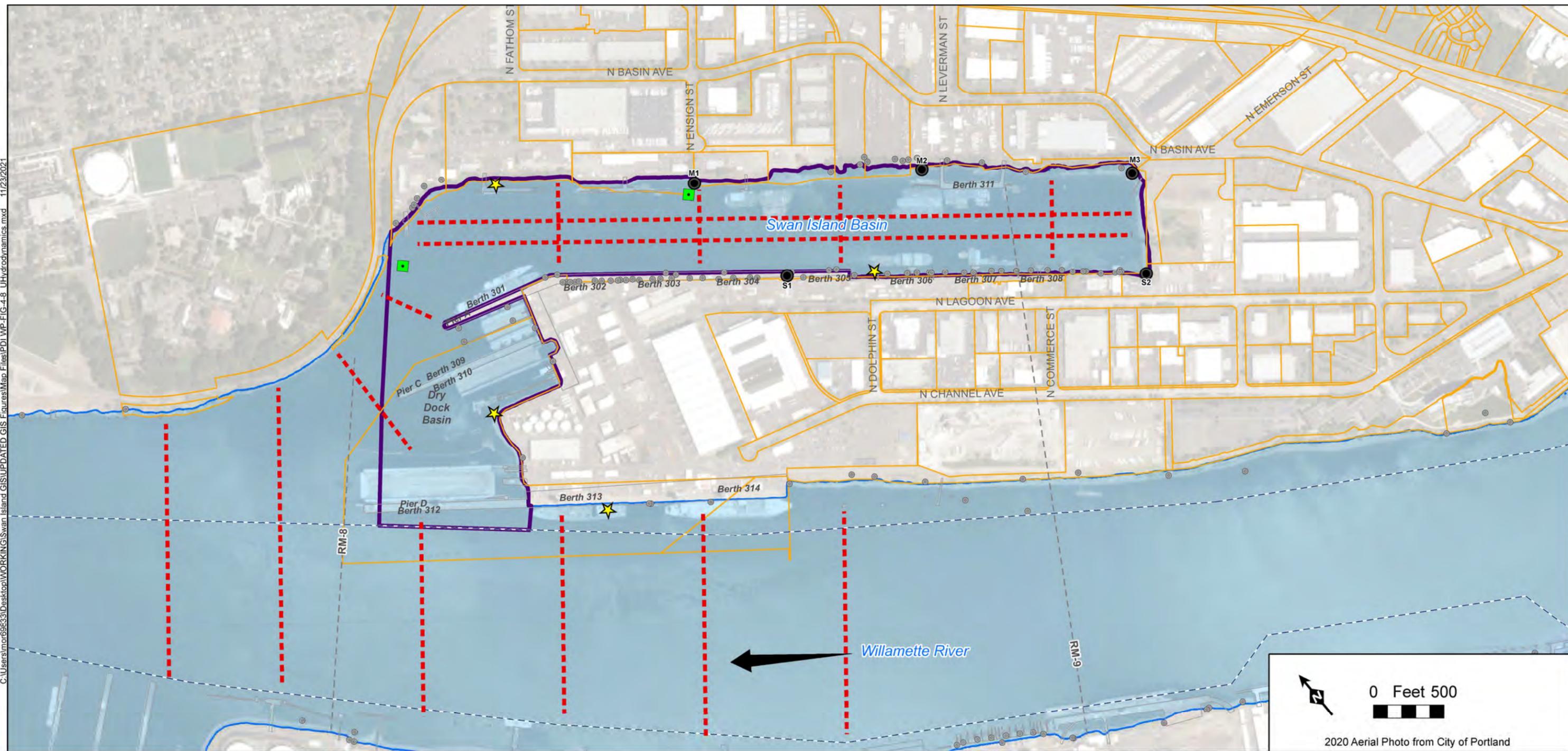
Figure 4-7  
Utility and Debris Data Collection Plan

Prepared on 11/23/2021

Pre-Design Investigation Work Plan  
Swan Island Basin



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- City of Portland Stormwater Outfall
- Non-City Outfall
- Dock Drain
- River Mile (RM)
- ▭ Swan Island Sediment Decision Unit (SDU)
- Federal Navigation Channel (USACE, 2020)
- ▭ Docks and Structures
- ▭ Tax Lot Boundary
- ▭ Ordinary High Water (City of Portland, 2013)
- ← River Flow Direction
- ★ Wind Wave and Boat Wake Sensors
- Bottom-Mounted ADCPs and Suspended Sediment Sensors
- Boat-Mounted ADCP Transects

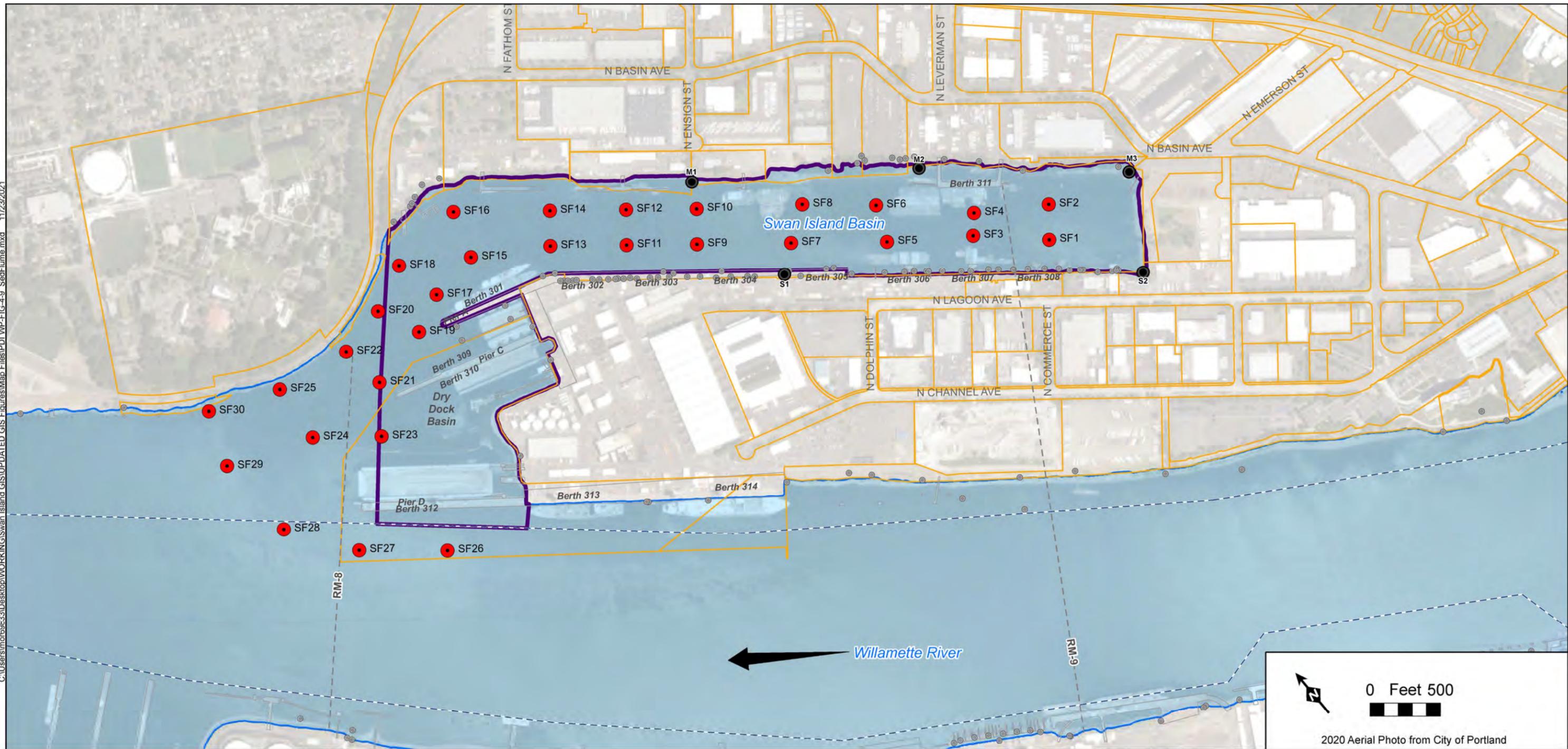
USACE: U.S. Army Corps of Engineers

**Figure 4-8**  
Hydrodynamics and Sediment  
Dynamics Data Collection Plan

Prepared on 11/23/2021

Pre-Design Investigation Work Plan  
Swan Island Basin

C:\Users\mro69633\Desktop\WORKING\Swan\_Island\_GIS\UPDATED GIS\Map\_Files\Map\_Files\PDI\_WP-FIG-4-9\_SedFlume.mxd 11/23/2021



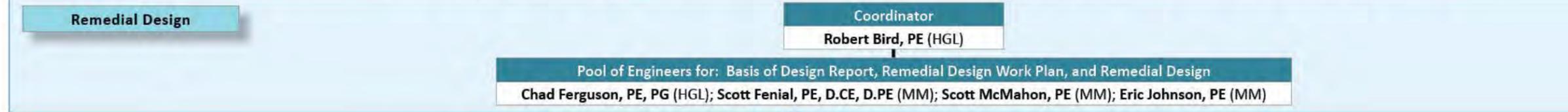
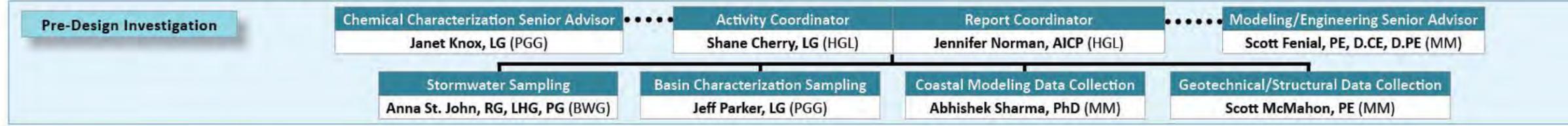
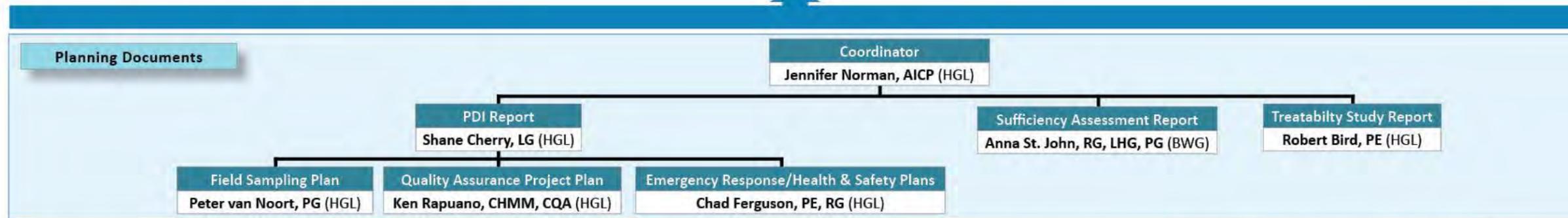
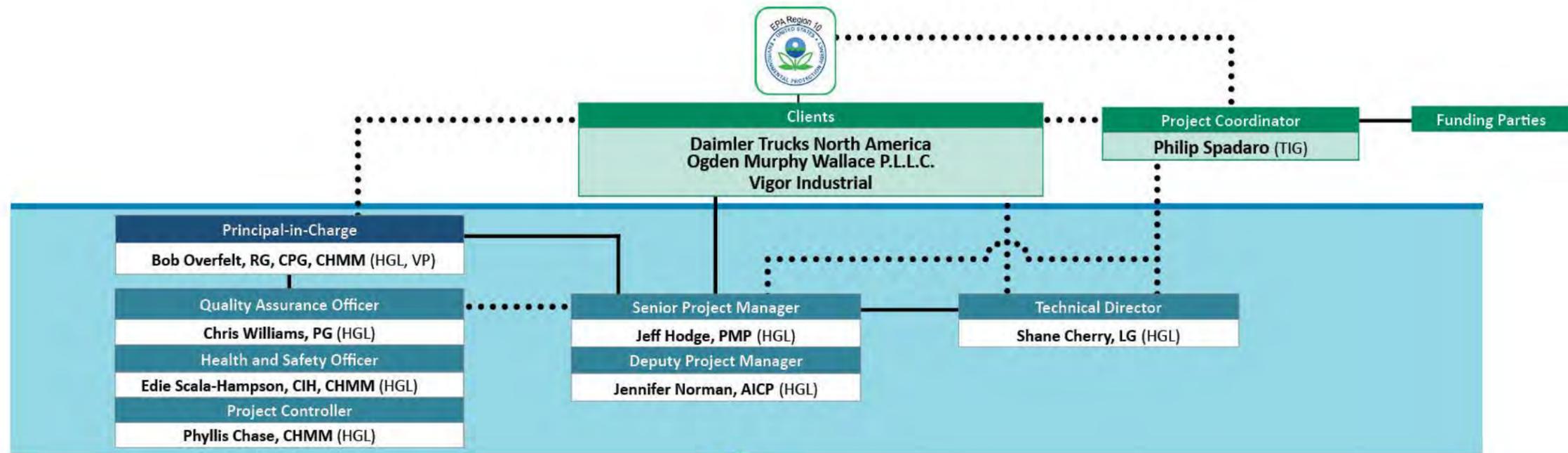
**Figure 4-9**  
SedFlume Sampling Locations

- City of Portland Stormwater Outfall
- SedFlume Cores (30 Total)
- Non-City Outfall
- Dock Drain
- River Mile (RM)
- ▭ Swan Island Sediment Decision Unit (SDU)
- ▭ Federal Navigation Channel (USACE, 2020)
- ▭ Docks and Structures
- ▭ Tax Lot Boundary
- ▭ Ordinary High Water (City of Portland, 2013)
- ← River Flow Direction

USACE: U.S. Army Corps of Engineers

Prepared on 11/23/2021  
Pre-Design Investigation Work Plan  
Swan Island Basin

PACIFIC groundwater GROUP  
**HGL** HydroGeologic, Inc.  
**MOTT MACDONALD**  
 BRIDGEWATER GROUP



HydroGeoLogic, Inc. (HGL), Mott MacDonald (MM), Pacific Groundwater Group (PGG), and Bridgewater Group (BWG) Supporting Staff

**Key Subcontractors**

Analytical Services				Data Management / Validation		Sampling Services			Other Services	
ALS Environmental	Analytical Resource Inc.	Cape Fear Analytical	Northwest Geotech, Inc.	Higgins Data Designs	Ecochem	Gravity Marine	Integral	Drilling: TBD	IDW Disposal: TBD	Cap Construction: TBD
Survey Services										
Groundwater Seep Testing: TBD	Dive Inspections: TBD	Magnetometer Debris: TBD	Multibeam Bathymetry: TBD	Laser Scan Structure: TBD	Topographic: TBD	Acoustic Doppler: TBD	Wave Measurement: TBD			

**Legend**

- Reporting
- Communication
- Management Team
- Technical Team

**Figure 5-1**  
 SIB Remedial Design Organizational Chart

Prepared on 06/07/2022



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## **APPENDICES**

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**APPENDIX A**  
**FIELD SAMPLING PLAN**

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**FIELD SAMPLING PLAN  
REVISION 3**

**REMEDIAL DESIGN SERVICES  
SWAN ISLAND BASIN PROJECT AREA  
CERCLA DOCKET NO. 10-2021-00**

**PORTLAND HARBOR SUPERFUND SITE  
PORTLAND, MULTNOMAH COUNTY, OREGON**

**Contract Number: DT2002**

*Prepared for:*

**Swan Island Basin Remedial Design Group**

*Prepared by:*



**11107 Sunset Hills Road, Suite 400  
Reston, Virginia 20190**

*With assistance from:*

**M**

**M**

**PACIFIC groundwater GROUP**

**MOTT  
MACDONALD**

**BRIDGEWATER GROUP**

**May 2022**

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**FIELD SAMPLING PLAN  
REVISION 3**

**REMEDIAL DESIGN SERVICES  
SWAN ISLAND BASIN PROJECT AREA  
CERCLA DOCKET NO. 10-2021-001**

**PORTLAND HARBOR SUPERFUND SITE  
PORTLAND, MULTNOMAH COUNTY, OREGON**

**Prepared for:**

**Swan Island Basin Remedial Design Group**

**Prepared by:**

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11107 Sunset Hills Road, Suite 400  
Reston, Virginia 20190**

**With assistance from:**

**Mott MacDonald  
Pacific Groundwater Group  
Bridgewater Group**

**May 2022**

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**Field Sampling Plan  
Swan Island Basin Project Area  
Portland Harbor Superfund Site**

**Record of Changes / Summary of Revisions**

<b>Revision No.</b>	<b>Revision Date</b>	<b>Document Name (If other than entire document, list revised sections or pages)</b>
0	June 29, 2021	Draft Field Sampling Plan for EPA review
1	December 10, 2021	Revisions per EPA comments received August 13, 2021
2	March 16, 2022	Revisions per EPA comments received February 1, 2022
3	May 10, 2022	Revisions per EPA comments received April 5, 2022

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Appendix B	Field Sampling Forms
Appendix C	Waste Management Plan
Appendix D	Subcontractor Statement of Work

## LIST OF ACRONYMS AND ABBREVIATIONS

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%	percent
°C	degrees Celsius
µg/mg	micrograms per milligram
ADCP	acoustic doppler current profiler
AECOM	AECOM Technical Services
AOC	Administrative Settlement and Order on Consent
ASAOC	Administrative Settlement Agreement and Order on Consent
ASCE	American Society of Civil Engineers
ASTM	American Society of Testing and Materials
BANCS	Bank Assessment for Non-point Source Consequences of Sediment
BODR	Basis of Design Report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	centimeter
CoC	chain of custody
COC	contaminants of concern
CPT	cone penetration test
CRD	Columbia River Datum
CTD	Conductivity, Temperature, and Depth
CUL	cleanup level
DDx	DDD + DDE + DDT
DMP	Data Management Plan
DRET	dredge elutriate test
EB	equipment blank
ECSI	Environmental Cleanup Site Information
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
ERP	Emergency Response Plan
FD	field duplicate
FSP	Field Sampling Plan
ft	feet/foot
FTL	Field Team Leader
g	gram
g/L	grams per liter
Geosyntec	Geosyntec Consultants, Inc.
GIS	geographic information systems
GPS	global positioning system

## LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

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HASP	Health and Safety Plan
HGL	HydroGeoLogic, Inc.
HVS	high-volume sampling
ID	identification
JSCS	Joint Source Control Strategy
L	liter
L/min	liter per minute
LiDAR	light detection and ranging
mg	milligram
mg/L	milligrams per liter
mL	milliliter
mm	millimeter
MS	matrix spike
MSD	matrix spike duplicate
MTLS	Mobile Terrestrial LiDAR Survey
NAD83	North American Datum 1983
NAPL	nonaqueous phase liquid
NAVD88	North American Vertical Datum of 1988
NOAA	National Oceanic and Atmospheric Administration
OBS	optical backscatter point sensor
OCP	organochlorine pesticides
ODEQ	Oregon Department of Environmental Quality
OHW	ordinary high water
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
PCDD	Polychlorinated Dibenzo-p-Dioxin
PCDF	Polychlorinated Dibenzofuran
PDI	Pre-Design Investigation
pg	picogram
pg/mg	picograms per milligram
PGG	Pacific Groundwater Group
PHSS	Portland Harbor Superfund Site
PID	photoionization detector
PM	project manager
PP	primary party
PTW	principal threat waste

## LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

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PUF	polyurethane foam
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RAL	Remedial Action Level
RD	Remedial Design
RM	river mile
ROD	Record of Decision
SGS	SGS North America, Inc.
SIB Site	SIB Project Area
SIB	Swan Island Basin
SMA	Sediment Management Area
SOP	standard operating procedure
SSC	suspended solids concentration
TB	trip blank
TBT	tributyltin
TSS	total suspended solids
UFP	Uniform Federal Policy
USACE	U.S. Army Corps of Engineers
USCS	Unified Soil Classification System
Vibracore	vibratory core tube driver

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**FIELD SAMPLING PLAN  
SWAN ISLAND BASIN PROJECT AREA  
PORTLAND HARBOR SUPERFUND SITE  
PORTLAND, MULTNOMAH COUNTY, OREGON**

## **1.0 INTRODUCTION**

On December 1, 2000, the Portland Harbor Superfund Site (PHSS) was listed on the National Priorities List due mainly to concerns about contamination in the sediments and the potential risks to human health and the environment from consuming fish. The most widespread contaminants found at PHSS include polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and dioxins/furans.

In January 2017, the U.S. Environmental Protection Agency (EPA) issued a Record of Decision (ROD) that presents the selected remedy for the in-river portion of PHSS contamination. The selected remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and to the extent practicable, the National Contingency Plan.

On January 14, 2021, certain Parties<sup>1</sup> and EPA voluntarily entered into an *Administrative Settlement Agreement and Order on Consent (ASAOC)* (EPA, 2021), to perform Remedial Design (RD) work within the Swan Island Basin (SIB) Project Area of PHSS. Figure 1-1 shows the SIB Project Area and vicinity.

This *Field Sampling Plan* (FSP) serves as Appendix A to the *SIB Draft Pre-Design Investigation Work Plan* (HydroGeoLogic, Inc. [HGL], 2021a). The Pre-Design Investigation (PDI) Work Plan provides background information on the project, identifies the data gaps to be filled, and summarizes the data and information gathering tasks that will be conducted during the PDI to fill these data gaps.

This FSP supports and guides the PDI sampling within the SIB Project Area and the SIB Upland Area and provides details for field sampling locations and procedures for the planned PDI project tasks. In addition to this FSP, other PDI planning documents that are being submitted concurrently include the following:

- *Draft Uniform Federal Policy-Quality Assurance Project Plan* (HGL, 2021b), Appendix B of the PDI Work Plan: Provides quality control (QC) elements to satisfy the data quality objectives for each task specified in the PDI Work Plan. The protocols established in the Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP) are necessary to

---

<sup>1</sup> Parties to the Administrative Settlement Agreement and Order on Consent (ASAOC) are EPA and Daimler Trucks North America LLC, Vigor Industrial LLC, Cascade General, Inc., and Shipyard Commerce Center LLC (collectively, Respondent(s)); Maritime Administration, U.S. Coast Guard, U.S. General Services Administration, Bonneville Power Administration, and U.S. Department of Defense (collectively, Settling Federal Agencies); and the state of Oregon, acting by and through the Department of State Lands, the city of Portland, and the Port of Portland (collectively, Settling Public Entities).

ensure the data generated is of a sufficient quality to support development of valid conclusions.

- *Draft Health and Safety Plan* (HGL, 2021c), Appendix C of the PDI Work Plan: Identifies and describes physical, chemical, and biological hazards relevant to each planned field task, and provides hazard mitigation techniques to address these hazards.
- *Draft Emergency Response Plan* (HGL, 2021d), Appendix D of the PDI Work Plan: The Emergency Response Plan (ERP) will be used in the event of an accident or emergency during performance of the RD work.

Portions of this FSP were derived from the Surface and Subsurface Sediment Field Sampling Plan for Swan Island Lagoon, Portland Harbor Superfund Site from Pacific Groundwater Group (PGG) (PGG, 2018).

## **1.1 PROJECT SETTING**

The SIB Project Area (SIB Site) is the active cleanup area designated in the ROD between approximately river mile (RM) 8.1 and RM 9.2 on the northeast side of the Willamette River (Figure 1-1). The SIB Project Area is approximately 1.1 miles in length, 117 acres in size, and includes riverbanks from top of the bank to the river. The upland area adjacent to the SIB Site, which discharges to the SIB includes approximately 588 acres of mostly impervious area with primarily light industrial uses (Figure 1-2). Stormwater discharges from the upland area to the SIB from five city outfall basins (M-1, M-2, M-3, S-1, and S-2), six Port of Portland outfalls, as well as multiple private outfalls. Potentially contaminated riverbanks are present in the SIB Project Area as well as impacted surface and subsurface sediment.

## **1.2 BACKGROUND**

The historical and present-day description of the SIB Site provides relevant context for understanding the physical work environment for sample and data collection that will be guided by this FSP. The Willamette River is the 19th largest river in the United States and is one of 14 American Heritage Rivers in the country. The Willamette River flows into the larger Columbia River, which eventually flows into the Pacific Ocean. Even though the Willamette River is nearly 100 RMs from the Pacific, there are tidal influences within the SIB project area and overall, it is a large and dynamic river. During its 309-mile course, which ends at its confluence with the Columbia River, it drains 11.7 percent (%) of the area in the state of Oregon.

In 1891, the Oregon State Legislature created the Port of Portland. Since the late 1800s, the Portland Harbor section of the Lower Willamette River has been extensively modified to accommodate a vigorous shipping industry. Modifications include redirection and channelization of the main river; draining seasonal and permanent wetlands in the lower floodplain; and relatively frequent dredging to maintain the navigation channel, access to docks, and wharf facilities. Constructed structures, such as wharfs, piers, floating docks, and pilings, are especially common in Portland Harbor where urbanization and industrialization are most prevalent. These structures largely accommodate or support shipping traffic within the river and stabilize the riverbanks for urban development. Riprap is the most common bank-stabilization method although upland

bulkheads and rubble piles are also used. Seawalls help control periodic flooding as most of the original wetlands bordering the river in the Portland Harbor area have been filled.

Historically, contaminants from many facilities entered the river system from different activities including, but not limited to ship building and repair; ship dismantling; wood treatment and lumber milling; storage of bulk fuels; manufactured gas production; chemical manufacturing and storage; metal recycling, production, and fabrication; steel mills, smelters, and foundries; and electrical production and distribution. These activities have resulted in direct discharges from upland areas through stormwater and wastewater outfalls; releases and spills from commercial operations occurring over the water; municipal combined sewer overflows; and indirect discharges through overland flow, bank erosion, groundwater, and other nonpoint sources. In addition, contaminants from off-site sources have reached the SIB project area through surface water and sediment transport from upstream and through atmospheric deposition. Operations that continue today along the riverbanks include bulk fuel storage, barge building, ship repair, automobile scrapping, recycling, steel manufacturing, cement manufacturing, operation and repair of electrical transformers (including electrical substations), and many smaller industrial operations.

A federal navigation channel, with an authorized depth of -40 feet (ft) Columbia River Datum<sup>2</sup> (CRD), extends from the confluence of the Lower Willamette River with the Columbia River to RM 11.6. Container and other commercial vessels regularly transit the river. Certain parts of the river require periodic maintenance dredging to keep the navigation channel at its authorized depth. In addition, the Port of Portland and other private entities periodically perform maintenance dredging to support access to dock and wharf facilities. Dredging activity has greatly altered the physical and ecological environment of the river in Portland Harbor. The current navigation depth was authorized in 1962 and dredging work on the authorized 40-ft-deep channel from Portland and Vancouver to the Pacific was completed in 1976. In 1999, Congress authorized the Willamette River to be deepened to 43 ft; however, this has not yet occurred. Swan Island Lagoon was created in the 1930s when dredge spoils were used to fill in part of the channel and connect Swan Island to the mainland. The Willamette River channel, from the Broadway Bridge (RM 11.6) to the mouth (RM 0), varies in width from 600 to 1,900 ft. The U.S. Army Corps of Engineers (USACE) maintains the navigation channel.

Development of the river has resulted in major modifications to the ecological function of the Lower Willamette River. However, several species of invertebrates, fish, birds, amphibians, and mammals, including some protected by the Endangered Species Act, use habitats that occur within and along the river. The river is also an important pathway for migration of anadromous fish such as salmon and lamprey. Various recreational fisheries, including salmon, bass, sturgeon, crayfish, and others, use the Lower Willamette River. Resident fish in the site include but are not limited to smallmouth bass, brown bullhead, black crappie, and carp.

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<sup>2</sup> CRD is used as the nautical chart datum for the Lower Willamette River. CRD is a reference plane that USACE established in 1912 by observing low water elevations at various points along the Columbia and Willamette rivers (USACE, 1966). Consequently, CRD is not a fixed/level datum but slopes upward as one moves upstream. River users can obtain the depth on a chart and apply tide or river-level gauge readings, relative to CRD, to compute actual water depth. Low water values are used for navigation charting to provide conservative depth values in the event accurate tide data is not available to the river user.

### **1.3 PURPOSE AND OBJECTIVES**

This FSP describes the sampling methodologies and strategies that will be employed to achieve the objectives of the PDI, outlined in the PDI Work Plan. Information presented in this FSP includes field methods, sample handling, management of investigation-derived wastes, and an overview of the analytical programs associated with the different components of the PDI. The five principal data gap objectives of the PDI are summarized below.

1. Define the specific needs required to fully inform the design development and evaluation based on a conceptual design approach and strategy consistent with the ROD.
2. Define the specific needs to support the ASAOC applications required for Sediment Management Area (SMA) refinement, conceptual site model refinement, and effective use of the technology application decision tree shown in the PDI (Figure 1-3). As such, PDI surface sediment sampling will be completed to refine the lateral extent of contaminants of concern (COCs).
3. Compile and evaluate existing available data and analysis relevant to the defined data and analysis needs as determined by the design and required applications.
4. Identify data gaps by comparing what is needed to what is available.
5. Develop a work plan to guide the collection of new data and the completion of new analyses to address the data gaps.

In this FSP, “SMA” describes SIB Project Area sediments for which Remedial Action Levels (RALs) and/or principal threat waste (PTW) thresholds were exceeded and where a remedial technology of dredging or capping was assigned in the PHSS ROD (Figure 1-3) (EPA, 2017a).

## **2.0 DATA GAP SUMMARY**

The purpose of this FSP is to describe the data and information collection activities that will be used to support the PDI and ultimately the Basis of Design Report (BODR). The PDI Work Plan developed three data gap tasks: preliminary SMA delineation, conceptual site model refinement, and application of ROD technology application decision tree. See Section 3.0 of the PDI Work Plan for a detailed discussion on the types of data considered for use on this project. Section 4.0 of the PDI Work Plan provides a detailed overview of the PDI approach.

A summary of the data gap categories identified in the PDI Work Plan is provided below and summarized in more detail on Table 2-1:

1. Surface and Subsurface Sediment Contaminant Concentrations
2. Riverbank Characterization
3. Geotechnical Site Characterization
4. Sediment Porewater Characterization
5. Stormwater Outfall and Conveyance System Sampling
6. Bathymetry and Topography
7. Shoreline and Overwater Structures and Activities
8. Hydrodynamics and Sediment Dynamics Measurements
9. Existing Utilities and Debris Identification
10. Flood Impact Evaluation
11. Habitat Conditions Survey

In support of these data gaps, the following field data collection activities will be performed:

- Sediment surface and subsurface sampling;
- SedFlume analysis core sampling;
- Dredge elutriate sampling;
- Riverbank data sample collection;
- Geotechnical boring and cone penetration testing;
- Stormwater, stormwater solids, and in-line sediment trap sampling; and
- Habitat conditions survey.

The following surveys will be conducted, and additional data will be collected for an engineering analysis:

- Shoreline inspection and structural condition survey;
- Multi-beam bathymetric survey data;
- sub-bottom, magnetometer, and side-scan sonar data;
- mobile terrestrial light detection and ranging (LiDAR) survey (MTLS) data (laser scan);
- current, water level, wind-wave, and boat wake data; and,
- transect survey for thermal profiling at sediment/water interface.

The COCs and their respective cleanup levels (CULs) are listed in Table 2-2 of this FSP (EPA, 2020a).

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### **3.0 PROJECT ORGANIZATION AND FIELD TEAM**

Key project staff and their titles and responsibilities are provided in the RD team organizational chart in Worksheets #3 and #5 in the UFP-QAPP. The SIB Project Coordinator will notify the EPA Project Coordinator no less than 14 days before sample collection activities as required by the ASAOC statement of work Section 5.6 (d)(5) so that EPA can schedule planned oversight. The HGL project manager (PM) shall not make field adjustments without first obtaining EPA approval of deviations in the field through field change requests.

#### **3.1 TEAM ORGANIZATION AND RESPONSIBILITIES**

Team organization is detailed in the UFP-QAPP, see Worksheets #3 and #5 *Project Organization and QAPP Distribution*. HGL is coordinating activities for this FSP including management of subcontractors, field sampling, analysis, and reporting scoping tasks. HGL PM Jeff Hodge, will be responsible for overall project coordination and providing oversight on project deliverables.

Subcontractors for marine vessel support, analytical laboratory processing, and data validation will be arranged prior to fieldwork.

#### **3.2 COMMUNICATION AND INFORMATION FLOW**

The communication pathways strategy is outlined in Worksheet #6 of the UFP-QAPP. The field team leader (FTL) will be the point of contact for field staff during the implementation of this FSP. Deviations from this FSP or the UFP-QAPP will be reported to the PM and the Client Management Team and regulatory agencies for consultation.

#### **3.3 FSP PREPARATION AND CONTENT**

This FSP has been prepared in accordance with the following EPA decision and guidance documents.

- Guidance for Conducting Remedial Investigations and Feasibility Studies, EPA/540/G-89/004 (EPA, 1988).
- PHSS ROD for Portland Oregon (EPA, 2017a).
- Sampling Plan for Pre-RD, Baseline and Long-Term Monitoring (EPA, 2017b).
- Program Data Management Plan, Portland Harbor RD Investigation PHSS (EPA, 2018).
- Administrative Settlement and Order on Consent (AOC) for RD at Willamette Cove Project Area (EPA and WC Group, 2019).
- RD Guidelines and Considerations, PHSS, Oregon, (EPA, 2021).

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## **4.0 FIELD AND SAMPLING ACTIVITIES**

The field activities described in this section flow from the data gap evaluations sampling design that has been developed based on the results of previous site investigations. Sediment-related field sampling activities are surficial grab sampling, subsurface coring, and sediment erodibility sampling. Additional field activities include riverbank evaluation and riverbank soil sample collection; geotechnical investigation; surface water monitoring; and stormwater, stormwater solids, and in-line sediment trap sampling. Refer to Table 4-1 for a summary of field activities and associated proposed samples and analyses.

Field sampling activities will be conducted under the Health and Safety Plan (HASP) and performed in accordance with the standard operating procedures (SOPs) included in Appendix A of this FSP. SOPs were selected from previous Portland Harbor reports and five SOP libraries maintained respectively by HGL, EPA, Pacific Groundwater Group (PGG), Mott Macdonald (MM), and Bridgewater Group (Bridgewater). Standardized forms to be used for recording field data and documentation are included in Appendix B of this FSP. Individual SOPs also include field forms to be used.

Information on chain of custody (CoC), packaging, and shipping samples is in Worksheets #26 and #27 of the UFP-QAPP. Hard copies of these documents will be provided to the project team.

### **4.1 UTILITY LOCATES**

Before any intrusive activity at the SIB begins, steps will be taken to determine if the area contains underground utilities or subsurface debris, even though utilities and/or debris may have been previously located. Known underground utilities are presented in the National Oceanic and Atmospheric Administration (NOAA) Willamette River chart for the SIB (NOAA, 2019). Intrusive activities are defined as any activity that produces a manmade cut, cavity, hole, or trench, in the ground surface or sediment surface as a result of soil/sediment removal or any activity that results in an object placed into the earth below the surface. These activities include excavating, drilling, auguring, boring, shoveling, fence post driving, driving stakes, etc.

Prior to initiating intrusive fieldwork, within or adjacent to the SIB, the presence of subsurface utilities and debris will be evaluated in accordance with SOP 411.03 (Appendix A). NOAA navigation charts for the SIB Project Area will be reviewed to denote areas where abandoned cables are located. A site reconnaissance will be performed to identify and review site health and safety issues, locate proposed exploration locations, and identify other logistical issues. A minimum of 2 full business days, but not more than 10 full business days prior to beginning the subsurface investigation, each proposed on-land boring location will be marked for utility clearance through the Oregon Utility Notification Center (dial 811 or submit online at <https://digsafelyoregon.com/resources/locate-requests/>) and in accordance with SOP 411.03 (Appendix A). Exploration locations within the SIB (in-water locations) will be marked with a direction and offset from the closest adjacent high-bank location, and the specific location communicated to the Oregon Utility Notification Center through global positioning system (GPS) coordinates.

## **4.2 SEDIMENT SAMPLING**

The following sections describe the procedures and methods to be followed in collecting the surface and subsurface sediment samples. The historical surface and subsurface sediment sampling stations within the SIB Site are presented in Figure 4-1. Instructions on sampling procedures, recordkeeping, sample handling, storage and shipping, and field QC procedures are in Section 4.7 of this FSP. See Table 4-1 for a summary of sediment sample types, numbers, and analyses. A discussion of the relevant sample containers, analytes, preservation, and holding times requirements can be found in Worksheets #19 and 30 of the UFP-QAPP.

Surface sediment is defined as sediment within the top 1 ft (or 30 centimeters [cm]), and subsurface sediment is defined as sediment lower than 1 ft (or 30 cm) below mudline. A total of 186 locations will be sampled, including 5 surface grab sample locations and 181 subsurface coring locations. At 25 of the subsurface core locations, samples will be collected from the 0 to 1-ft interval to characterize surface contamination, for a total of 30 surface-sediment samples. The sediment sampling locations were selected to: a) update the spatial extent (horizontal and vertical) of contamination around the ROD-selected remedy (Alternative F Modified); b) refine the SMA footprint and technology assignments in the SIB; and c) delineate the extent of PTW. The sampling and analysis results will also support the evaluation of remedy effectiveness after implementation. Samples will be tested for focused COC analytes, including Total PCBs, Total PAHs, DDx, 2,3,7,8-TCDD, 1,2,3,7,8-PeCDD, 2,3,4,7,8-PeCDF, 2,3,7,8-TCDF, 1,2,3,4,7,8-HxCDF, and Total cPAHs (BaP Eq)<sup>3</sup>.

Additional surface and subsurface samples will be collected from depth intervals within the 181 sediment cores to be frozen and archived for potential future analysis to aid RD efforts. Refer to Sections 4.2.2 and 4.2.3 for the full description of the sediment collection procedures and sediment samples to be collected. Procedures for positioning and sample location are discussed Section 7.0 and in SOP A-7 Horizontal and Vertical Control (Appendix A).

### **4.2.1 Sampling Vessels and Equipment**

The marine vessel subcontractor will operate the vessel and perform the surface and subsurface sediment sampling activities. The subcontractor will utilize one sampling vessel, equipped with hydraulic power grab sampler and Vibratory Core Tube Driver (vibracore) to complete the work. The vessel that is anticipated for use has a virtual anchoring system that incorporates an autopilot and two small motors to keep the vessel on station without needing to set fixed anchors. The vessel will target proposed locations, record actual GPS sampling coordinates, and export a coordinate file electronically. In addition, field personnel will record the coordinates on field data sheets. The vessel will be mobilized from the city of Portland public boat ramp at N. Basin Avenue or the Marine Consortium (Fred Devine Diving and Salvage) dock near the N. Ensigh Street cul-de-sac.

The hydraulic power grab sampler will target penetration depths of 30 cm (0 to 1 ft) and will be retrieved on deck. A medium-sized power grab, designed and manufactured by the vessel

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<sup>3</sup> Two constituents (naphthalene and chlorobenzene) not listed on the PHSS COC list are listed as additional PTW constituents. Chlorobenzene was not detected in surface or subsurface sediment samples from the SIB Project Area, and is not considered further in this FSP. Naphthalene will be analyzed along with other PAHs.

subcontractor, will be used for this project. The medium-sized power grab will have a recovery volume of about 0.05 to 0.08 cubic yards for acceptable grabs. Samples will be collected on the vessel and stored on ice until transferred to the analytical laboratory. At each sample collection location, a GPS will be used to position the vessel at a fixed sampling station. As stated in the PDI Work Plan, final coordinates will be reported after fieldwork is complete.

Vibracore tubes will be advanced up to 10 ft. A minimum of 4-inch-diameter Lexan, aluminum, or stainless core tubes and custom core catchers will be used for core collection. New polycarbonate liners may be used in the interior of the core tubes to help core recovery and processing.

Equipment and supplies will include equipment for positioning, sampling, sample processing, recording, and shipping samples. The analytical laboratory will supply sample containers and preservatives, as well as coolers and packing material.

#### **4.2.2 Surface Sediment Sample Collection Procedures**

Surface sediment sample types and sampling depth intervals are consistent and comparable with protocols from previous investigations so that the datasets are comparable (EPA, 2016a; EPA, 2016b).

A total of 29 surface sediment samples will be collected according to a grid-pattern sample design. One additional sample from grid cell C37 will be collected as a targeted resample of a total PAHs outlier result from 2002 associated with the Station ID: WLCOFJ02M0304M3040. There will be a combined 30 surface sediment samples. These locations include five hydraulic grab samples and the top 30.48 cm (1 ft) from 25 core (subsurface sampling) locations that were identified as data gaps (see PDI Work Plan Sections 3.0 and 4.0). The grids are shown on Figure 4-2. Table 4-2 summarizes the sampling approach. Figure 4-3 shows proposed surface sediment sample stations within the SIB Site. At subsurface core locations where the 0- to 1 ft interval is not needed for surface sample analyses, the 0- to 1-ft interval will be frozen and archived.

In locations where a core is collected but a surface sample is not needed to meet 150-ft spacing criteria, the top interval of cores will be archived. Some of these may be necessary to fill in COC-specific data gaps. These potential data gaps include:

- Grid cells D2 and F35 for tributyltin (TBT);
- Grid cells C3, K3, and L4 for diesel, pesticides, and TBT;
- Grid cells O7 and B26 for pesticides;
- Grid cell B28 and C28 for dioxin/furans;
- Grid cell B29 for metals, diesel, and TBT; and
- Grid cells B34 and B35 for diesel and TBT.

These potential sample analyses, and others that come up as appropriate, will be analyzed from archived material on a case-by-case basis as an additional phase of analysis. Analysis of archived surface samples will be performed, as necessary, to meet 150-ft spacing criteria along the SMA

boundary for each specific COC. EPA may be consulted for review on the necessity of analyzing archived material in some cases.

#### **4.2.2.1 Grab Sampling**

In general, sample collection will be performed as described in SOP 403.08 (Appendix A). This section includes grab sampling procedures, a target recovery and relocation plan, and information on surface sample collection and compositing.

##### *4.2.2.1.1 Power-Grab Sampling*

Surface sediment grab samples will be collected with a hydraulic power grab sampler. The hydraulic power grab sampler will target collection of sediment from the upper 0 to 30 cm of sediment at each sample location (without adjusting vessel position). Power grab samples will consist of a three-point composite sample like manual grab locations. Based upon field determination, samples that do not meet each of the following criterion will not be accepted (acceptance criteria) (PSEP, 1996; Integral, 2004):

1. No or minimal excess water leaking from the jaws of the sampler.
2. No excessive turbidity in the overlying water of the sampler.
3. Sampler did not over-penetrate.
4. Sediment surface appears to be intact with minimal disturbance.
5. Program-specific penetration (20 cm) has been achieved.

For this sampling, the acceptance penetration depth for grab samples is 20 cm, as was used in previous studies. A minimum of three consecutive casts of the grab sampler will be attempted at each location, while trying to achieve the 20-cm penetration depth. Additional attempts may be made based on professional judgement of the FTL. If a 20-cm penetration depth cannot be obtained, the sample of the greatest depth will be retained. If field conditions preclude the field staff from collecting proposed target samples (e.g., limited access, poor recovery, safety concerns, debris/rock/bedrock causing refusal), then the FTL will adjust or abandon the location and record the reason in the field logbook. All information related to failed attempts will be documented and reported with the other field notes. If an adjusted sample location falls outside of a 25-ft radius of the planned sample location, or if a sample location is abandoned, the location will be documented in a field change request for EPA approval. Section 8.1.1 of this FSP describes the procedure for requesting EPA approval.

After grab sample acceptance, sediments will be collected from the hydraulic power grab using a stainless-steel spoon, avoiding sediments in contact with the sides of the sampler. Organisms larger than 1 cm and pieces of debris will be removed and noted in the sample log sheet. Large organisms will be returned to the SIB. The sediment will be placed in a large, stainless-steel bowl and homogenized. Once the volume of sediment from each grab has been homogenized to a uniform consistency and color, sediments will be visually described and recorded on field logs or sample description forms (Appendix B). The following information will be recorded: sediment texture; sediment color; presence, type, and strength of odors; grab penetration depth (nearest cm), degree of leakage, or sediment surface disturbance; and obvious abnormalities such as wood/shell fragments or large organisms. Sediments will be placed in the appropriate laboratory-provided

sampling containers and stored in a cooler at 4 degrees Celsius (°C) until transport to the laboratory.

#### *4.2.2.1.2 Manual-Grab Sampling*

Due to access limitations or low water levels exposing shallow sediments, it may be necessary to collect surface sediment samples using manual sampling equipment (i.e., shovels, hand augers) appropriate to the field conditions encountered at the time of sampling. Similar to the power-grab samplers, the manual-grab target sample interval will be from 0 to 30 cm in depth, with a minimum penetration depth of 20 cm. Three manual-grab samples will be collected at each location within 25 ft of the core station centroid for compositing as described in Section 4.2.2.2. Coordinates for every manual grab station will be read on a handheld GPS and recorded in the field notes or tablet.

#### *4.2.2.1.3 Surface Sediment Target Recovery and Relocation Plan*

Grab samples not meeting the target criteria outlined in Section 4.2.2.1.1 will be rejected and the sample collection steps repeated until the acceptance criteria are met; however, no more than nine individual grab attempts will occur at each sample station (i.e., no more than three attempts at each grab location). In areas in which sediment conditions do not allow penetration of 20 cm below mud line after three grab attempts, the field staff will document the attempts and move to the next grab composite location. Subsample locations may be adjusted based on unexpected field conditions (e.g., presence of riprap, logs, large debris, or other obstructions). A manual probe may be used to evaluate the sediment quality (i.e., hardness, presence of obstructions, and other factors) in the general vicinity of rejected surface sample locations, to identify a suitable offset location. Deployment attempts will be repeated within an approximate 10-ft radius of the target subsample location. If two of the three composite grabs are successful, the surface sample will be considered a successful sample. If material is recovered from only one of the three composite grab locations, following consultation with the HGL PM, FTL, and EPA, the target coordinates at the unsuccessfully sampled station may be updated or the single grab may be accepted. Grab samples, regardless of acceptance, will be logged as they are collected, and accepted subsamples will be processed as described in Section 4.2.3.1.2. Any unused sample volume will be disposed of offsite as investigation derived waste.

#### **4.2.2.2 Surface Sample Collection and Compositing**

Approximately 1 liter (L) of sediments will be collected from each surface grab location and transferred to a stainless-steel bowl for mixing to homogenize the samples as detailed in SOP 403.03 (Appendix A). Sediments that are in contact with the sides of the sampling device will be avoided when collecting the minimum volume for homogenization. Large rocks, organisms, and pieces of debris will be avoided during collection or removed during homogenization and noted in the sample description form. The transfer container and mixing bowl will be rinsed but not decontaminated between grab sample composite locations. Prior to mixing, the following physical characteristics of the grab samples will be described and recorded on a sample description form using the American Society of Testing Materials (ASTM) D2488 visual soil classification procedure (ASTM, 2017). This procedure includes describing sediment texture; sediment color; presence, type, and strength of odors or petroleum sheens; grab penetration depth (to the nearest cm); and obvious features or characteristics, such as wood, shell fragments, or biological activity.

The maximum depth of evidence of biological activity will be noted at each sample location. After the sample is thoroughly mixed, the required amounts will be transferred to the appropriate sampling containers. Worksheets #19 and #30 in the UFP-QAPP list the analysis to be performed (see solid matrix), sample preservation appropriate to the analytical method, the analytical extraction and holding time, and the type and volume of containers required per sample/analysis. After thoroughly wiping down the sample container threads, the container lid will be sealed, wrapped in bubble wrap, and the wrapped container sealed in a plastic bag, then stored on ice in a sample cooler. This will prevent leakage and potential cross-contamination.

### **4.2.3 Subsurface Sediment Sampling**

Subsurface sediment core samples will be collected at 181 selected locations as shown in Figure 4-4. These locations were identified using a 150-ft grid based on core density for PHSS RDs (EPA, 2021), RM 9W, Willamette Cover, and effective spacing in Terminal 4. The grid is shown on Figure 4-2. Collection of sediment cores and the various drilling methods that can be used for their collection are discussed below.

Proposed subsurface core location identifications (IDs), proposed grid cell IDs, mudline elevations, core depths, and target sample intervals for the cells are presented in Table 4-3. Core location and sample IDs will correspond with the surface sediment station ID; therefore, the core station IDs will not be numerically sequential.

#### **4.2.3.1 Sediment Core Collection**

Subsurface sediment core samples will be collected with a target penetration depth of 10 ft below mud line. Total core tube length is 15 ft. Subsurface samples will be collected at 1-ft intervals from each core. Ten of the core locations will be collected with a target penetration depth of 20 ft using 20-ft core tube lengths to help constrain depth of RAL and PTW exceedances. These ten deeper core samples will be collected from grid cells N0, J8, E18, C19, E20, E22, E27, E33, D35, and F35. Two cores, collected from grid cells H0 and I0, will be archived and analyzed depending on any identified RAL and PTW threshold exceedances in neighboring cells H1 and I1.

Analyses will be performed on the 1-ft sample intervals from 1 ft below mud line to 6 ft below mud line. Sample intervals below 6 ft depths will be frozen and archived for possible future analyses. Analysis of archived subsurface sediment will most likely be triggered by the need to constrain the depth of contamination with two consecutive 1-ft intervals below the deepest CUL exceedance after the first phase of sample results are received. It may not be necessary to perform analysis on every core to constrain depth of contamination, and EPA will be consulted on any reductions to the analysis of archived samples. Additional archived material may be analyzed as necessary, and in consultation with EPA, as needed, to support RD. For example, an anonymously high COC result may warrant analysis of nearby (horizontally and vertically) archived material.

Table 4-3 presents the location, sample IDs, core depths, and analyses for these samples. Subsurface core sample collection will be performed as described in SOP 403.07 (Appendix A). In general, coring will follow these steps:

- Core tube caps will be removed immediately prior to placement into coring device to minimize potential core contamination.
- Position will be recorded when the vibracore first rests on the sediment surface.
- The vibracore will be advanced without power (under its own weight), then vibration will be applied until the core tube is advanced to the target depth (10 or 20 ft) or refusal.
- After a brief pause, the core tube will be extracted from the sediment using only the minimum vibratory power needed for extraction.
- As soon as the core tube daylight to the surface water/air interface, a bottom cap will be placed over the tube to prevent material loss out of the core catcher.
- The exterior side walls of core tube will be inspected for signs of potential nonaqueous phase liquid (NAPL) and scrapes/scoring of the tube walls from contact with dense gravel/debris. If NAPL is suspected, then the field staff will take appropriate field precautions, as described in SOP A-1 Hydrocarbon Field Screening (Appendix A).
- The following core collection data will be recorded in the core collection log that can be found in Appendix B.
  - Date/Time. Local date and time of initial use of the vibracore at each station.
  - Depth to Mudline. Water depth at the sampling station at the time of core collection.
  - Total Drive Length. Core tube length and depth of the core tube penetration into the subsurface.
  - Recovered Length. Thickness of the sediment column retained in the core tube prior to sectioning and removal of the core catcher.
  - Sediment Observation. Grain size, color, notable odors, debris, etc. observed at each of the cut ends of the core section.
- Samples designated for freezing and archiving at the analytical laboratory will be documented as appropriate on the CoC, in accordance with the UFP-QAPP.

#### *4.2.3.1.1 Core Acceptance Criteria and Contingency Plans*

Core will be accepted, rejected, or stored on the vessel pending another drive attempt. Each subsurface sediment core will be retrieved on deck and accepted if each of the following acceptance criterion is met:

- Overlying water is present and the surface is intact.
- Core has 80% recovery versus penetration, which is consistent with other sites in Portland Harbor.
- Core tube is in good condition (not excessively bent).
- Minimum penetration depth has been achieved (within +/- 2 ft of target).

Note that the field staff will achieve 80% sample recovery using various methodologies. Sample attempts will be made within the 25-ft radius tolerance. For deviations outside the 25-ft tolerance,

EPA will be notified by a method accessible to the field crew while on site (e.g., mobile phone followed up with an email). If EPA is not available, field sampling will proceed and deviations from the FSP will be documented in the field logbook. If the target 80% recovery is not achieved after three attempts, the SIB RD Group's representative will contact EPA to discuss the potential deviations prior to abandoning the location. These potential deviations may include relocating to an alternative station or potentially processing a core with a lower sample recovery percentage. The cores from each attempt will be retained until an acceptable core (as defined above) is acquired. If an acceptable core is not obtained, then the best of three attempts will be retained and processed. If recovery is poor in the three attempts (<60% recovery) then the FTL will decide and document if additional cores should be attempted and location adjusted further from the target location.

After core acceptance, water will be carefully decanted from the top of the core tube to minimize sediment disturbance. Cores will be cut horizontally into segments (approximately 4 ft long) for handling, storage, and transport. Core tubes will be capped with aluminum foil and plastic caps, scribed on the sidewalls with core and segment ID (A, B, C, etc.) and "up" arrow, stored upright with ice, then transferred upright from the sampling vessel to the processing facility, and processed immediately. Alternatively, the liner may be extracted from the entire core tube or tube segments for handling, storage, and transport directly following core collection.

During the subsurface sediment coring efforts, the field staff may encounter field conditions that preclude collection of acceptable cores at the planned location (e.g., limited access, poor recovery, safety concerns, debris/rock/bedrock causing refusal).

EPA will be kept informed of issues associated with sample recovery during the field investigation. Approximately 1,000 grams (g), wet weight, or 1 L of sediments are required for the COC analyte list. Additional material may be required at a particular location for field and laboratory quality assurance (QA)/QC. If the recovered volume of sediments at a particular depth interval is insufficient for the analytes, an additional core will be advanced within 10 ft of the location of the original core and an additional sample will be collected at the same depth.

#### *4.2.3.1.2 Core Processing and Subsurface Sample Collection*

Core logging and processing are anticipated to occur concurrently with sample collection either on the sampling vessel or at an onshore facility. Cores will be offloaded after core collection, midday and/or end of day, with every effort made for immediate processing. The processing facility will be equipped with a core extraction trays, tables, core processing area, decontamination area, and sample storage area.

Each core tube will be fixed in place and cut along the long axis using a circular saw. The tube is rotated 180-degrees and cut again. After each core is cut, the core tube will be moved to a sampling tray and opened. Alternatively, the liner may be extracted from the core tube without cutting to a sampling tray. The liner will be cut longitudinally with a decontaminated knife with a stainless-steel blade. Each sediment core will be measured for percent recovery, systematically logged and described in the field logbook and photographed prior to sampling as discussed below. See SOP A-3 Sampling Photography for further information on sampling photography.

After the core is exposed, a mini-RAE 3000 photoionization detector (PID) with 10.6 electron-volt lamp will be used for prescreening of each core. The PID monitor will be slowly moved down the core from top to bottom just above the core. PID readings will be recorded in the field logbook. If there is an elevated PID reading or if sheens/petroleum-like odors are suspected, then a headspace screening will be conducted following headspace field screening procedures described in SOP A-2 PID Screening and Calibration Procedures (Appendix A).

A qualified geologist will describe the sediment on a core log following the ASTM D2488 visual soil classification procedure in HGL SOP 403.07 (ASTM, 2017; Appendix A). The following information will be recorded for each core:

- Soil or formation name/Unified Soil Classification System (USCS) symbol;
- Gradation degree of sorting;
- Principal constituent;
- Specific descriptors for principal constituents (e.g., plasticity, grain size, and shape);
- Firmness/hardness;
- Minor constituents;
- Moisture content;
- Color;
- Particle morphology; and
- Other descriptors (such as, visual evidence of contamination, specific monitoring equipment readings including PID/organic vapor analyzer readings, visual stratification and lenses, vegetation, debris, and evidence of biological activity).

The representative sediment sample interval (e.g., 1 ft for dredging) will be collected and placed into a decontaminated stainless-steel bowl. Sediment from each subsample will be individually mixed in the decontaminated, stainless-steel bowl to a uniform color and texture using a decontaminated, stainless-steel spoon. If an aluminum core barrel is used, care will be taken to not include sediment that is in direct contact with the core tube. In addition, core tube cutting can introduce shavings to the core sediment; care will be taken to avoid mixing these shavings into the homogenate. The sediments will be stirred periodically while individual samples are taken to ensure that the mixture remains homogeneous. Pre-labeled jars for chemical testing will be filled with the homogenized sediment. The analysis to be completed on the samples is summarized in Worksheet 19 and 30 of the UFP-QAPP (see solid matrix). Collected samples will be placed in laboratory provided glass jars and stored in a cooler at 0 to 6°C until transport to the laboratory. See Section 4.9 for decontamination procedures. Adequate volumes of sediments will be collected for the required analyses.

#### **4.2.3.2 Direct-Push Sampling**

Given the potential sediment investigation time frame based on the AOC schedule, work is anticipated to occur in summer 2022. It is anticipated that water levels in the Willamette River will be relatively low and that access to Shallow Region sample stations may not be achievable by boat

or barge. To collect sediment cores from the Shallow Region, a direct-push drill rig may be deployed to the sample station from land or a shallow draft vessel with landing hatch, whichever allows for easiest and safest access (SOP 403.04). The direct-push drilling equipment will be small, maneuverable, and track mounted to facilitate access to soft, wet, and potentially uneven shoreline areas. Direct-push borings reach target depth of 10 ft using successive 4-ft long core tubes, and the acceptance criteria listed in Section 4.2.3.1.1. Each 4-ft-long tube will have a 3.25-inch outer diameter steel sample barrel lined with clear acrylic sleeves. To minimize sediment disturbance, borings will be advanced through a temporary polyvinyl chloride (PVC) casing. Once the sampler is retrieved (either to the sampling vessel or to land), the acrylic sleeve will be removed for sampling processing in accordance with Section 4.2.3.1.2.

#### **4.2.3.3 Vibracore Sampling**

For the in-water portions of the sampling area, cores will be targeted for collection using a customized vibracore deployed from the sampling vessel operated by the marine subcontractor (Section 4.2.1). The vibracore is a wireline-suspended hydraulic system that vibrates and drives a 15-ft long, 4-inch outer diameter aluminum core tube into the sediments. A continuous sediment sample is retained within the tube with the aid of a stainless-steel retainer at the bottom of each aluminum tube. A core liner may be used with this device. Following positioning at a given sampling station, the vibracore will be deployed off the foredeck of the vessel and slowly lowered to the sediment surface. The core tube will be advanced to obtain adequate core penetration (target sample depth). The core penetration depth will be estimated by means of a pressure transducer attached to the top of the core barrel. The vibracore may not be effective if gravels and cobbles are encountered. If refusal is met after three attempts, the station will be abandoned and more robust methods, such as sonic drilling, will be evaluated for the PDI.

#### **4.2.3.4 Hand Auger Sampling**

If needed, due to access limitations, subsurface sediments at Shallow Region sampling stations exposed during low water will be collected by field staff using a stainless-steel hand auger (SOP 403.02). These hand borings will be advanced through a temporary PVC casing to keep the borehole open. The hand borings will be advanced until refusal is met, likely within the upper 4 ft below mud line. Grab samples will be removed from the hand auger barrel and processed in accordance with Section 4.2.2.1. The temporary PVC casing will be removed upon completion of the hand boring.

#### **4.2.4 Sediment Erodibility (SedFlume) Sample Collection**

The sediment bed within the SIB contains both cohesive and non-cohesive sediments. Erosion and settling of non-cohesive sediments (sand and gravel), in general, can be estimated from grain size distribution and sediment density. However, for cohesive sediments that are a mixture of sand, silt, and clay sized particles, the sediment transport processes can be dominated by other factors such as particle size distribution, particle coatings, fine sediment mineralogy, organic content, bulk density, gas content, pore-water chemistry, and biological activity (USACE, 2014).

The influence of cohesion on sediment processes is significant as the critical shear stress and erosion rates for cohesive sediments can vary over several orders of magnitude for sediments with

only slightly differing properties. Due to lack of quantitative methods available to determine erosion rate from cohesive sediment properties and the sensitivity and wide range of influencing parameters, erosion characteristics of cohesive sediments will be analyzed using sediment core sampling, and site-specific erosion analysis using erosion flumes (USACE, 2014).

The SedFlume sampling program was designed based on review of previous sampling that was performed in Portland Harbor (Sea Engineering, Inc., 2006). The previous programs included two samples in the SIB: one sample near the SIB entrance and one sample in the SIB central interior. Analysis of those testing results indicates significant differences in sediment erodibility properties, including erosion rates and fines content. Therefore, a robust sampling program was determined to be warranted to capture these significant differences in sediment erodibility.

Sediment cores to be used in SedFlume analysis will be collected at 30 prescribed locations within and adjacent to the SIB project area as shown in Figure 4-5 and listed in Table 4-4. At each sediment coring location, a GPS will be used to position the vessel at a fixed sampling station. A pole will be attached with clamps to the 10 cm by 15 cm rectangular core. A valve will be temporarily affixed to the top of the core tube to provide suction when the core is pulled out of the sediment bed. The core will then be lowered into the water and positioned perpendicular to the sediment bed. Pressure will be applied by hand until at least 30 cm and no more than 100 cm of the core has penetrated the sediment bed (Sea Engineering, Inc., 2006).

Upon penetration of the core barrel into the sediment bed, the valve will open upward and allow the sediment to enter the core tube and water to exit without disturbing the sediment surface or deeper strata. When the barrel is lifted from the sediment bed, the valve will close and retain the sediment inside the core tube. The core will be immediately inspected visually for length and quality. The cores will then be capped and immediately delivered upright at ambient temperature to the SedFlume laboratory for further analysis.

Field staff will accompany the driller and a SedFlume expert (both subcontractors) in the field to observe and document core extraction and preparation of the cores for shipping, as well as to confirm proper waste management.

#### **4.2.5 Dredge Elutriate Testing**

Three samples for dredge elutriate testing (DRET) shall be collected from grid cells F14, D5, and C20 to evaluate the potential for short term contaminant releases during dredging operations. These grid cells are all located within areas where dredging is the expected remedial technology and contain a wide variety of sediment contaminant concentrations based on historical data, which will inform water quality impacts from a wide range of dredge areas. See below for more information on DRET procedures and parameters. The samples will be collected in accordance with SOP 403.08 Sediment Sampling (Appendix A) and tested for all ROD Errata #2 Table 17 Surface Water COCs (Table 4-5). The results from DRET shall be evaluated against both chronic and acute water quality criteria as defined in Section 4.2.5.2, and used to support EPA's development of performance standards for use during dredging operations.

#### 4.2.5.1 **Bulk Sediment Sampling and Testing**

- Bulk sediment samples are required for disposal characterization and DRET for sediment treatability and handling properties. The analytical results will inform whether the dredged sediment is hazardous or nonhazardous for disposal purposes. Investigation-derived waste will be properly characterized and disposed of by NRC-US Ecology, which has been performing this task for other RD areas under agreement with Gravity Marine. The bulk sediment testing has been designed to inform and to fill the following data gaps: **Contaminant Release and Water QC During Dredging**. Elutriate water samples from bulk sediment will be analyzed by DRET to evaluate the potential for short-term releases during dredging operations. DRET procedures are described in *Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities – Testing Manual* (USACE, 2003). In addition to DRET, these elutriate water samples will also be analyzed for bulk chemistry and conventional parameters to inform compliance with applicable water quality permitting requirements during dredging.
- **Dredged Material Disposal Characterization**. Samples of the bulk sediment, as collected and after amendment, will be tested as specified in the Resource Conservation and Recovery Act by the toxicity characteristic leaching procedure and for ignitability, corrosivity, and listed waste to characterize dredged sediments for disposal. See Worksheet 15 of the UFP-QAPP for the required analytes. Samples will also be analyzed for bulk chemistry (see the waste soil matrix in Worksheets 19 and 30 of the UFP-QAPP) to inform compliance with potential disposal facility acceptance criteria. Collected samples will be placed in laboratory provided glass jars and stored in a cooler at 0 to 6°C until transport to the laboratory.

#### 4.2.5.2 **Dredge Elutriate Testing**

DRET will be completed on the three bulk samples per the procedures described in *Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities – Testing Manual* (USACE, 2003). Elutriates will be generated from initial slurry concentrations of 1 gram per liter (g/L) and 10 g/L. The elutriate (i.e., DRET bulk water samples) will be tested for bulk chemistry and conventional parameters, including the constituents listed in ROD Errata #2 Table 17 (EPA, 2020), to inform compliance with applicable water quality permitting requirements during dredging. Table 4-5 lists the constituents that will be analyzed in the elutriate and the associated surface water screening level. Screening levels are based on the EPA National Recommended Water Quality Criteria. For constituents where the water quality criteria do not have numerical values, screening levels were based on the following:

- Oregon Administrative Rule 340-041-8033 Table 30: Aquatic Life Water Quality Criteria for Toxic Pollutants; and
- Oak Ridge National Laboratory Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota (Suter and Tsao 1996).

### **4.2.5.3 Bulk Sediment and Surface Water Sampling**

A second vibracore will be collected at select locations to perform bulk sediment testing including waste characterization and DRET for stabilization and handling to support RD. Surface water samples for the DRET slurries will be collocated with the DRET sediment sampling locations. The surface water samples will be composited to provide a single bulk water sample for DRET slurry and treatability testing. Volumes required for DRET testing include two, 5-gallon containers and two, 5-L containers.

## **4.3 RIVERBANK CHARACTERIZATION**

This section describes riverbank material sample collection procedures. The riverbank characterization will be completed in two phases. The first phase will include a reconnaissance of the entire riverbank within the SIB Project Area and completion of a bank stability analysis using the Bank Assessment for Non-point Source Consequences of Sediment (BANCS) model including Bank Erosion Hazard Index and Near Bank Stress determinations to identify the erodibility of the riverbank. The first phase of the proposed riverbank characterization includes assembly of existing chemical, topographic and geomorphic data and visually inspecting the riverbank and material types to determine input parameters for the BANCS evaluation. The reconnaissance will occur at 126 transects between the top of the bank and the toe of the bank at mean lower low water along the SIB riverbank (Figure 4-6). The first phase reconnaissance would be performed when water levels are at their lowest in SIB (anticipated for late 2021 or early 2022). After this visual inspection, HGL will provide a riverbank sampling plan as a Field Sampling Plan Addendum with the data quality objectives and proposed sampling locations.

The field teams will carefully and completely document the as-sampled location information for incorporation into the project geographic information systems (GIS) database.

Because homeless people are present in the city's Swan Island boat ramp parking lot and the adjacent riverbank (i.e., head of SIB), an outreach strategy and protocol will be included as an appendix to the HASP.

### **4.3.1 Riverbank Data Characterization**

Characterization data was available for only three shoreline properties in the SIB Upland Area, including city property and public boat ramp at the end of SIB, and two former operable units of the SUIF (Portland Shipyard and Port property on N Lagoon Avenue). The historical riverbank sample results for these three sites were evaluated in Section 6 and Appendix E of the draft Sufficiency Assessment Report (HGL, 2021). ROD CULs for riverbank soil and in-water sediment and PCB RAL exceedances were identified. Detected concentrations of metals, PCBs, and PAHs exceeded the ROD CULs at the Portland Shipyard, and PCBs exceeded the RAL and PTW threshold. Because the lateral extents of the exceedances were not defined and/or all ROD COCs were not analyzed, these conditions were identified as data gaps for the PDI and additional characterization proposed.

The objective of this task is to continue evaluating the existing physical and chemical data available along the riverbanks in the SIB Project Area (see Figure 4-6) and review findings of the

Sufficiency Assessment Report regarding the riverbanks and adjacent uplands. These findings will be used to inform additional riverbank shoreline inspection and chemical characterization (i.e., riverbank reconnaissance) of the SIB Project Area shoreline properties as described in Section 5.3. Evaluation of existing SIB riverbank data/information will include a review of available site plans, topographic maps, aerial photographs, LiDAR maps, geologic maps, riverbank and near shore soil and sediment sampling data, boring logs, geotechnical reports, and other reports previously submitted to EPA or the Oregon Department of Environmental Quality (ODEQ) with respect to ROD riverbanks or riverbank Environmental Cleanup Site Information (ECSI) sites.

#### **4.3.2 Riverbank Physical Inspection and Erodibility Evaluation**

The purpose of conducting riverbank reconnaissance is to evaluate physical riverbank/shoreline conditions, per the *Guidance for River Bank Characterization and Evaluations at the Portland Harbor Superfund Site* (EPA, 2019b), and as summarized in the PDI Work Plan, including:

- extent and type/size of river armoring (percentage of bank covered by each type of armor);
- general condition of armoring (i.e., whether the material is stable, unstable, or sloughing into the river);
- observation of previous riverbank source control measures for integrity in providing protection against erosion, visual classification of unarmored riverbank soil types following ASTM D2488 (ASTM, 2017), and the USCS visual soil classification procedures;
- visual observations, topographic measurements, and photographs to document the physical characteristics of the riverbank;
- evidence of shoreline erosion and/or instability due to overland flow, wave and/or vessel wake, or other factors;
- location of armoring relative to the toe of the slope, top of the bank, and ordinary high-water elevation;
- presence of vegetation including vegetation type, rooting depth and density, and the percentage of the riverbank surface that is covered by vegetation; and
- presence of aquatic vegetation.

During the site reconnaissance, erosional scours, scarps, slumps, and landslides on the riverbanks, if present, will be mapped and recorded with a hand-held GPS unit as a location of current and/or future erosion potential of soil to the river. Characterization will extend from the top of the riverbank to the mean low water, or the lowest elevation visible at the time of inspection.

The field team will collect the following riverbank physical and material characteristics to support a quantitative evaluation, if needed:

- Height of the bank: Riverbank height is measured from the top of the bank, defined as the point where the slope of the land surface changes from toward the river to toward the

uplands, to the toe of the slope, defined as the first significant break in slope that is below ordinary high water (OHW) but above mean high water. Bank height can be difficult to determine in the field and should be measured using survey methods. Bank height may instead be determined from topographic and bathymetric maps.

- **Bankfull level:** Bankfull level is the point on the riverbank that contains normal, non-flood-level flows of the river throughout the year and is typically identifiable by visible changes in topography, vegetation type, or sediment grain size (EPA, 2019b). For the Willamette River, the bankfull level is approximated by the OHW elevation, which is equivalent to 20.08 ft North American Vertical Datum of 1988 (NAVD88) (USACE, 2014).
- **Bank angle:** The maximum bank angle between the toe of the slope and the top of the bank will be determined from topographic or bathymetric maps or measured in the field using a clinometer or other suitable direct field measurement technique.
- **Surface protection:** Surface protection is the amount of the riverbank that is covered and protected by woody debris, rooted vegetation, embedded boulders, revetment, bedrock, or other embedded materials that protect the bank from erosion (EPA, 2019b). Riverbank surface protection will be assessed in the field and visual observations recorded, including:
  - o Type and size of protection, the location relative to the toe of the slope, top of the bank, and OHW elevation.
  - o Percent of the riverbank surface protected and general condition of protection if the protection is afforded by armoring.
  - o General condition of the armoring, including whether the material is stable, unstable, or sloughing into the river. If the riverbank is vegetated, the general vegetation type and the percentage of the riverbank surface that is covered by vegetation will be documented. The vegetation types will be used to infer rooting depth and density.
  - o Bank composition, which is the soil type(s) that comprise the riverbank.

Field classifications will be performed using the procedures described in ASTM Standard D2488, Standard Practice for Description and Identification of Soils (ASTM, 2017). Riverbank samples may be collected for sieve analysis to supplement visual classification and verify grain-size distribution.

During this inspection, a Physical Shoreline Inspection Form will be completed to document the conditions observed. This will be done for each tenth of an RM throughout the SIB Project Area. This field form is included in Appendix B and was developed to allow field personnel to collect the relevant information detailed in the *Guidance for River Bank Characterizations and Evaluations at the Portland Harbor Superfund Site* (EPA, 2019a). Additional relevant field forms for Bank Erosion Hazard Index (Rosgen, 2014), Structural Inspection, and Near Bank Stress Risk are also available in Appendix B. Photographs will be taken to document areas of interest, including areas of visible erosion, armoring, permanent structures, and vegetation. The areas of interest will also be documented using a handheld GPS unit (e.g., Trimble Geo 7x), providing the ability to map these features for use in the PDI Evaluation Report. A GPS unit will provide

approximate +/- 1 meter accuracy with daily check-in to known benchmarks. Tolerance to known benchmark check-ins shall be no greater than 5 meters, with typical performance expected to be within 2 to 5 meters.

### **4.3.3 Riverbank Soil Characterization**

The SIB riverbanks will be accessed by field staff via upland areas or by boat where upland access is restricted. Most areas are accessible through the facility properties and field staff will follow the sign-in/sign-out protocols for the respective facilities. A total of 126 transects (1 per every 100-lineal-ft) are targeted for visual inspection and possible sample collection at the top, face, and toe of the bank (mean lower low water) at low water levels using manual and hand auguring field techniques. If the 126 transects can be sampled successfully to the planned depth of 3 ft, 126 surface soil samples and 126 subsurface soil samples will be collected at the top, face, and toe of each transect along the bank. Pursuant to EPA's recommendation in its September 24, 2021, comments on the Draft FSP, the sampling plan for the head of the lagoon will differ from that along the rest of the SIB because of the homogeneous nature of this area (i.e., sandy beach and riverbank consisting of dredge material). Incremental sampling methodology will be applied to this 700-ft wide area (ITRC, 2020), including the collection of 30 aliquots of soil from two decision units, surface and subsurface soil, per the 0.29-acre area. Locations will be selected using a random number method and overlaid on a proposed sample location plan.

Before collecting soil samples, a clean plastic-covered workspace will be established on the ground surface. Sample bottles will remain covered in plastic bags inside the plastic-lined ice chests until ready to be filled. Shallow soil borings will be advanced, via hand auger, to a depth of 3 ft vertically below ground surface into the bank, perpendicular to the ground surface, and samples will be collected continuously on 1-ft (~30-cm) sampling intervals (SOP 403.02). Surface soil samples will be collected using decontaminated (or single use) hand tools (SOP 403.06). The top layer of vegetation and gravel, if any, will be temporarily moved in an area at least 6 inches in diameter.

Soil samples will be visually characterized for sediment type, color, moisture content, texture, grain size and shape, sheen/odor, consistency, visible evidence of staining, and other observations. Samples will be visually described following USCS-based, visual-manual ID in accordance with the ASTM D2488 standard practice (ASTM, 2017). A logging key of the visual classification method is provided in Attachments 1 through 5 of SOP 403.07. The colors will be designated using a Munsell color chart. This information will be recorded on the Borehole Log Field Form (SOP 403.07).

Olfactory observations (odors) or positive responses to an organic vapor detector will be recorded on the soil boring log. Examples of odors may include, but are not limited to, sulfur/sulfide, petroleum, and fuel-type odors. If potential sheen or NAPL is observed, descriptions detailed in SOP A-1 Hydrocarbon Field Screening must be used to record field observations (Appendix A). The depth where signs of NAPL begin and end (including olfactory, visual, and MultiRAE/PID observations) will be noted in the boring log.

The samples will be analyzed for the solid (chemical analysis only) parameters listed in Worksheets 19 and 30 of the UFP-QAPP. Collected samples will be placed in laboratory provided glass jars and stored in a cooler at 0 to 6°C until transport to the laboratory. Hand augers will be

decontaminated between sampling intervals. Upon completion of sampling at each boring location, the hole will be backfilled with native material and topsoil, vegetation, or armoring will be replaced to the extent possible. If refusal is met, sample locations will be relocated. Up to three attempts will be made to relocate soil borings. Coordinates for every sampling station where a sample is collected will be read on a handheld GPS and recorded in the field notes or tablet.

#### **4.4 GEOTECHNICAL INVESTIGATION**

The following section describes the procedures and sample processing techniques for the collection of geotechnical information in the SIB Project Area. Boring and cone penetration test (CPT) locations are shown on Figure 4-7 and listed in Table 4-6. Analytical methods are summarized in Table 4-1.

##### **4.4.1 Investigation Location and Utility Clearance**

A site reconnaissance will be performed to identify and review site health and safety issues, locate proposed exploration locations, and identify other logistical issues in accordance with Section 4.1.

##### **4.4.2 Exploratory Borings**

Exploratory borings are planned both within the SIB (in water), and on the surrounding wharf structures and bank (on land). A licensed drilling subcontractor will provide drilling services. On-land borings will be advanced with a truck or track-mounted drill rig equipped with rotary wash and/or auger drill tooling. In-water borings will be drilled from a dedicated drill ship equipped with a rotary wash drill rig, a central moon-pool, and hydrostatically controlled spuds capable of holding the vessel in water depths of up to 55 ft.

Existing semi-empirical correlations will be used to estimate geotechnical parameters from the CPT sampling results (cone tip resistance,  $q_c$ , and “sleeve friction”,  $f_s$ ) including but not limited to over consolidation ratio, undrained shear strength, relative density, one dimensional compressibility, and Young’s and shear moduli.

Both on-land and in-water borings will be initially identified in the field with a hand-held GPS device, and in-water will be advanced to a termination depth of approximately 50 ft below the mudline. Prior to drilling, a weighted line will be used to determine the depth of the mudline relative to the deck of the drill ship. Following drilling, the mudline elevation will be estimated based on bathymetric survey data, GPS location data, and the water level at the time of drilling. Final “as-built” boring locations will be identified using real-time kinematic positioning observations with a horizontal precision of less than or equal to 0.03 ft, and a vertical precision of less than or equal to 0.05 ft. Horizontal positions of the as-built boring locations will be recorded in the North American Datum 1983 (NAD83), Oregon North coordinate system (international ft).

Standard penetration tests will be conducted in accordance with ASTM D1586 (ASTM, 2018), with consideration given to ASTM 1587 and 3550. Standard penetration test blow counts will be logged in accordance with ASTM D1586. Standard penetration test, thick-wall ring lined, and thin-walled samplers will be used to obtain soil samples at selected intervals at 2 to 3 ft in the upper 15 ft and at 5-ft intervals thereafter. For efficiency in the deeper borings, the sampling interval may

be extended in the field depending on the expected stratigraphy and data needs; however, sampling will be focused on the areas of interest for analysis of the relevant structure or project component. Estimates of the undrained shear strength of cohesive soils will be made using a hand-held pocket penetrometer or torvane shear device, as appropriate.

In general, on-land borings will be advanced to a termination depth of roughly 60 ft below adjacent ground, and in-water borings will be advanced to a termination depth of approximately 50 ft below the mudline. Drilling and sampling equipment will be decontaminated before beginning each new boring as described in SOP 411.02 (Appendix A). Drilling spoils and excess fluids will be containerized and stored on site for testing and disposal. Testing and disposal of investigation derived waste is described in Appendix C.

Borings will be logged by a field engineer or geologist who will package samples and transport them to the laboratory for further evaluation and testing. Logging will be performed in accordance with the geotechnical soil logging SOP R-4 (Appendix A) and recorded on forms within SOP R-4. Observations the field logger will document include but are not limited to:

- Borehole diameter;
- Variation in drilling conditions throughout boring depth;
- Drill cuttings;
- Drill crew drilling observations;
- Variation in samples or cuttings with depth;
- Moisture content (dry, moist, wet) will be noted where possible since drilling fluid may affect observed moisture content;
- Sample type, diameter, depth interval, pressure, and recovery percentage; and
- Soil classification in general accordance with ASTM D2488 (ASTM, 2017).

Soil samples obtained from the borings will be packaged and sealed in the field to reduce moisture loss and disturbance, then transported in general accordance with ASTM D4220 (ASTM, 2014).

#### **4.4.3 Cone Penetration Testing**

Both on-land and in-water CPTs will be conducted by hydraulically pushing an instrumented steel cone into the ground in general accordance with ASTM D5778 (ASTM, 2020). On-land CPTs will be performed with a 25-ton CPT truck rig and in-water CPTs will be performed from the same dedicated drill ship used to perform the rotary drilling and soil sampling. The instrumented cone assembly includes a cone tip with a 60-degree apex and a cone base area of 15 square cm, a friction sleeve segment with a surface area of 225 square cm, a pore pressure transducer mounted near the base (shoulder) of the cone tip, and geophone sensors located just above the friction sleeve. Downhole shear wave velocity measurements will be performed at select CPT locations, at approximately 3-ft intervals, for the full depth of the sounding. Pore-water pressure dissipation tests to evaluate static piezometric pressure will be performed at both on-land and in-water CPT locations.

Both on-land and in-water CPT locations will be initially identified in the field with a hand-held GPS device. Final “as-built” CPT locations will be identified using real-time kinematic positioning observations with a horizontal precision of less than or equal to 0.03 ft, and a vertical precision of less than or equal to 0.05 ft. Horizontal positions of the as-built CPT locations will be recorded in NAD83, Oregon North coordinate system (international ft).

In general, both on-land and in-water CPTs will be advanced to a termination depth of approximately 100 ft, or practical refusal, whichever occurs first. CPT tooling will be decontaminated before beginning each new boring as described in Section 4.9.

#### **4.4.4 Boring and Cone Penetration Test Abandonment**

At the completion of the drilling, borings will be abandoned in accordance with Oregon Water Resources Department requirements (Oregon Administrative Rules 690-240-0005), which involve filling the hole by tremie with bentonite grout slurry to prevent vertical migration of groundwater. The driller will certify the proper abandonment by filing a Geotechnical Hole Report with the Oregon Water Resources Department.

#### **4.5 STORMWATER AND STORMWATER SOLIDS SAMPLING**

Current stormwater and stormwater solids concentrations are needed to help determine ongoing ROD Table 17 COC concentrations and loads to the SIB sediments. Samples will be collected from five city of Portland outfall basins (M-1, M-2, M-3, S-1 and S-2) as well as select private outfall basins along the shoreline of the SIB (Table 4-7 and Figure 4-8). Equipment will be placed at elevations sufficient to minimize the potential for river water to backflow to the sample locations and compromise flow data quality, the integrity of the sediment traps, and collection of stormwater samples representative of discharges in upland outfall basins.

Techniques for obtaining stormwater samples from city conveyance systems include using a high-volume sampling (HVS) system to collect and process each sample set (Gravity Marine PR2900). The system consists of a high-volume peristaltic pump or submersible pump, depending on the depth of the water in the manholes, and a series of filters to capture the particulate phase and a resin column to capture the dissolved fraction of focused ROD COCs. Stormwater collected via the high-volume pump will be run through an HVS system to separate stormwater and stormwater solids for separate phase (dissolved and particulate) analyses. This method is used to collect samples for analysis of hydrophobic organic compounds (dioxins/furans, PCBs, and pesticides) by ultra-low detection limit analytical methods. Analysis of stormwater samples collected via the HVS method is more likely to detect lower concentrations of focused COCs resulting in method detection limits that are at or below the CULs in ROD Errata #2 Table 17 (EPA, 2020). This method also allows for quantification of hydrophobic organic chemicals in the suspended particle and dissolved phases of the water column. EPA has approved the Gravity Marine PR2900 sampling system for the collection of representative surface water and stormwater samples in the PHSS (AECOM Technical Services [AECOM] and Geosyntec Consultants, Inc. [Geosyntec], 2018; and Foth Infrastructure & Environment, LLC, 2021). In addition to the samples collected by the HVS system, physical field measurements and a separate whole water sample will be collected using a separate pump and carboy.

Stormwater sampling criteria will be consistent with the criteria in Appendix D of the 2005 ODEQ and EPA Joint Source Control Strategy (JSCS) guidance:

- An antecedent dry period of at least 24 hours (as defined by less than 0.1 inch of precipitation over the previous 24 hours)
- A minimum predicted rainfall volume of greater than 0.2 inch per event
- An expected storm duration of at least 3 hours.

The storm will be tracked via the NOAA, National Weather Service, local media outlets, and the Windy forecast at [www.windy.com](http://www.windy.com) to anticipate the length of the storm event and to determine if the storm event will meet the Portland Harbor JSCS storm event criteria.

Because homeless people are present in the city's Swan Island boat ramp parking lot where manhole AAQ-004 (M-3 outfall basin) is located (i.e., head of SIB), an outreach strategy and protocol will be included as an appendix to the HASP.

In addition to collecting stormwater solids via the HVS method, stormwater solids will be collected by 1) manual grab sampling from public manhole sumps and adjacent laterals in the conveyance systems prior to installation of sediment traps; and 2) time-integrated, in-line, sediment traps within the public conveyance system.

Pulsar Measurement Greyline Stingray 2.0 level-velocity loggers will also be incorporated into the stormwater sampling program in the city outfall basins to continuously measure water levels and velocities over a 9-month period.

Because of the smaller size of the private outfall conveyance systems along the SIB shoreline, HGL proposes to equip the conveyance systems with Teledyne ISCO<sup>®</sup> portable autosamplers (6712C with flow sensors) to collect time-weighted, composite, stormwater samples, and flow measurements at elevations unlikely to be affected by backflow of river water during storm events during the same or similar storm events as the HVS samples. Manual grab samples of stormwater solids, if present, will also be collected in the private conveyance systems before deployment of the portable samplers.

HGL proposes to monitor portions of the private systems with the largest drainage basins, and that are most ROD COCs in direct discharges to SIB. These systems are associated with the following properties as shown on Figure 4-8: U.S. Coast Guard Marine Safety Unit Portland, ATC Leasing Co., Barge Eagle, Inc./Swan Island Boast Company, North Basin Watumull, DTNA Corp 5 Wind Tunnel, and the Port of Portland's North Lagoon Avenue property. HGL proposes to instrument conveyance systems to the outfalls with autosamplers with flow meters and possibly in-line solids traps (depending on access) and collect stormwater and solids samples during rain events meeting the ODEQ-EPA JSCS criteria, as described above. The exact sampling locations in the private conveyance systems will be identified after site access agreements have been negotiated and site inspections have been performed, and a list of them will be submitted to EPA for approval prior to equipment deployment and monitoring.

Solids will be visually described following ASTM D2488 (ASTM, 2017) and the USCS visual soil classification procedures.

The types of samples that will be collected at each of the proposed sample locations are shown on Figure 4-8.

#### **4.5.1 HVS Sampling Methodology for City Outfall Basins**

Stormwater and stormwater solids will be collected during three storm events that meet the JSCS criteria. Time-weighted samples will be collected by pumping large quantities of stormwater from city manholes with a high-volume peristaltic or submersible pump, depending on water depth, and processing the water through an HVS system. This work is proposed to be conducted by Gravity Marine with HGL oversight. High-volume water samples will be collected to quantify concentrations of targeted organic chemicals (e.g., dioxins/furans, PCBs, and pesticides) that could be present at levels too low to be detected using conventional sampling methods. This method also allows for quantification of hydrophobic organic chemicals in the suspended particle and dissolved phases of the water column. Stormwater and stormwater solids collection will be performed in accordance with SOP A-5 Gravity Marine HVS Sampling (Appendix A). A Pulsar Measurement Greyline Stingray 2.0 flow sensors will also be incorporated into the HVS stormwater program to continuously measure flow and volume during each HVS storm event and during an approximate 9-month period to measure seasonal flow trends.

Stormwater samples to be analyzed for ultra-low concentrations of organic compounds will be collected using a high-volume peristaltic pump (with no screen) with both platinum silicone tubing and extended Teflon™-lined polypropylene sample tubing lowered to the desired depth within the conveyance system. This sampling method is required to achieve the very low ROD focused COC CUL, which are below standard method reporting limits, for PCBs, dioxins/furans, and organochlorine pesticides (OCPs). Water pumped at a rate of up to 1.5 liters per minute (L/min) will be drawn through Teflon™ tubing and through each filter set. The pump rate will be managed to collect a minimum of 200 L over each storm event which typically last 4 to 6 hours. The HVS system can be paused if the stormwater flow temporarily subsides due to fluctuating precipitation rates. The rate of water pumped through the HVS will be checked at 15-minute intervals to ensure that water is flowing at a constant rate using a 1-L graduated cylinder and a timer. If the pump is not delivering the correct flow rate, fine adjustments will be made until the optimum flow is achieved. If a submersible pump is required because of the water depth in the manholes, the water will be pumped through Teflon coated tubing going to an intermediate 8-gallon carboy first, and then through the same type of tubing from the carboys to the HVS pump and standard peristaltic pump. The pumps will be turned on/off to maintain the level in the carboys at approximately 80% capacity without overflowing.

Within the HVS system, the stormwater will pass sequentially through a high vortex separator, a 0.45-micron glass fiber filter (142 millimeter [mm]), and a polyurethane foam (PUF) cartridge. The high vortex separator can separate suspended sediments by forcing the water in a centrifugal fashion. Solids collected from the vortex separator and 0.45-micron glass fiber filter will be combined, homogenized, and placed into appropriate sample containers for analysis. A list of required sample containers and preservatives can be found in Worksheets #19 and #30 of the UFP-QAPP. The compounds that bind to the adsorbent PUF material will be extracted and measured on

a gas chromatograph/mass spectrometer at the selected laboratory (SGS North America, Inc. [SGS]). Samples will be stored in a cooler at 0 to 6°C and sent to SGS for analysis.

Physical field measurements and a separate whole water sample will be collected in tandem with the HVS system sampling by connecting a second Teflon™-lined polypropylene tube to a second peristaltic pump, tubing set, and carboy with mixing chamber. This pump will have a flow-through chamber with a YSI Exo multi-meter installed for continuous measurement of dissolved oxygen, pH, turbidity, and temperature. A subset of stormwater collected in the carboy will be placed into appropriate sample containers for total suspended solids (TSS) and total organic carbon analysis. Required sample containers can be found in Worksheets #19 and #30 of the UFP-QAPP. Those sample bottles and the full volume of the carboy will then be stored in a cooler at 0 to 6 °C and transported to the selected laboratory for processing and analysis. The whole water sample will be analyzed for ROD Table 17 COCs, except the PCBs, OCPs, and dioxins and furans. If there is a sufficient volume of stormwater solids available in the carboy after the removal of the whole water sample, those solids will be separated by centrifuge in the laboratory and analyzed for ROD Table 17 COCs, except the PCBs, OCPs, and dioxins and furans.

## **4.5.2 Calculating Dissolved, Particulate, and Total Fractions from HVS Samples**

### **4.5.2.1 Particulate Phase**

Stormwater samples will be collected using the PR2900 HVS connected to a vortex solids separation system and a 0.45-micron glass filter. The high vortex separator captures suspended sediments by forcing the water in a centrifugal fashion before exiting toward the 0.45-micron glass filter and then the PUF cartridge. The solids captured in the vortex separation system and the solids on the glass filters will be placed in one sample container and shipped to the selected laboratory. The combined solids sample is referred to as the “Front Half” of the HVS system and will be analyzed by the selected laboratory to represent the total particulate phase fraction of ROD focused COCs collected throughout the storm. The concentration data from the particulate fraction will be used to 1) mathematically calculate the particulate phase portion of the whole water concentration (see Section 4.5.2.1.2), and 2) mathematically calculate the particulate concentration in units of solids, for comparison to the PHSS sediment CULs (see Section 4.5.2.1.3).

To support the second calculation, TSS will be measured by ALS Global from a sample collected from the carboy via a second peristaltic pump (SOP A-5 Gravity Marine HVS Sampling, Appendix A).

#### *4.5.2.1.1 Dissolved Phase*

After stormwater has been pumped through the “Front Half” of the HVS system and solids have been removed via the high vortex separator and 0.45-micron glass filter, the water will enter the “Back Half” of the HVS system and be drawn through the PUF cartridge. The cartridge will contain solid phase extraction resins that bind dissolved forms of the compounds in question (e.g., PCBs). Once the HVS system has been turned off, the sealed PUF cartridges will be labeled and sent to SGS for analysis of the dissolved fraction of PCB congeners, dioxins/furans, and OCPs in stormwater. These analyses are listed for the aqueous matrix in Worksheets #19 and #30. Collected

samples will be placed in laboratory provided glass jars and stored in a cooler at 0 to 6°C until transport to the laboratory.

#### *4.5.2.1.2 Whole Water Concentration*

One objective of the HVS sampling method will be to quantify the PCB congeners, dioxins/furans, and OCPs concentrations in stormwater at levels that are below, or similar to, the low level CULs established for surface water in PHSS. This section describes how to convert the mass measurements provided by the laboratory into a whole water concentration that can be compared to PHSS surface water CULs.

The laboratory will report the total mass of the particulate (i.e., “Front Half”) and dissolved phase (i.e., “BackHalf” driver COCs) in laboratory reports in units of picograms (pg). Once that data has been validated, it will be used to mathematically calculate whole water concentrations using the following equation.

$$\frac{\text{Particulate Phase (pg)}}{\text{Sample Volume (L)}} + \frac{\text{Dissolved Phase (pg)}}{\text{Sample Volume (L)}} = \text{COC Concentration (pg/L)}$$

where:

- Particulate phase is the analytical sample consisting of the solids from the vortex and glass microfiber filters (pg/sample);
- Dissolved phase is the dissolved fraction adsorbed to the PUF cartridge (pg/sample); and
- Sample volume is the total amount of water passed through the PR2900 during sample collection (L).

As noted in SOP A-5 Gravity Marine HVS Sampling (Appendix A), a minimum target volume of 200 L of water will be pumped through the system. Flow rates will be low (approximately 1.5 L/min) to allow for adsorption of dissolved-phase COCs to the PUF cartridge and to ensure that equal representation from the storm is reflected in the combined analytical results. Each storm and associated location will have different total volumes pumped. These volumes will be provided by the subcontractor and used by HGL in these calculations.

#### *4.5.2.1.3 Particulate Phase Concentration*

A second objective of the HVS sampling method is to capture enough stormwater solids to quantify the concentration and loading rate of those solids discharging from the city outfalls to the Willamette River and evaluate the risk of on-going recontamination to sediment near the outfalls. This section describes how the particulate phase mass provided by SGS (in pg) and the TSS measurement provided by ALS Global (in milligrams per liter [mg/L]) will be used to calculate the focused COC concentrations in stormwater solids, which can then be compared to the PHSS CULs and RALs.

After the laboratory data are validated, the data will be used to mathematically calculate whole water concentrations in picograms per milligram (pg/mg) using the following equation.

$$\frac{\frac{\text{Particulate Phase (pg)}}{\text{Sample Volume (L)}}}{\text{TSS (mg/L)}} = \text{COC Concentration } [\mu\text{g/kg}]$$

where:

- Particulate phase is the analytical sample consisting of the solids from the vortex and glass microfiber filters (pg/sample);
- Sample volume is the total amount of water passed through the PR2900 during sample collection (L);
- TSS is the concentrations (in mg/L) measured from an aliquot of water collected from the carboy sample; and
- The resultant ROD focused COC concentration is in micrograms per kilogram, which is equivalent to pg/mg.

### **4.5.3 Automatic Stormwater Sampling Methodology for Private Outfalls**

During the three storm events selected for HVS or similar events meeting ODEQ-EPA JSCS criteria, as defined above, time-weighted, composite stormwater samples will be collected from six locations using automatic samplers to provide a “snapshot” of COC concentrations discharging to the SIB during rain events meeting the ODEQ-EPA JSCS criteria similar to the HVS samples collected in city outfall basins, although during shorter sampling duration events. Time-weighted, composite samples will be collected during storm periods expected to have higher chemical concentrations (e.g., first flush or rising limb), to increase the likelihood of detecting COCs if discharging in stormwater.

Autosamplers (e.g., Teledyne ISCO® 6712C portable samplers with flow meters) will be used to collect grab samples from small private conveyance systems to assess whether COCs in stormwater are controlled prior to removal action. The samplers will be automatically programmed to collect samples to evaluate COC concentrations discharging to SIB and the need for source control measures. Proposed private facility locations were selected based on the location of discharges relative to SMAs, ROD CUL/RAL exceedances, and/or lack of data adjacent to SMAs.

The autosamplers will be installed at locations that best represent stormwater flow to selected outfalls to SIB. The autosamplers will either be installed inside a stormwater feature (manhole or catch basin) or stored adjacent to the feature at ground level depending on location conditions, access, and security. The autosamplers will be connected to a compatible flow sensor that will establish when flow is elevated above baseline conditions and record real-time velocity and volume. The autosampler will have a dedicated 5-gallon whole water sample container from which the sampler will pump representative unfiltered stormwater at a rate and frequency dependent on the measured flow rate and volume (i.e., a storm-event, time-weighted, and composite sample). The autosampler will be programmed to collect sample water throughout an event meeting JSCS criteria, pausing when flows temporarily subside during "flashy" storm events. The autosampler will be monitored and potentially controlled by a remote laptop and field crews may check the autosampler to ensure that it is working properly. After the whole water sample has been collected, the field crew will retrieve the sample container and deliver it on ice to the processing facility,

where the stirred volume will be subsampled for ROD Table 17 COCs. Minimum analytical holding times and preservative requirements will be observed.

The automatic samplers are proposed for deployment in the private systems because the systems are too small and convey too little flow to support the use of the HVS sampling approach. Compared to a grab sample, the HVS methodology approach provides a superior characterization of chemical loading rates by accounting for the variability of COC concentrations over the range of variable discharge rates. HVS sampling also provides a means of determining COC loading rates when COC concentrations in stormwater are low. Automated samplers do not provide the same benefits as the HVS methodology, but they are superior to grab samples because they provide flow measurements that are correlated with the timing of sample collection such that samples are obtained consistent with ODEQ/EPA 2005 JSCS guidance (i.e., samples will be collected within 3 hours of the onset of discharge, and a minimum of one sample will be collected during the first flush [defined in the JSCS as the first 30 minutes after the onset of discharge]) (ODEQ and EPA 2005).

#### **4.5.4 Manual Grab Stormwater Solids Sampling Methodology**

Manual grabs to collect stormwater solids from manhole sumps and/or adjacent pipe inlets will be conducted in a single sampling event. Sampling will be performed in accordance with SOP A-4 Storm Drain Sampling (Appendix A).

Sample collection from manhole sumps and/or adjacent conveyance systems will incorporate material representative of the total depth of accumulated solids. The stormwater solids sampling subcontractor will select sampling equipment that is suitable for site conditions. Sampling equipment will be decontaminated prior to use. Section 4.9 provides more detailed information on decontamination procedures.

Any standing water in the manhole sump will be pumped out to ensure collection of a representative sample of stormwater solids. Firm solids above the water line are most easily collected using manual tools such as a stainless-steel spoon, scoop, or trowel. If necessary, the spoon, scoop, or trowel may be attached to an extension pole to reach the bottom of the manhole and/or adjacent pipe inlets, provided a representative sample can be recovered intact. Sample collection will avoid scraping the pipe walls to prevent the collection of iron precipitate. Stainless steel bucket augers (hand augers) typically have long handles (>4 ft) and can also be used to collect solids from deeper junctions. While it may be possible to sample solids in manhole sumps without confined space entry, manholes without sumps or without visible solids may require confined space entry to determine if sufficient solids have accumulated in the adjacent conveyance systems for collection. If no or limited solids are present, it will be noted in the field documentation and an alternative nearby manhole may be selected for evaluation based on consultation with the HGL PM and technical leader.

Clean and appropriate sampling equipment will be advanced into the manhole sump, where present, to collect solids in each pipe inlet entering the manhole. Solids will be described following ASTM Standard D2488 (ASTM, 2017) and the USCS visual soil classification procedures. Collected solids will be placed in laboratory-provided glass jars and stored in a cooler at 0 to 6°C

until transport to the laboratory where they will be frozen for possible future analyses, if inadequate volumes are collected from in-line sediment traps installed in the system.

#### **4.5.5 In-Line Sediment Trap Sampling Methodology**

In-line sediment traps will be installed in select locations in the city’s conveyance system during December 2021 if the city grants access. In-line sediment traps will consist of custom stainless-steel brackets holding 1-L high-density polyethylene sample bottles. At each designated sampling location, in-line sediment traps will be installed at the bottom of the conveyance system. In-line sediment traps will be firmly secured to the conveyance system to prevent unintended transport of the equipment. It is anticipated that confined space entry procedures will be required to install the sediment traps. These procedures will be outlined in the HASP. In-line sediment trap brackets and related equipment will be decontaminated prior to installation and new clean laboratory supplied 1-L bottles will be utilized within the brackets.

Each trap is equipped with four, laboratory-supplied, 1-L, wide-mouth, polyethylene bottles. The sample bottles will be removed and replaced at the end of February, April, and June 2022 for compositing and analyses representing wet season accumulation. Bottles will be deployed from June 2022 until October 2022 before the wet season first-flush event and analyses will represent dry weather accumulation. The dry season deployment may be terminated early if wet weather is predicted prior to the end of October. The locations are shown on Figure 4-8. Sampling of stormwater solids via in-line sediment traps is proposed to be conducted by an HGL subcontractor. Sampling will be performed in accordance with SOP A-6 In-Line Sediment Trap (Appendix A).

When the sample bottles are collected and submitted for archival and subsequent analysis after the first targeted deployment period, they will be replaced by clean and decontaminated bottles. Section 4.9 provides more detailed information on decontamination procedures. At the end of each targeted deployment period, the four, 1-L sample bottles will be capped and stored in a cooler at 0 to 6 °C until transport to the laboratory and archival pending compositing and analyses. The entire sediment trap solids samples will be analyzed. At the end of the final deployment period, in-line sediment traps and equipment will be removed from the stormwater systems.

#### **4.5.6 Flow Monitoring Methodology**

Pulsar Measurement Greyline Stingray 2.0 level-velocity loggers will be incorporated into the stormwater sampling program in the city outfall basins to continuously measure water levels and velocities. These parameters will be converted to flow and volume using the cross-sectional geometry of the flow in the pipe during the HVS event as well as during the entire wet and dry seasons. The conversion to flow will be made using Manning’s equation (Chow, 1959) with adaptations specific to flow in partially filled pipes:

$$Q = (1.49/n) A (R_h^{2/3}) S^{1/2}$$

where:

- Q = flow rate
- n = Manning's roughness coefficient
- A = cross-section area of the flow
- $R_h$  = hydraulic radius
- S = slope

It is expected that during sampling events the stormwater pipes will be flowing partially full. Flow calculations for partially full pipe flow are complicated by two considerations: (1) the equations for calculating the hydraulic radius ( $R_h$ ) are different depending on whether the pipe is flowing more than half full or less than half full, and (2) the Manning roughness coefficient must be considered to vary as a function of the ratio of depth of flow to diameter for the calculations to be accurate. Camp's method (Camp, 1946) will be used to determine the appropriate Manning roughness coefficient based on the depth of flow relative to the pipe diameter.

The loggers will be mounted on stainless steel plates and securely fastened to the bottom of the stormwater pipe using small (0.25-inch) stainless steel anchor bolts and nuts. The cable from the logger module to the probe will be fastened to the pipe using the same hardware and protected from high flows. If necessary, the cable will be shielded using a 1-inch flexible electric conduit. The module will be positioned near the top of the invert, directly beneath the manhole cover, to allow easy access for downloads and inspections. The logger module will be fitted with cable strap locations, which will be used to tie the module to the top ladder rung.

#### **4.5.7 Contingency Plans**

##### **4.5.7.1 HVS System Sampling**

The HVS system will target the optimal 200-L total volume collected at the average 1.5 L/min pump rate (target stormwater volume of 53 gallons). If the storm flow volume or flow period does not allow for attainment of this sample volume, but still meets the JSCS criteria for a qualifying storm, the sample will still be collected at an adjusted flow rate. The effect of pumping less than the optimal 200 L minimum through the HVS system will affect the achievable laboratory detection limit, although even with limited volume the detection limits for the HVS system samples will be well below those that can be achieved using conventional laboratory analyses. If river backflow is predicted to occur at the proposed HVS locations, the sampling will be conducted at the alternate locations (AAM107 in the M-1 outfall basin and AQQ104 in the M-3 outfall basin), HGL will target events expected to occur near low tide.

##### **4.5.7.2 Manual Grab Solids Sampling**

Manual stormwater solids grab samples will be collected if a minimum of 8 ounces of solids are present. If less than 8 ounces of solids are present, then alternative locations further upstream in the conveyance system will be inspected, and the location with at least 8 ounces of sediment will be sampled. Alternative locations without at least 8 ounces of sediment present will not be sampled.

#### **4.5.7.3 In-Line Sediment Trap Sampling**

Each location includes four sample bottles, which increases the anticipated mass of collected stormwater solids compared to less bottles. If sample volume is limited, analysis of the ROD focused COCs (PCBS, dioxins/furans, OCPs) will be prioritized over the remaining ROD COCs.

#### **4.5.7.4 General**

In instances where ROD COCs and conventional parameters are targeted for analysis, but the volume of stormwater solids or stormwater is limited, then analysis of PCBs, dioxins/furans, and OCPs will be prioritized over other COCs with metals analysis completed on any remaining solid or liquid. In these cases, the HGL sampling and analysis coordinator, in consultation with the HGL PM, will provide the laboratory with a list of the analytical priorities for that specific sample location.

### **4.6 HABITAT CONDITIONS SURVEY**

A reconnaissance-level habitat conditions survey will be performed to address data gaps related to characterization of aquatic resources within the shallow nearshore zone and ecological conditions along the banks as they pertain to ecological benefits imparted to the adjacent aquatic resources. A field reconnaissance survey will be conducted of the entire shoreline included within the SIB Project Area to qualitatively document both bank conditions and substrate conditions within the shallow nearshore zone. The shoreline survey will describe present-day conditions around the shoreline and riverbanks and provide consistency in the quality and applicability of the data. The habitat survey will be integrated with and conducted as part of the riverbank physical inspection and erodibility evaluation described in Section 5.3.4.

### **4.7 SAMPLE HANDLING AND CUSTODY**

Sample handling and custody includes the field-related considerations connected with selecting sample containers, preservatives, allowable holding times, and analyses requested. To verify the samples are traceable, field staff will follow the procedures for sample handling and custody procedures as described in the UFP-QAPP Worksheets #26 and 27.

#### **4.7.1 Field Sample Preservation and Containers**

See UFP-QAPP Worksheets #19 and #30 Sample Containers, Preservation, and Hold Times.

#### **4.7.2 Field Sample Identification, Tracking, and Labeling**

Each sample collected will be assigned a unique sample ID number and will be collected from a unique station location. Several samples can be collected from a single station.

##### **4.7.2.1 Identification**

Sample ID will be based on waterbody, media, and sample location as follows:

#### *4.7.2.1.1 Surface Sediment Sample Nomenclature*

Sample nomenclature for surface sediment grid sampling will be developed to relate samples to the grid pattern and sample interval. Samples will be uniquely identified as follows:

##### Water Body-Grid Node-Sample Depth-Date

where:

- Water Body = A predesignated water body acronym, such as “SIB” for Swan Island Basin.
- Grid Node = Alphanumeric code for each node. Letter “A” to “T” identify up/down river locations, and numbers “1” to “7” identify cross-river locations. (e.g., J5).
- Sample Depth = The actual depth interval of the collected sample (top## - bottom##). For example, if the penetration depth of the grab sampler is 27 cm, the sample ID will include "0-27".
- Date = The date of sample collection will be added to the sample ID in the following month, day, year format: MMDDYYYY.

For example, a surface grab sample from grid node J5, where the grab sampler penetrated to a depth of 27 cm and was collected on October 15, 2021, would have the sample ID: SIB-J5-0-27-10152021.

#### *4.7.2.1.2 Stream In-Channel Sediment Sample Nomenclature*

This nomenclature will also be used for DRET and in-line sediment trap sampling. Each in-channel stream sediment sample will be uniquely identified as follows:

##### Water Body-Sed-Location-Date

where:

- Water Body = A predesignated water body acronym, such as “SIB” for Swan Island Basin.
- Sed = Sediment sample.
- Location = A predesignated location described, such as “MP1” for Mid-Point Station 1.
- Date = The date of sample collection will be added to the sample ID in the following month, day, year format: MMDDYYYY.

#### *4.7.2.1.3 Subsurface Sediment Sample Nomenclature*

Sample nomenclature for subsurface samples will be developed to relate samples to sample type, location, and sample interval. Samples will be uniquely identified as follows:

##### Water Body-AA-Location-Sample Depth-Date

where:

- Water Body = A predesignated water body acronym, such as “SIB” for Swan Island Basin.
- AA = Sample type, SC for sediment core or SF for SedFlume.
- Location = A predesignated location described, such as “MP1” for Mid-Point Station 1.
- Sample Depth = The actual depth interval of the collected sample in ft (top## - bottom##). For example, if the penetration depth of the grab sampler is 0 to 1 ft, the sample ID will include "0-1".
- Date = The date of sample collection will be added to the sample ID in the following month, day, year format: MMDDYYYY.

For example, a sediment core sample from grid node JS for the 0- to 1-ft interval collected on October 15, 2021, would have the sample ID SIB-SC-MP1-1-2-10152021.

#### *4.7.2.1.4 Geotechnical Sediment Sample Nomenclature*

Each geotechnical and CPT sample will be uniquely identified as follows:

Water Body-Geo-Location-Date

where:

- Water Body = A predesignated water body acronym, such as “SIB” for Swan Island Basin.
- Geo = Geotechnical sample.
- Location = A predesignated location.
- Date = The date of sample collection will be added to the sample ID in the following month, day, year format: MMDDYYYY.

For example, a cone penetration sample from CPTW-5 collected on October 15, 2021, would have the sample ID SIB-Geo-CPTW7-10152021.

#### *4.7.2.1.5 Stormwater Sample Nomenclature*

Each stormwater sample will be uniquely identified as follows:

Water Body-SW-Location-Date

where:

- Water Body = A predesignated water body acronym, such as “SIB” for Swan Island Basin.
- SW = Stormwater sample.

- Location = A predesignated location.
- Date = The date of sample collection will be added to the sample ID in the following month, day, year format: MMDDYYYY.

For example, a sample from WR-437 collected on October 15, 2021, would have the sample ID SIB-SW-WR437-10152021.

#### *4.7.2.1.6 QC Sample Nomenclature*

Field QC samples will be performed using the following protocols: (1) matrix spike (MS) and matrix spike duplicate (MSD) samples will be identified by using the parent sample location ID with “MS” and “MSD” appended, and (2) field duplicates, equipment blanks, and trip blanks will be identified as “BB##-MMDDYYYY,” where “BB” will be for the QC sample type: field duplicate (FD), equipment blank (EB), or trip blank (TB); “##” will represent the consecutive sample number (01, 02, 03, etc.); and “MMDDYYYY” will represent the month, day, and the four digits of the year that the sample was collected.

For example, the third FD collected during a sampling activity on October 15, 2021, would have the sample ID FD03-10152021.

The field logbook will include the parent or sample location ID that is associated with the field QC samples. All QC samples will have “1200” as the collection time.

#### **4.7.2.2 Field Sample Tracking**

See Worksheet #6 in the UFP-QAPP for a discussion on tracking field samples.

#### **4.7.2.3 Field Sample Labeling**

Sample labels will include the information presented in Worksheets #26 and #27 Sample Handling, Custody, and Disposal of the UFP-QAPP.

#### **4.7.3 Sample Chain of Custody**

The CoC record is employed as physical evidence of sample custody and control. This record system provides the means to identify, track, and monitor each individual sample from the point of collection through the final data reporting.

See UFP-QAPP Worksheets #26 and #27 Sample Handling, Custody, and Disposal for information on sample custody requirements, including procedures on packaging, shipment, and delivery to the laboratory.

### **4.8 FIELD SUPPLIES AND EQUIPMENT**

The FTL will prepare field supply and equipment lists at least one month in advance of planned field activities. The field team will review the HASP for an additional list of required health and safety supplies. Field equipment will be inspected to ensure working condition before commencing

fieldwork. Analytical instrument testing, inspection, maintenance, setup, and calibration will be conducted in the field in accordance with the requirements identified in the SOPs and manufacturer instructions. In addition, each of the specified field analytical methods provides protocols for proper instrument setup and tuning, and critical operating parameters. Instrument maintenance and repair will be documented in maintenance log or record books.

#### **4.8.1 Calibration**

Equipment used at the site will be calibrated according to the manufacturer specifications, if necessary. Field equipment will be calibrated before the start of each workday and calibration data will be documented in the Daily Equipment Calibration Log Form (Appendix B). Instrument drift from prior calibration will be recorded in the field logbook. Procedures for PID calibration are provided in SOP A-2 PID Screening and Calibration Procedures (Appendix A). Equipment found to be damaged, inoperable, or out of calibration will not be used until the discrepancy is corrected and verified by the field task manager or designee. As necessary, a detector sensitivity or test grid may be used to test the functionality before daily use, and results documented accordingly. Once equipment has been used, it will be maintained following manufacturer recommendations, and at intervals recommended by the manufacturer.

#### **4.8.2 Maintenance**

Maintenance and troubleshooting of the instruments to be used for field parameter measurements will be completed, as described in the manufacturers' instruction manuals and the SOPs for their use. Used calibration fluids will be containerized and disposed of as described in the Waste Management Plan (Appendix C).

### **4.9 DECONTAMINATION**

Procedures for decontamination will be implemented to avoid cross contamination of samples that are submitted for chemical analyses. Decontamination procedures will meet the requirements contained in SOP 411.02 Sampling Equipment Cleaning and Decontamination.

Final decontamination of equipment used to collect the samples will be required prior to equipment demobilization from the site. This decontamination step is required to prevent contaminants from being transported off site. The same procedures used for decontamination between sample locations will be used during final decontamination.

#### **4.9.1 Hand Sampling Tools**

Non-disposable sampling and testing equipment exposed to the sample medium will be decontaminated to prevent cross contamination between sampling points. For recasts at a location, the grab sampler or other recasting equipment will be rinsed/sprayed with river water until solid material is removed.

Reusable sampling equipment will be decontaminated between stations. The decontamination steps will include an initial rinse with vessel riverwater to dislodge particles, a scrub with brush and Alconox™ or other phosphate-free detergent, and then a rinse with deionized water. In the event of excessive oily/tar residue, the sampling equipment may be scrubbed using a fast-

evaporating distillate of petroleum (such as toluene or xylene) or Simple Green™ until all visual signs of contamination are absent. If used, the distillate of petroleum product will not include use of oily paint thinners. Following removal of the oily/tar residue, the equipment will be rinsed with Alconox™ and distilled water to ensure the removal of the petroleum distillate. If NAPL is encountered and a solvent rinse is conducted, a field equipment wipe blank may be collected after decontaminating the equipment. This process will be documented in the field logbook for tracking purposes. The wipe blank can be archived (frozen) for future analysis if cross-contamination is suspected. Sampling spoons and bowls will be covered with aluminum foil until use (dull side down). Core tubes and core catchers will be washed in a similar manner.

Gloves will be replaced before and after handling each sample or conducting decontamination procedures. Field equipment decontamination dates and times will be noted in the logbook.

#### **4.9.2 Drilling Equipment**

The following is the standard procedure for field cleaning augers, drill stems, rods, tools, and associated equipment. This procedure does not apply to soil samplers, well casings, well screens, or other equipment used to obtain samples for chemical analyses.

- Wash with tap water and soap using a brush, if necessary, to remove particulate matter and surface films. Steam cleaning (high-pressure hot water with soap) may be necessary to remove matter that is difficult to remove with the brush. Drilling equipment that is steam cleaned should be placed on racks or sawhorses at least 2 ft above the floor of the decontamination pad. Hollow-stem augers, drill rods, etc., that are hollow or have holes that transmit water or drilling fluids, should be cleaned on the inside with vigorous brushing.
- Rinse thoroughly with tap water.
- Remove from the decontamination pad and cover with clean, unused plastic. If stored overnight, the plastic should be secured to ensure that it stays in place.

If drilling equipment is contaminated with oily/tar that cannot be decontaminated with an Alconox™ detergent rinse, a concentrated Alconox™ rinse will be attempted. If that approach is still unsuccessful, then a fast-evaporating distillate of petroleum (such as toluene or xylene) will be used to remove the oily/tar residue. This distillate of petroleum product will not include use of oily paint thinners. Following removal of the oily/tar residue, the equipment will be rinsed with Alconox™ and distilled water to ensure the removal of the petroleum distillate.

#### **4.10 WASTE MANAGEMENT PLAN**

See Appendix C for the Waste Management Plan. The Waste Management Plan describes the wastes that will be generated during performance of the field activities and provides details on how the waste will be handled, transported, and disposed. The Waste Management Tracking Log Form can be found in Appendix B.

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## **5.0 ENGINEERING FIELD ACTIVITIES**

The following sections provide overviews on field activities intended to provide data for engineering purposes that will feed directly into the RD. Field activities will be performed in accordance with statements of work developed for specialty subcontractors (Appendix D), as well as the vertical and horizontal control guidelines outlined in Section 7.0.

### **5.1 BATHYMETRY AND TOPOGRAPHY**

Accurate elevation data is required for many purposes on the project. Per the data gap analysis, new multi-beam bathymetric survey data is required for the project site. Multi-beam bathymetric survey data should cover the entire project area to the extent feasible given the presence of some obstructions in the SIB. Also, per the data gap analysis, new topographic survey data will not be collected during the PDI as existing LiDAR data and new laser scan data provide sufficient upland elevation information for pre-design studies and sitewide topographic surveying is currently unnecessary. Topographic data will be further collected later in areas where necessary to support detailed engineering design. Multi-beam bathymetric survey data will be acquired by a subcontractor using a subcontractor vessel in 1 or 2 days with Mott MacDonald oversight. Mott MacDonald staff will accompany the surveyors for key portions of the survey activity and observe instrument calibration, real-time data collection, and discuss key elements of the vessel positioning and data calibration and correction. Figure 5-1 shows the proposed area for collection of multi-beam bathymetric survey data.

### **5.2 DETECTION OF EXISTING BURIED UTILITIES AND DEBRIS**

Five separate methods will be utilized to identify potential buried utilities and debris that may affect Remedial Action. Two of these methods are described in other sections: 1) a multi-beam bathymetric survey (see Section 5.1) will be performed to identify objects on the seabed over which a vessel can pass, and some below-water parts of structures/debris; and 2) an MTLIS (see Section 5.3.3) will be performed to locate above-water debris and nearshore marine structures. This section focuses on three additional types of field surveys that will allow the project team to identify and locate objects in water, both above and below the riverbed:

- sub-bottom survey,
- magnetometer survey, and
- side-scan sonar.

This data will be acquired by a subcontractor using a subcontractor vessel in 1 or 2 days with Mott MacDonald oversight. Mott MacDonald staff will accompany the surveyors for key portions of the survey activity and observe instrument calibration, real-time data collection, and discuss key elements of the vessel positioning, and data calibration and correction. Data will be collected along transects shown in Figure 5-2 at a minimum, with additional transects and focused data collection around detected objects.

### **5.3 SHORELINE/OVERWATER STRUCTURE INSPECTION AND CONDITION ASSESSMENT**

An overwater structures field inspection and condition assessment will be performed in general accordance with the American Society of Civil Engineers (ASCE) *Waterfront Facilities Inspection and Assessment Manual of Practice*, ASCE Manual of Practice No. 130 (ASCE, 2015). The inspections will follow a two-step process: first, a screening-level inspection will be performed on overwater structures via site walk and boat tour; then, a select number of structures will be chosen to receive a more in-depth dive inspection. In addition, a boat-mounted laser scan survey will be performed to locate and document the shoreline, in-water emergent debris, and nearshore marine structures. The condition of each structure will be assessed, and findings will be summarized in accordance with ASCE Manual of Practice No. 130 in the PDI Evaluation Report (see Section 12.0). A summary of the inspections and additional laser scan survey is provided in the following sections.

#### **5.3.1 Screening Level Structural Inspections**

A screening-level visual inspection of readily accessible, main structural systems components and fender piles will be conducted to be able to form an engineering opinion on the general condition of each structure and confirm as-built layout and structural details. The screening inspection results will identify those structures that are recommended to receive a dive inspection and to make further inspection recommendations.

The inspections will be conducted above the deck of each structure first on foot, then via boat to observe the above-water components beneath the deck. Photographs, video documentation, and physical and/or electronic field notes from this effort will be collected and provided with inspection reports. Noticeable signs of distress and deterioration, focusing on main structural system components, will be noted and, where possible, an estimate of remaining capacity will be made. Main structural system components will include prestressed concrete, steel pipe, or treated timber pile; steel sheet pile cellular structures; reinforced concrete, timber, or steel pile caps, beams, and joists; reinforced concrete or timber decking; structural bracing; and fender piles.

Should repairs or structural modifications be required on a given structure to achieve the RD, a repair-level inspection will be needed during the final design phase to confirm precise quantities and deterioration locations that require repair.

#### **5.3.2 Dive Inspection of In-Water Structures**

Selected in-water and overwater structures will be inspected by a dive team. The structures selected for a dive inspection will be based on the results of the screening-level inspections and preliminary analysis of the impacts of the Remedial Action on the structures. For structures anticipated to be impacted by the Remedial Action, a top to bottom inspection will be conducted.

To avoid affecting facility operations during the inspection, communication with the local facility operations team during the inspection period will be maintained. Points of contact (routine and emergency) will be established prior to the start of diving operations for expected vessel movements while the team is on site. Daily contact at the beginning, during, and end of the

inspection day will be maintained to confirm required facility operations individuals are aware of intended diving operations in the vicinity of the overwater structure. Dive flags will be displayed, and appropriate very high frequency radio channels will be monitored. A marine traffic radio will be used to hail vessels approaching too close to the dive operations.

The inspection will consist of a visual and tactile structural inspection (Level I) of the entire visible surface from channel bottom to the top with particular attention given to observed areas of deterioration or apparent distress. The inspection will also include Level II (in-depth visual) inspection of 10% of the members by removing a 1-ft-high band or 1-ft-square area of biological growth around the entire circumference of the pile/member at the channel bottom, mid-height, and waterline. A Level III (nondestructive testing) inspection will be performed on up to 5% of each timber and steel member to detect hidden or interior damage. Additional information on this activity will be provided by the subcontractor and added as an SOW to Appendix D and/or addenda to the HASP.

### **5.3.3 Mobile Terrestrial LiDAR Survey of Existing Structures, Debris and Shoreline**

An MTLS survey or boat-mounted laser scan survey will be performed to locate and document the shoreline, in-water emergent debris, and nearshore marine structures. This data will be acquired by a subcontractor using a subcontractor vessel in 1 or 2 days with Mott MacDonald oversight. Mott MacDonald field sampling staff will accompany the surveyors for key portions of the survey activity and observe instrument calibration, real-time data collection, and discuss key elements of the vessel positioning, data calibration and correction, and final processing. Data will be collected along the shoreline shown in Figure 5-3 at a minimum, with additional focused data collection around important structures and concentrations of marine debris.

## **5.4 HYDRODYNAMICS AND SEDIMENT DYNAMICS**

The purposes of field sampling hydrodynamic and sediment dynamics data are to generate data necessary to evaluate recontamination potential, and to demonstrate stability/persistence of the remedy under both river hydrodynamics and anthropogenic hydrodynamics (e.g., propeller wash). Field data collected is used to either directly characterize the site, or is used as input to, or validation of, numerical modeling tools.

### **5.4.1 Current Velocities and Water Levels**

Current velocities will be measured for the purposes of characterizing the site and refining the conceptual site model, as well as for input to, and validation of, numerical modeling tools (hydrodynamics and sediment transport models). Current data provides the magnitude and direction of flow throughout the water column at a given time and location. Current velocities and low-frequency water levels (i.e., tides) will be measured using a combination of both boat-mounted, and two (2) bottom-mounted, acoustic doppler current profilers (ADCPs). This data will be acquired by a subcontractor using a subcontractor vessel during deployment and/or recovery of bottom-mounted instruments with Mott MacDonald oversight. The bottom-mounted sensors will collect data for two (2) consecutive 30-day periods, with a mid-program recovery, onboard data review, and redeployment to ensure data quality. Mott MacDonald staff will accompany the subcontractor for key portions of the deployment and measurement activity and observe instrument

calibration, real-time data collection; and discuss key elements of the vessel positioning, and data calibration, and correction. Proposed deployment locations of the bottom-mounted ADCPs and proposed transects for collecting boat-mounted ADCP data are shown in Figure 5-4. Lateral transect locations were chosen to measure alongshore currents and eddying effects, while avoiding active vessel mooring locations. Longitudinal transects were included to capture cross-basin currents that likely occur in some locations due to eddying effects. It is understood that currents are likely quite small within the interior of the basin and demonstrating this is an important element of validating the SIB conceptual site model.

#### **5.4.2 Wind-Waves and Boat Wakes**

High-frequency, free surface elevation measurements will be collected in the SIB Project Area to assist in characterizing wind waves and boat wakes. This data will be acquired by a subcontractor using a subcontractor vessel during deployment and/or recovery of pile-mounted instruments with Mott MacDonald oversight. Four (4) pile-mounted sensors will collect data for two (2) consecutive 30-day periods, with a mid-program recovery, onboard data review, and redeployment to ensure data quality. Mott MacDonald staff will accompany the subcontractor for key portions of the deployment activity and observe instrument placement, data testing, and recovery, and discuss final data evaluation. Wind-wave and boat-wake free surface elevation measurements will be collected at the approximate locations shown in Figure 5-4, depending on availability of suitable structures upon which to mount the sensors and permission from the owners/operators.

#### **5.4.3 Suspended Sediments**

Suspended sediment sensors will be deployed by a subcontractor using a subcontractor vessel at the same time as, and co-located with, the bottom-mounted ADCPs described in Section 5.4.1 and shown in Figure 5-4. Suspended sediment measurements are a low-cost way to determine the amount of suspended solids moving in the water column over time which supports recontamination evaluation and understanding of general sediment dynamics. Deployment, recovery and redeployment, and final recovery activities will also be identical to those performed for the bottom-mounted ADCPs. As with the ADCPs, the two (2) bottom-mounted turbidity sensors will collect data for two (2) consecutive 30-day periods, with a mid-program recovery, onboard data review, and redeployment to ensure data quality.

A logging Conductivity, Temperature, and Depth (CTD) Sonde equipped with a turbidity sensor will be mounted on the ADCP platforms and oriented such that the sensor portion or the CTD is near the level of the first ADCP data bin or at least near the same distance from the bottom as the ADCP head. The CTD will collect sensor data concurrently with the sampling period of the ADCP. A third CTD will be used to collect water quality profiles that include optical turbidity for at least three (3) ensembles during the current profiling at each bottom mount for through column correlation with back-scatter data. CTD profiles will be collected concurrently with water samples. The purpose will be to collect data throughout the water column to provide a vertical variation profile to supplement the near-bottom optical backscatter point sensor (OBS)/turbidity measurements. Note that due to equipment shortages and availability, an infrared turbidity OBS sensor may be used in place of an optical turbidity CTD.

To assist with data correlation and quality checks, approximately 500 milliliters (mL) to 1,000 mL of water will be collected for laboratory analysis of turbidity and TSS based on the laboratory's requirements. A maximum analysis of up to 10 water samples will be collected following the first deployment of the ADCP platforms, and up to 10 water samples will be collected following the second deployment. A water grab sampler will be used to collect a water sample within the first sample bin (estimated to be approximately 1 meter from bottom) near both ADCP stations during an ensemble recording event. Turbidity from these samples will be recorded on the boat upon recovery using a handheld turbidity meter then processed for transport to a laboratory for testing (turbidity and TSS only).

Additional water samples shall be taken at random locations along the proposed ADCP transects following a CTD profile at the close of the transect at an area and depth indicating varying backscatter on the ADCP real-time display. Water samples will be analyzed by a contract laboratory for TSS, by EPA Method 160.2 and suspended solids concentration (SSC) analytical method, ASTM D 3977-97, Standard Test Method for Determining Sediment Concentration in Water Samples (ASTM, 1999). Results of laboratory analysis and details of the sample collection will be provided with the PDI Evaluation Report. Laboratory water samples will be collected concurrent to the first deployment and service deployment event only.

Prior to deployment, turbidity sensors will be pre-calibrated using a nominal range concentration turbidity standard for the site. The position of the turbidity sensor will be set such that it is within the first ADCP bin (from bottom). Water samples for TSS/SSC measurements will be collected at the same level as the turbidity measurement and near the instrument location. Pre-calibration of the turbidity sensors will be standardized using a two-point calibration with distilled water and a high concentration turbidity standard to set the internal offset and scale of the OBS or alternate turbidity sensor. During the TSS calibration, short-term averages (as provided by logger) will be recorded with the OBS/turbidity sensor in a thoroughly mixed container of site sediment collected within the sediment traps, or those collected using a small grab sampler (backup) and distilled water. Three to five sediment concentrations, ranging up to 4.0 g/L will be used to develop a calibration curve. This calibration will likely be represented by a non-linear second or third order polynomial curve with a specific calibration for each sensor. During post processing, the stored data logger values (in nephelometric turbidity units, counts or millivolts) will be processed with the developed calibration equations to produce SSC values for each averaged field measurement.

## **5.5 POREWATER UPWELLING LOCATION SURVEY**

Per the PDI, this will consist of manually deploying a Trident Probe, a multi-sensor sampling device, to measure temperature and specific conductance contrast between porewater, or interstitial water, in surface sediment and overlying surface water at discrete stations to identify potential upwelling zones along transects within the SIB Project Area. Appendix A contains SOP A-8 for the Trident Probe. Identification and mapping of locations within the SIB Project Area where upward porewater migration occurs is needed to address data gaps. Figure 5-5 is a map of proposed transects to evaluate porewater upwelling locations where capping may not be effective or, alternatively, locations where adjustments to engineered cap design may be required to prevent breakthrough of COCs through the cap due to upward migration of porewater through contaminated sediments below the cap.

The survey will be conducted on fifteen 800-ft-wide transects across SIB (with up to 10 stations each where no permanent structures are present) and two 400-ft-wide transects at the head of SIB (8 stations) for a total of up to 158 stations. The Trident probe measurements are planned to be collected at a rate of 15 stations per day. The Trident probe records temperature and specific conductance measurements every 5 seconds; the reported measurements are the average over a 30-second interval.

Measurements may deviate from the transects to map those areas with the largest temperature and conductance gradients between sediment and overlying surface water. Measurements may deviate from the proposed transect lines if a strong contrast in surface water and porewater conductivity measurements is recorded in one area along a transect to delineate the extent of that contrast on and around the transect line area and to quantify variability within the potential upwelling zone. The stronger the difference in measurements, the more measurements will be collected in that area to map the extent of the upwelling zone(s). These additional stations will be within 50 ft of the previous station. In addition, deviations from proposed station locations may occur if the substrate is too hard to manually drive the Trident Probe into the sediment, vessels or other over-water features present during the survey.

The timing of the investigation will be planned during the time of the year when the river surface elevations are dropping, has less tidal fluctuations (neap tides), temperature contrasts between surface water and groundwater are greatest, and seasonal groundwater elevations are higher than river elevations. Figure 4-1b of the PDI Work Plan shows groundwater elevations relative to river elevations for those wells closest to the basin versus the river channel. Some groundwater elevations consistently plot close to river elevations, reflecting high connectivity with the river, and, as a result, are influenced by mean river level and potentially the tides. Groundwater elevations were higher than river elevations in December 2001, March 2002, July 2002, October 2002, March 2003, September 2003, December 2003, January 2005, October 2005, September 2006, October 2006, January 2007, and September 2007. In addition to a comparison of groundwater elevations relative to river elevations, the timeframe for discharge mapping is also related to a temperature signal difference between groundwater and surface water. This difference is generally stronger during the winter (groundwater warmer than surface water) and summer (groundwater cooler than surface water) and weaker during transition periods of fall and spring based on Gravity Marine and Coastal Monitoring Associates professional experience on rivers in the Pacific Northwest. For example, in late February 2022, river temperatures were 6 to 7 degrees Celsius, and are expected to provide a good contrast with groundwater temperatures (estimated to be between 12 and 15 degrees Celsius [Bridgewater, 2020]). Also in late February 2022, discharge and gauge heights were low (below 25<sup>th</sup> percentile) with low river conditions (<https://waterdata.usgs.gov/nwis/uv?14211720>). The survey period was selected to correspond as closely as possible to neap tide conditions when tidal fluctuations are relatively small (~2 ft). The subsurface probe depth was also selected to be at 18 inches, deep enough to be minimally affected by tidal fluctuations. As a result, the upwelling survey is proposed for February and March 2022.

The upwelling survey results will be overlaid on proposed cap areas and possibly used to identify future collection stations for quantitative measurements of seepage rates in proposed cap areas for cap modeling. The need for porewater analyses will be assessed after the delineation of upwelling zones and may occur as part of the RD for cap design.

## **6.0 FIELD DOCUMENTATION REQUIREMENTS**

This section defines the specific records and data that must be maintained for each field activity to ensure that samples and data are traceable and defensible. At a minimum, data will be collected to meet EPA requirements for electronic data deliverables (EDDs) including specific data needs and reporting for EQUiST™. The specific requirements are discussed in the Data Management Plan (DMP) located in Section 9.0.

### **6.1 FIELD LOGBOOK**

A written record of sampling activities and field observations will be maintained in a bound, water-resistant field logbook with consecutively numbered pages (or suitable tablet). Entries will be legibly written in black or blue, indelible ink. Entry errors will be corrected by drawing one solid line through the incorrect entry, followed by the user's initials and date, with the correct information entered in proximity to the erroneous entry. At the end of each workday or task, the individual making the entries will sign and date the field logbook. Factual and objective language will be used. Entries will be complete and accurate enough to allow reconstruction of each field activity. Activities should be recorded contemporaneously. When not in use, the logbook will be stored in the permanent project file. After completion of the sampling activities, the field logbooks will be kept in the custody of the HGL PM or subcontract team member's PM. Additional guidance is provided in SOP 300.04 (Appendix A).

Information recorded in field logbooks will include, but not be limited to sampling time, weather conditions, unusual events, and field measurements. Field logbooks should also contain qualitative or semi-qualitative information on sample conditions such as odor and color. Deviations from SOPs or guidance documents will be recorded in the field logbook.

### **6.2 CALIBRATION LOGS**

Record equipment calibration, including instrument type and serial number; calibration supplies used; calibration methods and calibration results; and date, time, and personnel performing the calibration in the Calibration Log field form (Appendix B). Calibrate equipment used during the investigation daily, at a minimum, in accordance with manufacturer recommendations.

### **6.3 PHOTOGRAPHIC LOGS**

Digital photographs will be taken in the field to document representative sampling locations, collected samples, site conditions, and other salient site-related observations. Photographs will be date stamped and should be provided by using a digital camera or a video camera capable of recording the date on the image. Details of each photograph should be recorded in the logbook with the location of the photographer (including GPS coordinates), direction the photograph was taken, the subject of the photograph, and its significance (i.e., why the picture was taken). Where appropriate, the photograph location, direction, and subject also should be shown on a site sketch.

A photographic log will be kept to record the date the photograph was taken, location, photo ID number, brief photographic description, direction the photographer is facing (if appropriate), and, for example, if sheen was produced during collection of sediment samples. Photographs and

relevant log information will be downloaded onto a field computer on a regular basis for upload to SharePoint, in accordance with data management requirements. Additional guidance is included in SOP A-3 Sampling Photography (Appendix A).

#### **6.4 OTHER DOCUMENTATION**

In addition to the physical and/or electronic field notes, activity-specific forms such as for soil and sediment sampling, will be completed. Field sampling activity forms are planned to be generated through EQUIS™. Field forms will need to be routinely scanned for upload to SharePoint, in accordance with data management requirements. These forms are included in Appendix B.

#### **6.5 ENGINEERING FIELD INSPECTION DOCUMENTATION**

Engineering inspection activities will be performed, documented, and stored digitally within the Mott MacDonald SmartInspect system. The system will include activity-specific digital forms to be completed via waterproof smart device (iOS or Android), with field geolocation of photographs and basic measurements. Field logs compiled using SmartInspect are real-time uploaded to an online database in standard SQL server or other database formats. The stored database formats provide immediate use in ArcGIS, CSV or other standard formats and field progress and reports will be monitored in real-time from the office during the inspection activities via the online ArcGIS platform. The engineering field inspection documentation will follow SOP 300.04 in principle, but with digital logbooks and automatic database incorporation.

## **7.0 HORIZONTAL AND VERTICAL CONTROL**

Station positioning and vertical control will be performed as outlined in SOP A-7 Horizontal and Vertical Control (Appendix A). A differential GPS unit will be used to confirm the horizontal sampling locations to an accuracy of 1 to 2 meters. The differential GPS accuracy will be confirmed each morning and evening to a known land-based survey point. Confirmed station locations will be recorded to the nearest whole ft in NAD83 Oregon State Plane Coordinate System, Oregon North Zone.

### **7.1 POSITIONING, HORIZONTAL, AND VERTICAL CONTROL**

Vertical control will be established using an on-board fathometer or lead line to measure depth to mudline at sample locations. A bar check will be conducted daily prior to sampling. This will be done by lowering a metal plate at a known distance below the sonar and recording the value. The depth will be analyzed for accuracy based on the draft of the sonar below the waterline. Draft values will be input into the survey navigation software HYPACK. This allows for static offsets to be applied to real-time depth data and corrected for accurate depth readings. Any adjustments in the draft value will be measured and input directly in the hardware configuration of the HYPACK survey software prior to sampling.

Water depths will be converted to elevations in ft NAVD88 based on the river stage at the time of sampling as recorded at the Morrison Street Bridge located at RM 12.7. The gauge reports a value that is 0.3 ft above CRD. CRD depths will be converted to NAVD88 elevations using the USACE conversion for RM 7.5 to Broadway Bridge: CRD is 5.28 ft above the NAVD88 elevation at RM 9.7.

### **7.2 NAVIGATION AND STATION POSITIONING**

The proposed sampling locations for sediment activities, geotechnical, riverbank, stormwater, and stormwater solids are presented in Figures 4-3 through 4-8, and Tables 4-2 through 4-6. Surface sample station coordinates are not listed but will be collected from three locations within a 25-ft radius of the target sediment core stations (see Figure 4-3). The standard projection method to be utilized during field activities is Horizontal Datum: NAD83, State Plane Coordinate System, Oregon North Zone. The datum that will be utilized to record vertical positioning is NAVD88. Finalized station coordinates will be pre-loaded into GPS units to facilitate proper location of the sample stations by the field teams.

Gravity Marine will use differential GPS hard-wired to the vessel for horizontal positioning. Two points, provided in Table 7-1, represent known benchmarks surveyed in 2018 by David Evans. These will be used for daily check-ins by boat to assess GPS accuracy over the course of the sediment sampling work. The positioning objective is to determine and record the horizontal field positions of sampling station locations to within  $\pm 5$  ft.

#### **7.2.1 Positioning at Sediment Sample Stations**

For the power-grab and vibracore sampling, the marine subcontractors, in coordination with the on-board sampling staff, will position the support vessel and power-grab sampler as close as

practical to the target sample station and will anchor the vessel in place during sample collection. The latitude and longitude coordinates of the sample will be obtained by a GPS unit positioned directly above the sampling instrument when the equipment is on the river bottom. Vertical positioning is required to establish the elevation of the mudline at the sampling stations. While the sampling device is in place at the sampling station, depth to mud line will be measured using a fathometer on the vessel before or during the sampling. A lead line (or pole), equipped with a flat plate to better sense soft sediments, is typically used to verify the readings on the vessel's depth finder. Vertical measurements to the mudline will be recorded to the nearest 0.1 ft below the water surface. Additionally, a tide board will be installed in the SIB Project Area, coupled with a surface stilling well, for direct readings of water surface elevations in NAVD88. Water surface elevation readings will be recorded periodically while sampling and used in combination with water depth readings to calculate mud line elevations at sample stations. GPS precision and accuracy will be confirmed each morning and evening at a fixed surveyed benchmark (to be determined), approved by EPA prior to initiating the sediment sampling work, and then recorded.

### **7.2.2 Positioning at Geotechnical Sample Stations**

For geotechnical soil sampling, northing and easting coordinates will be obtained during field activities using either a hand-held or rod-mounted GPS unit. For over-water sampling, station positioning from the sampling vessel will be accomplished using GPS equipment capable of sub-foot accuracies, recognizing that station accuracy may be affected by satellite positioning and obstructions, such as the railroad bridge, large vessels, and heavy cloud cover. For sampling stations, the sampling staff will record the coordinates for each sample location on the field forms. Difficulties in achieving satellite coverage will be noted in the field logbook.

## **8.0 QUALITY CONTROL**

### **8.1 CHANGE MANAGEMENT**

Changes to the sample stations and methodologies described in this FSP may be required during the field program. The protocols for change management, discussed in this section, will be applied to keep the project moving forward smoothly and efficiently.

#### **8.1.1 Field Decisions and Documentation**

Field teams will report field condition-driven deviations from the FSP to the FTL for consultation and determination of the appropriate response. This category of field changes includes moving a sample station due to obstacles or refusal, modifying target depths or acceptable sample recovery at core locations, and other routine field decisions that are not uncommon in a large sediment investigation field effort. The decision-making process for documenting field change will require 1) verbal communication with EPA to initially discuss the situation and possible solutions, and 2) written documentation of the change. When these conditions arise, the experienced field team and FTL will use best professional judgment to determine the appropriate course of action by first notifying the PM, who will then notify the appropriate EPA contact (or their designee) of the proposed modification in scope for EPA approval. Changes to the FSP will be documented and approved in the form of a field change request form (unless already approved orally by EPA in the field, in which case the oral approval will be documented in writing in the field change request form and daily report).

QA/QC procedures and sample requirements are detailed in the UFP-QAPP Worksheet #12. Field duplicates and other field QC samples, such as temperature blanks and rinsate blanks, will be collected as outlined in the project UFP-QAPP. Rinsate blanks will be collected by pouring deionized water over the sampling spoons and core tubes (if a liner is not used) after field decontamination.

#### **8.1.2 Project Management and EPA Decisions**

Some issues that deviate from the FSP, or other project plans, may require the decision-making process to be elevated to the HGL PM. These are deviations that fundamentally modify the project approach and put the ability to meet project objectives at risk. Once elevated to the HGL PM these issues would require resolution before work could continue. This category includes encountering conditions that significantly change the conceptual site model. Issues that require involvement and approval of the HGL PM and EPA also include significant safety concerns that require work to stop to make corrective actions. See the HASP for more information on project safety protocols.

## **8.2 ANALYTICAL REQUIREMENTS FOR FIELD QUALITY CONTROL**

Field data will be recorded in the field on data forms and in logbooks that the FTL will review at the end of each field day. The review will include ID of values outside of reasonable ranges and completeness. In addition, the FTL will download electronic files (GPS and digital photographs) at the end of each field day to ensure there are no data collection problems and that the data that

was to be recorded at each reach was obtained. The task manager will provide further review (QA/QC) of the field data logbooks, forms, and electronic files prior to transmittal to HGL.

Field QC samples will consist of FDs, MSs, MSDs, TBs, and EBs. Worksheet #20 in the UFP-QAPP provides a summary of the required QC samples, frequency, and analyses necessary to complete the sampling activities. Section 4.7.2.1.6 of this FSP describes the QC sample nomenclature.

### **8.3 SEDIMENT SAMPLES**

The comprehensive analytical list for surface sediments is presented in Worksheet #15 of the UFP-QAPP. As identified in Worksheets #19 and #30 of the UFP-QAPP, the different analytical methods used for the sampling program have unique extraction and hold time requirements. The following protocol for sediment sample archival (via freezing) is proposed. The laboratory hold time for the COCs listed in Worksheet #15 of the UFP-QAPP is 2 years for metals, 180 days for mercury, and 1 year for other material held at  $-10^{\circ}\text{C}$ , including PCB Aroclors, PCDD/PCDFs, and DDx (EPA, 2017a; EPA, 2019b).

### **8.4 GEOTECHNICAL SAMPLES**

Geotechnical samples will be evaluated to assess the physical and engineering properties of the soils encountered during the site investigation. Geotechnical laboratory testing will be performed in accordance with current ASTM standards (Worksheet #12.10 of the UFP-QAPP).

## **9.0 DATA MANAGEMENT PLAN**

To ensure that environmental data collected at the SIB adheres to certain standards and practices, a programmatic level DMP (EPA, 2020b) was developed that provides overall guidance and data requirements for the various performing parties who conduct sampling under the PDI.

### **9.1 OVERVIEW**

The objective of this DMP is to ensure that environmental and engineering data and supportive information are collected and documented in a consistent manner and managed in a manner that preserves, protects, and makes the information available to stakeholders, primary parties (PPs), and other affected groups. This DMP applies to data and information collected in support of the PHSS by the PPs involved in RD sampling activities and select engineering activities. While previous sections cover how other information (e.g., photographs, field logs) is managed, this section is intended to address the type of data deemed critical to overall decision making and RD for the site.

### **9.2 FIELD DATA MANAGEMENT**

The following data management procedures will be performed for engineering and scientific activities in the field:

- Samples will be given a unique identifier (Section 4.7.2, Field Sample Identification, Tracking, and Labeling of this FSP).
- Samples will be collected and transported under CoC control (Section 4.7.3, Sample Chain of Custody of this FSP).
- Deviations from the FSP are clearly recorded in logbooks.
- Field logbooks and data sheets will be maintained (Section 6.1, Field Logbook of this FSP).
- Field QA/QC samples will be collected according to Worksheet #12 of the UFP-QAPP.

### **9.3 FIELD SAMPLING ACTIVITIES**

At end of each field day, the FTL will upload copies of the field records including physical and/or electronic field notes, field sampling forms, and CoCs to the HGL SharePoint site. Original logbooks and forms will be kept in the project file until project closeout.

#### **9.3.1 Electronic Data Management**

Field logbooks and field forms will be scanned into legible PDF and retained in both electronic versions on SharePoint and printed versions stored in a safe location for inclusion into site reports as appendices.

Field sampling data and analytical results will be maintained by HGL in EQUIS™ database developed by Earthsoft, Inc. Field measurements, sample data, and CoC information will be

managed electronically using an approved software tool. This software tool will be used to capture sampling, observational, and monitoring field data; print labels for collected samples; generate CoC documentation; and transmit CoC reports and sample collection information to the EPA PM or laboratory electronically. The field data will be uploaded to EQUiS™ daily in preparation for submittal of the analytical results and to facilitate electronic sample tracking. At the completion of field activities, the laboratory will prepare EQUiS™ EDDs with laboratory analytical data that the data manager will upload into the HGL EQUiS™ database. Unvalidated data will be flagged in the database as “draft.”

Contracted laboratories will follow EDD procedures covered in the UFP-QAPP and their respective subcontracts.

### **9.3.2 Post-Analysis Data Management**

Analytical laboratories will be required to adhere to QA/QC procedures outlined in the UFP-QAPP. Laboratories will provide data for field investigations in electronic format and QA/QC reports, including a narrative of the standard QA/QC protocols. Data validation and data management will be performed according to the UFP-QAPP by a third-party data validator.

The validator will be provided with an EQUiS™ validation EDD for each analytical package. The validator will update the EDD with validation qualifiers and reason codes; and will flag one result of any duplicate, dilution, or replicate analyses as “reportable.” Following data validation, the data validation EDD will be uploaded into the EQUiS™ database and the corresponding analytical results will be flagged as “final.” After data validation and database management are completed, final data summary files will be completed. The project database will allow for data export into formats consistent with other post-ROD sediment investigations.

## **9.4 ENGINEERING ACTIVITIES**

### **9.4.1 Electronic Data Management**

The Database Manager will incorporate select electronic field data into the engineer’s project database. Electronic data will be managed in accordance with the EPA *Program Data Management Plan: Portland Harbor Remedial Design Investigation* (EPA, 2020b) or the most up-to-date EPA guidance.

### **9.4.2 Post-Analysis Data Management**

Analytical laboratories will be required to adhere to QA/QC procedures outlined in the UFP-QAPP. Laboratories will provide data for field investigations in electronic format and QA/QC reports, including a narrative of the standard QA/QC protocols. Data validation and data management will be performed according to the UFP-QAPP by a third-party data validator.

Following data validation, data, supplementary information, and validator qualifiers will be compiled into a database for the project. After data validation and database management are completed, final data summary files will be completed. The project database will allow for data export into formats consistent with other post-ROD sediment investigations.

## **9.5 LABORATORY SELECTION**

With the large numbers of samples and multiple analytes, it is best to separate the sample analyses among laboratories that specialize in certain analytical methods and have the capacity to complete the work on schedule. For analytical consistency such as with preparation methods and detection and reporting limits, the same laboratories will be used to perform the physical and chemical analyses:

- A laboratory will be selected to analyze for chlorinated pesticides, PAHs, phthalates, TBT, and total solids.
- A laboratory will be selected to analyze for PCB Aroclors, total petroleum hydrocarbons diesel extended range, metals including mercury, total organic carbon, grain size, and total solids.
- A laboratory will be selected to analyze for dioxins/furans.
- A laboratory will be selected to analyze for PCB congeners and specific gravity.
- Laboratories with detection limits below ROD Table 17 CULs and/or ROD Table 21 RALs will be selected to the greatest extent practicable.

Samples will be placed in laboratory-supplied sample containers and preserved according to analytical protocols. Sample containers, preservation requirements, holding times, and sample sizes are provided for analytes and analyses in Worksheets #19 and #30 of the UFP-QAPP. Additional details on the analytical methods, QA/QC requirements and procedures, and laboratory-specific QA/QC requirements are detailed in the UFP-QAPP.

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## **10.0 PERMITS AND ACCESS AGREEMENTS**

CERCLA response actions are exempt from the requirement to obtain federal, state, or local permits, and that exemption should apply to PDI sampling activities conducted under the terms of the ASAOC. Under the terms of the exemption, the work would still require coordination with regulatory agencies, and the work would have to meet the substantive requirements of the regulations applicable to those permits. Two specific permits that would normally apply to the PDI in-water sampling activities are identified and described below.

The investigation area is within the Willamette River, and the proposed sampling locations are below the OHW line in this area. These activities require Oregon Division of State Lands permission for access (i.e., application and fee for Short Term Access Agreement). Additionally, access agreements will need to be negotiated with the City to enter the stormwater conveyance systems and with private property owners to access the stormwater systems and riverbanks.

For sampling, if the total volume of sediment disturbed is less than 10 cubic yards, then the project would likely qualify for a Minimal Disturbance General Authorization. Per USACE, sediment sampling and other in-water disturbance activities are authorized under Nationwide Permit 6 – Survey Activities; submittal of a General Authorization application will be required. If EPA requires work outside of the in-water work window, USACE can authorize under a SLOPES STU variance. Applications should be submitted at least 6 months in advance of the in-water sampling.

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## **11.0 HEALTH AND SAFETY**

Field survey and sampling activities will be conducted according to HGL’s Health, Safety, and Environment Program requirements, which include project-specific field safety instructions. In accordance with HGL policy, HGL field team members and subcontractors must successfully satisfy HGL and site-specific health and safety requirements before working on the site, including Drug-Free Workplace training, wearing required personal protective equipment, and other requirements of the field safety instructions. Employees working over or near water will be provided with U.S. Coast Guard-approved life jackets or buoyant work vests. See the project-specific HASP, which includes an ERP, for further information.

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## **12.0 REPORTING**

Field sampling activities and results will be summarized in the PDI Evaluation Report. In accordance with the contract statement of work, the report will include the following:

- 1) Summary of the investigations performed;
- 2) Summary of deviations from the FSP;
- 3) Summary of investigation results;
- 4) Summary of validated data (i.e., tables and graphics);
- 5) Data validation reports and laboratory data reports;
- 6) Narrative interpretation of data and results;
- 7) Results of statistical and modeling analyses, if applicable;
- 8) Photographs documenting the work conducted; and
- 9) Conclusions and recommendations on whether the data is sufficient to complete the BODR.

Engineering data, particularly survey data, will be summarized in the PDI Evaluation Report and incorporated into the BODR.

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## 13.0 REFERENCES

- AECOM Technical Services (AECOM) and Geosyntec Consultants, Inc. (Geosyntec), 2018a. *Surface Sediment Field Sampling Plan*, Portland Harbor Pre-Remedial Design Investigation and Baseline Sampling. Portland Harbor Superfund Site. June.
- AECOM and Geosyntec, 2018b. *Surface Water and Sediment Trap Field Sampling Plan*, Portland Harbor Pre-Remedial Design Investigation and Baseline Sampling. Portland Harbor Superfund Site. September 27.
- American Society of Civil Engineers (ASCE), 2015. *ASCE Manual of Practice 130*, Waterfront Facilities Inspection and Assessment Manual of Practice.
- American Society of Testing and Materials (ASTM), 1999. D 3977-97, *Standard Test Method for Determining Sediment Concentration in Water Samples*, ASTM International, West Conshohocken, PA, at URL [www.astm.org](http://www.astm.org).
- ASTM, 2014. D4220 / D4220M-14, *Standard Practices for Preserving and Transporting Soil Samples*, ASTM International, West Conshohocken, PA, at URL [www.astm.org](http://www.astm.org).
- ASTM, 2017. D2488-17e1, *Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)*, ASTM International, West Conshohocken, PA, at URL [www.astm.org](http://www.astm.org).
- ASTM, 2018. D1586, *Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils*, ASTM International, West Conshohocken, PA, at URL [www.astm.org](http://www.astm.org).
- ASTM, 2020. D5778-20, *Standard Test Method for Electronic Friction Cone and Piezocone Penetration Testing of Soils*, ASTM International, West Conshohocken, PA, at URL [www.astm.org](http://www.astm.org).
- Bridgewater, 2020. Interim Report for Source Control Evaluation: Updated Final Groundwater Monitoring Well Installation and Development, 2017 – 2018 Sampling and Analyses, and Proposed Transition Zone Water Sampling and Analyses. Revised August 13.
- Camp, T.R., 1946. Design of Sewers to Facilitate Flow, *Sewage Works Journal* 18 (3).
- Chow, V. T., 1959. *Open Channel Hydraulics*, New York: McGraw-Hill.
- Foth Infrastructure & Environment, LLC. 2021. Final Pre-Design Investigation Work Plan, River Mile 9 West – Portland harbor Superfund Site, Portland, Oregon. February.
- Geosyntec, 2016. *Sampling and Analysis Plan*, Swan Island Lagoon, Portland, Oregon.
- Gravity Consulting, Inc, 2021. SW-27, *Standard Operating Procedure for High-Volume Storm Water Sampling for Analysis of Compounds with Low Detection Limits*.

- HydroGeoLogic, Inc. (HGL), 2021a. *Draft Pre-Design Investigation Work Plan*, Remedial Design Services, Swan Island Basin Project Area, Portland Harbor Superfund Site, Portland, Multnomah County, Oregon.
- HGL, 2021b. *Draft Uniform Federal Policy - Quality Assurance Project Plan*. Remedial Design Services, Swan Island Basin Project Area, Portland Harbor Superfund Site, Portland, Multnomah County, Oregon.
- HGL, 2021c. *Draft Health and Safety Plan*. Remedial Design Services, Swan Island Basin Project Area, Portland Harbor Superfund Site, Portland, Multnomah County, Oregon.
- HGL, 2021d. *Draft Emergency Response Plan*. Remedial Design Services, Swan Island Basin Project Area, Portland Harbor Superfund Site, Portland, Multnomah County, Oregon.
- Integral, 2004. *Round 2 Field Sampling Plan*. Sediment Sampling and Benthic Toxicity Testing Prepared for the Lower Willamette Group (LWG) for submittal and approval by EPA Region 10. June.
- Integral, 2006. *Preliminary Upstream & Downstream Sediment Data Evaluation and Round 3A Field Sampling Plan for Upstream & Downstream Sediment Sampling*. Prepared for the Lower Willamette Group (LWG) for submittal and approval by EPA Region 10.
- Interstate Technology Regulatory Council, 2020. Incremental Sampling Methodology Update (ISM-2). <https://ism-2.itrcweb.org>
- Oregon Department of Environmental Quality (ODEQ) and U.S. Environmental Protection Agency (EPA), 2005. *Portland Harbor Joint Control Strategy*, Portland Harbor Superfund Site, Portland, Oregon.
- National Oceanic and Atmospheric Administration (NOAA), 2019. BookletChart 18527, Willamette River – Swan Island Basin, OR.
- Pacific Groundwater Group (PGG), 2018. *Surface and Subsurface Sediment Field Sampling Plan*, Swan Island Lagoon, Portland Harbor Superfund Site, Portland, Oregon.
- Puget Sound Estuary Program, 1996. *Puget Sound Estuary Program: Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound*. Final Report. TC-3991-04. Prepared for U.S. Environmental Protection Agency, Region 10 and Puget Sound Estuary Program, Seattle, Washington. Tetra Tech and HRA, Inc., Bellevue, Washington.
- Rosgen, D., 2014. *River Stability Field Guide*.
- Sea Engineering, Inc., 2006. *Sedflume Analysis*, Willamette River, Portland, OR.
- Suter, G. W. and Tsao, C. L. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision. Risk Assessment Program, Health Sciences Research Division, Oak Ridge, Tennessee. June.

- U.S. Army Corps of Engineers (USACE), 1966. Aerial photograph COE 324 taken February 22, 1966.
- USACE, 2003. *Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities*, Testing Manual.
- USACE, 2014. Kalamazoo River Cohesive Sediment Erosion Field Study.
- U.S. Environmental Protection Agency (EPA), 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies*. EPA/540/G 89/004.
- EPA, 2014. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846)*, Third Edition, Update V.
- EPA, 2016a. *Portland Harbor RI/FS, Final Remedial Investigation Report*, Portland Oregon. United States Environmental Protection Agency Region 10, Seattle, Washington. February.
- EPA, 2016b. *Portland Harbor RI/FS, Final Feasibility Study*, Portland Oregon. United States Environmental Protection Agency Region 10, Seattle, Washington. June.
- EPA, 2017a. *Record of Decision*, Portland Harbor Superfund Site, Portland Oregon. United States Environmental Protection Agency Region 10, Seattle, Washington.
- EPA, 2017b. *ASAOC between EPA and the Pre-RD AOC Group for Pre-Remedial Design Investigation Studies*, Portland Harbor Superfund Site, Portland Oregon. United States Environmental Protection Agency Region 10, Seattle, Washington.
- EPA, 2018. *Program Data Management Plan*, Portland Harbor Remedial Design Investigation Portland Harbor Superfund Site, Portland, Oregon.
- EPA, 2019a. *Explanation of Significant Differences*, Portland Harbor Superfund Site, Multnomah County, Oregon.
- EPA, 2019b. *Guidance for River Bank Characterizations and Evaluations at the Portland Harbor Superfund Site*, Portland, Oregon. September 10.
- EPA, 2020a. Errata #2 for Portland Harbor Superfund Site Record of Decision Table 17. January.
- EPA, 2020. *Program Data Management Plan: Portland Harbor Remedial Design Investigation*, Portland Harbor Superfund Site, Portland, Oregon.
- EPA, 2021. *Remedial Design Guidelines and Considerations*, Portland Harbor Superfund Site Portland, Oregon.
- EPA and Willamette Cove Group, 2019. *Administrative Settlement Agreement and Order on Consent for Remedial Design at Willamette Cove Project Area*, Portland Harbor Superfund Site, Portland, Oregon.

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## **TABLES**

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**Table 2-1  
Data Gap Summary Table, Portland Harbor Superfund Site  
Field Sampling Plan, Swan Island Basin Project Area, Portland, Oregon**

<b>Data Type</b>	<b>Data Gaps</b>	<b>Proposed Data Collection</b>
Surface Sediment Contaminant Concentrations	Minor gaps in spatial coverage to characterize horizontal extent of contamination within SMA	30 surface samples to fill data gaps and refine delineation of SMA boundary (5 surface grabs, 25 samples collected from 0- to 1-foot interval of selected cores)
	Data needed to support analysis of short-term water quality effects during dredging activities	3 bulk sediment samples to support DRET
Subsurface Sediment Contaminant Concentrations	Insufficient core data to characterize vertical extent of contamination within SMA	171 cores to 10-foot depth (including 2 cores archived); 10 cores to 20-foot depth. Sample 150-foot grid
		Sample at 1-foot intervals from 1- to 6-foot depth for 10-foot cores, and 1- to 15-foot depth for 20-foot cores (total 985 samples)
Riverbank Characterization	Riverbanks within SIB Project Area not adequately characterized to assess source	Visual survey of physical bank conditions to evaluate erosion potential and delineate areas of potentially erodible sediments
	control sufficiency and inform stabilization as part of RD	Coordinate with geotechnical sampling program to evaluate geotechnical failure potential and characterize soil conditions (e.g., grain size, soil erodibility)
Geotechnical Site Characterization	Site stratigraphy and geotechnical design parameters	Historical geological and geotechnical records and survey maps
		New program of in-water borings, upland borings, CPTs, and groundwater elevation observations.
		Total of 31 borings and 15 CPTs
Sediment Porewater Characterization	No available data to map upward porewater migration within areas of potential sediment capping	Transect survey using vessel-mounted or towed instrument for thermal profiling at sediment/water interface within SMA
Stormwater Outfall and Conveyance System Sampling	Lack of adequate data on RPC loading from municipal and private outfalls to determine source	Inventory of the current status of discharges from private outfalls RPC exceedances in sediments
	control sufficiency and complete the Sufficiency Assessment Report	Conduct high-volume, flow-weighted sampling to support RPC load calculations at five municipal SW outfalls

**Table 2-1 (continued)**  
**Data Gap Summary Table, Portland Harbor Superfund Site**  
**Field Sampling Plan, Swan Island Basin Project Area, Portland, Oregon**

<b>Data Type</b>	<b>Data Gaps</b>	<b>Proposed Data Collection</b>
Stormwater Outfall and Conveyance System Sampling  (continued)		Collect SW grab samples and SW solids samples using in-line traps at 11 locations
		Conduct reconnaissance of six private outfalls to determine if additional sampling is necessary
Bathymetry and Topography	Complete recent multi-beam survey of the SIB Project Area for use in analysis and RD	Sitewide multi-beam bathymetric survey with complete coverage
Shoreline and Overwater Structures and Activities	Structural information required to make a functional structures determination and evaluate RA impacts on existing structures, and overwater activities to determine recontamination	Structural information for all potentially affected shoreline and over-water structures
		Mobile Terrestrial LiDAR Survey
		Land-based and water-based inspections
		Owner/operator interviews to evaluate activities and future use
Hydrodynamics and Sediment Dynamics Measurements	Hydrodynamic/transport processes for conceptual site model refinement, data for model validation, and data for direct use in RD	Owner/operator interviews to determine current and future navigation requirements
		Measurement of:
		Currents from vessel-mounted instruments
		Currents from bottom-mounted instruments
		Suspended sediments, wind waves, and boat wakes
Existing Utilities and Debris Identification	Locations and elevations of existing utilities and marine debris affecting RA	Sediment erodibility (SedFlume cores) at 30 locations
		Sub-bottom profile survey along transects
		Magnetometer survey along transects
Flood Impact Evaluation	Understanding of potential RA impacts on 500-year flood elevations	Side-scan sonar with complete coverage
		Flood impact modeling to evaluate potential net rise due to RA

**Table 2-1 (continued)**  
**Data Gap Summary Table, Portland Harbor Superfund Site**  
**Field Sampling Plan, Swan Island Basin Project Area, Portland, Oregon**

Data Type	Data Gaps	Proposed Data Collection
Habitat Conditions Survey	Aquatic and terrestrial habitat conditions in shallow nearshore zone and on riverbanks not adequately documented to support analysis of RD	Conduct a habitat conditions survey focused on shorelines to document bank conditions and substrate conditions within the shallow nearshore zone
	impacts to aquatic resources within waters of the U.S.	Coordinate habitat survey with riverbank characterization for efficiency based on overlapping information needs

**Notes:**

Study Area = Swan Island Basin Study Area between river miles 8.1 and 9.2

**Acronyms:**

- CPTs = cone penetration tests
- DRET = dredge elutriate testing
- LiDAR = light detection and ranging
- RA = Remedial Action
- RD = Remedial Design
- RPC = recontamination potential chemical
- SIB = Swan Island Basin
- SMA = Sediment Management Area
- SW = stormwater

**Table 2-2**  
**Cleanup Levels for Sediment and Riverbank Soil, Portland Harbor Superfund Site**  
**Field Sampling Plan, Swan Island Basin, Portland, Oregon**

<b>Riverbank Soil/Sediment Cleanup Levels (CULs) <sup>1</sup></b>		
<b>Contaminant</b>	<b>Unit</b>	<b>Concentration</b>
Aldrin	µg/kg	2
Arsenic	mg/kg	3 (B)
BEHP	µg/kg	135
Cadmium	mg/kg	0.51
Chlordane	µg/kg	1.4
Copper	mg/kg	359
DDD	µg/kg	114
DDE	µg/kg	50
DDT	µg/kg	246
DDx	µg/kg	6.1
Dieldrin	µg/kg	0.07
HxCDF	µg/kg	0.0004 (B)
Lindane	µg/kg	5
Lead	mg/kg	196
Mercury	mg/kg	0.085
PCBs	µg/kg	9 (B)
PAHs	µg/kg	23000
cPAHs (BaP eq)	µg/kg	774/85/1,076
Dioxins/Furans (2,3,7,8-TCDD eq)	µg/kg	0.01
PeCDD	µg/kg	0.0002 (B)
PeCDF	µg/kg	0.0003 (B)
TCDD	µg/kg	0.0002 (B)
TCDF	µg/kg	0.00040658 (B)
TPH-Diesel	mg/kg	91
Tributyltin	µg/kg	3080
Zinc	mg/kg	459

**Footnotes:**

<sup>1</sup> Portland Harbor Superfund Site (PHSS) Record of Decision (ROD) Table 17 as revised by U.S. Environmental Protection Agency Errata #2 for PHSS ROD Table 17 dated January 14, 2020.

**Acronyms:**

µg/kg = micrograms per kilogram

mg/kg = milligrams per kilogram

B = Background-based number

BaP eq = benzo(a)pyrene equivalent

BEHP = bis(2-ethylhexyl)phthalate

DDD = dichlorodiphenyldichloroethane

DDE = dichlorodiphenyldichloroethene

DDT = dichlorodiphenyltrichloroethane

DDx = DDD + DDE + DDT

HxCDF = 1,2,3,4,7,8-hexachlorodibenzofuran

PAH = polycyclic aromatic hydrocarbon

PCB = polychlorinated biphenyl

PeCDD = 1,2,3,7,8-pentachlorodibenzo-p-dioxin

PeCDF = 2,3,4,7,8-pentachlorodibenzofuran

TCDD = 2,3,7,8-tetrachlorodibenzo-p-dioxin

TCDF = 2,3,7,8-tetrachlorodibenzofurans

TPH = total petroleum hydrocarbons

**Table 4-1  
Summary of Sample Activities, Numbers, and Analyses, Portland Harbor Superfund Site  
Field Sampling Plan, Swan Island Basin Study Area, Portland, Oregon**

Sample Type	Number of Stations	Number of Samples	Analyses
Surface Sediment	30	Surface samples: 30	All sediment COCs (ROD Table 17)
		5 grab only	
Subsurface Sediment Cores	181	Cores: 181	All sediment COCs (ROD Table 17)
		Samples: 985	
Sediment Erodibility (SedFlume)	30	30	Per subcontractor statement of work
Dredge Elutriate Sediments	3	3	All surface water COCs (ROD Table 17)
Riverbank	150	Surface Soils: 150	All riverbank soil COCs (ROD Table 17)
		Subsurface Soils: 150	
Geotechnical Investigation	Borings: 31	Between 12 and 17 (50-60 ft total; every 2-3 ft in the upper 15 ft and at 5- ft intervals thereafter)	Natural moisture content (ASTM D2216) Sieve analysis (ASTM D6913) Hydrometer analysis (ASTM D7928) Sieve and hydrometer analysis (ASTM D6913; ASTM D7928) Atterberg limits (ASTM D4318-17e1) Specific gravity determinations (ASTM D5550-14) Direct shear test (ASTM D3080) Consolidated undrained triaxial tests with pore pressure measurements (ASTM D4767) Consolidation tests (ASTM D2435)
	Cone Penetration Tests: 15		
Stormwater and Stormwater Solids	City of Portland Stormwater Outfall Stations: 5, 3 Events	HVS Stormwater: 15	All surface water COCs (ROD Table 17)
		HVS Solids: 15	Focused COCs
		12 Sediment Trap Stations - In-Line Solids: 24	Focused COCs
	Private Manhole Stations: 6	Manual Grab Aqueous: 18	All surface water COCs (ROD Table 17)
		Manual Grab Solids: 6	Focused COCs
City of Portland Stormwater Outfall Stations: 5	Manual Grab Solids: 5	Focused COCs	

**Notes:**

Surface samples will target 0- to 30-centimeter depth  
 Study Area = Swan Island Basin Study Area between river miles 8.1 and 9.2.  
 See Table 2.2 for details on focused COCs and SIB RPCs.

**Acronyms:**

ASTM = ASTM International  
COCs = contaminants of concern  
HVS = high-volume sampling  
ROD = Record of Decision

RPC = recontamination potential chemical  
SIB = Swan Island Basin  
TBD = To Be Determined based on Phase 1 results

**Sources:**

ASTM, 2014. D5550-14, Standard Test Methods for Specific Gravity of Soil Solids by Gas Pycnometer, ASTM International, West Conshohocken, PA, at URL [www.astm.org](http://www.astm.org).  
ASTM, 2017a. D4318-17e1, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils, ASTM International, West Conshohocken, PA, at URL [www.astm.org](http://www.astm.org).  
ASTM, 2017b. D6913 / D6913M-17, Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis, ASTM International, West Conshohocken, PA, at URL [www.astm.org](http://www.astm.org).  
ASTM, 2017c. D6919-17, Standard Test Method for Determination of Dissolved Alkali and Alkaline Earth Cations and Ammonium in Water and Wastewater by Ion Chromatography, ASTM International, West Conshohocken, PA, at URL [www.astm.org](http://www.astm.org).  
ASTM, 2017d. D6928-17, Standard Test Method for Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus, ASTM International, West Conshohocken, PA, at URL [www.astm.org](http://www.astm.org).  
ASTM, 2017e. D7928-17, Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis, ASTM International, West Conshohocken, PA, at URL [www.astm.org](http://www.astm.org).  
ASTM, 2019. D2216-19, Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass, ASTM International, West Conshohocken, PA, at URL [www.astm.org](http://www.astm.org).  
ASTM, 2020a. D2435 / D2435M-11(2020), Standard Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading, ASTM International, West Conshohocken, PA, at URL [www.astm.org](http://www.astm.org).  
ASTM, 2020b. D3080/D3080M-11 (Withdrawn 2020), Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions, ASTM International, West Conshohocken, PA, at URL [www.astm.org](http://www.astm.org).  
ASTM, 2020c. D4767-11(2020), Standard Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils, ASTM International, West Conshohocken, PA, at URL [www.astm.org](http://www.astm.org).

**Table 4-2**  
**Surface Sediment Sample Locations, Portland Harbor Superfund Site**  
**Field Sampling Plan, Swan Island Basin Study Area, Portland, Oregon**

Location ID <sup>a</sup>	Node X	Proposed Grid Cell ID		Target Bottom (cm)	Sample Collection Type	SMA <sup>b</sup>
		Node Y	Target Top (cm)			
05B	5	B	0	30	Top Core Interval	Edge
06B	6	B	0	30	Grab	Edge
07B	7	B	0	30	Grab	Edge
09B	9	B	0	30	Top Core Interval	Edge
18B	18	B	0	30	Top Core Interval	Edge
24B	24	B	0	30	Top Core Interval	Edge
25B	25	B	0	30	Top Core Interval	Edge
30B	30	B	0	30	Top Core Interval	Edge
31B	31	B	0	30	Top Core Interval	Edge
37B	37	B	0	30	Top Core Interval	Edge
22C	22	C	0	30	Top Core Interval	Edge
24C	24	C	0	30	Top Core Interval	Edge
25C	25	C	0	30	Top Core Interval	Edge
26C	26	C	0	30	Top Core Interval	Edge
27C	27	C	0	30	Top Core Interval	Edge
28C	28	C	0	30	Top Core Interval	Edge
32C	32	C	0	30	Grab	Edge
34C	34	C	0	30	Top Core Interval	Edge
36C	36	C	0	30	Grab	Edge
37C	37	C	0	30	Top Core Interval	Edge
37E	37	E	0	30	Top Core Interval	Edge
01G	1	G	0	30	Top Core Interval	Edge
01H	1	H	0	30	Top Core Interval	Edge
02H	2	H	0	30	Top Core Interval	Edge
03I	3	I	0	30	Top Core Interval	Edge
03J	3	J	0	30	Top Core Interval	Edge
04M	4	M	0	30	Top Core Interval	Edge
07N	7	N	0	30	Top Core Interval	Edge
07P	7	P	0	30	Top Core Interval	Edge
08P	8	P	0	30	Grab	Edge

**Notes:**

Surface samples will be collected from one side of a divided core from 0 to 1 feet, or split from homogenized grab sediments. The other half and remaining undivided cores and homogenized grab sediments will be archived for future use. See FSP for more details.

Study Area = Swan Island Basin Study Area between river miles 8.1 and 9.2.

**Footnotes:**

a) Sample IDs will include Location ID, sample type, depth of sampling interval in cm, and date.

b) All Phase 1 surface samples will be collected from 150- by 150-foot grid cells along the edge of the ROD-defined SIB SMA

**Acronyms:**

cm = centimeter

FSP = Field Sampling Plan

ID = identification

ROD = Record of Decision

SIB = Swan Island Basin

SMA = Sediment Management Area

**Table 4-3**  
**Subsurface Sediment Sample Locations, Portland Harbor Superfund Site**  
**Field Sampling Plan, Swan Island Basin Study Area, Portland, Oregon**

Location ID <sup>a</sup>	Proposed Grid Cell ID		Cell-Center Mudline Depth <sup>b</sup> (NAVD88)	Cell-Center Mudline Depth (CRD ft)	Target Penetration Depth (ft)	Minimum Recovery <sup>c</sup> (ft)	Target Sample Intervals (cm below mudline)	SMA <sup>d</sup>
	Node X	Node Y						
04BY	4	B	10.7	5.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
05BY	5	B	3.0	-2.3	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
08BY	8	B	-6.9	-12.2	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
09BY	9	B	-4.2	-9.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
10BY	10	B	4.6	-0.7	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
11BY	11	B	-0.4	-5.7	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
13BY	13	B	2.1	-3.1	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
18BY	18	B	7.4	2.2	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
19BY	19	B	6.6	1.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
20BY	20	B	14.4	9.1	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
22BY	22	B	9.4	4.1	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Outside
23BY	23	B	8.9	3.6	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Outside
24BY	24	B	8.9	3.6	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Outside
25BY	25	B	7.6	2.3	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Outside
26BY	26	B	5.8	0.5	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Outside
28BY	28	B	-10.4	-15.7	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Outside
29BY	29	B	-9.4	-14.7	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Outside
30BY	30	B	-1.5	-6.8	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
31BY	31	B	-3.6	-8.9	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
32BY	32	B	6.2	0.9	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
33BY	33	B	7.0	1.7	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Outside
34BY	34	B	7.3	2.0	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
35BY	35	B	7.7	2.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
37BY	37	B	11.9	6.6	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
03CY	3	C	2.1	-3.2	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
05CY	5	C	-18.2	-23.5	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
06CY	6	C	-23.3	-28.6	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
07CY	7	C	-24.1	-29.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
08CY	8	C	-23.8	-29.0	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
09CY	9	C	-20.6	-25.9	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
10CY	10	C	-20.2	-25.5	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
11CY	11	C	-16.5	-21.8	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
12CY	12	C	-17.3	-22.5	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
13CY	13	C	-16.4	-21.7	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
14CY	14	C	-16.6	-21.9	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
18CY	18	C	-12.4	-17.7	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
19CY	19	C	-15.6	-20.9	20	16	30-60; 60-90; 90-120; 120-150; 150-180; 180-210; 210-240; 240-270; 270-300; 300-330; 330-360; 360-390; 390-420; 420-450	Inside
20CY	20	C	-17.2	-22.5	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
22CY	22	C	-16.6	-21.9	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
23CY	23	C	-20.4	-25.7	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
24CY	24	C	-19.9	-25.1	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
25CY	25	C	-20.2	-25.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
26CY	26	C	-19.7	-24.9	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
27CY	27	C	-19.1	-24.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge

**Table 4-3 (Continued)**  
**Subsurface Sediment Sample Locations, Portland Harbor Superfund Site**  
**Field Sampling Plan, Swan Island Basin Study Area, Portland, Oregon**

Location ID <sup>a</sup>	Proposed Grid Cell ID		Cell-Center Mudline Depth <sup>b</sup> (NAVD88)	Cell-Center Mudline Depth (CRD ft)	Target Penetration Depth (ft)	Minimum Recovery <sup>c</sup> (ft)	Target Sample Intervals (cm below mudline)	SMA <sup>d</sup>
	Node X	Node Y						
28CY	28	C	-18.2	-23.5	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
30CY	30	C	-17.2	-22.5	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
31CY	31	C	-16.1	-21.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
33CY	33	C	-11.9	-17.2	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
34CY	34	C	-10.2	-15.5	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
35CY	35	C	-8.5	-13.8	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
37CY	37	C	5.8	0.5	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
02DY	2	D	7.4	2.2	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
05DY	5	D	-22.8	-28.1	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
06DY	6	D	-23.8	-29.1	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
07DY	7	D	-24.7	-30.0	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
08DY	8	D	-24.5	-29.7	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
10DY	10	D	-25.7	-31.0	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
12DY	12	D	-26.6	-31.9	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
13DY	13	D	-26.5	-31.7	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
14DY	14	D	-26.1	-31.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
15DY	15	D	-26.2	-31.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
17DY	17	D	-24.3	-29.6	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
18DY	18	D	-22.4	-27.7	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
19DY	19	D	-25.0	-30.3	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
22DY	22	D	-22.9	-28.2	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
23DY	23	D	-21.6	-26.9	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
25DY	25	D	-20.6	-25.9	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
26DY	26	D	-19.7	-24.9	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
30DY	30	D	-16.8	-22.1	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
31DY	31	D	-15.7	-21.0	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
33DY	33	D	-12.1	-17.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
35DY	35	D	-7.4	-12.7	20	16	30-60; 60-90; 90-120; 120-150; 150-180; 180-210; 210-240; 240-270; 270-300; 300-330; 330-360; 360-390; 390-420; 420-450	Inside
36DY	36	D	-3.7	-9.0	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
37DY	37	D	6.9	1.6	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
02EY	2	E	-10.2	-15.5	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
03EY	3	E	-18.6	-23.9	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
04EY	4	E	-27.8	-33.0	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
05EY	5	E	-28.8	-34.1	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
06EY	6	E	-28.1	-33.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
07EY	7	E	-28.2	-33.5	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
08EY	8	E	-28.1	-33.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
09EY	9	E	-27.9	-33.2	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
10EY	10	E	-27.9	-33.2	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
11EY	11	E	-27.8	-33.1	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
13EY	13	E	-28.0	-33.3	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
14EY	14	E	-27.7	-33.0	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
15EY	15	E	-27.9	-33.2	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
17EY	17	E	-27.0	-32.3	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside

**Table 4-3 (Continued)**  
**Subsurface Sediment Sample Locations, Portland Harbor Superfund Site**  
**Field Sampling Plan, Swan Island Basin Study Area, Portland, Oregon**

Location ID <sup>a</sup>	Proposed Grid Cell ID		Cell-Center Mudline Depth <sup>b</sup> (NAVD88)	Cell-Center Mudline Depth (CRD ft)	Target Penetration Depth (ft)	Minimum Recovery <sup>c</sup> (ft)	Target Sample Intervals (cm below mudline)	SMA <sup>d</sup>
	Node X	Node Y						
18EY	18	E	-26.4	-31.7	20	16	30-60; 60-90; 90-120; 120-150; 150-180; 180-210; 210-240; 240-270; 270-300; 300-330; 330-360; 360-390; 390-420; 420-450	Inside
19EY	19	E	-26.0	-31.2	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
20EY	20	E	-27.0	-32.3	20	16	30-60; 60-90; 90-120; 120-150; 150-180; 180-210; 210-240; 240-270; 270-300; 300-330; 330-360; 360-390; 390-420; 420-450	Inside
22EY	22	E	-25.2	-30.5	20	16	30-60; 60-90; 90-120; 120-150; 150-180; 180-210; 210-240; 240-270; 270-300; 300-330; 330-360; 360-390; 390-420; 420-450	Inside
23EY	23	E	-24.4	-29.7	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
24EY	24	E	-29.1	-34.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
25EY	25	E	-20.0	-25.2	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
26EY	26	E	-16.6	-21.9	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
27EY	27	E	-18.5	-23.7	20	16	30-60; 60-90; 90-120; 120-150; 150-180; 180-210; 210-240; 240-270; 270-300; 300-330; 330-360; 360-390; 390-420; 420-450	Inside
28EY	28	E	-17.1	-22.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
29EY	29	E	-17.6	-22.8	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
30EY	30	E	-16.5	-21.8	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
31EY	31	E	-16.1	-21.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
32EY	32	E	-15.6	-20.9	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
33EY	33	E	-13.2	-18.5	20	16	30-60; 60-90; 90-120; 120-150; 150-180; 180-210; 210-240; 240-270; 270-300; 300-330; 330-360; 360-390; 390-420; 420-450	Inside
34EY	34	E	-10.1	-15.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
35EY	35	E	-6.7	-12.0	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
36EY	36	E	-2.9	-8.2	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
37EY	37	E	5.4	0.1	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
02FY	2	F	-18.3	-23.6	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
03FY	3	F	-32.0	-37.3	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
04FY	4	F	-29.5	-34.7	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
05FY	5	F	-30.0	-35.3	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
06FY	6	F	-29.9	-35.1	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
08FY	8	F	-28.3	-33.6	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
09FY	9	F	-27.2	-32.5	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
11FY	11	F	-27.7	-32.9	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
12FY	12	F	-27.8	-33.1	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
13FY	13	F	-27.3	-32.6	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
14FY	14	F	-29.1	-34.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
17FY	17	F	-27.7	-33.0	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
18FY	18	F	-27.9	-33.2	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
20FY	20	F	-27.6	-32.8	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
21FY	21	F	-26.1	-31.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
22FY	22	F	-26.8	-32.0	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
23FY	23	F	-31.3	-36.6	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
25FY	25	F	-15.3	-20.5	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
27FY	27	F	-13.9	-19.2	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
28FY	28	F	-13.7	-19.0	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
31FY	31	F	-14.2	-19.5	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
32FY	32	F	-13.9	-19.2	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside

**Table 4-3 (Continued)**  
**Subsurface Sediment Sample Locations, Portland Harbor Superfund Site**  
**Field Sampling Plan, Swan Island Basin Study Area, Portland, Oregon**

Location ID <sup>a</sup>	Proposed Grid Cell ID		Cell-Center Mudline Depth <sup>b</sup> (NAVD88)	Cell-Center Mudline Depth (CRD ft)	Target Penetration Depth (ft)	Minimum Recovery <sup>c</sup> (ft)	Target Sample Intervals (cm below mudline)	SMA <sup>d</sup>
	Node X	Node Y						
35FY	35	F	-6.6	-11.9	20	16	30-60; 60-90; 90-120; 120-150; 150-180; 180-210; 210-240; 240-270; 270-300; 300-330; 330-360; 360-390; 390-420; 420-450	Inside
37FY	37	F	4.9	-0.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
01GY	1	G	-5.7	-11.0	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
02GY	2	G	-22.2	-27.5	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
04GY	4	G	-31.0	-36.3	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
06GY	6	G	-26.9	-32.2	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
07GY	7	G	-27.0	-32.3	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
08GY	8	G	-22.0	-27.2	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
00HY	0	H	10.0	4.7	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Outside
01HY	1	H	-20.5	-25.8	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
02HY	2	H	-26.1	-31.3	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
03HY	3	H	-29.2	-34.5	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
04HY	4	H	-28.6	-33.9	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
05HY	5	H	-24.4	-29.7	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
06HY	6	H	-43.7	-49.0	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
07HY	7	H	-43.1	-48.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
08HY	8	H	-43.9	-49.2	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
00IY	0	Y	-2.2	-7.5	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Outside
03IY	3	I	-28.8	-34.1	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
04IY	4	I	-39.6	-44.9	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
05IY	5	I	-43.9	-49.2	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
06IY	6	I	-41.5	-46.8	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
08IY	8	I	-37.1	-42.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
03JY	3	J	-27.8	-33.1	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
06JY	6	J	-36.6	-41.9	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
07JY	7	J	-42.2	-47.5	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
08JY	8	J	-52.8	-58.1	20	16	30-60; 60-90; 90-120; 120-150; 150-180; 180-210; 210-240; 240-270; 270-300; 300-330; 330-360; 360-390; 390-420; 420-450	Inside
01KY	1	K	-30.2	-35.5	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Outside
03KY	3	K	-27.1	-32.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
04KY	4	K	-26.4	-31.7	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
05KY	5	K	-51.1	-56.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
07KY	7	K	-51.1	-56.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
03LY	3	L	-37.7	-43.0	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
04LY	4	L	-39.6	-44.9	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
05LY	5	L	-46.4	-51.7	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
06LY	6	L	-38.2	-43.5	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
07LY	7	L	-22.3	-27.6	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
08LY	8	L	-3.7	-9.0	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
09LY	9	L	9.2	4.0	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
04MY	4	M	-37.4	-42.6	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
05MY	5	M	-29.5	-34.8	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
06MY	6	M	2.3	-3.0	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Inside
00NY	0	N	24.1	-29.4	20	16	30-60; 60-90; 90-120; 120-150; 150-180; 180-210; 210-240; 240-270; 270-300; 300-330; 330-360; 360-390; 390-420; 420-450	Outside

**Table 4-3 (Continued)**  
**Subsurface Sediment Sample Locations, Portland Harbor Superfund Site**  
**Field Sampling Plan, Swan Island Basin Study Area, Portland, Oregon**

Location ID <sup>a</sup>	Proposed Grid Cell ID		Cell-Center Mudline Depth <sup>b</sup> (NAVD88)	Cell-Center Mudline Depth (CRD ft)	Target Penetration Depth (ft)	Minimum Recovery <sup>c</sup> (ft)	Target Sample Intervals (cm below mudline)	SMA <sup>d</sup>
	Node X	Node Y						
03NY	3	N	-25.8	-31.1	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Outside
05NY	5	N	-6.7	-12.0	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
07NY	7	N	7.1	1.8	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
04OY	4	O	-48.1	-53.4	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Outside
07OY	7	O	-15.9	-21.2	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
07PY	7	P	-17.9	-23.2	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Edge
02RY	2	R	-40.7	-46.0	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Outside
04RY	4	R	-37.0	-42.3	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Outside
06RY	6	R	-38.7	-44.0	10	8	30-60; 60-90; 90-120; 120-150; 150-180	Outside

**Notes:**

USACE conversion from CRD to NAVD88 for river mile 7.5 to 11.7 at Broadway Bridge: CRD is 5.28 ft above NAVD88 at river mile 9.7.

Subsurface samples will be collected from one side of a divided core from 1 to 6 ft at 1-ft intervals.

The other half and remaining undivided cores will be archived for future use. See FSP for more details.

Study Area = Swan Island Basin Study Area between river miles 8.1 and 9.2.

**Footnotes:**

a) Sample IDs will include water body name, sample type, location ID, sample interval in cm, and date.

b) Mudline elevations based on the center of the portion of each grid cell overlapping SIB. Actual sample locations may vary.

c) Minimum recovery is defined as 70% of the sampling interval (EPA, 2021)

d) 150- by 150-ft grid cells are 'Inside' when they fall entirely within the ROD-defined SIB SMA, 'Edge' when they overlap the SMA boundary, and 'Outside' when they fall entirely outside the SMA boundary.

**Acronyms:**

cm = centimeters

ft = feet

CRD = Columbia River Datum

ID = identification

EPA = U.S. Environmental Protection Agency

FSP = Field Sampling Plan

NAVD88 = North American Vertical Datum of 1988

ROD = Record of Decision

SIB = Swan Island Basin

SMA = Sediment Management Area

USACE = U.S. Army Corps of Engineers

**Reference:**

EPA, 2021. Remedial Design Guidelines and Considerations, Portland Harbor Superfund Site, Portland, Oregon.

**Table 4-4  
Sediment Erodibility (SedFlume) Sample Locations, Portland Harbor Superfund Site  
Field Sampling Plan, Swan Island Basin Study Area, Portland, Oregon**

Location ID <sup>a</sup>	Proposed Locations (NAD83) <sup>b</sup>		Mudline Depth (ft, NAVD88) <sup>c</sup>	Mudline Depth (below CRD ft) <sup>d</sup>	Proposed Analyses
	Easting (ft)	Northing (ft)			Standard SedFlume
SF1	7,636,366	698,959	13.2	18.5	X
SF2	7,636,523	699,150	12.5	17.8	X
SF3	7,635,972	699,327	17.3	22.6	X
SF4	7,636,062	699,444	17.5	22.7	X
SF5	7,635,476	699,687	19.7	25.0	X
SF6	7,635,564	699,932	20.0	25.3	X
SF7	7,634,947	700,120	25.8	31.1	X
SF8	7,635,167	700,274	21.0	26.2	X
SF9	7,634,431	700,542	26.9	32.2	X
SF10	7,634,588	700,733	17.4	22.7	X
SF11	7,634,044	700,858	28.2	33.5	X
SF12	7,634,201	701,050	19.4	24.7	X
SF13	7,633,624	701,202	27.9	33.2	X
SF14	7,633,781	701,393	21.4	26.6	X
SF15	7,633,142	701,503	29.8	35.0	X
SF16	7,633,251	701,826	18.9	24.1	X
SF17	7,632,784	701,457	30.5	35.8	X
SF18	7,632,713	701,785	18.3	23.6	X
SF19	7,632,519	701,335	29.6	34.9	X
SF20	7,632,390	701,634	20.6	25.9	X
SF21	7,632,075	701,242	31.1	36.4	X
SF22	7,632,034	701,561	12.4	17.6	X
SF23	7,631,843	700,943	29.9	35.2	X
SF24	7,631,464	701,251	31.2	36.5	X
SF25	7,631,502	701,659	13.7	19.0	X
SF26	7,631,682	700,022	41.9	47.2	X
SF27	7,631,203	700,427	41.1	46.4	X
SF28	7,630,888	700,884	51.1	56.4	X
SF29	7,630,866	701,486	35.3	40.6	X
SF30	7,631,017	701,866	9.6	14.9	X

**Notes:**

Study Area = Swan Island Basin Study Area between river miles 8.1 and 9.2.

**Footnotes:**

- a) Sample IDs will include water body name, sample type, location ID, sample depth, and date.
- b) Horizontal Projection: NAD83 Oregon State Plane North (international ft)
- c) Elevations from 2018 NOAA multi-beam bathymetry and 2014 ORC LiDAR
- d) USACE conversion from CRD to NAVD88 for river mile 7.5 to 11.7 at Broadway Bridge: CRD is 5.28 ft above NAVD88 at river mile 9.7.

**Acronyms:**

ft = feet	NAVD88 = North American Vertical Datum of 1988
CRD = Columbia River datum	NOAA = National Oceanic and Atmospheric Administration
ID = identification	OLC = Oregon LiDAR Consortium
LiDAR = light detection and ranging	USACE = U.S. Army Corps of Engineers
NAD83 = North American Datum of 1983	

**Table 4-5**  
**Surface Water Screening Levels for Dredge Elutriate Testing, Portland Harbor Superfund Site**  
**Field Sampling Plan, Swan Island Basin, Portland, Oregon**

Surface Water Screening Levels in µg/L							
Contaminant	National Recommended Water Quality Criteria			OAR 340-041-8033		ORNL – Toxicological Benchmarks	
	Aquatic Life Criteria		Human Health Criteria	Table 30 – Aquatic Life Criteria		Tier II	
	Acute	Chronic	Consumption of Organism Only	Acute	Chronic	Acute	Chronic
Aldrin	3	---	0.00000077 <sup>3</sup>	3	---		
Arsenic	340 <sup>2</sup>	150 <sup>2</sup>	0.14 <sup>3</sup>	340 <sup>2</sup>	150 <sup>2</sup>	66 <sup>5</sup>	3.1 <sup>5</sup>
BEHP			0.37 <sup>3</sup>			27	3.0
Cadmium	1.8 <sup>1,2</sup>	0.72 <sup>1,2</sup>	---	3.9 <sup>1,2</sup>	0.25 <sup>1,2</sup>	---	---
Chlordane	2.4	0.0043	0.00032 <sup>3</sup>	2.4	0.0043	---	---
Copper	---	---	---	---	---	---	
DDD	---	---	---	---	---	0.19	0.011
DDE	---	---	---	---	---	---	---
DDT	---	---	---	1.1	0.001	---	0.013
DDx	---	---	---	---	---	---	---
Dieldrin	0.24	0.056	0.0000012 <sup>3</sup>	0.24	0.056	---	---
Lindane	0.95	---	---	0.95	0.08	---	---
Lead	65 <sup>1,2</sup>	2.5 <sup>1,2</sup>	---	65 <sup>1,2</sup>	2.5 <sup>1,2</sup>	---	---
Mercury	1.4 <sup>2</sup>	0.77 <sup>2</sup>	---	2.4	0.012	---	1.3
PCBs	---	0.014	0.000064 <sup>3</sup>	2	0.014	---	0.14
PAHs	---	---	---	---	---	---	---
cPAHs (BaP eq)	---	---	---	---	---	---	---
Dioxins/Furans (2,3,7,8-TCDD eq)	---	---	5.1e-9 <sup>3</sup>	---	---	---	---
TPH-Diesel	---	---	---	---	---	---	---
Tributyltin	0.46	0.072	---	---	---	---	---
Zinc	120 <sup>2</sup>	120 <sup>2</sup>	26,000 <sup>3</sup>	117 <sup>1,2</sup>	118 <sup>1,2</sup>	---	---

**Footnotes:**

<sup>1</sup> The freshwater criteria for these metals are expressed as a function of hardness. The values given here correspond to a hardness of 100 milligrams per liter.

<sup>2</sup> Freshwater criteria for metals are expressed in terms of the dissolved metal in the water column.

<sup>3</sup> Based on a carcinogenicity of 10<sup>-6</sup> risk.

<sup>4</sup> Freshwater criteria are calculated using the Biotic Ligand Model.

<sup>5</sup> Criteria are for Arsenic V.

**Table 4-5 (Continued)**  
**Surface Water Screening Levels for Dredge Elutriate Testing, Portland Harbor Superfund Site**  
**Field Sampling Plan, Swan Island Basin, Portland, Oregon**

**Acronyms:**

µg/L = micrograms per liter

BaP eq = benzo(a)pyrene equivalent

BEHP = bis(2-ethylhexyl)phthalate

cPAH = carcinogenic polycyclic aromatic hydrocarbons

DDD = dichlorodiphenyldichloroethane

DDE = dichlorodiphenyldichloroethene

DDT = dichlorodiphenyltrichloroethane

DDx = DDD + DDE + DDT

OAR = Oregon Administrative Rules

ORNL = Oak Ridge National Laboratory

PAH = polycyclic aromatic hydrocarbon

PCB = polychlorinated biphenyl

TPH = total petroleum hydrocarbons

TCDD = 2,3,7,8-tetrachlorodibenzofuran

TCDD Eq = TCDD Toxic Equivalency

**Table 4-6  
Geotechnical Sampling, Portland Harbor Superfund Site  
Field Sampling Plan, Swan Island Basin Study Area, Portland, Oregon**

Location ID <sup>a</sup>	Proposed Locations (NAD83) <sup>b</sup>		Surface Elevation (ft, NAVD88) <sup>c</sup>	Surface Elevation (ft, CRD) <sup>d</sup>	Target Depth Below Mudline
	Easting (ft)	Northing (ft)			
B-1	7,633,292	702,076	10.67	5.39	TBD
B-2	7,633,658	701,872	10.76	5.48	TBD
B-3	7,634,226	701,373	10.78	5.50	TBD
B-4	7,634,578	701,089	11.10	5.82	TBD
B-5	7,635,074	700,701	10.51	5.23	TBD
B-6	7,636,214	699,858	10.85	5.57	TBD
B-7	7,636,555	699,550	10.43	5.15	TBD
B-8	7,637,130	699,135	10.38	5.10	TBD
B-9	7,637,002	698,584	9.49	4.21	TBD
B-10	7,636,214	698,741	10.70	5.42	TBD
B-11	7,635,686	699,141	10.93	5.65	TBD
B-12	7,635,125	699,593	10.73	5.45	TBD
B-13	7,633,917	700,592	10.81	5.53	TBD
B-14	7,633,401	701,046	10.99	5.71	TBD
B-15	7,632,953	700,412	11.82	6.54	TBD
B-16	7,632,550	700,321	11.29	6.01	TBD
BW-1	7,633,253	701,852	-15.83	-21.11	TBD
BW-2	7,634,117	701,247	-12.74	-18.02	TBD
BW-3	7,635,254	700,239	-17.33	-22.61	TBD
BW-4	7,636,496	699,295	-12.55	-17.83	TBD
BW-5	7,636,717	698,587	-2.39	-7.67	TBD
BW-6	7,635,705	699,331	-14.32	-19.60	TBD
BW-7	7,634,591	700,274	-27.24	-32.52	TBD
BW-8	7,632,716	701,334	-28.98	-34.26	TBD
BW-9	7,632,393	700,943	-39.47	-44.75	TBD
BW-10	7,631,957	700,935	-31.79	-37.07	TBD
BW-11	7,633,057	701,519	-29.60	-34.88	TBD
BW-12	7,633,815	701,206	-27.08	-32.36	TBD
BW-13	7,634,751	700,446	-24.16	-29.44	TBD
BW-14	7,635,784	699,575	-18.40	-23.68	TBD
BW-15	7,636,567	698,932	-9.90	-15.18	TBD
CPT-1	7,635,816	700,274	10.03	4.75	TBD
CPT-2	7,634,482	700,137	10.73	5.45	TBD
CPT-3	7,633,251	700,904	10.91	5.63	TBD
CPTW-1	7,632,779	701,870	-13.22	-18.50	TBD
CPTW-2	7,633,621	701,613	-23.65	-28.93	TBD
CPTW-3	7,634,581	700,870	-12.85	-18.13	TBD
CPTW-4	7,635,617	699,996	-17.21	-22.49	TBD
CPTW-5	7,636,930	698,951	-5.80	-11.08	TBD
CPTW-6	7,636,309	698,883	-13.03	-18.31	TBD
CPTW-7	7,635,221	699,762	-23.95	-29.23	TBD
CPTW-8	7,634,023	700,737	-27.23	-32.51	TBD
CPTW-9	7,633,512	701,117	-27.25	-32.53	TBD

**Table 4-6 (Continued)**  
**Geotechnical Sampling, Portland Harbor Superfund Site**  
**Field Sampling Plan, Swan Island Basin Study Area, Portland, Oregon**

Location ID <sup>a</sup>	Proposed Locations (NAD83) <sup>b</sup>		Surface Elevation (ft, NAVD88) <sup>c</sup>	Surface Elevation (ft, CRD) <sup>d</sup>	Target Depth Below Mudline
	Easting (ft)	Northing (ft)			
CPTW-10	7,632,723	701,171	-45.05	-50.33	TBD
CPTW-11	7,632,274	700,590	-6.37	-11.65	TBD
CPTW-12	7,632,137	699,978	-33.83	-39.11	TBD

**Notes:**

Proposed analysis methods are listed in Table 4-1

**Footnotes:**

- a) Sample IDs will include water body name, sample type, location ID, and date.
- b) Horizontal Projection: NAD83 Oregon State Plant North (international ft)
- c) Elevations from 2018 NOAA multi-beam bathymetry and 2014 OLC LiDAR

**Acronyms:**

- ft = feet
- CRD = Columbia River datum
- ID = identification
- LiDAR = light detection and ranging
- NAD83 = North American Datum 1983
- NAVD88 = North American Vertical Datum of 1988
- NOAA = National Oceanic and Atmospheric Administration
- OLC = Oregon LiDAR Consortium
- TBD = to be determined

**Table 4-7**  
**Summary of Stormwater System Sampling Activities and Locations**  
**PDI Work Plan Field Sampling Plan; Swan Island Basin Project Area, Portland, Oregon**

Basin ID	Primary Sample Location		Sample Media and Proposed Analytical Suite					Proposed Sample Location Info				Alternate Sample Location		Sample Media and Proposed Analytical Suite					Alternate Sample Location Information			
	Manhole ID	Analyte List	Stormwater		Stormwater Solids			Depth (Portland Maps ft)	Pipe Diameter (Portland Maps inches)	Pipe Invert Elevation (COP)	Pipe Invert Elevation (MBDC)	Manhole ID	Analyte List	Stormwater		Stormwater Solids			Depth (Portland Maps ft)	Pipe Elevation (COP)	Pipe Elevation (MBDC)	
			Sample Frequency	Collection Method	Analyte List	Sample Frequency	Collection Method							Sample Frequency	Collection Method	Analyte List	Sample Frequency	Collection Method				
City of Portland Stormwater Conveyance System											City of Portland Stormwater Conveyance System											
M-1	AAM107 <sup>a</sup>	ROD Table 17 COCs, minus ROD focused COCs	3 Events (2 wet season, 1 dry season)	HVS	ROD focused COCs	3 Events (2 wet season, 1 dry season)	HVS	26.3	inlets 60 (AAM107-APX575) & outlet 60 (OFM-1)	9.5	6.58	AAM104	ROD Table 17, or only ROD Table 21 COCs, if limited volume	3 Events (2 wet season, 1 dry season)	HVS	ROD focused COCs	3 Events (2 wet season, 1 dry season)	HVS	25	15.93	13.01	
					ROD Table 17, or only ROD focused COCs, if limited volume	2 wet season samples from lateral from basin, 2 dry season samples from lateral from basin	ILS									ROD Table 17, or only ROD focused COCs, if limited volume	1 wet season sample from sub-basins, 1 dry season sample from sub-basins	ILS				
					ROD Table 17, or only ROD focused COCs, if limited volume	1 sample, from upstream side of AMM107 before equipment deployment	MSG										ROD focused COCs, if limited volume	1 sample in each of three laterals to AAM104 before equipment deployment	MSG			
													AAJ935 (north subbasin)					ROD Table 17, or only ROD focused COCs, if limited volume	1 wet season sample from manhole, 1 dry season sample from manhole	ILS	16.5	14.88
																ROD focused COCs, if limited volume	1 sample in AAJ935 before equipment deployment	MSG				

**Table 4-7 (Continued)**  
**Summary of Stormwater System Sampling Activities and Locations**  
**PDI Work Plan Field Sampling Plan; Swan Island Basin Project Area, Portland, Oregon**

Basin ID	Primary Sample Location	Sample Media and Proposed Analytical Suite						Proposed Sample Location Info				Alternate Sample Location	Sample Media and Proposed Analytical Suite						Alternate Sample Location Information		
		Stormwater			Stormwater Solids			Depth (Portland Maps ft)	Pipe Diameter (Portland Maps inches)	Pipe Invert Elevation (COP)	Pipe Invert Elevation (MBDC)		Stormwater			Stormwater Solids			Depth (Portland Maps ft)	Pipe Elevation (COP)	Pipe Elevation (MBDC)
		Analyte List	Sample Frequency	Collection Method	Analyte List	Sample Frequency	Collection Method						Analyte List	Sample Frequency	Collection Method	Analyte List	Sample Frequency	Collection Method			
M-1 cont.	AAM107 cont.											AAJ810 (northwest subbasin)					1 wet season sample from sub-basin, 1 dry season sample from sub-basin	ILS	16.5	15.93	13.01
																	1 sample in AAJ810 before equipment deployment	MSG			
												AAM105 (southeast subbasin)					1 wet season sample from sub-basin, 1 dry season sample from sub-basins	ILS	20.6	16.5	13.58
																	1 sample in AAM105 before equipment deployment	MSG			
M-2	AAM169	ROD Table 17 COCs, minus ROD focused COCs	3 Events (2 wet season, 1 dry season)	HVS	ROD focused COCs	3 Events (2 wet season, 1 dry season)	HVS	20.6	inlets 21 (AAM169-AAM165), 60 (AAM169-AAM170), 27 (AAM169-AAM192) and outlet 60 (OFM-2)	10.57	7.65	AAM170 (north subbasin)	ROD Table 17, or only ROD Table 21 COCs, if limited volume	3 Events (2 wet season, 1 dry season)	HVS	ROD focused COCs	3 Events (2 wet season, 1 dry season)	HVS	20.9	10.93	8.01



**Table 4-7 (Continued)**  
**Summary of Stormwater System Sampling Activities and Locations**  
**PDI Work Plan Field Sampling Plan; Swan Island Basin Project Area, Portland, Oregon**

Basin ID	Primary Sample Location	Sample Media and Proposed Analytical Suite						Proposed Sample Location Info				Alternate Sample Location	Sample Media and Proposed Analytical Suite						Alternate Sample Location Information		
		Stormwater			Stormwater Solids			Depth (Portland Maps ft)	Pipe Diameter (Portland Maps inches)	Pipe Invert Elevation (COP)	Pipe Invert Elevation (MBDC)		Stormwater			Stormwater Solids			Depth (Portland Maps ft)	Pipe Elevation (COP)	Pipe Elevation (MBDC)
		Analyte List	Sample Frequency	Collection Method	Analyte List	Sample Frequency	Collection Method						Analyte List	Sample Frequency	Collection Method	Analyte List	Sample Frequency	Collection Method			
M-3	AAQ004 <sup>b</sup>	ROD Table 17 COCs, minus ROD focused COCs	3 Events (2 wet season, 1 dry season)	HVS	ROD focused COCs	3 Events (2 wet season, 1 dry season)	HVS	24.6	inlets 18 (AAQ004-AAP976) and 48 (AAQ004-AAQ-005)	6.03 (AAQ004-AAQ003)	3.11	AAQ005	ROD Table 17 COCs, minus ROD focused COCs	3 Events (2 wet season, 1 dry season)	HVS	ROD focused COCs	3 Events (2 wet season, 1 dry season)	HVS	22.6	9.89	6.97
					ROD Table 17, or only ROD focused COCs, if limited volume	3 wet season samples from laterals to sub-basins, 3 dry season samples from laterals to sub-basins	ILS									ROD Table 17, or only ROD focused COCs, if limited volume	3 wet season samples from laterals to sub-basins, 3 dry season samples from laterals to sub-basins	ILS			
					ROD Table 17, or only ROD focused COCs, if limited volume	3 samples one per lateral in AMM104 before equipment deployment	MSG									ROD Table 17, or only ROD focused COCs, if limited volume	3 samples one per lateral in AMM104 before equipment deployment	MSG			

**Table 4-7 (Continued)**  
**Summary of Stormwater System Sampling Activities and Locations**  
**PDI Work Plan Field Sampling Plan; Swan Island Basin Project Area, Portland, Oregon**

Basin ID	Primary Sample Location Manhole ID	Sample Media and Proposed Analytical Suite						Proposed Sample Location Info				Alternate Sample Location Manhole ID	Sample Media and Proposed Analytical Suite						Alternate Sample Location Information		
		Stormwater			Stormwater Solids			Depth (Portland Maps ft)	Pipe Diameter (Portland Maps inches)	Pipe Invert Elevation (COP)	Pipe Invert Elevation (MBDC)		Stormwater			Stormwater Solids			Depth (Portland Maps ft)	Pipe Elevation (COP)	Pipe Elevation (MBDC)
		Analyte List	Sample Frequency	Collection Method	Analyte List	Sample Frequency	Collection Method						Analyte List	Sample Frequency	Collection Method	Analyte List	Sample Frequency	Collection Method			
S-1	AAM131	ROD Table 17 COCs, minus ROD focused COCs	3 Events (2 wet season, 1 dry season)	HVS	ROD focused COCs	3 Events (2 wet season, 1 dry season)	HVS	21.7	inlets 27 (AAM131-AAM128), 18 (AAM131-AAM133) outlet 36 (OFS-1)	14.76	11.83		None proposed								
					ROD Table 17, or only ROD focused COCs, if limited volume	2 wet season samples from laterals to sub-basins, 2 dry season samples from laterals to sub-basins	ILS														
					ROD Table 17, or only ROD focused COCs, if limited volume	2 samples, one per lateral, from AMM107 before equipment deployment	MSG														
S-2	AAP957	ROD Table 17 COCs, minus ROD focused COCs	3 Events (2 wet season, 1 dry season)	HVS	ROD focused COCs	3 Events (2 wet season, 1 dry season)	HVS	22.1	inlets 30 (AAP957-AAP955), 21 (AAP957-AAP970) outlet 36 (OFS-2)	14.71	11.79		None proposed								
					ROD Table 17, or only ROD focused COCs, if limited volume	2 wet season samples from laterals to sub-basins, 2 dry season samples from laterals to sub-basins	ILS														
					ROD Table 17, or only ROD focused COCs, if limited volume	2 samples, one per lateral, from AMM107 before equipment deployment	MSG														



**Table 7-1**  
**2018 Control Survey Results, Portland Harbor Superfund Site**  
**Field Sampling Plan, Swan Island Basin Study Area, Portland, Oregon**

<b>Control Point</b>	<b>NAD83 (2011)</b>		<b>NAVD88 (Geoid12b) Elevation (International Feet)</b>
	<b>Northing (International Feet)</b>	<b>Easting (International Feet)</b>	
PH1	698702.464	7637426.371	33.379
PH2	700967.870	7634507.670	NA

**Acronyms:**

NAD83 = North American Datum 1983

NAVD88 = North American Vertical Datum of 1988

NA = not applicable

## **FIGURES**

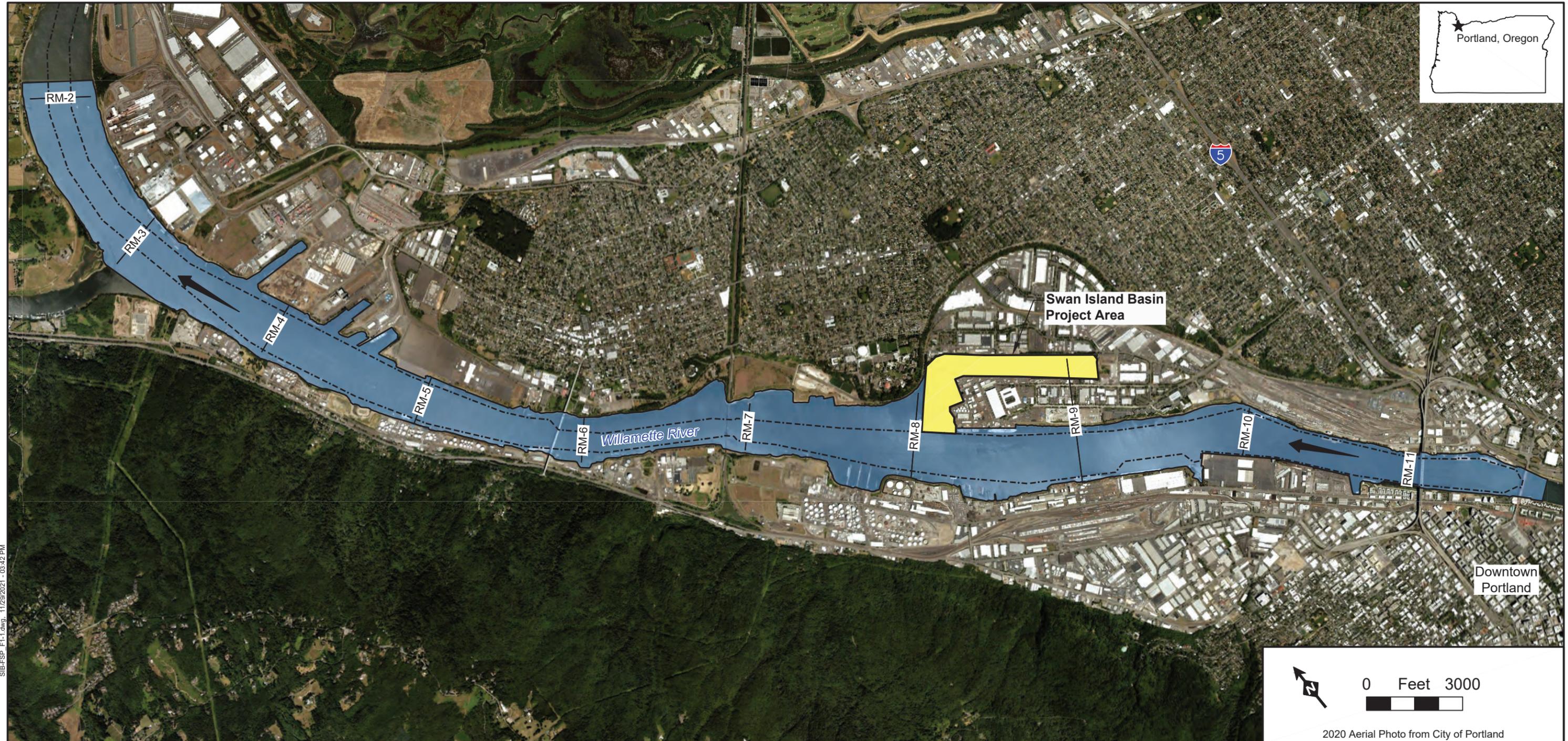
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## FSP FIGURES LIST OF ACRONYMS

---

BWTP	Ballast Wastewater Treatment Plant
CO	commercial
COP	City of Portland
CPT	Cone Penetration test
DTNA	Diamler Trucks North America
EPA	U.S. Environmental Protection Agency
HGL	HydroGeologic Inc.
HVS	high-volume sampling ; in-line solids and stormwater
IH	heavy industrial
IL	light industrial
LiDAR	light detection and ranging
MSG	manual solids grab
MSU	Marine safety unit
MU	mixed-use residential
NOAA	National Oceanic Atmospheric Agency
OS	parks and open space
OU	operable unit
PHSS	Portland Harbor Superfund Site
RI/FS	Remedial Investigation Feasibility Study
RLIS	Oregon Metro Regional Land Information System
RM	River Mile
ROD	Record of Decision
SDU	Sediment Decision Unit
SIB	Swan Island Basin
SIUF	Swan Island Upland Facility
SF	single family residential
SIB	Swan Island Basin
SMA	Sediment Management Area
SWG	stormwater grab
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
WR	inactive former non-contact cooling water discharge

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- Federal Navigation Channel (USACE 2020)
- ← River Flow Direction
- Swan Island Basin Project Area
- Portland Harbor Superfund Site Boundary (River Mile 1.9 to 11.8)

Notes:  
 NOAA - National Oceanic and Atmospheric Administration  
 RM - River Mile  
 SIB - Swan Island Basin  
 USACE - U.S. Army Corps of Engineers

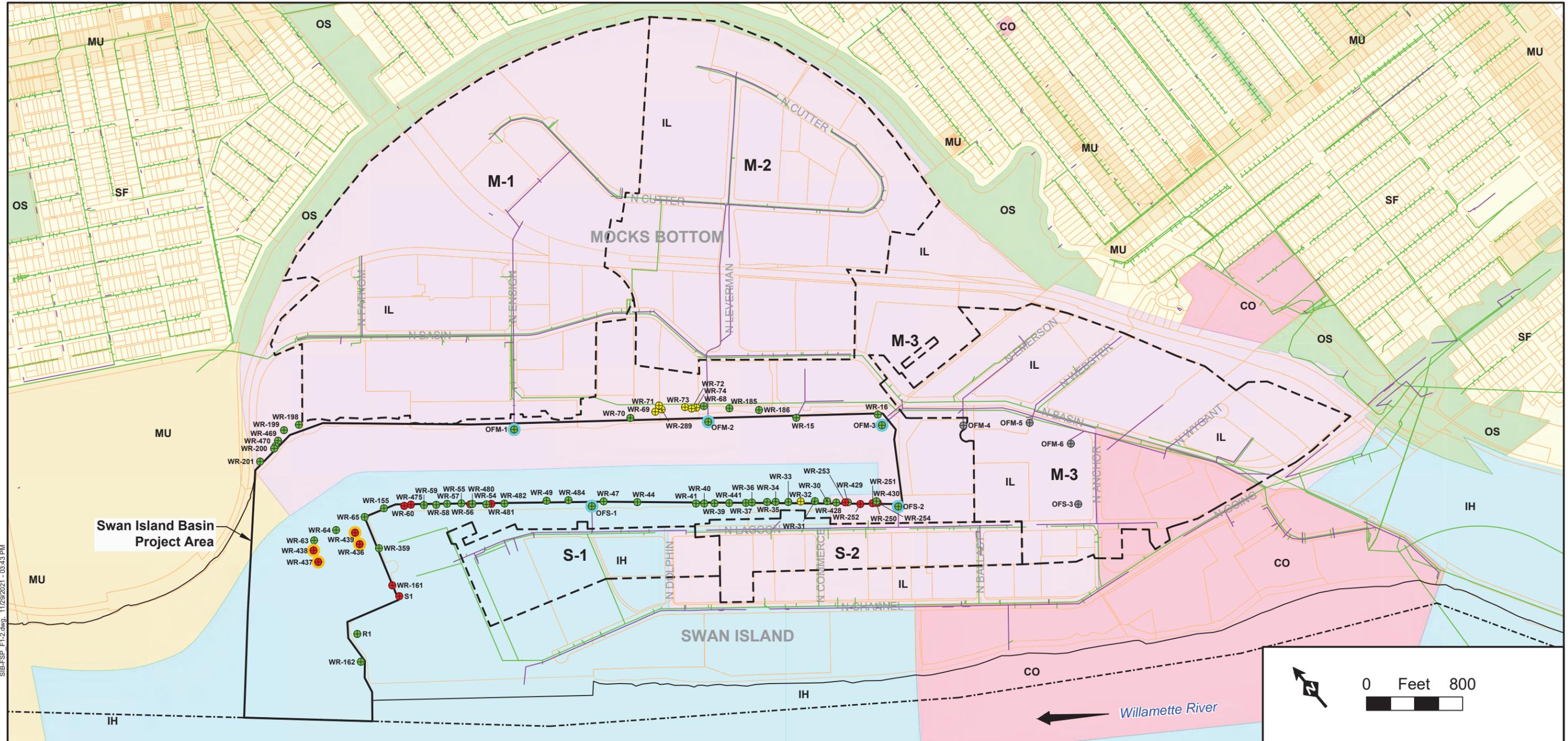
Source:  
 NOAA, 2016. Booklet Chart, Willamette River – Swan Island Basin, NOAA Chart 18527 at URL:  
[https://www.charts.noaa.gov/BookletChart/18527\\_BookletChart.pdf](https://www.charts.noaa.gov/BookletChart/18527_BookletChart.pdf)  
 - Navigation Channel

**Figure 1-1**  
**SIB Project Area Location Map**

Prepared on 11/29/2021  
 Field Sampling Plan  
 Swan Island Basin



2020 Aerial Photo from City of Portland



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- - - - - Drainage Basin      - - - - - Federal Navigation Channel (USACE 2020)      ← River Flow Direction  
 Zoning:      Tax Lot Boundary

<b>IH</b> Heavy Industrial	<b>MU</b> Mixed Use Residential
<b>IL</b> Light Industrial	<b>SF</b> Single Family Residential
<b>CO</b> Commercial	<b>OS</b> Parks and Open Space

**Collection Lines**  
 — Stormwater Line      — Sewer Line

**Outfalls**  
 ● Active      ● Inactive      ⊕ Abandoned      ⊕ Unknown  
 ⊕ Active - City of Portland Municipal Outfalls (M-1, M-2, M-3, S-1 and S-2)  
 ⊕ Inactive - Former Non-Contact Cooling Water Discharge Points (WR-436 through WR-439)

**Notes:**  
 NOAA - National Oceanic and Atmospheric Administration  
 SIB - Swan Island Basin  
 USACE - U.S. Army Corps of Engineers

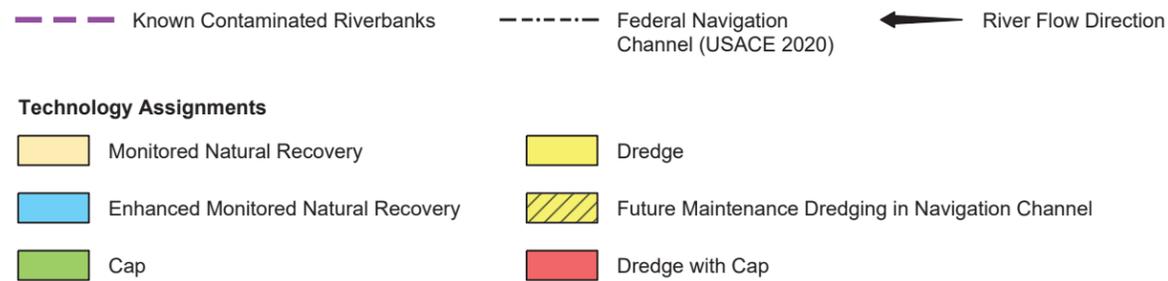
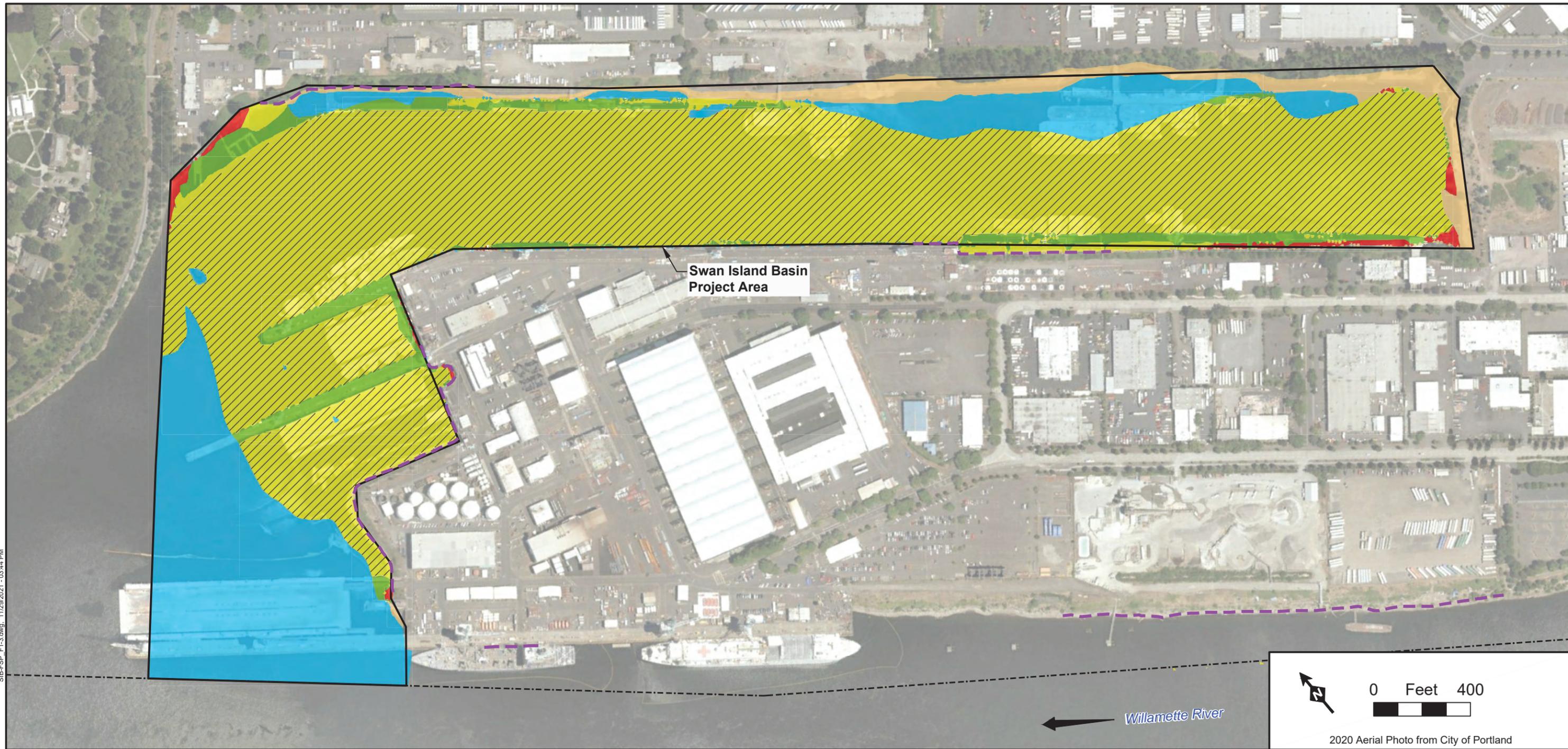
**Sources:**  
 (1) City of Portland Bureau of Environmental Services  
 - Outfalls  
 - Drainage Basins (except S-1)  
 - Collection Lines  
 (2) Vigor Stormwater Program Staff  
 - Portland Shipyard Outfalls (June 21, 2021)  
 - Drainage Basin S-1  
 (3) Oregon Metro Regional Land Information System  
 - Zoning (January 26, 2021)  
 - Tax Lots (July 23, 2020)  
 (4) NOAA, 2016. Booklet Chart, Willamette River – Swan Island Basin, NOAA Chart 18527 at URL: [https://www.charts.noaa.gov/BookletChart/18527\\_BookletChart.pdf](https://www.charts.noaa.gov/BookletChart/18527_BookletChart.pdf)  
 - Navigation Channel

## Figure 1-2 SIB Upland Area Zoning and Drainage Basins

Prepared on 11/29/2021

Field Sampling Plan  
Swan Island Basin Project Area

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Notes:  
 EPA - U.S. Environmental Protection Agency  
 NOAA - National Oceanic and Atmospheric Administration  
 PHSS - Portland Harbor Superfund Site  
 ROD - Record of Decision  
 SIB - Swan Island Basin  
 USACE - U.S. Army Corps of Engineers

Sources:  
 (1) Adapted from: Figure 31d from EPA, 2017. ROD, PHSS, Portland, Oregon.  
 - Technology Assignments  
 - Known Contaminated Riverbanks  
 (2) NOAA, 2016. Booklet Chart, Willamette River – Swan Island Basin, NOAA Chart 18527 at URL:  
[https://www.charts.noaa.gov/BookletChart/18527\\_BookletChart.pdf](https://www.charts.noaa.gov/BookletChart/18527_BookletChart.pdf)  
 - Navigation Channel

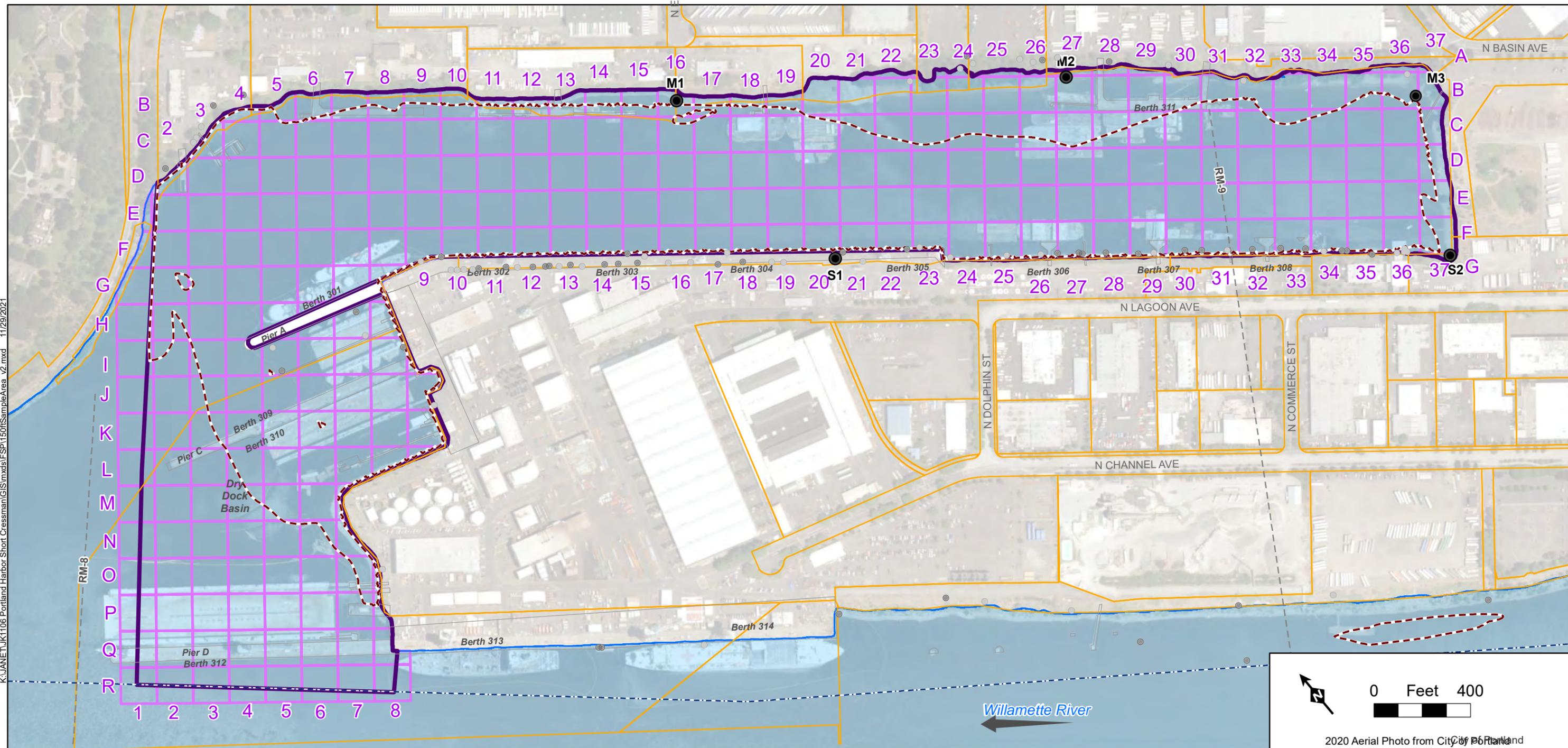
**Figure 1-3**  
**SIB Project Area**  
**Technology Assignments per the**  
**PHSS ROD**

Prepared on 11/29/2021  
 Field Sampling Plan  
 Swan Island Basin Project Area





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- 150-foot Sample Grid
- ROD Sediment Management Area (SMA)

- City of Portland Stormwater Outfall
- Non-City Outfall
- River Mile (RM)
- Swan Island Sediment Decision Unit (SDU)
- Federal Navigation Channel (USACE, 2020)
- Docks and Structures
- Tax Lot Boundary
- Ordinary High Water (City of Portland, 2013)
- River Flow Direction

Notes:  
 ROD – Record of Decision  
 USACE – United States Army Corps of Engineers

**Figure 4-2**  
**Sample Grid**

Field Sampling Plan  
 Swan Island Basin

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- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>□ Surface Sample Locations</li> <li>■ Proposed Surface Grab Sample Location</li> <li>▲ Proposed Surface Core Sample Location</li> </ul> <p>150-foot Sample Grid Category:</p> <ul style="list-style-type: none"> <li>■ Existing Surface Sample</li> <li>■ Grid Cell Without Existing Data within SMA</li> <li>■ Grid Cell Without Existing Data on Border of SMA</li> <li>□ No Sample</li> <li>▨ Additional surface samples to meet 150-foot spacing</li> </ul> | <ul style="list-style-type: none"> <li>■ Sample Above Principal Threat Waste (PTW)</li> <li>■ Sample Above Remedial Action Level (RAL)</li> <li>■ Sample Above Clean Up Level (CUL)</li> <li>● City of Portland Stormwater Outfall</li> <li>● Non-City Outfall</li> <li>--- River Mile (RM)</li> <li>▭ Swan Island Sediment Decision Unit (SDU)</li> <li>▭ Federal Navigation Channel (USACE, 2020)</li> <li>▭ Docks and Structures</li> <li>▭ Tax Lot Boundary</li> <li>▭ Ordinary High Water (City of Portland, 2013)</li> <li>▭ ROD Sediment Management Area (SMA)</li> </ul> |
|--|--|

Notes:  
 ROD – Record of Decision  
 USACE – United States Army Corps of Engineers

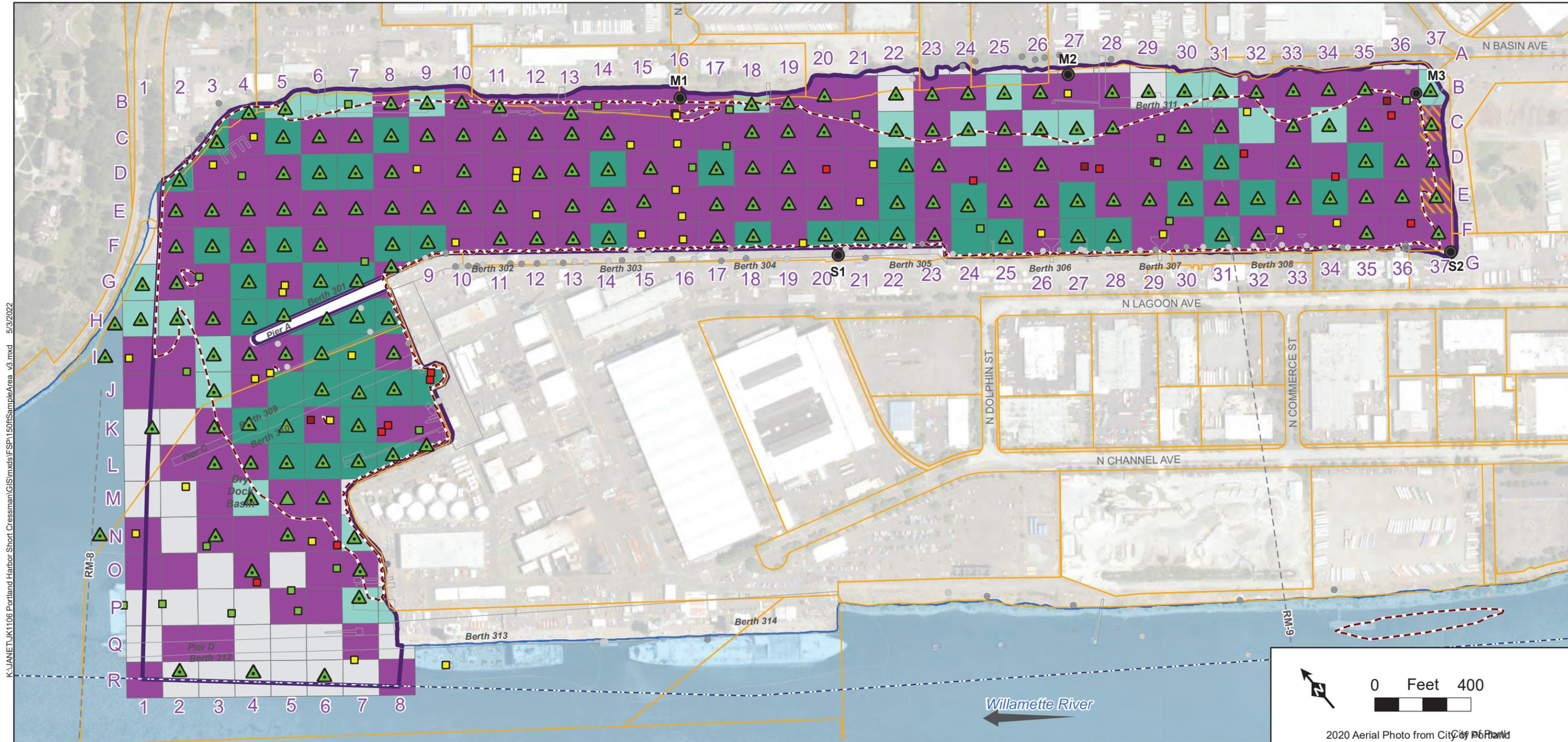
← River Flow Direction

Data Sources:  
 • AECOM and Geosyntec, 2019. PDI Evaluation Report. Prepared for United States EPA, Region 10.  
 • EPA and CDM Smith, 2016. Portland Harbor RI/FS Feasibility Study.  
 • PGG, 2019a. Surface and Subsurface Sediment Field Sampling and Data Report. Prepared for Daimler Trucks North America LLC.  
 • PGG, 2019b. Surface and Subsurface Sediment Field Sampling and Data Report. Prepared for de maximis, inc.

**Figure 4-3**  
**Surface Sample Locations**

Field Sampling Plan  
 Swan Island Basin





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- Subsurface Sample Locations
  - PTW Present, No Clean Confirmation (<2-ft clean at bottom of core)
  - PTW Present, Clean Confirmation (>2-ft clean at bottom of core)
  - PTW Not Present
  - ▲ Proposed Subsurface Sample Location
- 150-foot Sample Grid Category:
- Existing Surface Sample
  - Grid Cell Without Existing Data within SMA
  - Grid Cell Without Existing Data on Border of SMA
  - No Sample
  - Additional surface samples to meet 150-foot spacing

- City of Portland Stormwater Outfall
- Non-City Outfall
- River Mile (RM)
- Swan Island Sediment Decision Unit (SDU)
- Federal Navigation Channel (USACE, 2020)
- Docks and Structures
- Tax Lot Boundary
- Ordinary High Water (City of Portland, 2013)
- ROD Sediment Management Area (SMA)

Notes:  
 ROD – Record of Decision  
 USACE – United States Army Corps of Engineers

← River Flow Direction

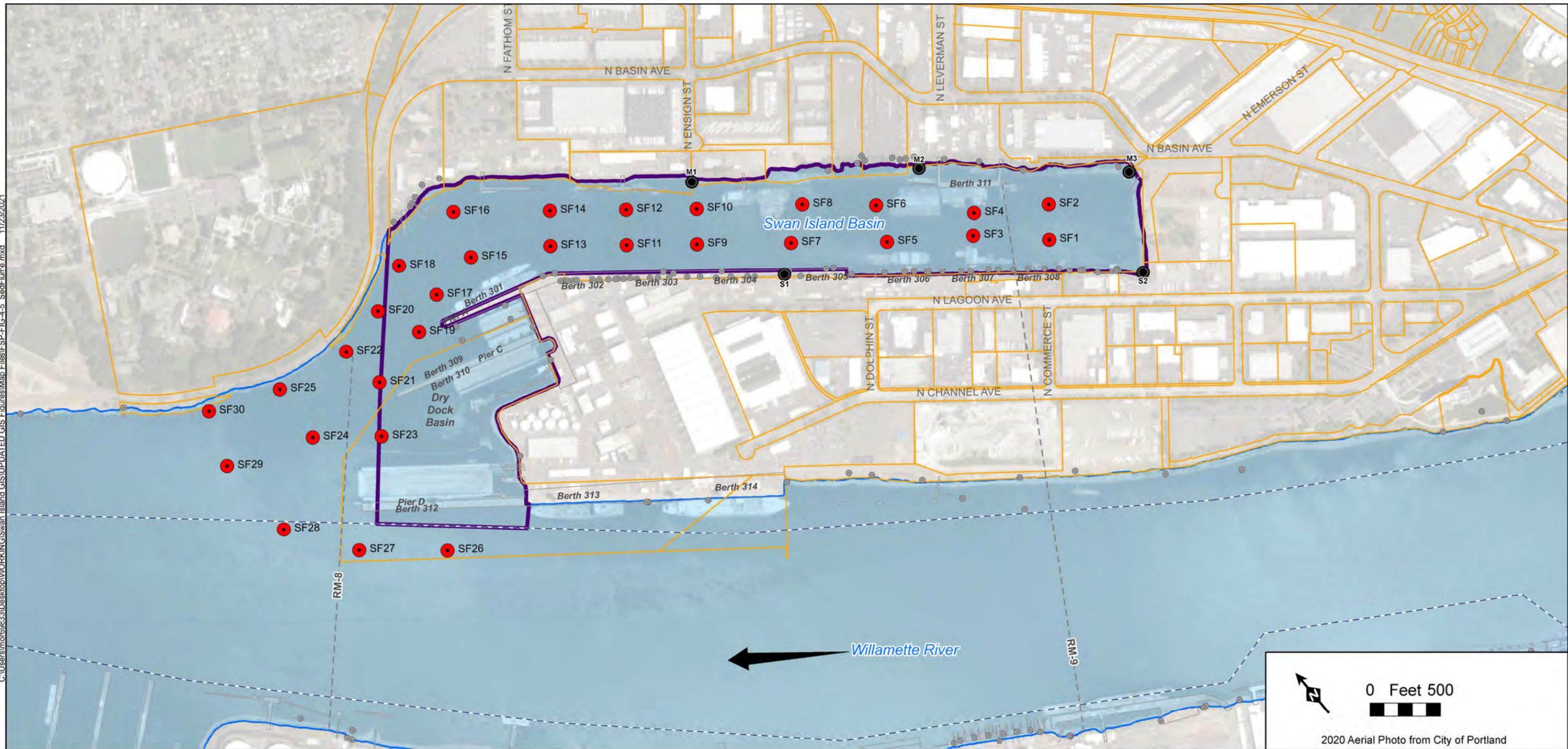
Data Sources:  
 • AECOM and Geosyntec, 2019. PDI Evaluation Report. Prepared for United States EPA, Region 10.  
 • EPA and CDM Smith, 2016. Portland Harbor RI/FS Feasibility Study.  
 • PGG, 2019a. Surface and Subsurface Sediment Field Sampling and Data Report. Prepared for Daimler Trucks North America LLC.  
 • PGG, 2019b. Surface and Subsurface Sediment Field Sampling and Data Report. Prepared for de maximis, inc.

**Figure 4-4**  
**Subsurface Sampling Locations**

Field Sampling Plan  
 Swan Island Basin



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- City of Portland Stormwater Outfall
- SedFlume Cores (30 Total)
- Non-City Outfall
- Dock Drain
- River Mile (RM)
- ▭ Swan Island Sediment Decision Unit (SDU)
- ▭ Federal Navigation Channel (USACE, 2020)
- ▭ Docks and Structures
- ▭ Tax Lot Boundary
- ▭ Ordinary High Water (City of Portland, 2013)
- ← River Flow Direction

USACE: U.S. Army Corps of Engineers

Figure 4-5  
SedFlume Sampling Locations

Prepared on 11/23/2021  
Field Sampling Plan  
Swan Island Basin





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- - - - - Drainage Basin      - - - - - Federal Navigation Channel (USACE 2020)      ← River Flow Direction  
 - - - - - Tax Lot Boundary

**Riverbank Investigations**

- Riverbank Sampling Transect (proposed)
- Known Contaminated Riverbanks
- Previous Riverbank Investigation Areas Exceeding Cleanup Levels

**Collection Lines**

- Stormwater Line
- Sewer Line

**Outfalls**

- Active
- Inactive
- Abandoned
- Unknown
- Active - City of Portland Municipal Outfalls (M-1, M-2, M-3, S-1 and S-2)
- Inactive - Former Non-Contact Cooling Water Discharge Points (WR-436 through WR-439)

**Notes:**

- EPA - U.S. Environmental Protection Agency
- ODEQ - Oregon Department of Environmental Quality
- OU - Operable Unit
- NAVD88 - North American Vertical Datum of 1988
- NOAA - National Oceanic and Atmospheric Administration
- PHSS - Portland Harbor Superfund Site
- ROD - Record of Decision
- SIUF - Swan Island Upland Facility
- USACE - U.S. Army Corps of Engineers

**Sources:**

- (1) PHSS ROD, EPA, January 2017
  - Known Contaminated Riverbanks
- (2) Ash Creek Associates, 2012a and b
  - Previous Riverbank Investigation Areas Exceeding Cleanup Levels (Shipyard)
- (3) Groundwater Solutions Inc., 2013
  - Previous Riverbank Investigation Areas Exceeding

**Cleanup Levels (End of Lagoon)**

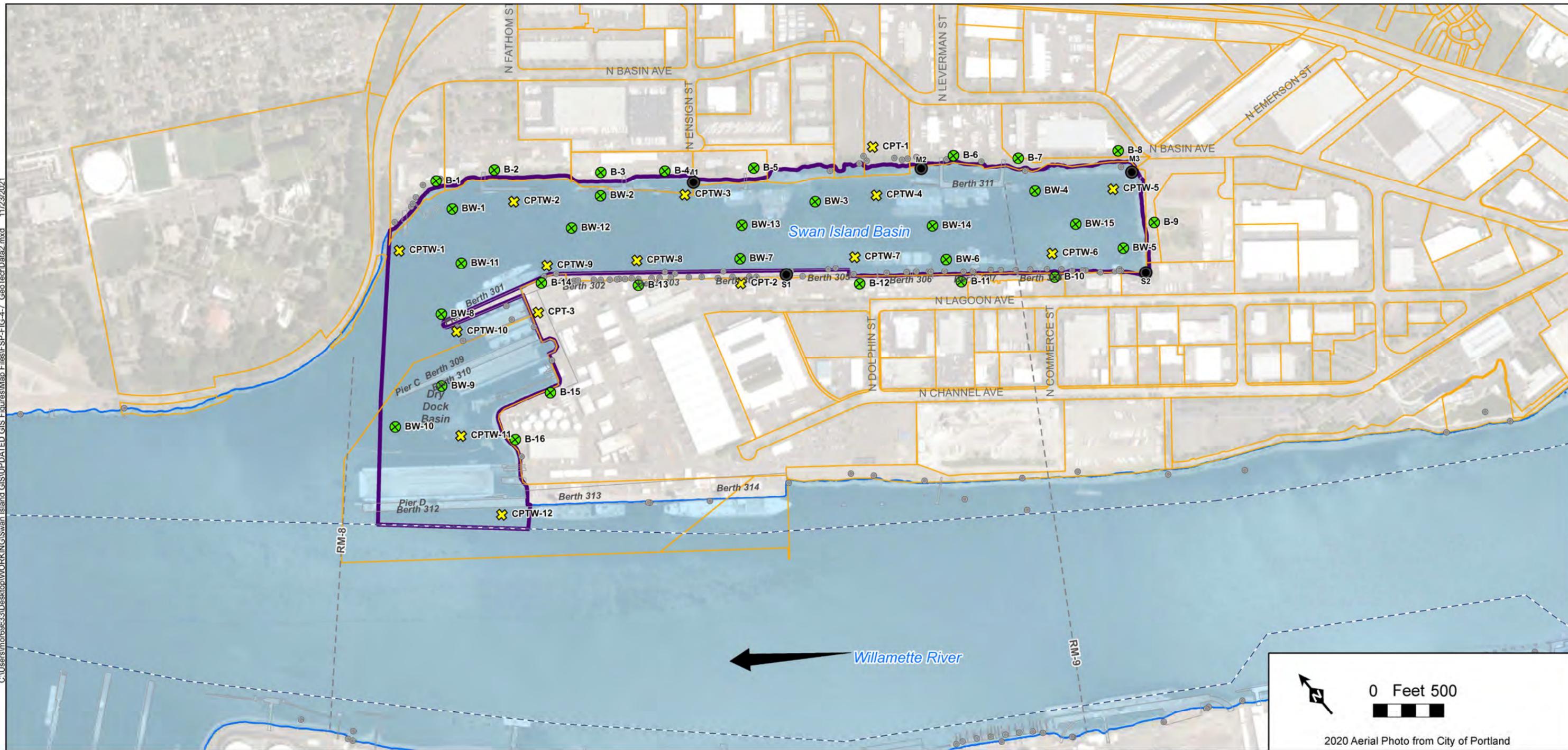
- (4) City of Portland Bureau of Environmental Services
  - Outfalls
  - Drainage Basins (except S-1)
  - Collection Lines
- (5) Vigor Stormwater Program Staff
  - Portland Shipyard Outfalls (June 21, 2021)
  - Drainage Basin S-1
- (6) NOAA, 2016. Booklet Chart, Willamette River – Swan Island Basin, NOAA Chart 18527 at URL: [https://www.charts.noaa.gov/BookletChart/18527\\_BookletChart.pdf](https://www.charts.noaa.gov/BookletChart/18527_BookletChart.pdf)
  - Navigation Channel
- (7) Oregon Metro Regional Land Information System
  - Tax Lots (July 23, 2020)
- (8) EPA Riverbank Guidance, Figure 3 RB Conceptual Diagrams, December 2019
  - Mean Low Water
  - Ordinary High Water

## Figure 4-6 Proposed Riverbank Characterization Transects

Prepared on 11/29/2021

Field Sampling Plan  
Swan Island Basin Project Area

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- City of Portland Stormwater Outfall
- Non-City Outfall
- Dock Drain
- - - River Mile (RM)
- ▭ Swan Island Sediment Decision Unit (SDU)
- - - Federal Navigation Channel (USACE, 2020)
- ▭ Docks and Structures
- ▭ Tax Lot Boundary
- ▭ Ordinary High Water (City of Portland, 2013)
- ← River Flow Direction
- ⊕ Geotechnical Boring
- ⊕ Cone Penetration Test (CPT)

USACE: U.S. Army Corps of Engineers

### Figure 4-7 Geotechnical Sampling Locations

Prepared on 11/23/2021  
Field Sampling Plan  
Swan Island Basin





- Sources:
- (1) City of Portland Bureau of Environmental Services
    - Outfalls
    - Drainage Basins (except S-1)
    - Collection Lines
    - Manholes
  - (2) Vigor Stormwater Program Staff
    - Portland Shipyard Outfalls (June 21, 2021)
    - Drainage Basin S-1
  - (3) Oregon Metro Regional Land Information System
    - Tax Lots (July 23, 2020)
  - (4) NOAA, 2016. Booklet Chart, Willamette River – Swan Island Basin, NOAA Chart 18527 at URL: [https://www.charts.noaa.gov/BookletChart/18527\\_BookletChart.pdf](https://www.charts.noaa.gov/BookletChart/18527_BookletChart.pdf)
    - Navigation Channel

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Stormwater Line	Drainage Basin
2006 Stormwater Line Cleaning	Federal Navigation Channel (USACE 2020)
Manhole	River Flow Direction
Tax Lot Boundary	

**Proposed Sampling Methods**

SWG Stormwater Grab	ILS In-Line Solids
HVS In-Line Solids and Stormwater	MSG Manual Solids Grab

Symbols repeated for sampling of multiple laterals at indicated manhole

**Outfalls**

Active	Inactive	Abandoned	Unknown
Active - City of Portland Municipal Outfalls (M-1, M-2, M-3, S-1 and S-2)			
Inactive - Former Non-Contact Cooling Water Discharge Points (WR-436 through WR-439)			

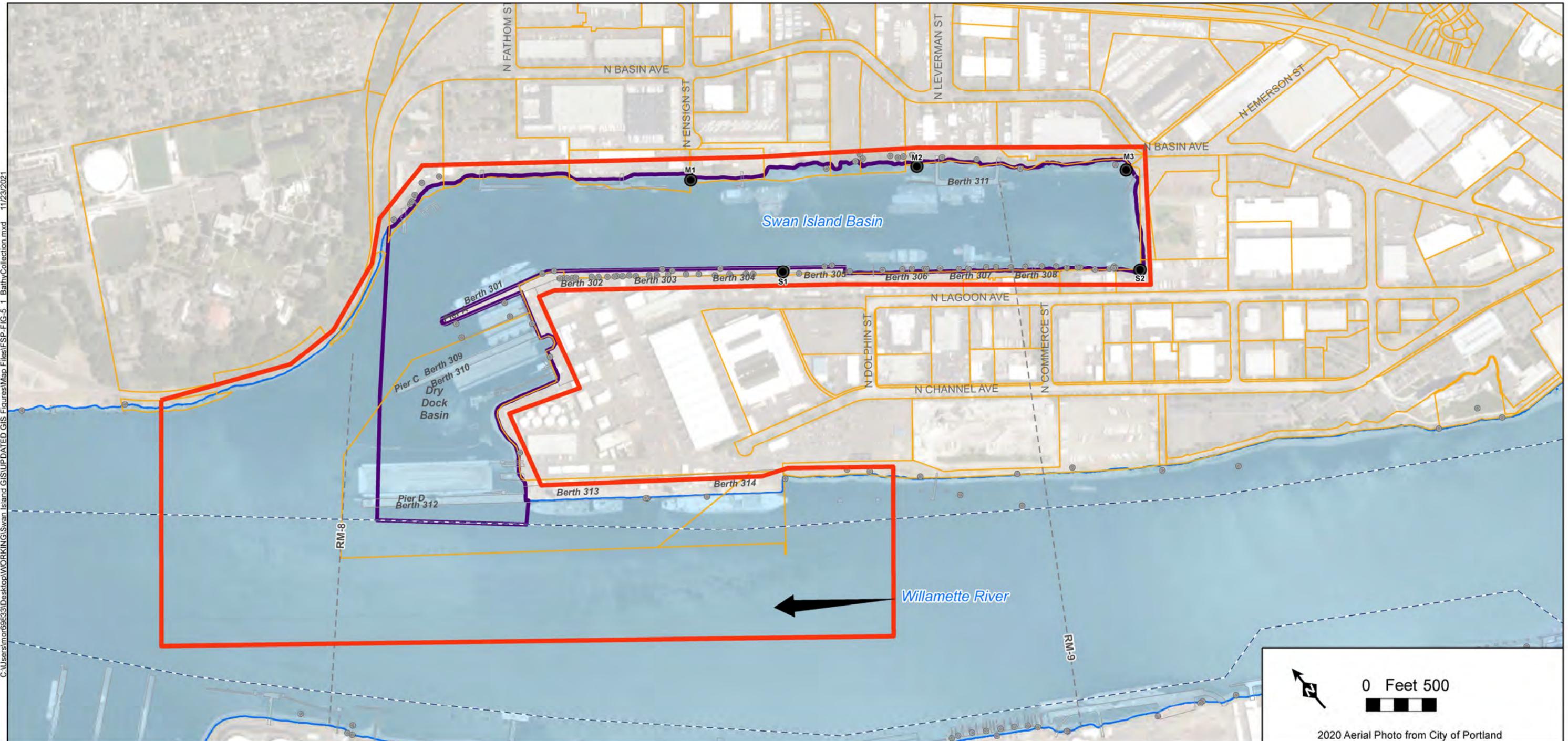
- Notes:
- EPA - U.S. Environmental Protection Agency
  - HVS - High Volume Sampling
  - NOAA - National Oceanic and Atmospheric Administration
  - RI/FS - Remedial Investigation/Feasibility Study
  - ROD - Record of Decision
  - USACE - U.S. Army Corps of Engineers
- (1) The high volume sampling system methodology includes pumping stormwater at a consistent rate over the duration of the storm and running high volumes of water through the HVS system to distinguish between the dissolved and solids fractions and obtain ROD Cleanup Levels for focused contaminants of concern.
  - (2) The in-line sediment trap design is similar to that utilized in the EPA-approved Round 3A Stormwater Field Sampling Plan, Portland Harbor RI/FS (LWG, 2007). If possible, one trap will be installed in each lateral.
  - (3) Manual stormwater solid grab samples will be collected at time of manhole entry if a minimum of 8-oz of solids are present in manhole/lateral. If less than 8-oz of solids are present, then the manual grab sample locations shall be abandoned and alternative upstream locations will be inspected and selected.
  - (4) Stormwater grab samples will be collected using ISCO auto-samplers.
  - (5) Where visual outfall inspections reveal the presence of solids, a single composite manual grab sample will be collected from all outfalls on the property.

**Figure 4-8**  
Proposed Stormwater Sampling Locations

Prepared on 11/29/2021  
Field Sampling Plan  
Swan Island Basin Project Area



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0 Feet 500

2020 Aerial Photo from City of Portland

- City of Portland Stormwater Outfall
- Non-City Outfall
- Dock Drain
- - - River Mile (RM)
- Swan Island Sediment Decision Unit (SDU)
- - - Federal Navigation Channel (USACE, 2020)
- Docks and Structures
- Tax Lot Boundary
- Ordinary High Water (City of Portland, 2013)
- ← River Flow Direction

Proposed Multibeam Bathymetry  
 — Data Collection Area

**Figure 5-1**  
**Bathymetry Data Collection Plan**

USACE: U.S. Army Corps of Engineers

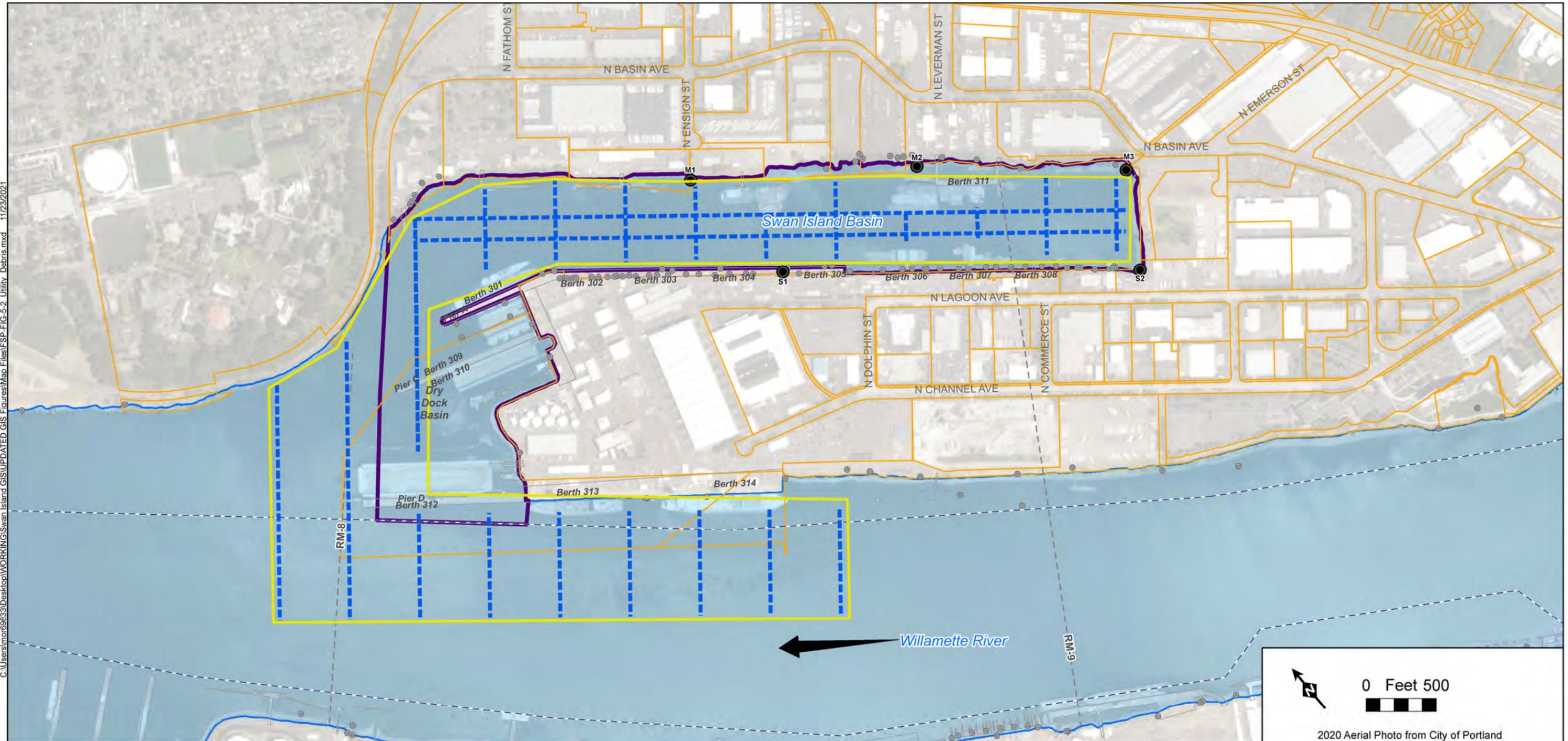
Prepared on 11/23/2021  
 Field Sampling Plan  
 Swan Island Basin

PACIFIC groundwater GROUP

**HGL** M M  
 HydroGeologic, Inc. MOTT MACDONALD

BRIDGEWATER GROUP

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0 Feet 500

2020 Aerial Photo from City of Portland

- City of Portland Stormwater Outfall
- Non-City Outfall
- Dock Drain
- - - River Mile (RM)
- Swan Island Sediment Decision Unit (SDU)
- - - Federal Navigation Channel (USACE, 2020)
- Docks and Structures
- Tax Lot Boundary
- Ordinary High Water (City of Portland, 2013)
- ← River Flow Direction

- - - Sub-Bottom Profile & Magnetometer Survey Transects
- Side-Scan Sonar Coverage

**Figure 5-2**  
Utility and Debris Data Collection Plan

USACE: U.S. Army Corps of Engineers

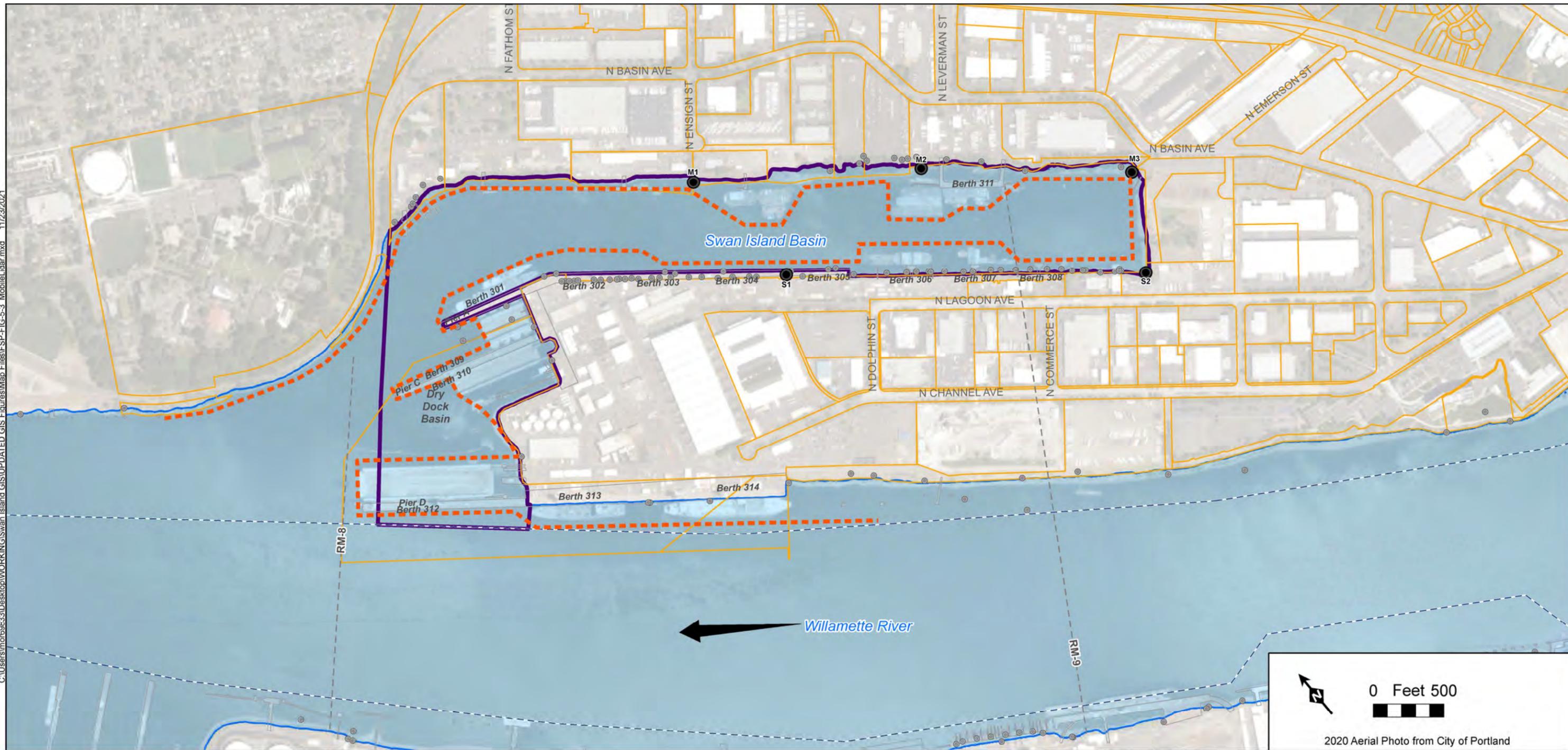
Prepared on 11/23/2021  
Field Sampling Plan  
Swan Island Basin

PACIFIC groundwater GROUP

**HGL** M M  
HydroGeologic, Inc. MOTT MACDONALD

BRIDGEWATER GROUP

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- City of Portland Stormwater Outfall
- Non-City Outfall
- Dock Drain
- River Mile (RM)
- ▭ Swan Island Sediment Decision Unit (SDU)
- ▭ Federal Navigation Channel (USACE, 2020)
- ▭ Docks and Structures
- ▭ Tax Lot Boundary
- ▭ Ordinary High Water (City of Portland, 2013)
- ← River Flow Direction

--- Laser Scan

Figure 5-3  
Mobile Terrestrial LiDAR Data  
Collection Plan

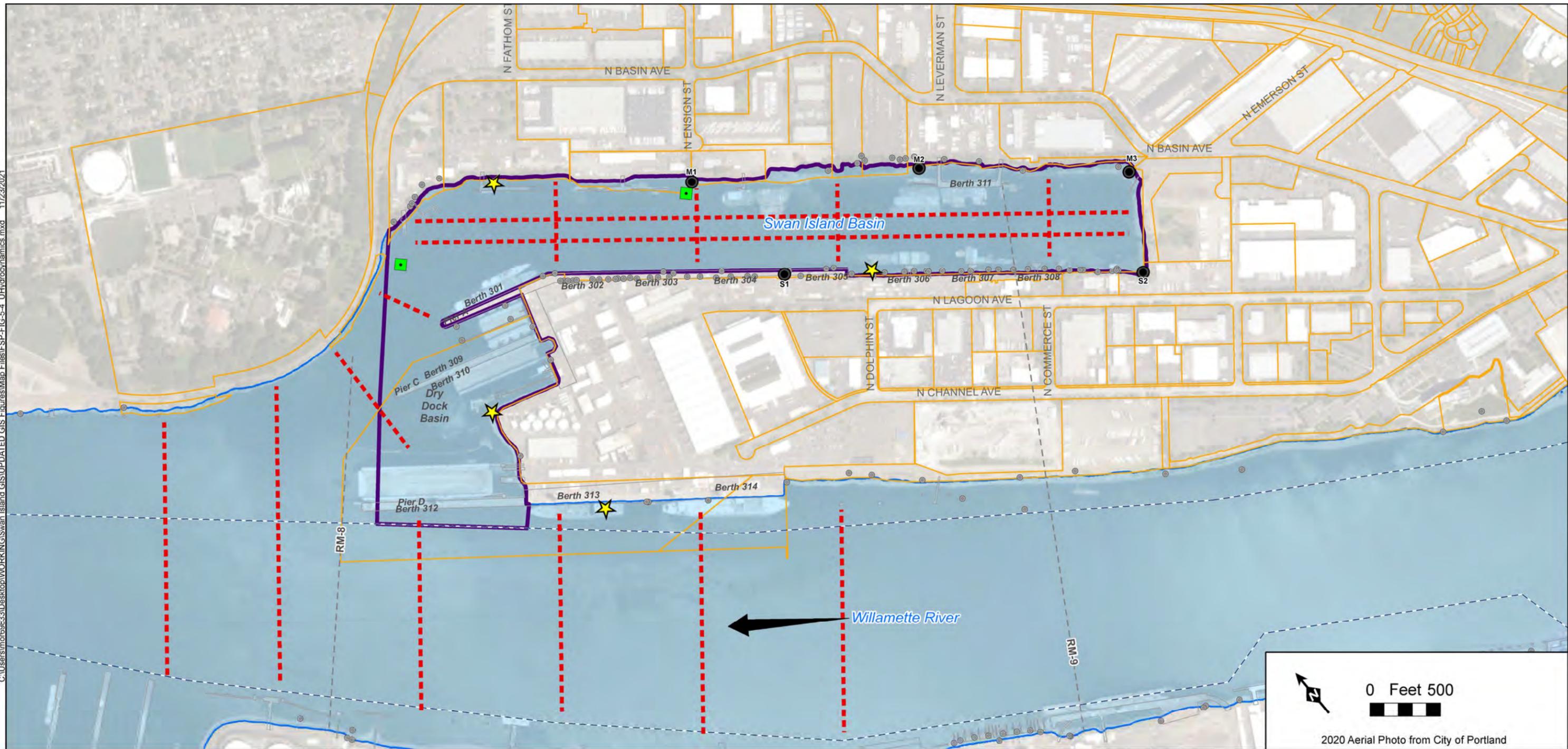
USACE: U.S. Army Corps of Engineers

Prepared on 11/23/2021

Field Sampling Plan  
Swan Island Basin



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- City of Portland Stormwater Outfall
- Non-City Outfall
- Dock Drain
- River Mile (RM)
- ▭ Swan Island Sediment Decision Unit (SDU)
- ▭ Federal Navigation Channel (USACE, 2020)
- ▭ Docks and Structures
- ▭ Tax Lot Boundary
- ▭ Ordinary High Water (City of Portland, 2013)
- ← River Flow Direction
- ★ Wind Wave & Boat Wake Sensors
- Bottom-Mounted Acoustic Doppler Current Profilers & Suspended Sediment Sensors
- Boat-Mounted Acoustic Doppler Current Profiler Transects

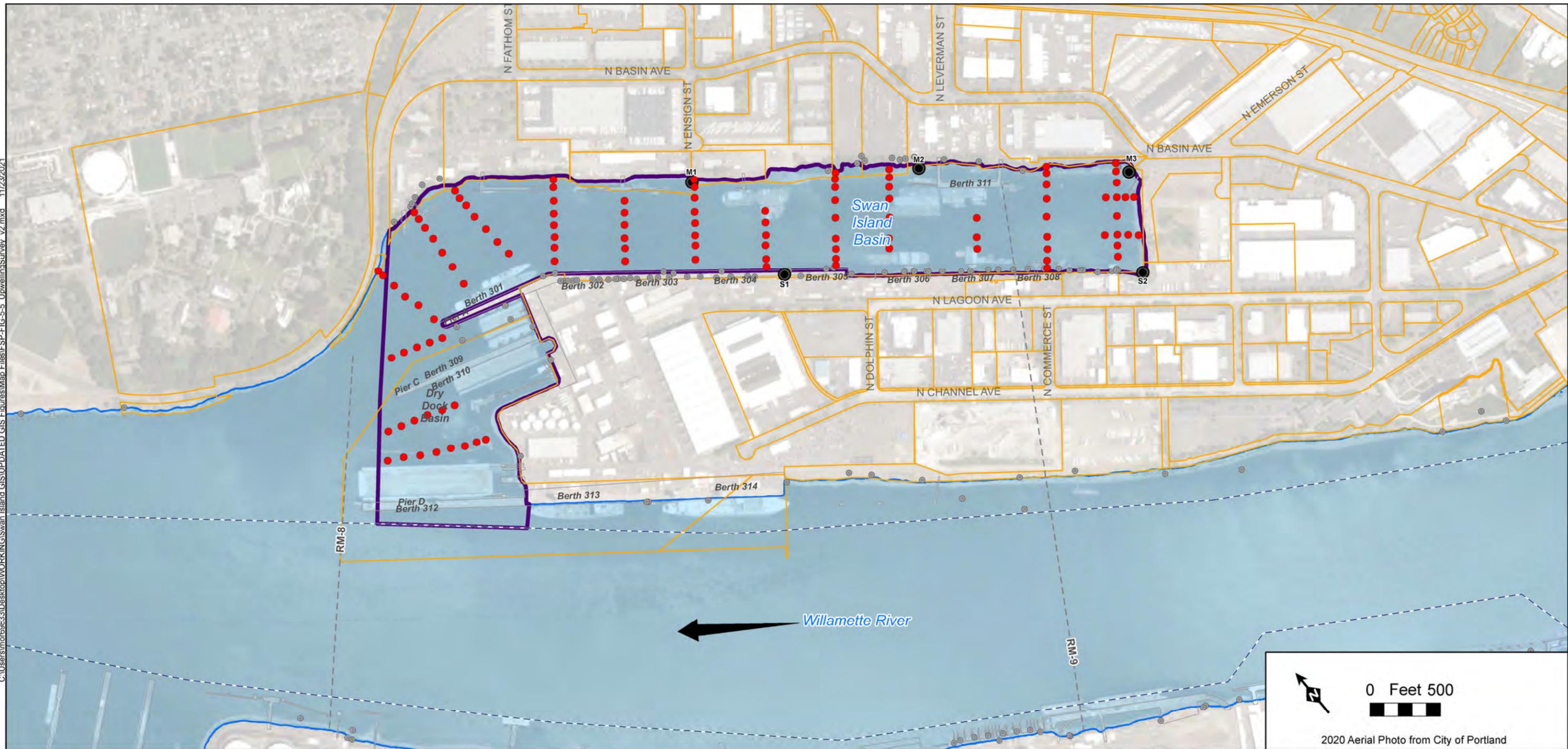
USACE: U.S. Army Corps of Engineers

Figure 5-4  
Hydrodynamics and Sediment  
Dynamics Data Collection Plan

Prepared on 11/23/2021  
Field Sampling Plan  
Swan Island Basin

PACIFICgroundwaterGROUP  
**HGL** M M  
 HydroGeologic, Inc. MOTT MACDONALD  
 BRIDGEWATERGROUP

C:\Users\m069633\Desktop\WORKING\Swan\_Island\_GIS\UPDATED GIS Figures\Map Files\FSP-FIG-5-5 UpwellingSurvey\_v2.mxd 11/23/2021



- City of Portland Stormwater Outfall
- Non-City Outfall
- Dock Drain
- River Mile (RM)
- ▭ Swan Island Sediment Decision Unit (SDU)
- ▭ Federal Navigation Channel (USACE, 2020)
- ▭ Docks and Structures
- ▭ Tax Lot Boundary
- ▭ Ordinary High Water (City of Portland, 2013)
- ← River Flow Direction
- Upwelling Survey Locations

USACE: U.S. Army Corps of Engineers

Figure 5-5  
Proposed Upwelling Survey Transects

Prepared on 11/23/2021  
Field Sampling Plan  
Swan Island Basin



## **APPENDICES**

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## **APPENDIX A**

### **STANDARD OPERATING PROCEDURES**

- HGL SOP 300.04 Field Logbook Use and Maintenance
- HGL SOP 403.02 Hand-Operated Auger Soil Sampling
- HGL SOP 403.03 Soil or Sediment Sample Composting
- HGL SOP 403.04 Direct-Push Technology Soil Sampling
- HGL SOP 403.06 Surface and Shallow Depth Soil Sampling
- HGL SOP 403.07 Borehole Logging
- HGL SOP 403.08 Sediment Sampling
- HGL SOP 411.02 Sampling Equipment Cleaning and Decontamination
- HGL SOP 411.03 Subsurface Utility Avoidance
- PGG SOP A-1 Hydrocarbon Field Screening (Integral, 2004)
- PGG SOP A-2 PID Screening and Calibration Procedures (AECOM and Geosyntec, 2018a)
- PGG SOP A-3 Sampling Photography
- EPA SOP A-4 Storm Drain Sampling
- Gravity SOP A-5 Gravity Marine HVS Sampling
- FMC SOP A-6 In-Line Sediment Trap
- PGG SOP A-7 Horizontal and Vertical Control
- BWG SOP A-8 Trident Probe
- MM SOP R-4 Geotechnical Soil Logging

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**SOP 300.04, SIB Project Area, PHSS**  
**(Source: Field Logbook Use and Maintenance)**

	<b>STANDARD OPERATING PROCEDURE</b>	
	Approved by: <b>Dick, Jeff</b>	<small>Digitally signed by Dick, Jeff Date: 2019.11.24 13:42:00 -05'00'</small> <b>Corporate Quality Manager</b>
<b>Field Logbook Use and Maintenance</b>	<b>SOP No.: 300.04 (formerly 4.07)</b>	
	<b>SOP Category: QA/QC</b>	
	<b>Revision No.: 3</b>	
	<b>Revision Date: November 20, 2019</b>	
		<b>Review Date: November 2021</b>

## 1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to describe the methods for use and maintenance of field logbooks. This procedure outlines methods, lists examples for proper data entry into a field logbook, and provides the standardized HGL format. Field logbooks provide a means for recording observations and activities at a site and are intended to provide sufficient data and observations to reconstruct field events. Logbooks are a primary source of evidence referenced during legal proceedings. The overall requirement is to document field activities without having to rely on memory.

## 2.0 SCOPE AND APPLICATIONS

This procedure provides guidance for logbook use and maintenance during routine field operations on environmental projects. Site-specific deviations from the methods presented herein must be approved by the assigned HGL project manager and the HGL project quality assurance/quality control officer. Consult the project-specific planning documents for other documentation requirements that apply to the project.

## 3.0 GENERAL REQUIREMENTS

All project work must be performed in accordance with the project-specific planning documents. Refer to the project-specific health and safety plan for relevant health and safety requirements.

Any deviations from specified project requirements must be justified to and authorized by the project manager and/or the relevant program manager and documented in the planning documents after consultation and approval by the client (refer to change or variance documentation requirements in the planning documents). Deviations from requirements are documented sufficiently to re-create the modified process and/or product and associated approvals.

All field personnel present on site to conduct work related to environmental projects are responsible for documenting field activities in project field logbooks. If field personnel are working in teams, one team member should be assigned to document the work performed. Documentation in the logbooks must be legible, and the logbooks must be maintained over the course of the project in accordance with this SOP.

The HGL field team leader, or approved designee, prepares daily logs to provide clients records of significant events, observations, and measurements taken in the field. These daily logs rely on documentation from the logbooks and should match.

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The HGL field team leader should check logbook entries at the end of each field day to ensure that they are complete/adequate and communicate any deficiencies and corrective measures immediately. Logbook entries should be reviewed on a regular basis by the project manager or an approved designee to verify that they have been completed in accordance with this SOP. This could be done as part of the three-phase control inspections for each task or definable feature of work. Regular reviews of logbook ensure that adjustments to the information in the logbook, if needed, can be made early on in the performance of the task and establish expectations for documented information.

## **4.0 PROCEDURE**

### **4.1 INTRODUCTION**

Field logbooks provide a means for recording and documenting for the record observations and activities at a site. Field logbooks are intended to provide sufficient data and observation notes to enable participants to reconstruct events that occurred while performing field activities and to refresh the memory of field personnel when drafting reports or giving testimony during legal proceedings. As such, all entries must be as factual, detailed, and as descriptive as possible so that a particular situation can be reconstructed without reliance on the memory of field crews. Field logbooks are not intended to be used as the sole source of project or sampling information. A sufficient number of logbooks are assigned to a project to ensure that each field team has a logbook at all times.

### **4.2 FIELD LOGBOOK IDENTIFICATION**

Field logbooks are bound books with consecutively prenumbered pages. Logbooks are permanently assigned to field personnel for the duration of the project or sampling event. When not in use, the field logbooks are to be stored in site project files. If site activities stop for an extended period (2 weeks or more), field logbooks are to be stored in the project files in the appropriate HGL office. The field logbooks are scanned on a regular basis, grouped in files by field event and by logbook, and stored electronically in the proper project file located on SharePoint.

The cover of each logbook contains the following information:

- Organization to which the book is assigned (HGL),
- Site name (including operable unit designation),
- Project number,
- Book number, and
- Start and end dates of the information in the logbook.

### **4.3 LOGBOOK ENTRY PROCEDURES**

Every field team must have a logbook, and each field activity is recorded in the logbook by a designated field team member to provide daily records of significant events, observations, and

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measurements during field operations. Beginning on the first blank page and extending through as many pages as necessary, the following list provides examples of useful and pertinent information that may be recorded (optional).

- Serial numbers and model numbers for equipment that will be used for the project duration,
- Formulas, constants, and example calculations,
- Useful telephone numbers, and
- County, state, and site address.

Entries into the logbook may contain a variety of information. At a minimum, the following information must be recorded on the first page of the logbook entry for each workday:

- Date (on all pages),
- Site name, site location, and project number,
- Weather at start of day and projected for the day (changes during the day should be documented at the time of the change),
- Names of field personnel and subcontractors present and directly involved in the field activities, with their initials in order to reference them by initials during the day to facilitate note taking,
- Level of personal protective equipment being used on the site,
- Equipment used and calibration procedures followed,
- Start time, and
- Any field calculations.

In addition, information recorded in the field logbook during the day includes, but is not limited to, the following:

- Sample description including sample numbers, collection time, depth, volume, type and number of containers, preservative, and media sampled;
- Information on field quality control samples (e.g., duplicates, trip blanks, rinsates, and matrix spike/matrix spike duplicates [MS/MSDs]);
- Sample courier airbill numbers and associated chains of custody numbers;
- Observations about site and samples (odors, appearances, etc.);
- Information about any activities, extraneous to sampling activities, that may affect the integrity of the samples;
- Any public involvement, visitors, or press interest, comments, or questions; as well as times present at site;
- Equipment used on site including time and date of calibration along with calibration gas/fluid lot numbers and expiration dates, and calibration results;

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- Background levels of each instrument and possible background interferences;
- Instrument readings for the borehole, cuttings, or samples in the breathing zone and from the specified depth of the borehole, etc.;
- Field parameters (pH, specific conductivity, etc., as required by the sampling method and planning documents);
- Unusual observances, irregularities, or problems noted on site or with instrumentation used;
- Maps or photographs acquired or taken at the sampling site, including photograph numbers and descriptions;
- A photographic log that lists subject, person taking photograph, distance to subject, direction, time, photograph number, and noteworthy items for each photograph stating what feature/item the photo is documenting;
- A description of the investigation-derived waste (IDW) generated, the quantity generated, and the manner of IDW storage employed; and
- Forms numbers/titles and any information contained therein used during sampling (Note that a form does not take the place of the field logbook.).

All logbook entries are made in indelible black or blue ink. No erasures are permitted. If an incorrect entry is made, the data is crossed out with a single strike mark and initialed and dated by the originator. Entries are to be organized into easily understandable tables if possible. A sample format is shown in Attachment 1. A Logbook Quick Guide, which provides logbook entry requirements and suggestions, is included as Attachment 2. This guide can be copied and taped to the inside cover of a logbooks for quick reference.

All logbook pages are initialed and dated at the top of each page. The time (in 12- or 24-hour format) is recorded next to each entry. No pages or spaces are left blank. If the last entry for a day is not at the end of a page, a diagonal line is drawn through the remaining space, and the line is signed and dated.

Logbooks can become contaminated when used in the field. Every effort should be made by the field team to avoid contaminating the logbook. Logbooks can be kept in seal-top poly bags, or temporary plastic covers may be used.

#### **4.4 REVIEW**

The assigned field team leader, or an approved designee, checks field logbooks for completeness and accuracy on an appropriate site-specific schedule determined by the project leader. Any discrepancies in the logbooks are noted and returned to the originator for correction. The originator or other field team member knowledgeable about the field task reviews the comments, makes

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appropriate revisions, and signs and dates them. The reviewer verifies that revisions have been made before placing the logbook photocopies on the project file in SharePoint.

## 5.0 REVISION HISTORY

Revision 0		Initial Release
Revision 1	December 2010	Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting.
Revision 2	July 2017	Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting.
Revision 3	November 20, 2019	Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting.

## ATTACHMENTS

Attachment 1 – Example Field Logbook

Attachment 2 – Logbook Quick Guide

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**ATTACHMENT 1**  
**EXAMPLE FIELD LOGBOOK**

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Ann Vogel  
11/16/95

November 6, 1995, AX1015.13.00

pH Meter

Model # = 12345

Serial # = 6789

Conductivity Meter

Model # = 12345

Serial # = 6789

$C^2 = a^2 + b^2$

if  $a = 3$

if  $b = 4$

then:  $a^2 + b^2 = c^2$

$3^2 + 4^2 = 5^2$

$9 + 16 = 25$

$c = 5$

$r = 3.14159$

Phone log:

Subject of phone call

date of phone call

person talking to

distance traveled on

Time of phone call

Approximate time

**INFORMATION RECORDED IN THE FRONT LOG**

**DOES OPTIONAL**

- serial model # of equipment (series)
- incubator, container, sample tubes
- used phone #
- site address

**DAILY RECORDING REQUIREMENTS**

- initials and date (top of every page)
- weather
- date methods (you may cross reference a previous days method if identical)
- personnel present on site
- pipe
- signatures of individual recording into equipment/procedures used
- sample descriptions (time, depth, volume, containers, preserv, etc.)
- GC samples (field and lab)
- observations
- field parameters
- map/photos drawn or taken
- form #
- scheduled paperwork

When using a field form information recorded in the field does not need to be written twice. Cross reference the field form # in the log book and record the information only on the appropriate field form.

**DO NOT LEAVE ANY BLANK SPACES/PAGES.**

If a page is necessarily left blank or there is unused space at the end of a day's entry, draw a diagonal line through the space and initial and date the line.

Phone log home # 123-4567

105 Denver Office # 203/291-9700

125 San Francisco # 415/774-2300 (Home)

Smith Site

Butler County, Colorado

Address: 1234 W. Main Street

Manitou, Colorado 80000

Directions to Site:

west on I-70

Exit 95B

head south approx 3 miles

Site is on east side of dirt road

AV 11/10/95

2

November 6, 1995 Site Visit

0700 Arrive on site

Weather: 80°, sunny, slight breeze (~5 mph) from southwest.

VOS Field Team: EPA OSC:

M.R. Smith

K.W. Wagner

P.R. Lane

PRP representative, L.M. Stein, will be accompanying the VOS Field Team.

Personal Protective Equipment - LEVEL D

will be used on-site (refer to site-specific health & safety plan).

All equipment will be decontaminated as follows:

- Brush equipment scrub brush to remove gross particulates.
- Scrub thoroughly with Alconox/water solution.
- Rinse with reagent-grade distilled water.

- Rinse with reagent-grade Methanol.
- Rinse with reagent-grade distilled water.

Allow equipment to gravity drain. Wrap equipment in tinfoil if not immediately used.

Sample procedure:

All surface water samples will be taken using a clean decontaminated TEFLON scoop; stainless steel spoon and stainless steel bowl will be used for sediment samples.

AV 11/10/95

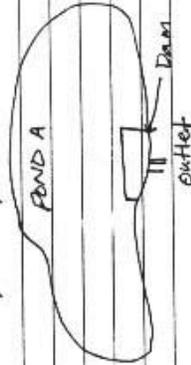
3

The samples will be taken from the ponds at the center of the dam opposite the outlets. (see below; refer to sample plan).

All total suspended solids (TSS) samples will be collected in a 500 ml polystyrene bottle - No preservative is necessary.

All VOA samples will be collected in two 40-ml amber glass vials and will be collected first. Preservation will be 4°C (ice).

→ Meters (pH) Decon = Rinse with reagent-grade distilled water



0730: Leave trailer. Go to sample location SS-1 @ Pond A.

0745: Arrive @ Pond A. Decon. equipment as described - on page 2 of this logbook.

Calibrate pH meter - Rinse probe

Time	STD	Reading
0753	7.00	7.00 Rinse probe
0754	4.00	4.00 Rinse probe
0756	Calibrate	Conductivity meter using 10,000 STD - Rinse probe

11/6/95 AV  
5

AV 11/6/95  
4

Time	Sample	Sample #	Label #	FIELD PARAMETERS
0802	V0A	81088 V0A	101	TIME PH Conductivity
0803	TSS	81088 TSSA	103*	0924 6.00 590
Decon equipment (scoop only)				Decon meters as noted on page 3
* Label 102 fell in mud - destroyed it.				Fill out surface water quality sheet.
Field Parameters				
Time	PH	Conductivity		
0815	6.35	610		0940 - Leave Pond B - head back to trailer to pack samplers for shipment.
Decon equipment (meters only)				
Fill out surface water quality sheet.				
Note - wind speed is picking up - The ponds became turbulent.				0952 - Arrive at Trailer.
0839 - Leave Pond A - go to Pond B.				0959 - Complete chain-of-custody forms for samplers to be shipped. Wrap samplers according to VAS TSOB.
0840 - Arrive at Pond B				1020 - Seal Cooler and attach Custody seals.
Pond B sampling procedure.				1030 - Take cooler to Federal Express for shipping.
0842 - Decon equipment.				COI # 1234567
Calibrate PH meter				1035 - Leave Federal express. Sampling complete.
Time	STD	Reading		
0844	4.00	4.00	Rinse probe	
0845	7.00	7.00	Rinse probe	
0847 Calibrate conductivity meter using 10000 STD - Rinse probe.				
Decon sampling equipment (scoop).				
Time	Sample	Sample #	Label #	
0902	V0A	81088 V0A BD	106	
0903	TSS	81088 TSS BD	107	
0903 Decon scoop.				
Rinse Samples				
Time	Sample	Sample #	Label #	
0920	V0A	81088 V0A	1407-108	

11/6/95  
AV

**ATTACHMENT 2**  
**LOGBOOK QUICK GUIDE**

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## LOGBOOK QUICK GUIDE

### TOP

Location: County/City/State

Project/Client: Project/Client Name

### MINIMAL REQUIREMENTS

- times of activities (military)
- author of day's entries
- field team members
- field team member assignments
- field activities
- EPA or other regulatory personnel observing - activities
- other personnel
- public or press visitors
- equipment used
- equipment calibration information
- serial numbers of equipment
- weather
- decontamination methods
- level of PPE
- calculations used
- **sample information**
  - ID
  - depth
  - volume
  - containers
  - preservative
  - media
  - QC samples

## LOGBOOK QUICK GUIDE

### MINIMAL REQUIREMENTS (cont.)

- background levels and readings
- possible instrument interferences
- photographs
  - + number
  - + direction
  - + description
  - + photographer

### OTHER REQUIREMENTS

- unusual observations
- strike through mistakes with single line
- diagonal line across unused portion of page with signature and date
- use indelible black or blue ink
- no erasable ink
- generate tables when possible for information
- leave no pages blank
- place North arrow on sketches
- leave no open lines
- staple business cards of visitors in book
- deviations from approved plans
- field forms completed

\* *Black text applies to all activities*

\* *Red text applies to activities that include sampling*

**SOP 403.02, SIB Project Area, PHSS  
(Source: Hand-Operated Auger Soil Sampling)**

	<b>STANDARD OPERATING PROCEDURE</b>	
	Approved by: <b>Jeff Dick</b>	<small>Digitally signed by Jeff Dick DN: cn=Jeff Dick, o, ou, email=jdick@hgl.com, c=US Date: 2019.08.02 07:28:29 -04'00'</small> Corporate Quality Manager
<b>Hand-Operated Auger Soil Sampling</b>	<b>SOP No.: 403.02 (formerly 2.03)</b>	
	<b>SOP Category: Environmental Services</b>	
	<b>Revision No.: 2</b>	
	<b>Revision Date: August 1, 2019</b>	
	<b>Review Date: August 2021</b>	

## 1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to describe the standard method and equipment used to collect soil samples at the surface or in shallow subsurface using a hand auger.

## 2.0 SCOPE AND APPLICATION

This procedure yields a disturbed sample and applies to a wide variety of soil types including sands, clays, and silts. A hand auger is typically a small, lightweight metal cylinder (bucket), open at both ends with a cutting bit on the bottom. Diameters typically range between 1 and 4 inches. A T-shaped handle is attached to the top of the bucket by extendable rods. The augers are rotated into the ground until the bucket is full, then lifted out of the borehole and emptied. The maximum depth of hand auger investigations is typically 10 feet below ground surface. The use of an auger is of limited value in rocky soil. This procedure is not appropriate for collecting samples at a discrete depth, but may be used to collect samples at an approximate depth.

## 3.0 GENERAL REQUIREMENTS

All work must be performed in accordance with the project-specific planning documents. Refer to the project-specific health and safety plan for relevant health and safety requirements.

Any deviations from specified requirements must be justified to and authorized by the project manager and/or the relevant program manager. Deviations from requirements must be sufficiently documented to re-create the modified process.

## 4.0 EQUIPMENT

The equipment required may include hand-operated, spiral-type, ship-type, open-tubular, orchard-barrel, open-spiral, closed-spiral, post-hole, clamshell, Edelman, or Iwan augers. Augers typically are used with 3- to 4-foot-long metal extension rods and T-handles (fixed or ratcheted). The use of stainless steel augers is preferred. Augers plated with chrome or coated with other materials, except Teflon<sup>®</sup>, cannot be used.

Sampling tools and equipment should be protected from contamination sources before sampling and decontaminated before and between sampling locations, as specified in SOP 2.01: *Sampling Equipment Cleaning and Decontamination*.

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	<b>SOP Category: Environmental Services</b>
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	<b>Revision Date: August 1, 2019</b>
	<b>Review Date: August 2021</b>

## 5.0 PROCEDURES

1. Don clean gloves. Using a decontaminated stainless steel spoon or other approved utensil, remove surface vegetation and debris from the immediate area around the marked sampling point.
2. Do not allow sampling equipment to touch potentially contaminated surfaces.
3. Record the appropriate information and observations about the sample location in the field logbook.
4. Assemble the decontaminated auger, extension, and T-handle, if necessary, and advance the auger into the soil to the desired depth. Mark the length of the hand auger rods every 0.5 foot to determine auger head depth relative to the ground surface when advancing or tag the bottom of the borehole (if the borehole stays open) with a weighted tape measure or water level meter.
5. Withdraw the auger from the soil.
6. If a sample is not being collected, remove the soil from the auger bucket and repeat Steps 4 and 5. While removing the soil from the auger bucket, the subsurface lithology should be described as specified in SOP 2.14: *Geologic Borehole Logging*. If a sample is to be collected in the next depth interval, replace the auger bucket with a clean decontaminated bucket and repeat Steps 2 through 4. Change gloves at each sampling location, or each time a new sample is to be collected, to avoid cross-contamination.
7. Perform any field monitoring required in the project-specific planning documents.

If collecting samples for analyses other than volatile organic compound (VOC) analyses, refer to Steps 8 and 9.

8. Using a decontaminated stainless steel spoon, spatula, disposable scoop, remove soil from the auger bucket and place in a stainless steel or glass container. Food-grade disposable aluminum pans may also be used but cannot be reused. Clean nitrile gloves may be donned to remove soil from the auger bucket by hand. Discard the top 2 or 3 inches of soil in the auger as this soil may consist of borehole slough from above. Mix or composite soil as directed by the project-specific planning documents. Using a decontaminated spoon or other approved utensil, remove any large rocks or other organic material (worms, grass, leaves, roots, etc.). Clean nitrile gloves may also be donned to remove large rocks or other organic material by hand.
9. Using a decontaminated stainless steel spoon, spatula, or disposable scoop, as appropriate, place soil samples in appropriate containers. Clean nitrile gloves may be donned to place soil into appropriate containers. Place samples in containers defined according to analytical

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	<b>SOP Category: Environmental Services</b>
	<b>Revision No.: 2</b>
	<b>Revision Date: August 1, 2019</b>
	<b>Review Date: August 2021</b>

needs specified in the project-specific planning documents, label samples, and then (when appropriate) pack on ice as soon as possible.

If collecting samples for VOC analysis, refer to Steps 10 and 11.

10. Remove the hand auger from the boring when the top of the specified sampling depth has been reached. Fit a slide-hammer to the top of the appropriate number of extension rods required to reach the total depth of the hole. Attach an impact sampler to the bottom of the extension rod(s) and drive the impact sampler into the soil to a depth of at least 6 inches. Remove the sampler from the borehole.
11. Collect VOC samples in accordance with SOP 403.01.0: *VOC Soil Sample Collection*. When samples are being collected for multiple analyses, samples that can be degraded by aeration (e.g., VOCs) are collected first and with the least disturbance possible to minimize analyte loss. VOC samples must not be composited.

## 6.0 REVISION HISTORY

Revision 0	December 2010	Initial Release
Revision 1	April 2017	Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting.
Revision 2	August 1, 2019	Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting.

**SOP 403.03, SIB Project Area, PHSS  
(Source: Soil or Sediment Sample Compositing)**

	<b>STANDARD OPERATING PROCEDURE</b>	
	Approved by: <b>Jeff Dick</b>	<small>Digitally signed by Jeff Dick DN: cn=Jeff Dick, o, ou, email=jdick@hgl.com, c=US Date: 2019.08.02 07:30:04 +0400</small>
<b>Soil or Sediment Sample Compositing</b>	<b>SOP No.: 403.03 (formerly 2.04)</b>	
	<b>SOP Category: Environmental Services</b>	
	<b>Revision No.: 4</b>	
	<b>Revision Date: August 1, 2019</b>	
	<b>Review Date: August 2021</b>	

## 1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to outline methods that may be used for field compositing soil or sediment samples before they are submitted to an analytical laboratory.

## 2.0 SCOPE

This procedure applies to compositing soil or sediment. This procedure does not apply to sample collection, but rather to combining samples in preparation for submittal for testing. Samples for volatile organic compound analyses must NOT be composited.

## 3.0 GENERAL REQUIREMENTS

All work must be performed in accordance with the site- or project-specific planning documents. Refer to the project-specific health and safety plan for relevant health and safety requirements.

Any deviations from specified requirements must be justified to and authorized by the project manager and/or the relevant program manager. Deviations from requirements must be sufficiently documented to re-create the modified process.

## 4.0 PROCEDURES

Soil or sediment that is to be sampled must be mixed as thoroughly as possible before being transferred to the sample container. Anomalous or suspected highly contaminated samples must be brought to the attention of the field manager.

- Soil or sediment that is composited must meet the following requirements:
  - Uniform collection techniques must be used to retrieve sample aliquots.
  - Aliquots must be of equal or known proportion.
  - The soil or sediment must be well mixed.
- The most common method of mixing (compositing) is referred to as quartering. The soil or sediment is placed in a pan or tray and divided into quarters. Each quarter is mixed individually, and then all quarters are mixed together to form a homogenous matrix. This procedure is repeated several times until the sample is adequately mixed. If round bowls are used for sample mixing, adequate mixing is achieved by stirring the soil or sediment in a circular fashion and occasionally turning the soil or sediment over. Mixing bowls and

<b>Soil or Sediment Sample Compositing</b>	<b>SOP No.: 403.03 (formerly 2.04)</b>
	<b>SOP Category: Environmental Services</b>
	<b>Revision No.: 4</b>
	<b>Revision Date: August 1, 2019</b>
	<b>Review Date: August 2021</b>

stirring devices must be stainless steel and be decontaminated prior to use. Samples are homogenized before being placed into containers, except for volatile organic analyses.

- Sampling tools, instruments, and equipment must be protected from contamination sources before use and decontaminated after use as specified in SOP 2.01: *Sampling Equipment Cleaning and Decontamination*.
- Composite samples must be packaged, labeled, and prepared for shipment in accordance with the project-specific planning documents.
- The field logbook must be completed in accordance with procedures detailed in SOP 4.07: *Field Logbook Use and Maintenance*.

## 5.0 RECORDS

Documentation generated as a result of this procedure must be collected and maintained in accordance with requirements specified in the project-specific planning documents.

- Complete the field logbook in accordance with procedures listed in SOP 4.07: *Field Logbook Use and Maintenance*.

## 6.0 REVISION HISTORY

Revision 0		Initial Release
Revision 1		Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting.
Revision 2	April 2009	Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting.
Revision 3	April 2017	Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting.
Revision 4	August 1, 2019	Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting.

**SOP 403.04, SIB Project Area, PHSS**  
**(Source: Direct-Push Technology Soil and Groundwater Sampling)**

	<b>STANDARD OPERATING PROCEDURE</b>	
	Approved by: <b>Dick, Jeff</b>	Digitally signed by Dick, Jeff Date: 2020.06.18 16:04:57 -04'00'
<b>Direct-Push Technology Soil and Groundwater Sampling</b>	<b>SOP No.: 403.04 (formerly 2.05)</b>	
	<b>SOP Category: Environmental Services</b>	
	<b>Revision No.: 3</b>	
	<b>Revision Date: June 18, 2020</b>	
	<b>Review Date: June 2022</b>	

## 1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to describe the standard method and equipment used to collect soil and groundwater samples using direct-push technology (DPT).

## 2.0 SCOPE AND APPLICATION

The DPT soil sampling method applies to a wide variety of soil types including sands, clays, and silts. Samples may be collected from discrete intervals where high sample recovery rates can be achieved such as in clays and silts. However, where sample recovery rates are low, such as may be the case in loose sand, the sample collection depth intervals may be approximate. DPT soil sampling methods are of limited value in rocky soil. Where rocky soils limit the use of DPT, a different technology, such as hollow-stem auger drilling equipment, must be used. This procedure is appropriate for collecting groundwater samples at discrete depths.

## 3.0 GENERAL REQUIREMENTS

All work must be performed in accordance with the project-specific planning documents. Refer to the project-specific health and safety plan and project-specific quality assurance project plan for relevant health and safety and quality control requirements, respectively.

Any deviations from specified requirements must be justified to and authorized by the project manager and/or the relevant program manager. Deviations from requirements must be sufficiently documented to re-create the modified process.

## 4.0 PRECAUTIONS

The following precautions should be employed during DPT sampling operations:

- Subsurface and aboveground utility lines must be identified and cleared before exploratory boring drilling activities can be performed. Procedures outlined in HGL SOP 411.03: *Subsurface Utility Avoidance*, must be followed.
- Every attempt should be made to minimize the transfer of potentially contaminated material to downhole equipment, or to any equipment and supplies stored on the site.
- Every attempt should be made to contain contaminated soil and water and to prevent further contamination of the environment.

<b>Direct-Push Technology Soil and Groundwater Sampling</b>	SOP No.: 403.04 (formerly 2.05)
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- Sampling tools and equipment must be protected from sources of contamination before sampling and decontaminated before and between sampling, as specified in SOP 411.02: *Sampling Equipment Cleaning and Decontamination*.

## 5.0 DPT SAMPLING PROCEDURES

DPT soil sampling is accomplished using a Geoprobe® or other similar truck- or track-mounted hydraulic sampler. DPT involves advancing a sampling probe using direct hydraulic pressure or a hydraulically driven rotary hammer. Boreholes are typically advanced using a 2.5- to 3-inch-diameter lead sampler attached to 1- or 2-inch-diameter probe rods, which are placed under hydraulic downward pressure. In unstable soils, a dual-tube system may be used where the lead sampler and center rods are used within larger diameter probe rods to prevent caving of material into the sample interval. Sampler sizes can vary from 1.25 to 4.5 inches in outer diameter (OD); however, 2.25- to 3.25-inch OD samplers are typical. Liner sizes can vary from 1.0 to 3.0 inches in internal diameter (ID); however, 1.125- to 1.85-inch ID liners are typical. Borings remain open only as long as necessary to collect the soil and/or groundwater samples and log the lithology, if required by the project-specific planning documents.

Specific sampling tools could require slightly different handling methods. For example, if sampling devices and probe rod extensions do not have quick-connect fittings, adjustable or pipe wrenches could be needed to change equipment configurations. The procedures described in this SOP are for power-driven DPT methods or tube samplers, and they are consistent with ASTM International Standard Guides D6282/D6282M-14 and D6001-05(2012).

### 5.1.1 Soil Sampling Procedures

The soil samples obtained using DPT are collected in acetate, brass, or stainless steel sampling tubes. Acetate tubes are most commonly used. Sampling is initiated at the soil interface, unless otherwise specified in the project-specific planning documents.

- Place plastic sheeting on the ground around the sampling location to prevent cross contamination.
- Attach the direct-push sampler with liner and cutting shoe to a rod extension.
- Clear the area to be sampled of any surface debris (e.g., twigs, rocks, litter). Remove the first 8 to 15 centimeters (cm) of surface soil from an approximately 15-cm radius around the drilling location to prevent near-surface soil particles from falling down the hole.
- Begin advancing the direct-push sampler, periodically removing accumulated soils. This step prevents accidentally brushing loose material back down the borehole when removing the sampler or adding probe rods.

## Direct-Push Technology Soil and Groundwater Sampling

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- After reaching the desired depth, slowly and carefully remove the direct-push tool from the boring. If collecting a core sample, remove the cutting shoe and liner from the sampler and replace it with a precleaned thin-walled tube sampler. Insert a disposable acetate liner into the sampler with optional core catcher, and install the sampler and cutting shoe.
- Carefully lower the sampler down the borehole and gradually force the sampler into the soil. Care should be taken to avoid scraping the borehole sides when not using a dual-tube system. Hammering the probe rods to facilitate coring should be avoided, as the vibrations could cause the borehole walls to collapse.
- Once the sampler reaches the top of the sampling interval, drive the sampler down into the soil the length of the corer.
- Pull the probe rods and sampler out of the hole.
- Remove the sampler by twisting to prevent losing the core and unscrew the probe rods.
- Remove the cutting shoe and remove the acetate liner containing the core from the device.
- Carefully cut the acetate liner to expose the core.
- Screen the core with a field detector as described in the project-specific planning documents. If required by the project plans, collect volatile organic compound (VOC) samples immediately after opening the acetate liner. VOC samples must be collected in accordance with SOP 403.01: *VOC Soil Sample Collection*.
- Discard the top of the core (approximately 2.5 cm), as it will contain any material collected by the corer before penetration of the layer being sampled.
- Provide a lithologic description in accordance with SOP 403.07: *Geologic Borehole Logging*.
- If homogenization of the soil sample is appropriate for the remaining analytical parameters, or if compositing of different locations is desired, follow the procedures detailed in SOP 403.03: *Soil or Sediment Sample Compositing*. Otherwise, transfer the sample into an appropriate container with a stainless steel spoon or equivalent and secure the cap tightly.
- Label the sample bottle(s) with the appropriate sample label as described in the project-specific planning documents. Complete the label carefully and clearly, addressing all the categories or parameters.
- Place filled sample containers on ice immediately.
- Complete all chain of custody documents and record information in the field logbook in accordance with procedures listed in SOP 300.04: *Field Logbook Use and Maintenance* and on the Field Sampling Report (Attachment 1).
- Prepare the samples for shipment in accordance with the project-specific planning documents.

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- Decontaminate sampling equipment after use and between sampling locations in accordance with procedures detailed in SOP 411.02: *Sampling Equipment Cleaning and Decontamination*.
- If no more cores are needed from the borehole, abandon the borehole with bentonite grout or chips and return the surface to its initial condition (e.g., topsoil, asphalt, or pavement).
- Soil generated during DPT activities that was not used for sampling should be treated as investigation-derived waste (IDW) and managed in accordance with the project-specific planning documents.

### 5.1.2 Groundwater Sampling Procedures

DPT groundwater samples can be collected using a hydropunch sampler. This type of groundwater sampling is best used for characterizing a site to determine the best placement of permanent wells. Procedures for collecting a water sample with a hydropunch are discussed in detail in this section. Note that the hydraulic conductivity of a formation could affect the time required to collect a sample. That is, more time could be required if groundwater recharge is slow. In those instances, the probe rods and hydropunch sampler can remain in the ground while the rig moves to another location to allow the water to recharge. After sufficient recharge, bailing or pumping can begin again.

- Place plastic sheeting on the ground around the sampling location to prevent cross contamination.
- Attach the sealed-screen sampler (hydropunch) to the probe rods.
- Clear the area to be sampled of any surface debris (e.g., twigs, rocks, litter). Remove the first 8 to 15 cm of surface soil from an approximately 15-cm radius around the drilling location to prevent near-surface soil particles from falling down the hole.
- Begin advancing the hydropunch. The screen is driven to a depth such that the middle of the screen is set at the sample target depth.
- After reaching the desired depth, retract the protective outer rod of the sampler to expose the screen to groundwater. If necessary, an instrument can be lowered down through the center of the probe rods to check the water level and ensure that the sampler has sufficient water for sampling.
- Lower tubing with check valve, bailer, or peristaltic pump down through the probe rods to the screen of the hydropunch to collect the groundwater sample. Groundwater samples are collected most commonly using polyethylene or Teflon<sup>®</sup> tubing with a check valve attached to the bottom. An up/down oscillating motion on the tubing pumps the water column up in the tubing to the ground surface or until enough water volume is in the tubing for the samples. Groundwater samples are collected directly from the bottom of the tubing, after removing the check valve, and placed in sample containers according to the project-specific planning documents.

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- Unless otherwise specified in the project-specific planning documents, collect the groundwater samples without purging sediment or groundwater to minimize disturbance to the sample.
- If sediment is expected in the sample, consider using sample containers without a hydrochloric acid preservative. Mixing the sediment often found in direct push groundwater samples with the hydrochloric acid causes a reaction that generates a gaseous product that creates unwanted headspace in the groundwater sample.
- If a bailer is used, retrieve the sample from the bailer and place it in an appropriate sample container.
- If a peristaltic pump is used, fill the appropriate sample container from the pump effluent tubing.
- If required, place a portion of the sample in a container to collect field parameters (temperature, pH, conductivity, dissolved oxygen, oxygen reduction potential, and turbidity).
- Label the sample bottles with the appropriate sample labels as described in the project-specific planning documents. Complete the label carefully and clearly, addressing all the categories or parameters.
- Place filled sample containers on ice immediately.
- Complete all chain of custody documents and record information in the field logbook in accordance with procedures listed in SOP 300.04: *Field Logbook Use and Maintenance* and on the Field Sampling Report (Attachment 1).
- Prepare samples for shipment in accordance with the project-specific planning documents.
- Pull the rods and hydropunch sampler from the hole.
- Decontaminate sampling equipment after each use and between sampling locations in accordance with procedures detailed in SOP 411.02: *Sampling Equipment Cleaning and Decontamination*.
- If additional samples are not needed from the borehole, abandon the borehole with bentonite chips and return the surface to its initial condition (e.g., topsoil, asphalt, or pavement).
- Manage IDW generated during hydropunch sampling in accordance with the project-specific planning documents.

## **6.0 RECORDS**

Documentation generated as a result of this SOP must be collected and maintained in accordance with requirements specified in the project-specific planning documents.

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- Document all daily field activities in the field logbook in accordance with procedures listed in SOP 300.04: *Field Logbook Use and Maintenance*.
- Complete a Field Sampling Report (Attachment 1) for each soil and groundwater sample.

## 7.0 REFERENCES

ASTM International (ASTM). D6282/D6282M-14: Standard Guide for Direct Push Soil Sampling for Environmental Site Characterizations.

ASTM. D6001-05(2012): Standard Guide for Direct-Push Groundwater Sampling for Environmental Site Characterization.

## 8.0 REVISION HISTORY

Revision 0	April 2009	Initial Release
Revision 1	April 2017	Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting.
Revision 2	February 2018	Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting.
Revision 3	June 18, 2020	Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting, which included changing the SOP number from 2.05 to 403.04.

## ATTACHMENTS

Attachment 1 – Field Sampling Report

**ATTACHMENT 1**  
**FIELD SAMPLING REPORT**

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## FIELD SAMPLING REPORT

LOCATION: SITE:	PROJECT NAME: PROJECT NO:
--------------------	------------------------------

### SAMPLE INFORMATION

SAMPLE ID: MATRIX TYPE: SAMPLE COLLECTION METHOD: LOW-FLOW    BAILER    PASSIVE    OTHER _____ LOT CONTROL #: _____ (Ambient Blank # - Equipment Blank # - Trip Blank # - Cooler #) CHAIN-OF-CUSTODY #: _____ SAMPLE BEG. DEPTH (FT): SAMPLE END DEPTH (FT): GRAB ( )    COMPOSITE ( )	DATE: _____ TIME: _____ ENTER SAMPLE NUMBERS FOR QC SAMPLES/ BLANKS ASSOCIATED WITH THIS SAMPLE: MATRIX SPIKE (MS): _____ MATRIX SPIKE DUP (SD): _____ FIELD DUP (FD): _____ AMBIENT BLANK (AB): _____ EQUIPMENT BLANK (EB): _____ TRIP BLANK (TB): _____
---	---

CONTAINER		PRESERVATIVE/ PREPARATION	ANALYTICAL METHOD	ANALYSIS
SIZE/TYPE	#			

### NOTABLE OBSERVATIONS

PID READINGS	SAMPLE CHARACTERISTICS	MISCELLANEOUS
1st (TOC):	COLOR:	
2nd (BZ):	ODOR:	
	OTHER:	

pH \_\_\_\_\_ Temperature \_\_\_\_\_ (C)    Dissolved Oxygen \_\_\_\_\_ (mg/L)    Specific Conductivity \_\_\_\_\_ (mS/cm)  
 Ferrous Iron \_\_\_\_\_ (mg/L)    Oxidation/Reduction Potential \_\_\_\_\_ (mv)    Turbidity \_\_\_\_\_ (NTU)

### GENERAL INFORMATION

WEATHER:    SUN/CLEAR \_\_\_\_\_    OVERCAST/RAIN \_\_\_\_\_    WIND DIRECTION \_\_\_\_\_    AMBIENT TEMPERATURE \_\_\_\_\_  
 SHIPMENT VIA:    FEDEX \_\_\_\_\_    HAND DELIVER \_\_\_\_\_    COURIER \_\_\_\_\_    OTHER \_\_\_\_\_  
 SHIPPED TO: \_\_\_\_\_  
 COMMENTS: \_\_\_\_\_  
 SAMPLER: \_\_\_\_\_    OBSERVER: \_\_\_\_\_

MATRIX TYPE CODES	SAMPLE COLLECTION METHOD CODES
DC=DRILL CUTTINGS	B=BAILER
WG=GROUND WATER	BP=GAS OPERATED BLADDER PUMP
LH=HAZARDOUS LIQUID WASTE	CS=COMPOSITE SAMPLE
SH=HAZARDOUS SOLID WASTE	EC/TC=ENCORE/TERRA CORE SAMPLER
SE=SEDIMENT	GB=GEOPROBE
W=WATER	H=HOLLOW STEM AUGER
SL=SLUDGE	OTHER
SO=SOIL	G = GRAB
GS=SOIL GAS	HA=HAND AUGER
WS=SURFACE WATER	HY=HYDRASLEEVE
SW=SWAB/WIPE	NS=NON-SUBMERSIBLE PUMP
	PP=PERISTALTIC PUMP
	SP=SUBMERSIBLE PUMP
	SS=SPLIT SPOON
	TR=TROWEL

**SOP 403.06, SIB Project Area, PHSS**  
**(Source: Surface and Shallow Depth Soil Sampling)**

	<b>STANDARD OPERATING PROCEDURE</b>	
	Approved by: <b>Dick, Jeff</b>	Corporate Quality Manager
<b>Surface and Shallow Depth Soil Sampling</b>	<b>SOP No.: 403.06 (formerly 2.13)</b>	
	<b>SOP Category: Environmental Services</b>	
	<b>Revision No.: 3</b>	
	<b>Revision Date: June 24, 2020</b>	
	<b>Review Date: June 2022</b>	

## 1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to describe the equipment and operations used for sampling surface and shallow depth soils. This procedure outlines the methods for soil sampling with routine field operations on environmental projects.

## 2.0 SCOPE AND APPLICATIONS

The objective of surface and shallow depth soil sampling is to ascertain the nature and extent of soil contamination at a site. The data can be used to identify contaminant sources, evaluate potential threats to human health or the environment, evaluate potential exposure pathways, or calculate environmental risks. For the purposes of this SOP, soil is defined as all unconsolidated materials above bedrock; surface soils are those that occur 0 to 6 inches below ground surface; and shallow depth soils are soils located above the bedrock surface and from 6 inches to 2 feet below ground surface.

## 3.0 GENERAL REQUIREMENTS

All work is performed in accordance with the project-specific planning documents. Refer to the project-specific health and safety plan for relevant health and safety requirements.

Any deviations from specified requirements must be justified to and authorized by the project manager and/or the relevant program manager and discussed in the approved project plans. Deviations from requirements must be documented sufficiently to re-create the modified process.

## 4.0 PROCEDURES

### 4.1 SAMPLING EQUIPMENT

Typically, equipment required for surface and shallow depth soil should be specified in the project field sampling plan or work plan. Equipment includes the following:

- Stainless steel mixing bowl,
- Stainless steel trowels or spoons,
- Stainless steel hand auger,
- Stainless steel core sampler that uses stainless steel or Lexan® liners (optional),
- Stainless steel shovel, and
- Appropriate sample containers.

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Disposable sampling equipment items, such as a sampling spoon, may be used instead of stainless steel equipment. An example of a hand auger is provided in Attachment 1.

## 4.2 DECONTAMINATION

Before initial use, and after each subsequent use, all nondedicated or nondisposable sampling equipment must be decontaminated using the procedures outlined in HGL SOP 411.02: *Sampling Equipment Cleaning and Decontamination*.

## 4.3 SAMPLING LOCATION/SITE SELECTION

Follow the sample design criteria outlined in the project plan for each sampling event. Relocate the sample sites when conditions dictate, such as when natural or artificial obstructions are present at the proposed sample location (such as boulders or asphalt). Document the actual sample locations on a topographic map or site sketch and photograph all sample locations. GPS coordinates for the new location may also need to be recorded.

## 4.4 GENERAL

All boreholes and pits are filled in with the material removed during sampling unless otherwise specified in the project-specific planning documents. Where a vegetative turf has been established, fill in with native soil or potting soil and replace the turf if practical in all holes or trenches when sampling is completed.

### 4.4.1 Homogenizing Samples

Homogenizing is the mixing of a sample to provide a uniform distribution of the contaminants. Proper homogenization ensures that the containerized samples are representative of the total soil sample collected. All samples to be composited or split should be homogenized after all aliquots have been combined. **Do not homogenize (mix or stir) samples for volatile compound analysis. Follow the procedures outlined in HGL SOP 403.01: VOC Soil Sample Collection for collection of such samples.**

### 4.4.2 Compositing Samples

Compositing is the process of physically combining and homogenizing several individual soil aliquots of the same volume or weight. Compositing samples provide an average concentration of contaminants over a certain number of sampling points. Refer to HGL SOP 403.03: *Soil or Sediment Sample Compositing*.

### 4.4.3 Splitting Samples

Splitting samples is performed when multiple portions of the same samples must be analyzed separately. After preparation, fill the sample containers for the same analyses one after another in

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a consistent manner (parent sample for semivolatile organic compounds [SVOCs] analysis, then split sample for SVOC analysis; parent sample for total metals analysis, then split sample for total metals analysis; and so forth).

#### 4.5 SURFACE SOIL SAMPLING

Perform the following steps for surface soil sampling:

- Before sampling, remove leaves, grass, and surface debris from the area using a decontaminated stainless steel trowel or disposable sampling spoon.
- Label the lid of the sample container with an indelible pen or affix the sample label to the side of the jar. Tape over the label to seal out dirt and water before filling the container with soil, if possible.
- Collect surface soil samples with a decontaminated stainless steel trowel, spoon, or hand auger and transfer them to a decontaminated stainless steel bowl for homogenizing. If VOC analyses are to be conducted, collect the VOC sample first following the procedures outlined in HGL SOP 403.01: *VOC Soil Sample Collection*, then transfer the appropriate aliquot of soil to the decontaminated stainless steel bowl for homogenizing.
- Collect samples in the order of volatilization sensitivity. The most common collection order is as follows:
  - VOC,
  - Purgeable organic carbon,
  - Purgeable organic halogens,
  - Total organic halogens,
  - Total organic carbon,
  - Extractable organics,
  - Total metals,
  - Phenols,
  - Cyanide, and
  - Radionuclides.
- Immediately transfer the sample into a container appropriate to the analysis being performed.
- Place the samples in a cooler with ice. The temperature in the cooler must be maintained at approximately 4°C (if appropriate for analyses) for transport to an analytical laboratory.
- Material removed to collect the samples is returned to the boreholes and pits. Excess soil sample media should be treated as investigation-derived waste (IDW) and managed in accordance with the project-specific planning documents.
- Decontaminate all sampling equipment following HGL SOP 411.02, *Sampling Equipment Cleaning and Decontamination*.

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#### 4.6 SURFACE SOIL SAMPLING (COMPOSITE SAMPLES ONLY)

Perform the following steps for surface soil (composite) sampling:

- Before sampling, remove leaves, grass, and surface debris from the area using a decontaminated stainless steel trowel.
- Collect surface soil aliquots with a decontaminated stainless steel spoon, trowel, or hand auger and place them in a stainless steel bowl and homogenize. Homogenize the sample in accordance with HGL SOP 403.03: *Soil or Sediment Sample Compositing*. Follow the procedures outlined in HGL SOP 403.01: *VOC Soil Sample Collection*, for samples collected for VOC analysis.
- Label the sample container and place it in a cooler chilled to 4°C . Complete the chain of custody record and pack it in the sample cooler.
- Material removed to collect the samples is returned to the boreholes and pits. Excess soil sample media IDW should be managed in accordance with the project-specific planning documents.
- Decontaminate all nondedicated sampling equipment following HGL SOP 411.02: *Sampling Equipment Cleaning and Decontamination*.

#### 4.7 SHALLOW DEPTH SOIL SAMPLING

Perform the following steps to collect shallow depth soil samples:

- Use a decontaminated stainless steel shovel to remove the top layer of soil and leaves, grass, and surface debris.
- Excavate soil to the pre-determined sampling depth using a decontaminated hand auger. Periodically remove the cuttings from the auger.
- When the proper sample depth is reached, remove the hand auger and all cuttings from the hole.
- Lower the decontaminated core sampler or hand auger to the bottom of the hole. When using a core sampler, it must contain a decontaminated liner appropriate for the constituents to be analyzed.
- Mark the sample interval on the hammer stem or auger.
- Operate the slide hammer on the core sampler to drive the sampler head into the soil, or advance the auger until it is flush with the interval mark at ground level.
- Record weight of hammer, length of slide, blow counts, and geologic soil data for all samples collected with a core sampler in the field logbook as outlined in HGL SOP

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300.04: *Field Logbook Use and Maintenance*. This information may also be entered on Attachment 2, Surface and Shallow Soil Sampling Log.

- When the core sampler liner or auger has been advanced to the total depth of the required sample, remove it from the bottom of the hole.
- Immediately remove the liner from the core sampler and transfer the sample into a container or stainless steel bowl appropriate to the analysis being performed and then composite and homogenize it in accordance with HGL SOP 403.03: *Soil or Sediment Sample Compositing*. For VOC analysis follow the sample procedures outlined in HGL SOP 403.01: *VOC Soil Sample Collection*.
- Label the sample container and place it in a cooler chilled to 4°C . Complete the chain of custody record and pack it in the sample cooler.
- Material removed to collect the samples is returned to the boreholes and pits. Excess soil sample media IDW should be managed in accordance with the project-specific planning documents.
- Decontaminate all sampling nondedicated equipment following HGL SOP 411.02: *Sampling Equipment Cleaning and Decontamination*.

#### 4.8 ABANDONMENT PROCEDURES

Abandon boreholes and fill them to grade with the material removed for sampling, if approved, or clean fill.

#### 5.0 DOCUMENTATION

Record applicable sampling information in the field logbook as outlined in HGL SOP 300.04: *Field Logbook Use and Maintenance*. This information can also be entered on Attachment 2, Surface and Shallow Soil Sampling Log.

The project manager or an approved designee checks all field sheets and field logbooks used to record information during sampling for completeness and accuracy as soon as possible after the sampling event. Any discrepancies are noted, and the documents are returned to the originator for correction. The reviewer acknowledges that these review comments have been incorporated by signing and dating the “checked by” and “date” blanks on the field sheets and at the applicable places in the logbook.

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## 6.0 REVISION HISTORY

Revision 0	July 2010	Initial Release
Revision 1	July 2017	Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting.
Revision 2	February 2018	Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting.
Revision 3	June 24, 2020	Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting, which included changing the SOP number from 2.13 to 403.06.

## ATTACHMENTS

- Attachment 1 – Example of Hand Auger and Core Sampler
- Attachment 2 – Surface and Shallow Soil Sampling Log

**ATTACHMENT 1**  
**EXAMPLE OF HAND AUGER AND CORE SAMPLER**

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*The world's finest  
sampling equipment.*

## Basic Soil Sampling Kit - 5/8" Threaded

Technical Data Sheet • page 1 of 1

### DESCRIPTION:

Hand auger kit includes a Standard type Regular, Mud and Sand Auger plus an AMS Core Sampler\* with slide hammer. Included accessories are three 4 foot (1.2m) extensions, cross handle, cleaning brush, 2 crescent wrenches and slip wrench all contained in an AMS Deluxe storage and transport case. Two sizes of kit are available, 3 1/4 inch (8.3 cm) augers with 2 inch (5.1 cm) Core Sampler and 2 1/4 inch (5.7 cm) augers with 1 1/2" Core Sampler. Quick connect is not available with this kit.

### APPLICATION:

Use of the augers for accessing the sampling point at depths of up to about 12 feet (3.6 m) with the supplied extensions and AMS slide hammer. The sample may be collected within a removable retaining cylinder (liner). Plastic end caps are included.

### FEATURES

AMS Soil augers are designed to rapidly remove soils of all types, using the specially designed bits on the Regular, Mud, and Sand models. The auger tips are tungsten carbide hard surfaced and heat treated before sharpening. The core sampler features a heat treated coring tip on the cylinder and a threaded end cap. All attachment couplings are 5/8 NC threaded.

### BENEFITS

For your convenience, all the items necessary for accessing a sampling point and then taking a sample are included. AMS soil buckets are the most efficient available in terms of effort required and speed. The AMS Core Sampler allows immediate core examination or a sample may be collected in a retaining cylinder for later use.

### USE:

Assemble the chosen soil auger with an extension and cross handle. Place at the desired angle on the soil surface and turn three revolutions, or until full. Lift carefully from the hole and empty from the bail by tapping the cross handle on the ground. Repeat until the sampling depth is reached. Assemble core sampler to an extension(s) and slide hammer. Place in the hole and mark the extension six inches (5.1 m) above the soil surface. Use the slide hammer to drive in the the sampler to the mark and carefully remove. Disassemble, remove the liner and place the cap on each end.

### HELPFUL HINTS:

Use plumbers wick on 5/8 inch male threads used with Slide Hammer to help threads stay tight. Keep all fittings and samplers clean, dry and free of dirt or Mud. You can clean tooling with soapy water. Always dry to prevent rusting. Use a wire brush on male threads. Use vegetable oil on tools to prevent fittings locking up and rusting. When using augers, use rubber O-rings on male 5/8 inch thread to help take apart.

### SPECIFICATIONS:

AMS Soil Auger Kits are manufactured by AMS from all USA made materials. See separate AMS Technical Data Sheets for details on the Regular, Mud, Sand & Soil Augers, Core Sampler, Extensions, Cross Handles, Slide

Hammer, and Liners. Crescent wrenches are made from chrome plated forged steel. The cleaning brush is made with nylon bristles, with a twisted wire handle. The AMS Deluxe Case is molded from glass reinforced plastic with a lid gasket and lockable hasps.

### Kit Composed of the Following Items:

Item	Size	Part #	Size	Part#
1- Regular Auger	3 1/4"	400.06	2 1/4"	400.08
1- Mud Auger	3 1/4"	400.18	2 1/4"	400.20
1- Sand Auger	3 1/4"	400.40	2 1/4"	400.42
1- Cross Handle		406.04		406.04
3- Thrd. Extensions	4'	408.03	4'	408.03
1- Core Sampler*	2" x 6"	404.10	1 1/2" x 6	404.38
*w/slip wrench, liner & caps				
1- Slide Hammer		400.99		400.99
1-AMS Nylon Brush	2"	430.07	1 1/2"	430.11
2- Crescent Wrenches				421.10
1- Slip Wrench		421.29		421.29
1-AMS Deluxe Case		430.01		430.01
* Patent Pending, USA & Foreign				

### ANCILLARY ITEMS:

AMS Extensions, Liners, End Caps, End Cap Inserts, Sieves, Soil Color Charts, and Sample Containers.

### Basic Soil Sampling Kit



### Basic Soil Sampling Kit

Size	Basic Kit Regular
2 1/4"	209.53
3 1/4"	209.51

Sampling Equipment  
PowerProbe  
Well Management  
Pest Control  
PowerCore

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**ATTACHMENT 2**  
**SURFACE AND SHALLOW SOIL SAMPLING LOG**

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# Surface and Shallow Soil Sampling Log

Records Management Data

Project Number	Project Name	Page _____ of _____
----------------	--------------	---------------------

<b>General Info</b>	Location		
	Surface Elevation ft.	Date Started	Date Completed
	Field Investigator	C of Cr	
	Sampling Excavation Method	Sampling Method	
	Depth of Excavation ft.	Depth Water First Encountered ft.	Backfill Material

<b>Sampling Info</b>	Sample Number	Depth (ft)	Lithologic Description <sup>1</sup>	Sample Container	Analyses Requested

<b>Plan View</b>		<b>Legend</b>
		Soil Sampling Location

Recorded By:	Date	Checked By:	Date:
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<sup>1</sup>Include such data as OVM, pH, blow counts, or other physical reading observations.

**SOP 403.07, SIB Project Area, PHSS  
(Source: Borehole Logging)**

	<b>STANDARD OPERATING PROCEDURE</b>	
	Approved by: Theresa Rojas	Digitally signed by Theresa Rojas Date: 2021.10.04 10:43:31 -04'00' Corporate Quality Director
<b>Geologic Borehole Logging</b>	<b>SOP No.: 403.07 (formerly 2.14)</b>	
	<b>SOP Category: Environmental Services</b>	
	<b>Revision No.: 2</b>	
	<b>Revision Date: October 4, 2021</b>	
	<b>Review Date: November 2021</b>	

## 1.0 PURPOSE

This Standard Operating Procedure (SOP) defines the methodology for conducting lithologic logging of cores, cuttings, split-spoon samples, and subsurface samples collected during field operations at sites where environmental investigations are performed by HGL.

## 2.0 SCOPE AND APPLICATIONS

The installation of monitoring wells, piezometers, and boreholes is a standard practice at many sites requiring environmental investigations. Following the guidelines presented in this SOP will help ensure that pertinent data is collected so that all borehole logs made while installing these devices at a site can be standardized to create a consistent, uniform database from which interpretive conclusions can be made with minimal decision error. A borehole log provides lithologic descriptions to characterize the physical subsurface and the geologic and hydrologic processes operating at the site. A properly prepared borehole log serves as an essential tool for evaluating and correlating these processes.

This SOP provides guidance for routine field operations on environmental projects, and was derived from *A Compendium of Superfund Field Operations Methods*, U.S. Environmental Protection Agency (EPA) (EPA/540/P-87/001 [Office of Solid Waste and Emergency Response {OSWER Directive} 9355.0-14]); and other industry standards.

## 3.0 GENERAL REQUIREMENTS

All work will be performed in accordance with the project-specific planning documents. Refer to the project-specific health and safety plan for relevant health and safety requirements.

Any deviations from specified requirements will be justified to and authorized by the project manager and/or the relevant program manager and discussed in the approved project plans. Deviations from requirements will be sufficiently documented to re-create the modified process.

## 4.0 PROCEDURES

### 4.1 INTRODUCTION

Boreholes should be logged by a trained geologist, or other earth scientist under the supervision of a geologist. Large-scale inferences such as vertical and horizontal extent of strata, facies changes, attitude of bedding or layering, structural features (faults, folds, fractures, dikes, etc.), location of the water table, lithologic characterizations, and the extent of subsurface contamination are made from small-scale observations recorded on the borehole log. These observations include bedding, grain

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size, degree of sorting, shape of grains, color, hardness, organic vapor levels, and other observable physical characteristics including visible evidence of contamination.

Logging should document both general and specific lithologic information about the borehole. In all cases, the lithologic log should be identified with the following:

- Specific site number,
- Well/boring number,
- Drilling method,
- Location,
- Date of drilling,
- Individual logger (geologist),
- Drilling contractor,
- Significant organic vapor reading,
- Visible evidence of contamination, such as staining or odor,
- Depth to water first encountered,
- Final depth of water level,
- Well/boring elevation (if data is available),
- Total depth in feet,
- Graphic log, and,
- Lithologic description.

Lithologic descriptions for unconsolidated materials often use the Unified Soil Classification System (USCS) or standard geologic field description methods (Compton, 1962).

Lithologic descriptions of unconsolidated material should contain the following characteristics when possible:

- Soil or formation name,
- Gradation degree of sorting,
- Principal constituent,
- Specific descriptors for principal constituents (for example, plasticity, grain size, and shape),
- Firmness/hardness,
- Minor constituents,
- Moisture content,
- Color,
- Particle morphology, and

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- Other descriptors (such as, visual evidence of contamination, specific monitoring equipment readings including photoionization detector [PID]/organic vapor analyzer [OVA] readings).

## **4.2 CLASSIFICATION SYSTEM**

The following subsections describe in detail the parameters and descriptive terminology used to classify each sample for the borehole log.

### **4.2.1 Soil or Formation Name**

The soil or formation name will include the major constituent(s) and may be preceded by a single-word modifier indicating the subordinate constituent. Percentages of each constituent will be used to classify the material without actually recording constituent percentage. The textural terms used to classify a soil are shown in Attachment 1, Triangular Diagram Showing Percentage of Sand, Silt, and Clay in Each Textural Class. If logging unconsolidated materials, a USCS symbol should be recorded. The USCS symbols are provided in Attachment 2, Unified Soil Classification System Table.

### **4.2.2 Gradation (Degree of Sorting)**

Size sorting describes the extent to which grain size is uniform. The comparison chart listed in Attachment 3, Comparison Chart for Estimating Degree of Sorting, is used to describe coarse-grained soils being logged from a borehole. The USCS describes soils in terms of grading, which is the opposite of sorting. For example, a poorly graded sand (USCS classification SP) is well sorted and has a predominant grain size, and a well graded gravel (USCS classification GW) is poorly sorted and has a wide distribution of grain sizes.

### **4.2.3 Principal Constituent**

Principal constituents recorded during borehole logging include an identification of the following unconsolidated material types in order of increasing grain size:

- Clay,
- Silt,
- Sand,
- Gravel,
- Cobbles, and
- Boulders.

If known, an identification of the potential source of the material should be made (such as alluvium, colluvium, artificial fill, or residual material).

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#### 4.2.4 Principal Constituent Descriptors

Additional descriptors for the principal material constituents may be added to the log to further delineate or accurately record subtle changes in the lithologic structure. Modifiers such as grain size, shape, and plasticity of materials (high, medium, and low plasticity). (Note: Plasticity is the property of permanently changing shape without movement on any visible fractures.)

#### 4.2.5 Consistency/Density/Rock Hardness

The characteristics of unconsolidated material are often determined by hand or the Standard Penetration Test (SPT).

Hand testing of unconsolidated material involves pressing the thumb into the undisturbed material to determine its consistency based on the following descriptors:

<u>Depth of Thumb Imprint</u>	<u>Cohesive Consistency (Clay)</u>
Greater than 1 inch	Very soft
Approximately 1 inch	Soft
Approximately ¼ inch	Firm
Thumb will not indent soil but readily indented by fingernail	Hard
Thumb nail will not indent soil	Very hard

The SPT involves driving a split-spoon sampler into the material by dropping a 140-pound weight from a height of 30 inches. The resistance of the material is reported in the number of blows of the weight required to drive the spoon one foot and translates into the following descriptors:

<u>Number of Blows/Foot</u>	<u>Cohesive Consistency (Clay)</u>
0–2	Very soft
2–4	Soft
4–8	Medium
8–15	Stiff
15–30	Very stiff
30+	Hard

<u>Number of Blows/Foot</u>	<u>Cohesive Consistency (Gravel)</u>
0–4	Very loose
4–10	Loose
10–30	Medium dense
30–50	Dense
50+	Very Dense

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<u>Number of Blows/Foot</u>	<u>Rock Hardness</u>
<20	Weathered
20–30	Firm
30–50	Medium Hard
50–80	Hard
80+	Very Hard

#### 4.2.6 Minor Constituents

Constituents not previously described in the principal constituent description may be described as a percentage or by weight. Typically, modifiers for minor constituents conform to the following standards:

- No modifier < 5 percent,
- Slightly 5 to 12 percent,
- Moderately (add ‘-y’ or ‘-ey’ such as silty clay) 12 to 40 percent, or
- Very 40 to 50%.

#### 4.2.7 Moisture Content

The terms used to describe the relative moisture content of a field soil sample are as follows:

- Dry – The sample is completely without moisture. Dry, silty sands, for example, will produce suspended particles when dropped by hand.
- Damp – Samples containing a very slight amount of water.
- Moist – Soils in this range are near the maximum water content for their maximum compactibility or density. Moist fine-grained soils with a water content greater than their plastic limit will form a ball when compressed in the hand.
- Wet – The soil samples are wet enough to produce free water upon shaking but still contain unoccupied air voids. Fine-grained soils close to the liquid limit would be termed wet.
- Saturated – Soils with no air voids. Samples placed in sample jars or bags will probably have standing water after a short period of time.

#### 4.2.8 Plasticity

The plasticity of fine-grained soils is recorded on the borehole log. A fine-grained soil can be non-plastic or have low, medium, or high plasticity. The plasticity is measured by the ability to roll the material into a 1/8-inch-thick thread based on the following descriptors:

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- Non-plastic – The thread cannot be rolled at any water content.
- Low plasticity – The thread can barely be rolled and a lump cannot be formed when drier than the plastic limit.
- Medium plasticity - The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
- High plasticity – It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier the plastic limit.

#### **4.2.9 Color**

The color of soil and associated materials will be recorded on the borehole log. Color descriptors should include but are not limited to the following descriptors: black, gray-black, brown, olive, mottled, and streaked. A Munsell Soil Color Chart should be used to provide general logging guidance, but specific use is not necessary for adequately describing lithology.

#### **4.2.10 Particle Morphology**

The key elements of particle morphology are roundness and sphericity. Roundness is a measure of the curvature of grain corners. Sphericity is a measure of how equal the three axial lengths (x, y, z) of an object are. Determination of both properties is facilitated by the use of a hand lens. Estimate grain roundness and sphericity in coarse-grained soils by using an American Geological Institute (AGI) data sheet (Attachment 4).

#### **4.2.11 Other Descriptors**

Field screening data collected during the drilling process may help further characterize site conditions during subsurface investigations. Readings from on-site monitoring equipment such as PIDs, flame ionization detectors (FIDs), or OVAs should be recorded at each sample interval. Other useful information includes the organic content and the presence or absence of waste material in samples.

#### **4.2.12 Particle Size Distribution**

An estimate of particle sorting by grain size is often useful for borehole logging purposes. Precise estimates of percent composition of the sample are not necessary.

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### USCS Grain Size Categories

Exact Size Limits	Approximate Inch Equivalents	Name of Loose Aggregate
>256 mm	>10 in.	Boulder gravel
64–256 mm	2.5–10 in.	Cobble gravel
32–64 mm	1.2–2.5 in.	Very coarse pebble gravel
16–32 mm	0.6–1.2 in.	Coarse pebble gravel
8–16 mm	0.3–0.6 in.	Medium pebble gravel
4–8 mm	0.15–0.3 in.	Fine pebble gravel
2–4 mm	0.08–0.15 in.	Granule (or very fine pebble) gravel
1–2 mm	0.04–0.08 in.	Very coarse sand
1/2–1 mm	0.02–0.04 in.	Coarse sand
1/4–1/2 mm	0.01–0.02 in.	Medium sand
1/8–1/4 mm	0.005–0.01 in.	Fine sand
1/16–1/8 mm	0.002–0.005 in.	Very fine sand
1/256–1/16 mm	0.00015–0.002 in.	Silt
<1/256 mm	<0.00015 in.	Clay (clay-size materials)

mm = millimeters

Source: Wentworth Scale; Compton 1962

The Comparison Chart for Estimating Percentage Composition (Attachment 5) can be used to estimate the percentage of various grain sizes present in a sample. However, visual estimates usually provide sufficient information for characterizing site lithology.

### 4.3 BOREHOLE LOGS

Record data collected during exploratory boring soil logging in the field logbook and on Attachment 6, Borehole Log. Use this log on all applicable field drilling and subsurface sampling operations.

Geologic correlation and aquifer properties prediction are dependent on good exploratory boring sample descriptions. Rotary drilling with fluids is generally unacceptable since the drilling fluids may potentially contaminate the aquifer under investigation and provide inaccurate water levels. High quality borehole data are generally acquired with a direct-push acetate-lined sampler, a split-spoon sampler, or a sonic core barrel. This method of sampling provides detailed logging because the samples collected are undisturbed. The lithofacies interpreted from air-rotary or auger cuttings logs may lack the accuracy necessary for detailed correlation. Where possible, techniques such as geophysical borehole logging will be used to supplement cuttings descriptions. Note on the log any geologic description determined from borehole cuttings. The cuttings are often mixed over the entire length of the boring.

In bedrock formations, cuttings may be acquired from a reverse circulation, air rotary, or dual-wall rotary boring. These cuttings do not provide information on the in situ properties of the materials, but do provide adequate sample description information.

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In summary, close sample spacing or continuous sampling in a boring provide the best material for descriptive geology. Use traditional geologic terminology and supplement with the USCS descriptive system when appropriate. Provide sufficient data on layering and other sedimentary structures and undisturbed textures. Sample numbers, depths, and analytes should be included in each description. The applicable field methods described by Compton (1962) and AGI (1982) are recommended. These methods are fully referenced in Section 5.0.

#### **4.4 REVIEW**

Personnel conducting borehole logging of soil will record field data on Attachment 6, Borehole Log, and will record a chronological summary in the project logbook. The applicable methods outlined in this procedure shall be used to record the data on this log. The personnel conducting these operations will sign and date the “logged by” and “date” blanks on Attachment 6, Borehole Log.

The Project Manager or designee shall check all field generated data and Attachment 6, Borehole Log, for completeness and accuracy. Any discrepancies will be noted, and the logs will be returned to the originator for correction. The reviewer will acknowledge that corrections have been incorporated by signing and dating the “reviewed by” and “date” blanks on Attachment 6, Borehole Log.

#### **5.0 REFERENCES**

American Geological Institute (AGI), 1982. AGI Data Sheets. Falls Church, Virginia.

ASTM International, 2009. ASTM D2488-09a: *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*. West Conshohocken, Pennsylvania.

Compton, Robert R., 1962. *Manual of Field Geology*. John Wiley and Sons, Inc. New York, New York.

Munsell, 1988. Munsell Soil Color Charts. Macbeth Division, Kollmorgen Instruments Corporation, Baltimore, Maryland.

#### **6.0 REVISION HISTORY**

Revision 0	December 2010	Initial Release
Revision 1	July 2017	Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting.
Revision 2	November 20, 2019	Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting.

<b>Geologic Borehole Logging</b>	<b>SOP No.: 403.07 (formerly 2.14)</b>
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	<b>Review Date: November 2021</b>

## **ATTACHMENTS**

Attachment 1 – Triangular Diagram Showing Percentage of Sand, Silt and Clay in Each Textural Class

Attachment 2 – Unified Soil Classification System Table

Attachment 3 – Comparison Chart for Estimating Degree of Sorting

Attachment 4 – Comparison Chart for Estimating Roundness and Sphericity

Attachment 5 – Comparison Chart for Estimating Percentage Composition

Attachment 6 – Borehole Log

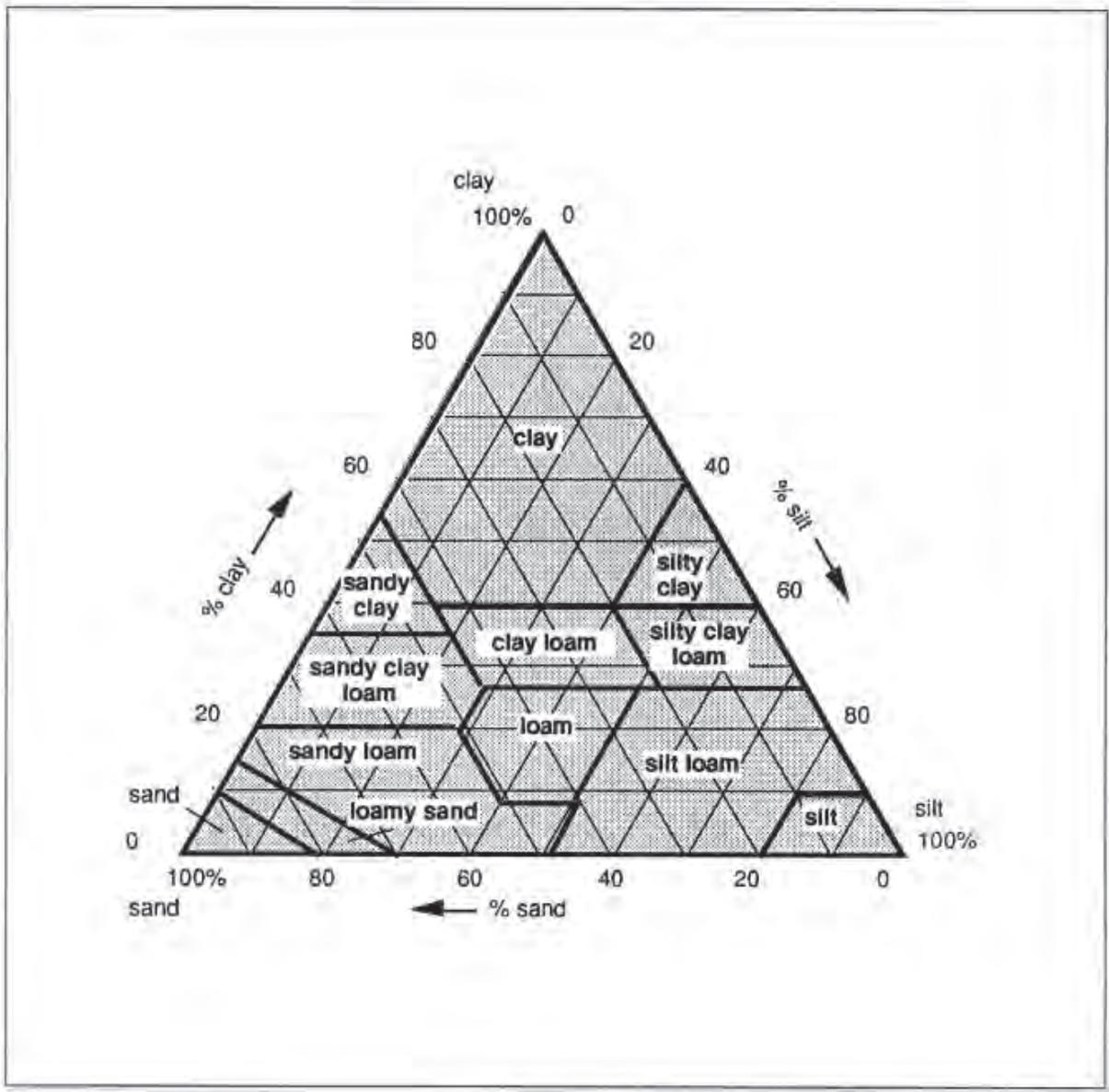
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**ATTACHMENT 1**

**TRIANGULAR DIAGRAM SHOWING PERCENTAGE OF SAND, SILT  
AND CLAY IN EACH TEXTURAL CLASS**

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**Attachment 1**  
**Triangular Diagram Showing Percentage of Sand, Silt and Clay in Each Textural Class**



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**ATTACHMENT 2**  
**UNIFIED SOIL CLASSIFICATION SYSTEM TABLE**

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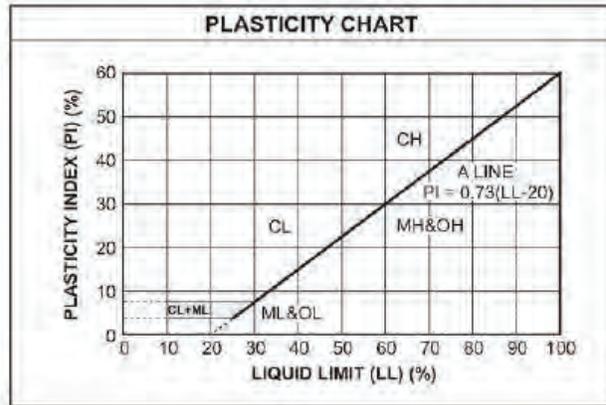
## Attachment 2 Unified Soil Classification System Table

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART		
<b>COARSE-GRAINED SOILS</b> (more than 50% of material is larger than No. 200 sieve size.)		
Clean Gravels (Less than 5% fines)		
<b>GRAVELS</b> More than 50% of coarse fraction larger than No. 4 sieve size		GW Well-graded gravels, gravel-sand mixtures, little or no fines.
		GP Poorly-graded gravels, gravel-sand mixtures, little or no fines.
	Gravels with fines (More than 12% fines)	
		GM Silty gravels, gravel-sand-silt mixtures
		GC Clayey gravels, gravel-sand-clay mixtures
Clean Sands (Less than 5% fines)		
<b>SANDS</b> 50% or more of coarse fraction smaller than No. 4 sieve size		SW Well-graded sands, gravelly sands, little or no fines.
		SP Poorly graded sands, gravelly sands, little or no fines.
	Sands with fines (More than 12% fines)	
		SM Silty sands, sand-silt mixtures
		SC Clayey sands, sand-clay mixtures
<b>FINE-GRAINED SOILS</b> (50% or more of material is smaller than No. 200 sieve size.)		
<b>SILTS AND CLAYS</b> Liquid limit less than 50%		ML Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
		CL Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL Organic silts and organic silty clays of low plasticity
<b>SILTS AND CLAYS</b> Liquid limit 50% or greater		MH Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH Inorganic clays of high plasticity, fat clays
		OH Organic clays of medium to high plasticity, organic silts
<b>HIGHLY ORGANIC SOILS</b>		PT Peat and other highly organic soils

LABORATORY CLASSIFICATION CRITERIA		
GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4;	$C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4;	$C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent ..... GW, GP, SW, SP  
 More than 12 percent ..... GM, GC, SM, SC  
 5 to 12 percent ..... Borderline cases requiring dual symbols



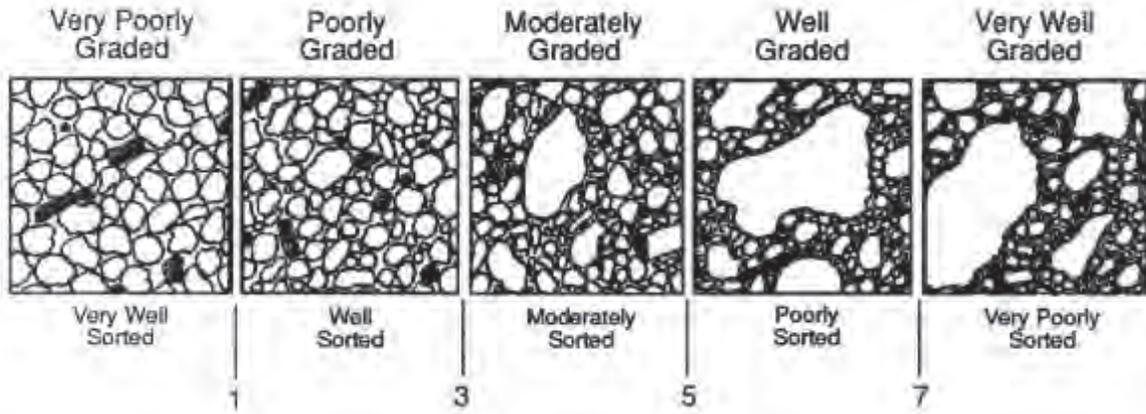
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**ATTACHMENT 3**

**COMPARISON CHART FOR ESTIMATING DEGREE OF SORTING**

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**Attachment 3**  
**Comparison Chart for Estimating Degree of Sorting**



Terms for degrees of sorting. The numbers indicate the number of size-classes included by the bulk (80 percent) of the material. The drawings represent sandstones as seen with a hand lens. Silt and clay-size materials are shown diagrammatically by the fine stipple.

Reference: Compton, R.R. 1962. *Manual of Geology*. John Wiley & Sons, Inc. New York, N. p. 214

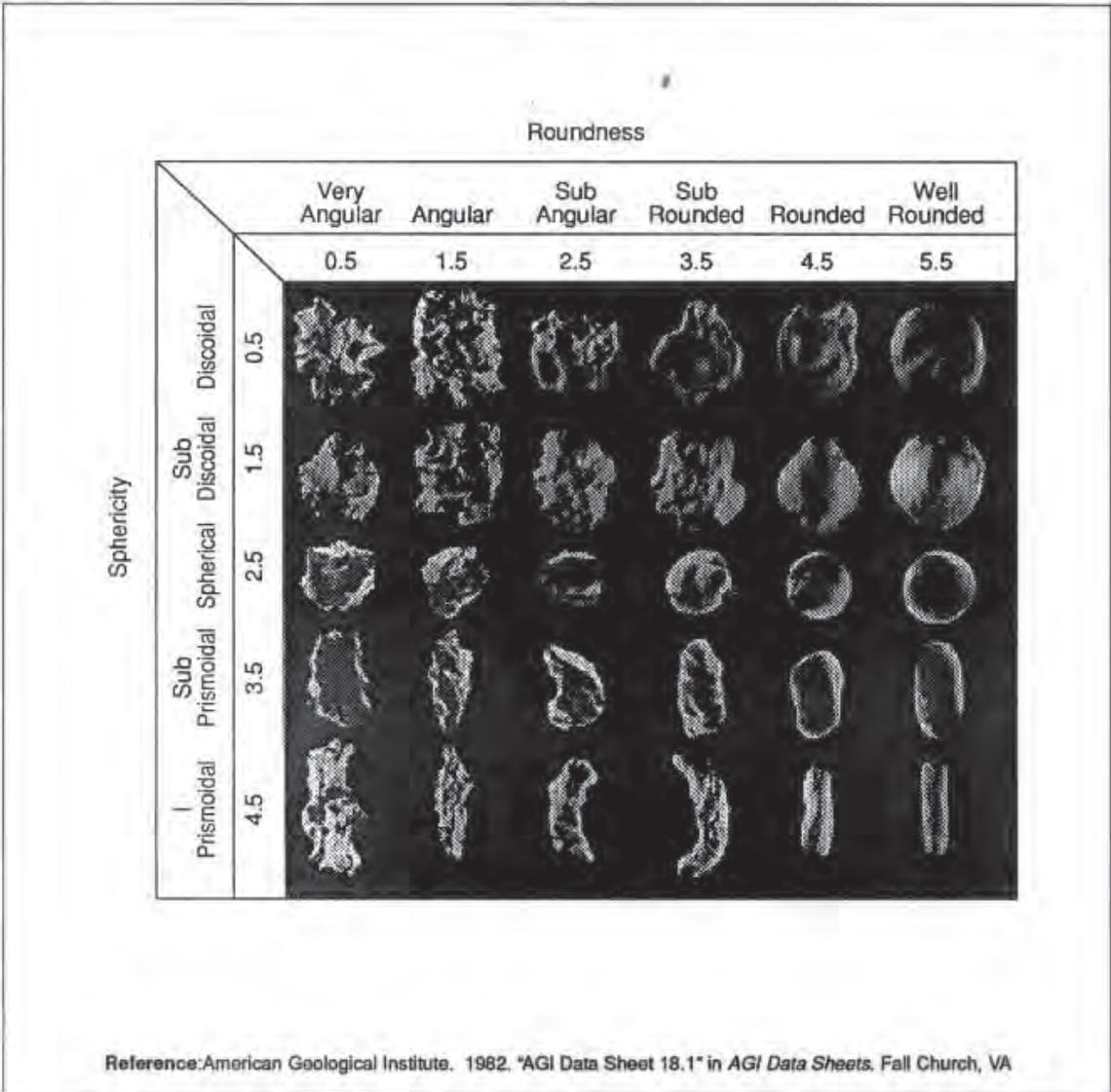
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**ATTACHMENT 4**

**COMPARISON CHART FOR ESTIMATING  
ROUNDNESS AND SPHERICITY**

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**Attachment 4  
Comparison Chart for Estimating Roundness and Sphericity**



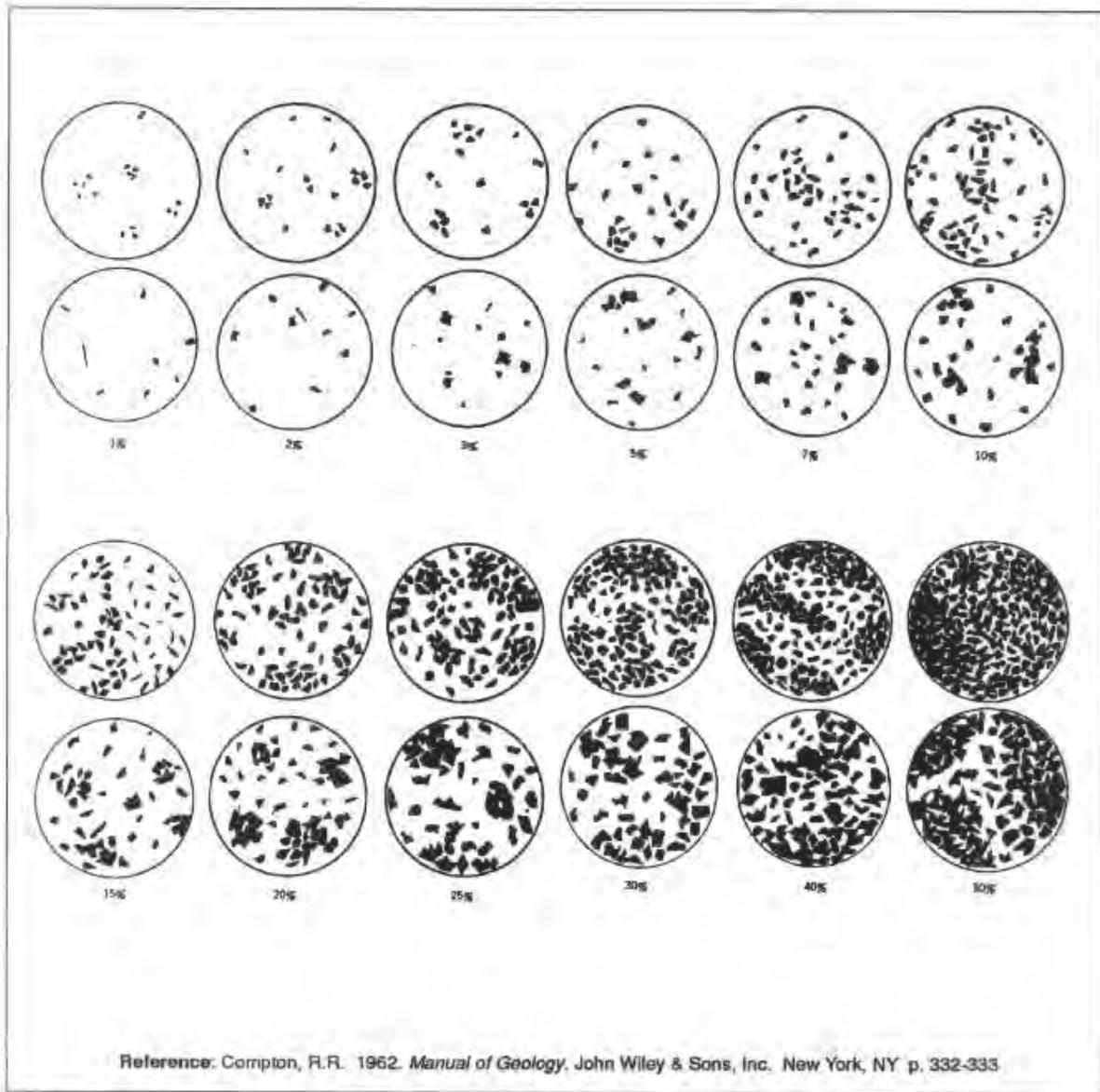
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**ATTACHMENT 5**

**COMPARISON CHART FOR ESTIMATING  
PERCENTAGE COMPOSITION**

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**Attachment 5**  
**Comparison Chart for Estimating Percentage Composition**



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**ATTACHMENT 6**  
**BOREHOLE LOG**

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# Attachment 6 Borehole Log



## BORING LOG

Borehole ID: \_\_\_\_\_  
Sheet \_\_\_\_\_ of \_\_\_\_\_

Project Name		Project Number		Site ID	Location	
Drilling Company		Driller		Ground Elevation	Total Drilled Depth	
Drilling Equipment	Drilling Method	Borehole Diameter	Date/Time Drilling Started		Date/Time Total Depth Reached	
Type of Sampling Device			Water Level (bgs)			
			First		Final	
Sample Hammer			Hydrogeologist		Checked by/Date	
Type			Driving Wt.		Drop	
Location Description (include sketch in field logbook)						
Depth	Interval	Recovery	Blow Counts	Description <small>(Include lithology, grain size, sorting, angularity, Munsell color name &amp; notation, mineralogy, bedding, plasticity, density, consistency, etc., as applicable)</small>		USCS Symbol
						Lithology
						Water Content
						Remarks <small>(Include all sample types &amp; depth, odor, organic vapor measurements, etc.)</small>



## BORING LOG (cont'd)

Borehole ID: \_\_\_\_\_  
 Sheet \_\_\_\_\_ of \_\_\_\_\_

Project Name				Project Number		Location		
Location Description (include sketch in field logbook)								
Depth	Interval	Recovery	Blow Counts	Description <small>(Include lithology, grain size, sorting, angularity, Munsell color name &amp; notation, mineralogy, bedding, plasticity, density, consistency, etc., as applicable)</small>	USCS Symbol	Lithology	Water Content	Remarks <small>(Include all sample types &amp; depth, odor, organic vapor measurements, etc.)</small>

**SOP 403.08, SIB Project Area, PHSS  
(Source: Sediment Sampling)**

	<b>STANDARD OPERATING PROCEDURE</b>	
	Approved by: <b>Dick, Jeff</b>	<small>Digitally signed by Dick, Jeff Date: 2020.03.24 18:37:26 -04'00'</small> <b>Corporate Quality Manager</b>
<b>Sediment Sampling</b>	<b>SOP No.: 403.08 (formerly 2.15)</b>	
	<b>SOP Category: Environmental Services</b>	
	<b>Revision No.: 2</b>	
	<b>Revision Date: March 25, 2020</b>	
		<b>Review Date: March 2022</b>

## 1.0 PURPOSE

This standard operating procedure (SOP) establishes the guidelines for sediment sampling using a variety of sampling devices. Methods for preventing sample and equipment cross-contamination are included. Proper sediment sampling ensures that any evaluations of sediment contamination are based on actual contaminant levels and are not based on improper sampling techniques.

This SOP provides guidance for routine field operations on environmental projects. Site-specific deviations from the methods presented herein must be approved by the HGL project manager.

## 2.0 SCOPE AND APPLICATIONS

Field personnel collecting sediment samples are responsible for performing the applicable tasks outlined in this procedure when conducting work related to environmental projects.

The project manager or an approved designee is responsible for checking all work performed and verifying that the work satisfies the applicable tasks required by this procedure. This verification will be accomplished by reviewing all documents and data produced during work performance.

## 3.0 GENERAL REQUIREMENTS

All work will be performed in accordance with the project-specific planning documents. Refer to the project-specific health and safety plan for relevant health and safety requirements.

Any deviations from specified requirements will be justified to and authorized by the project manager and/or the relevant program manager and documented in the approved project plans. Deviations from requirements will be sufficiently documented to re-create the modified process.

## 4.0 SAMPLING EQUIPMENT AND TECHNIQUES

Sediment samples may be obtained using on-shore or off-shore techniques. Sediment sampling equipment and techniques must be designed to minimize the risk of dilution or loss of material as the sample is moved through the water column. Sediment sampling devices are described below.

### 4.1 DIP SAMPLERS

A dip sampler consists of a pole with a jar or scoop attached. The pole may be made of bamboo, wood, Teflon<sup>®</sup>, or aluminum and be either telescoping or of fixed length. The scoop or jar at the end of the pole is attached by a clamp.

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The dip sampler is operated by submerging the jar or scoop and pulling it through the sediments to be sampled. The samples retrieved are then transferred into the appropriate sample container after decanting the liquid. Further decanting can occur while the sample is present in the sample jar. Avoid contact with sampler's gloves. Transferring the sample may require the use of a stainless steel or Teflon<sup>®</sup> spoon/spatula.

## **4.2 HAND-OPERATED CORE SAMPLERS**

Hand-operated sediment core samplers are used to obtain sediment samples in shallow water (less than 3 feet). These samplers operate in a manner similar to soil core samplers. However, because of the saturated conditions of most sediments, provisions must be made to retain the sample within the core. Core samplers are generally constructed of a rigid metal outer tube into which a 2-inch plastic core sleeve fits with minimum clearance. The cutting edge of the core sampler has a recessed lip on which the plastic sleeve rests and that can accommodate a core retainer. This retainer is oriented such that when the sampler is pressed into the sediment, the core is free to move past the retainer. Due to construction of the retainer, the core will not fall through the retainer upon removal of the sampler from the sediment. Some core samplers are also equipped with a butterfly valve below the core barrel that helps retain the material when the sampler is removed from the sediment.

After the sampler has been removed from the sediment, the plastic sleeve is removed. The sediment is removed from the sleeve and placed in the appropriate sample container. Chlorinated organics will not be collected using core samplers because core sleeves and retainers are generally made of plastic. The hand-operated core sampler will not be useful for obtaining samples of gravelly, stony, or consolidated sediments. Examples of hand-operated core samplers are referenced in Attachment 1.

## **4.3 GRAVITY CORE SAMPLERS**

Gravity core samplers are used to obtain sediment samples in water bodies or lagoons with depths greater than 3 to 5 feet. These types of samplers can be used for collecting 1- to 2-foot cores of surface sediments at depths of up to 100 feet beneath the water surface.

As with all core-type samplers, gravity core samplers are not suitable for obtaining samples of coarse, gravelly, stony, or consolidated deposits. They are, however, useful for fine-grained inorganic sediment sampling.

The gravity core sampler operates in a manner similar to the hand-operated core in that a 2-inch plastic sleeve fits within a metal core housing fitted with a cutting edge. Plastic nests are used to retain the core within the plastic sleeve. An opening exists above the core sleeve to allow free flow of water into and through the core as it moves vertically downward to the sediment. The sampler has a field personnel-operated, messenger-activated valve assembly that seals the opening above the plastic sleeve following sediment penetration. This valve is activated by the messenger, creating a partial vacuum to assist in sample retention during retrieval.

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Samples are obtained by allowing the sampler, which is attached to approximately 100 feet of stainless steel aircraft cable, to drop to the benthic deposits. The weight of the sampler drives the core into the sediment to varying depths depending on the characteristics of the sediments. The messenger is then dropped by field personnel on the taut aircraft cable to seal the opening above the plastic sleeve. The sampler is then carefully retrieved.

Upon retrieval of the sampler, the plastic core sleeve is removed and the sample is placed in the appropriate sample container. Care should be exercised in labeling to properly identify sample orientation. Examples of gravity core samplers are referenced in Attachment 2.

#### **4.4 DREDGES**

Dredges are generally used to sample sediments that cannot easily be obtained using coring devices or when large quantities of materials are required. Various dredge designs are available for sampling in deep or turbulent waters and for obtaining samples from gravelly, stony, or dense deposits.

Dredges generally consist of a clam shell arrangement of two buckets. The buckets may either close upon impact or be activated by use of a messenger. Dredges are commonly quite heavy and may require use of a winch and crane assembly for sample retrieval.

Upon retrieval of the dredge, the sample can either be sieved or transferred directly to a sample container for labeling and storage. Examples of dredge types that could be used for sampling include Ponar, Petersen, and Ekman dredges, which are referenced in Attachment 3.

#### **4.5 HAND AUGERS**

Sediment samples may be collected using a hand auger. When using a hand auger, provisions must be made to ensure that sediment samples remain in the auger. Hand augers are best utilized when sampling non-subaqueous sediments. Additional information on hand augers can be found in SOP 403.06: *Surface and Shallow Depth Soil Sampling*.

### **5.0 PROCEDURES**

#### **5.1 SAMPLING SEDIMENT WITH NO OVERLYING SURFACE WATER**

Sediment samples obtained from areas with no overlying surface water will be collected in accordance with the following procedures:

- Record all data in the field logbooks in accordance with SOP 300.04: *Field Logbook Use and Maintenance*.

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- Insert a decontaminated Teflon<sup>®</sup> or stainless steel spoon, scoop, or trowel into the sediment to the desired depth and remove the collected sample, or rotate and push down a decontaminated hand auger into the sediment to the desired depth and remove the collected sample. A disposable scoop may be used for specified media and analytical parameters in accordance with the site-specific project plans.
- Collect samples for volatile organic compounds (VOC) analyses, if applicable, from the sampling device or from unmixed sediment placed into a stainless steel bowl in accordance with SOP 403.01: *VOC Soil Sample Collection*.
- Place the sample in a decontaminated stainless steel bowl. Stir the sample thoroughly (non-VOC samples only) with a decontaminated stainless steel spoon or spatula—or with a dedicated disposable scoop—to provide a homogeneous mixture before filling sampling containers.
- Follow the guidelines in the site-specific project plans and Quality Assurance Project Plan (QAPP) for aliquot size (mass), container type, storage conditions, and holding times. [Note: When sampling in coarse materials, such as gravel, discretion must be used to limit inclusion of large sediment particles. As the analysis of sediments performed by the laboratory is typically restricted to particles less than 2 millimeters in size, care must be taken to ensure that there is sufficient sample volume consisting of particles smaller than 2 millimeters. As a general rule, particles larger than 0.5 inch (12.7 millimeters) in size should be excluded unless a grain size analysis is planned.] Fill the appropriate sample containers as detailed in the site-specific project plans. Identify or label samples carefully and clearly, addressing all the categories or parameters.
- Label the sample containers and place the filled sample containers on ice immediately.
- Decontaminate the sampling equipment in accordance with SOP 411.02: *Sampling Equipment Cleaning and Decontamination*, after use and between sampling if dedicated disposable scoops are not used. Don new clean gloves before beginning sampling activities and at each sampling point.
- Complete all chain of custody documents and record information in the Field Sampling Report (Attachment 4) and the field logbook (see the project-specific QAPP for sample custody procedures).

## 5.2 SHALLOW STREAM SEDIMENT SAMPLING

Stream sediment sampling within shallow (less than 2 feet) water will be conducted in accordance with the following procedures. Note that if co-located surface water samples are being collected, the surface water sample should be collected first.

- Collect the sample in an area of sediment accumulation, such as the inside of stream meanders, quiet shallow areas, and low-velocity zones. Avoid areas of net erosion, such as high-velocity, turbulent flow zones.

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- If possible, collect the sample while remaining on the stream bank. If the sample cannot be obtained from the bank, enter the stream from a point downstream of the sediment sampling location. Consult the site health and safety plan before entering the river to avoid potential hazards. Collect the sediment sample by reaching into the stream with a decontaminated stainless steel spoon or Teflon<sup>®</sup> scoop and scooping a sample in an upstream direction. Attempt to minimize the loss of fine material. A disposable scoop may be used for specified media and analytical parameters, in accordance with the site-specific project plans.
- Collect samples for VOC analyses, if applicable, from the sampling device or from unmixed sediment placed into a stainless steel bowl in accordance with SOP 403.01: *VOC Soil Sample Collection*.
- Place sample in a stainless steel bowl and gently mix with a stainless steel spoon or dedicated disposable scoop (non-VOC samples only). Transfer the sediment samples to the appropriate sample containers using the stainless steel spoon or dedicated disposable scoop. Do not mix samples for volatile organic analyses.
- Follow the guidelines in the site-specific project plans and QAPP for aliquot size (mass), container type, storage conditions, and holding times. See note under Section 5.1 for sampling coarse materials. Fill the appropriate sample containers as detailed in the site-specific project plans. Identify or label samples carefully and clearly, addressing all the categories or parameters.
- Decontaminate the sampling equipment in accordance with SOP 411.02: *Sampling Equipment Cleaning and Decontamination*, after use and between sampling if dedicated disposable scoops are not used. Don new clean gloves before beginning sampling activities and at each sampling point.
- Complete all chain of custody documents and record information in the Field Sampling Report (Attachment 4) and the field logbook (see the project-specific QAPP for sample custody procedures).

### 5.3 SUBAQUEOUS SEDIMENT SAMPLING

Subaqueous sediment sampling from lakes, ponds, lagoons, and surface impoundments will consist of the following:

- Select the most appropriate sediment sampling device (as described in Section 4.0).
- Decontaminate all sampling equipment in accordance with SOP 411.02: *Sampling Equipment Cleaning and Decontamination*.
- If sampling from a boat equipped with an engine, attempt to collect the sample with the boat engine off or attempt to ensure that all exhaust fumes are directed away from the sample collection area until the sample has been collected.

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- Lower the sampler at a controlled descent of approximately 1 foot per second until the sampler reaches the sediment surface, as indicated by a slackening of the cable. Release the weighted messenger, if applicable, to engage the closing mechanism of the dredge. Slowly retrieve the sampler and raise it at a controlled speed. When the sampler is at the water surface, attach a tag line(s) to steady and pull the sampler back into the boat. If large samplers are used, a motorized winch may be required for retrieval.
- Open and tie back any vent flaps on the sampler and carefully siphon off any overlying water, disposing of it over the side of the boat.
- Visually inspect the sample for acceptability (for example, determine if an undisturbed surface layer is evident, the overlying water is not excessively turbid, and adequate penetration is achieved). If the sample is not acceptable, discard it and collect another sample from an adjacent and upstream location.
- Carefully extrude the sediment from the sampler by slowly lifting on the winch cable and sliding the sample out the bottom of the sampler. If using core liners, remove the front face of the core liner to expose the side of the core.
- Visually inspect the side of the sample to identify any obvious stratification (such as different sediment types, sizes, or colors). If no patterns are evident, collect a sample from the surface and mid-core depth. During some investigations, it may be necessary to collect separate samples from the surface and mid-core depths. This may best be accomplished by gently scraping the side of the core with a decontaminated stainless steel scraper or knife. Scrape from the bottom to the top of the core only. If the sediment is unconsolidated, do not scrape.
- Remove the upper 2 centimeters of the sample using a decontaminated Teflon<sup>®</sup> or stainless steel scoop—or dedicated disposable scoop—and place it in the sample container. From an undisturbed area of the sample surface, scoop a 2-centimeter sample only if grain size analysis is required. After grain size analysis samples are collected, scrape off the upper sediment layer and discard it overboard. Collect samples from the mid-section of the sediment. Sediment must be removed with caution to avoid cross-contaminating the sample (that is, from exposure to engine exhaust, rust, or grease).
- Do not include nonrepresentative materials, such as twigs or debris, in the sample. Do not include sediments that have come into contact with the side of the sampler or core liner for analysis.
- Follow the guidelines in the site-specific project plans and QAPP for aliquot size (mass), container type, storage conditions, and holding times. Fill the appropriate sample containers as detailed in the site-specific project plans. Identify or label samples carefully and clearly, addressing all the categories or parameters;
- Decontaminate the sampling equipment in accordance with SOP 411.02: *Sampling Equipment Cleaning and Decontamination* after use and between sampling if dedicated

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disposable scoops are not used. Don new clean gloves before beginning sampling activities and at each sampling point.

- Complete all chain of custody documents and record information in the Field Sampling Report (Attachment 4) and the field logbook (see the project-specific QAPP for sample custody procedures).

## 6.0 RECORDS

Documentation generated as a result of this procedure is collected and maintained in accordance with requirements detailed in the project-specific planning documents. The field logbook will be completed in accordance with procedures listed in SOP 300.04: *Field Logbook Use and Maintenance*. A Field Sampling Report will be filled out for each sediment sample collected (Attachment 4).

## 7.0 REVISION HISTORY

Revision 0	December 2010	Initial Release
Revision 1	August 11, 2017	Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting.
Revision 2	February 25, 2020	Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting, which included changing the SOP number from 2.15 to 403.08.

## ATTACHMENTS

- Attachment 1 – Core Sampler
- Attachment 2 – Gravity Core Sampler
- Attachment 3 – Dredges
- Attachment 4 – Field Sampling Report

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**ATTACHMENT 1  
CORE SAMPLER**

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## CORE SAMPLER



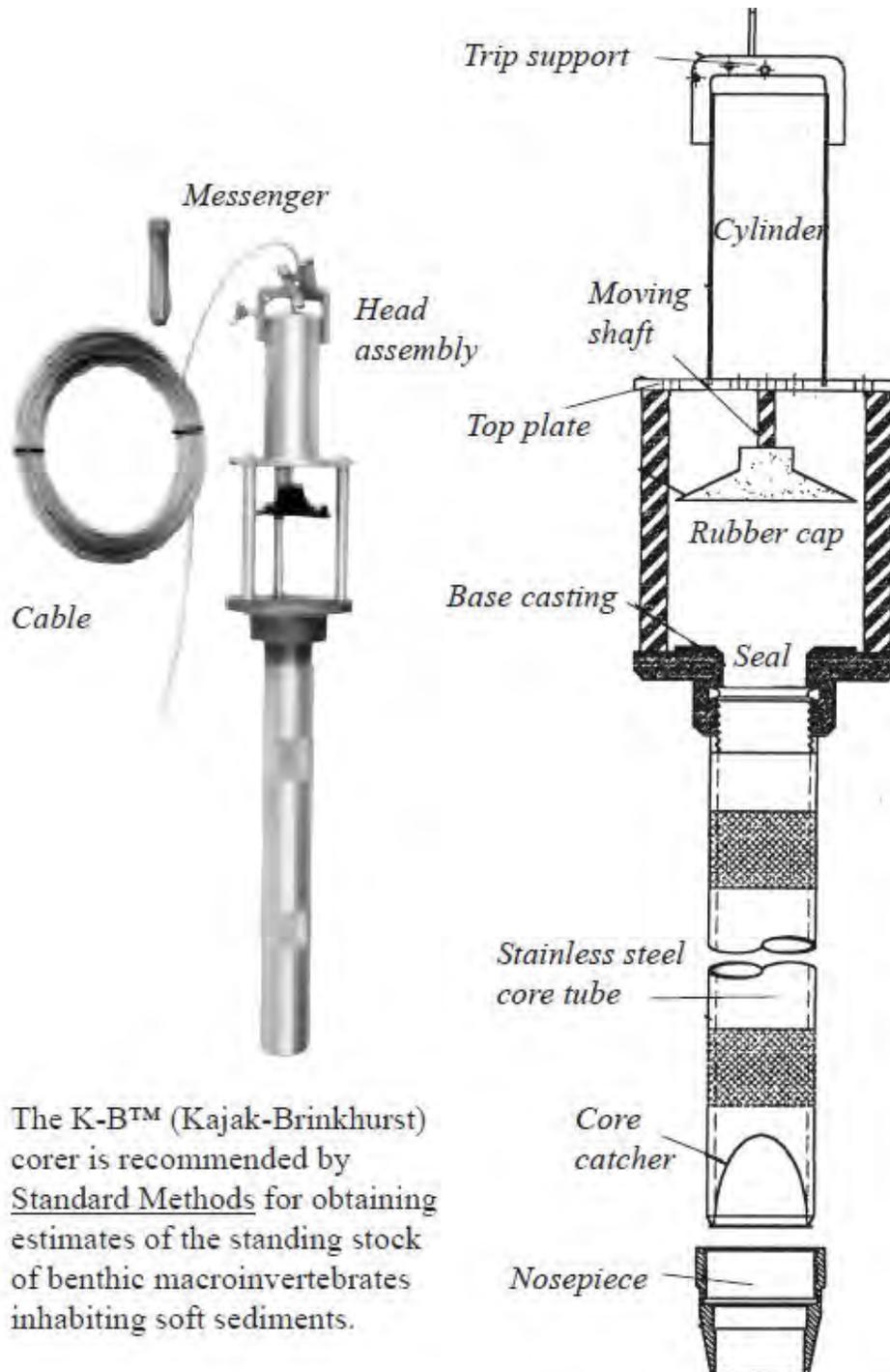
AMS Core Sampler (<http://www.ams-samplers.com/hand-tooling/sludge-and-sediment-samplers/sludge-and-sediment-samplers/sludge-and-sediment-samplers.html>)

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**ATTACHMENT 2**  
**GRAVITY CORE SAMPLER**

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## K-B GRAVITY CORER



The K-B™ (Kajak-Brinkhurst) corer is recommended by Standard Methods for obtaining estimates of the standing stock of benthic macroinvertebrates inhabiting soft sediments.

Wildco K-B Corer (<http://shop.sciencefirst.com/wildco/k-b-corers/7815-k-b-corer.html>)

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**ATTACHMENT 3  
DREDGES**

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## PONAR



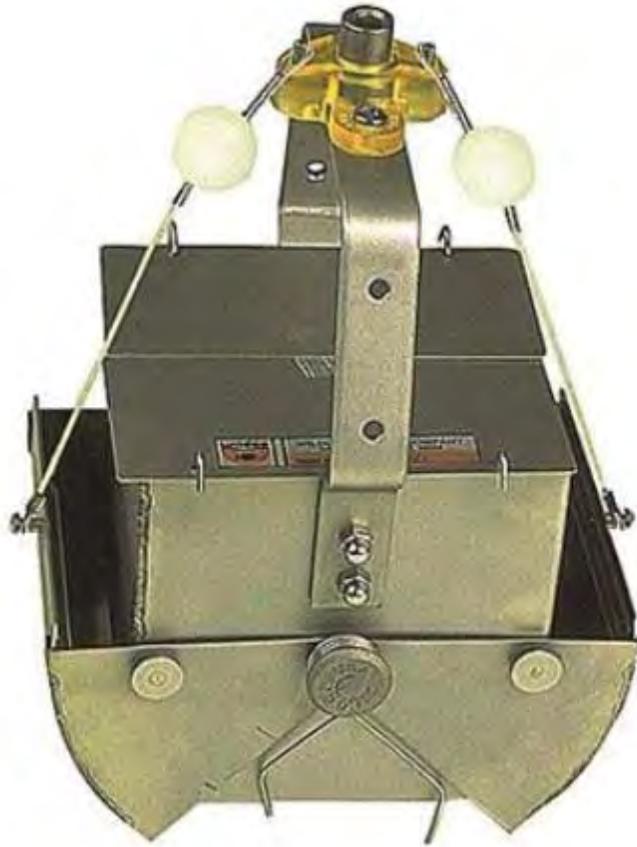
WILDSCO Ponar Dredge ([http://www.benmeadows.com/wildco-ponar-grabs\\_36816477/](http://www.benmeadows.com/wildco-ponar-grabs_36816477/))

## PETERSON



WILDCO Peterson Dredge (<https://www.coleparmer.com/p/mn/7270>)

## EKMAN



EKMAN Dredge ([http://www.benmeadows.com/ekman-bottom-grab-sampler\\_36816471/?searchterm=ekman%2bdredge](http://www.benmeadows.com/ekman-bottom-grab-sampler_36816471/?searchterm=ekman%2bdredge))

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**ATTACHMENT 4**  
**FIELD SAMPLING REPORT**

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## FIELD SAMPLING REPORT

LOCATION: \_\_\_\_\_ PROJECT: \_\_\_\_\_

SITE: \_\_\_\_\_

### SAMPLE INFORMATION

MATRIX \_\_\_\_\_ SAMPLE ID: \_\_\_\_\_

SAMPLING METHOD \_\_\_\_\_ DUP./REP. OF: \_\_\_\_\_

BEGINNING DEPTH \_\_\_\_\_ MATRIX SPIKE/MATRIX SPIKE DUPLICATE  
YES ( ) NO ( )

END DEPTH \_\_\_\_\_

GRAB ( ) COMPOSITE ( ) DATE: \_\_\_\_\_ TIME: \_\_\_\_\_

CONTAINER	PRESERVATIVE/ PREPARATION	EXTRACTION METHOD	ANALYTICAL METHOD	ANALYSIS
SIZE/TYPE	#			

### NOTABLE OBSERVATIONS

PID READINGS	SAMPLE CHARACTERISTICS	MISCELLANEOUS
1st	COLOR:	
2nd	ODOR:	
	OTHER:	

pH \_\_\_\_\_ Temperature \_\_\_\_\_ Dissolved oxygen \_\_\_\_\_ Specific Conductivity \_\_\_\_\_

### GENERAL INFORMATION

WEATHER: SUN/CLEAR \_\_\_\_\_ OVERCAST/RAIN \_\_\_\_\_ WIND DIRECTION \_\_\_\_\_ AMBIENT TEMP \_\_\_\_\_

SHIPMENT VIA: FEDEX \_\_\_\_\_ HAND DELIVER \_\_\_\_\_ COURIER \_\_\_\_\_ OTHER \_\_\_\_\_

SHIPPED TO: \_\_\_\_\_

COMMENTS: \_\_\_\_\_

SAMPLER: \_\_\_\_\_ OBSERVER: \_\_\_\_\_

MATRIX TYPE CODES	SAMPLING METHOD CODES
DC=DRILL CUTTINGS	B=BAILER
WG=GROUND WATER	BR=BRASS RING
LH=HAZARDOUS LIQUID WASTE	CS=COMPOSITE SAMPLE
SH=HAZARDOUS SOLID WASTE	C=CONTINUOUS FLIGHT AUGER
SE=SEDIMENT	DT=DRIVEN TUBE
SL=SLUDGE	W=SWAB/WIPE
SO=SOIL	G=GRAB
SG=SOIL GAS	HA=HAND AUGER
WS=SURFACE WATER	H=HOLLOW STEM AUGER
SW=SWAB/WIPE	HP=HYDRO PUNCH
	SS=SPLIT SPOON
	SP=SUBMERSIBLE PUMP

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**SOP 411.02, SIB Project Area, PHSS**  
**(Source: Sampling Equipment Cleaning and Decontamination)**

	<b>STANDARD OPERATING PROCEDURE</b>	
	Approved by: <b>Dick, Jeff</b>	<small>Digitally signed by Dick, Jeff Date: 2020.06.18 16:05:40 -04'00'</small> <b>Corporate Quality Manager</b>
<b>Sampling Equipment Cleaning and Decontamination</b>	<b>SOP No.: 411.02 (formerly 2.01)</b>	
	<b>SOP Category: Environmental Services</b>	
	<b>Revision No.: 5</b>	
	<b>Revision Date: June 18, 2020</b>	
	<b>Review Date: June 2022</b>	

## 1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to describe field methods to be used for cleaning and decontaminating sampling equipment.

This procedure is specifically applicable to sampling equipment that has been used to collect environmental samples or could have been exposed to contamination that could affect worker safety and/or the integrity of the analytical results of the media sampled.

Other decontamination procedures may apply to a specific project; refer to the project-specific planning documents for project-specific decontamination methods and schedules.

Any deviations from specified requirements must be justified to and authorized by the project manager and/or the relevant program manager and discussed in the approved project plans. Deviations from requirements are documented sufficiently to re-create the modified process.

## 2.0 SUMMARY OF THE METHOD

This SOP describes the procedures to be followed to achieve effective decontamination as follows: (1) remove contaminants from contaminated surfaces, (2) minimize the spread of contamination to uncontaminated surfaces, (3) avoid any cross-contamination of samples, and (4) minimize personnel exposures. The intent is to accomplish the required level of decontamination while minimizing the generation of additional solid and liquid waste.

## 3.0 DEFINITIONS

*ASTM Type II Water:* This is the type of deionized reagent grade water, as defined by ASTM International, used in the final rinse of surfaces of contaminated equipment.

*Equipment:* Equipment comprises those items (variously referred to as “field equipment” or “sampling equipment”) that are necessary to conduct sampling activities but that do not directly contact the samples.

*Laboratory Detergent:* This is a standard brand of phosphate-free laboratory detergent such as Liquinox® or Luminox®. Liquinox® is a traditional anionic laboratory detergent used for general cleaning and when there is concern that harsher cleaners could affect the stability of the sampling equipment. Luminox® is a specialized detergent that can remove oils and organic contamination. It may be used in lieu of a solvent rinse step in cleaning equipment for trace contaminant sampling.

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Where not specified in these procedures, either detergent is acceptable. The project-specific plans should indicate if Luminox® use is acceptable.

*Organic-free Water:* This is tap water that has been treated with activated carbon and deionizing units. At a minimum, the finished water must meet the analytical criteria of deionized water, and it should contain no detectable pesticides, herbicides, or extractable organic compounds and no volatile organic compounds above minimum detectable levels for a given set of analyses. Organic-free water obtained by other methods is acceptable as long as it meets the above analytical criteria.

*Potable/Tap Water:* Potable/tap water is provided by local city sources and is safe for consumption. Chemical analysis of the water source is not required before it is used. Deionized water or organic-free water may be substituted for tap water.

*Sampling Devices:* This is equipment used to acquire samples.

## 4.0 GENERAL REQUIREMENTS

All work is performed in accordance with the project-specific planning documents. Refer to the project-specific health and safety plan for relevant health and safety requirements. Any deviations from specified requirements must be justified to and authorized by the project manager and/or the relevant program manager. Deviations from requirements are documented sufficiently to re-create the modified process.

## 5.0 EQUIPMENT AND SUPPLIES

The following equipment is specific to decontamination requirements and does not include required safety equipment and field documentation described in the site-specific plans. Project-specific plans should be consulted for any additional equipment or deviations from the list below:

- Laboratory detergent,
- Brushes (not wire wound),
- Paper towels/rags,
- Squirt bottles (one for each decontamination fluid),
- 5-gallon buckets or decontamination pad/kiddie pool to contain decontamination fluids,
- Potable water,
- Deionized water,
- Drums or containers for decontamination fluids/solids,
- Drum/container waste labels,
- Sampling containers for decontamination fluid/solid sampling,
- Aluminum foil,
- Steam cleaner, and
- Generator and fuel.

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## 6.0 PROCEDURAL STEPS

Decontamination of sampling devices is performed in a designated decontamination area, removed from any sampling or dedicated office location. This designated area must be in a location free of direct exposure to airborne and radiological surface contaminants and upwind of any field activities that could jeopardize the decontamination procedures or cross contaminate the cleaned equipment.

### 6.1 GENERAL

The following general rules are followed for decontamination operations:

- Contaminated or dirty sampling devices/equipment should not be stored with or above clean (decontaminated) sampling devices/equipment.
- Clean, decontaminated sampling devices should be segregated from all other equipment and supplies.
- Paint or any other coatings must be removed from any part of a sampling device that may either contact a sample or may otherwise affect sample integrity. After such coatings are removed, the sampling device must be decontaminated using the appropriate method.
- For any of the specific decontamination methods that may be used, the substitution of higher-grade water is permitted (for example, using deionized water in place of tap water). However, deionized water is less effective than tap water in rinsing away detergent during the initial rinse.
- Decontaminated sampling devices and all filled and empty sample containers are stored in locations protected from exposure to any contaminant.
- The method for decontaminating sampling devices and the exterior of sample containers that have been exposed to radioactive material is based on the material contaminated, the sample medium, the radiation levels, and the specific radionuclides to be removed.
- The release of decontaminated sampling devices and sample containers for unrestricted use is based on site-specific criteria. These site-specific criteria should be detailed in the project-specific plans.
- Rags/paper towels used during decontamination activities may become a hazardous waste and require segregation. Refer to the project-specific plans for hazardous waste disposal requirements.
- Sampling devices must be decontaminated before being used in the field to prevent potential cross-contamination of a sample.
- Sampling devices must be decontaminated between samples to prevent cross-contamination.

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- Sampling devices must be decontaminated at the close of the sampling event before being taken off site.
- An acceptable alternative to cleaning and decontaminating sampling devices is using items cleaned or sterilized by the manufacturer that are discarded after one use. Care must be exercised to ensure that such previously cleaned or sterilized items do not retain residues of chemical or radioactive sterilizing agents that might interfere with analytical techniques.
- Whenever visible dirt, droplets of liquid, stains, or other extraneous materials are detected on the exterior of a sample container, the exterior surfaces must be decontaminated. This step should be performed before the container is placed in a sample cooler or shipping container.
- For sample containers used in controlled access areas, more rigorous cleaning and/or radiation monitoring may be required before removal from the site. Refer to the project-specific planning documents for details.
- Decontamination fluids/solids as well as other used cleaning supplies, such as paper towels and rags, should be treated as investigation-derived waste and managed in accordance with the project-specific planning documents.

## 6.2 DECONTAMINATION METHODS

The following decontamination methods are examples of some of those most commonly used in field investigations. Note that the decontamination methods described in this section are for guidance only; the project-specific planning documents and the SOPs referenced in them provide the actual procedures that must be followed. The field operations manager may need to adjust decontamination practices to fit the sampling situation and applicable requirements. All variances from the project-specific planning documents must be approved by the project manager in advance and documented. Procedures for packaging and disposing of all waste generated during decontamination are described in the project-specific planning documents.

### 6.2.1 Water Level Indicators

The following steps are taken to decontaminate water level indicators. Unless conditions warrant, it is only necessary to decontaminate the wetted portion of the measuring tape. It may be more practical to decontaminate the tape as it is being rewound, but with the reel several feet away from the wellhead (see project-specific planning documents):

1. Wash with detergent and tap water.
2. Rinse with tap water.
3. Rinse with deionized water.

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### 6.2.2 Submersible Groundwater Pumps

The following procedures are taken to decontaminate submersible pumps used to collect groundwater samples. This is the general procedure for non-dedicated pumps, unless the dedicated pump is being removed from the well.

1. Disconnect and discard the previously used tubing from the pump. Wash the pump exterior with detergent and water.
2. Prepare and fill three containers with decontamination solutions consisting of Container 1, tap water and detergent solution; Container 2, a tap water rinsing solution; and Container 3, a deionized water final rinsing solution. The containers should be large enough to hold the pump and 1 to 2 liters of solution. An array of 2-foot-long 2-inch PVC pipes with bottom caps is a common arrangement. Buckets can also be used as long as the water covers the intake screen of the pump. The containers should be labeled to ensure that decontamination is completed in the correct steps. The solutions should be changed at least daily.
3. Place the pump in Container 1. Turn the pump on and circulate the detergent and water solution through the pump and then turn the pump off.
4. Place the pump in Container 2. Turn the pump on and circulate the tap water through the pump and then turn the pump off.
5. Place the pump in container 3. Turn the pump on and circulate the deionized water through the pump and then turn the pump off.
6. Disconnect the power and remove the pump from Container 3.
7. Decontaminate the power lead by washing it with detergent and water, followed by tap water and a deionized water rinse. This step may be performed before washing the pump, if desired.
8. Wind the power lead back on a reel, and place the pump and reel in a clean plastic bag.

### 6.2.3 Bladder Pumps

The following procedures are used to decontaminate bladder pumps that use disposable bladders. If the bladder pump being used does not have a disposable bladder, the decontamination procedures outlined in Section 6.2.2 should be used.

1. Disconnect and discard previously used tubing from the pump.
2. Completely disassemble the pump, being careful not to lose the check balls, O-rings, ferrules, or other small parts.
3. Remove and discard the pump bladder.

<b>Sampling Equipment Cleaning and Decontamination</b>	<b>SOP No.: 411.02 (formerly 2.01)</b>
	<b>SOP Category: Environmental Services</b>
	<b>Revision No.: 5</b>
	<b>Revision Date: June 18, 2020</b>
	<b>Review Date: June 2022</b>

4. Clean all parts with tap water and detergent, using a brush if necessary to remove particulate matter and surface films.
5. Rinse thoroughly with tap water.
6. Rinse thoroughly with deionized water.
7. Install a new pump bladder.
8. Reassemble the pump and wrap it in aluminum foil or store it in a decontaminated pump storage tube.

#### **6.2.4 Small Tools/Samplers**

The following procedures are used to decontaminate small tools/samplers (e.g., stainless steel bowls, sample trowels, and hand augers).

1. Wash the tools/samplers with detergent and tap water, using a brush to remove particulate matter and surface film.
2. Rinse thoroughly with tap water.
3. Rinse thoroughly with deionized water.
4. Wrap the tools/samplers in aluminum foil or place them in a clean plastic bag.

#### **6.2.5 Drilling and Direct-Push Technology Sampling Equipment**

These procedures are used for drilling and direct-push technology (DPT) sampling activities involving the construction of monitoring wells to be used for collecting groundwater samples or for collecting soil and groundwater samples.

##### **6.2.5.1 Drill and DPT Rig**

Any portion of the drill or DPT rig or backhoe over the borehole or sample location that has come into contact with soil or groundwater (mast, backhoe bucket, drilling platform, hoist, cathead) should be steam cleaned (detergent and high-pressure hot water) between boreholes or sample locations. A decontamination pad should be constructed as specified in the project-specific plans to contain soil and decontamination fluids.

##### **6.2.5.2 Downhole Drilling and DPT Equipment**

The following is the standard procedure for field cleaning augers, drill stems, rods, tools, and associated equipment.

1. Wash the equipment with tap water and detergent, using a brush if necessary to remove particulate matter and surface film. Steam cleaning may be necessary to remove matter that

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is difficult to remove with the brush. Drilling equipment that is steam cleaned should be placed on racks above the floor of the decontamination pad. Hollow-stem augers, drill rods, drive casing, and other equipment that is hollow or has holes that transmit water or drilling fluids should be cleaned on the inside with vigorous brushing or steam cleaning.

2. Rinse the equipment with tap water.
3. Remove the equipment from the decontamination pad and cover it with clean plastic or reinstall the equipment on the drill rig.

### 6.3 QUALITY CONTROL

The effectiveness of the decontamination procedures is monitored by submitting samples of rinse water to the laboratory for low-level analyses of the parameters of interest, also referred to as equipment blanks. An attempt should be made to select different sampling devices each time devices are decontaminated to ensure that a representative sampling of all devices is obtained over the length of the project. Equipment blanks should be collected as specified in the project-specific planning documents.

### 7.0 RECORDS

Documentation generated as a result of this procedure is collected and recorded in a field logbook in accordance with procedures listed in SOP 300.04: *Field Logbook Use and Maintenance*.

### 8.0 REVISION HISTORY

Revision 0		Initial Release
Revision 1	December 2010	Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting.
Revision 2		Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting.
Revision 3	July 2017	Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting.
Revision 4	February 2018	Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting.
Revision 5	June 18, 2020	Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting, which included changing the SOP number from 2.01 to 411.02.

**SOP 411.03, SIB Project Area, PHSS  
(Source: Subsurface Utility Avoidance)**

	<b>STANDARD OPERATING PROCEDURE</b>	
	Approved by:	Corporate Quality Manager
<b>Subsurface Utility Avoidance</b>	SOP No.: 411.03 (formerly 401.01)	
	SOP Category: Environmental Services	
	Revision No.: 3	
	Revision Date: September 29, 2020	
	Review Date: September 2022	

## 1.0 SCOPE AND APPLICABILITY

This procedure applies to work that involves penetrating the soil surface with powered equipment during drilling or excavation activities. It is permissible to use a client’s or facility owner/operator’s utility avoidance procedure in lieu of this procedure if it provides equivalent protection.

For overhead utility lines avoidance, see the following procedures:

- HGL H&S Procedure 21: *Excavation and Trenching*,
- HGL H&S Procedure 27: *Drilling Safety*,
- HGL H&S Procedure 32: *Aerial Lift and Elevated Work Platform*, and
- HGL H&S Procedure 40: *Forklifts and Earthmoving Equipment*.

### 1.1 SUMMARY OF METHOD

This procedure establishes the minimum requirements for avoiding damage to subsurface utilities from unintentional contact with powered equipment.

### 1.2 HEALTH AND SAFETY WARNINGS

This procedure is not intended to address the hazards associated with subsurface investigation activities. Consult HGL Health and Safety (H&S) Procedure 21: *Excavation and Trenching* and Procedure 27: *Drilling Safety* for safety guidance and requirements. Do not perform intrusive work in areas that may contain unexploded ordnance (UXO) without a UXO escort and clearance by qualified UXO personnel.

Follow the procedures below if a utility is damaged during work (refer to the project Health and Safety Plan or Accident Prevention Plan for project contact information):

- If a gas line has been breached, shut down all nearby equipment that might provide an ignition source.
- Evacuate the immediate area of the breach unless the breached item clearly poses no hazard to personnel, as determined by the Site Safety and Health Officer (SSHO).
- Notify the owner/manager of the utility and emergency services (as appropriate) immediately. Note that in many cases contacting the public utility locating service (using One Call, calling 811, or going online to <https://call811.com>) will notify the member utility. In some states it is required by law to notify the One Call service.

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- If a buried electrical line is cut or damaged, call the power company emergency number for instructions.
- Notify the HGL Project Manager and H&S Director.
- Do not proceed with activities until the situation has been assessed by qualified H&S or utility owner personnel and written permission to resume work has been granted by the Project Manager and H&S Director.

### **1.3 PERSONNEL RESPONSIBILITIES**

The Project Manager is responsible for the following:

- Obtaining any facility-specific requirements/procedures for intrusive work, such as a dig permit;
- Obtaining specifications and “as-built” drawings for any buried lines, utilities, tanks, or other structures at the site and reviewing the proposed locations for drilling or excavation relative to those structures;
- Verifying that if client or facility utility avoidance procedures are to be used, they provide protection that is equivalent to that provided by this HGL SOP;
- Arranging for additional utility location beyond One Call service, such as private utility locating subcontractors, if
  - No accurate utility maps or “as-built” drawings are available,
  - Work is being performed close to high-value or high-hazard buried utilities, or
  - Work is being performed in residential areas, inside buildings, outside of public rights-of-way, or in other locations where unmapped utilities may be present.
- Arranging for UXO escort and UXO clearance if unexploded ordnance may be present;
- Ensuring that utility owner/manager emergency phone numbers are in emergency contact lists; and
- Ensuring that arrangements and procedures for subsurface utility avoidance are addressed during the pre-mobilization readiness review. These include establishing procedures for intrusive activities within 5 feet of a utility; arranging for HGL not to be responsible for damages to subsurface utilities in accordance with the One Call service or facility liability provisions; and obtaining a written waiver from the client or site owner, if needed.

The Field Manager is responsible for the following:

- Contacting the state utility One Call service and/or facility utility program to locate and mark subsurface utilities and hazards at the worksite and to update them during the duration of the work;

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- Completing the utility avoidance checklist attached to this SOP before the start of intrusive work;
- Ensuring that fieldwork involving powered drilling or excavation follows this procedure and other applicable requirements including HGL H&S procedures;
- Ensuring that site personnel are trained on the requirements of this SOP;
- Discussing utility-related emergency procedures in the pre-mobilization readiness review and daily safety briefings;
- Ensuring that all drilling or excavation locations are marked using high-visibility paint or some other recognizable and durable marking;
- Reviewing utility maps against field markings and resolving any inconsistencies or questions with the One Call service or facility utility program;
- Verifying at the start of each workday that drilling/excavation and utility markings are intact and clear, and contacting the One Call service or facility utility program to re-mark utilities if necessary;
- Understanding the utility incident reporting requirements for the state and facility where the work is done; and
- Reporting immediately any unintentional contact or damage to subsurface assets or hazards.

#### **1.4 DATA AND RECORDS MANAGEMENT**

Steps taken to avoid damaging utilities must be documented in the appropriate records such as the utility avoidance checklist, pre-drilling checklist, inspection checklist from H&S Procedure 21, field logbooks, and photographs, including photographs of the utility marks relative to the boring/excavation prior to the start of intrusive activities. Copies of utility maps, completed dig permits, and other relevant documentation must be kept at the project site and in the project files.

## **2.0 PROCEDURE**

The Field Manager is responsible for executing this procedure on the project site and completing the Utility Avoidance Checklist in Attachment 1 before the start of intrusive work.

Before commencing intrusive work using powered equipment, contact the public utility locating service (using One Call, calling 811, or going online to <https://call811.com>), the facility’s utility program, or a private utility contractor. Utilities not in the public right-of-way are typically not marked by the One Call service.

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Complete a walk-over survey of excavation or drilling locations prior to intrusive activities and then visually confirm that known utilities have been marked as appropriate and that markings are consistent with visible cues of possible subsurface utilities including the following:

- Utility posts/line markers,
- Water shutoff valves,
- Sewer cleanouts/manhole covers,
- Discharge pipes,
- Stormwater inlets,
- Irrigation wells and pivots,
- Fire hydrants (hydrants are typically offset from the water main by several feet),
- Junction boxes,
- Electrical poles with conduit into the subsurface,
- Light poles,
- Storage tank vents,
- Transformers, and
- Cuts/patches in pavement.

Determine if proposed drilling or excavation locations are immediately between storage tanks and product dispenser systems, between storage tanks and control units or buildings, between underground storage tanks and tank air vents, between manholes and sewer connections, or between any features that are likely to be connected by a subsurface utility, and if they are, relocate the drilling/excavation locations if possible. Identify facility assets (for example, equipment, control centers, fire suppression systems, vital communication systems, hospitals, police stations) that may be impacted or harmed if a utility is breached. Know the location of any shutoff valves in the area (for example, irrigation lines). Take photographs of all drilling and excavation locations prior to, during, and after work is complete.

Contact the One Call service or facility utility program if a utility is encountered that has not been marked or communicated to complete the locate and marking for that utility. If a utility is encountered and has not been marked or communicated by the One Call service or facility utility program, notify the Project Manager and H&S Director, who will determine the next step, such as arranging an independent utility survey and notifying the One Call service or facility utility program of the failure.

If a planned intrusive location is within 5 feet of a utility, reposition the work if feasible and request a new utility clearance by the One Call service. Consult the Project Manager before deciding to relocate a planned drilling or excavation location; obtain client approval if necessary. Keep in mind that many utility markings are approximations and that the utilities may be several feet from the markings.

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For drilling operations, if it is not feasible to relocate the drilling location, excavate at least the first 5 feet (deeper if it is likely that there are deeper utilities) of boreholes with a low-impact technique such as hand augering, hydrovacating, or air knifing. Pre-excavation of boreholes using low-impact techniques must also be performed under the following conditions:

- The location of utilities is uncertain.
- The work is being done in a residential or high population commercial area.

It is permissible to omit low-impact pre-excavation of boreholes under the following conditions:

- It has been verified that no hazardous (for example, gas, liquid fuel, or electric) or mission-critical communication (for example, fiber optic) subsurface utilities exist within 25 feet of the planned drilling location and that HGL will not be responsible for damages to subsurface utilities in accordance with the One Call service or facility liability provisions; or
- A written waiver has been obtained from the client or site owner.

Situations that do not fit the above criteria should be resolved at the pre-mobilization readiness review. Decisions to forego low-impact pre-excavation of drilling boreholes are subject to Program Manager approval through the issuance of a Subsurface Utility Avoidance memorandum or Field Work Variance. The memorandum must detail the justification to forgo the procedures outlined in this SOP, H&S Procedure 21: *Excavation and Trenching* and H&S Procedure 27: *Drilling Safety*. The revised procedure must be discussed during the readiness review meeting with all task participants, and the signed memorandum must be included with the readiness review form and/or pre-drilling checklist.

Criteria for determining the need to pre-excavate boreholes are summarized below:

<b>Criterion</b>	<b>Utility Location</b>	<b>Other Condition</b>	<b>Decision</b>
a	Within 5 feet		Pre-excavate
b	Between 5 and 25 feet	Uncertain if utilities are present	Pre-excavate
c	More than 25 feet	No hazardous or high-value utilities are present	May skip pre-excavation
d	Uncertain	Residential or high-population commercial	Pre-excavate
e	Uncertain	No hazardous or high-value utilities are present; HGL liability waived	May skip pre-excavation
f	Uncertain	Not d or e	Site-specific; resolve at pre-mobilization readiness review and document in review minutes

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For excavation operations, if utilities are located within the planned excavation or within 5 feet of the limits of the excavation, the precise location of those utilities must be determined by excavating with low-impact tools such as hand auger, shovel, hydrovac or air knife. This may be necessary at several locations within the excavation area to confirm that the apparent route and depth of the utility do not change. **If a utility extends throughout the area to be excavated, the utility must be exposed to confirm its location and depth at least once every 10 feet. The utility must be exposed continuously, using low impact techniques, when performing powered excavation within 5 feet of the utility.**

HGL must inspect excavations managed by subcontractors at sufficient frequency and at least daily to confirm that the subcontractor is complying with these requirements and must require the subcontractor to make corrections if they are not in compliance.

If subsurface obstructions prevent reaching a depth of 5 feet using low-impact techniques, verify that the obstruction itself is not a utility (for example, a concrete sewer pipe versus concrete rubble). Conversely, if there is a credible probability that utilities are present at depths greater than 5 feet, the low-impact excavation may be continued to greater depths. **It is not permissible to omit low-impact excavation due to a lack of suitable equipment.**

Inspect the low-impact excavation and excavated material for indications of utilities, such as the edge of a pipe visible in the sidewall of the excavation or the presence of pea gravel that may be pipe bedding. If a subsurface utility is unintentionally encountered at any time during a low-impact or powered boring or excavation, cease all work in the immediate area and contact the SSHO and Field Manager.

Any material generated during pre-excavation activities is managed in accordance with the project-specific planning documents.

Maintain and protect markings for utility locations during the work. If utility markings are weathered away or removed, or if the location or boundaries of the activity change, repeat the locating processes and replace the markings. Many utility incidents occur when the boundaries of excavations are changed or the marked utility locations wear off.

### 3.0 REFERENCES

HGL, H&S Procedure 21: *Excavation and Trenching*.

HGL, H&S Procedure 21.1: *Excavation and Trenching*, Appendix A, Inspection Checklist.

HGL, H&S Procedure 27: *Drilling Safety*.

HGL, H&S Procedure 32: *Aerial Lift and Elevated Work Platform*.

HGL, H&S Procedure 40: *Forklifts and Earthmoving Equipment*.

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### **3.0 REVISION HISTORY**

Revision 0	July 2016	Initial Release
Revision 1	May 2017	Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting.
Revision 2	June 1, 2018	Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting.
Revision 3	September 29, 2020	Updated to incorporate lessons learned on the process and to reflect changes in SOP formatting, which included changing the SOP number from 401.01 to 411.03.

### **ATTACHMENTS**

Attachment 1 – Utility Avoidance Checklist

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**ATTACHMENT 1**  
**UTILITY AVOIDANCE CHECKLIST**

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## UTILITY AVOIDANCE CHECKLIST

Date: \_\_\_\_\_ Project/Site: \_\_\_\_\_

Field Manager: \_\_\_\_\_

Work to be Performed: \_\_\_\_\_

Consideration	Y	N	Explanation	Initial
1. Has a dig permit been obtained and approved?				
2. Has state One Call service been contacted?				
3. Has facility utility program been contacted?				
4. Has a private utility locating survey been conducted?				
5. Have as-built drawings been reviewed for utilities or subsurface hazards (e.g., USTs)?				
6. Has a visual inspection of the work area(s) been completed, including taking photographs?				
7. Have all known utilities and subsurface hazards been clearly marked?				
8. Has a visual inspection indicated the possible presence of other utilities or subsurface hazards?				
9. Are intrusive activities being conducted within 5 feet of a utility?				
10. If Item 9 is YES, can activity be relocated?				
11. Are any final drilling locations within 5 feet of a utility; are utility locations uncertain or working in residential or high population area? If YES, excavate first 5 feet using low-impact techniques				
12. Are any utilities within 5 feet of the excavation limits? If YES, determine precise location with low-impact techniques.				
13. Can drilling proceed WITHOUT excavating the upper 5 feet with low-impact techniques? Explain why.				
14. If working near overhead power lines, is a minimum clearance of 20 feet being maintained?				
15. Has written approval been granted by the Program Manager to deviate from SOP 411.03? Attach to checklist.				
Other considerations:				

**SOP A-1, SIB Project Area, PHSS  
(Source: Hydrocarbon Field Screening)**

# Standard Operating Procedure

## Hydrocarbon Field Screening by Sheen Test

### 1.0 Purpose and Applicability

The Standard Operating Procedure (SOP) for sheen test describes a procedure to visually estimate areas of possible hydrocarbon impacts in soil or sediment. In addition, screening results can be used to aid in the selection of soil/sediment samples for chemical analysis. The field screening method includes a visual examination and water jar screening test.

Visual screening consists of inspecting the soil/sediment for stains, nonaqueous-phase liquids (NAPL), and/or sheens indicative of residual hydrocarbons. Visual screening is most effective at detecting heavy hydrocarbons, such as creosote, free-phase NAPL or high hydrocarbon concentrations. Water sheen screening from a representative soil/sediment sample is a more sensitive method at detecting the presence of hydrocarbons.

### 2.0 Responsibilities

The project manager is responsible for ensuring that a properly designed sampling program is prepared prior to any sample collection. The field sampling coordinator will have the responsibility to oversee and ensure that all sampling is performed in accordance with the project-specific sampling program and this SOP. In addition, the field sampling coordinator must ensure that all field workers are fully apprised of this SOP.

### 3.0 Health and Safety

This section presents the potential hazards associated with this technique. The site-specific Health & Safety Plan (HASP) will take precedence over this document. Note that sample collection usually requires Level D personal protection unless there is a potential for airborne or dermal exposures to site contaminants.

Health and safety hazards include but are not limited to the following:

- Dermal exposure to potentially contaminated media: proper personal protective equipment (PPE) is used to mitigate dermal contact including the impact of splashes of water or media to skin and/or eyes;
- Inhalation exposure when handling impacted media: respiratory protection should follow the procedures outlined in the project Site-Specific HASP; and
- Broken glass, in the event that a glass jar is used: use care when handling glassware.

### 4.0 Supporting Materials

The following materials must be on hand in sufficient quantity to ensure that proper screening procedures may be followed:

- Approximately one cubic-inch of media to be screened;
- 4 of 8 oz. wide-mouth, clear glass jar;
- Stirring devise (i.e. spoon);
- Squirt bottle; and
- Supply of distilled water.

## 5.0 Methods and Procedures

The strategy used to collect soil/sediment samples in the field for sheen testing will depend on the nature/grain size of the material and the type of hydrocarbon. Discrete samples may be collected from specific depths where NAPL is likely to occur. When lithology is coarse-grained material over fine-grained material, then a sample should be collected just above this interface where NAPL may be pooling above the “aquitarde”. Similarly, where fine-grained material overlies a coarse-grained layer with suspected impacts, the sample should be collected just below the contact. When lithology is fine-grained, then a sample should be collected near the contact with the coarse-grained layer. Alternatively, when lithology is finely bedded (< 1-inch thick), then homogenized samples may be collected over a larger depth interval to gain an “average” observation.

If the sample is being collected from inside a sediment core tube, the tube should be cut open longitudinally along the length of the core tube to prevent additional smearing. Make sure the interior of the sediment is exposed as a “fresh surface”. Be sure to discard any material along the inside side-walls of the core tube; this is called the “smear zone”. The smear zone may mask the true stratigraphy of a subsurface core sample. Then, use a spoon to scrap material across the “fresh” surface of the depth interval of interest, and place into sample jars for further observation. Once the sample volume is collected (approximately 1 oz or more depending upon grain size) the sample is examined and tested as described below.

### **Visual Examination**

In the field, observe sediment core tubes or soil samples for evidence of NAPL. Look at the material and note color and type/nature of occurrence. Observe the exterior and interior sidewalls of the sampling container for signs of staining. If wet, observe the nature of liquid. Among gravels, observe the surface of the gravel for signs of sheen and/or NAPL.

### **Water Sheen Test**

Water sheen screening involves placing soil/sediment in a clear glass jar or a black plastic pan partially filled with water, and observing the water surface for signs of a sheen. The volume of soil/sediment required for observation is approximately one cubic inch, or 10 mls, or about one tablespoon of media. For practical application in the field or lab, place about one cubic inch of soil/sediment (roughly 1 oz) in a 4 to 8 oz jar filled ¼-full with water. For larger volumes, use about 2 oz of material in an 8 oz wide-mouth glass jar filled ¼-full with water. Even larger volumes are needed for gravel. A plastic baggy may be substitute for a glass jar if field conditions require. Crush the material in the jar using a stirring devise (i.e., spoon), and shake the sealed jar vigorously for 30 seconds and allow the material to settle. Observe the water surface and sidewalls of the jar for signs of sheen, LNAPL, and DNAPL. Quantify the amount of sheen and blebs in the water surface using the following sheen classification:

No Sheen	No visible sheen on water surface
Slight Sheen	Light, colorless, dull sheen; spread is irregular, not rapid; sheen dissipates rapidly
Moderate Sheen	Light to heavy sheen, may have some color/iridescence; spread is irregular to flowing, may be rapid; few remaining areas without sheen on water surface
Heavy Sheen	Heavy sheen with color/iridescence; spread is rapid; entire water surface may be covered with sheen; visible droplets of immiscible liquids (i.e. NAPL)

Quantify the spatial coverage of sheen and size/diameter NAPL blebs if observed. The color is often described as rainbow or metallic for sheens and dark brown to black for blebs, droplets, and staining. Observe the sidewalls of the jar and estimate the thickness of LNAPL on the water surface and the thickness of DNAPL accumulated at the bottom of the jar. Record visual signs of staining on jar sidewalls and stirring device.

Field screening results will be recorded on the field logs forms or in a field notebook. Field screening results are site-specific and location-specific. Factors that may affect the performance of this method include: operator experience (experimentation may be required before routine screening is started) ambient air temperature, soil type, soil moisture, organic content, and type of hydrocarbon. Headspace screening may be collected to help correlate results and observations.

## 6.0 Quality Assurance/Quality Control

Not applicable.

## 7.0 Documentation

Documentation may consist of all or part of the following:

- Field sampling forms;
- Field log book; and
- Chain-of-custody forms.

Field records should contain sufficient detail to provide a clear understanding of how and where samples were collected. All documentation shall be placed in the project files and retained following completion of the project.

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## Field Description Key for Potential NAPL in Sediment

The intent of this field description key is to provide field personnel with guidelines for logging and observing sediment conditions associated with potential presence of Non-Aqueous Phase Liquid (NAPL) in a consistent and factual manner.

### VISUAL DESCRIPTORS

The range of conditions that could exist in sediments include:

- **NAPL** (Non-Aqueous Phase Liquid) – a separate phase liquid that may be lighter than water (LNAPL) or denser than water (DNAPL). NAPL can have varying consistency (viscosity) and can range from non-viscous to highly viscous (taffy-like). NAPL observations should be accompanied by applicable olfactory with smell (see descriptors below) and other visual observations (e.g., color and viscosity). The visual appearance of NAPL should be noted using descriptors below as appropriate. If NAPL is identified, then a sheen or shake test should be completed as described in this SOP in the Hydrocarbon Field Screening by Sheen Test portion.
  - **Free Product** – the entirety of the pore space for a sample interval is saturated with NAPL. Care should be taken to ensure that the saturation described is not related to water in the sample. Depending on the viscosity, NAPL saturated materials may freely drain from a soil sample and should be documented accordingly.
  - **Present**– In some cases, NAPL may be present in the pore spaces, or some of the pore spaces, but not coating the soil grains. The NAPL occurrence may be greater than blebs but not freely draining (saturated) and not hydraulically continuous. In these cases, the appearance/abundance of the NAPL should be noted.
  - **Blebs or Globules**– discrete, multi-shaped NAPL in or on the soil matrix. Include additional descriptors to the extent practicable such as the approximate size (typically ranging in size from 0.01 to 0.05 inches in diameter) and quantity (number of blebs or qualitative estimate) to the extent practical.
  - **Coated** – soil grains are coated with NAPL – there is not sufficient NAPL present to saturate the pore spaces. Use modifiers such as light, moderate or heavy to indicate the degree of coating.
  - **Semi-solid NAPL**– NAPL that is present as a super viscous liquid and appears in a solid or semi-solid phase. The magnitude of the observed solid NAPL should be described (discrete granules, tarry balls, taffy-like, or a solid layer).
- **Sheen** – iridescent sheen. The sheen characteristics need to be described in the field log, including the color, and iridescent sheens need to be distinguished from bacterial sheens which tend to break up at angles on the water surface; whereas a non-bacterial sheen will be continuous and will not break up. Sheens can be described as:
  - Discontinuous sheen (i.e., spotty, streaks, florets) within a section of core and does not fill sediment pore spaces.

- Continuous sheen (i.e., covering an area greater than 1 square inch) within a section of core but does not fill pore spaces. Describe percent cover.
- **Stained** – visible, unnatural discoloration of the soil, with no visible NAPL.

### **Other Visual Impacts and Descriptors**

In many cases, observed NAPL may be associated with a particular stratigraphic layer (e.g, sand lamination, woody debris layer, gravel lense), gas bubble, or void; NAPL distribution in relation to stratigraphy must be described. What does the material look like immediately above and below the area with suspected NAPL (e.g, clay). Impacts should be described using other visual descriptors as well, as applicable. Descriptors may include, but not be limited to, color, consistency, thickness, viscosity, water content, associated stratigraphy, presence shell or wood fragments or other debris, does NAPL flow out of the core tube, does it appear more or less viscous than water, results of jar sheen test, etc. Also note the staining of sampling equipment, and interior and exterior side-walls of the sampling tube, especially if entrainment of NAPL up the side-walls is suspected as an artifact of sample collection.

### **OLFACTORY DESCRIPTORS**

Field personnel will not conduct olfactory testing as part of sample processing, because vapor inhalation is a potential health and safety risk. However, if incidental odors are noted by field personnel during regular sample processing activities, field personnel will record this observation in the field forms. General descriptors that could be used are the following:

- Note odors similar to mothballs, driveway sealer, highway paving oil, sewage or other odors that are acrid, burnt, or sulfur-like, etc.
- Other odors that are not believed to be natural should also be identified with descriptors such as organic, ammonia, sweet, chemical etc., as applicable.
- Use modifiers such as strong, moderate or slight to indicate intensity of the observed odor.
- In instances where multiple odors are present, a combination of descriptors should be used to clearly identify where these co-mingled impacts are present.

However, olfactory descriptions are more subjective than visual inspections. Visual inspection may be aided by a PID, ultraviolet (UV) fluorescence examination, shake test, or similar device, to monitor and record organic odors and suspected NAPL in the field. One may also consider collecting a sample of the suspected NAPL to assess physical characteristics and potential mobility.

*Last revised by AGF and Geosyntec on 1/18/18  
Saved in Seattle server in P:\Projects\Portland Pre-Design PNG0767A\600 Deliverables (AECOM&Geosyntec)\FSP Subsurface Core\Appendices*

**SOP A-2, SIB Project Area, PHSS**  
**(Source: PID Screening and Calibration Procedures)**

## **PID Field Screening (Integral 2004)**

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Except for sample volumes collected for volatile analytes, sediment from each subsample will be individually mixed in the decontaminated, stainless-steel bowl to a uniform color and texture using a decontaminated, stainless-steel spoon. The sediment will be stirred periodically while individual samples are taken to ensure that the mixture remains homogeneous. Care will be taken to not include sediment that is in direct contact with the aluminum tube. In addition, the cutting of the aluminum tube can introduce metal shavings to the core sediment. Care will also be taken to avoid mixing these shavings into the homogenate. Pre-labeled jars for chemical testing will be filled with the homogenized sediment.

The types and number of field QC samples for subsurface sediment samples will follow the same guidelines prescribed for surface sediment samples. If additional volumes of sediment are required to perform all analyses in addition to QC analyses, an additional core may need to be collected from the same location and subsampled and homogenized accordingly.

Sample handling and storage procedures will follow those described for surface sediment samples in Section 4.6.1 with the following exception. When required, sediment subsamples for volatile organics will be collected from within appropriate intervals following the opening of the core and designation of the lithologic units. This process will minimize the release of volatile organics caused by mixing. Rinsate blanks will be performed at the same frequency (5%) as performed for the surface sediment sampling program.

#### **4.6.4 Subsurface Sediment Sample Field Screening**

In addition to visual observation, headspace screening using a photoionization detector (PID) and/or flame ionization detector (FID) may be used on all sample intervals to aid in the selection of samples to be analyzed.

##### **Headspace Screening**

Headspace screening involves the semi-quantitative measurement of total volatile compounds in the air above the sample material. Headspace concentrations will be measured using the following procedure.

1. A small representative sample will be collected from each sample interval to be screened using a decontaminated sampling spoon. The material will be placed in a resealable plastic bag or glass jar with a septum lid.
2. The bag or jar will be tightly sealed (the jar with aluminum foil and plastic lid with septum opening), and the material will be allowed to warm at least to the ambient temperature ( $>32^{\circ}$  F). The sample will be allowed to sit for at least 10 to no more than 60 minutes to allow headspace concentrations to develop, and shaken

periodically for at least 30 seconds at the beginning and end of the development period.

3. The PID/FID probe tip will be inserted into the container within the headspace, with care taken to avoid taking sediment or moisture into the probe.
4. The highest reading (excluding possible erratic readings) on the meter will be recorded for the sample.
5. The deepest sample interval showing a response during headspace screening will be submitted in the initial round of analyses.

#### **4.7 WASTE DISPOSAL**

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Any excess water or sediment remaining after processing will be returned to the river in the vicinity of the collection site. Any water or sediment spilled on the deck of the sampling vessel will be washed into the surface waters at the collection site before proceeding to the next station.

All disposable materials used in sample processing, such as paper towels and disposable coveralls and gloves, will be placed in heavyweight garbage bags or other appropriate containers. Disposable supplies will be removed from the site by sampling personnel and placed in a normal refuse container for disposal at a solid waste landfill. Phosphate-free, detergent-bearing, liquid wastes from decontamination of the sampling equipment will be washed overboard or disposed of into the sanitary sewer system. Waste solvent rinses will be held in sealed plastic buckets and disposed of into the sanitary sewer. Oily or other obviously contaminated investigation-derived waste will be placed in appropriate containers, and a waste determination will be made before it is disposed of at an appropriate facility.

#### **4.8 SAMPLE HANDLING AND TRANSPORT**

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Since samples collected in support of CERCLA activities may be used in litigation, their possession must be traceable from the time of sample collection through laboratory and data analysis to introduction as evidence. To ensure samples are traceable, the following procedures will be followed.

##### **4.8.1 Chain-Of-Custody Procedures**

Samples are in custody if they are in the custodian's view, stored in a secure place with restricted access, or placed in a container secured with custody seals. A chain-of-custody record will be signed by each person who has custody of the samples

# STANDARD OPERATING PROCEDURE

## PID EQUIPMENT CALIBRATION, OPERATION, AND MAINTENANCE

### **Introduction**

The standard operating procedure (SOP) for photoionization detector (PID) equipment calibration describes a procedure to confirm that monitoring equipment used for screening the quality and safety of sediment samples are operating within the manufacturer's specifications.

### **Calibration**

PIDs will be calibrated on a daily basis each morning prior to making measurements and will be adjusted to operate within the manufacturers' specifications. The PIDs will be calibrated using 100 parts per million (ppm) isobutylene calibration gas provided by the equipment vendor.<sup>1</sup> After calibration, the equipment output will read "Span 1 is done and reading is XXX." Manufacturer states that reading should be close to span gas value. Field crew is using a span gas value of 100 ppm  $\pm$  5%. If readings are outside of this value, then equipment will be sent back to the manufacturer for maintenance. All calibration information shall be recorded in the project logbook.

Special attention shall be noted by field crew to instruments that may be affected by the change in the ambient temperature or humidity. Calibration checks should also be performed when sampling conditions change significantly, sample matrix changes, and/or readings are unstable or there is a change of parameter measurements that appear unusual.

As needed through the day, a black marker may be used to confirm a "positive" reading by the PID instrument.

### **Maintenance**

All field monitoring equipment and accessories are to be maintained in accordance with the manufacturer's recommendations and specifications and/or established field practices. All maintenance will be performed by qualified personnel and documented in the field logbook or returned to manufacturer for maintenance.

Equipment requiring battery charging shall be charged as recommended by the manufacturer. Backup batteries for meters requiring them shall be included as part of the meters' accessories. Care must be taken to protect meters from adverse elements. Protective measures may involve placing the meter in a large plastic bag to shield it from the weather.

### **Documentation**

All field equipment calibration, maintenance, and operation information shall be recorded within the field logbook to document that appropriate procedures have been followed and to track the equipment operation.

<sup>1</sup> 100 ppm calibration gas = "Span 1"

Logbook entries shall contain, but are not necessarily limited to, the following:

- Equipment model and serial numbers
- Date and time of calibration or maintenance performed
- Calibration standard used
- Calibration lot number and expiration date if listed on bottle
- Calibration procedure used if there are multiple options
- Calibration and calibration check readings, including units used
- Problems and solutions regarding use, calibration, or maintenance of the equipment
- Other pertinent information

Field records should contain sufficient detail to provide a clear understanding of which equipment was used and how equipment was calibrated. All documentation shall be placed in the project files and retained following completion of the project.

**SOP A-3, SIB Project Area, PHSS  
(Source: Sampling Photography)**

# STANDARD OPERATING PROCEDURE

## CORE PHOTOGRAPHY PROCEDURES FOR SEDIMENT CORING

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### **Purpose**

The purpose of this standard operating procedure (SOP) is to describe core photography procedures.

### **Scope and Applicability**

This SOP is applicable to taking digital photographs of subsurface sediment cores.

### **Equipment and Materials**

Equipment and materials for taking digital photographs include the following:

- Digital camera
- Spare batteries
- Tripod
- Color calibration card
- Measuring tape
- Light stands
- Digital camera-carrying case and manual
- Photo log form
- Dry-erase board
- Dry-erase marker
- Black waterproof pen

### **Typical Camera Features**

- Save photographs (in standard mode) directly to a memory stick or comparable device
- Auto focus; manual focus available if required
- Zoom
- Brightness control
- Playback of photographs on camera screen
- Display of photograph number, date, and time

- Timed or remote release
- Display showing time remaining on battery and remaining disk capacity
- Ability to protect and delete images that have been taken

## **Camera Use**

A digital camera will be used by the core processing team to photo document the subsurface sediment cores. The field team leader will be responsible for digital photograph documentation or for assigning documentation duties to a team member. Digital photographs will be collected at a high-pixel setting such that enlargements can be made with minimal degradation in picture quality.

## **Photograph Documentation Procedures**

### ***Field Team Responsibilities***

The core processing team will keep a daily hard copy log of all photographs. The following digital photograph data will be collected:

- Date and time—as provided by the camera display
- Team members—list each team member
- Camera identifier (type, model, equipment number)
- Sample Location ID and depth interval
- Photograph ID—record the number of the photograph and the photograph file name (as coded below)
- Description—the target of the photograph

### ***Photography Procedures***

- Sediment cores should be photographed indoors with flood lights and oriented so that shadows are eliminated.
- The camera should be affixed to a tripod and photos taken using a timed or remote release to minimize shaking.
- The axis of the camera lens should be as close to perpendicular as possible to the core to minimize distortion of core and linear features.
- A measuring scale (e.g., tape measure or ruler) should be placed adjacent to the edge of the core as a size reference.
- A color proof strip should be included in the photo to ensure true color reproduction during photo post processing.
- The core Location ID and depth interval should be written onto a dry erase board and included in the photo frame.

### ***Digital Photograph File Name***

At the end of each field day, the member of the field team who is responsible for the camera will transfer the electronic data from the camera to the field operations computer. The folder structure will be as follows (or as specified in the Data Quality Management Plan [DQMP]):

\\DATA\PHOTOS\YYYYMMDD\SAMPLE AREA\file\[1, 2, 3, ....N]

The notation YYYYMMDD represents the year, month, and day. The sample area is the sampling area name (e.g., Willamette River). The individual files for the day (e.g., file 1, file 2, file N) will be placed within this folder using the default file identifier provided by the camera.

### ***Transfer of Information and Archive***

After the photograph disks have been uploaded, the original hard copy of the photograph log will be initialed and dated by the team member who downloaded the photographs, then archived by the field team leader.

### ***Sample Processing Coordinator Responsibilities***

The field team leader will be responsible for 1) reviewing electronic photographs and the logs as they are made available to ensure consistency and completeness of annotations; 2) collecting and archiving the hard copies of the photograph logs; 3) reviewing electronic photographs and the logs as they are made available to ensure consistency and completeness of annotations; and 4) notifying the sampling team leader of apparent inconsistencies and making recommendations for corrective action.

### **Key Checks and Items**

Important checks for digital camera management include the following:

- Make sure the camera's battery is fully charged on a daily basis.
- Keep extra memory sticks available.
- To save battery life, use flash only when necessary.
- Make sure the camera quality level is set at "best" or equivalent (high pixel).
- Review photograph records periodically to ensure that the electronic photographs, dry erase board information, and the Specimen Tally and Location Form agree.
- Leave enough time at the end of the field day to transfer the data.

**SOP A-4, SIB Project Area, PHSS  
(Source: Storm Drain Sampling)**

## 1. PURPOSE AND SCOPE

The following text describes the techniques that will be employed to collect sediment samples at specified locations. For the purposes of this project, and where necessary, HGL will adopt the **SOP for Confined Space Entry to be performed by certified contractors**.

## 2. REQUIRED EQUIPMENT

The following equipment and supplies will be used for sediment sample collection:

- Photoionization detectors (PIDs)
- Laboratory-supplied containers
- Decontamination kit (buckets, brushes, Alconox, and tap and deionized water)
- Camera
- Sharpies/pens
- Labels
- Chain-of-Custody forms
- Ice and cooler
- 25-foot grab sample pole with 12-oz. sample cup
- Paper towels
- Personal protective equipment (PPE), including hard hat, boots, high-visibility vest, safety glasses, and nitrile gloves

## 3. SEDIMENT RETRIEVAL METHODS

The methods for retrieving the accumulated sediment are presented below.

- Using safe lifting techniques, traffic controls (if needed), and implementing all health and safety protocols, open the manhole cover.
- Observe sediment volume present. If the volume is adequate for analytical laboratory requirements (8 oz), proceed with sample collection consistent with this SOP.
- Using a grab sample pole fitted with a sample cup or stainless beaker, collect a representative sample by scooping the sediment from the accumulated location.
- Slowly raise the sample cup to the surface and place the sediment into the laboratory-supplied containers (decant water from top).
- Repeat the procedure until the sample container is filled with sediment.
- Label the sample container.
- Close the manhole cover.
- Decontaminate the sample cup before the next location is sampled.



#### 4. DECONTAMINATION PROCEDURES

Decontamination of sampling equipment must be conducted consistently to ensure the quality of samples collected. Disposable equipment intended for one-time use will not be decontaminated but will be packaged for appropriate disposal.

Decontamination will occur after each use of a piece of equipment between sample locations. All sampling equipment that comes into contact with sampling media (grab pole, stainless beaker, cups, etc.) will be decontaminated according to EPA Region 10 recommended procedures. The following, to be carried out in sequence, is an EPA Region 10 recommended procedure for the decontamination of sampling equipment:

- Non-phosphate detergent and tap water wash, using a brush if necessary
- Tap water rinse
- Deionized/distilled water rinse (first rinse)
- Deionized/distilled water rinse (second rinse)

Equipment will be decontaminated in a predesignated area, and clean bulky equipment items will be stored in their cases or on visqueen in uncontaminated areas. Cleaned small equipment items will be stored in their cases or in plastic bags. Materials to be stored more than a few hours will also be covered.

#### 5. FIELD FORMS

During each site visit to retrieve accumulated sediment, the field crews will complete a field form which will record the following information:

- Name of staff conducting sampling
- Location
- Date/time of sampling
- Presence and approximate depth of any water at the location
- Approximate volume of sediment sampled
- General comments/observations

**Gravity (SOP) A-5, SIB Project Area, PHSS  
(Source: Gravity Marine HVS Sampling)**

## **GRAVITY CONSULTING STANDARD OPERATING PROCEDURE (SOP) A-5**

### **HIGH-VOLUME STORM WATER SAMPLING FOR ANALYSIS OF COMPOUNDS WITH LOW DETECTION LIMITS**

#### **SCOPE AND APPLICATION**

This SOP describes the protocol for collecting high-volume (HV) water samples using a Gravity PR2900 pump system coupled with a polyurethane foam (PUF) cartridge and a vortex separator, the collection of parallel peristaltic whole water sample, and the collection of physical sample parameters. This SOP is specific to HV techniques used for storm water sampling and should be an addendum to the primary projects Quality Assurance Project Plan (QAPP).

High volumes of surface water samples are collected to quantify surface water concentrations of targeted organic chemicals (e.g., dioxins, PCBs, and pesticides) that could be present at levels too low to be detected using conventional sampling methods. This method also allows for quantification of hydrophobic organic chemicals (HOCs) in the suspended particle and dissolved phases of the water column.

HV storm water sampling techniques make it possible to obtain enough mass from the storm event to allow quantitation of the target compounds. In summary, a large volume of water is collected with a pump and passed through a vortex separator and then through a cartridge containing PUF material that binds the dissolved forms of the compound in question. The dissolved compounds that bind to adsorbent foam material (i.e. the PUF) are later extracted in the laboratory and measured on a gas chromatograph/mass spectrometer. Trace metal clean sampling techniques are also used for the collection of HV water samples to be analyzed for organic compounds and conventional parameters, such as total suspended solids, dissolved organic carbon, and total dissolved solids. Using these techniques guarantees a high level of sample integrity and minimizes the potential for contamination during sample handling.

This SOP utilizes and augments the procedures outlined in the San Francisco Estuary Institute's *Field Sampling Manual for the Regional Monitoring Program for Trace Substances* (David et al. 2001), the *Interagency Field Manual for the Collection of Water-Quality Data* (USGS, various dates), and U.S. Environmental Protection Agency (EPA) Method 1669, *Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels* (USEPA 1996). A goal of this SOP is to ensure that the highest quality, most representative data are collected, and that these data are comparable to data collected by different programs that follow EPA guidelines.

## **STATION ACCESS**

Prior to entering select areas for storm water sampling that are safe to access. It may be necessary to acquire permission from the landowner to access the property. Access permission must be acquired in advance of the sampling program and may require a written agreement.

## **STATION LOCATION**

Water samples will be collected at specific HV locations identified in the project planning documents (e.g. Field Sampling Plan [FSP]). Samples will be collected over the period of the storm event so ensure locations have 24/7 access.

## **SUMMARY OF METHOD**

At each station, dedicated/new Teflon™ tubing will be connected to a dedicated decontaminated primary pump attached to a pipe with weighted base mount and flow sensor and lowered into the storm water pipe making sure the primary pump inlet does not come into contact with any accumulated sediment. There will be a dedicated primary pump at each location, the pump is constructed with all stainless steel components and will be decontaminated before deployment. The primary pump variable flow is operated by a surface controller that will be set at approximately 3 L/min and will pump the storm water into a dedicated decontaminated surface level primary glass carboy which will in turn supply both the HVS outflow and whole water sample volume needed for continuous sample flow. Examples of the fully stainless steel primary pumps selected are the Geosub 2 from Geotech and the Proactive Monsoon from ECT Manufacturing. Both of these pumps are designed to continuously pump water to the surface where vertical distances exceed the capabilities of available peristaltic pumps, the pumping rates can also be accurately controlled at the surface using the manufacturer supplied controller units.

Two lengths of dedicated/new Teflon™ tubing will be inserted fully into the primary glass carboy, one of the sampling tubes will be directed to the internal HVS peristaltic pump intake, which leads to a high vortex separator. The high vortex separator is able to separate suspended sediments by forcing the water in a centrifugal fashion before exiting towards the 0.45 micron glass filter and then the PUF cartridge. Water is then drawn through the PUF cartridge which contains solid phase extraction resins that bind dissolved forms of the compounds in question (e.g., HOCs). A constant rate of water, approximately 1.5 L/min, is pumped through this system. Every 15 minutes the rate of water pumped is checked to ensure that water is flowing at a constant rate. To check that the pump is accurately delivering the desired rate of volume, the pump outflow must be checked with a 1 L graduated plastic cylinder and a timer. If the pump is not delivering the correct flow rate, fine adjustments must be made until the optimum flow is achieved.

After the desired volume has passed through the PUF cartridge, the HVS peristaltic pump is turned off and the PUF cartridge and the 0.45 micron glass filter are removed. Two stainless steel nuts that cap each end of the PUF cartridge are reattached. The cartridge is then labeled, taped, placed in resealable bags, and placed in a cooler with wet ice. The volume from the vortex separator containing the suspended particles sample is added to the 0.45 micron flat filter, and placed in a labeled 8 oz jar before being placed in a cooler with ice. The vortex sampler volume is removed by shutting the main line valve to the off position and opening the vortex outlet valve while running the pump for 10 seconds.

Physical field measurements and a separate whole water sample will be collected in tandem with the HVS sampling system by connecting the second Teflon™ tube to a secondary peristaltic pump, tubing set, and secondary glass sample carboy. This pump will also have a flow-thru chamber with YSI Exo multi-meter installed for continuous measurement of Dissolved Oxygen, PH, turbidity, and temperature. Assuming adequate sample volume, flow via the second tubing will be continuous at a similar or lower flow rate than the primary HVS tubing and discharge from the second tubing will alternate between filling the secondary glass carboy and pumping to waste. This set-up intends to keep samples coming out of both tubes representative of the total storm flow throughout the pumping duration, the continuous flow will ensure that the combined HVS and whole water sample collection pumping rates will be equivalent to the primary pump flow rate set to approximately 3 L/min to avoid the primary glass carboy being overfilled during the sample collection period. Once the secondary whole water sample is collected the peristaltic pump will be used to collect TSS and TOC samples from the agitated secondary glass sample carboy in laboratory supplied sample containers for analysis. The remaining whole water sample in the secondary glass sample carboy can be submitted to the laboratory for all other analysis in accordance with project planning documents.

## **PROCEDURES**

The sampling team should comprise two people. Staff are needed to conduct the sampling and keep track of sample logging and sample processing.

### **Equipment Preparation**

A sufficient amount of dedicated sampling equipment will be brought to the field to minimize the amount of decontamination procedures that need to be performed . SGS laboratory is responsible for preparing its equipment prior to delivery. All PUF cartridges will be cleaned, pre-weighed, numbered at the laboratory, and individually packaged before being shipped to the site under chain-of-custody. The list of necessary equipment is provided as Attachment 1 to this SOP.

The following steps are taken to set up the surface water collection system:

1. Assemble and secure the flow meter and primary pump to the weighted base mount.
2. Set up a clean area for the sampling equipment.
3. Attach a length of dedicated/new Teflon™ tubing to the primary pump, which will be secured to the base mounted pipe with flow sensor. The pipe with base mount, primary pump, flow sensor and tubing will then be lowered into the storm water pipe making sure the primary pump inlet does not come into contact with any accumulated sediment. The primary pump intake shall be pointed in the up-pipe direction within the water column. The outflow end of the main sample tube will be directed into the primary glass carboy (Note: The length of the Teflon™ tubing will vary depending on project-specific requirements and storm water manhole vault height at each given station).
4. Insert the intake end of the two lengths of Teflon™ sample tubing into the primary glass carboy.
5. Attach the two lengths of Teflon™ tubing (collecting end) to 30-cm platinum cured silicone™ tubing and a 1-m Teflon™ tubing, sequentially, and then connect the platinum cured silicone™ part of these interconnected pieces of tubing firmly into place inside the large peristaltic pump head. The outlet tubing should be directed away from the storm water conveyance to ensure sampled water does not drain back into the outfall.
6. Secure the pumps and pump speed controllers and connect them to a generator or inverter with an extension cord. The generator should be positioned downwind from the sampling and should not be run while the PUF is being transferred to or from the sampler
7. Connect one of the Teflon™ tubes to a flow thru chamber to the whole water physical sample glass sample carboy and setup YSI Exo1 for water quality monitoring parameter logging.
8. Connect the other Teflon™ tube to the HVS intake tubing.

## **HVS Sample Collection**

The following steps are taken to collect and process a standard HVS storm water sample:

1. Remove the protective cap from the sampling tube and insert fully into the primary glass carboy.
2. Switch the pump on and purge at least 3 tubing volumes of water through the tubing to ensure a representative sample is collected. During purge, calibrate pump flow rate to 1.5 L/min using a 1 L graduated cylinder.

3. Once purging is complete and flow rates are set, attach tubing outlet to vortex separator and pump storm water through the sample tubing into the vortex separator and through the PUF cartridge at a constant rate of approximately 1.5 L/min.
4. Every 15 minutes, record pump rate to ensure that the target rate of approximately 1.5 L/min is maintained. If the pump rate falls +/- 5% outside this range (i.e., outside of the range of 1.425 L/min to 1.575 L/min), adjust the speed of the pump.
5. Turn off the pump once the desired volume of storm water has been pumped through the PUF cartridge or the storm event ends.
6. Remove the PUF cartridge and cap each end with stainless steel nuts.
7. Remove the 0.45 micron flat filter and place in 8 oz. jar. If multiple flat filters are collected during the sample collection pumping these will be combined in the same 8oz jar for compositing at the testing laboratory.
8. Add the solids from the vortex separator into the flat filter 8 oz. jar by shutting the main line valve to the off position and opening the vortex outlet valve while running the pump for 10 seconds to purge the vortex separator. If needed, rinse the inside of the vortex separator with a squirt bottle filled with deionized water.
9. Attach sampling label, which contains the date, time, project name or number, sample ID, type of analysis required, and sampler initials per project planning documents (e.g. Quality Assurance Project Plan [QAPP])
10. Once the PUF cartridge and solids jar are properly closed and labeled, place them inside a cooler containing wet ice and store at approximately 6°C. All samples are to be stored in coolers with ice prior to submittal and/or shipping to the analytical laboratory, per project planning documents (e.g. QAPP)

### **Whole Water Sample Collection**

The following steps are taken to collect the whole water storm water sample, in parallel with the HVS sample:

1. Remove the protective cap from the sampling tube and insert fully into the primary glass carboy.
2. Switch the pump on and purge at least 3 tubing volumes of water through the tubing to ensure a representative sample is collected.
3. Once purging is complete and flow rates are set, attach tubing outlet to the whole water dedicated carboy with an in-line flow-thru chamber connected to a YSI Exo multi-meter installed for measurement of Dissolved Oxygen, PH, turbidity, and temperature set to be recorded every 15 minutes.

4. Every 15 minutes, collect 1L of whole water into the secondary glass carboy. When not actively filling the carboy, this second tubing will be pumping to waste to maintain the constant pumping rate. The outlet tubing should be directed away from the storm water conveyance to ensure sampled water does not drain back into the outfall.
5. Turn off the pumps once the desired volume of storm water has been obtained or the storm event ends.
6. By reversing the peristaltic pump collect the TSS and TOC samples from the agitated secondary glass sample carboy into laboratory supplied sample containers, ensure the samples are properly sealed and labeled, place on wet ice and store at approximately 6°C.
7. Attach sampling label to the remaining whole water secondary glass sample carboy, which contains the date, time, project name or number, sample ID, type of analysis required, and sampler initials per project planning documents (e.g. Quality Assurance Project Plan [QAPP])
8. Once the carboy is properly sealed and labeled, place it on wet ice and store at approximately 6°C. All samples are to be stored on ice prior to submittal and/or shipping to the analytical laboratory, per project planning documents (e.g. QAPP).

## **Decontamination of HV Equipment**

Dedicated sample tubing will be used at each sample location so decontamination will be unnecessary. Prior to sampling, the following steps are taken to decontaminate the HV water sampling equipment. The procedure specific to the high-volume sampling equipment is provided below.

1. Plumb decon silicone and Teflon tubing to the HVS system and whole water peristaltic pump
2. Pump 2 liters of Liquinox solution through PR2900 system
3. Pump 1 liter of DI water through the PR2900 system
4. Pump 1 liter of Methanol through PR2900 system
5. Pump 1 liter of DI water through PR2900 system
6. Pump 0.5 liter of Hexane through PR2900 system
7. Pump 1 liter of DI water through PR2900 system
8. Rinse the dedicated primary pump, primary glass carboy and secondary sample glass carboy with Liquinox
9. Rinse the dedicated primary pump, primary glass carboy and secondary sample glass carboy with DI

10. Rinse the dedicated primary pump, primary glass carboy and secondary sample glass carboy with Methanol
11. Rinse the dedicated primary pump, primary glass carboy and secondary sample glass carboy with DI
12. Rinse the dedicated primary pump, primary glass carboy and secondary sample glass carboy with Hexane
13. Rinse the dedicated primary pump, primary glass carboy and secondary sample glass carboy with DI
14. Cap all exposed inlets and outlets and wrap the primary pump with aluminum foil ready for sample collection

## **WATER QUALITY MEASUREMENTS**

Physical and chemical water parameters will be collected at storm water stations. Several physical and chemical water parameters are best measured in the field because of the unstable nature of the parameter or because the information is needed to direct further sampling. It is frequently preferable to perform these analyses in the field, especially if the samples will not be immediately transported to the analytical laboratory (pH, in particular, should be measured in the field if feasible). A YSI multimeter Exo1 with flow thru chamber will be used to log Dissolved Oxygen, pH, turbidity, and temperature parameters.

The YSI will run for the full duration of the sampling event to observe any potential changes in the physical parameters of the sample. The physical parameter data will be recorded every 15 minutes during sample pumping at each location.

Documentation of instrument information will adhere to project planning documents (e.g. FSP), and at a minimum will contain the name(s) of the person(s) making the measurement and the field equipment used to make that measurement must be recorded in the field logbook and on any field forms used during the sampling event. Equipment maintenance and calibration records must be kept in logbooks and field records so that the procedures are traceable. All field records will be checked by field staff for completeness and electronically provided to the Client.

## **STORMWATER FLOW MEASUREMENT**

A Greyline Stingray 2.0 flow sensor (or equivalent) will also be incorporated into the sampling program to measure flow and volume. The flow sensor transmits ultrasonic pulses that travel through the water and reflect off the liquid surface. To monitor water level, the Stingray 2.0 precisely measures the time it takes for echoes to return to the sensor. Velocity is measured with an ultrasonic signal continuously injected into the flow. This high frequency sound is

reflected back to the sensor from particles or bubbles suspended in the liquid. If the fluid is in motion, the echoes return at an altered frequency proportionate to flow velocity. The Stingray 2.0 uses this Doppler frequency shift to accurately calculate flow velocity. The Stingray will be attached to the base plate of the pole used to deploy the sampling tube.

The Stingray will run for the full duration of the sampling event to observe any potential changes in the flow. The flow sensor Greyline Logger software will display and record near continuous log files and flow rates in graph and table formats. Flow data reports including minimum, maximum and average flow, and calculated flow totals will be generated.

## **SAMPLE HANDLING**

Standard “clean and dirty hand” techniques will be observed on this project. Clean hands are required for sample collection and handling, as described above. Field staff will wear appropriate non-contaminating, disposable, powderless nitrile gloves during the entire sampling operation. Gloves will be changed frequently, usually with each change in task (wearing multiple layers of gloves allows rapid glove changes).

*Clean hands* are required for all operations that involve equipment that comes into contact with the sample, including the following activities:

- Handling the PUF column, 0.45 micron flat filter and vortex separator vial
- Handling the intake end of the sample tube or line
- Setting up working space inside the processing chambers
- Setting up the equipment (i.e., high volume sampler and PUF cartridges) inside the chambers
- Handling the vortex separator
- Changing the chamber covers as needed.

*Dirty Hands* take care of all operations that involve contact with potential sources of contamination, including the following activities:

- Working exclusively exterior to the processing and preservation chambers
- Preparing a clean workspace (inside boat)
- Preparing and operating the sampling equipment, including the pumps and discrete samplers
- Handling the generator or other power supply for samplers
- Handling the tools, such as hammers, wrenches, keys, locks, and sample-flow manifolds
- Handling the single or multi-parameter instruments for field measurements

- Setting up and checking the field-measurement instruments
- Measuring and recording the water depths and field measurements.

All samples are stored in coolers with ice at approximately 6°C until transferred to the laboratory at the conclusion of the sampling day or the following day. The sampling team leader is responsible for maintaining sample integrity throughout the sampling event.

Sample contamination will be avoided by handling the sample containers with clean gloves, and transferring the samples into clean refrigerators (or clean coolers) immediately after samples have been brought back from the field. Sample bottles will always be handled by personnel wearing disposable, powderless nitrile gloves. This includes any and all sample handling that may occur during sample packing and shipping.

## REFERENCES

David, N., D. Bell, and J. Gold. 2001. Field sampling manual for the Regional Monitoring Program for Trace Substances. San Francisco Estuarine Institute, San Francisco, CA.

USEPA. 1996. Method 1669 - Sampling ambient water for trace metals at EPA water quality criteria levels. U.S. Environmental Protection Agency, Office of Water Engineering and Analysis Division (4303). Washington, DC.

USGS. [various dates]. National field manual for the collection of water-quality data: U.S. Geological Survey techniques of water-resources investigations, Book 9, Chap. A1-A9. Available online at <http://pubs.water.usgs.gov/twri9A>. U.S. Geological Survey. Accessed February 5, 2008, at <http://water.usgs.gov/owq/FieldManual/index.html#Citation>.

## ATTACHMENT 1. FIELD EQUIPMENT LIST

- High volume peristaltic pump with vortex separator
- Primary in-line pump
- Secondary peristaltic pump
- teflon® tubing
- Primary glass carboy
- Secondary glass sample carboy
- YSI Exo1 water parameter multi-meter capable of measuring pH, reduction/oxidation (redox) potential, temperature, specific conductance, turbidity, and dissolved oxygen
- Greyline Stingray 2.0 flow sensor or equivalent
- Teflon-lined polyethylene sample tubing (length is site dependent)
- Platinum cured silicone tubing
- Plastic zip-ties
- Water Sampling Log forms
- Sample tags/labels and appropriate documentation (e.g., chain-of-custody forms)
- Insulated cooler(s), chain-of-custody seals, Ziploc® bags
- Sample containers (PUF cartridges, vortex separator vials)
- Coolers
- Wet ice
- Nitrile gloves
- First aid kit
- Eye wash kit
- Duct tape
- Clear tape
- Packing tape dispenser
- Tool box
- Coated weights for water samplers
- Non-metallic wire for winch spool
- 2000 watt power generator or inverter
- Paper towels
- Dilute solution of Liquinox
- Deionized water
- Extension cord
- Power strip
- Resealable plastic bags (i.e., 1 gallon and 1 quart)
- Methanol
- Hexane
- 0.45 micron flat filters

**SOP A-6, SIB Project Area, PHSS  
(Source: In-Line Sediment Trap)**

## 1. PURPOSE AND SCOPE

The following text describes the techniques that will be employed to collect in-line sediments at locations identified in the Pre-Design Investigation (PDI) Work Plan.

## 2. EQUIPMENT

To assess incoming contaminant loads and movement of settleable suspended solids, in-line sediment traps will be deployed and sampled. In-line sediment traps will be installed and retrieved in select locations as described in the PDI Work Plan.

In-line sediment traps addressed by this SOP include the deployment of four 1-Liter HDPE sample bottles held in place with a custom stainless-steel bracket. At each designated sampling location, in-line sediment traps will be installed at the bottom of the conveyance system. In-line sediment traps will be firmly secured to the conveyance system to prevent unintended transport of the equipment. All in-line sediment traps and related equipment will be decontaminated prior to installation.

The HGL Confined Space Entry SOP will be followed by certified contractors entering manholes.

## 3. DEPLOYMENT OF SEDIMENT TRAPS

As identified in the PDI Work Plan, in-line sediment trap structures will be installed (Figure 1). Field crews **with confined space entry training** will perform a confined space entry in accordance with HGL Confined Space Entry SOP to install the sediment traps in the flow. A confined space entry will also be required to collect the sediment samples. Each of the 1-liter HDPE sample bottles with removeable Teflon®-lined lids will be held to the bottom of the pipe using custom stainless-steel hardware and brackets (Figure 2).

Sediment traps will be deployed at each location and the sample bottles will be retrieved at the intervals described in the PDI WP. When sample bottles are collected and archived, a clean bottle will be installed in the trap. Sediment samples will be capped, labeled, sealed, and submitted to the laboratory in accordance with the appropriate project planning documents. In general, procedures detailed in this SOP are adopted from the approved Portland Harbor RI/FS Stormwater Field Sampling Plan (LWG 2007; Appendix C).

Figure 1. Schematic of deployed Boston sediment trap.

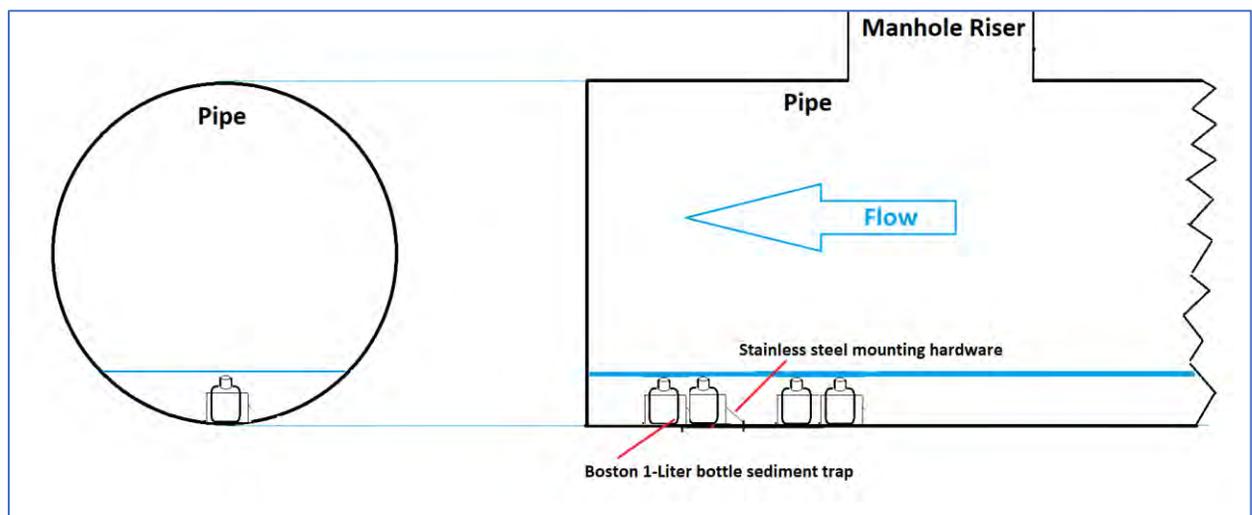


Figure 2. Installation photograph of example deployed sediment traps.



#### 4. INSTALLATION METHODS

Experienced field personnel will install the in-line sediment traps using stainless steel hardware and using inert materials. A confined space entry will be required to install the in-line sediment traps. Where traffic controls are required, a traffic control permit will be obtained from the City of Portland. An encroachment permit from the City may also be required to install the in-line sediment traps.

When installing the brackets in the field at the sampling sites, field crews will clean the area around the stainless-steel anchor bolts to remove any concrete dust or debris. After the bolts are set or other procedures are complete, the work site will be scrubbed with a brush to remove any debris and rinsed with deionized water before the sampling hardware (sample bottle holder) is mounted. Care will be taken to capture the rinse water from the work area.

#### 5. LIST OF EQUIPMENT NEEDED FOR IN-LINE SEDIMENT TRAP SAMPLING

The following equipment and supplies will be used for sediment sample collection:

- Photoionization detectors (PIDs)
- Confined space entry and personnel retrieval equipment
- Laboratory-supplied 1-Liter sample bottles
- Decontamination kit (buckets, brushes, Alconox, and tap and deionized water)
- Camera
- Sharpies/pens
- Labels
- Chain-of-Custody forms
- Ice and cooler
- Paper towels
- Personal protective equipment (PPE), including hard hat, boots, safety glasses, high-visibility vest, nitrile gloves, and ear plugs for drilling activities
- Confined space entry PPE.

## 6. SEDIMENT RETRIEVAL METHODS

In accordance with the PDI WP, the sediment traps will be collected and archived in the analytical laboratory and a clean bottle will be installed to the trap bracket. The methods for retrieving the accumulated sediment are presented below. A confined space entry will be performed to retrieve sediment samples according to these instructions:

- Using safe lifting techniques, traffic controls (if needed), and implementing all health and safety protocols, open the manhole cover.
- Perform the confined space entry into the manhole and prepare to retrieve the sediment trap bottles.
- Implement **“clean hands – dirty hands” method** (EPA 1996; Attachment B) for collecting samples.
- Use phthalate-free vinyl gloves to place the Teflon lids on the sample bottles.
- Remove the sample bottle from the bracket and transfer each bottle to the surface.
- Label the bottle, pack on ice, and prepare for transport to the analytical laboratory.
- Place new laboratory-provided 1-Liter sample bottles back into the brackets, remove the lids, and store the lids in a phthalate-free bag.
- Exit the confined space and replace the manhole cover.

## 7. DECONTAMINATION PROCEDURES

Decontamination of sampling equipment must be conducted consistently to ensure the quality of samples collected. Disposable equipment intended for one-time use will not be decontaminated but will be packaged for appropriate disposal.

Decontamination will occur prior to each use of a piece of equipment. All sampling devices that potentially contact sampling media (grab pole, stainless beaker, cups, etc.) will be decontaminated according to EPA Region 10 recommended procedures. The following, to be carried out in sequence, is an EPA Region 10 recommended procedure for the decontamination of sampling equipment:

- Non-phosphate detergent and tap water wash, using a brush if necessary
- Tap water rinse
- Deionized/distilled water rinse (first rinse)
- Deionized/distilled water rinse (second rinse)

Equipment will be decontaminated in a predesignated area, and clean bulky equipment items will be stored in their cases or on visqueen in uncontaminated areas. Cleaned small equipment items will be stored in their cases or in plastic bags. Materials to be stored more than a few hours will also be covered.

## 8. FIELD FORMS

During each site visit to retrieve accumulated sediment, the field crews will complete a field form which will record the following information:

- Name of staff conducting downloading
- Location
- Date/time of sampling
- Approximate volume of sediment sampled
- Condition of the sediment traps
- General comments/observations

**SOP A-7, SIB Project Area, PHSS**  
**(Source: Horizontal and Vertical Control)**

# STANDARD OPERATING PROCEDURE

## HORIZONTAL AND VERTICAL SURVEY

### CONTROL

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#### **Introduction**

This Standard Operating Procedure (SOP) has been developed for the Pre-Remedial Design Sampling and Baseline Investigations (PDI) at the Portland Harbor Superfund Site located in Portland, Oregon to confirm accurate positioning of vessels and samples during sample collection activities. The survey control requirements described in this SOP are specifically for environmental sample collection and will generally comply with map-grade precision and accuracy in contrast to the geodetic-grade precision and accuracy performed for the Bathymetric Survey conducted by David Evans and Associates (DEA). However, the same survey control points and geodetic parameters will be used in both surveys for consistency, and a portion of the quality assurance/quality control (QA/QC) process will involve consultation with DEA Oregon Professional Land Surveyor (PLS) staff to review the map-grade data collected for the environmental sample collection.

The organization of this SOP is as follows:

- Methodology Overview
- Project Geodetic Parameters
- Survey Accuracy, Precision, and Control
- Primary Equipment
- Hand-Held GPS Operation
- Vessel Navigation and Equipment Operation
- Data Processing and QA/QC Procedures

Tables, figures, and attachments are presented at the end of the SOP.

#### **Methodology Overview**

##### ***Horizontal (Map) Data Collection***

A combination of vessel-mounted and hand-held GPS receivers will be used to navigate to sampling locations and to collect map location coordinates (Northings, Eastings) for those sampling locations. The vessel-mounted GPS receivers will be the primary tool used for navigation to the pre-planned sampling locations in a GIS file, which will be pre-loaded into the vessel navigational system. The hand-held GPS devices will be used as a backup and confirmation of vessel position only if there are problems with the vessel GPS navigation system or if there is no specific vessel navigation system (i.e., smaller boats). Since the inception of field work, the vessel GPS coordinates have been consistently verified and deemed to be sufficient to meet position and accuracy requirements for the project. The hand-held GPS devices will primarily be used for studies involving small vessels. These devices will also have the pre-loaded basemap content depicting planned sampling locations.

The vessel GPS will operate in two modes, collecting both a separate continuous data stream of positional information (line file) and recording GPS soundings (target file) when a sample is specifically

collected. The sample location target file will be recorded when the sampling device is in position for the grab (e.g., when sampler is on the river bottom). The specific Location ID associated with the sample will also be recorded in the GPS device log. Field personnel will be required to write that same Location ID on their field data collection forms at the same time. Both the continuous and episodic dataset will be timestamped to allow comparison of the two types of data. This data will be recorded and maintained on the vessel, and will also be exported from the vessel navigation system and archived to project servers on a daily basis.

The hand-held GPS devices will be operated independently of the vessel's systems and will be used to record a location sounding wherever a sample is collected only for studies unable to use the vessel GPS navigation system. The sample location sounding will be recorded approximately at the same time as when the vessel GPS measurement is collected (e.g., when sampler is in position). The specific Location ID associated with the sample will also be recorded on the GPS device. Field personnel will write this Location ID on the field forms only if the vessel measurement described earlier cannot be collected for some reason (e.g., equipment failure). These measurements will also be timestamped. The data from the hand-held GPS devices will be wirelessly synchronized to a "cloud" web service in near real-time; the data from the "cloud" will also be downloaded and saved to project servers daily.

### ***Vertical Data Collection***

Vertical (elevation) data is also required for water levels, sample collection depth below surface water, and bottom (mudline) depth location for some types of sample locations. For increased precision and accuracy, it is proposed that bottom (mudline) depth locations (e.g., for sediment cores) be calculated from the bathymetric surface to be developed by the hydrographic survey performed by DEA (since the data will be collected within a few months of each other). The NAVD88 elevation will be calculated from the intersection of the surface map location coordinates collected as described earlier, projected vertically down to the bathymetric surface (United States Army Corps of Engineers [USACE], 2004). The elevation from the intersection of the bathymetric surface will be used as the final or "best" elevation for the sample.

In contrast, for depth measurements that require less precision (e.g., water levels, depth to samples below water surface), the onboard vessel sonar will be used to record depth and then subsequently calculate elevation. All depths will be recorded relative to the water surface and time tagged to correct with time tagged gauge data for obtaining riverbed elevations. The elevation will be calculated to NAVD88 datum. To correct elevations, gauge data from the Northwest River Forecast Center will be downloaded for gauge PRT03, which is representative of the former Morrison gauge which has been moved. This gauge does not report NAVD88 elevations but rather reports a value that is 0.3 feet above Columbia River Datum (CRD). Corrections from CRD to NAVD88 differ moving down the river from the gauge due to the fact that NAVD88 is a reference normal to gravity (water does not flow if the elevation is unchanging), and CRD is a gradient datum that follows the lower water surface. In Portland Harbor, the difference between CRD and NAVD88 (Geoid12b) ranges from 0.00 feet CRD = -5.16 feet NAVD88 (Geoid12b) at Willamette River river mile (RM) 2.0, to 0.00 feet CRD = -5.41 feet NAVD88 (Geoid12b) at Willamette River RM 12.8 (approximate location of PRT03 Gauge). Accordingly, a correction to the Willamette Gauge in Portland would be  $-5.41+0.3$  or  $-5.11$  feet at RM 12.8. An approximation would be to subtract 5 feet from the gauge reading for the full length of the

study area, but precision will vary depending on tides and river gradient.

For sample locations requiring vertical information, depth will be recorded by field staff on their data collection forms relative to the water surface, and these values will be loaded to the project database as described in the Data Quality Management Plan (DQMP). Final calculated NAVD88 elevation data (feet) will also be entered into a separate data field in the project database after completion of spatial analysis, calculations, and QA/QC. DEA will provide support during the QA/QC process to verify proper calculation of NAVD88 elevation data.

### ***Location Position Recording in Project Database***

#### Discrete Samples

When discrete samples are collected, the Location ID and the location coordinates (Northing/Easting) will be recorded on the GPS device(s) and the field data collection form(s). The location coordinates will be based on the vessel GPS instantaneous target measurement. This target measurement will be the location coordinate pair loaded initially to the project database. After the field event is completed, the target measurement will be compared to the line file (vessel continuous GPS measurement) to confirm that the coordinate pair loaded to the project database is appropriate. If analysis reveals precision or accuracy issues, the loaded location coordinate pair in the project database may be updated and edited with a better value derived from the line file. In general, the hand-held GPS devices will be used as a backup and confirmation of vessel position only if there are problems with the vessel GPS navigation system or an independent navigation system is not available on the vessel. These coordinates will be loaded to the project database only if there is a significant problem with the vessel GPS (e.g., equipment failure) or if there is no vessel GPS.

#### Composite Samples

When composite samples are collected, location coordinates will also be recorded as both target measurements and continuous measurements using the vessel GPS. The continuous GPS measurements will be recorded during the entire compositing event, and instantaneous target measurements will be collected when the sampler is in position for each individual composite grab. At each compositing location, a target measurement will be recorded in the vessel GPS along with the Location ID with an “a,” “b,” or “c” suffix. These measurements will be recorded on the field forms in the same manner (e.g., there will be three sets of location coordinates, lithologic descriptions, etc.).

When the location data is loaded to the project database, a single set of location coordinates will be recorded in the project database with a Location ID that excludes the “a,” “b,” or “c” suffix. As a presumed middle time point, the “b” set of coordinates will be loaded with the primary Location ID to the project database. After the field event is completed, the target measurement associated with the “b” location composite will be compared to the line file (vessel continuous GPS measurement) to assess vessel position and the timeframe of the entire sampling event to confirm if the coordinate pair loaded to the project database is appropriate. The goal will be to finalize the location coordinate information in the project database based on the most representative position based on this analysis. Similar to discrete sample collection, a hand-held GPS device and related data will only be loaded to the project database if there is a significant problem with operation of the vessel GPS or if the vessel does not have a GPS.

Finally, after field data are collected and surveys are completed, as defined in the DQMP, the location coordinate data will be joined with the tabular data collected by the field teams and loaded to the project database.

## **Project Geodetic Parameters**

The geodetic parameters to be used for the PDI field studies will be as follows:

***Horizontal Datum:*** North American Datum of 1983 (2011)

***Projection:*** State Plane Coordinate System (SPCS) Oregon North Zone

***Vertical Datum:*** North American Vertical Datum of 1988 (NAVD88) Geoid12b

***Units:*** International Feet

## **Survey Accuracy, Precision, and Control**

The anticipated horizontal accuracy of environmental sampling associated with vessel and hand-held GPS devices is a range of 1 to 5 meters (target 1 to 2 meters for the DGPS unit itself). This should be consistent with RI target accuracy (Integral 2002) and best practices (Puget Sound Estuary Protocols [PSEP] 1998 and US Environmental Protection Agency [EPA] 2008).

The anticipated vertical accuracy of final elevation calculations derived from vessel sonar systems is anticipated to be 1.0 meter.

Table 1 summarizes the survey control locations used in the DEA Bathymetric Survey, which will be used for the environment sample collection work described in this SOP. Figure 1 shows the PH2 piling at Fred Devine boat dock, and Figure 2 shows the approximate locations of the survey control references. Attachment 1 contains detailed survey sheets of the control points: Raindeer, PH1 and PH2, and 2100.

## **Primary Equipment**

- Trimble® SPS 461 GPS with dual antennas (vessel GPS)
- A-frame assembly, sampling winch (vessel boom)
- Trimble® R1 (hand held GPS), tethered to Bluetooth® capable smartphone or tablet, ESRI Collector software with Trimble® GNSS Status middleware
- GPS owner's manual
- Writing tools (pencils, Sharpie®)
- Field logbook
- Spare batteries and/or battery charger
- Compass
- Tape measure

## **Hand-Held GPS Operations**

For ease of use, the project team will utilize smartphones tethered to the Trimble® R1 GNSS Receiver via a Bluetooth® connection. The smartphone will be configured with Trimble's middleware software called GNSS Status to convert and stream NMEA satellite data to the smartphone for real-time

correction and display to a simple electronic data collection form developed on the ESRI Collector platform. The form will contain a limited number of data fields, including location, study name and operator, date, and notes or comments. This form is not intended to duplicate the content and scope of the field data collection forms, but rather clearly link the GPS data to those forms via the unique Location ID. There are metadata fields available as well from these GPS records, such as estimated horizontal accuracy.

Collected data recorded onto the phone will be transmitted wirelessly via a synchronization process invoked when data is “saved” to the device. The data will be pushed to AECOM Online’s Portal and ArcGIS Server for storage of “corrected” location coordinates, Location ID, and other information captured when the GPS sounding is recorded. The sampling event will be trackable in near-real-time as samples are collected on the ArcGIS Portal Interface. Either dedicated, experienced GPS-operators will be collecting the measurements on the smartphones, or, due to the very simple nature of the interface, field personnel will be trained to use the devices. Initial training sessions were already successfully conducted March 19-20, 2018 on use of the smartphone GPS interface. These handheld devices were successfully used for the first 2 weeks of field work. For some studies, such as the smallmouth bass tracking study, these handhelds may be used as the primary GPS due to smaller vessel configuration.

### **Vessel Navigation and Equipment Operation**

Vessel positioning will be conducted through the marine navigation and hydrographic software package HYPACK. This software package allows the visualization of the vessel over navigable charts, the processing of satellite corrections, stored hardware, and vessel parameters, as well as the storing of physical target locations during sampling activities. HYPACK version 2017 will be used for this project.

Vessel position is measured using a Trimble SPS 461 GPS dual antenna receiver. The dual antennas provide precise vessel positioning via both satellite and differential radio corrections along with heading correction to 0.09 degree. GPS data is output through a serial connection into computer running the HYPACK software, for vessel positioning and target collection.

At each sampling location, depth to mudline will be measured using an onboard fathometer (with lead line as confirmation as needed) immediately prior to or during the sampling. Water depths are measured at each station using an Airmar ss510 survey sonar at the sampling point and confirmed daily with a lead line with reference to water surface. Vertical measurements will be recorded to the nearest 0.1 foot. Water depths will be converted to elevations in NAVD88 based on the river stage at the time of sampling as recorded at the closest available tide gage.

### **Data Processing and QA/QC Procedures**

All GPS devices will be subject to a position check to confirm the accuracy of the on-vessel GPS and hand-held GPS devices and to validate the positions derived from each GPS receiver. Correctors being applied as needed, resulting in a position that is within specified positioning accuracy of the DEA published position for control monument PH1 and PH2. At the start and end of each field day, the PH2 benchmark location will be visited by boat to perform a position check. At the piling serving as the control monument, the on-vessel GPS calibrated to the top of A-frame assembly will be maneuvered as close to the benchmark piling as possible to record a point. The GPS-derived position

of the sampling vessel is compared with the known horizontal location; results will be recorded in HYPACK to confirm that accuracy is within +/- 2 meters. For handheld GPS, field staff will occupy the PH1 at the Swan Island boat launch parking lot. Using the R1 and phone/tablet combination GPS setup, the field staff will hold the R1 above PH1 and wait for a satellite “fix,” and when ready, the staff will record the GPS location in Collector. This GPS location will be compared to the known coordinates to confirm the accuracy is within +/- 2 meters. The survey control monuments act as a known location to allow for corrected station location coordinates during post-processing of data as needed. If a need arises to locate another benchmark, there are several USGS control points near the project area and near the AECOM project warehouse. Experienced GPS operators on the project team will be involved in all aspects of field data collection events to troubleshoot devices and assist in daily review of extracted geospatial datasets. Additional details on QA/QC procedures can be found on the DQMP.

## **References**

- AECOM (AECOM Technical Services) and Geosyntec (Geosyntec Consultants, Inc.). 2018. Data Quality Management Plan Portland Harbor Pre-Remedial Design Investigation and Baseline Sampling. Portland Harbor Superfund Site. 22 February.
- Integral (Integral Consulting). 2002. Round 1 Field Sampling Plan. Prepared for the Lower Willamette Group (LWG) for submittal and approval by EPA Region 10. June 14.
- EPA (United States Environmental Protection Agency). 2008. National Geospatial Data Policy. August 24.
- PSEP. 1998. Recommended Guidelines for Station Positioning in Puget Sound. Prepared for United States EPA Region 10 and the Puget Sound Water Quality Action Team. September.
- USACE (United States Army Corps of Engineers). 2004. Engineering and Design Hydrographic Surveying Manual, EM 1110-2-1003, U.S. Army Corps of Engineers, April 2004

## **Attachments**

PH Control Points of 2100, Portland Harbor (PH1 and PH2), and Raindeer survey monuments, as well as figures presenting PH2.

**Table 1. Benchmark Monument Coordinates and Description**

Designation	Approx. Location	Description	NAD83 (2011), Oregon SPCS North (ft)		NAVD88 Elevation (ft)
			Northing	Easting	
DEMSI-BASE	Columbia River	Fixed antenna with height at antenna reference point	718172.70	7654431.05	73.58
DEMSI- CHECK	Columbia River	Fixed antenna with height at antenna reference point	718170.73	7654419.84	71.67
RAINDEER	RM 2	USACE Brass Cap	722443.24	7614886.64	35.44
Portland Harbor (PH1)	Swan Island Boat Ramp	1/2" Iron Rod with red plastic cap stamped "DEA Control" Point is 0.3 feet south of the back of curb at the Swan Island Boat Ramp, 10.5 feet north of a cyclone fence, and 60 feet east of a light post	698702.46	7637426.37	33.38
Portland Harbor 2 (PH2)	Fred Devine Boat Dock	Reference point is 0.2 feet SE of the SE side of a 1-1/2 foot steel pile. This is the furthest SE pile at the end of the Fred Devine Diving and Salvage Company dock in the Swan Island Lagoon. This pile is to be used for daily position checks for sediment sampling operations. Pile is for position only and not elevation.	700967.87	7634507.67	NA
2100	RM 13	5/8" bolt on SW corner of screen wall at DEA office 2100 SW River Parkway, Portland, OR	678400.01	7645190.81	159.51

General Notes:

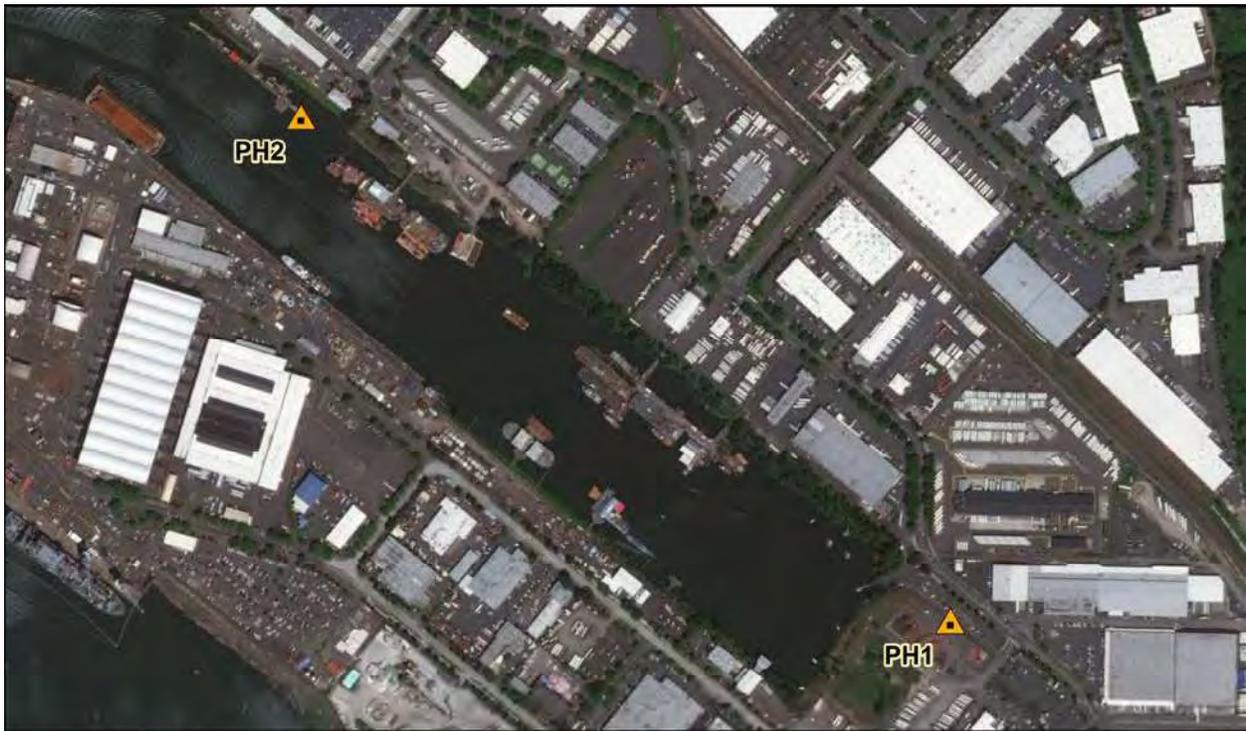
1. The two DEMSI and the 2100 stations are transceiver beacon stations in upland areas (Green Shade).
2. PH1 is located at the Swan Island boat ramp parking lot and accessible by foot.
3. PH2 is located at a piling at the boat dock where project-related vessels will be docked and is accessible by boat.
4. Raindeer station is located adjacent to the river and accessible by foot (for the hand-held GPS).

Acronyms:

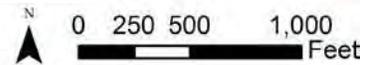
DEA = David Evans and Associates; ft = feet; NAD83 = North American Datum of 1983; NAVD88 = North American Vertical Datum of 1988; PH = Portland Harbor; RM = river mile; USACE = US Army Corps of Engineers; SPCS = State Plane Coordinate System



**Figure 1. Photograph of Piling PH2, at the end of the Fred Devine Boat Dock. Piling was captured in DEA bathymetric survey. Photo is facing northwest.**



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



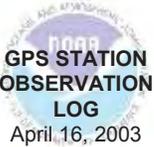
PH2 is located on the SE corner of the Fred Devine Boat Dock, where Gravity's boats berth every night.



PH1 is located on the SW side of the Swan Island Boat Launch parking lot, where field crews park to meet the boats at the launch dock.

**Figure 2. Locations of control monuments PH1 and PH2 at Swan Island Boat Launch and Fred Devine Boat Dock, respectively.**

NOTE: This form intended for field use. Unsolicited data submitted to NGS must be converted to bluebook format.

 <p>GPS STATION OBSERVATION LOG April 16, 2003</p>	Station Designation: (check applicable: __ FBN__ CBN__ PAC__ SAC__ BM) <b>2100</b>	Station PID, if any:	Date (UTC): <b>06-Mar-18</b>
	General Location: <b>DEA Office 2100 SW River Parkway, Portland</b>	Airport ID, if any:	Station 4-Character ID: <b>065</b>

Project Name: <b>Portland Harbor - AETR00000034</b>	Project Number: <b>GPS-</b>	Station Serial # (SSN):	Session ID:(A,B,C etc)
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NAD83 Latitude o ' "	NAD83 Longitude o ' "	NAD83 Ellipsoidal Height meters	Agency Full Name: <b>David Evans and Associates, Inc.</b> Operator Full Name: <b>David T. Moehl</b> Phone #: ( ) <b>(360) 314-3200</b> e-mail address: <b>dtm@deainc.com</b>
Observation Session Times (UTC): Sched. Start _____ Stop _____		NAVD88 Orthometric Ht. meters	
Actual Start <b>18:55</b> Stop <b>23:00</b>		GEOID99 Geoid Height meters	

Receiver Brand & Model: <b>Trimble SPS855</b> <b>69855-60</b> P/N: <b>5506R0075</b> S/N: Firmware Version: <b>5.30</b> <input type="checkbox"/> CamCorder Battery, <input type="checkbox"/> 12V DC, <input checked="" type="checkbox"/> 110V AC, <input type="checkbox"/> Other	Antenna Code*, Brand & Model: <b>Trimble Zephyr 3 Base</b> <b>115000-10</b> P/N: <b>3121179869</b> S/N: Cable Length, meters: <b>10</b> Vehicle is Parked <u>n/a</u> meters ____ (direction) from antenna.	Antenna plumb before session? <input checked="" type="checkbox"/> (Y/N) Circle Yes or No Antenna plumb after session? <input checked="" type="checkbox"/> (Y/N) -If no, explain Antenna oriented to true North? <input checked="" type="checkbox"/> (Y/N) Weather observed at antenna ht. <input checked="" type="checkbox"/> (Y/N) Antenna ground plane used? <input checked="" type="checkbox"/> (Y/N) "
---	--	--

Tripod or Antenna Mount: Check one: <input type="checkbox"/> Fixed-Leg Tripod, <input type="checkbox"/> Collapsible-leg tripod, <input checked="" type="checkbox"/> Fixed Mount Brand & Model: <b>Bolt</b> P/N: S/N: Last Adjustment date:  Psychrometer (if used) Brand & Model:  P/N: S/N: Last Calibration or check Date:	<b>** ANTENNA HEIGHT **</b>		<b>Before Session Begins:</b>		<b>After Session Ends:</b>	
			Meters	Feet	Meters	Feet
	<b>A= Datum point to Top of Tripod (Tripod Height)</b>		<b>0.000</b>		<b>0.000</b>	
	<b>B= Additional offset to ARP if any (Tribrach/Spacer)</b>		<b>0.000</b>		<b>0.000</b>	
	<b>H= Antenna Height = A + B</b> <b>= Datum Point to Antenna Reference Point (ARP)</b>		<b>0.000</b>	<b>0.00</b>	<b>0.000</b>	<b>0.00</b>

Meters = Feet x (0.3048)      Note &/or sketch **ANY** unusual conditions.  
 Height Entered Into Receiver = **0.000** meters. **Be Very Explicit** as to where and how Measured!

Barometer (if used) Brand & Model:  S/N:	Weather Data	Weather Codes	Time (UTC)	Dry-Bulb Temp		WetBulb Temp		Rel. % Humidity	Atm. Pressure		
				Fahrenheit	Celsius	Fahrenheit	Celsius		inches Hg	millibar	
	Before		00000	18:55							
	Middle										
After		00000	23:00								

Remarks, Comments on Problems, Sketches, Pencil Rubbing, etc:

**5/8" bolt found on the southeast corner of the VAC screen wall on DEA office roof at 2100 SW River Parkway, Portland, OR. The geodetic antenna was screwed tight to the top of the double nut on the 5/8" bolt. The antenna height = zero to the antenna reference point (bottom of antenna mount).**

Weather codes are required. Weather data are optional but encouraged. \*Antenna code comes from ant\_info file furnished by project coordinator.

Data File Name(s): <b>00750650.T02</b> (Standard NGS Format = aaaadddd.xxx) where aaaa=4-Character ID, ddd=Day of Year, s=Session ID, xxx=file dependant extension	Updated Station Description: <input type="checkbox"/> Attached <input type="checkbox"/> Submitted earlier Visibility Obstruction Form: <input type="checkbox"/> Attached <input type="checkbox"/> Submitted earlier Photographs of Station: <input checked="" type="checkbox"/> Attached <input type="checkbox"/> Submitted earlier Pencil Rubbing of Mark: <input type="checkbox"/> Attached	LOG CHECKED BY: <b>Jon Dasler</b>
--	--	--------------------------------------

Table of Weather Codes	CODE	PROBLEM	VISIBILITY	TEMPERATURE	CLOUD COVER	WIND
	0	did not occur	Good, over 15 miles	Normal, 32° F- 80° F	Clear, below 20%	Calm, under 5mph (8km/h)
	1	did occur	Fair, 7-15 miles	Hot, over 80°F (27 C)	Cloudy, 20% to 70%	Moderate, 5 to 15 mph
	2	- not used -	Poor, under 7 miles	Cold, below 32° F (0 C)	Overcast, over 70%	Strong, over 15 mph (24km/h)
Examples:	00000 = No problem, good visibility, normal temp, clear, calm wind		12121 = Problems, poor visibility, hot, overcast, moderate wind			

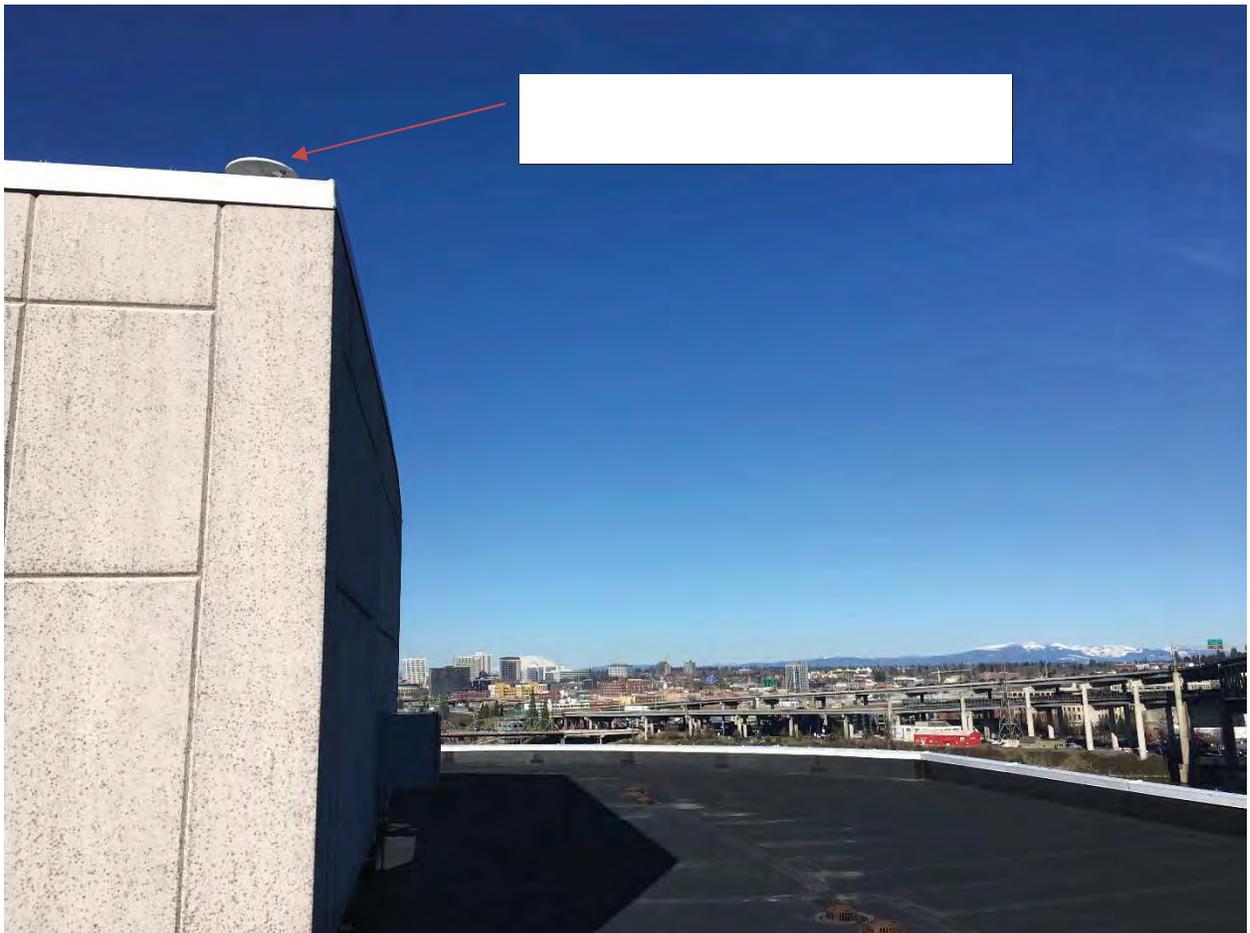
**Photo of Monument 2100**



**Photo of Monument 2100**



**GNSS Setup on 2100**



NOTE: This form intended for field use. Unsolicited data submitted to NGS must be converted to bluebook format.

 April 16, 2003	Station Designation: (check applicable: __ FBN__ CBN__ PAC__ SAC__ BM) <b>Portland Harbor 1 (PH1)</b>	Station PID, if any:	Date (UTC): <b>06-Mar-18</b>
	General Location: <b>Swan Island Boat Launch</b>	Airport ID, if any:	Station 4-Character ID: <b>065</b>

Project Name: <b>Portland Harbor - AETR00000034</b>	Project Number: <b>GPS-</b>	Station Serial # (SSN):	Session ID:(A,B,C etc)
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NAD83 Latitude o ' "	NAD83 Longitude o ' "	NAD83 Ellipsoidal Height meters	Agency Full Name: <b>David Evans and Associate, Inc.</b> Operator Full Name: <b>David T. Moehl</b> Phone #: ( ) <b>(360) 314-3200</b> e-mail address: <b>dtm@deainc.com</b>
Observation Session Times (UTC): Sched. Start _____ Stop _____		NAVD88 Orthometric Ht. meters	
Actual Start <b>19:30</b> Stop <b>21:32</b>		GEOID99 Geoid Height meters	

Receiver Brand & Model: <b>Trimble SPS985</b> <b>82500-60</b> P/N: <b>5616F59510</b> S/N: Firmware Version: <b>5.30</b> <input type="checkbox"/> CamCorder Battery, <input type="checkbox"/> 12V DC, <input type="checkbox"/> 110V AC, <input checked="" type="checkbox"/> Other	Antenna Code*, Brand & Model: <b>Trimble SPS985 Internal</b> P/N: S/N: Cable Length, meters: <b>n/a</b> Vehicle is Parked <b>10</b> meters <b>N</b> (direction) from antenna.	Antenna plumb before session? <input checked="" type="checkbox"/> (Y/N) Circle Yes or No Antenna plumb after session? <input checked="" type="checkbox"/> (Y/N) -If no, explain Antenna oriented to true North? <input checked="" type="checkbox"/> (Y/N) Weather observed at antenna ht. <input checked="" type="checkbox"/> (Y/N) Antenna ground plane used? <input checked="" type="checkbox"/> (Y/N)
		Antenna radome used? <input checked="" type="checkbox"/> (Y/N) If yes, describe. Eccentric occupation (>0.5 mm)? <input checked="" type="checkbox"/> (Y/N) Use Any obstructions above 10'? <input checked="" type="checkbox"/> (Y/N) Vis. form Radio interference source nearby <input checked="" type="checkbox"/> (Y/N)

Tripod or Antenna Mount: Check one: <input checked="" type="checkbox"/> Fixed-Leg Tripod, <input type="checkbox"/> Collapsible-leg tripod <input type="checkbox"/> Fixed Mount Brand & Model: <b>Seco fixed height</b> P/N: <b>5115-00-FLY</b> S/N: <b>2018-03-05</b> Last Adjustment date: <b>2018-03-05</b> Psychrometer (if used) Brand & Model: P/N: S/N: Last Calibration or check Date:	<b>** ANTENNA HEIGHT **</b>		<b>Before Session Begins:</b>		<b>After Session Ends:</b>	
			Meters	Feet	Meters	Feet
	<b>A= Datum point to Top of Tripod (Tripod Height)</b>		<b>2.000</b>		<b>2.000</b>	
	<b>B= Additional offset to ARP if any (Tribrach/Spacer)</b>		<b>0.000</b>		<b>0.000</b>	
	<b>H= Antenna Height = A + B</b> <b>= Datum Point to Antenna Reference Point (ARP)</b>		<b>2.000</b>	<b>6.56</b>	<b>2.000</b>	<b>6.56</b>

Meters = Feet x (0.3048)      Note &/or sketch **ANY** unusual conditions.  
 Height Entered Into Receiver = **2.000** meters. **Be Very Explicit as to where and how Measured!**

Barometer (if used) Brand & Model:  S/N:	Weather Data	Weather Codes	Time (UTC)	Dry-Bulb Temp		WetBulb Temp		Rel. % Humidity	Atm. Pressure		
				Fahrenheit	Celsius	Fahrenheit	Celsius		inches Hg	millibar	
	Before	00000	19:30								
	Middle										
After	00000	21:32									

Remarks, Comments on Problems, Sketches, Pencil Rubbing, etc:

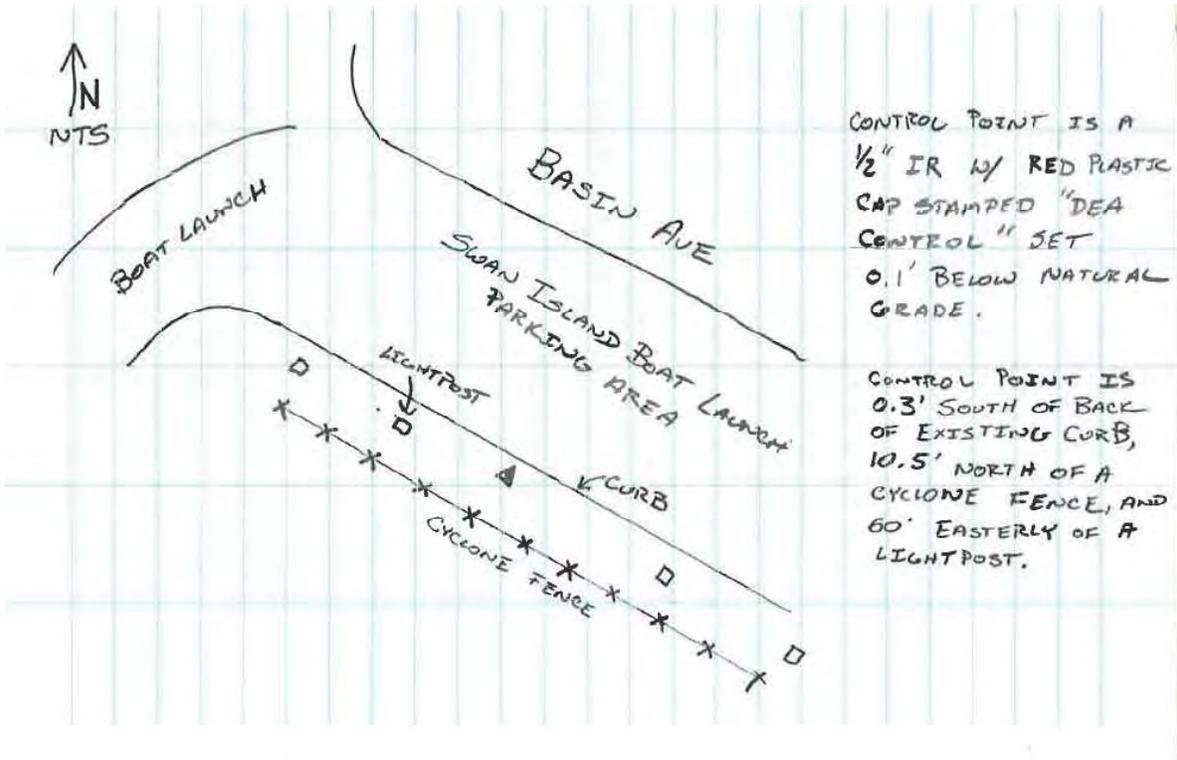
**Control point is a 1/2" iron rod with red plastic cap stamped "DEA CONTROL" set 0.1' below natural grade. Control point is 0.3' south of the back of curb, 10.5' north of a cyclone fence and 60' easterly of the 2nd light post east of the boat ramp. See detached sketch and photos.**

Weather codes are required. Weather data are optional but encouraged. \*Antenna code comes from ant\_info file furnished by project coordinator.

<b>Data File Name(s):</b> <b>95100650.T02</b> (Standard NGS Format = aaaaaddds.xxx) where aaaa=4-Character ID, ddd=Day of Year, s=Session ID, xxx=file dependant extension	Updated Station Description: <input type="checkbox"/> Attached <input type="checkbox"/> Submitted earlier Visibility Obstruction Form: <input type="checkbox"/> Attached <input type="checkbox"/> Submitted earlier Photographs of Station: <input checked="" type="checkbox"/> Attached <input type="checkbox"/> Submitted earlier Pencil Rubbing of Mark: <input type="checkbox"/> Attached	<b>LOG CHECKED BY:</b> <b>Jon Dasler</b>
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Table of Weather Codes	CODE	PROBLEM	VISIBILITY	TEMPERATURE	CLOUD COVER	WIND
	0	did not occur	Good, over 15 miles	Normal, 32° F- 80° F	Clear, below 20%	Calm, under 5mph (8km/h)
	1	did occur	Fair, 7-15 miles	Hot, over 80°F (27 C)	Cloudy, 20% to 70%	Moderate, 5 to 15 mph
	2	- not used -	Poor, under 7 miles	Cold, below 32° F (0 C)	Overcast, over 70%	Strong, over 15 mph (24km/h)
Examples:	00000 = No problem, good visibility, normal temp, clear, calm wind		12121 = Problems, poor visibility, hot, overcast, moderate wind			

# Sketch of Monument PH1



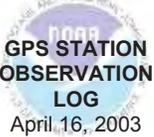
**Photo of Monument PH1**



**GNSS Setup on PH1**



NOTE: This form intended for field use. Unsolicited data submitted to NGS must be converted to bluebook format.

 <p>GPS STATION OBSERVATION LOG April 16, 2003</p>	Station Designation: (check applicable: __ FBN__ CBN__ PAC__ SAC__ BM) <b>Portland Harbor 2 (PH2)</b>	Station PID, if any:	Date (UTC): <b>20-Apr-18</b>
	General Location: <b>Fred Devine Boat Dock</b>	Airport ID, if any:	Station 4-Character ID: <b>111</b>
Project Name: <b>Portland Harbor - AETR00000034</b>		Project Number: <b>GPS-</b>	Station Serial # (SSN): Session ID:(A,B,C etc)

NAD83 Latitude o ' "	NAD83 Longitude o ' "	NAD83 Ellipsoidal Height meters	Agency Full Name: <b>David Evans and Associate, Inc.</b> Operator Full Name: <b>David T. Moehl</b> Phone #: ( ) <b>(360) 314-3200</b> e-mail address: <b>dtm@deainc.com</b>
Observation Session Times (UTC): Sched. Start _____ Stop _____		NAVD88 Orthometric Ht. meters	
Actual Start <b>19:45</b> Stop <b>19:49</b>		GEOID99 Geoid Height meters	
Epoch Interval = <b>1</b> Seconds Elevation Mask = <b>10</b> Degrees			

Receiver Brand & Model: <b>Trimble SPS985</b> <b>82500-60</b> P/N: <b>5616F59510</b> S/N: <b>5.30</b> Firmware Version: <input type="checkbox"/> CamCorder Battery, <input type="checkbox"/> 12V DC, <input type="checkbox"/> 110V AC, <input checked="" type="checkbox"/> Other	Antenna Code*, Brand & Model: <b>Trimble SPS985 Internal</b> P/N: S/N: Cable Length, meters: <b>n/a</b> Vehicle is Parked <input checked="" type="checkbox"/> meters _____ (direction) from antenna.	Antenna plumb before session? (Y/N) <input checked="" type="checkbox"/> Circle Antenna plumb after session? (Y/N) <input checked="" type="checkbox"/> Yes or No Antenna oriented to true North? (Y/N) <input checked="" type="checkbox"/> -If no, Weather observed at antenna ht. (Y/N) <input checked="" type="checkbox"/> explain Antenna ground plane used? (Y/N) <input checked="" type="checkbox"/> " Antenna radome used? (Y/N) <input checked="" type="checkbox"/> If yes, Eccentric occupation (>0.5 mm)? (Y/N) <input checked="" type="checkbox"/> describe. Any obstructions above 10'? (Y/N) <input checked="" type="checkbox"/> Use Radio interference source nearby (Y/N) <input checked="" type="checkbox"/> Vis. form
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Tripod or Antenna Mount: Check one: <input checked="" type="checkbox"/> Fixed-Leg Tripod, <input type="checkbox"/> Collapsible-leg tripod, <input type="checkbox"/> Fixed Mount Brand & Model: <b>Seco fixed height</b> P/N: S/N: <b>5115-00-FLY</b> Last Adjustment date: <b>2018-03-05</b> Psychrometer (if used) Brand & Model: P/N: S/N: Last Calibration or check Date:	<b>** ANTENNA HEIGHT **</b>		<b>Before Session Begins:</b>		<b>After Session Ends:</b>	
			Meters	Feet	Meters	Feet
	<b>A= Datum point to Top of Tripod (Tripod Height)</b>		<b>2.000</b>		<b>2.000</b>	
	<b>B= Additional offset to ARP if any (Tribrach/Spacer)</b>		<b>0.000</b>		<b>0.000</b>	
	<b>H= Antenna Height = A + B</b> <b>= Datum Point to Antenna Reference Point (ARP)</b>		<b>2.000</b>	<b>6.56</b>	<b>2.000</b>	<b>6.56</b>
Meters = Feet x (0.3048)      Note &/or sketch <b>ANY</b> unusual conditions. Height Entered Into Receiver = <b>2.000</b> meters. <b>Be Very Explicit as to where and how Measured!</b>						

Barometer (if used) Brand & Model: S/N:	Weather Data	Weather Codes	Time (UTC)	Dry-Bulb Temp		WetBulb Temp		Rel. % Humidity	Atm. Pressure	
				Fahrenheit	Celsius	Fahrenheit	Celsius		inches Hg	millibar
	Before	00010	19:45							
	Middle									
	After	00010	19:49							

Remarks, Comments on Problems, Sketches, Pencil Rubbing, etc:

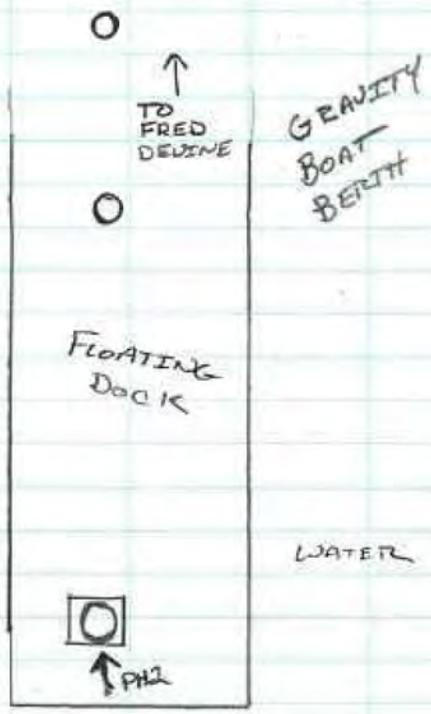
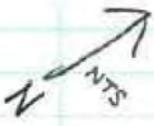
Reference point is 0.2 feet SE of the SE side of a 1-1/2 foot steel pile. This is the furthest SE pile at the end of the Fred Devine Diving and Salvage Company dock in the Swan Island Lagoon. This pile is to be used for daily position checks for sediment sampling operations. Pile is for position only and not elevation. NAD83(2011) Oregon North Zone International Feet Coordinates North 700967.9 East 7634507.7

Weather codes are required. Weather data are optional but encouraged. \*Antenna code comes from ant\_info file furnished by project coordinator.

<b>Data File Name(s):</b> (Standard NGS Format = aaaadddd.xxx) where aaaa=4-Character ID, ddd=Day of Year, s=Session ID, xxx=file dependant extension	Updated Station Description: <input type="checkbox"/> Attached <input type="checkbox"/> Submitted earlier Visibility Obstruction Form: <input type="checkbox"/> Attached <input type="checkbox"/> Submitted earlier Photographs of Station: <input checked="" type="checkbox"/> Attached <input type="checkbox"/> Submitted earlier Pencil Rubbing of Mark: <input type="checkbox"/> Attached	LOG CHECKED BY: <b>Jon Dasler</b>
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Table of Weather Codes	CODE	PROBLEM	VISIBILITY	TEMPERATURE	CLOUD COVER	WIND
	0	did not occur	Good, over 15 miles	Normal, 32° F- 80° F	Clear, below 20%	Calm, under 5mph (8km/h)
	1	did occur	Fair, 7-15 miles	Hot, over 80°F (27 C)	Cloudy, 20% to 70%	Moderate, 5 to 15 mph
	2	- not used -	Poor, under 7 miles	Cold, below 32° F (0 C)	Overcast, over 70%	Strong, over 15 mph (24km/h)
Examples:	00000 = No problem, good visibility, normal temp, clear, calm wind		12121 = Problems, poor visibility, hot, overcast, moderate wind			

# Sketch and Fieldnotes



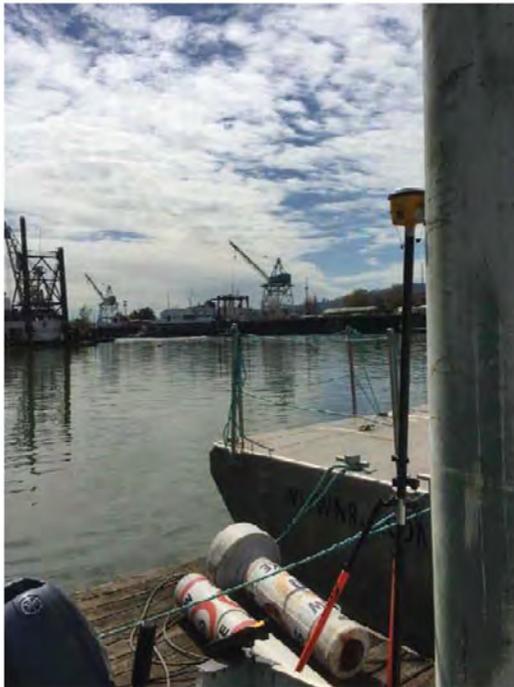
200	CHK PHI		
	KNOWN COORDS	OBS	$\Delta$ (FT)
	N = 698702.46	N = 698702.45	0.01
	E = 7637426.37	E = 7637426.39	0.02
	Z = 33.38	Z = 33.37	0.01
201	SE FACE OF PILE		
	3-MIN OBS		
	N = 700967.87		
	E = 7634507.67		
	Z = N/A		
202	SW FACE	TOP	
203	NW FACE	TOP	
204	NE FACE	TOP	

WATER

## Overview of PH2 Pile



## GNSS Setup on PH2 Pile

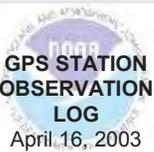


View facing south



View facing northwest

NOTE: This form intended for field use. Unsolicited data submitted to NGS must be converted to bluebook format.

 <p>GPS STATION OBSERVATION LOG April 16, 2003</p>	Station Designation: (check applicable: __ FBN__ CBN__ PAC__ SAC__ BM) <b>Raindeer</b>	Station PID, if any:	Date (UTC): <b>06-Mar-18</b>
	General Location: <b>Sauvie Island, Willamette River</b>	Airport ID, if any:	Station 4-Character ID: <b>065</b>

Project Name: <b>Portland Harbor - AETR00000034</b>	Project Number: <b>GPS-</b>	Station Serial # (SSN):	Session ID:(A,B,C etc)
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NAD83 Latitude o ' "	NAD83 Longitude o ' "	NAD83 Ellipsoidal Height meters	Agency Full Name: <b>David Evans and Associates, Inc.</b> Operator Full Name: <b>David T. Moehl</b> Phone #: ( ) <b>(360) 314-3200</b> e-mail address: <b>dtm@deainc.com</b>
Observation Session Times (UTC): Sched. Start _____ Stop _____		NAVD88 Orthometric Ht. meters	
Actual Start <b>17:38</b> Stop <b>23:45</b>		GEOID99 Geoid Height meters	

Receiver Brand & Model: <b>Trimble SPS855</b> <b>69855-60</b> P/N: <b>5506R0074</b> S/N: <b>5506R0074</b> Firmware Version: <b>5.30</b> <input type="checkbox"/> CamCorder Battery, <input checked="" type="checkbox"/> 12V DC, <input type="checkbox"/> 110V AC, <input type="checkbox"/> Other	Antenna Code*, Brand & Model: <b>Trimble Zephyr 3 Base</b> <b>115000-00</b> P/N: <b>1551129193</b> S/N: <b>1551129193</b> Cable Length, meters: <b>10</b> Vehicle is Parked <u>n/a</u> meters _____(direction) from antenna.	Antenna plumb before session? <input checked="" type="checkbox"/> (Y/N) Circle Antenna plumb after session? <input checked="" type="checkbox"/> (Y/N) Yes or No Antenna oriented to true North? <input checked="" type="checkbox"/> (Y/N) -If no, Weather observed at antenna ht. (Y/N) explain Antenna ground plane used? (Y/N) " Antenna radome used? (Y/N) If yes, Eccentric occupation (>0.5 mm)? (Y/N) describe. Any obstructions above 10'? (Y/N) Use Radio interference source nearby (Y/N) Vis. form
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Tripod or Antenna Mount: Check one: <input checked="" type="checkbox"/> Fixed-Leg Tripod, <input type="checkbox"/> Collapsible-leg tripod <input type="checkbox"/> Fixed Mount Brand & Model: <b>Seco fixed height</b> P/N: <b>5115-00-FLY</b> S/N: <b>5115-00-FLY</b> Last Adjustment date: <b>2018-03-05</b> Psychrometer (if used) Brand & Model:  P/N: S/N: Last Calibration or check Date:	<b>** ANTENNA HEIGHT **</b>		<b>Before Session Begins:</b>		<b>After Session Ends:</b>	
			Meters	Feet	Meters	Feet
	<b>A= Datum point to Top of Tripod (Tripod Height)</b>		<b>2.000</b>		<b>2.000</b>	
	<b>B= Additional offset to ARP if any (Tribrach/Spacer)</b>		<b>-0.003</b>		<b>-0.003</b>	
	<b>H= Antenna Height = A + B</b> <b>= Datum Point to Antenna Reference Point (ARP)</b>		<b>1.997</b>	<b>6.55</b>	<b>1.997</b>	<b>6.55</b>

Meters = Feet x (0.3048)      Note &/or sketch **ANY** unusual conditions.  
 Height Entered Into Receiver = **2.000** meters. **Be Very Explicit** as to where and how Measured!

Barometer (if used) Brand & Model:  S/N:	Weather Data	Weather Codes	Time (UTC)	Dry-Bulb Temp		WetBulb Temp		Rel. % Humidity	Atm. Pressure		
				Fahrenheit	Celsius	Fahrenheit	Celsius		inches Hg	millibar	
	Before		00000	17:38							
	Middle										
After		00000	23:45								

Remarks, Comments on Problems, Sketches, Pencil Rubbing, etc:

Weather codes are required. Weather data are optional but encouraged. \*Antenna code comes from ant\_info file furnished by project coordinator.

<b>Data File Name(s):</b> <b>00740650.T02</b> (Standard NGS Format = aaaaaddds.xxx) where aaaa=4-Character ID, ddd=Day of Year, s=Session ID, xxx=file dependant extension	Updated Station Description: <input type="checkbox"/> Attached <input type="checkbox"/> Submitted earlier Visibility Obstruction Form: <input type="checkbox"/> Attached <input type="checkbox"/> Submitted earlier Photographs of Station: <input checked="" type="checkbox"/> Attached <input type="checkbox"/> Submitted earlier Pencil Rubbing of Mark: <input type="checkbox"/> Attached	<b>LOG CHECKED BY:</b>  <b>Jon Dasler</b>
--	--	---

Table of Weather Codes	CODE	PROBLEM	VISIBILITY	TEMPERATURE	CLOUD COVER	WIND
	0	did not occur	Good, over 15 miles	Normal, 32° F- 80° F	Clear, below 20%	Calm, under 5mph (8km/h)
	1	did occur	Fair, 7-15 miles	Hot, over 80°F (27 C)	Cloudy, 20% to 70%	Moderate, 5 to 15 mph
	2	- not used -	Poor, under 7 miles	Cold, below 32° F (0 C)	Overcast, over 70%	Strong, over 15 mph (24km/h)
Examples:	00000 = No problem, good visibility, normal temp, clear, calm wind		12121 = Problems, poor visibility, hot, overcast, moderate wind			

Photo of Monument RAINDEER



Photo of Monument RAINDEER



## GNSS Setup on RAINDEER



**SOP A-8, SIB Project Area, PHSS  
(Source: Trident Probe)**

# **TRIDENT PROBE STANDARD OPERATING PROCEDURES**

## **TECHNOLOGY DESCRIPTION**

The Trident probe is a direct-push, integrated temperature sensor, conductivity sensor, grain-size sensor and porewater sampler developed to screen sites for areas where groundwater may be discharging to a surface water body (Chadwick et al., 2003; Figure 1). Differences in observed conductivity and temperature indicate areas where groundwater discharge is occurring. The integral porewater sampler can be used to rapidly confirm the presence of groundwater constituents and map the subsurface distribution of contaminants of concern.

### **Trident Conductivity/Temperature Sensors**

The subsurface temperature sensor consists of a ruggedized digital oceanographic thermometer embedded near the tip of a 90 cm long stainless-steel probe (Figure 1). The sensor has a measurement range of -5 to +45 °C at an accuracy of <0.1 °C, and a resolution of 0.001 °C. The sensor response time is about 60 s. The subsurface conductivity probe utilizes a small diameter, stainless steel, AC-excitation 3-electrode sensor, installed at the tip of the same 90 cm probe that houses the temperature sensor (Figure 1). The conductivity sensor has a range of 0 to 80 mS/cm, an accuracy of <2% of the calibrated range, and a resolution of 0.01 mS/cm. The subsurface probe is used to measure the bulk conductivity signal which varies primarily as a function of changes in salinity, and secondarily as a function of clay content and porosity. A reference conductivity and temperature sensor also is mounted on the instrument frame to provide a direct comparison of the overlying surface water conditions with the interstitial water conditions (Figure 1). For the temperature sensor, areas of groundwater seepage may appear either as warm or cold contrast to the surface water depending on the seasonal and site characteristics. For the conductivity sensor, areas of likely groundwater seepage are generally associated with low conductivity in coastal areas where fresh groundwater is discharging to seawater, but may be associated with high conductivity in rivers and lakes

where the groundwater often has higher total dissolved solids relative to the surface water.

### **Liquid-Tip Conductivity Sensor**

The subsurface conductivity probe can also be used in the “liquid tip” configuration in which the sensor is housed within a secondary screen and responds only to the porewater conductivity (Chadwick et al., 2007; Figure 2). The liquid tip configuration uses a small diameter sampling tube to purge the conductivity cell until the readings stabilize (generally <100 ml; Figure 3). The data are then recorded in the same manner as with the bulk conductivity sensor.

### **Data Acquisition System**

Trident sensors are coupled through an underwater connector and cable to a deck unit that integrates the probe and reference temperature, conductivity and SED-FSP signals with the signal from a Global Positioning System (GPS) sensor mounted on the top of the push-pole (Figure 1). The GPS is a Garmin model 17 with a stated accuracy of <15 m in standard mode, and <3 m in Wide-Area Augmentation System (WAAS) mode. The integrated data stream from the deck unit is sent to a laptop via RS-232. The laptop is used to apply calibration and temperature corrections to the signals, and record and display the results.

### **Porewater Sampler**

The water-sampling probe allows interstitial waters to be extracted from the sediment at selected depths up to about 90 cm below the sediment water interface. Porewater is collected by a low-flow peristaltic pump extraction through a small-diameter, Teflon-coated, stainless steel probe (Figure 4). The probes consist of a length of 9.5 mm diameter stainless steel tubing fitted with a solid, removable point. On the side of the tube near the tip there is a sample port consisting of a hole covered by a small mesh size (250  $\mu\text{m}$ ) stainless steel screen. The screen section is easily removable for cleaning or replacement if required (Figure 4). The porewater sampler can also be configured with a secondary screen with a sand-pack to provide a pre-filter for the sampling and to minimize clogging of the sampler (Figure 5). This secondary screen is installed over the

outside of the probe, and the void between the probe and the screen is packed with pre-cleaned sand. Multiple probes can be used together to further increase surface area, enhance sampling rate, and minimize potential clogging.

## **FIELD SAMPLING PROCEDURE**

A Trident survey is conducted by inserting the probe into the seabed (seabed is used here to mean the bottom of the ocean, estuary, or bay) from a boat or by wading. In operation, the Trident probe can be deployed in several ways depending primarily on the depth of the site. In water of moderate depths (1-10 m), the probe is easily deployed from a small boat using the push rod (Figure 6). It is important that the boat be well anchored to minimize lateral loading on the probe during the insertion. In deeper water (>10 m), the probe can be deployed by diver, or can be attached to a landing frame (Figure 6). In very shallow water (<1 m) the probe can be installed by wading.

### **Conductivity and Temperature Sampling**

Once on station with the probe inserted, data is collected from the conductivity and temperature sensors using the TridentTalk software. If the liquid tip sensor is being used, the cell must be purged prior to data collection. The TridentTalk software provides a display of the probe and reference temperature and conductivity signals, along with the GPS position. The software also automatically calculates and displays the probe vs. reference temperature and conductivity contrast. Once the sensor readings have stabilized, the data is recorded by activating the “Log current data” button on the TridentTalk display. The data can then be reviewed in numeric format, or displayed spatially using the AGIS graphical information system software. The spatial AGIS display provides a capability for rapidly evaluating the most likely areas of groundwater discharge based on temperature and conductivity contrast. Once data recording is completed, the probe is retrieved. If the liquid tip sensor is being used, the sensor cell must be cleaned between stations by removing any accumulated particles and rinsing the cell with appropriate solution (generally surface water). A typical shoreline sampling grid for a Trident sensor survey is shown in Figure 7. Typical results for a liquid-tip sensor survey are shown in Figure 8.

## **Porewater Sampling**

Once on station with the porewater probe inserted, the probe and sampling tube is purged of ~3 volumes using the sampling pump. The pump should be run at a low enough rate to avoid over pressure and clogging or excessive vacuum bubbles in the sampling line. With the sampler purged, the porewater samples can then be collected in accordance with the volume and quality control requirements of the project. Once the sampling is complete, the probe is retrieve and decontaminated in accordance with project requirements prior to sample collection at the next station. Typical results for a shoreline porewater sampling survey are shown in Figure 9.

## **REFERENCES**

Chadwick, D.B., J. Groves, C. Smith, and R. Paulsen. 2003. Hardware description and sampling protocols for the Trident Probe and UltraSeep system: Technologies to evaluate contaminant transfer between groundwater and surface water. Technical Report #1902, SSC San Diego, United States Navy.

Chadwick, D.B., J. Guerrero, G. Rosen, J. Groves, C. Smith, R. Paulsen, A. Burton, and M. Greenberg, 2007. The Trident Probe capabilities and applications for identifying and mapping groundwater discharge zones. Proceedings of SETAC North America 28th Annual Meeting, Milwaukee, WI.

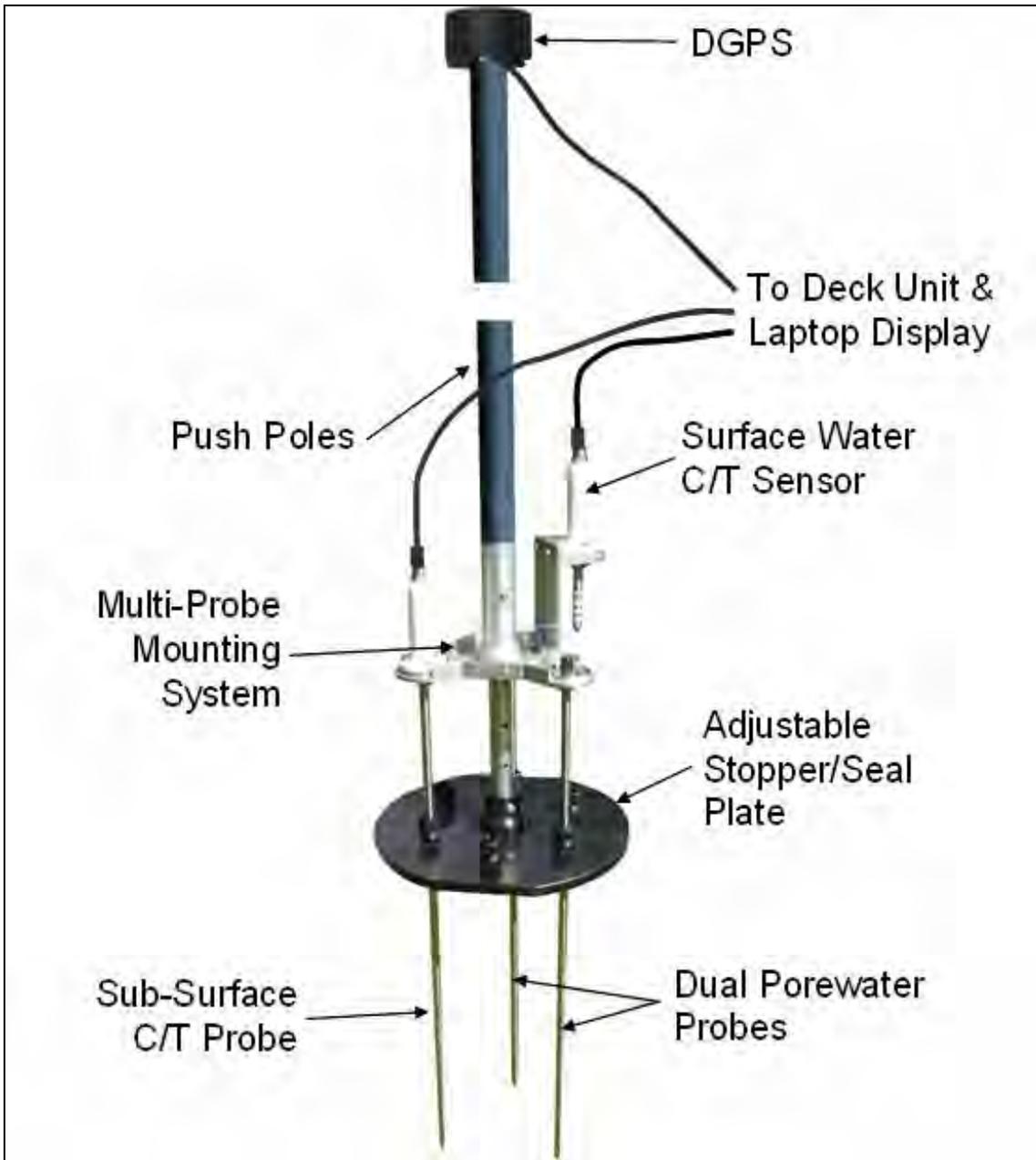


Figure 1. Complete Trident Probe showing sensor and water sampling probes, push-pole, DGPS unit.

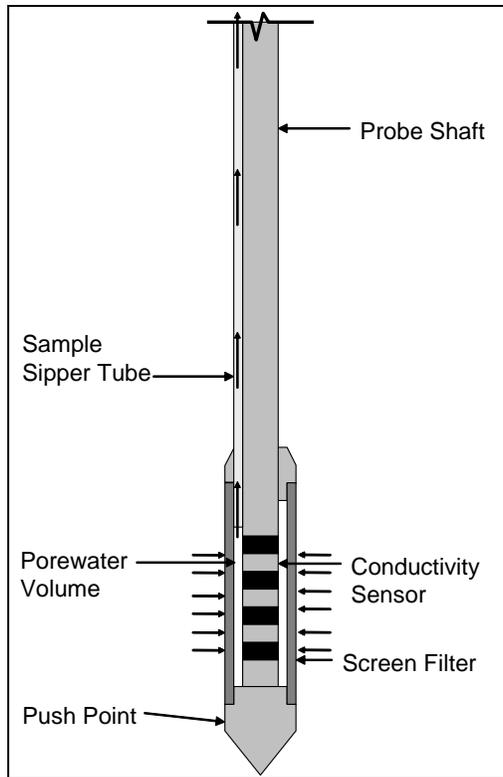


Figure 2. Schematic of the liquid-tip Trident conductivity probe.

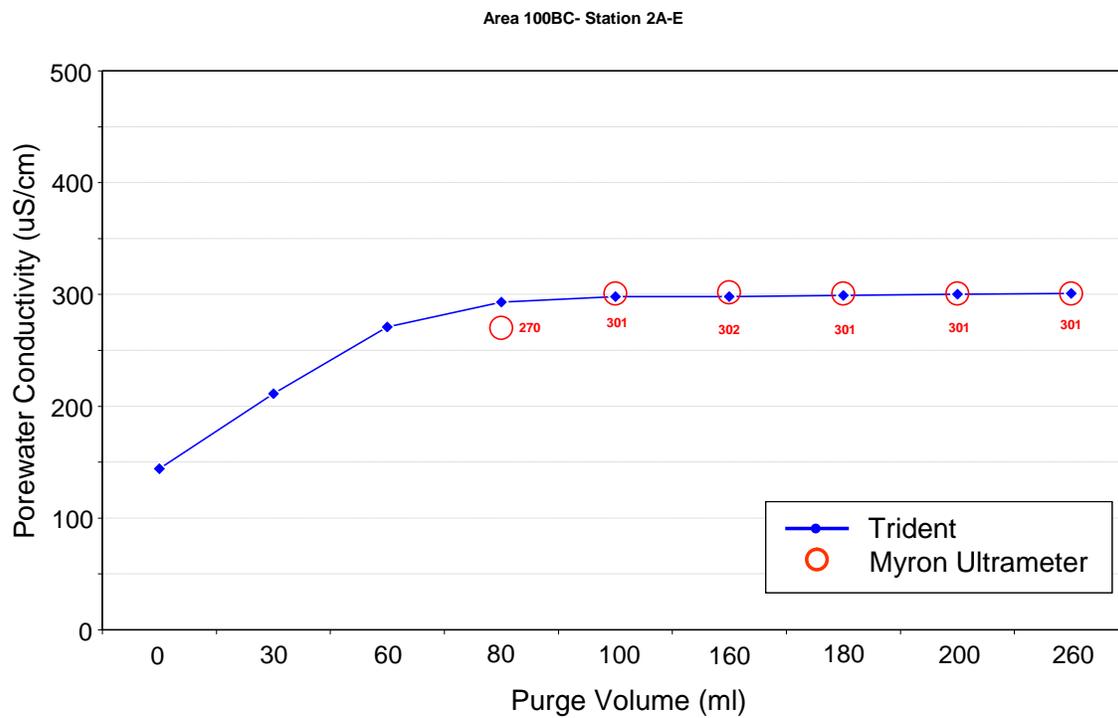


Figure 3. Typical porewater conductivity vs. purge volume for the liquid tip sensor.



Figure 4. Trident porewater system components.



Figure 5. Trident porewater sampler with sand-pack system.

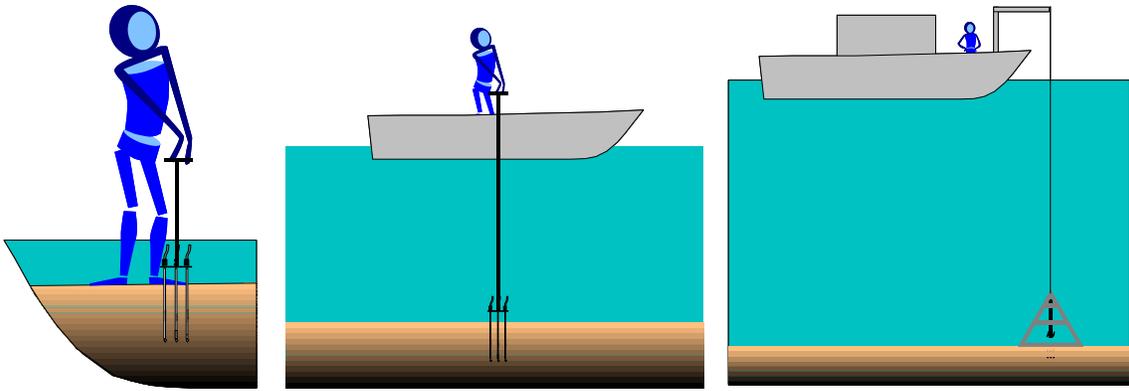


Figure 6. (Left to right) shallow-water (0 to 3 ft) push-pole, mid-range (3 to 30 ft) push-pole, and deep-water (>30 ft) deployment methods for Trident probe. Diver method not shown.

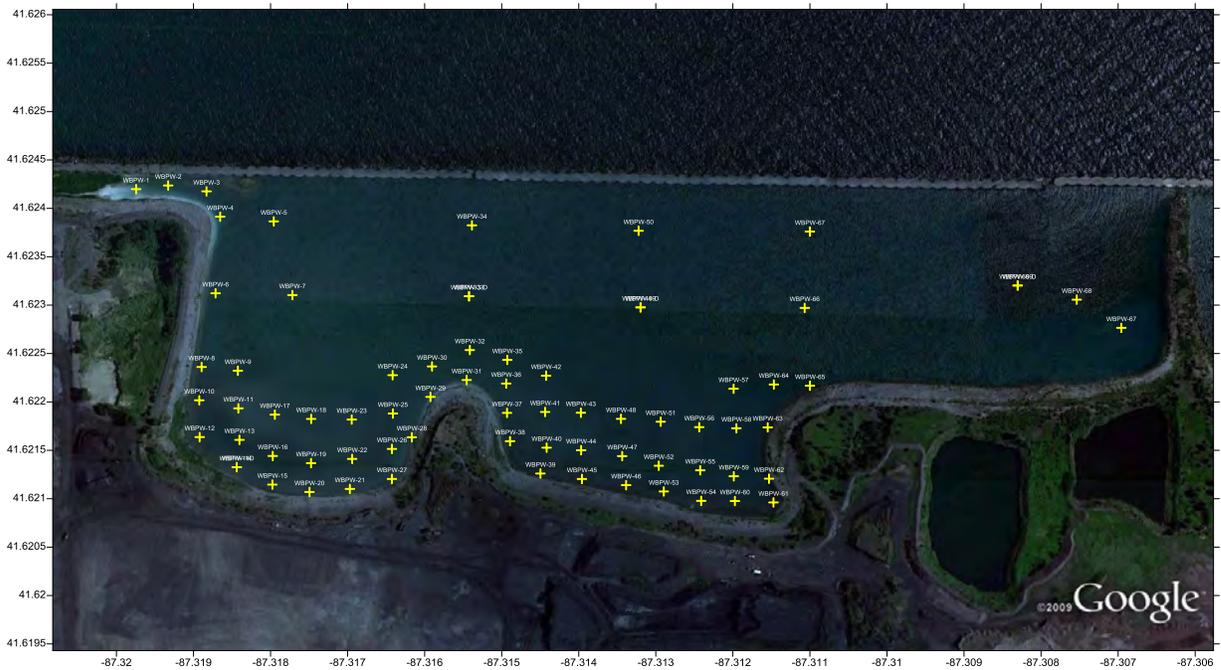


Figure 7. Typical shoreline survey grid for a Trident Probe survey.

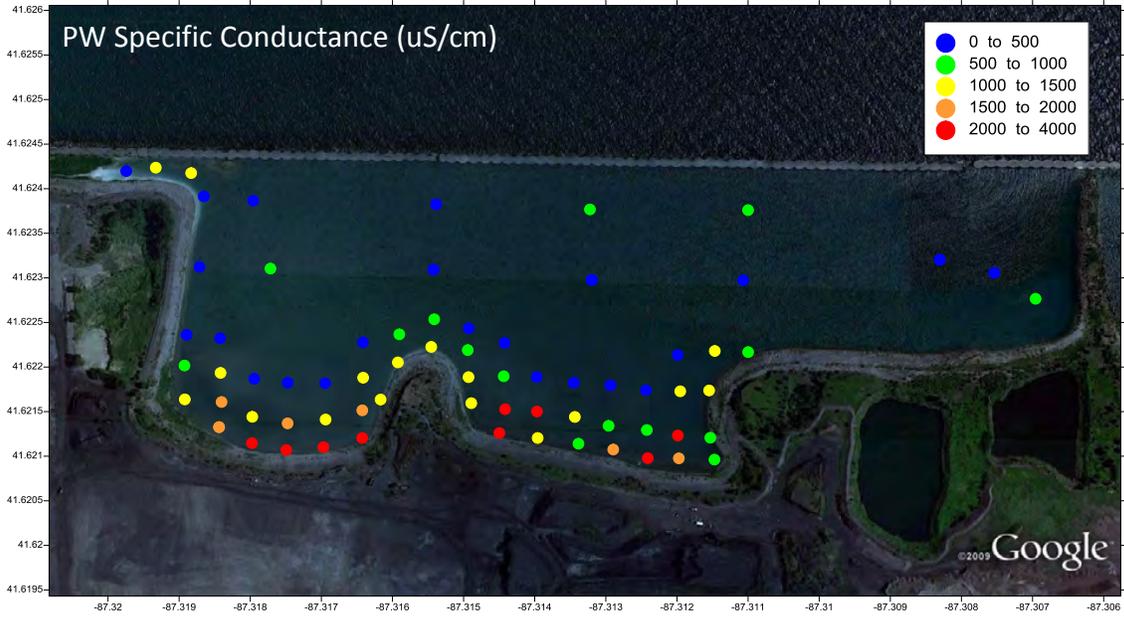


Figure 8. Example of liquid-tip sensor results for conductivity to detect groundwater discharge zones in a shoreline survey grid. In this case at a freshwater site, the groundwater was characterized by higher specific conductance levels than the surface water.

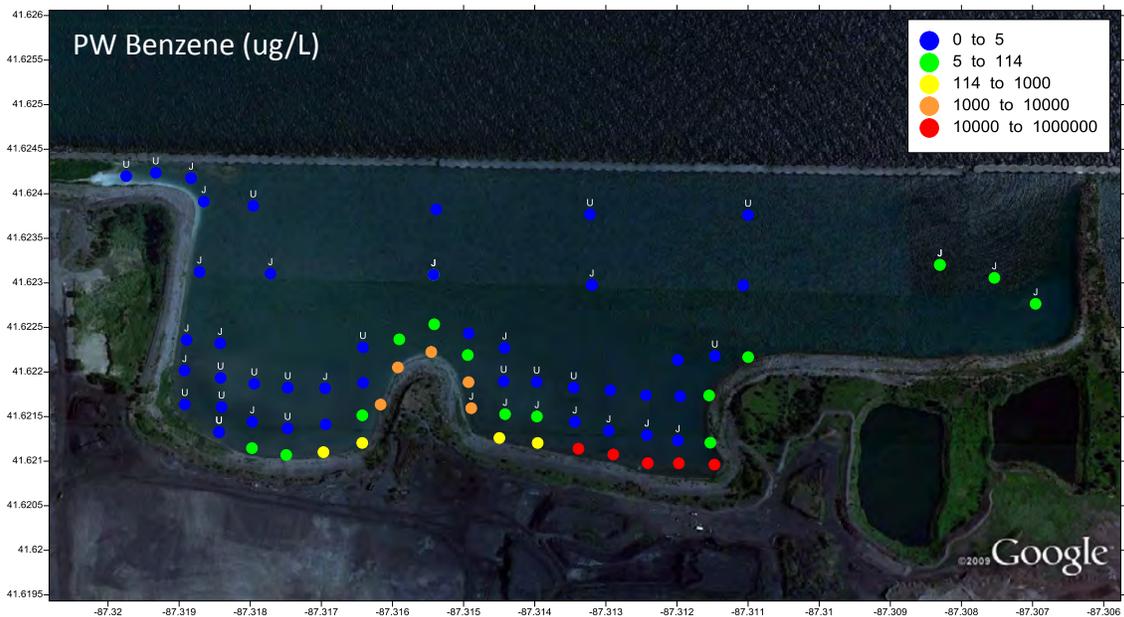


Figure 9. Example of porewater survey results for Benzene in a shoreline survey grid.

## **ADDENDUM 1. DETAILED FIELD PROCEDURES FOR TRIDENT PROBE SENSOR SAMPLING**

Standard field procedures for Trident sensor sampling are described below. While these procedures are generally applicable, they serve as a guide and may be subject to site-specific variations depending on the particular study design and requirements.

### **Applicable Field Conditions**

Trident sensor measurements are applicable to a wide range of field conditions. In general, the measurements focus on characterizing subsurface and surface water temperature and conductivity, and the contrast between these, at soft-bottom sediment sites with the potential for groundwater-surface water interaction. Using various configurations, the sensors have been extended to use in gravel, cobble, and other more resistant bottom types, but these typically require special armoring and drive systems. The temperature sensors are applicable over the widest range of conditions. The conductivity sensors can be used in either the “bulk” conductivity configuration, or the “liquid-tip” configuration.

In the bulk configuration, the conductivity sensor is exposed directly to the sediment, and the reading reflects the combined conductivity of the sediment and the porewater. Bulk measurements can be useful in certain applications, particularly when evaluating relative subsurface difference either in sediment properties (when the porewater conductivity is relatively constant), or when evaluating porewater conductivity differences (when the sediment properties are relatively constant). In general, these measurements will not be useful for measuring contrast with surface water because of the bias associated with the effect of the sediment on the reading. Also, it is often the case that the degree of uniformity of the porewater conductivity or sediment characteristics is not known or is known to be variable and then the bulk measurements may be difficult to interpret. The bulk conductivity probe should thus only be used with these factors in consideration.

In the liquid-tip configuration, the conductivity sensor is contained within a screened tip on the probe which allows porewater to be drawn in. Thus the liquid-tip configuration gives readings that reflect only the porewater conductivity. This allows for more direct

assessment of potential groundwater discharge zones and for direct comparison with surface water readings to evaluate contrast. The liquid-tip configuration utilizes a 250 micron outer screen over the sensor. Thus it tends to work well in medium to coarse grain sediments. In very fine sediments, particles can be drawn into the sampler and this may confound the measurement because of the effects of the particles on the conductivity reading. Thus caution should be used in applying this configuration in fine sediments. Evidence of high particle loads entering the measurement cell is usually apparent when the probe is retrieved and disassembled for cleaning between stations. If significant amounts of fine particles are found in the cell, and if the readings appear erratic or biased relative to expected values, consideration should be given to using the Trident porewater sampler with a sand pack to collect small volume water samples for conductivity measurements using the handheld Ultrameter instead of the in situ sensor.

### **Probe Configurations**

The Trident provides for a range of different probe configurations. Sensor probes can be combined with water sampling probes. Multiple probes can be used for replication or at different sampling depths. Surface water sensors and samplers can be included. Probe configuration is largely a function of the study design so there is no standard configuration. The maximum number of probes for the hex-head Trident is 6 not including surface water probes. The maximum probe length is typically 3 feet, although longer probes have been applied for special studies. Using the extension plates, each probe can be set to an independent subsurface penetration depth. In general, when using the sensor probes to detect groundwater upwelling zones, the strength of the signal tends to increase with depth. Thus setting the probes to deeper depths will generally result in stronger signals. Setting probes at depths less than about 6 inches can result in higher potential for draw-down, so shallow probe depths should be used with caution.

### **Sensor System Preparation**

Preparation of the sensor system prior to field measurements is described below.

1. Gather the equipment and materials described in the equipment list.

2. Clean the sensor probes with warm water and a lab-grade detergent such as Alconox or RBS, using a green scrunge pad to polish the conductivity sensors thoroughly.
3. For the liquid-tip probe, assemble the sensor probe inside the probe armor and the liquid-tip screen.
4. Connect the probe(s) to the Trident deck unit and verify communications.
5. Run TridentTalk, select the probe settings option, note down all of the previous calibration coefficients, and then change all of the coefficients to a slope of one (+1.000) and an intercept of zero (+0.000).
6. Calibrate the temperature sensor(s) using a three-point calibration in a temperature bath (verified by NIST thermometer) spanning the range of expected values at the site, and three replicate measurements for each standard.
7. Input the calibration data into the standard calibration spreadsheet template and note the new calibration coefficients.
8. Enter the new coefficients into TridentTalk for the respective probes.
9. Using the temperature bath (verified by NIST thermometer) check the calibrated temperature readings against the thermometer. Relative percent differences (RPDs) should be in the range of 0.1-0.5%.
10. Calibrate the conductivity sensor(s) using a three-point calibration of NIST standards spanning the range of expected values at the site, and three replicate measurements for each standard. If the liquid-tip configuration is being used, calibrate with the probe armor and screen in place.
11. Input the calibration data into the standard calibration spreadsheet template and note the new calibration coefficients. Relative standard deviations (RSDs) of the replicates should be in the range of 0.1-1%.
12. Enter the new coefficients into TridentTalk for the respective probes.
13. Using the conductivity standards check the calibrated readings against the standards. Relative percent differences (RPDs) should be in the range of 0.1-1%.
14. Rinse the probes with clean DI water to remove any residual calibration solution, and zip tie a clean plastic bag over the tip to keep clean until ready for field use.

15. Assemble the probes onto the hex-head (and extension plates if needed) in the desired configuration.
16. Install the stopper plate including the stopper plate pole and adjustment rod.
17. Insert the shore extension pole into the hex-head with a retainer pin.
18. Connect the sensor cables and zip tie them to the short pole to provide strain relief. If desired, install the camera system on the frame for use in verifying the push depth.
19. Connect the communication cables to the deck unit and the deck unit to the field computer, start TridentTalk, and verify that all of the probes and the GPS unit are functioning properly. If installed, verify the camera is functioning properly.
20. If using the liquid-tip, connect a clean length of tubing of sufficient length to reach the bottom at the deepest target station, and secure it to the short pole using zipties. The tube and cables can be bundled with zipties as well.
21. The system is now ready for field use.

### **Field Sensor Measurements**

Follow the procedure below to collect Trident sensor measurements in the field.

1. Assemble all of the required equipment from the equipment list, along with the assembled Trident system on the sampling boat or at the shoreline area if wading.
2. Connect the probes and the GPS to the deck unit, and the deck unit to the field laptop, start TridentTalk, and verify that everything is functioning properly.
3. In TridentTalk, setup the station name and data file as needed. Normally the station name is change for each station, and the filename is change for each day. Replicates at the same station are automatically designated under TridentTalk.
4. Setup the desired sampling interval in seconds.
5. Verify that the computer clock is properly set and synchronized in TridentTalk.
6. If using the liquid-tip, connect the purge tube to the pump.
7. Using the boat or wading, position to the target station. This can be done using the GPS, a navigation system, or by known landmarks.
8. Use a depth meter or other method to determine and record the water depth in the logbook. Assemble the required number of push poles to reach the bottom.

9. Lower the probe to the bottom, adding poles as needed to reach the target depth. If the push poles are to be released after the push, make sure an install the release pin in the first pole.
10. Gage the initial contact with the bottom by feel and note the pole height relative to the water level or the boat rail. Push the probe into the bottom until significant resistance is felt. Note the pole height and estimate if the probe is fully penetrated. If not, continue to work the probe in by hand or using a slide hammer or other drive method until full penetration is achieved. If installed, verify penetration with the camera. If using the release point, pull the release pin and remove the push poles. Note the bottom type in the logbook based on feel or visual observations in shallow water.
11. If using the liquid-tip, start the cell purge and purge a minimum of 100 ml, checking the stability of the temperature and conductivity readings during the purge using TridentTalk.
12. Install the Trident GPS in the top of the push pole. If using the release point, hold the GPS over the push location. If using a handheld GPS, hold it next to the push pole or above the push location and record the position.
13. Once the readings have stabilized, record the data for the station and note the values and the position data in the logbook.
14. Retrieve the probe to the surface using the push poles or retrieval line as applicable.
15. Clean the probe to remove any sediment or residue using a soft brush and DI water. If using the liquid-tip, remove the screen, check for excessive particles in the cell, and clean the screen, sensor and probe body. If an significant contamination or residue is present (e.g. sheen), use a mild lab detergent to clean the probe and rinse with DI water.
16. If the liquid-tip is used, flush the tubing with surface water, and then pump any residual water out of the tubes. If significant contamination or residue is present the tubing can be deconed by pumping a mild lab detergent followed by DI water through the system, or the tubing can be changed out for new tubing.

17. Once the probe and the tubing are clean, re-assemble any screens, tips or tubing that was removed/disconnected, and the probe is ready for redeployment.
18. Once a day (generally at the end of the day), the conductivity sensor calibration should be checked by immersing the sensor in a NIST standard. Normally the standard should be the one that is closest to the range of conductivities observed at the site. If the RPD of the reading is more than 2% different from the standard, the sensor should be lightly polished with a scrunge pad and the check repeated. If the reading is still more than 2% different from the standard, the sensor should be re-calibrated in accordance with steps described above in the System Preparation section.
19. The temperature sensor calibrations are generally very stable and should not require re-calibration during the period of a typical survey.

## **ADDENDUM 2. DETAILED FIELD PROCEDURES FOR TRIDENT PROBE WATER SAMPLING**

Standard field procedures for Trident water sampling are described below. While these procedures are generally applicable, they serve as a guide and may be subject to site-specific variations depending on the particular study design and requirements.

### **Applicable Field Conditions**

Trident water sampling is applicable to a wide range of field conditions. In general, the sampling focuses on collection of sufficient subsurface and surface water samples volume to characterize the target water quality and chemical conditions for the study. Using various configurations, the water samplers have been extended to use in conditions ranging from fine sediments to gravel, cobble, and other more resistant bottom types. There are two primary configurations for the water sampler including the un-armored small-diameter probe with small screen, and the armored large diameter probe with large screen and internal sand-pack filter. Sampling in coarse sediment can often be carried out using an un-armored probe with just the small filter screen. Sampling in fine sediments often requires the use of the armored probe with the larger outer screen and internal sand-pack filter.

### **Probe Configurations**

The Trident provides for a range of different probe configurations. Water sampling probes can be combined with sensor probes. Multiple probes can be used for replication or at different sampling depths. Surface water sensors and samplers can be included. Probe configuration is largely a function of the study design so there is no standard configuration. The maximum number of probes for the hex-head Trident is 6 not including surface water probes. The maximum probe length is typically 3 feet, although longer probes have been applied for special studies. Using the extension plates, each probe can be set to an independent subsurface penetration depth. Setting probes at depths less than about 6 inches can result in higher potential for draw-down, so shallow probe depths should be used with caution.

## Water Sampling System Preparation

Preparation of the water sampling system prior to field measurements is described below.

1. Gather the equipment and materials described in the equipment list.
2. Clean the water sampling probes, screens and tips with warm water and a lab-grade detergent such as Alconox or RBS, using a soft bristle brush. Rinse thoroughly with DI water and allow to dry. Place the screens and tips in clean Ziploc bags. Note that the solutions used to decontaminate the probes may vary depending on if the probe is being used only to collect water quality samples, or if the probe is being used to collect samples for chemical analysis.
3. Replace the internal tubing in the probe with new, pre-cleaned Teflon tubing. Install a pre-cleaned Teflon tee or union fitting on the exposed end of the tubing and cover the open end with a blank ferrule fitting or parafilm.
4. If using the sand-pack and probe armor, assemble the water sampling probe inside the probe armor. Ziptie a plastic bag over the clean probe tip.
5. Assemble the probes onto the hex-head (and extension plates if needed) in the desired configuration.
6. Install the stopper plate including the stopper plate pole and adjustment rod.
7. Insert the shore extension pole into the hex-head with a retainer pin.
8. Connect a pre-cleaned length of tubing to the probe coupling of sufficient length to reach the bottom at the deepest target station, and secure it to the short pole using zipties. A surface water sampling tube can also be ziptied to the pole or the frame at the desired height above the bottom. If multiple tubes are being used they can be bundled with zipties as well.
9. If not using the sand-pack, install the small screen and tip and re-cover the tip with the protective bag.
10. If using the sand-pack, stand the probe vertically with the probe tips pointing up and install the small inner and large outer screens. Fill the void between the inner probe and the outer screen with a slurry of filter sand by rinsing it into the void with clean DI water. Leave about 1/8 inch unfilled for the tip to fit into. Install the

large tip and re-cover the probe tip with the plastic bag. Note that different filter sands can be used for different applications.

11. The system is now ready for field use.

### **Field Water Sampling**

Follow the procedure below to collect Trident sensor measurements in the field.

1. Assemble all of the required equipment from the equipment list, along with the assembled Trident system on the sampling boat or at the shoreline area if wading.
2. Using the boat or wading, position to the target station. This can be done using the GPS, a navigation system, or by known landmarks.
3. Use a depth meter or other method to determine and record the water depth in the logbook. Assemble the required number of push poles to reach the bottom.
4. Lower the probe to the bottom, adding poles as needed to reach the target depth. If the push poles are to be released after the push, make sure to install the release pin in the first pole.
5. Gage the initial contact with the bottom by feel and note the pole height relative to the water level or the boat rail. Push the probe into the bottom until significant resistance is felt. Note the pole height and estimate if the probe is fully penetrated. If not, continue to work the probe in by hand or using a slide hammer or other drive method until full penetration is achieved. If installed, verify penetration with the camera. If using the release point, pull the release pin and remove the push poles. Note the bottom type in the logbook based on feel or visual observations in shallow water.
6. Start the sample purge and purge a minimum of 100 ml, checking the stability of the water quality readings during the purge using the handheld Ultrameter.
7. Hold the GPS next to the push pole or above the push location and record the position.
8. Once the water quality readings have stabilized, record the data for the station and note the values and the position data in the logbook.
9. If chemical samples are to be collected, continue to pump and collect samples as required.

10. Retrieve the probe to the surface using the push poles or retrieval line as applicable.
11. Clean the exterior of the probe to remove any sediment or residue using a soft brush and Alconox solution. If using the sand-pack, remove the tip and the outer screen and dispose of the sand. Remove the internal screen and clean the entire probe exterior, screens and tip with Alconox solution and a soft brush followed by DI rinse.
12. If the sample tubing is to be re-used, decon the tubing by back flushing with the sampling pump using Alconox solution followed by DI water (or other decon solutions as required by the chemical sampling). Alternatively, the short length of internal probe tubing can be deconed in this way, and the long length of sampling tubing can be replaced with new pre-cleaned tubing. It is not advised to change the internal probe tubing in the field, but this can be done as well if the application requires. Rinse the probe tips again with DI after the back flush is completed.
13. Once the probe and the tubing are clean, re-assemble any screens, tips or tubing that was removed/disconnected. If the sand-pack is being used, re-pack the probe with clean sand. The probe is ready for re-deployment.

## **ADDENDUM 3. TRIDENT EQUIPMENT LIST**

### **General Hardware**

- Standard Hex Head and Hardware
- Extension Plate Hex Head and Hardware
- Extension Plates and Hardware
- Stopper Plate with Seal Glands
- Stopper Plate Pole and Adjustment Rod
- Single Probe Hex Head (for single probe configurations only)
- Single Probe Extension Plates and Hardware (for single probe configurations only)
- Single Probe Stopper Plate (for single probe configurations only)
- Short (1 m) Push Pole
- Standard Push Poles (2 m) and Clips
- Probe Mounting Brackets

### **Sensor System**

- C/T Sensor Probes
- C/T Reference Probes
- C/T Small Tips
- C/T Armor
- C/T Liquid-Tip Screens
- C/T Large Tips

### **Water Sampling System**

- PW Probes
- PW Small Screen and Tips
- PW Armor
- PW Large Screens and Tips
- Pump – Masterflex E/S Portable Sampler IP54

- Pump Head – Masterflex L/S #7518-10
- Pump Tubing – Masterflex silicone L/S 14
- Sample Tubing – Cole Parmer 1/8” Teflon FEP
- Couplings - Entegris Teflon PFA 1/8”SU2N, UT2N

### **Deck Gear and Ancillary Equipment**

- C/T and GPS Cables - Impulse
- Trident Deck Unit
- Trident Integrated GPS – Garmin GPS16
- Handheld GPS – Trimble GeoXT
- Field Computers – Dell Inspiron
- Inverter – Black and Decker 1008 48-OC
- Battery – Duralast Marine Battery
- USB/Serial – Keyspan USA 19-HS
- GFI – TRD Model 14650 Software – Trident Talk, Rosepoint Coastal Explorer
- Water Quality Meter – Myron L Ultrameter model 6P
- Hand-Held Depth Sounder – Vexilar LPS-1

### **Expendables**

- Wipes – Kimwipes
- Gloves – Cole Parmer Powder free nitrile EW-81602-65
- Wrap - Parafilm
- Cleaner - Alconox
- Lab-Water – 18 Mohm lab-grade deionized water
- Distilled water
- Filter Sand – Sigma-Aldrich Davisil 636, Polysciences Glass Beads (250-300µm), #60 Industrial Silica Sand (and others)

**SOP R-4, SIB Project Area, PHSS  
(Source: Geotechnical Soil Logging)**

# Standard Operating Procedure Geotechnical Soil Logging

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<b>Checked by:</b>	Frank Greguras	<b>Revision Number:</b>	4
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## 1 Purpose

This Standard Operating Procedure (SOP) defines standard practices for identification and classification of soil samples collected during geotechnical site investigations and preparation of the associated field logs. This document is based on applicable ASTM International (ASTM) standards, Federal Highway Administration (FHWA) guidance documents, and the 2010 California Department of Transportation (Caltrans) Soil and Rock Logging, Classification, and Presentation Manual.

## 2 Scope

This SOP does not supersede or replace the ASTM standards that it is based on. The intent of the SOP is to clearly communicate the procedures for logging, describing, and identifying soil samples in the field based on visual manual procedures. The field soil descriptions developed based on the procedures described herein may be corrected, calibrated, or verified based on the results of the geotechnical laboratory tests performed following the subsurface investigation

## 3 General Requirements

All work should be performed in accordance with the project specific geotechnical site investigation plan as well as the project specific health and safety plan. While not covered specifically in this SOP, at a minimum the field engineer performing the soil logging should have a thorough understanding of the following prior to the commencement of the subsurface investigation:

- Field exploration methods, sampling requirements, and types and frequency of field tests to be performed
- The site-specific health and safety plan and any associated site hazards
- Permitting requirements and restrictions (borehole destruction, encroachment, etc.)
- Traffic control requirements and plan
- Underground Service Alert (USA) ticket and member utility response status

Boreholes should be logged by a suitably trained engineer or geologist, under the supervision of the project design geotechnical engineer or engineering geologist.

## 4 Field Procedure for Soil Logging

### 4.1 General Project and Borehole Information

Field logs should properly identify the general project information, site location, drilling tools and methods used, and the personnel involved in the fieldwork. The information described in Table 1 should be recorded for each borehole. A sample field logging form for a sample project is provided in Appendix A.

**Table 1. Required Field Logging Form Information**

	Description
1	Date of Work
2	Borehole Identification
3	Project and Site Information <ul style="list-style-type: none"> <li>• Project name</li> <li>• Project number</li> </ul>
4	Borehole Location and Elevation <ul style="list-style-type: none"> <li>• Latitude and longitude or northing and easting</li> <li>• Horizontal coordinate system and datum</li> <li>• Elevation</li> <li>• Vertical datum</li> <li>• Method of borehole location and approximate accuracy</li> </ul>
5	Personnel <ul style="list-style-type: none"> <li>• Logger (engineer or geologist)</li> <li>• Drill crew</li> <li>• Inspector (or other visitors)</li> </ul>
6	Drilling and Sampling Equipment <ul style="list-style-type: none"> <li>• Drill rig (manufacturer and model, and equipment identification number)</li> <li>• Drilling method</li> <li>• Drill tooling               <ul style="list-style-type: none"> <li>– Drill rod description (type, diameter)</li> <li>– Drill bit description</li> <li>– Casing (type, diameter) and installation depth</li> </ul> </li> <li>• SPT hammer type</li> <li>• Hammer Energy Ratio (ERi)</li> <li>• Type of Sampler(s) and Size(s)</li> </ul>
7	Groundwater <ul style="list-style-type: none"> <li>• Method of observation</li> <li>• Date, time, and elevation of each reading</li> </ul>
8	Borehole Completion <ul style="list-style-type: none"> <li>• Reason for termination</li> <li>• Backfill method</li> <li>• Instrumentation installed</li> <li>• Grout inspection documentation</li> </ul>

Adapted from Figure 2-3 from Soil and Logging, Classification and Presentation Manual (Caltrans, 2010).

Boreholes will be drilled using a combination of hand auger, hollow stem and solid stem continuous flight augers, and/or rotary wash methods. At the near surface, hand augering is preferred to obtain shallow subsurface information, confirm the borehole location is absent of underground utilities, and collect bulk samples. Below hand auger depths, hollow stem or solid stem continuous flight augers should be utilized until groundwater is encountered and measured. Hollow stem drilling should be performed in accordance with ASTM D6151 and solid stem drilling with ASTM D1452.

Sampling should be performed using split-barrel samplers and thin-walled (Shelby) samplers in dry drilling. The split-barrel (or split spoon) sampler is used to obtain driven disturbed soil samples. The two most common types of split-barrel samplers include the Standard Penetration Test (SPT) sampler and the Modified California sampler. The SPT sampler is best suited to obtain disturbed samples in cohesionless soils performed in accordance with ASTM D1586. The Modified California sampler is used when gravels are present or for soil samples that need to be confined in a liner. The Modified California sampler should be used in accordance with ASTM D3550. The type of hammer and hammer efficiency should be requested from the drilling contractor to provide accurate correction factors for the standard penetration resistance, referred to as the number of blow counts or “N”, when the split-sampler is driven. The thin-wall tube (Shelby) sampler is hydraulically advanced to obtain relatively undisturbed samples of cohesive soils.

After groundwater is encountered, the drill rig equipment should be converted to rotary wash drilling and performed in accordance with ASTM D5783. Rotary wash methods are preferred below the groundwater table to reduce borehole caving, heaving, and the disturbance of samples. In addition to split-barrel and Shelby tube sampling, the Dames & Moore Piston sampler and Pitcher Barrel sampler can be used to collect soil samples below the groundwater table. The Dames & Moore Piston sampler is hydraulically advanced and useful for sampling soft soils where sample recovery is often difficult and in soils that will require laboratory testing. The Piston sampler is used in accordance with ASTM 6519-15. The Pitcher Barrel sampler is used to obtain relatively undisturbed samples in hard fine-grained soils and granular soils with clay. The Pitcher Barrel is used in accordance with ASTM D1587.

While sampling, field tests including the pocket penetrometer test and hand-held torvane test should be performed on cohesive samples that are free of substantial voids or hard inclusions to ensure an accurate representation of consistency. Both tests should only be used as an index of the unconfined compressive strength (UCS) of cohesive samples and should not be used in place of a laboratory strength tests. Pocket penetrometer tests should be performed in accordance with the recommendations provided by the device manufacturer and hand-held torvane tests should be performed in accordance with ASTM D4648. Other tests for plasticity, dry strength, dilatancy, and toughness should be performed on cohesive samples to identify and describe the soil in accordance with ASTM D2488.

## 4.2 Soil Description

This section presents the method for soil identification and description based on ASTM D2488, USBR (2001), and Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010). A degree of uncertainty exists in visual soil description and identification such as for identifying percentages of soil constituents and for the other soil descriptions explained in the subsequent sections. Laboratory testing should be performed on selected soil samples to confirm field identifications.

### 4.2.1 Soil Description and Identification

When describing and identifying soil, record the data on the field log in accordance with, and in the sequence shown in Table 2. Items marked “required” must be used, when applicable, to describe the soil sample. For

example, percent cobbles and/or boulders is required only if cobbles and/or boulders are encountered. Do not report negative information (e.g. no boulders or cobbles).

Use semicolons between required descriptors, commas within a descriptive component for optional descriptors, and a period at the end of each descriptive sequence. Table 2 below summarizes the order of appearance for description terms in the borehole log. The items marked with a dot under the required column must be used to describe the soil sample.

**Table 2. Identification and Description Sequence**

Sequence	Identification Components	Required	Optional
1	Group Name	●	
2	Group Symbol	●	
3	Consistency of Cohesive Soil	●	
4	Apparent Density of Cohesionless Soil	●	
5	Color	●	
6	Moisture	●	
7	Percent or Proportion of Soil	●	
	Particle Size	●	
	Particle Angularity		○
	Particle Shape		○
8	Plasticity (for fine-grained soil)		○
9	Dry Strength (for fine-grained soil)		○
10	Dilatancy (for fine-grained soil)		○
11	Toughness (for fine-grained soil)		○
12	Structure		○
13	Cementation	●	
14	Percent of Cobbles and Boulders	●	
	Description of Cobbles and Boulders	●	
15	Consistency Field Test Result	●	
16	Additional Comments		○

Figure 2-5 from Soil and Logging, Classification and Presentation Manual (Caltrans, 2010).

#### 4.2.2 Group Name and Group Symbol

The group name and group symbol for a soil should be identified using Table 3 and Table 4 for fine or coarse-grained soils, respectively. This should be performed in accordance with ASTM D2488 and is only applicable to materials passing the 3-inch sieve. The percentage(s) of cobbles and/or boulders (if encountered) must be reported on the borehole log per Section 4.2.3.13.

A soil is classified as fine-grained if it contains 50% or more material that passes through a Number 200 sieve, measured by weight. A coarse-grained soil contains fewer than 50% fines. A coarse-

grained soil is identified as gravel if the percentage of gravel is greater than the percentage of sand, or as sand if the percentage of gravel is equal to or less than the percentage of sand. A well-graded sand or gravel has roughly equal amounts of all particle sizes. A poorly-graded sand or gravel is missing one or more particle sizes.

If a soil falls into two groups, a borderline symbol should be used. To indicate that the soil may fall into one of two groups, use a borderline symbol, which is two symbols separated by a slash, e.g., SC/CL or CL/CH. A borderline symbol must be used when:

- The percentage of fines is estimated to be between 45 and 55%. One symbol must be for a coarse-grained soil with fines; the other for a fine-grained soil, e.g., GM/ML or CL/SC
- The percentage of sand and the percentage of gravel are estimated to be about the same, e.g., GP/SP, SC/GC, GM/SM
- The soil could be well or poorly-graded, e.g., GW/GP, SW/SP
- The dominant fine-grained component of the soil could be either silt or clay, e.g., CL/ML, CH/MH, SC/SM

The group name for a soil with a borderline symbol must be the group name for the first symbol, except for:

- CL/CH lean to fat CLAY
- ML/CL CLAYEY SILT
- CL/ML SILTY CLAY

Borderline symbols should not be used indiscriminately. Use of a single group symbol is preferred. For soils that contain about 10% fines, a dual symbol consisting of two symbols that are separated by a hyphen may be used. Dual symbols include GP-GM, SW-SC, and CL-ML.

**Table 3. Identification of Fine-Grained Soil**

Group Symbol	Coarse Fraction	Coarse Fraction	Sand or Gravel	Group Name	
CL	<30% plus No.200	<15% plus No.200		Lean CLAY	
		15-25% plus No.200	% sand $\geq$ % gravel	Lean CLAY with SAND	
	$\geq$ 30% plus No.200	15-25% plus No.200	% sand < % gravel	< 15% gravel	Lean CLAY with GRAVEL
			% sand $\geq$ % gravel	$\geq$ 15% gravel	SANDY lean CLAY
			% sand < % gravel	< 15% sand	SANDY lean CLAY with GRAVEL
			% sand < % gravel	$\geq$ 15% sand	GRAVELLY lean CLAY
ML	<30% plus No.200	<15% plus No.200		SILT	
		15-25% plus No.200	% sand $\geq$ % gravel	SILT with SAND	
	$\geq$ 30% plus No.200	15-25% plus No.200	% sand < % gravel	% sand < % gravel	SILT with GRAVEL
			% sand $\geq$ % gravel	< 15% gravel	SANDY SILT
			% sand < % gravel	$\geq$ 15% gravel	SANDY SILT with GRAVEL
			% sand < % gravel	< 15% sand	GRAVELLY SILT
CH	<30% plus No.200	<15% plus No.200		Fat CLAY	
		15-25% plus No.200	% sand $\geq$ % gravel	Fat CLAY with SAND	
	$\geq$ 30% plus No.200	15-25% plus No.200	% sand < % gravel	% sand < % gravel	Fat CLAY with GRAVEL
			% sand $\geq$ % gravel	< 15% gravel	SANDY fat CLAY
			% sand < % gravel	$\geq$ 15% gravel	SANDY fat CLAY with GRAVEL
			% sand < % gravel	< 15% sand	GRAVELLY fat CLAY
MH	<30% plus No.200	<15% plus No.200		Elastic SILT	
		15-25% plus No.200	% sand $\geq$ % gravel	Elastic SILT with SAND	
	$\geq$ 30% plus No.200	15-25% plus No.200	% sand < % gravel	% sand < % gravel	Elastic SILT with GRAVEL
			% sand $\geq$ % gravel	< 15% gravel	SANDY elastic SILT
			% sand < % gravel	$\geq$ 15% gravel	SANDY elastic SILT with GRAVEL
			% sand < % gravel	< 15% sand	GRAVELLY elastic SILT
OL/OH	<30% plus No.200	<15% plus No.200		ORGANIC SOIL	
		15-25% plus No.200	% sand $\geq$ % gravel	ORGANIC SOIL with SAND	
	$\geq$ 30% plus No.200	15-25% plus No.200	% sand < % gravel	% sand < % gravel	ORGANIC SOIL with GRAVEL
			% sand $\geq$ % gravel	< 15% gravel	SANDY ORGANIC SOIL
			% sand < % gravel	$\geq$ 15% gravel	SANDY ORGANIC SOIL with GRAVEL
			% sand < % gravel	< 15% sand	GRAVELLY ORGANIC SOIL
		$\geq$ 15% sand	GRAVELLY ORGANIC SOIL with SAND		

Figure 2-6 from Soil and Logging, Classification and Presentation Manual (Caltrans, 2010).

**Table 4. Identification of Coarse-Grained Soil**

	Fines	Grade	Type of Fines	Group Symbol	Sand/Gravel	Group Name
Gravel	≤ 5%	Well		GW	< 15% sand	Well-graded GRAVEL
					≥ 15% sand	Well-graded GRAVEL with SAND
		Poorly		GP	< 15% sand	Poorly-graded GRAVEL
					≥ 15% sand	Poorly-graded GRAVEL with SAND
	10%	Well	ML or MH	GW-GM	< 15% sand	Well-graded GRAVEL with SILT
					≥ 15% sand	Well-graded GRAVEL with SILT and SAND
			CL or CH	GW-GC	< 15% sand	Well-graded GRAVEL with CLAY
					≥ 15% sand	Well-graded GRAVEL with CLAY and SAND
		Poorly	ML or MH	GP-GM	< 15% sand	Poorly-graded GRAVEL with SILT
					≥ 15% sand	Poorly-graded GRAVEL with SILT and SAND
			CL or CH	GP-GC	< 15% sand	Poorly-graded GRAVEL with CLAY
					≥ 15% sand	Poorly-graded GRAVEL with CLAY and SAND
≥ 15%		ML or MH	GM	< 15% sand	SILTY GRAVEL	
				≥ 15% sand	SILTY GRAVEL with SAND	
	CL or CH	GC	< 15% sand	CLAYEY GRAVEL		
			≥ 15% sand	CLAYEY GRAVEL with SAND		
Sand	≤ 5%	Well		SW	< 15% gravel	Well-graded SAND
					≥ 15% gravel	Well-graded SAND with GRAVEL
		Poorly		SP	< 15% gravel	Poorly-graded SAND
					≥ 15% gravel	Poorly-graded SAND with GRAVEL
	10%	Well	ML or MH	SW-SM	< 15% gravel	Well-graded SAND with SILT
					≥ 15% gravel	Well-graded SAND with SILT and GRAVEL
			CL or CH	SW-SC	< 15% gravel	Well-graded SAND with CLAY
					≥ 15% gravel	Well-graded SAND with CLAY and GRAVEL
		Poorly	ML or MH	SP-SM	< 15% gravel	Poorly-graded SAND with SILT
					≥ 15% gravel	Poorly-graded SAND with SILT and GRAVEL
			CL or CH	SP-SC	< 15% gravel	Poorly-graded SAND with CLAY
					≥ 15% gravel	Poorly-graded SAND with CLAY and GRAVEL
≥ 15%		ML or MH	SM	< 15% gravel	SILTY SAND	
				≥ 15% gravel	SILTY SAND with GRAVEL	
	CL or CH	SC	< 15% gravel	CLAYEY SAND		
			≥ 15% gravel	CLAYEY SAND with GRAVEL		

Figure 2-8 from Soil and Logging, Classification and Presentation Manual (Caltrans, 2010).

### 4.2.3 Consistency of Cohesive Soil

The required field procedure for the determination of consistency of cohesive soil is to perform tests with a pocket penetrometer or torvane on relatively undisturbed samples, or to perform down-hole vane shear tests. The test result(s) are added to the description sequence using the syntax “PP = measurement”, “TV = measurement”, or “VS = measurement” where the measurement is in units of tons per square foot or tsf. Based upon the field test measurement, the consistency will range from very soft to hard (AASHTO 1988). The pocket penetrometer and other instrument tests provide an index of the unconfined compressive strength values (UCS) that can be correlated to the undrained shear strength value (Su) of the soil, but laboratory strength testing should be performed to validate field measurements.

For pocket penetrometer and torvane tests, the testing surface of the soil sample should be cleaned with a soil knife prior to performing the field test to remove any obvious signs of disturbance due to sample handling. Performing multiple pocket penetrometer tests and averaging the sum is recommended to ensure the consistency value is representative of the entire sample. Avoid performing field tests on an area that has visible hard fragments such as wood or gravel. Use the terms and criteria in Table 5 to describe the consistency of predominantly cohesive soil.

**Table 5. Consistency of Cohesive Soil**

Description	Pocket Penetrometer Measurement, PP,(tsf)	Torvane Measurement, TV,(tsf)	Vane Shear Measurement, VS,(tsf)
Very Soft	PP < 0.25	TV < 0.12	VS < 0.12
Soft	0.25 ≤ PP < 0.5	0.12 ≤ TV < 0.25	0.12 ≤ VS < 0.25
Medium Stiff	0.5 ≤ PP < 1	0.25 ≤ TV < 0.5	0.25 ≤ VS < 0.5
Stiff	1 ≤ PP < 2	0.5 ≤ TV < 1	0.5 ≤ VS < 1
Very Stiff	2 ≤ PP < 4	1 ≤ TV < 2	1 ≤ VS < 2
Hard	4 ≤ PP	2 ≤ TV	2 ≤ VS

Figure 2-9 from Soil and Logging, Classification and Presentation Manual (Caltrans, 2010).

#### 4.2.3.1 Apparent Density of Cohesionless Soil

The apparent density of predominantly cohesionless soil ranges from very loose to very dense and is described in accordance with ASTM D1586. Table 6 presents the density terms for cohesionless soils. The apparent density can be obtained from the N-value recorded during a Standard Penetration Test, that is then corrected for energy efficiency. An energy efficiency of 60% is considered standard per ASTM D4633.

**Table 6. Apparent Density of Cohesionless Soil**

Description	SPT $N_{60}$ (blows/ft)
Very Loose	$N_{60} < 5$
Loose	$5 \leq N_{60} < 10$
Medium Dense	$10 \leq N_{60} < 30$
Dense	$30 \leq N_{60} < 50$
Very dense	$50 \leq N_{60}$

Figure 2-10 from Soil and Logging, Classification and Presentation Manual (Caltrans, 2010).

The  $N_{60}$  value is defined as

$$N_{60} = N_{measured} * (ER_i/60)$$

The hammer energy ratio is known as the hammer efficiency and is obtained from the drilling contractor. This value can be assumed as 60% if the value is unknown at the time of drilling. After drilling, the value should be requested and the density descriptions should be checked and updated, if necessary.

$$ER_i = \text{Hammer energy ratio (\%)}$$

#### 4.2.3.2 Color

The predominant color(s) of the soil sample should be described during logging based on the Munsell Soil Color Charts (2009) and in accordance with ASTM D1535. The terms presented in Table 7 can be used if significant color variation is observed.

**Table 7. Color Terms**

Description	Definition	Examples
Variegated	Having streaks, marks, or patches of a different color or colors; varicolored	Variegated green, gray and black
Mottled	Having spots or blotches different colors	Mottled green, gray and black
Multicolored	Lots of colors (state predominant colors)	Multicolored, green, gray and black

Figure 2-11 from Soil and Logging, Classification and Presentation Manual (Caltrans, 2010).

#### 4.2.3.3 Moisture

The moisture of the soil should be evaluated after obtaining the soil sample, and prior to packaging, so that the in-situ state is described. Table 8 presents the moisture conditions.

**Table 8. Moisture**

Description	Criteria
Dry	No discernable moisture
Moist	Moisture present, but no free water
Wet	Visible free water

Figure 2-12 from Soil and Logging, Classification and Presentation Manual (Caltrans, 2010).

#### 4.2.3.4 Percent or Proportion of Soil

The percentage or proportion of gravel, sand, and fines in a soil should be evaluated by weight of the total sample (excluding the cobbles and boulders), either by using a proportional descriptor (seen in Table 9) or as a weight percentage (not using a range), that is estimated to the nearest 5% of the total sample. The soil should be described for each soil particle size identified in order of decreasing proportion. The percentages should be written on a borehole log in order of decreasing composition.

**Table 9. Percent of Proportion of Soil**

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	$5 \leq Pp \leq 10\%$
Little	$15 \leq Pp \leq 25\%$
Some	$30 \leq Pp \leq 45\%$
Mostly	$50 \leq Pp \leq 100\%$

Figure 2-13 from Soil and Logging, Classification and Presentation Manual (Caltrans, 2010).

#### 4.2.3.5 Particle Size

The particle sizes in a sample are described in Table 10. Typically, sand and gravel particles are readily identified due to their size; however, particles smaller than a silt are not easily discernible by visual examination.

**Table 10. Particle Size**

Description	Sieve Size	Approximate Particle Size (in)
Boulder	Greater than 12 in.	$12 < P_s$
Cobble	3 to 12 in.	$3 < P_s \leq 12$
Coarse Gravel	3/4 to 3 in.	$3/4 < P_s \leq 3$
Fine Gravel	No. 4 to 3/4 in.	$1/5 < P_s \leq 3/4$
Coarse Sand	No. 10 to No. 4	$1/16 < P_s \leq 1/5$
Medium Sand	No. 40 to No. 10	$1/64 < P_s \leq 1/16$
Fine Sand	No. 200 to No. 40	$1/300 < P_s \leq 1/64$
Silt and Clay	Passing No. 200	$P_s \leq 1/300$

Figure 2-14 from Soil and Logging, Classification and Presentation Manual (Caltrans, 2010).

To determine the range of particle sizes present in a sample, a sedimentation test can be performed. This is a field test that uses a small sample of the soil that is placed into a clean, clear vial and filled with water. The vial is sealed, shaken with the water, and placed down so that the particles can settle. For particles larger than a silt, it takes about ½ minute to drop a distance of 100 mm. This test offers a rough estimation of size and the proportion of particles in a sample.

#### 4.2.3.6 Particle Angularity

For coarse-grained soils, the angularity of particles can be described in accordance with Table 11. A range of particle sizes may be present for the same type of particle (i.e., “subangular to subrounded gravel”) and should be noted on the borehole log in order of increasing roundness.

**Table 11. Particle Angularity**

Description	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular	Particles are similar to angular description, but have rounded edges
Subrounded	Particles have nearly plane sides, but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges

Figure 2-15 from Soil and Logging, Classification and Presentation Manual (Caltrans, 2010).

#### 4.2.3.7 Particle Shape

The shape of the gravels, cobbles, and boulders can be described as flat, elongated, or a combination of both. Table 12 presents the description terms for particle shape.

**Table 12. Particle Shape**

Description	Criteria
Flat	Particles with width/thickness > 3
Elongated	Particles with length/width > 3
Flat and Elongated	Particles meet criteria for both flat and elongated

Figure 2-16 from Soil and Logging, Classification and Presentation Manual (Caltrans, 2010).

#### 4.2.3.8 Plasticity

The plasticity of a fine-grained soil is measured in the field by the ability to roll the sample into a 1/8-inch-thick thread based on the criteria presented in Table 13. Plasticity ranges from nonplastic to high plasticity for fine-grained soils.

**Table 13. Plasticity**

Description	Criteria
Nonplastic	A 1/8-in. thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

Figure 2-17 from Soil and Logging, Classification and Presentation Manual (Caltrans, 2010).

#### 4.2.3.9 Dry Strength

The dry strength is applicable for fine-grained soils and described using Table 14. The dry strength test is performed by allowing a portion of the sample to dry out and then pressed between the fingers. The dry fragments that cannot be crumbled or broken tend to exhibit high dry strength and plasticity. Fragments that can be crushed with gentle finger pressure are characteristic of low dry strength and plasticity.

**Table 14. Dry Strength**

Description	Criteria
None	The dry specimen crumbles into powder with mere pressure of handling.
Low	The dry specimen crumbles into powder with some finger pressure.
Medium	The dry specimen breaks into pieces or crumbles with considerable finger pressure.
High	The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface.
Very High	The dry specimen cannot be broken between the thumb and a hard surface.

Figure 2-18 from Soil and Logging, Classification and Presentation Manual (Caltrans, 2010).

#### 4.2.3.10 Dilatancy

The dilatancy of fine-grained soils can be determined through a dilatancy (shaking) test and described in accordance with Table 15. For a dilatancy test, water is dropped onto the sample while the soil is held in the palm of the hand until the sample shows a wet appearance on its surface when shaken or bounced. Then the soil should be lightly squeezed between the thumb and forefinger and released to observe its reaction. If the soil exhibits a dull dry surface upon squeezing and a glassy wet surface immediately upon releasing the pressure, the soil is considered to have rapid dilatancy that is typical of silty (nonplastic to low plasticity) soils.

**Table 15. Dilatancy**

Description	Criteria
None	No visible change in the specimen
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing

Figure 2-19 from Soil and Logging, Classification and Presentation Manual (Caltrans, 2010).

#### 4.2.3.11 Toughness

The toughness of fine-grained soils can be described in accordance with Table 16. A sample should be rolled by the palm of the hand on a smooth surface to a thread about 1/8-inch diameter. Fold and reroll the sample threads repeatedly until the thread crumbles at a diameter of about 1/8-inch to assess the soil's toughness at the plastic limit.

**Table 16. Toughness**

Description	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft.
Medium	Medium pressure is required to roll the thread to near the plastic limit. The thread and the lump have medium stiffness.
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness.

Figure 2-20 from Soil and Logging, Classification and Presentation Manual (Caltrans, 2010).

#### 4.2.3.12 Cementation

The cementation of intact coarse-grained soils can be described using Table 17.

**Table 17. Cementation**

Description	Criteria
Weak	Crumbles or breaks with handling or light finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

Figure 2-22 from Soil and Logging, Classification and Presentation Manual (Caltrans, 2010).

#### 4.2.3.13 Percent of Cobbles and Boulders

Particles greater than 3 inches in diameter are identified and described as "COBBLES," or "BOULDERS," or "COBBLES and BOULDERS". Cobbles and boulders must be reported by volume percentage (to the nearest 5%).

Isolated boulders may be treated as individual units and described as such. If the predominant constituent of the layer is estimated to be cobbles and/or boulders, the group name must be "COBBLES" or "BOULDERS" or "COBBLES and BOULDERS" with the matrix soil description following. There is no group symbol for cobbles and/or boulders.

#### 4.2.3.14 Description of Interbedded Soil

For interbedded soils, state the predominant soil group name and symbol followed by the bedding thickness of the components and the group name and symbol of the secondary layers. The bedding thickness categories are shown in Table 18.

**Table 18. Bedding Spacing**

Description	Thickness/Spacing, Sb
Massive	10 ft. < Sb
Very Thickly Bedded	3 ft. < Sb ≤ 10 ft.
Thickly Bedded	1 ft. < Sb ≤ 3 ft.
Moderately Bedded	4 in. < Sb ≤ 1 ft.
Thinly Bedded	1 in. < Sb ≤ 4 in.
Very Thinly Bedded	1/4 in. < Sb ≤ 1 in.
Laminated	Sb ≤ 1/4 in.

Figure 2-30 from Soil and Logging, Classification and Presentation Manual (Caltrans, 2010).

#### 4.2.3.15 Description of Fills

Fill materials are distinct from native soils in that they are artificial and should be documented for their thickness and soil type. Fill can consist of typical soils in addition to construction and paving remnants. While logging, write the word "FILL" in parenthesis after the soil description and include comments for additional materials in the soil description such as the presence of asphalt fragments or debris. For complex fills (e.g. interbedded and highly variable soil with multiple particle sizes), state the predominant soil group name and symbol followed by the layer thickness.

#### 4.2.3.16 Additional Comments

Additional comments that may be noted if encountered may include:

- Amount of roots or root holes
- Amount of mica, gypsum, etc.
- Presence of voids
- Surface coatings on coarse-grained particles
- Oxide staining
- Odor
- Cementing agents (e.g. calcium carbonate)
- Geologic formation name or soil survey unit name

#### 4.2.3.17 Other Drilling Observations

Other observations that should be noted on the borehole log include:

- Caving or sloughing of borehole and the vertical extent of the occurrence
- Difficulty in drilling (rig chatter)
- Changes in drill cuttings
- Ground water inflow
- Loss and return of drill fluid circulation
- Changes in drilling methods

## 5 References

- American Association of State Highway and Transportation Officials (AASHTO). (1988). Manual on Subsurface Investigations.
- ASTM International. (2016). ASTM D1452 / D1452M-16, Standard Practice for Soil Exploration and Sampling by Auger Borings. [https://doi.org/10.1520/D1452\\_D1452M-16](https://doi.org/10.1520/D1452_D1452M-16)
- ASTM International. (2018). ASTM D1535-14, Standard Practice for Specifying Color by the Munsell System, <https://doi.org/10.1520/D1535-14R18>
- ASTM International. (2018). ASTM D1586 / D1586M-18, Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils. [https://doi.org/10.1520/D1586\\_D1586M-18](https://doi.org/10.1520/D1586_D1586M-18)
- ASTM International. (2015). ASTM D1587 / D1587M-15, Standard Practice for Thin-Walled Tube Sampling of Fine-Grained Soils for Geotechnical Purposes. [https://doi.org/10.1520/D1587\\_D1587M-15](https://doi.org/10.1520/D1587_D1587M-15)
- ASTM International. (2017). ASTM D2487-17e1, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System). <https://doi.org/10.1520/D2487-17E01>
- ASTM International. (2017). ASTM D2488-17e1, Standard Practice for Description and Identification of Soils (Visual-Manual Procedures). <https://doi.org/10.1520/D2488-17E01>
- ASTM International. (2017). ASTM D3550 / D3550M-17, Standard Practice for Thick Wall, Ring-Lined, Split Barrel, Drive Sampling of Soils. [https://doi.org/10.1520/D3550\\_D3550M-17](https://doi.org/10.1520/D3550_D3550M-17)
- ASTM International. (2014). ASTM D4220 / D4220M-14, Standard Practices for Preserving and Transporting Soil Samples. [https://doi.org/10.1520/D4220\\_D4220M-14](https://doi.org/10.1520/D4220_D4220M-14)
- ASTM International. (2016). ASTM D4633-16, Standard Test Method for Energy Measurement for Dynamic Penetrometers. <https://doi.org/10.1520/D4633-16>
- ASTM International. (2016). ASTM D4648 / D4648M-16, Standard Test Methods for Laboratory Miniature Vane Shear Test for Saturated Fine-Grained Clayey Soil. [https://doi.org/10.1520/D4648\\_D4648M-16](https://doi.org/10.1520/D4648_D4648M-16)
- ASTM International. (2018). ASTM D5783-18, Standard Guide for Use of Direct Rotary Drilling with Water-Based Drilling Fluid for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices. <https://doi.org/10.1520/D5783-18>
- ASTM International. (2015). ASTM D6151 / D6151M-15, Standard Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling. [https://doi.org/10.1520/D6151\\_D6151M-15](https://doi.org/10.1520/D6151_D6151M-15)
- ASTM International. (2015). ASTM D6519-15, Standard Practice for Sampling of Soil Using the Hydraulically Operated Stationary Piston Sampler. <https://doi.org/10.1520/D6519-15>
- California Department of Transportation (Caltrans), Division of Engineering Services, Geotechnical Services. (2010). Soil and Rock Logging, Classification, and Presentation Manual.
- Mayne, P. W., Christopher, B. R., & DeJong, J. (2002). Subsurface Investigations--Geotechnical Site Characterization: Reference Manual (No. FHWA-NHI-01-031). United States. Federal Highway Administration.
- Munsell Color. (2009). Munsell Soil Color Book.

United States Department of the Interior, Bureau of Reclamation (2001). Engineering Geology Field Manual. Second Edition.

## **Appendix A. Blank Borehole Log**



## **Appendix B. Example Borehole Log**



## **Appendix C. Borehole Legend Sheet**

MAJOR DIVISIONS			GROUP NAMES		GENERAL NOTES
COARSE-GRAINED SOILS More than 50% retained on the No. 200 sieve	GRAVELS  MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	Clean gravels less than 5% fines	<b>GW</b>		
		Gravels with 5-12% fines	<b>GP</b>		Poorly Graded Gravel
			<b>GW-GM</b>		Well-Graded Gravel with Silt
			<b>GW-GC</b>		Well-Graded Gravel with Clay (or Silty Clay)
			<b>GP-GM</b>		Poorly Graded Gravel with Silt
			<b>GP-GC</b>		Poorly Graded Gravel with Clay (or Silty Clay)
			Gravels with more than 12% fines	<b>GM</b>	
		<b>GC</b>			Clayey Gravel
		<b>GC-GM</b>			Silty, Clayey Gravel
	SANDS  MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	Clean sand less than 5% fines	<b>SW</b>		Well-Graded Sand
		Sands with 5-12% fines	<b>SP</b>		Poorly Graded Sand
			<b>SW-SM</b>		Well-Graded Sand with Silt
			<b>SW-SC</b>		Well-Graded Sand with Clay (or Silty Clay)
			<b>SP-SM</b>		Poorly Graded Sand with Silt
			<b>SP-SC</b>		Poorly Graded Sand with Clay (or Silty Clay)
			Sands with more than 12% fines	<b>SM</b>	
		<b>SC</b>			Clayey Sand
		<b>SC-SM</b>			Silty, Clayey Sand
FINE-GRAINED SOILS 50% or more passes the No. 200 sieve	SILTS AND CLAYS  Liquid Limit Less than 50%	<b>ML</b>		Silt	
		<b>CL</b>		Lean Clay	
		<b>CL-ML</b>		Silty Clay	
	SILTS AND CLAYS  Liquid Limit Greater than 50%	<b>OL</b>		Organic Silt	
		<b>MH</b>		Elastic Silt	
		<b>CH</b>		Fat Clay	
	<b>OH</b>		Organic Clay		
	HIGHLY ORGANIC SOILS	<b>PT</b>		Peat or Highly Organic Soils	
		<b>FILL</b>		Debris or Mixed Fill	
	<b>AC</b>		Asphalt Concrete Pavement with Aggregate Base		

**GENERAL NOTES**

Classification of Soils per ASTM D2487 or D2488

Geologic Formation noted in bold font at the top of interpreted interval

Uncorrected Blowcounts for Modified California Liner Sampler shown in " ( ) "

Length of sample symbol approximates recovery length

**SAMPLER DRIVING RESISTANCE**

Number of blows with 140 lb. hammer, falling 30-in. to drive sampler 1-ft. after seating sampler 6-in.; for example,

Blows/ft	Description
25	25 blows drove sampler 12" after initial 6" of seating
50/7"	50 blows drove sampler 7" after initial 6" of seating
Ref/3"	50 blows drove sampler 3" during initial 6" seating interval (Ref=Refusal)

**STRENGTH TEST METHOD**

UC = Unconfined Compression  
TXUU = Unconsolidated Undrained Triaxial  
TXCU = Consolidated Undrained Triaxial  
tv = Pocket Torvane  
pp = Pocket Penetrometer  
FV = Field Vane Shear Test

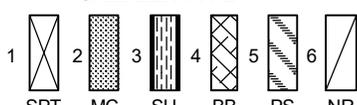
**OTHER TESTS**

k = Permeability  
Consol = Consolidation  
Gs = Specific Gravity  
MA = Particle Size Analysis  
PM = Pressuremeter  
EI = Expansion Index  
LEL = Lower Explosive Limit  
OXY = Oxygen Level Reading (%)  
OVM = Organic Vapor Measurement  
CR = Corrosion  
Abr. = SAT - Soil Abrasion Test

**WATER LEVEL SYMBOLS**

∇ Measured Depth to Water at Time of Drilling

**SAMPLER TYPE**



1 SPT  
2 MC  
3 SH  
4 BB  
5 PS  
6 NR

Samplers and sampler dimensions (unless otherwise noted in report text) are as follows:

1 SPT Sampler, driven 1 3/8" ID, 2" OD	4 Bulk Bag Sample (from cuttings)
2 MOD CA Liner Sampler 2.416" ID, 3" OD	5 Pitcher Sample
3 Shelby Thin-walled Tube, pushed 2 7/8" ID, 3" OD	6 No Recovery

**SOIL STRUCTURE**

Fissured: Containing shrinkage or relief cracks, often filled with fine sand or silt, usually more or less vertical.

Pocket: Inclusion of material of different texture that is smaller than the diameter of the sample.

Parting: Inclusion less than 1/8 inch thick extending through the sample.

Seam: Inclusion 1/8 inch to 3 inches thick extending through the sample.

Layer: Inclusion greater than 3 inches thick extending through the sample.

Laminated: Soil sample composed of alternating partings or seams of different soil types.

Interlayered: Soil sample composed of alternating layers of different soil type.

Homogeneous: Uniform composition

CONSISTENCY			RELATIVE DENSITY		INCREASING VISUAL MOISTURE CONTENT
Clays	Blows/Foot SPT	Pocket Penetrometer (tsf)	Sands and Gravels	Blows/Foot SPT	
<b>Very Soft</b>	< 2	0 - 0.25	<b>Very Loose</b>	0 - 4	↓ Dry Moist Wet
<b>Soft</b>	2 - 4	0.25 - 0.5	<b>Loose</b>	4 - 10	
<b>Medium</b>	4 - 8	0.5 - 1	<b>Medium Dense</b>	10 - 30	
<b>Stiff</b>	8 - 15	1 - 2	<b>Dense</b>	30 - 50	
<b>Very Stiff</b>	15 - 30	2 - 4	<b>Very Dense</b>	Over 50	
<b>Hard</b>	> 30	Over 4			

Information on each boring log is a compilation of subsurface conditions and soil or rock classifications obtained from the field as well as from laboratory testing of samples. Strata have been interpreted by commonly accepted procedures. The stratum lines on the logs may be transitional and approximate in nature. Water level measurements refer only to those observed at the time and places indicated, and can vary with time, geologic condition, or construction activity.

## TERMS AND SYMBOLS USED ON BORING LOGS

## **APPENDIX B**

### **FIELD SAMPLING FORMS**

1. Daily Equipment Calibration Log
2. Waste Tracking Log
3. Bank Erosion Hazard Index
4. Structural Inspection Form
5. Physical Shoreline Inspection Form
6. Near-Bank Stress Risk

(Individual SOPs also include forms to be used, which are not listed here)

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**Worksheet 3-11.** Form to calculate an overall Bank Erosion Hazard Index (BEHI) rating. Use **Figure 3-7** to determine individual BEHI scores.

<b>Bank Erosion Hazard Index (BEHI)</b>										
Stream:					Location:					
Station:					Observers:					
Date:	Stream Type:			Valley Type:						
<b>Study Bank Height to Bankfull Height ( C )</b>										
Study Bank Height (ft) =		<b>(A)</b>			<b>(B)</b>			<b>(C)</b>		<b>BEHI Score</b> <small>(Fig. 3-7)</small>
Root Depth (ft) =		<b>(D)</b>			<b>(A)</b>			<b>(E)</b>		
Root Density as % =		<b>(F)</b>			<b>(G)</b>			<b>(G)</b>		
<b>Bank Material Adjustment:</b>										
<b>Bedrock</b> (Overall Very Low BEHI)						<div style="display: flex; align-items: center; justify-content: center;"> <div style="font-size: 2em; margin-right: 10px;">➔</div> <div style="border: 1px solid black; padding: 5px;"> <b>Bank Material Adjustment</b> </div> </div>				
<b>Boulders</b> (Overall Low BEHI)										
<b>Cobble</b> (Subtract 10 points if uniform medium to large cobble)										
of bank material that is composed of sand										
<b>Sand</b> (Add 10 points)						<div style="display: flex; align-items: center; justify-content: center;"> <div style="font-size: 2em; margin-right: 10px;">➔</div> <div style="border: 1px solid black; padding: 5px;"> <b>Bank Material Adjustment</b> </div> </div>				
<b>Silt/Clay</b> (no adjustment unless primarily clay, then subtract 20 points)										
						<div style="display: flex; align-items: center; justify-content: center;"> <div style="font-size: 2em; margin-right: 10px;">➔</div> <div style="border: 1px solid black; padding: 5px;"> <b>Bank Material Adjustment</b> </div> </div>				
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Structural Inspection Form  
**SIB** Project Area, Portland Harbor Superfund Site

This field form was developed from the *Waterfront Facilities Inspection and Assessment* (ASCE, 2015) (Manual). An assessment using this form must be completed for each structure along the river bank with different physical and material characteristics because of the unique potential for instability each structure possesses. The level of inspection performed will be a non-destructive level 1 inspection. For further detail regarding Structural Inspection requirements, please refer to Section 3.2.2.2 of the Manual. As needed, information to complete this form may need to be obtained from topographic or bathymetric surveys or from available online reference for Portland Harbor, such as USGS gauging stations.

Prepared by: \_\_\_\_\_ Date: \_\_\_\_\_

Reviewed by: \_\_\_\_\_ Date: \_\_\_\_\_

<b>River Mile Segment:</b>	
<b>Use of river bank segment:</b>	
<b>Structure type:</b>	
<b>Structure material:</b>	
<b>Width and Depth of the River:</b>	
<b>Stream Velocity and Stage:</b>	
<b>Wind- and Boat-Induced Waves?</b>	

<b>GPS points collected within tenth of RM:</b>		
Location ID	Description of point:	Photo Taken (Y/N)?
<b>Additional Notes/Observations:</b>		



Physical Shoreline Inspection Form  
**SIB** Project Area, Portland Harbor Superfund Site

This field form was developed from the *Guidance for River Bank Characterizations and Evaluations at the Portland Harbor Superfund Site* (USEPA, 2019) (Guidance). An assessment using this form must be completed for each geomorphic area or segment of the river bank with different physical and material characteristics because of the unique potential for erodibility each segment possesses. For further detail regarding Physical Shoreline Inspection requirements, please refer to Section 2.3 of the Guidance. As needed, information to complete this form may need to be obtained from topographic or bathymetric surveys or from available online reference for Portland Harbor, such as USGS gauging stations.

Prepared by: \_\_\_\_\_ Date: \_\_\_\_\_

Reviewed by: \_\_\_\_\_ Date: \_\_\_\_\_

<b>River Mile Segment:</b>			
<b>Use of river bank segment:</b>			
<b>Bank Angle:</b>			
<b>Alignment of the River:</b>			
<b>Width and Depth of the River:</b>			
<b>Stream Velocity and Stage:</b>			
<b>Wind- and Boat-Induced Waves?</b>			
<b>River Bank Surface Protection:</b>			
Type of Surface Protection (woody debris, rooted vegetation, embedded boulders, revetment, bedrock, etc.):	% of Bank Covered by Surface Protection	Location of protection relative to the toe of the slop, top of the bank, and OHW elevation	
Type and Size of Armoring (riprap, rock, gravel, concrete, gabions, retaining walls, etc.):	% of Bank Covered by Armoring	Condition of armoring (stable, unstable, sloughing into river, etc.)	Location of armoring relative to the toe of the slop, top of the bank, and OHW elevation

Physical Shoreline Inspection Form  
**SIB** Project Area, Portland Harbor Superfund Site

River Bank Vegetation Type:	% of Bank Covered by Vegetation	Root Depth (depth relative to bank height in %):	Root Density (% of bank surface covered by roots):
<b>River Bank Soil Types classified using the Unified Soil Classification System determined by ASTM D2488:</b>			
Bedrock %:	Cobble %:	Sand or mostly sand %:	
Boulders %:	Gravel or mostly gravel %:	Silt or clay %:	
<b>Bank stratification (circle one):</b>	No layers	Single layer of erodible material	Multiple layers of erodible material
<b>Visible indicators of active river bank erosion due to overland flow, wave and/or vessel wake, or other factors?</b> Describe and document via photograph and GPS coordinates when possible.			
<b>Evidence of previous river bank SCMs. Describe current integrity in providing protection against erosion.</b>			
<b>Presence of Aquatic Vegetation?</b>		Yes	No
<b>GPS points collected within tenth of RM:</b>			
Location ID	Description of point:	Photo Taken (Y/N)?	
<b>Additional Notes/Observations:</b>			

**Worksheet 3-12.** Various field methods of estimating Near-Bank Stress (NBS) risk ratings to calculate an erosion rate.

Estimating Near-Bank Stress ( NBS )									
Stream:					Location:				
Station:			Stream Type:			Valley Type:			
Observers:					Date:				
Methods for Estimating Near-Bank Stress (NBS)									
(1) Channel pattern, transverse bar, or central bar creating NBS					Level I	Reconnaissance			
(2) Radius of curvature to bankfull width ( $R_c / W_{bkf}$ )					Level II	General Prediction			
(3) Pool slope to average water surface slope ( $S_p / S$ )					Level II	General Prediction			
(4) Pool slope to riffle slope ( $S_p / S_{rif}$ )					Level II	General Prediction			
(5) Near-bank maximum depth to bankfull mean depth ( $d_{nb} / d_{bkf}$ )					Level III	Detailed Prediction			
(6) Near-bank shear stress to bankfull shear stress ( $\tau_{nb} / \tau_{bkf}$ )					Level III	Detailed Prediction			
(7) Velocity profiles / Isovels / Velocity gradient					Level IV	Validation			
<b>Level I</b>	<b>(1)</b>	Transverse or central bars - short or discontinuous.....			<b>NBS = High / Very High</b>				
		Extensive deposition (continuous, cross-channel).....			<b>NBS = Extreme</b>				
		Chute cutoffs, down-valley meander migration, converging flow.....			<b>NBS = Extreme</b>				
<b>Level II</b>	<b>(2)</b>	Radius of Curvature $R_c$ (ft)	Bankfull Width $W_{bkf}$ (ft)	Ratio $R_c / W_{bkf}$	Near-Bank Stress (NBS)	<div style="border: 2px solid black; padding: 10px; width: fit-content; margin: auto;"> <b>Dominant Near-Bank Stress</b> </div>			
	<b>(3)</b>	Pool Slope $S_p$	Average Slope $S$	Ratio $S_p / S$	Near-Bank Stress (NBS)				
<b>(4)</b>	Pool Slope $S_p$	Riffle Slope $S_{rif}$	Ratio $S_p / S_{rif}$	Near-Bank Stress (NBS)					
<b>Level III</b>	<b>(5)</b>	Near-Bank Max Depth $d_{nb}$ (ft)	Mean Depth $d_{bkf}$ (ft)	Ratio $d_{nb} / d_{bkf}$	Near-Bank Stress (NBS)				
<b>(6)</b>	Near-Bank Max Depth $d_{nb}$ (ft)	Near-Bank Slope $S_{nb}$	Near-Bank Shear Stress $\tau_{nb}$ ( lb/ft <sup>2</sup> )	Mean Depth $d_{bkf}$ (ft)	Average Slope $S$	Bankfull Shear Stress $\tau_{bkf}$ (lb/ft <sup>2</sup> )	Ratio $\tau_{nb} / \tau_{bkf}$	Near-Bank Stress (NBS)	
<b>Level IV</b>	<b>(7)</b>	Velocity Gradient ( ft / sec / ft )		Near-Bank Stress (NBS)					
Converting Values to a Near-Bank Stress (NBS) Rating									
Near-Bank Stress (NBS) Ratings	Method Number								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)		
<b>Very Low</b>	N / A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50		
<b>Low</b>	N / A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00		
<b>Moderate</b>	N / A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60		
<b>High</b>	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00		
<b>Very High</b>	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40		
<b>Extreme</b>	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40		
<b>Overall Near-Bank Stress (NBS) Rating</b>									

## **APPENDIX C**

### **WASTE MANAGEMENT PLAN**

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**FINAL  
WASTE MANAGEMENT PLAN  
REVISION 3**

**REMEDIAL DESIGN SERVICES  
SWAN ISLAND BASIN PROJECT AREA  
PORTLAND HARBOR SUPERFUND SITE  
PORTLAND, MULTNOMAH COUNTY, OREGON  
CERCLA DOCKET NO. 10-2021-001**

**Contract Number: DT2002**

*Prepared for:*

**Swan Island Basin Remedial Design Group**

*Prepared by:*



**11107 Sunset Hills Road, Suite 400  
Reston, Virginia 20190**

*With assistance from:*



**May 2022**

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**Waste Management Plan  
Swan Island Basin Project Area  
Portland Harbor Superfund Site**

**Record of Changes / Summary of Revisions**

<b>Revision No.</b>	<b>Revision Date</b>	<b>Document Name (If other than entire document, list revised sections or pages)</b>
0	June 29, 2021	Draft Field Sampling Plan for EPA review
1	December 10, 2021	Revisions per EPA comments received August 13, 2021
2	March 16, 2022	Revisions per EPA comments received February 1, 2022
3	May 10, 2022	Revisions per EPA comments received April 5, 2022

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## LIST OF ACRONYMS AND ABBREVIATIONS

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%	percent
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
HASP	Health and Safety Plan
HGL	HydroGeoLogic, Inc.
ID	identification
IDW	investigation-derived wastes
LDR	Land Disposal Restriction
MSW	municipal solid waste
OAR	Oregon Administrative Rule
OSR	Office of Solid Waste
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyls
PID	photoionization detector
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
ROC	Regional OSR Contact
RPM	Remedial Program Manager
SOS	Scope of Services
SVOC	semi-volatile organic compound
TBD	to be determined
TCLP	toxicity characteristic leaching procedure
TSCA	Toxic Substances Control Act
TSDF	treatment, storage, and disposal facility
UFP	Uniform Federal Policy
UN	United Nations
VOC	volatile organic compound

## LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

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WM	waste manager
WMP	Waste Management Plan
WTL	Waste Tracking Log

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**WASTE MANAGEMENT PLAN  
SWAN ISLAND BASIN PROJECT AREA  
PORTLAND HARBOR SUPERFUND SITE  
PORTLAND, MULTNOMAH COUNTY, OREGON**

## **1.0 INTRODUCTION**

The Waste Management Plan (WMP) describes the procedures for safe handling, storage, transport, and disposal of investigation-derived wastes (IDW) generated during fieldwork. Wastes that are expected to be generated include excess sediments and/or soil from sampling, decontamination water, PPE and disposable sampling equipment, and municipal waste.

The following general guidelines will be followed to minimize the volume of waste streams generated during the project:

- Hazardous wastes will not be combined with non-hazardous wastes, and non-hazardous wastes will not be combined with non-contaminated wastes; waste types will be segregated so wastes are not unnecessarily managed or disposed;
- Cleaning and extra sampling supplies will be maintained outside potentially contaminated area to keep them clean and to minimize additional waste generation;
- Work will be planned ahead; selection of drilling locations, drilling methods, and sampling methods can help to reduce the amount of waste generated;
- Material and equipment will be decontaminated and reused when practical;
- Waste should be packed appropriately to minimize the number of containers. Bins containing soil should not be filled more than  $\frac{1}{2}$  to  $\frac{2}{3}$  full to avoid exceeding U.S. Department of Transportation (DOT) transport weight requirements;
- Appropriate waste containers, adequate to contain the volume of waste generated, will be used;
- Use of hazardous substances will be minimized; only the volume of standard solutions needed for testing will be brought, and minimal amounts of decontamination water will be used.

Work closely with you HydroGeoLogic, Inc. (HGL) Waste Manager (WM), Jody Sanchez, to ensure all waste is managed within the requirements of this plan.

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## **2.0 CHARACTERIZATION AND SAMPLING**

Waste generated from investigation activities that is not considered municipal solid waste (MSW) will undergo a waste-stream-specific hazardous waste determination for disposal at a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Office of Solid Waste (OSR) approved landfill in accordance with 40 CFR 300.440. Off-site treatment or disposal facilities will use the waste profile and supporting documentation, such as analytical data, to determine whether a waste meets the waste acceptance criteria. It is anticipated that sediment and decontamination water generated during the field activities will be characterized as nonhazardous. Additionally, the quantity of general waste will be estimated and the most cost-efficient method for containment will be determined.

Oregon Administrative Rule (OAR) 340-101-0033 lists wastes that are State-only hazardous wastes. State only hazardous wastes include pesticide residues and mixtures of wastes containing constituents of Federal P (3 percent [%]) & U (10%) listed wastes (see lists in 40 CFR 261.31 and 261.32).

The sampling procedures and analytical requirements are described below.

### **2.1 SOIL AND SEDIMENT**

Solid waste samples for characterization will be collected according to the following guidelines. Off-site treatment or disposal facilities may have different sampling requirements.

- One 5-point composite sample will be collected per 10 drums, per location and/or area for nonvolatile wastes;
- A single grab sample will be collected for volatile wastes. The grab sample will be collected from the drum that contains the location with the highest photoionization detector (PID) readings, or other indications of contamination.
- Analysis for each waste stream from each site will be based onsite history and potential constituents of concern for the Site. Analyses will be conducted in accordance with the methods and procedures outlined in the Worksheet #12 and #15 of the Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP).

Potential waste characterization analysis parameters for solid media include the following:

- Volatile Organic Compounds (VOCs);
- Semi-Volatile Organic Compounds (SVOCs);
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Herbicides;
- Pesticides;
- Resource Conservation and Recovery Act (RCRA) Metals;
- Polychlorinated Biphenyls (PCBs);
- Dioxins and Furans;

- pH;
- Flashpoint.

Additional parameters may be required by the disposal facility and will be added accordingly. Samples for toxicity characteristic leaching procedure (TCLP) analyses will be collected and put on hold. If any of the analytical results exceed 20x the TCLP waste criteria, these analyses will be conducted.

The waste characterization sample will be obtained from a container as follows:

- Procedure for Collecting Volatile Fractions:
  1. Using a hand auger or other device, retrieve a core from the container;
  2. Remove the core from the auger or other device using a disposable Terra Core sampler and place the sample into pre-preserved volatile organic analysis vials. The transfer operation should be completed in one minute or less to minimize loss of volatile components;
- Procedure for Collecting Non-Volatile Fractions:
  1. Collect several spoonfuls of the soil into a stainless steel bowl from five randomly selected sample locations and depths;
  2. Homogenize the five grab samples by quartering techniques using the stainless steel spoon;
  3. Fill the appropriate sample jars completely full of the homogenized sample;
  4. Close the jar, label the jar, and package the sample for shipment to the laboratory.

## **2.2 WASTEWATER CHARACTERIZATION SAMPLING**

Wastewater samples for characterization will be collected according to the following guidelines. Off-site treatment or disposal facilities may have different sampling requirements.

- One composite sample will be collected per 10 drums, per location and/or area for non-volatile wastes;
- A single grab sample will be collected for volatile wastes. The grab sample will be collected from the drum that contains the location with the highest PID readings, or other indications of contamination.

Analysis for each waste stream, for each investigation activity, will be based on-site history and potential constituents of concern for the Site. Analyses will be conducted in accordance with the methods and procedures outlined in the UFP-QAPP HGL, (2021).

Potential waste characterization analysis parameters for wastewater include the following:

- VOCs;
- SVOCs;

- PAHs;
- Herbicides;
- Pesticides;
- RCRA Metals;
- PCBs;
- Dioxins and Furans;
- pH.

Additional parameters may be required by the disposal facility and will be added accordingly.

Wastewater analytical results are directly comparable to the TCLP criteria; TCLP analyses will not be conducted on liquid samples unless the percent solids is greater than or equal to 0.5%.

The waste characterization sample will be obtained from a container as follows:

1. Collect a water sample from the container using a bailer or dip jar;
2. Fill the grab sample containers for VOC analysis first. Fill the containers so that there is no headspace;
3. Fill the sample containers for the remaining analyses;
4. Label and package the samples for shipment to the laboratory.

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### **3.0 GENERAL WASTE MANAGEMENT**

Wastes will be managed as hazardous if identified as containing a listed hazardous waste, or until analytical results are received and the waste is characterized as nonhazardous. Potentially hazardous wastes that are more-obviously highly contaminated, as evidenced by visual, olfactory, or vapor screening criteria, will be managed in separate containers from less-obviously contaminated wastes of the same media. All wastes will be containerized, and a waste determination made before it is disposed of at an appropriate waste facility. Waste disposal will occur as described below and is also addressed the Investigation Derived Waste Instructions Scope of Services (SOS) for further information (September 2020; Appendix D).

Any excess water or sediment spilled on the deck of the sampling vessel will be washed into the surface waters at the collection on-site before proceeding to the next station.

Phosphate-free detergent-bearing liquid wastes from decontamination of the sampling equipment will be sampled for site contaminants of concern. If discharge to a sanitary sewer system is identified as the most cost-effective method, the appropriate representative at the Portland Bureau of Environmental Services will be identified to request permission to discharge.

Due to the nature of the contaminants of concern at this site disposable or expendable materials such as Tyvek, gloves, sampling spoons, paper towels, plastic sheeting, and other used sampling material generated during sampling will be placed in drums for disposal at as nonhazardous waste at a Subtitle D (nonhazardous) landfill. Used core tubes will be decontaminated and then recycled to prevent potential further contamination at the waste facility.

In general, waste containing  $\geq 50$  ppm PCBs may be stored onsite for 180 days from the date of generation, as indicated under 40 CFR 761.65(c)(9) for PCB bulk product waste and PCB remediation waste. PCB-contaminated media is regulated as bulk PCB remediation waste and requires characterization for disposal. Final disposition is based on the as-found concentrations of PCBs within the media. If PCB concentrations exceed 50 ppm, the waste is considered a federal Toxic Substances Control Act (TSCA) PCB waste and must be transported off-site to a Class 1 disposal facility (permitted by the Oregon Department of Environmental Quality) by a licensed hazardous waste transporter within 90 days of the accumulation start date.

A waste designation memo (as noted in the SOS), if appropriate, will describe the characterization of any RCRA wastes (evaluated as part of the Remedial Design) and present the data needs necessary to arrange for the off-site disposal of the wastes at an appropriate facility.

If hazardous waste material is in exceedance of 10 cubic yards, workers may ship the waste from the Site to an out-of-state waste management facility only if, prior to any shipment, they provide notice to the appropriate state environmental official in the receiving facility's state and to the U.S. Environmental Protection Agency (EPA) Project Coordinator. The notice must include the following information, if available: (1) the name and location of the receiving facility; (2) the type and quantity of waste material to be shipped; (3) the schedule for the shipment; and (4) the method of transportation. Respondents also shall notify the state environmental official referenced above and the EPA Project Coordinator of any major changes in the shipment plan, such as a decision to

ship the waste material to a different out-of-state facility. Respondents shall provide the notice as soon as practicable after the award of the contract and before the waste material is shipped. This notice requirement does not apply to any off-Site shipments when the total quantity does not exceed 10 cubic yards.

### **3.1 CONTAINERS AND ACCUMULATION**

Hazardous wastes, Oregon State Only hazardous wastes, and potentially hazardous wastes will be stored consistent with the applicable requirements of 40 CFR Part 262. Storage containers used for transportation of hazardous wastes will comply with the requirements of 49 CFR Part 178. All wastes will be containerized in United Nations (UN) certified, 55-gallon, steel drums (1A2).

The waste accumulation area is identified as the staging area at the Fred Divine Dock in coordination with the marine vessel subcontractor. Figure C-1 denotes the location of the primary waste accumulation area; an alternate waste accumulate area is shown in case there are logistical conflicts with the primary location. The field crew will use the waste accumulation area to process samples and drum waste for designation and disposal. Good housekeeping practices will be maintained at waste accumulation areas. Waste accumulation areas, as well as fuel and chemical storage areas, will be protected from on-site and off-site vehicle traffic. Also, the waste accumulation area will be constructed with a secondary containment system consisting of a plastic-lined area with 2x4s or waddles and/or a pre-constructed system.

Containers of hazardous, State Only, and potentially hazardous wastes will be inspected and documented weekly for evidence of deterioration or leaks. Containers will be appropriately labeled as containing hazardous waste and the accumulation start date will be noted. The amount of wastes generated, both hazardous and nonhazardous, during field work will be documented on a waste tracking log (WTL) (WTL, Appendix B of the FSP).

Hazardous wastes may be stored on-site or accumulated in containers for a maximum of 90 days. The 90-day period begins on the date the waste is first generated and containerized.

Waste accumulation areas will contain emergency response equipment appropriate for the hazards associated with the generated IDW. The project Health and Safety Plan (HASP) for the Site identifies the project emergency response procedures, equipment, contacts, and phone numbers. Hazardous waste storage areas will have fire extinguishers for wastes known or suspected to be flammable or ignitable; decontamination equipment including an eyewash station; and an alarm system, radio, or cell phone available to staff working in the hazardous waste accumulation area. Spill control equipment, such as sorbent pads, will be available in the waste accumulation areas and in places where liquids are transferred between vessels.

Waste accumulation areas will be inspected and documented for malfunctions, deterioration, discharges, and leaks. Inspections will be performed monthly at a minimum. Hazardous waste containers will be inspected at least weekly for leaks, corrosion, or general deterioration. Inspections will be documented on an inspection form and in the field notebook. Deficiencies will be corrected immediately. If field work suspends for more than 7 days, alternative arrangements for weekly inspection of the hazardous waste containers will be made. Prior to demobilization, hazardous wastes will be disposed of.

### **3.2 DRUM REQUIREMENTS**

The following guidelines relate to accumulation of waste in small containers such as 55-gallon drums:

- Only new UN-approved drums will be used. Reconditioned drums purchased from an outside source are not acceptable. It is acceptable to reuse new drums from the Site that are in good condition and have been steam cleaned or if wastes are solid and nonhazardous;
- Drums will be inspected and inventoried on arrival for signs of contamination and deterioration. Compromised drums will be rejected;
- Drums will have UN approval numbers embossed on the bottom or stenciled on the side, “1A2/Y1.7/150” for liquids and “1A2/X425/S” for solids;
- Drums should be removable-head-type drums without bungs. Bung holes in the lid are acceptable for special applications, but bung holes in the side of the drum are never acceptable;
- No penetrating dents are allowed that could affect the integrity of the drum. Pay special attention to any dents at the drum seams. Use the highest level of integrity standards for drums intended to contain liquids;
- Adequate aisle space, minimum 30 inches, will be provided for containers such as 55 gallon drums to allow the unobstructed movement of personnel and equipment. A row of drums should be no more than two drums wide;
- Each drum will be provided with its own label, and labels will be visible (facing into the aisle);
- Drum lids/bungs will remain covered/closed except when removing or adding waste to the drum. Lids should fit correctly, and the gasket must be in good condition. Lids/Bungs will be properly secured at the end of each workday. “Closed” means rings are on and bolts are tightened down. Lids and bungs will be tightened for transport as required by DOT shipping regulations;
- When drums are being filled, make sure there is only one (1) waste stream being placed in the drum. Do not overfill containers. If drums are stored on pallets make sure the pallets are undamaged.
- Drums will be disposed of with the contents. If the contents are removed from the drums for off-site transportation and treatment or disposal, the drums will be decontaminated prior to reuse or before leaving the Site. If drums are emptied and stored on-site, they will be labeled with the word “empty” and the date they were emptied. Empty drums should be removed from the site within one (1) year;
- Drums containing liquids or hazardous waste will be provided with secondary containment and may not be located near a stormwater inlet or conveyance;
- Secondary containment systems will have sufficient capacity to contain 10% of the volume of containers or the volume of the largest container, whichever is greater, plus

the maximum rainfall from a 25-year, 24-hour storm event. Spilled or leaked waste and accumulated precipitation will be removed from the sump or collection area in a timely manner to prevent overflow of the collection system;

- The outsides of the drums must be free of hazardous waste residues;
- If drums become damaged to begin to leak, the contents will be immediately transferred to another container and the drum removed from service or the drum can be overpacked.

### **3.3 MARKS AND LABELS**

Waste containers must be labeled in accordance with 49 CFR 172. Until wastes are characterized, they must be handled as if they are hazardous and an Analysis pending label will be placed on the container. Once the waste has been characterized as hazardous, state only hazardous, or nonhazardous, the container will be relabeled appropriately.

Waste will have visible labels. The labels will include the type of waste, location from which the waste was generated, name and phone number of the generator point of contact, and accumulation start date. Any information not known when waste containers are initially labeled will be added when the information is known. Waste labels must be visible, legibly printed or stenciled, and placed on the container in such a manner that labels and markings on all containers are readily visible for inspection.

#### **3.3.1 Analysis Pending Labels**

A “Waste Analysis Pending” label may be used until the waste is characterized. This is a temporary label until analytical results are received and reviewed and the waste characterized as hazardous, state only hazardous, or nonhazardous. Once the waste is characterized, this label will be replaced with a hazardous waste or nonhazardous waste label. The “Waste Analysis Pending” label will include the contents, name and phone number of the generator point of contact, and accumulation start date. Such waste will be appropriately staged/stored until appropriate waste classification determinations are made under appropriate criteria.

#### **3.3.2 Hazardous Waste Labels**

A “Hazardous Waste” preprinted waterproof label with the following container marking requirements provided in 49 CFR 172 and 40 CFR 262.31 and 262.32 will be attached to the drum, container, or tank containing wastes that are determined to be hazardous based on process knowledge or sampling information. Prior to transport for off-site disposal, appropriate waste codes, the proper DOT shipping name, and the manifest number will be added to the hazardous waste label. Hazardous waste labels will display the following information:

- Accumulation start date: (date waste was first placed in the container);
- Generator name: Swan Island Basin Remedial Design Group;
- Generator contact: (to be determined [TBD]);
- Generator contact phone number: (TBD);

- Generator address: (TBD);
- EPA identification (ID) number: (TBD);
- Waste codes;
- Description of waste, including hazardous properties and physical state;
- Proper DOT shipping name;
- Manifest number (added before transportation);
- The appropriate DOT hazard class label will be placed on the container before it is loaded onto the transport vehicle.

### 3.3.3 Nonhazardous Waste Label

A “Nonhazardous Waste” preprinted waterproof label with the following information will be attached to the drum, container, or tank containing wastes that are determined to be nonhazardous based on process knowledge or sampling information.

- Drum accumulations start date;
- Generator name, contact, and contact number;
- Waste-specific information (composition, origin of waste (boring or well number), and other information necessary to identify the waste).

Samples of container labels are shown below:



### 3.4 WASTE SHIPPING AND DOCUMENTATION

Records of waste materials removed from the Site will be maintained. A binder will be maintained at the Site exclusively for waste transfer activities and copies provided to the Remedial Program Manager (RPM) and HGL WM. Hazardous wastes transported, treated, stored, or disposed will be recorded and reported. The following documents, as applicable, are required:

- Information on waste packaging, container markings, labeling, and placarding of waste shipments;
- Waste container inventory and inspection records;
- Waste profile sheets;
- Analytical results;
- OSR approval confirmation;
- Hazardous waste manifests;
- Land Disposal Restriction (LDR) notification and certification forms;
- Nonhazardous manifests;
- Safety Data Sheets; where appropriate;
- Piece counts, weigh tickets, and bills of lading for non-contaminated wastes;
- Receipts for general solid waste disposal.

All wastes will be tracked. Documentation associated with waste disposal will be appended to the report after completion of the fieldwork.

#### **3.4.1 CERCLA OSR Confirmation**

The OSR approval for each facility will be confirmed every 60 days unless noted otherwise by the Regional OSR Contact (ROC). An email will be prepared and sent to the ROC for each facility to confirm OSR approval. The email will include the following information:

- Name of facility receiving the waste;
- City and state of facility receiving the waste;
- EPA ID;
- Name of facility generating the waste;
- Amount and type of wastes;
- Expected shipping date.

Upon receiving written acceptance of the waste by the selected treatment, storage, and disposal facility (TSDF), the WM will work with the waste subcontractor to prepare the manifest (or shipping papers) and other support documentation.

#### **3.4.2 Waste Profiling**

Waste characterization information will be used to complete the waste profile form) provided by the designated off-site treatment or disposal facility as part of the waste acceptance process. The profile will be reviewed and approved by the WM. After WM approval, waste documentation will be provided to the RPM for review and signature, as the waste generator. Signed profiles will then be submitted to the designated receiving facility for approval. The profile typically requires the following information:

- Generator information, including name, address, contact, and phone number;

- Site name, including street and mailing address;
- Process generating waste such as soil cuttings or water/soils generated during sampling;
- Source of contamination and historical use (historical releases and dumping);
- Waste composition; for example, 95% soil, 5% debris;
- Physical state of waste, such as solid or liquid;
- Applicable hazardous waste codes.

The waste will be transported to the TSDF in accordance with both Federal and State requirements. Waste will be delivered to the TSDF within 35 days from the date the transporter takes possession as indicated by signature on the complete manifest package. A 24-hour hotline will be established and made available to the transporter and TSDF to report any issues while the waste is in transit.

### **3.4.3 Waste Transport**

Prior to off-site disposal of any waste, a waste approval package for each waste stream will be prepared. This package will include a waste profile naming Swan Island Basin Remedial Design Group as the generator of the waste, an analytical summary table(s) applicable to the waste, LDR notification or certification for any hazardous wastes, a completed waste manifest, and any other applicable information necessary for Swan Island Basin Remedial Design Group personnel to complete the review of the disposal package and sign as the generator.

The signed profile will then be submitted to the designated off-site facility for acceptance and approval. Once the approval letter is received from the designated facility, transportation can be scheduled. A licensed waste transporter will be contracted to transport the containerized IDW to the selected TSDFs. The contracted transporter will have required licenses, registrations, and certifications for the specific waste stream to be transported.

Prior to contracting with the hazardous waste transporter, the name, location, point of contact, EPA ID number, verification that the transporter is licensed to haul hazardous waste, and notice of violation status will be provided to the WM for approval. Prior to disposal or shipment off-site, the waste disposal subcontractor will label the drums with the appropriate DOT ID and classification information as required by applicable sections of 49 CFR, Parts 171, 172, 173, 178, and 179.

Waste transporters will cover loads and each truck will be inspected to verify the loads are secure, proper placarding is provided as necessary, and shipping documentation is accurate. In addition, the waste transporter will confirm that the vehicles are not leaking or releasing waste constituents from loading at the source site, along the haul route, and offloading at the approved disposal site.

Each transportation vehicle and load of waste will be inspected before leaving the Site and documented. The quantities or estimated quantities of waste leaving the Site will be recorded on the WTL. A contractor licensed for commercial transportation will transport nonhazardous wastes. In the event that wastes are hazardous, the transporter will have an EPA ID number and will comply with transportation requirements outlined in 49 CFR 171-179 (DOT); and 40 CFR 263.11 and 263.31 (Hazardous Waste Transportation).

Drivers of off-site disposal trucks must not come in physical contact with the contaminated material while covering the load or preparing it for transport. The transporter and field team leader will verify that there is no visible soil/waste material on the sides or tires of any trucks leaving the Site. Proper decontamination procedures will be used to remove soil or debris from the outsides of the vehicles, if necessary, to prevent soil from being tracked beyond designated work areas. The transporter will observe the following practices when hauling and transporting wastes off-site:

- Minimize impacts to general public traffic;
- Repair road damage caused by the transporter;
- Clean up waste spilled in transit;
- Line and cover trucks/trailers used for hauling contaminated waste to prevent releases and contamination;
- Decontaminate vehicles prior to reuse;
- Ensure that seals on trucks transporting liquids are in good condition;
- Ensure that no materials from other projects are combined with materials from this Site;
- Ensure that personnel involved in off-site disposal activities follow safety and spill response procedures outlined in the HASP and Emergency Response Plan.

#### **3.4.4 Shipment Methods**

Waste shipments will comply with procedures specified in the Hazardous Materials Transportation Act, 49 CFR 171. Hazardous materials will be properly classified, described, packaged, marked, and labeled for shipment as required by 49 CFR. Any hazardous material identified as a marine pollutant that is hauled in bulk will comply with the Marine Pollutant Act (49 CFR 171.4[c]). A bulk package for solids is defined as having a maximum net mass of 882 pounds or more and a maximum capacity of 119 gallons or more. Packaging and labeling of waste will be performed by staff trained to meet the DOT requirements (for example, hazardous materials employee training requirements under 49 CFR 172 Subpart H).

#### **3.4.5 Nonhazardous Waste Record**

Each load of nonhazardous waste will be shipped using a Nonhazardous Waste Record. At a minimum, the form will include the required fields (quantity of waste and disposal location) with the possibility of the following additional information:

- Generator information, including name, address, contact, and phone number;
- Transporter information, including name and phone number;
- Designated facility information, including name, address, and phone number;
- Site name, including street/mailing address;
- Type and number of containers;
- Task order or job number;
- Profile number; and
- 24-hour emergency phone number.

The generator and the transporter must sign the manifest prior to the load of waste leaving the Site. The original signed manifest will be returned to the address of the generator.

### **3.4.6 Municipal Solid Waste, Construction and Demolition Debris, and Recyclables**

MSW and construction and demolition debris that will be disposed of off-site as well as recyclables will be shipped under a nonhazardous manifest or a bill of lading. Quantities and shipments will be tracked on the WTL.

### **3.4.7 Hazardous Waste and PCB Waste**

Each load of hazardous waste, Oregon State Only hazardous waste, and PCB waste (as specified in TSCA) will be manifested on a hazardous manifest prior to leaving the Site. At a minimum, the manifest form will include the following information:

- Generator information, including name, address, contact, phone number, and EPA ID number;
- Transporter information, including name, address, contact, phone number, and EPA ID number;
- Designated facility information, including name, address, phone number, and EPA ID number;
- Site name, including street/mailling address;
- Proper DOT shipping name; for example, Hazardous Waste Solid, n.o.s., 9, UN 3077, PG III [D008];
- Type and number of containers;
- Quantity of waste (volumetric estimate);
- Task order or job number;
- Profile number;
- 24-Hour emergency phone number.

The generator and the transporter must sign the manifest prior to the load of waste leaving the Site. The original signed manifest will be returned to the address of the generator and a photographed and/or scanned copy saved to the HGL project files.

Additionally, each shipment of waste will also have a weight ticket. An LDR Notification/Certification is required for hazardous wastes. This form also requires the generator's signature, and submission to the designated facility.

If the signed hazardous waste manifest from the designated facility is not received within 35 days, HGL will contact the transporter or the designated facility to determine the status of the waste. If the signed hazardous waste manifest has not been received within 45 days, an "Exception Report" must be prepared and submitted to EPA.

### **3.5 TRAINING**

Field staff that will manage hazardous or potentially hazardous waste will meet the hazardous waste generator training requirements of 40 CFR 265.16 through the following:

- Occupational Safety and Health Administration 29 CFR 1910, Section 120, hazardous waste operations and emergency response training;
- On-the-job training, which includes:
  - Site-specific HASP review: requires each site worker, and guests to review and sign the plan
  - Activity hazard analysis and daily “tailgate” meetings
  - Project-specific Work Plan review
- Hazardous waste generator training requirements of 40 CFR 265.16, including the following:
  - Documented annual training provided by qualified instructor
  - Project-specific WMP review
- DOT training per 49 CFR 172, Subpart H, as appropriate, for those performing the following functions:
  - Selecting and marking packaging or container for hauling
  - Preparing hazardous materials for transportation
  - Loading, unloading, or handling hazardous materials
  - Operating a vehicle used to transport hazardous materials
  - Preparing or reviewing hazardous materials shipping papers, including hazardous waste manifests

## **4.0 DOCUMENTATION**

HGL will retain copies of profiles, weight tickets, transporter-signed and fully executed waste manifests, LDRs, and waste analysis records discussed in this WMP for each waste shipment in the project records for three (3) years. Documentation of soil transported off-site will be kept on-site or in the project records for a minimum of three (3) years. The following transportation and off-site disposal records and documents will be maintained at the project site:

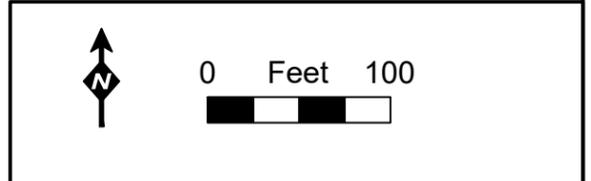
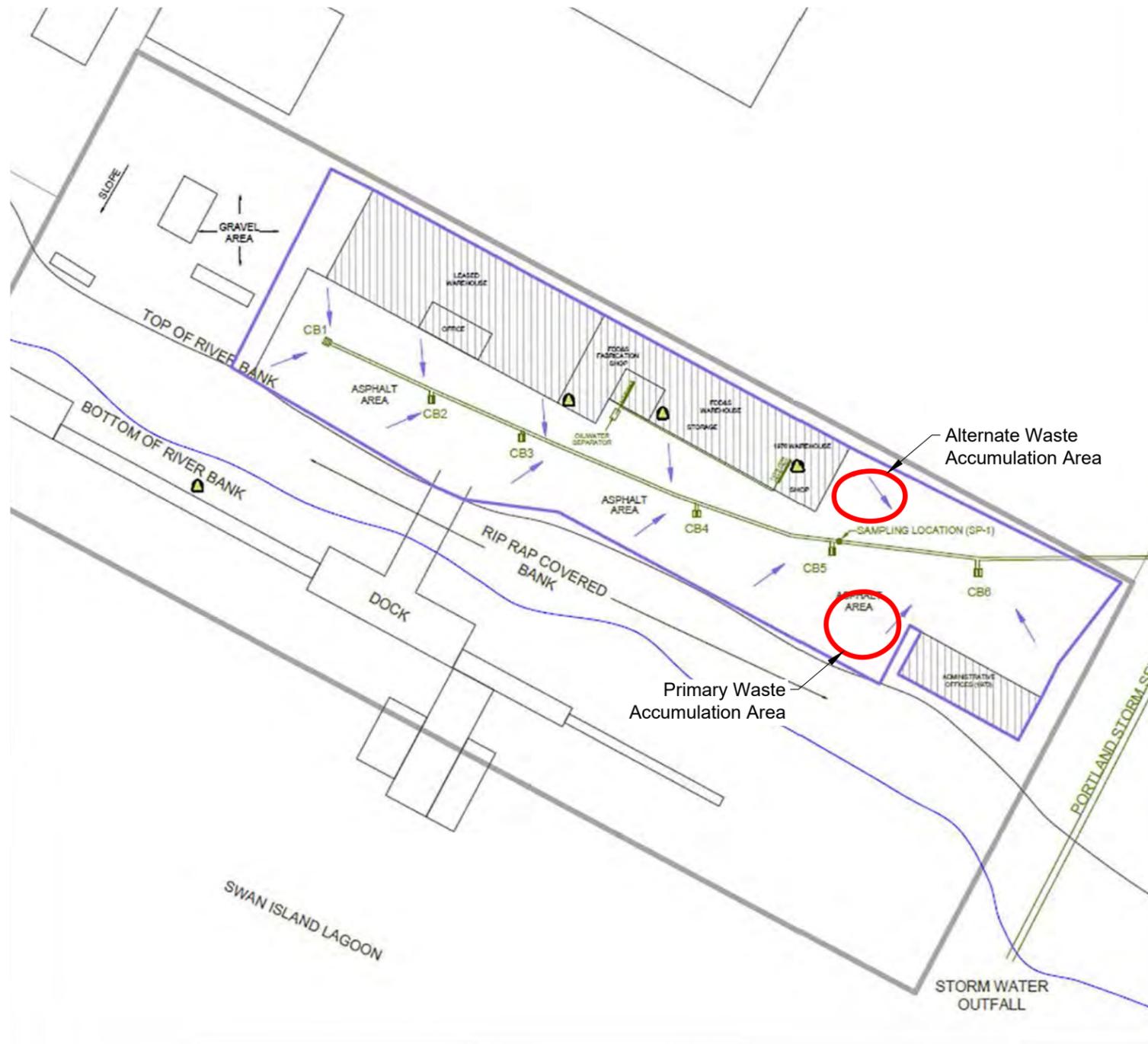
- Profiles and associated characterization data
- Manifests, LDR notifications and certifications, bills of lading, and weight tickets
- Off-site facility waste receipts and certificates of disposal, destruction, or recycling
- Inspection records, including weekly inspections of waste accumulation areas, and inspections of permitted units in accordance with the permit requirements
- Waste tracking logs
- Training records for each individual involved with the management of or occupationally exposed to hazardous waste, including the employee's job title related to each position, the name of the employee filling the position, a written job description, a written description of the type and amount of training required, and documentation that the training has been provided.

Copies of all documentation will be provided to EPA.

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**FIGURE**

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- APPROXIMATE BUILDING LOCATIONS
- APPROXIMATE PROPERTY BOUNDARIES
- APPROXIMATE SUBJECT PROPERTY BOUNDARIES
- APPROXIMATE SUBJECT BUILDINGS

- CATCH BASIN
- STORM/DRAIN LINES
- APPROXIMATE BOUNDARY OF STORM WATER DRAINAGE AREA
- DIRECTION OF STORM WATER SHEET FLOW
- LOCATION OF SPILL KIT

Note:  
ECSI - Environmental Cleanup Site Information

Source:  
Evren Northwest, 2010. May 2010 Supplement to Stormwater Source Control Evaluation [for Fred Devine Diving and Salvage]. October 25.

**Figure C-1**  
**US Ecology Site:**  
**Waste Accumulation Area**

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## **APPENDIX D**

**SUBCONTRACTOR SOWs WILL BE PROVIDED UPON REQUEST AND/OR  
WHEN AVAILABLE.**

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## **APPENDIX B**

### **QUALITY ASSURANCE PROJECT PLAN**

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**UNIFORM FEDERAL POLICY-  
QUALITY ASSURANCE PROJECT PLAN  
REVISION 3**

**REMEDIAL DESIGN SERVICES  
SWAN ISLAND BASIN PROJECT AREA  
CERCLA DOCKET NO. 10-2021-001**

**PORTLAND HARBOR SUPERFUND SITE  
PORTLAND, MULTNOMAH COUNTY, OREGON**

**Contract Number: DT2002**

*Prepared for:*

**Swan Island Basin Remedial Design Group**

*Prepared by:*



**11107 Sunset Hills Road, Suite 400  
Reston, Virginia 20190**

*With assistance from:*

**M**

**M**

**PACIFIC groundwater GROUP**

**MOTT  
MACDONALD**

**BRIDGEWATER GROUP**

**May 2022**



**UNIFORM FEDERAL POLICY-  
QUALITY ASSURANCE PROJECT PLAN  
REVISION 3**

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**Swan Island Basin Remedial Design Group**

**Prepared by:**

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**With assistance from:**

**Mott MacDonald  
Pacific Groundwater Group  
Bridgewater Group**

**May 2022**

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**Uniform Federal Policy-Quality Assurance Project Plan  
Swan Island Basin Project Area  
Portland Harbor Superfund Site**

**Record of Changes / Summary of Revisions**

Revision No.	Revision Date	Document Name (If other than entire document, list revised sections or pages)
0	June 29, 2021	Draft Uniform Federal Policy-Quality Assurance Project Plan for EPA review
1	December 10, 2021	Revisions per EPA comments received August 13, 2021
2	March 16, 2022	Revisions per EPA comments received February 1, 2022
3	May 10, 2022	Revisions per EPA comments received April 5, 2022

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- 
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  - B.2 Example LDC Checklists

## LIST OF ACRONYMS AND ABBREVIATIONS

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%	percent
%D	percent difference
%R	percent recovery
%RSD	percent relative standard deviation
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
µm	microns
A2LA	American Association for Laboratory Accreditation
AICP	American Institute of Certified Planners
ALS	ALS Environmental
ARI	Analytical Resources, Inc.
ASAOC	Administrative Settlement Agreement and Order on Consent
ASQ CQA	American Society for Quality Certified Quality Auditor
ASTM	ASTM International (formerly American Society for Testing and Materials)
B.A.	Bachelor of Arts
BaP	benzo(a)pyrene
B.S.	Bachelor of Science
°C	degrees Celsius
CA	corrective action
CASRN	Chemical Abstracts Service Registry Number
CCB	continuing calibration blank
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFA	Cape Fear Analytical
CFR	Code of Federal Regulations
CHMM	Certified Hazardous Materials Manager
CMT	Client Management Team
CoC	chain of custody
COC	contaminant of concern
cPAH	carcinogenic polycyclic aromatic hydrocarbons
CPG	Certified Professional Geologist
CQMC	Construction Quality Management for Contractors
CRM	certified reference material
CSM	conceptual site model
CUL	cleanup level
CVAA	cold vapor atomic absorption
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethene
DDT	dichlorodiphenyltrichloroethane

---

## LIST OF ACRONYMS AND ABBREVIATIONS (continued)

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DDx	the sum of the concentrations of the six DDD, DDE, and DDT compounds
DEA	David Evans and Associates, Inc.
DeCB	decachlorobiphenyl
DFTPP	decafluorotriphenylphosphine
DiCB	dichlorobiphenyl
DOC	dissolved organic carbon
DQI	data quality indicator
DQO	data quality objective
DRET	dredge elutriate test
DTNA	Daimler Trucks North America LLC
EDD	electronic data deliverable
EDL	estimated detection limit
EMPC	estimated maximum potential concentration
EPA	U.S. Environmental Protection Agency
FS	Feasibility Study
ft	foot/feet
FTL	field team leader
GC/ECD	gas chromatography/electron capture detector
GC/FID	gas chromatography/flame ionization detector
GC/FPD	gas chromatography/flame photometric detector
GC/MS	gas chromatography/mass spectrometry
H&S	health and safety
HCl	hydrochloric acid
HGL	HydroGeoLogic, Inc.
HNO <sub>3</sub>	nitric acid
HpCB	heptachlorobiphenyl
HpCDD	heptachlorodibenzo-p-dioxin
HpCDF	heptachlorodibenzofuran
HxCB	hexachlorobiphenyl
HxCDD	hexachlorodibenzo-p-dioxin
HxCDF	hexachlorodibenzofuran
HRGC/HRMS	high-resolution gas chromatography/high-resolution mass spectrometry
HVS	high-volume sampling
ICAL	initial calibration
ICB	initial calibration blank
ICP-MS	inductively coupled plasma-mass spectrometry
ICS	interference check solution
ICV	initial calibration verification
ID	identification

---

## LIST OF ACRONYMS AND ABBREVIATIONS (continued)

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IDQTF	Intergovernmental Data Quality Task Force
IDW	investigation-derived waste
L	liter
L.G.	Licensed Geologist
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LDC	Laboratory Data Consultants, Inc.
LWG	Lower Willamette Group
m/z	mass to charge ratio
M.A.	Master of Arts
M.A.T.	Master of Arts in Teaching
M.S.	Master of Science
MB	method blank
MBA	Master of Business Administration
MDL	method detection limit
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mL	milliliter
MoCB	monochlorobiphenyl
MS	matrix spike
MSD	matrix spike duplicate
mV	millivolts
NA	not applicable
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NELAC	National Environmental Laboratories Accreditation Conference
ng/L	nanogram per liter
NoCB	nonachlorobiphenyl
OcCB	octachlorobiphenyl
OCDD	octachlorodibenzo-p-dioxin
OCDF	octachlorodibenzofuran
ODEQ	Oregon Department of Environmental Quality
OMW	Ogden, Murphy, Wallace, PLLC
ORP	oxidation-reduction potential
oz	ounce
P.E.	Professional Engineer
P.G.	Professional Geologist
PAH	polycyclic aromatic hydrocarbon
PAL	project action limit

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## LIST OF ACRONYMS AND ABBREVIATIONS (continued)

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PARCCS	precision, accuracy, representativeness, completeness, comparability, and sensitivity
PCB	polychlorinated biphenyl
PDI	Pre-Design Investigation
PDS	post-digestion spike
PE	polyethylene
PeCB	pentachlorobiphenyl
PeCDD	pentachlorodibenzo-p-dioxin
PeCDF	pentachlorodibenzofuran
pg/g	picograms per gram
pg/L	picograms per liter
PGG	Pacific Groundwater Group
Ph.D.	Doctor of Philosophy
PHSS	Portland Harbor Superfund Site
PM	project manager
PMP	Project Management Professional
POC	point of contact
ppm	parts per million
PQL	practical quantitation limit
PTW	principal threat waste
PUF	polyurethane foam
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RAL	Remedial Action Level
RCRA	Resource Conservation Recovery Act
RD	Remedial Design
R.G.	Registered Geologist
RI	Remedial Investigation
RM	river mile
ROD	Record of Decision
RPC	recontamination potential chemicals
RPD	relative percent difference
RPM	Remedial Project Manager
RRF	relative response factor
RRT	relative retention time
RT	retention time
S/N	signal to noise ratio
SAR	Sufficiency Assessment Report
SEA	Striplin Environmental Associates, Inc.
SGS	SGS North America, Inc.

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## LIST OF ACRONYMS AND ABBREVIATIONS (continued)

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SIB	Swan Island Basin
SIM	selected ion monitoring
SM	standard methods for the evaluation of water and wastewater
SOP	standard operating procedure
SSHO	site safety and health officer
SVOC	semivolatile organic compound
TB	trip blank
TBD	to be determined
TCDD	tetrachlorodibenzo-p-dioxin
TCDF	tetrachlorodibenzofuran
TCLP	toxicity characteristic leaching procedure
TeCB	tetrachlorobiphenyl
TEF	toxic equivalency factor
TEQ	toxic equivalents
TIG Environmental	The Intelligence Group Environmental
TOC	total organic carbon
TrCB	trichlorobiphenyl
TSCA	Toxic Substances Control Act
TSS	total suspended solids
UFP	Uniform Federal Policy
ULL	Ultra-low level
VOA	volatile organic analysis
VOC	volatile organic compound

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**UNIFORM FEDERAL POLICY-QUALITY ASSURANCE PROJECT PLAN  
REMEDIAL DESIGN SERVICES  
SWAN ISLAND BASIN PROJECT AREA  
PORTLAND HARBOR SUPERFUND SITE  
PORTLAND, MULTNOMAH COUNTY, OREGON**

**INTRODUCTION**

This Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP) has been prepared by HydroGeoLogic, Inc. (HGL) to present the requirements for the collection of data to support the Remedial Design (RD) services for the Swan Island Basin (SIB) Project Area of the Portland Harbor Superfund Site (PHSS) in Portland, Multnomah County, Oregon. This work will be completed in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the PHSS Record of Decision (ROD) (U.S. Environmental Protection Agency [EPA], 2017) including Errata 1 (EPA, 2018) and Errata 2 (EPA, 2020), the Explanation of Significant Differences (EPA, 2019), and the Administrative Settlement Agreement and Order on Consent (ASAOC) (EPA, 2021).

This UFP-QAPP is intended to be used in conjunction with the Field Sampling Plan (FSP) (HGL, 2021a) for the SIB Project Area. This document meets the requirements and elements set forth in the Intergovernmental Data Quality Task Force (IDQTF) guidance document titled *Uniform Federal Policy for Quality Assurance Project Plans* (IDQTF, 2005) with the optimized worksheets developed in 2012 (IDQTF, 2012). This UFP-QAPP is specific to the SIB Project Area. It also includes supplemental information and requirements as necessary to support project-specific objectives.

**WORKSHEETS #1 AND #2**  
**TITLE AND APPROVAL PAGE**

UFP-QAPP, SIB Project Area, PHSS, Portland, Multnomah County, Oregon  
Document Title

U.S. Environmental Protection Agency, Region 10  
Lead Organization

Kenneth F. Rapuano, CHMM, CQA/HGL  
Preparer's Name and Organizational Affiliation

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(703) 736-4546; krapuano@hgl.com  
Preparer's Address, Telephone Number, and Email Address

May 2022  
Preparation Date

EPA Region 10 Remedial Project Manager: \_\_\_\_\_  
Signature  
Elisabeth Novak, EPA Region 10  
Printed Name/Organization

Client Management Team Coordinator:  \_\_\_\_\_  
Signature  
Philip Spadaro/The Intelligence Group  
Environmental  
Printed Name/Organization

Lead Contractor's Senior Project Manager:  \_\_\_\_\_  
Signature  
Jeff Hodge, PMP/HGL  
Printed Name/Organization

Lead Contractor's Project Quality Assurance Officer: Chris Williams \_\_\_\_\_  
Signature  
Chris Williams, CPG, P.G./HGL  
Printed Name/Organization

**WORKSHEETS #1 AND #2 (CONTINUED)**  
**TITLE AND APPROVAL PAGE**

**Site Name/Project Name:** RD, SIB Project Area, PHSS

**Site Location:** Portland, Multnomah County, Oregon

**Contractor Name:** HGL

**Contract Number:** DT2002

1. Identify guidance used to prepare the QAPP: EPA Requirements for Quality Assurance Project Plans, QA/R-5, EPA/240/B-01/003 (EPA, 2001); Guidance for Quality Assurance Project Plans, QA/G-5, EPA/240/R-02/009 (EPA, 2002); and UFP-QAPP, Parts 1-3, EPA/505/B-04/900A through 900C (IDQTF, 2005) and Optimized Worksheets (IDQTF, 2012).
2. Identify regulatory program: The SIB Project Area being addressed under CERCLA. EPA Region 10 is the lead regulatory agency for the SIB Project Area.
3. Identify approval entities: EPA Region 10, see approval signature on Page 1 of Worksheet #1 and #2.
4. The QAPP is: Project specific.
5. List dates of scoping sessions that were held: The Kick-off Technical Working Group Meeting was held on May 12, 2021.
6. List dates and titles of QAPP documents written for previous site work, if applicable:
  1. Quality Assurance Project Plan, Swan Island Lagoon, Sediment Sampling Investigation, Portland Harbor Superfund Site (Pacific Groundwater Group [PGG], 2018).
7. List organizational partners (stakeholders): EPA Region 10; Oregon Department of Environmental Quality (ODEQ); The Yakama Nation; The Five Tribes; and the Settling Federal Agencies, Settling Public Entities, and Respondents indicated in the ASAOC.
8. List data users: EPA Region 10; ODEQ; the Respondents indicated in the ASAOC; and the SIB RD Group contracted to the Respondents.
9. If required UFP-QAPP elements and required information are not applicable to the project, then circle the omitted UFP-QAPP elements and provide the required information on the attached table. Provide an explanation for their exclusion below: All UFP-QAPP worksheets are applicable.

**WORKSHEETS #3 AND #5**  
**PROJECT ORGANIZATION AND QAPP DISTRIBUTION**

**Distribution:**

The following is the distribution list for the UFP-QAPP for RD at the SIB Project Area.

QAPP Recipients	Title	Organization	Telephone Number	Email Address
<b><i>EPA Regulatory Program</i></b>				
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<b><i>Support Regulatory Agency</i></b>				
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Sarah Greenfield	In-Water Coordinator	ODEQ	(503) 229-5445	<a href="mailto:sarah.greenfield@deq.state.or.us">sarah.greenfield@deq.state.or.us</a>
<b><i>Settling Public Entities</i></b>				
Annie Von Burg	Environmental Policy Manager	City of Portland Bureau of Environmental Services	(503) 823-7859	<a href="mailto:annie.vonburg@portlandoregon.gov">annie.vonburg@portlandoregon.gov</a>
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Heidi Bullock	Environmental Program Manager	Port of Portland	(503) 415-6323	<a href="mailto:heidi.bullock@portofportland.com">heidi.bullock@portofportland.com</a>
Jessica Hamilton	Director, Harbor Environmental	Port of Portland	(503) 415-6033	<a href="mailto:jessica.hamilton@portofportland.com">jessica.hamilton@portofportland.com</a>
Teresa Jacobs	Assistant General Counsel	Port of Portland	(503) 415-6168	<a href="mailto:teresa.jacobs@portofportland.com">teresa.jacobs@portofportland.com</a>
Bill Ryan	Portland Harbor Superfund Specialist	Oregon Department of State Lands	(503) 986-5259	<a href="mailto:bill.ryan@dsl.state.or.us">bill.ryan@dsl.state.or.us</a>
Lynne Perry	Senior Assistant Attorney General	Oregon Department of Justice	(971) 673-1956	<a href="mailto:lynne.perry@doj.state.or.us">lynne.perry@doj.state.or.us</a>
<b><i>Tribal Stakeholders</i></b>				
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Courtney Johnson	Five Tribes Representative	Crag Law Center	(503) 525-2728	<a href="mailto:courtney@crag.org">courtney@crag.org</a>
Laura Shira	Yakama Nation Representative	Yakama Nation Fisheries	(509) 985-3561	<a href="mailto:shil@yakamafish-nsn.gov">shil@yakamafish-nsn.gov</a>
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J. W. Ring	The Marine Group LLC Representative	Ring Bender LLP	(503) 964-6723	<a href="mailto:jwring@ringbenderlaw.com">jwring@ringbenderlaw.com</a>
Christine Hein	The Marine Group LLC Representative	Ring Bender LLP	(503) 964-6726	<a href="mailto:chein@ringbenderlaw.com">chein@ringbenderlaw.com</a>
Caroline E. Lee	BAE Systems San Diego Ship Repair, Inc. Representative	DLA Piper LLP	(415) 836-2514	<a href="mailto:caroline.lee@dlapiper.com">caroline.lee@dlapiper.com</a>

**WORKSHEETS #3 AND #5 (CONTINUED)**  
**PROJECT ORGANIZATION AND QAPP DISTRIBUTION**

<b>QAPP Recipients</b>	<b>Title</b>	<b>Organization</b>	<b>Telephone Number</b>	<b>Email Address</b>
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Ed Carlson	CMT Member; Associate General Counsel	Vigor Industrial LLC	(971) 352-8115	<a href="mailto:ed.carlson@vigor.net">ed.carlson@vigor.net</a>
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<b>RD Group Technical Team</b>				
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Evan Sheesley	Structural Engineer	Mott MacDonald	(425) 778-4687	<a href="mailto:evan.sheesley@mottmac.com">evan.sheesley@mottmac.com</a>
Eric Johnson	Geotechnical Engineer	Mott MacDonald	(408) 414-7279	<a href="mailto:eric.johnson@mottmac.com">eric.johnson@mottmac.com</a>
John Dawson	Dredge Engineer	Mott MacDonald	(206) 487-1307	<a href="mailto:john.dawson@mottmac.com">john.dawson@mottmac.com</a>
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Jeff Parker	FTL/SSHO	Mott MacDonald	(360) 570-8244	<a href="mailto:jeffrey.parker@mottmac.com">jeffrey.parker@mottmac.com</a>
Anna St. John	Technical Leader	Bridgewater Group	(503) 675-2737	<a href="mailto:astjohn@bridgeh2o.com">astjohn@bridgeh2o.com</a>
Ken Rapuano	Chemistry QA Manager	HGL	(703) 736-4546	<a href="mailto:krapuano@hgl.com">krapuano@hgl.com</a>
Andrea Fletcher	Sampling and Analysis Coordinator	HGL	(913) 647-2537	<a href="mailto:afletcher@hgl.com">afletcher@hgl.com</a>
Shawn Hinz	Sampling Vessel Leader	Gravity Marine Services	(425) 659-2976	<a href="mailto:shawn@gravitymarine.com">shawn@gravitymarine.com</a>

**WORKSHEETS #3 AND #5 (CONTINUED)**  
**PROJECT ORGANIZATION AND QAPP DISTRIBUTION**

QAPP Recipients	Title	Organization	Telephone Number	Email Address
<i>Supporting Contractors</i>				
Dan Higgins	Data Manager	Dan Higgins Data Designs	(503) 789-4758	<a href="mailto:dan.higgins@danhigginsdatadesigns.com">dan.higgins@danhigginsdatadesigns.com</a>
Kurt Clarkson	Laboratory PM	ALS-Kelso	(360) 577-7222	<a href="mailto:kurt.lawson@alsglobal.com">kurt.lawson@alsglobal.com</a>
Kelly Bottem	Laboratory PM	ARI	(206) 695-6211	<a href="mailto:kelly.bottem@arilabs.com">kelly.bottem@arilabs.com</a>
Cynde Larkins	Laboratory PM	CFA	(910) 795-0421	<a href="mailto:cynde.larkins@cfanalytical.com">cynde.larkins@cfanalytical.com</a>
Thomas Ginsbach	Laboratory PM	Northwest Testing, Inc.	(503) 682-1880	<a href="mailto:tginsbach@nwgeotech.com">tginsbach@nwgeotech.com</a>
Amy Boehm	Laboratory PM	SGS-Wilmington	(910) 667-0135	<a href="mailto:amy.boehm@sgs.com">amy.boehm@sgs.com</a>
Christine Ransom	Data Validation PM	Ecochem	(206) 508-2109	<a href="mailto:cransom@ecochem.net">cransom@ecochem.net</a>
Pei Geng	Data Validation PM	LDC	(760) 827-1100 x141	<a href="mailto:pgeng@lab-data.com">pgeng@lab-data.com</a>

ALS = ALS Environmental  
ARI = Analytical Resources, Inc.  
CFA = Cape Fear Analytical  
CMT = Client Management Team  
DTNA = Daimler Trucks North America LLC  
FTL = field team leader  
LDC = Laboratory Data Consultants, Inc.  
OMW = Ogden, Murphy, Wallace, PLLC  
PM = project manager  
RPM = Remedial Project Manager  
QA = quality assurance  
SGS = SGS North America, Inc.  
SSHO = site safety and health officer  
TIG Environmental = The Intelligence Group Environmental

**WORKSHEETS #3 AND #5 (CONTINUED)**  
**PROJECT ORGANIZATION AND QAPP DISTRIBUTION**

**Responsibilities:**

Role	Responsibilities
<b><i>EPA Regulatory Program</i></b>	
EPA Region 10 RPM	Lead responsibility for developing and implementing community involvement activities. Has the authority as a RPM and/or an on-scene coordinator, as described in the NCP, including the authority to halt the work and/or to conduct or direct necessary response action when they determine that conditions at the SIB Project Area constitute an emergency or may present an immediate threat to public health or welfare or the environment due to a release or threatened release of waste material.
<b><i>Respondents Client Management Team</i></b>	
Project Coordinator	Serve as coordinating POC within the CMT and between EPA and the RD Group. Responsible for meeting monthly with the EPA RPM.
CMT Members	Represent the interest of the individual respondents and the CMT.
<b><i>RD Group Project Management Team and Project Staff</i></b>	
Principal-in-Charge (HGL)	Responsible for performance for the contract; ensures that HGL meets its performance objectives and contractual requirements.
Senior PM (HGL)	Responsible for overall project coordination and oversight on project deliverables. POC for information to and from DTNA and regulatory agencies. Oversees and coordinates SIB field and reporting activities with the project team and subconsultants.
Deputy PM (HGL)	Performs responsibilities of the Senior PM during Senior PM absence and as delegated by the Senior PM.
Technical Director (HGL)	Oversees technical aspects of project planning, sample collection, reporting, and data evaluation activities to ensure compliance with the project objectives.
Technical Leaders (Team Member: PGG, Mott MacDonald and Bridgewater Group)	Guides project activities assigned to their firms to ensure compliance with the project objectives.
QA Officer (HGL)	Responsible for ensuring the quality of planning and design deliverables and of technical services. Oversees project audit activities.
Health and Safety Officer (HGL)	Reviews planned field activities to ensure that site operations are performed in accordance with HGL, SIB Project Area, and regulatory safety requirements.
<b><i>RD Group Technical Team</i></b>	
Sampling and Analysis Coordinator	Contacts the laboratory to order sample containers and equipment prior to sampling events. Reviews CoCs against laboratory sample receipt and the event sampling plan. Resolves discrepancies with the laboratory and refers issues to the Chemistry QA Manager for resolution. Provides hard copy laboratory reports to the data validator and EDDs to the data manager.
Chemistry QA Manager	Author or approval of UFP-QAPP. Serves as primary POC for the laboratory to report data quality and other analytical issues and responsible for resolution. Provides chemistry and analytical guidance to the project team to ensure that data quality will meet the intended end use. Reviews or oversees the review of subcontracted data validation reports and evaluates overall data usability against DQOs.

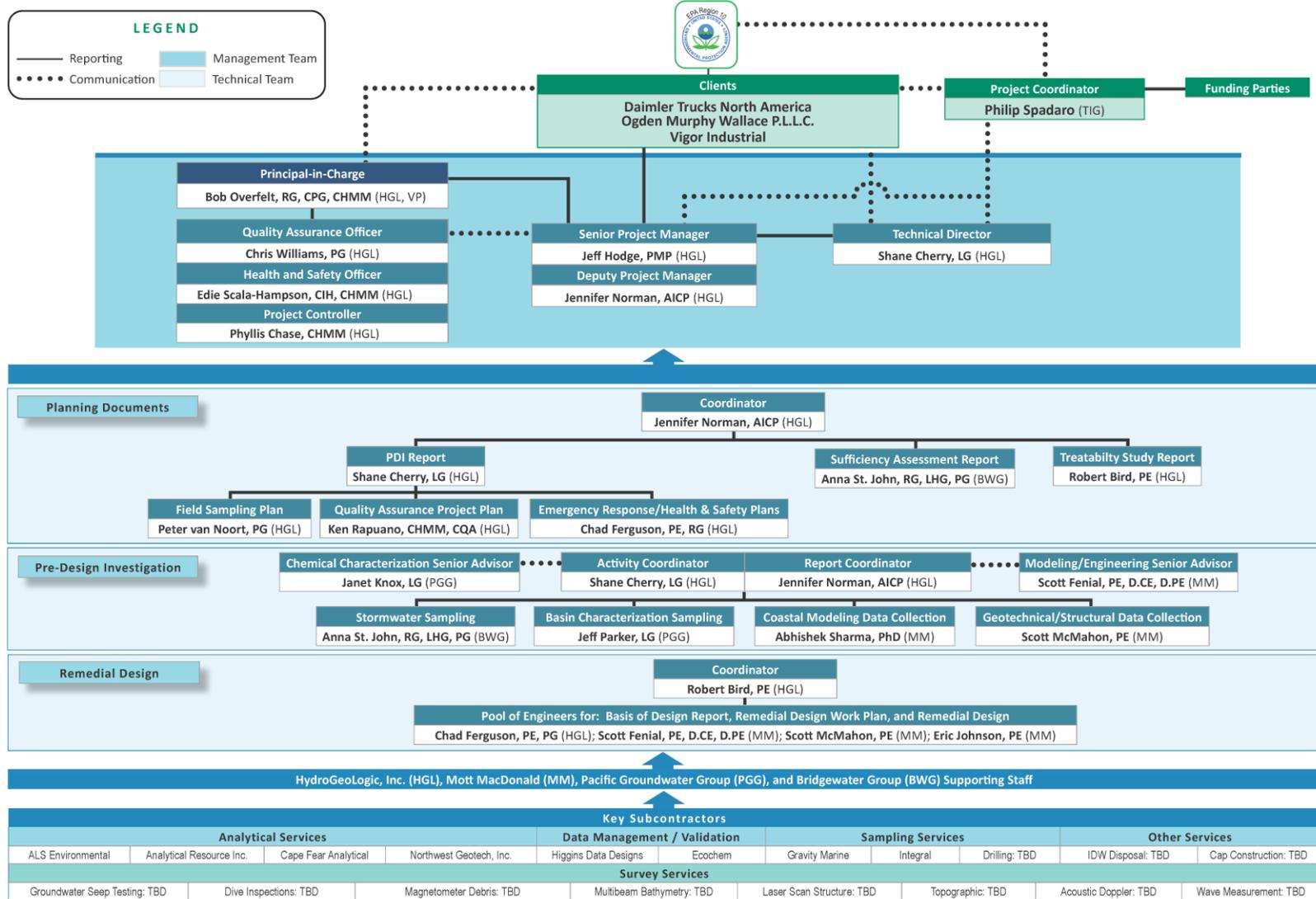
**WORKSHEETS #3 AND #5 (CONTINUED)**  
**PROJECT ORGANIZATION AND QAPP DISTRIBUTION**

<b>Role</b>	<b>Responsibilities</b>
Data Manager	Ensures that laboratory EDDs are properly formatted and complete. Uploads laboratory EDD's and field data into the project database. Assists the project chemistry and technical team members in retrieving and formatting data for use and presentation.
Site Manager	Serves as the coordinator for field activities within the Design team and the SIB Project Area occupants. Ensures that sampling activities are performed in accordance with HGL, project, and SIB Project Area requirements.
FTL	Oversees sampling events in the field. Responsible for the complete collection of samples for all parameters in accordance with project, SIB Project Area, and regulatory requirements. Ensures field team compliance with applicable safety requirements and good technical practices.
Sampling Vessel Leader	Serves as the overall authority for vessel-based project activities. Ensures that vessel-based activities are performed in accordance with project, HGL, SIB Project Area, and regulatory requirements. Will halt work if unsafe conditions (such as weather) are observed or are anticipated.
Activity Specific Technical Leaders (e.g., engineers, geologists, regulatory specialists)	Responsible for completing technical tasks to support RD as assigned by the Senior PM.
Laboratory PM	Primary POC for laboratory communications with the RD Group. Supports field sampling efforts by providing sample containers and other supplies to the Sampling and Analysis Coordinator and ensuring that the laboratory has capacity for planned sampling events. Communicates issues relating to data quality to the Chemistry QA Manager. Refers technical and QA issues to the laboratory QA manager for resolution. Ensures that the requirements of the UFP-QAPP are transmitted to laboratory personnel supporting this project. Performs final review of laboratory data reports before delivery.
Laboratory QA Manager	Provides technical support to the laboratory PM to ensure that laboratory analyses are performed in accordance with project requirements and that the project data is technically defensible. Initiates and documents CA required to address technical concerns either raised by the Chemistry QA Manager or from internal review and reporting.
Data Validation PM	Responsible for ensuring that data validation is performed in accordance with the requirements of this UFP-QAPP, including use of project-specific data qualification conventions. Reviews or oversees the review of data validation reports prior to delivery.

CA = corrective action  
 CoC = chain of custody  
 DQO = data quality objective  
 EDD = electronic data deliverables  
 NCP = National Oil and Hazardous Substances Pollution Contingency Plan  
 POC = point of contact

# WORKSHEETS #3 AND #5 (CONTINUED)

## PROJECT ORGANIZATION AND QAPP DISTRIBUTION

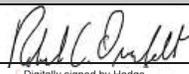


**Remedial Design Team Organizational Chart**

## WORKSHEETS #4, #7, AND #8 PROJECT PERSONNEL QUALIFICATIONS AND SIGN-OFF SHEET

In addition to the FTL listed in this sheet, sampling personnel assigned to this project are required to read this UFP-QAPP and sign off that they have done so before initiating field activities. Signatures for SIB Project Area worker acknowledgement will be maintained in the project file.

**Organization: HGL**

Bob Overfelt	Principal-in-Charge	B.S., Geology Experience: 34 Years	CPG, P.G., R.G., CHMM	 Digitally signed by Hodge, Jeff Date: 2022.06.09 20:13:16 -05'00'
Jeff Hodge	Senior PM	B.S., Environmental Health Experience: 23 Years	PMP	Hodge, Jeff
Jennifer K. Norman	Deputy PM	B.S., Environmental Science Experience: 29 Years	AICP	Norman, Jennifer Digitally signed by Norman, Jennifer Date: 2022.06.13 12:01:32 -07'00'
Shane Cherry	Technical Director	B.S., Earth, Atmospheric, and Planetary Sciences M.S., Geography & Environmental Engineering Experience: 26 Years	L.G.	Cherry, Shane Digitally signed by Cherry, Shane Date: 2022.06.09 17:51:54 -04'00'
Chris Williams	QA Officer	B.S., Geology Experience: 35 Years	CPG, P.G.	Williams, Chris Digitally signed by Williams, Chris Date: 2022.06.10 09:54:06 -05'00'
Edie Scala-Hampson	Health and Safety Officer	B.S., Biology Experience: 45 Years	CIH, CHMM	Edie Scala- Hampson CIH, CHMM Digitally signed by Edie Scala- Hampson CIH, CHMM Date: 2022.06.10 08:44:30 -05'00'
Robert Bird	Lead Design Engineer	B.S., Civil Engineering M.S., Environmental Engineering Experience: 33 Years	P.E.	Bird, Robert Digitally signed by Bird, Robert Date: 2022.06.17 12:05:33 -04'00'
Chad Ferguson	Assistant Design Engineer	B.S., Geological Engineering Experience: 25 Years	P.E., R.G.	Chad Ferguson, P.E., R.G. Digitally signed by Chad Ferguson, P.E., R.G. Date: 2022.06.13 10:44:08 -05'00'
Ken Rapuano	Chemistry QA Manager	B.S., Chemistry M.S., Chemistry Experience: 34 Years	CHMM, ASQ CQA	Kenneth F. Rapuano Digitally signed by Kenneth F. Rapuano Date: 2022.06.17 14:49:58 -04'00'
Andrea Fletcher	Sampling and Analysis Coordinator	B.A., History/Secondary Education B.S., Air Pollution Meteorology Experience: 29 Years		Fletcher, Andrea Digitally signed by Fletcher, Andrea Date: 2022.06.17 10:59:13 -05'00'

## WORKSHEETS #4, #7, AND #8 (CONTINUED) PROJECT PERSONNEL QUALIFICATIONS AND SIGN-OFF SHEET

**Organization: Mott MacDonald**

Evan Sheesley	Structural Engineer	B.S. Civil Engineering Experience: 14 years	P.E., S.E., ENV SP	Evan Sheesley <small>Digitally signed by Evan Sheesley DN: c=US, E=evan.sheesley@mottmac.com, O=Mott MacDonald LLC, CN=Evan Sheesley Reason: I have reviewed this document Date: 2022.06.13 12:11:38-0700'</small>
Eric Johnson	Geotechnical Engineer	B.S. Civil Engineering Experience: 15 years	P.E.	E. Johnson <small>Digitally signed by E. Johnson Date: 2022.06.13 09:21:09 -0700'</small>
John Dawson	Dredge Engineer	B.S. Civil Engineering M. Eng Civil & Construction Eng. Experience: 12 years	P.E.	John G. Dawson <small>Digitally signed by John G. Dawson DN: c=US, E=john.dawson@mottmac.com, O=Mott MacDonald, CN=John G. Dawson Date: 2022.06.13 12:04:37-0700'</small>
Matthew Taylor	Civil Engineer	B.S. Civil Engineering Experience: 10 years	P.E.	Matthew Taylor <small>Digitally signed by Matthew Taylor DN: c=US, E=matthew.taylor1@mottmac.com, CN=Matthew Taylor Date: 2022.06.13 12:06:37-0700'</small>
Scott Fenical	Technical Leader - Geotechnical	B.S., Mechanical Engineering M.S., Ocean Engineering Experience: 24 Years	P.E., D.CE, D.PE	Scott Fenical <small>Digitally signed by Scott Fenical DN: cn=Scott Fenical, c=US, o=Mott MacDonald, ou=West, email=scott.fenical@mottmac.com Date: 2022.06.12 20:13:43 - 0700'</small>
Janet Knox	Technical Leader - Chemistry	B.A. Geology, Geophysics, Geochem. M.S. Geology/Geochemistry Experience: 38 Years	L.G.	Janet Knox <small>Digitally signed by Janet Knox DN: cn=Janet Knox, c=US, o=Mott MacDonald, ou=GWT, email=janet.knox@mottmac.com Reason: I have reviewed this document Date: 2022.06.13 08:39:30 -0700'</small>
Abhishek Sharma	Coastal Modeling Leader	B.S., Civil Engineering M.S. and Ph.D., Ocean Engineering Experience: 8 Years		Abhishek Sharma <small>Digitally signed by Abhishek Sharma DN: cn=Abhishek Sharma, c=US, o=Mott MacDonald, email=abhishek.sharma@mottmac.com Date: 2022.06.13 09:15:33 -0700'</small>
Scott McMahon	Coastal Structure Leader	B.S., Civil Engineering M.S., Civil Engineering Experience: 28 years	P.E., ENV SP, LEED AP	Digitally signed by Scott McMahon Date: 2022.06.13 07:58:46-0700'
Jeff Parker	FTL/SSHO	B.A., Geology M.S., Earth and Planetary Science Experience: 16 Years	L.H.G., R.G.	Jeffrey Parker <small>Digitally signed by Jeffrey Parker DN: cn=Jeffrey Parker, c=US, o=Mott MacDonald, email=jeffrey.parker@mottmac.com Date: 2022.06.12 10:41:06 -0700'</small>

**WORKSHEETS #4, #7, AND #8 (CONTINUED)  
PROJECT PERSONNEL QUALIFICATIONS AND SIGN-OFF SHEET**

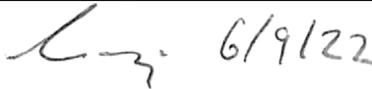
**Organization: TIG Environmental**

Name	Project Title/Role	Education/Experience	Specialized Training/ Certifications	Signature/Date
Phillip Spadaro	Project Coordinator	B.S., Chemistry M.S., Geochemistry Experience: 38 Years	R.G.	 6/29/22

**Organization: Bridgewater Group, Inc.**

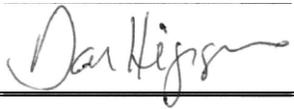
Name	Project Title/Role	Education/Experience	Specialized Training/ Certifications	Signature/Date
Anna St. John	Technical Leader	B.A. Psychobiology B.S. Geology M.S. Geology/Geohydrology Experience: 30 years	R.G., L.H.G., P.G.	 6/11/22

**Organization: Gravity Marine Services**

Name	Project Title/Role	Education/Experience	Specialized Training/ Certifications	Signature/Date
Shawn Hinz	Sampling Vessel Leader	M.S. Sediment Toxicology Ph.D. Environmental Modeling Experience: 24 years		 6/9/22

**WORKSHEETS #4, #7, AND #8 (CONTINUED)  
PROJECT PERSONNEL QUALIFICATIONS AND SIGN-OFF SHEET**

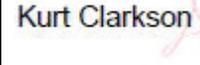
**Organization: Dan Higgins Data Designs**

Dan Higgins	Data Manager	B.S. Geology M.S. Hydrogeology M.A.T. Science		

**Organization: CFA**

Name	Project Title/Role	Education/Experience	Specialized Training/ Certifications	Signature/Date
Cynde Larkins	PM	B.S. Biology Experience: 11 years		 17JUN22
Coleman Corzine	QA Manager	B.S. Chemistry Experience: 6 years		 17JUN22

**Organization: ALS-Kelso**

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature/Date
Kurt Clarkson	PM and Technical Services Manager	B.S. / M.S. Science Experience: 20 years		 Digitally signed by Kurt Clarkson Date: 2022.06.28 16:36:40 -07'00'
Emily Davelaar	QA Manager, Environmental	B.S. Science Experience: 8 years		 Digitally signed by Kurt Clarkson Date: 2022.06.28 16:36:40 -07'00'

## WORKSHEETS #4, #7, AND #8 (CONTINUED) PROJECT PERSONNEL QUALIFICATIONS AND SIGN-OFF SHEET

### Organization: ARI

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature/Date
Kelly Bottem	Laboratory PM	A.A. Hazardous Materials Technology Experience: 27 years		Kelly Bottem <small>Digitally signed by Kelly Bottem Date: 2022.06.13 17:22:42 -07'00'</small>
Sue Dunnihoo	Client Services Director	B.A. Chemistry Graduate Studies in Oceanography Experience: 41 years		Susan Dunnihoo <small>Digitally signed by Susan Dunnihoo Date: 2022.06.14 14:46:27 -07'00'</small>
Bob Congleton	QA Manager	B.S. Conservation of Wildland Resources M.A. Policy Studies Experience: 16 years		<i>Bob Congleton</i> 6-14-22

### Organization: Northwest Testing, Inc.

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature/Date
Thomas S. Ginsbach	PM	B.S. Civil Engineering Experience: 38 years	P.E., G.E.	<i>Thomas S. Ginsbach</i>
Michael Ginsbach	QA Manager	B.S. Geology Experience: 26 years		<i>Michael Ginsbach</i>

### Organization: SGS-Wilmington

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature/Date
Amy Boehm	PM	B.A., Biology Experience: 31 years		<i>Amy Boehm</i> <small>Digitally signed by Amy Boehm Reason: I have reviewed this document Location: Wilmington, NC Date: 2022.06.13 19:08:16</small>
Jeannie Milholland	QA Manager	B.S. Biology Experience: 31 years		<i>Jeannie Milholland</i> 2022.06.13 17:37:16-04'00'

## WORKSHEETS #4, #7, AND #8 (CONTINUED) PROJECT PERSONNEL QUALIFICATIONS AND SIGN-OFF SHEET

### Organization: Ecochem

Christine Ransom	PM/Senior Project Chemist	B.S. Chemistry Experience: 30 years		Christine Ransom <small>Digitally signed by Christine Ransom Date: 2022.06.13 11:42:49 -0700'</small>

### Organization: LDC

Pei Geng	Senior Chemist/PM	B.S. Environmental Chemistry M.S. Organic Chemistry Experience: 30 years		<i>Pei Geng 6/17/22</i>

AICP = American Institute of Certified Planners  
 ASQ CQA = American Society for Quality Certified Quality Auditor  
 B.A. = Bachelor of Arts  
 B.S. = Bachelor of Science  
 CHMM = Certified Hazardous Materials Manager  
 CIH = Certified Industrial Hygienist  
 CPG = Certified Professional Geologist  
 CQMC = Construction Quality Management for Contractors  
 D.CE = Diplomate, Coastal Engineering  
 D.PE = Diplomate, Port Engineering  
 ENV SP = Envision™ Sustainability Professional  
 G.E. = Geotechnical Engineer  
 LEED AP = Leadership in Energy and Environmental Design Accredited Professional

L.G. = Licensed Geologist  
 M.A. = Master of Arts  
 M.A.T. = Master of Arts in Teaching  
 MBA = Master of Business Administration  
 M.Eng. = Master of Engineering  
 M.S. = Master of Science  
 P.E. = Professional Engineer  
 P.G. = Professional Geologist  
 Ph.D. = Doctor of Philosophy  
 PMP = Project Management Professional  
 R.G. = Registered Geologist  
 S.E. = Structural Engineer

## WORKSHEET #6 COMMUNICATION PATHWAYS

Communication Driver	Organization	Name/Role	Contact Information	Procedure
Regulatory agency oversight	EPA Region 10	Elisabeth Novak/ EPA RPM	(503) 326-3277 <a href="mailto:novak.elisabeth@epa.gov">novak.elisabeth@epa.gov</a>	Transmits directives and communication concerning the project to the Project Coordinator.
Communication with regulatory entities and RD Group	TIG Environmental	Philip Spadaro/ Project Coordinator	(206) 390-2842 <a href="mailto:pspadaro@intell-group.com">pspadaro@intell-group.com</a>	<p>Serves as the POC for communications between the RD Group and the regulatory oversight bodies. Will participate in monthly meetings with the EPA RPM.</p> <p>If the RD Group seeks permission to deviate from the approved work plan, schedule, or SOW, the Project Coordinator will submit a written request to EPA for approval outlining the proposed modification and its basis.</p> <p>Serves as the RD Group primary POC for the client. Provides direction on work execution to the RD Group PM and Deputy PM.</p>
POC with Project Coordinator/CMT	HGL	Jeff Hodge/PM  Jennifer Norman/Deputy PM	(913) 378-2302 <a href="mailto:jhodge@hgl.com">jhodge@hgl.com</a>  (425) 610-7840 <a href="mailto:normanj@hgl.com">normanj@hgl.com</a>	<p>Communicates project-related issues, including changes in schedule, changes in scope of fieldwork or delays, and recommendations to stop work, to the Project Coordinator by phone, email, or fax by close of business the next business day.</p> <p>Project information will be reported to the Project Coordinator through contract-required progress reports, email updates, teleconferences, and meetings. The HGL PM will document deviations from the UFP-QAPP and CAs and will report them to the Project Coordinator in memoranda. He will notify the Project Coordinator of laboratory CAs within 24 hours of receiving notification from the laboratory or Chemistry QA Manager.</p>
Field progress reports	Bridgewater Group  Mott MacDonald	Anna St. John/FTL  Jeff Parker/FTL	(503) 312-4676 <a href="mailto:astjohn@bridgeh2o.com">astjohn@bridgeh2o.com</a>  (206) 734-0937 <a href="mailto:jeffrey.parker@mottmac.com">jeffrey.parker@mottmac.com</a>	During field efforts, the FTL will prepare progress reports for submission to the HGL PM by the end of the following business day. The reports will include applicable field documentation including boring logs, site logbook entries, and sampling sheets and CoC forms generated to support field sampling.

**WORKSHEET #6 (CONTINUED)  
COMMUNICATION PATHWAYS**

<b>Communication Driver</b>	<b>Organization</b>	<b>Name</b>	<b>Contact Information</b>	<b>Procedure</b>
UFP-QAPP changes prior to fieldwork	HGL	Shane Cherry/ Technical Director	(239) 313-7495 <a href="mailto:scherry@hgl.com">scherry@hgl.com</a>	If errors or changed conditions require modification of the UFP-QAPP prior to initiation of fieldwork, the Technical Director will prepare revised text in collaboration with the Chemistry QA Manager and PM. Changes to the UFP-QAPP will require final approval from the CMT and regulatory agencies.
UFP-QAPP changes during project execution	Bridgewater Group	Anna St. John/ FTL	(503) 312-4676 <a href="mailto:astjohn@bridgeh2o.com">astjohn@bridgeh2o.com</a>	The FTL will notify the PM and Chemistry QA Manager of planned field deviations from the UFP-QAPP before implementing the changes. They will document changes in field daily progress reports and memoranda to the PM; review field operations daily and evaluate the need for field CAs (in collaboration with PM); and document CAs in the daily logs and in memoranda to the HGL PM. Changes to the UFP-QAPP will require final approval from the CMT and regulatory agencies.
	Mott MacDonald	Jeff Parker/FTL	(206) 734-0937 <a href="mailto:jeffrey.parker@mottmac.com">jeffrey.parker@mottmac.com</a>	
	Mott MacDonald	Abishek Sharma/ FTL	(415) 231-0690 <a href="mailto:abhishek.sharma@mottmac.com">abhishek.sharma@mottmac.com</a>	
	Mott MacDonald	Scott McMahon/FTL	(971) 260-3065 <a href="mailto:scott.mcmahon@mottmac.com">scott.mcmahon@mottmac.com</a>	
Field CAs	Bridgewater Group	Anna St. John/ FTL	(503) 312-4676 <a href="mailto:astjohn@bridgeh2o.com">astjohn@bridgeh2o.com</a>	CA resulting from either failure to follow UFP-QAPP requirements or changes in site conditions will be documented by the FTL; the FTL will communicate the need for a CA to the PM prior to the change or at a minimum on the same business day. The FTL may initiate an interim CA in the field subject to final approval by the HGL PM and QA Officer.
	Mott MacDonald	Jeff Parker/FTL	(206) 734-0937 <a href="mailto:jeffrey.parker@mottmac.com">jeffrey.parker@mottmac.com</a>	
	Mott MacDonald	Abishek Sharma/ FTL	(415) 231-0690 <a href="mailto:abhishek.sharma@mottmac.com">abhishek.sharma@mottmac.com</a>	
	Mott MacDonald	Scott McMahon/ FTL	(971) 260-3065 <a href="mailto:scott.mcmahon@mottmac.com">scott.mcmahon@mottmac.com</a>	

**WORKSHEET #6 (CONTINUED)  
COMMUNICATION PATHWAYS**

<b>Communication Driver</b>	<b>Organization</b>	<b>Name</b>	<b>Contact Information</b>	<b>Procedure</b>
Sample receipt discrepancies (e.g., broken or missing samples, improper preservation, missing analysis requests)	ALS-Kelso	Kurt Clarkson/ Lab PM	(360) 577-7222 <a href="mailto:kurt.clarkson@alsglobal.com">kurt.clarkson@alsglobal.com</a>	The laboratory PM will communicate discrepancies in the sample receipt to the HGL PM on the same business day that the discrepancy is identified. The PM, in consultation with the Chemistry QA Manager, will instruct the laboratory PM on the appropriate course of action.
	ARI	Kelly Bottem/Lab PM	(206) 695-6211 <a href="mailto:kelly.bottem@arilabs.com">kelly.bottem@arilabs.com</a>	
	CFA	Cynde Larkins/ Lab PM	(910) 795-0421 <a href="mailto:cynde.larkins@cfanalytical.com">cynde.larkins@cfanalytical.com</a>	
	Northwest Testing	Thomas Ginsbach/Lab PM	(503) 682-1880 <a href="mailto:tginsbach@nwgeotech.com">tginsbach@nwgeotech.com</a>	
	SGS-Wilmington	Amy Boehm/Lab PM	(910) 667-0135 <a href="mailto:amy.boehm@sgs.com">amy.boehm@sgs.com</a>	
Laboratory QC variances	HGL	Ken Rapuano/ Chemistry QA Manager	(703) 736-4546 <a href="mailto:krapuano@hgl.com">krapuano@hgl.com</a>	The Chemistry QA Manager will prepare variance requests in collaboration with laboratory PMs for transmittal to the CMT for approval.
Analytical CAs	HGL	Ken Rapuano/ Chemistry QA Manager	(703) 736-4546 <a href="mailto:krapuano@hgl.com">krapuano@hgl.com</a>	The need for laboratory CAs will be determined by the Chemistry QA Manager and/or laboratory PM or QA Manager and will be documented in memoranda to the HGL PM.
Data verification issues (e.g., incomplete records)	HGL	Ken Rapuano/ Chemistry QA Manager	(703) 736-4546 <a href="mailto:krapuano@hgl.com">krapuano@hgl.com</a>	The data validators will contact the laboratory directly when a discrepancy is a simple report generation error (such as a skipped page or data missing for a subcontracted analytical method). For systematic problems, such as incorrectly formatted data reports or failure to include required data QC elements, the data validators will contact the Chemistry QA Manager, who will work with the laboratory PM to ensure that properly formatted data reports are delivered to the data validators on a timely basis.

**WORKSHEET #6 (CONTINUED)  
COMMUNICATION PATHWAYS**

<b>Communication Driver</b>	<b>Organization</b>	<b>Name</b>	<b>Contact Information</b>	<b>Procedure</b>
Data validation issues (e.g., noncompliance with procedures)	HGL	Ken Rapuano/ Chemistry QA Manager	(703) 736-4546 <a href="mailto:krapuano@hgl.com">krapuano@hgl.com</a>	If it is determined that the laboratory is not in compliance with the requirements of the UFP-QAPP, the Chemistry QA Manager will coordinate with the laboratory PM to bring the laboratory's practices into compliance. In some cases, this will require the preparation of the variance request (see above).
Data review CAs	HGL	Ken Rapuano/ Chemistry QA Manager	(703) 736-4546 <a href="mailto:krapuano@hgl.com">krapuano@hgl.com</a>	Final analytical data cannot be released until required validation is complete and the Chemistry QA Manager has approved release.
Data tracking and management	HGL	Andrea Fletcher/ Sampling and Analysis Coordinator	(913) 647-2537 <a href="mailto:afletcher@hgl.com">afletcher@hgl.com</a>	The Sampling and Analysis Coordinator or designee will track data from the collection of samples through login at the laboratory to delivery of the technical report/SDG of electronic data, and its entry into the project database.

QC = quality control  
SOW = statement of work  
TBD = to be determined

**WORKSHEET #9**  
**PROJECT SCOPING SESSION PARTICIPANTS SHEET**

**Date of planning session:** May 12, 2021

**Location:** Microsoft Teams Call

**Purpose:** Technical Project Planning Meeting 1

**Participants:**

<b>Name</b>	<b>Organization</b>	<b>Title/Role</b>	<b>Email</b>
Elisabeth Novak	EPA	RPM/Project Coordinator	<a href="mailto:novak.elisabeth@epa.gov">novak.elisabeth@epa.gov</a>
Josie Clark	EPA	RPM	<a href="mailto:clark.josie@epa.gov">clark.josie@epa.gov</a>
Wesley Thomas	ODEQ	PM	<a href="mailto:wesley.thomas@deq.state.or.us">wesley.thomas@deq.state.or.us</a>
Sarah Greenfield	ODEQ	In-Water Coordinator	<a href="mailto:sarah.greenfield@deq.state.or.us">sarah.greenfield@deq.state.or.us</a>
David Lacey	ODEQ	Source Control Coordinator	<a href="mailto:david.j.lacey@state.or.us">david.j.lacey@state.or.us</a>
Phillip Spadaro	TIG Environmental	Project Coordinator	<a href="mailto:pspadaro@intell-group.com">pspadaro@intell-group.com</a>
Shane Cherry	HGL	Technical Director	<a href="mailto:scherry@hgl.com">scherry@hgl.com</a>
Jeff Hodge	HGL	Senior PM	<a href="mailto:jhodge@hgl.com">jhodge@hgl.com</a>
Jennifer Norman	HGL	Deputy PM	<a href="mailto:normanj@hgl.com">normanj@hgl.com</a>
Janet Knox	PGG	Technical Leader	<a href="mailto:janet.knox@mottmac.com">janet.knox@mottmac.com</a>
Scott Fenical	Mott MacDonald	Technical Leader	<a href="mailto:scott.fenical@mottmac.com">scott.fenical@mottmac.com</a>
Anna St. John	Bridgewater Group	Technical Leader	<a href="mailto:astjohn@bridgeh2o.com">astjohn@bridgeh2o.com</a>
Kassandra Tzou	CDM Smith	Technical Review	<a href="mailto:tzoukh@cdmsmith.com">tzoukh@cdmsmith.com</a>
Azhar Wardah	CDM Smith	Technical Review	<a href="mailto:azharw@cdmsmith.com">azharw@cdmsmith.com</a>
Kyle Vickstrom	CDM Smith	Technical Review	<a href="mailto:vickstromke@cdmsmith.com">vickstromke@cdmsmith.com</a>

## **WORKSHEET #10**

### **CONCEPTUAL SITE MODEL**

#### **10.0 INTRODUCTION**

The full conceptual site model (CSM) for PHSS is presented in the Remedial Investigation (RI)/Feasibility Study (FS) (EPA, 2016a) and ROD (EPA, 2017) for PHSS. The CSM is summarized in the Sufficiency Assessment Report (SAR) (HGL, 2021b) and the Pre-Design Investigation (PDI) Work Plan (HGL, 2021c) that have been prepared in association with this UFP-QAPP and the FSP (HGL, 2021a). The SAR presents a recontamination CSM for the SIB Project Area that provides a conceptual framework for evaluating source control sufficiency and the potential for post-remedy recontamination via upland and in-water transport pathways. A primary objective of the PDI Work Plan focuses on refinement of the site-specific application of the CSM to the SIB Project Area, including a data gap analysis, and preliminary SIB Project Area-specific CSM refinements are identified and discussed. The comprehensive refined CSM for the SIB Project Area is presented in Section 2.2 of the PDI Work Plan. This worksheet provides a summary of SIB Project Area background information but does not address the CSM presented in other documents.

The descriptions of the SIB Project Area and previous investigation and enforcement activities is summarized from the ROD (EPA, 2017), including the 2018 and 2020 errata, and the RD SOW attached to the ASAOC (EPA, 2021).

#### **10.1 DESCRIPTION**

##### **10.1.1 Portland Harbor Superfund Site**

PHSS was listed on the National Priorities List with Superfund Site Identification (ID) Number ORSFN1002155 in December 2000. The listing was mainly due to concerns about contamination in the sediments and the potential risks to human health and the environment from consuming the fish. Although PHSS includes both in-river and upland portions, the 2017 ROD describes the remedial alternatives that were considered and selects a final remedy for the in-river portion of PHSS from approximately river mile (RM) 1.9 to 11.8 and does not include actions to address the upland portion.

PHSS comprises an approximately 10-mile reach of the lower Willamette River in Portland, Multnomah County, Oregon (Figure 1-1 of the FSP), which is an urban and industrial section of the river north of, and downstream of, downtown Portland, Oregon. PHSS covers approximately 2,190 acres and extends from RM 1.9 (upriver end of the Port of Portland's Terminal 5) to RM 11.8 (near the Broadway Bridge).

While the harbor area is heavily industrialized, it is located within a region characterized by commercial, residential, recreational, and agricultural uses. Land use along the lower Willamette River in the harbor includes marine terminals, manufacturing, and other commercial operations, as well as public facilities, parks, and open spaces. In addition to industrial activities, the Willamette River and surrounding watershed historically offered access to abundant natural

resources in the river and on land. Many of these resources are still present such as fish, marine mammals, waterfowl, land mammals, and native plants.

The Willamette River is also important to many tribes. Fish are among the resources most frequently utilized by the tribes in the Portland Basin and the Willamette Valley. Culturally significant species include salmonids, lamprey (eels), eulachon (smelt), and sturgeon. Native people also fished for a variety of other resident species, including mountain whitefish, chiselmouth, northern pikeminnow, peamouth, and suckers (Butler 2004; Saleeby 1983). The harvest of the Pacific lamprey was, and continues to be, important to many tribes. Native plants were and continue to be gathered for food and medicinal purposes as well. Tribes have reserved hunting, fishing (particularly salmon and sturgeon species), and certain gathering rights through Treaties with the United States. These activities provide food for Tribal families and cultural heritage knowledge and skills. Tribal uses of these resources continue today, but access to suitable patches of habitat continues to be both a challenge and an essential element of maintaining local Tribal cultural knowledge, practices, and traditions.

### **10.1.2 The Swan Island Basin Project Area**

The SIB Project Area has been defined in the ASAO as the active cleanup area designated on Figure 31d of the ROD between approximately RM 8.1 and RM 9.2 on the northeast side of the Willamette River. SAR Figure 1-1 shows the location of the SIB Project Area within PHSS, and SAR Figure 1-2 shows a detail of the SIB Project Area and the surrounding area, including zoning and drainage features. The SIB Project Area is approximately 1.1 miles long, covers 117 acres, and includes riverbanks from the top of the bank to the river. A detailed description of the SIB Project Area physical setting is presented in Section 3.1 of the SAR. Section 3.2 of the SAR presents a detailed description of the shoreline and overwater structures within the SIB Project Area.

## **10.2 HISTORY AND ENFORCEMENT ACTIVITIES**

The following sections provide an overview of PHSS. The development history of the SIB Project Area is presented in Section 3.1.3 of the SAR. Site investigation activities at the SIB Project Area were generally conducted as a component of the PHSS-wide investigations described below. Field investigation activities specific to the SIB Project Area are discussed in Section 3.4 of the SAR.

### **10.2.1 History**

The Willamette River is the 19th largest river in the United States and is one of 14 American Heritage Rivers in the country. The Willamette River flows into the larger Columbia River, which eventually flows into the Pacific Ocean. Even though the Willamette River is nearly 100 RMs from the Pacific, there are tidal influences within the SIB Project Area and, overall, it is a large and dynamic river. During its 309-mile course, which ends at its confluence with the Columbia River, it drains 11.7 percent (%) of the area in the state of Oregon. In 1891, the Oregon State Legislature created the Port of Portland. Since the late 1800s, the Portland Harbor section of the lower Willamette River has been extensively modified to accommodate a vigorous shipping industry. Modifications include redirection and channelization of the main river; draining seasonal and permanent wetlands in the lower floodplain; and relatively frequent dredging to maintain the

navigation channel, access to docks, and wharf facilities. Constructed structures, such as wharfs, piers, floating docks, and pilings, are especially common in Portland Harbor where urbanization and industrialization are most prevalent. These structures largely accommodate or support shipping traffic within the river and stabilize the riverbanks for urban development. Riprap is the most common bank-stabilization method although upland bulkheads and rubble piles are also used. Seawalls help control periodic flooding as most of the original wetlands bordering the river in the Portland Harbor area have been filled.

Historically, contaminants from many facilities entered the river system from different activities including, but not limited to ship building and repair; ship dismantling; wood treatment and lumber milling; storage of bulk fuels; manufactured gas production; chemical manufacturing and storage; metal recycling, production, and fabrication; steel mills, smelters, and foundries; and electrical production and distribution. These activities have resulted in direct discharges from upland areas through stormwater and wastewater outfalls; releases and spills from commercial operations occurring over the water; municipal combined sewer overflows; and indirect discharges through overland flow, bank erosion, groundwater, and other nonpoint sources. In addition, contaminants from off-site sources have reached PHSS through surface water and sediment transport from upstream and through atmospheric deposition. Operations that continue today along the riverbanks include bulk fuel storage; barge building; ship repair; automobile scrapping; recycling; steel manufacturing; cement manufacturing; operation and repair of electrical transformers, including electrical substations; and many smaller industrial operations.

A federal navigation channel extends from the confluence of the lower Willamette River with the Columbia River to RM 11.6. Container and other commercial vessels regularly transit the river. Certain parts of the river require periodic maintenance dredging to keep the navigation channel at its authorized depth. In addition, the Port of Portland and other private entities periodically perform maintenance dredging to support access to dock and wharf facilities. Dredging activity has greatly altered the physical and ecological environment of the river in Portland Harbor. The current navigation depth was authorized in 1962 and dredging work on the authorized 40-foot (ft)-deep channel from Portland and Vancouver (Washington) to the Pacific was completed in 1976. In 1999, Congress authorized the Willamette River to be deepened to 43 ft; however, this has not yet occurred. Swan Island Lagoon (currently known as SIB) was created in the 1930s when dredge spoils were used to fill in part of the channel and connect Swan Island to the mainland. The federal navigation channel is located within the main river channel and does not extend into the SIB. The Willamette River channel, from the Broadway Bridge (RM 11.6) to the mouth (RM 0), varies in width from 600 to 1,900 ft. The U.S. Army Corps of Engineers maintains the navigation channel. Historical dredging activities at the SIB Project Area are discussed in Section 3.3 of the SAR.

Development of the river has resulted in major modifications to the ecological function of the lower Willamette River. However, several species of invertebrates, fish, birds, amphibians, and mammals, including some protected by the Endangered Species Act, use habitats that occur within and along the river. The river is also an important pathway for migration of anadromous fish such as salmon and lamprey. Various recreational fisheries, including salmon, bass, sturgeon, crayfish, and others, use the lower Willamette River. Resident fish in PHSS include, but are not limited to, smallmouth bass, brown bullhead, black crappie, and carp.

## **10.2.2 Historical Site Investigations**

Numerous investigations have been conducted of Portland Harbor dating back to the 1920s; however, most studies were conducted from the late 1970s through the 1990s. Some investigations were conducted on a larger scale (e.g., several RMs) while others were conducted on a smaller scale (e.g., less than 1 RM). Larger scale investigations typically were conducted by or for federal or state agencies, such as the U.S. Army Corps of Engineers, the U.S. Geological Survey, the Oregon Department of State Lands, the Oregon Department of Fish and Wildlife, the ODEQ Water Program, and EPA, to assess the river system. Smaller scale investigations typically were conducted by private parties for the purposes of maintenance dredging, construction and maintenance of in-river structures, or assessment of fate and transport of contamination from upland or in-river releases.

## **10.2.3 Preliminary Assessment and Site Investigation (1998)**

EPA conducted a Preliminary Assessment/Site Inspection of PHSS in May 1998 (Roy F. Weston, 1998). Sediment data collected during the Preliminary Assessment/Site Inspection and previous investigations resulted in the listing of PHSS on the National Priorities List.

## **10.2.4 Remedial Investigation/Feasibility Study (2001-2016)**

A group of PHSS stakeholders identified as the Lower Willamette Group (LWG) conducted an RI/FS under a series of ASAOs between LWG and EPA. The on-site component of the RI/FS included preliminary studies and three rounds of RI field investigations (EPA, 2016a). The study area investigated during RI field activities included the area of the SIB. The RI was conducted in four phases.

- Preliminary studies (non-chemical data) conducted from late 2000 to early 2002.
- Round 1 RI field investigations conducted from mid-2002 to spring 2004.
- Round 2 RI field investigations conducted from fall 2004 to spring 2006.
- Round 3 RI field investigations conducted from early 2006 through early 2008.

The preliminary studies were necessary to scope the work for conducting the RI. This phase of studies included a multi-beam bathymetric survey of the lower Willamette River (David Evans and Associates, Inc. [DEA], 2002a), a juvenile salmonid residence time survey (Ellis Ecological Services, 2002), a Sediment Trend Analysis<sup>®</sup> survey (GeoSea Consulting, 2001; Striplin Environmental Associates, Inc. [SEA], 2002a), a sediment profile imaging survey of the lower Willamette River (SEA, 2002b), and an acoustic Doppler current profiler survey conducted to measure current velocities at several transects in the river (DEA, 2002b).

Each round of RI field investigations included sampling and analysis of environmental media and the tissue of one or more species of aquatic life in the RI study area, including plants, shellfish, and fish. These conventional sampling efforts were supplemented by non-chemical testing, including geotechnical characterization, ecosystem evaluation, and cultural resource analysis.

### **10.3 ORIGINAL REMEDY**

The RI report included a comprehensive site characterization, a baseline human health risk assessment, and a baseline ecological risk assessment. The RI identified contaminants of concern (COCs) in surface water, groundwater, sediment, and biota tissue on a PHSS-wide basis and developed medium-specific cleanup levels (CULs).

#### **10.3.1 PHSS Sitewide Remedy**

The RI findings were used to produce an FS (EPA, 2016b). The FS established remedial action objectives for protection of human health and ecological protection in affected site media and evaluated multiple potential Remedial Action alternatives at PHSS. EPA issued a ROD for the in-river portion of PHSS, including the SIB, in 2017. A modification to Alternative F was chosen as the selected remedy at PHSS. The selected remedy includes a location-specific combination of sediment dredging, excavation of riverbank soil, capping, ex-situ treatment, enhanced natural recovery, and monitored natural recovery to address COCs and principal threat waste (PTW) at PHSS.

#### **10.3.2 Remedial Design at SIB**

The ROD describes a post-ROD sampling effort for PHSS to delineate and refine the Sediment Management Area (SMA) footprints, refine the CSM, determine baseline conditions, and support RD. On December 19, 2017, EPA entered into an ASAOC with the Pre-RD Agreement and Order on Consent Investigation Group to conduct the PDI and baseline sampling studies at PHSS. Additional post-ROD studies have been conducted as part of this overall PDI effort as described in Section 3.1 of the PDI Work Plan (HGL, 2021c).

## **WORKSHEET #11**

### **DATA QUALITY OBJECTIVES**

#### **11.0 DATA QUALITY OBJECTIVES**

The development of DQOs focuses on the end use of the collected data and on determining the corresponding data measurement objectives of precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS) necessary to satisfy the end use (see Worksheet #12). The DQO process involves seven steps designed to ensure that the type, quantity, and quality of data collected are appropriate for the intended application. Each step supports the project efforts by clarifying the project objective, defining the most appropriate type of data to be collected, and specifying acceptable levels of decision criteria. The steps are defined in *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G4, EPA/240/B-06/001 (EPA, 2006), as follows:

- State the problem,
- Identify the goals of the project,
- Identify information inputs,
- Define the boundaries of the project,
- Develop the analytic approach,
- Specify performance or acceptance criteria, and
- Develop the plan for obtaining data.

The process is based on a framework that, through continual evaluation during project activities, allows for DQO modification as project needs change. The field activities to be conducted at the SIB Project Area under this project are based on the requirements of the PHSS ROD (EPA, 2017) and the SOW included in the ASAOC (EPA, 2021). Sampling and analysis will be performed in accordance with the project planning documents listed in Section 11.7. Table 11-1 illustrates the application of the DQO process to data collection efforts of the PDI Work Plan.

#### **11.1 STATE THE PROBLEM**

The ROD states that a post-ROD sampling effort will be conducted to support the RD, refine the CSM, and establish a baseline dataset for comparison to post-remedy conditions. The ASAOC SOW includes a data gap analysis as a component of RD, followed by additional PDI sampling to obtain chemical and geotechnical data to address the identified data gaps. This PDI study covers many elements of sampling and data collection, including sampling and analysis of surface and subsurface sediment, sediment porewater, and riverbank surface and shallow core soil; soil and sediment borings advanced to collect geotechnical samples; site characteristic measurements such as bathymetry, acoustic doppler current profiler surveys, and wave and boat wake measurements; and surveying and inspection (including by dive teams).

#### **11.2 IDENTIFY THE GOALS OF THE PROJECT**

The primary goal of this project is to complete a comprehensive RD that addresses remediation of the contamination at the SIB Project Area. To prepare the RD, interim site data evaluation and

collection activities are required to update and evaluate site conditions at the SIB Project Area to refine the CSM. The purpose of the PDI for the SIB Project Area is to:

- Determine what data and analysis are necessary to inform the RD;
- Identify and evaluate relevant, applicable and existing data and analysis;
- Identify data gaps; and
- Propose an approach to collect the data and complete the analyses required to address those data gaps and design the remedy.

The overarching objective of the PDI focuses on compiling a complete body of data and analysis to fully inform the development and evaluation of a sustainable and effective RD for the SIB Project Area. Within that primary objective, other specific objectives are used to guide the planning and implementation of the PDI to ensure this primary goal is met. Those objectives are listed below.

1. Define the specific data and analysis needs required to fully inform the design development and evaluation based on a conceptual design approach and strategy consistent with the ROD.
2. Ensure that the data and analysis needs are sufficient to support the three applications specifically required in the ASAOC for SMA refinement, CSM refinement, and effective use of the technology application decision tree (PDI Work Plan Figure 1-3).
3. Compile and evaluate existing available data and analysis relevant to the defined data and analysis needs as determined by the design and required applications.
4. Identify data gaps by comparing what is needed to what is available.
5. Develop a work plan to guide the collection of new data and the completion of new analyses to address the data gaps.

### **11.3 IDENTIFY INFORMATION INPUTS**

To achieve the goals of the SIB sediment investigation, the following information inputs will be collected in the following categories.

#### **11.3.1 Chemical Data**

Environmental sampling will include sampling surface and subsurface sediment, surface and shallow core soil, sediment elutriate, stormwater, and stormwater sediment for analysis of contaminants and target COCs in ROD Table 17, PTW in ROD Table 21, and for geotechnical analyses by ASTM methods.

#### **11.3.2 Engineering Analysis and Design Data**

Information inputs in this category will include multi-beam hydrographic and topographic survey data, geotechnical borings (on land and in water), vessel-mounted laser scan for locating and documenting locations of existing structures, and a combination of sub-bottom profiling and

magnetometer surveys for detection of debris and existing buried utilities. A dive inspection will be performed to visually inspect selected marine structures.

### **11.3.3 Numerical Modeling and Analysis**

Information inputs in this category will include multi-beam hydrographic and topographic survey data, sediment cores for SedFlume (erodibility) analysis, tidal/river current data, suspended sediment concentration data, and wind-wave and boat wake data (free surface measurements).

## **11.4 DEFINE THE BOUNDARIES OF THE PROJECT**

The SIB Project Area (Figure 1-1 of the FSP) is located on the northeastern side of the Lower Willamette River in PHSS between RM 8 and RM 9.2.

## **11.5 DEVELOP THE ANALYTIC APPROACH**

The field investigation component of the PDI will collect environmental data integral to achieving the goals of the study listed above. Data will be collected from medium-specific sampling events conducted in the SIB Project Area.

A critical component of planning for the SIB PDI is the sufficiency assessment, which will evaluate sources of contaminants to determine whether they have been adequately investigated and sufficiently controlled or considered such that the Remedial Action can proceed. The results of the sufficiency assessment have been incorporated into the data gap analysis included in the PDI Work Plan (HGL, 2021c). The project analytical methods, including target analytes and the associated laboratory sensitivity limits and the project action limits (PALs), are presented in Worksheet #15. The target analytes include the focused COCs for each site medium and those additional COCs identified on a medium-specific basis in ROD Table 17. The expansion of analyte lists beyond the focused COCs is intended to characterize contamination left in place to be addressed by remediation alternatives other than removal. Analysis for the full medium-specific analyte lists will also ensure that potential sources of off-site recontamination are addressed. The analyte lists for soil/sediment based on ROD Table 17 encompass PTW analytes identified in ROD Table 21 except chlorobenzene. This compound does not have a soil/sediment CUL and the historical data set for SIB does not include any chlorobenzene detections above the Remedial Action Level (RAL) of 320 micrograms per kilogram ( $\mu\text{g}/\text{kg}$ ) presented in ROD Table 21; therefore, this compound is not included in the project-specific analyte lists. This approach is consistent with the approach taken for a PDI performed at nearby PHSS subsite RM 9 West (Foth, 2021).

## **11.6 SPECIFY PERFORMANCE AND ACCEPTANCE CRITERIA**

The measurement performance criteria for data associated with the specific analyses include the data quality indicators (DQIs) PARCCS. To meet PARCCS requirements, QC criteria are provided in the standard field and laboratory methods. The PARCCS parameters and the associated QC samples and elements associated with them are presented below.

- Precision: Field duplicates, laboratory duplicates, laboratory control sample (LCS)/laboratory control sample duplicates (LCSD), and matrix spike (MS)/matrix spike duplicate samples (MSD).
- Accuracy (and bias): MSs, LCSs, surrogates, field and laboratory QC blanks, instrument initial calibration (ICAL), and instrument continuing calibration checks.
- Representativeness: Field sampling design, sample collection standard operating procedures (SOPs), and field and laboratory QC blanks.
- Completeness: Evaluation of the number of usable data points obtained against the number projected.
- Comparability: Use of standardized field and laboratory methods and the consistent use of field and laboratory SOPs.
- Sensitivity: Method Detection Limit (MDL) studies, instrument ICAL, and instrument sensitivity checks.

Specific objectives for each PARCCS element are established to develop sampling protocols, applicable documentation, sample handling procedures, and measurement system procedures that will be used during field activities. These are described in more detail in Worksheet #12, Worksheet #15, Worksheet #24, and Worksheet #28.

The SIB Project Area is already fully characterized, and the analytical data from this PDI will be used to fill data gaps to support RD activities. The project DQOs have been developed to address an estimation problem and determining the probability limits on decision errors is not required. Screening level analytical data with a 10% definitive data (see Section 12.3 of Worksheet #12) will be a sufficient level of data quality to support project decision-making. Geotechnical data will be of screening level. The data validation guidelines presented in Worksheet #36 reflect these performance criteria.

## **11.7 DEVELOP THE PLAN FOR OBTAINING DATA**

The PDI sampling and analysis strategy is based on the 2017 ROD and the 2021 ASAOC SOW. The basis of the sampling design and approach and sampling locations are presented in Section 4.0 of the SIB PDI Work Plan (HGL, 2021c).

**Table 11-1**  
**Summary of the 7 steps for Systematic Planning Using the DQO Process, as applied to the Swan Island Basin (SIB) Remedial Design (RD)**

Step	Mobile LiDAR	Bathymetry	Side-scan Sonar	Magnetometer	Sub-bottom Profiling	Geotechnical Sampling	Chemistry Sampling	Current Profiling	SedFlume Sampling	
1	State the problem	RD requires knowledge of exposed debris, marine structure locations, and riverbank elevations in SIB.	RD requires accurate depth information in the river and SIB.	RD requires identification of debris and/or utilities that could pose a hazard during dredging or capping.	RD requires identification of ferrous material both above and below the mudline that could pose a hazard during any dredging or capping activity, including UXOs.	RD requires geological information and identification of buried debris that could pose a hazard during dredging or capping.	RD requires soil engineering properties for analysis of riverbank stability, cap stability, functional structures evaluation, and design.	RD requires current velocity and direction data to understand SIB dynamics and calibrate/validate numerical models.	RD requires soil erodibility properties for analysis of sediment resuspension and scour as part of recontamination studies.	
2	Identify the goals of the study	Estimate locations of emergent debris, marine structures and riverbank elevations.	Estimate submerged riverbed elevations.	Identify underwater debris and estimate its location to evaluate whether it requires removal as part of Remedial Action (RA) and provide data to help interpret bathymetry data gaps.	Identify ferrous material both above and below the mudline and estimate their locations to determine whether they affect RA.	Illustrate geological formations, identify the presence of buried debris/utilities, and estimate their locations to determine whether they affect RA.	Identify and characterize the types of soil present at the site, develop estimates of geotechnical engineering design parameters, identify geotechnical hazards, and assess overall ground conditions.	Estimate site sediment COC concentrations by targeting surface and subsurface data gaps.	Estimate speed and direction of currents in the river and in SIB.	Estimate soil erodibility and density properties for use in resuspension and scour analysis.
3	Identify information inputs	New locations and elevations of marine structures, emergent debris, and riverbank elevations are needed. Inputs to surveyors include focus areas, overlap with bathymetry data by covering lowest possible areas on profile. Survey accuracy goal prescribed to surveyor is positioning to 2-3cm accuracy to the extent feasible, with data sampling rate of 200 Hz within 300 feet scanning range.	New submerged riverbed elevations are needed. Inputs to surveyors include covering best available upper riverbank area, and coverage as complete as possible considering unavoidable obstructions. Survey accuracy goal prescribed to surveyor is best feasible based on field conditions, at sampling frequency 400 kHz within 200m operational range.	New imaging of locations of in-water debris is needed. Position and object detection location accuracy goal prescribed to surveyor is best possible based on field conditions, and detection of objects down to 0.45m in size at maximum 100m range. Complete nearshore coverage is prescribed to the extent feasible based on obstructions encountered in the field.	New locations of ferrous objects are needed. Object detection accuracy goal prescribed to surveyor is best possible based on field conditions, towing magnetometer at least 2.5 vessel lengths behind vessel, at 7m above riverbed. Surveyor to survey initial site-wide transects, identify targets for further identification, and run localized transects around detections.	New imaging of locations of geological strata and buried objects is needed. Sub-bottom geology/object detection accuracy goal prescribed to surveyor is best possible penetration based on field conditions, up to 25m for detailed stratification at layer resolution 5cm. Surveyor to survey initial site-wide transects, identify targets for further identification, and run localized transects around detections.	New soil engineering properties are needed. Inputs to the geotechnical sampling program include soil borings, cone penetration tests, shear wave velocity tests, pore pressure dissipation testing, and PS-wave suspension logging at select locations. Additional information regarding the geotechnical sampling information inputs is included in Section 4.4 of the Field Sampling Plan and in the PDI Work Plan.	New surface and subsurface sediment concentration samples are needed. Inputs to the sediment chemistry sampling include surface grab samples targeting the top 30cm of sediment and subsurface cores targeting 1-foot intervals from the sediment surface to 10- to 20-feet, and the laboratory analyses performed on those samples.	New measurements of current speed and direction is needed, using typical industry performance criteria, and typical industry sampling and analysis methods are deemed appropriate.	New soil erodibility properties are needed. Inputs to SedFlume field core collection and laboratory analysis consist of only locations to be sampled. Sampling crew will sample cores up to 30cm typical surface sediments at 30 distinct locations. Laboratory methods are standardized as developed by subcontractor.
4	Define the boundaries of the study	SIB areas with riverbanks and marine structures potentially affected by RA. See Figure 5-3 of the Field Sampling Plan.	SIB site-wide riverbed areas and nearby Lower Willamette River riverbed areas near areas to undergo RA. See Figure 5-1 of the Field Sampling Plan.	SIB site-wide areas with submerged debris, riverbanks, and marine structures potentially affected by RA. See Figure 5-2 of the Field Sampling Plan.	SIB site-wide riverbed areas potentially affected by RA. See Figure 5-2 of the Field Sampling Plan.	SIB riverbed areas potentially affected by RA. See Figure 5-2 of the Field Sampling Plan.	SIB site-wide riverbed and upland areas potentially affected by RA. See Figure 4-7 of the Field Sampling Plan.	SIB site-wide riverbed areas potentially affected by RA. See Figures 4-3 and 4-4 of the Field Sampling Plan.	SIB water body and nearby Lower Willamette River water body areas that control water and sediment movements to SIB. See Appendix A.	SIB site-wide riverbed areas potentially affected by RA. See Figure 5-4 of the Field Sampling Plan.

**Table 11-1 (Continued)**  
**Summary of the 7 steps for Systematic Planning Using the DQO Process, as applied to the Swan Island Basin (SIB) Remedial Design (RD)**

Step	Mobile LiDAR	Bathymetry	Side-scan Sonar	Magnetometer	Sub-bottom Profiling	Geotechnical Sampling	Chemistry Sampling	Current Profiling	SedFlume Sampling	
5	Develop the analytical approach	Parameter of interest is point cloud location data; methodologies already exist for data collection (see Sections 2.5 and 2.6 of Appendix A).	Parameter of interest is elevation data; methodologies already exist for data collection (see Sections 2.7 and 2.8 of Appendix A).	Parameter of interest is identification of objects; methodologies already exist for data collection (see Sections 3 and 3.1 of Appendix A).	Parameter of interest is identification of ferrous objects; methodologies already exist for data collection (see Sections 4 and 4.1 of Appendix A).	Parameter of interest is identification of geological patterns and objects; methodologies already exist for data collection (see Sections 5 and 5.1 of Appendix A).	Parameters of interest are engineering soil properties. Methodologies for drilling, sampling, and testing already exist (see Section 4.4 of the Field Sampling Plan).	Parameters of interest are soil chemistry including contaminants of concern. Methodologies for drilling, sampling, and testing already exist (see Section 4.2 of the Field Sampling Plan).	Parameter of interest is identification of speed and direction of water movement; methodologies already exist for data collection.	Parameters of interest are soil erodibility properties (critical shear stress for erosion, erosion rate) and density properties. Methodologies for collection and laboratory analysis already exist (see Section 5.4 of the Field Sampling Plan).
6	Specify performance or acceptance criteria	Performance goals include overlap with bathymetry data to the extent feasible in the field, as well as structure/debris identification. Best available position accuracy described in Appendix A, Sections 2.5 and 2.6, are suitable for reliable use.	Performance criteria including achieving best available position accuracy and data returns based on equipment described in Appendix A, Sections 2.7 and 2.8, are suitable for reliable use.	Performance criteria including achieving best available position accuracy and data returns based on equipment described in Appendix A, Sections 3 and 3.1, are suitable for reliable use.	Performance criteria including achieving best available position accuracy and ferrous material data returns based on equipment described in Appendix A, Sections 4 and 4.1, are suitable for reliable use.	Performance criteria including achieving best available position accuracy and geological data pattern returns based on equipment described in Appendix A, Sections 5 and 5.1, are suitable for reliable use.	Performance criteria include achieving best estimate of soil properties are described in the applicable ASTM standards and guidance documents described in Section 4.4 of the Field Sampling Plan. Additionally, geotechnical sampling will be performed under the observation and direction of an engineer/geologist.	Performance criteria include achieving best estimates of soil chemistry according to field methodology and standards used for laboratory testing described in Section 4.2 of the Field Sampling Plan.	Standard industry accuracy tolerances described in Appendix A are suitable for reliable use.	Performance criteria include achieving best estimate of soil erodibility and density properties according to subcontractor standard methodology (see Section 5.4 of the Field Sampling Plan). Typical laboratory reporting by subcontractor is suitable for use.
7	Develop the plan for obtaining data	Plan for locations is shown in Figure 5-3 of the Field Sampling Plan, and methodology for collection is described in Appendix A Sections 2.5 and 2.6.	Plan for locations is shown in Figure 5-1 of the Field Sampling Plan, and methodology for collection described in Appendix A Sections 2.7 and 2.8.	Plan for locations is shown in Figure 5-2 of the Field Sampling Plan, and methodology for collection is described in Appendix A Sections 3 and 3.1.	Plan for locations is shown in Figure 5-2 of the Field Sampling Plan, and methodology for collection is described in Appendix A Sections 4 and 4.1.	Plan for locations is shown in Figure 5-2 of the Field Sampling Plan, and methodology for collection is described in Appendix A Sections 5 and 5.1.	Plan for locations is shown in Figure 4-7 of the Field Sampling Plan, and methodology for collection is described in Section 4.4 of the Field Sampling Plan).	Plan for locations is shown in Figures 4-3 and 4-4 of the Field Sampling Plan, and methodology for collection is described in Section 4.2.	Standard industry approach to data collection is preferred. See Appendix A for additional details.	Plan for locations is shown in Figure 5-4 of the Field Sampling Plan. Methodology for data collection is described in Section 5.4 of the Field Sampling Plan.

**WORKSHEET #12**  
**METHOD MEASUREMENT PERFORMANCE CRITERIA TABLES**

**12.0 MEASUREMENT PERFORMANCE CRITERIA**

The overall QC objective for this project is to develop and implement procedures for sample collection, laboratory analysis, field measurement, and data reporting that will provide data of a degree of quality consistent with its intended use as described in the DQO process (Worksheet #11). Worksheet #12 and the associated method-specific worksheets present the performance criteria for the analytical measurements performed in support of this project. The project analytical methods are primarily from EPA’s SW-846 methods compendium (EPA, 2015) unless otherwise noted.

**12.1 DATA QUALITY INDICATORS**

Of the six PARCCS DQIs, precision, accuracy, completeness, and sensitivity can be quantitatively measured and assessed. The parameters of comparability and representativeness are primarily qualitative in nature.

**12.1.1 Quantitative Data Quality Indicators**

Quantitative DQIs can be measured and assessed by performing QC checks and evaluating the results against numerical acceptance criteria. For this project, method-specified control limits will be used; where the method does not specify control limits, QC checks will be evaluated against the laboratory’s internally generated control limits for routine analyses. These QC limits will be sufficient to ensure that the analytical methods are performed under acceptable conditions and that results can be used as reported for the intended purposes following the data validation and quality evaluation processes, as described in Worksheet #36 and Worksheet #37.

**12.1.1.1 Precision**

Precision is the measure of variability between individual sample measurements under prescribed conditions. Precision can be assessed by replicate measurements of known laboratory standards and by analysis of duplicate environmental samples (spiked or unspiked). Precision is determined by evaluating the relative percent difference (RPD) between duplicate sample results. Replicate measurements of known standards (LCS/LCSD pairs), spiked samples (MS/MSD pairs), and laboratory duplicate analyses are routinely monitored by the laboratory by comparing the RPD with established control limits. The formula for calculating RPD is as follows:

$$RPD = \frac{|S - D|}{\frac{(S + D)}{2}} \times 100$$

where:

- S = first sample value (original sample, LCS, or MS value); and
- D = second sample value (duplicate sample, LCSD, or MSD value).

The overall precision of measurement data is affected by both sampling and analytical factors. Analytical precision is much easier to control and quantify than sampling precision; there is more historical data related to individual method performance, and the “universe” is not limited to the samples received in an individual laboratory. In contrast, sampling precision is unique to the project. Sampling precision will be measured through the laboratory analysis of field duplicate samples. For field duplicates, homogenized samples will be split into two samples for analysis to assess sample homogenization and matrix heterogeneity variability. Laboratory precision will be measured through the analysis of MS/MSD pairs, LCS/LCSD pairs, and laboratory duplicate pairs.

### 12.1.1.2 Accuracy

Accuracy is the degree of agreement of a measurement to an accepted reference or true value. An evaluation of the accuracy of a measurement system provides an estimate of measurement bias. Overall analytical accuracy is assessed on a batch-specific basis by evaluating the percent recovery (%R) of known concentrations for each analyte in the LCS (and LCSD) against the QC limits. One known reference standard or LCS is analyzed for every batch (maximum of 20 samples). The accuracy of specific sample analyses is assessed by evaluating the %R of the surrogate spike compounds (organic analyses). The %R QC criteria for MS/MSDs will be used to assess the potential for matrix interferences. The formula for calculating %R is as follows:

$$\%R = \frac{A - B}{C} \times 100$$

where:

- A = the analyte concentration determined experimentally from the spiked sample;
- B = the background level determined by a separate analysis of the unspiked sample (for calibration standards, LCSs, and surrogate compounds, the value of this term is zero); and
- C = the amount of the spike added.

Accuracy is also measured using percent difference (%D) between a result and the expected value. The %D is usually used to evaluate accuracy when the acceptance of a QC result is dependent on another analytical result and not on a pre-defined window of acceptance, such as evaluation of continuing calibration verification (CCV) standard performance against the results of the corresponding ICAL. The formula for calculating %D is as follows:

$$\%D = \frac{A - B}{A} \times 100$$

where:

- A = the original quantity measured, and
- B = the comparison quantity measured.

The accuracy of an individual data point can be affected by random fluctuations within the sampling and analysis system. Accuracy can also be affected by systematic factors due to sampling, the properties of the sampled matrix, the properties of the target analyte, and analytical system problems.

There are three broad categories of mechanisms by which bias can be introduced into analytical results, which can be monitored by the sampling and analysis QC procedures.

- High bias, which can stem from cross-contamination of sampling, packaging, or analytical equipment and materials. Cross-contamination is monitored through blank samples, such as equipment blanks (EBs), field blanks, trip blanks (TBs), and method blanks (MBs). These samples assess the potential for cross-contamination from, respectively, sampling equipment, ambient conditions, packaging and shipping procedures, and laboratory equipment. Data validation protocols provide a structured protocol for data qualification based on blank contamination.
- Low bias, which can stem from the dispersion and degradation of target analytes. The effects of these mechanisms are difficult to quantify. Sampling accuracy can be maximized, however, by the adoption and adherence to a strict field QA program. Specifically, sampling procedures will be performed following the standard protocols described in the FSP (HGL, 2021a). Appropriate sample containers, physical and chemical sample preservation, and holding times for preparation and analysis have been established to address potential analyte losses due to analyte loss or degradation. Through regular review of field procedures, deficiencies will be documented and corrected in a timely manner.
- High or low bias, as indicated by %R discrepancies, can occur due to calibration issues, system control problems, sample preparation issues, and challenging sample matrices. Analytical accuracy in the laboratory will be determined through the analysis of surrogates, LCSs, and MS/MSDs. As with blank samples, data validation protocols provide a structured protocol for data qualification based on high or low analyte recoveries outside of the acceptance limits.

### 12.1.1.3 Completeness

Completeness is a measure of the amount of valid data obtained compared with the amount that was expected to be obtained under correct, normal conditions. It is calculated for the aggregation of data measured for sampling events or other defined set of samples. Valid data is data that is usable in the context of the project goals and DQOs. Completeness is calculated and reported for each method, matrix, and analyte combination. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the dataset.

Sampling completeness is defined as the percentage of analytical results obtained compared with the projected number of analytical results that would be obtained from planned sample locations. Analytical completeness is defined as the percentage of valid (nonrejected) analytical results obtained from measurement systems compared with the total number of analytical results requested. The formula for calculating sampling completeness is as follows:

$$\text{Sampling Completeness} = \frac{\text{Number of Data Points Obtained}}{\text{Number of Planned Data Points}} \times 100\%$$

The formula for calculating analytical completeness is as follows:

$$\text{Analytical Completeness} = \frac{\text{Number of Acceptable Laboratory Measurements}}{\text{Number of Laboratory Measurements Reported}} \times 100\%$$

The overall completeness for each aspect of this project is defined as the sampling completeness multiplied by the laboratory completeness. Although the ideal of 100% data completeness may not be achieved for a dataset, that dataset may still be usable to make project-specific decisions. The impact of rejected or missing data on project decisions will be evaluated on a case-by-case basis in accordance with Worksheet #37. In addition to calculating overall completeness for project datasets, completeness can be evaluated as subsets of the overall dataset, including subsets selected by method, matrix, or analyte. Completeness will generally be calculated on a task-specific and project-specific basis.

Completeness is calculated at the end of the data validation process and generally is not used to evaluate an ongoing data generation process. However, the potential impact on completeness is one of the deciding factors in determining the appropriate course of CA when sample results are affected by a QA discrepancy.

#### **12.1.1.4 Sensitivity**

Sensitivity is defined as the capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest.

The MDL is the smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration at the 99% level of confidence. At the MDL, the false positive rate (Type I error) is 1%. MDLs are specific to an individual determination performed at an individual laboratory.

The estimated detection limit (EDL) is similar to the MDL, but instead of being calculated across all laboratory instruments based on spiking studies using statistical methods, the EDL for target analytes is calculated on a sample-specific basis using the quantified instrument noise in each sample analysis. The reporting of non-detected results at the EDL as an alternative to the use of the MDL (see below) is limited to analyses performed by high-resolution gas chromatography/high-resolution mass spectrometry (HRGC/HRMS).

The practical quantitation limit (PQL), also known as the reporting limit, is the lowest concentration that produces a quantitative result within specified limits of precision and bias. The PQL for each analyte should be set at or above the concentration of the lowest ICAL standard.

Detected analytical results with quantitation at or above the MDL, but below the PQL, will be reported as detections by the laboratory with the qualification “J.” Detected analytical results at or above the PQL will be reported without qualification unless affected by a QC issue. To maintain comparability with data reporting conventions used in previous SIB Project Area investigations, non-detected results or results with concentrations below the associated MDL, will be reported by the laboratory as the MDL with the qualification “U.” Alternative reporting formats for non-detections are acceptable if the result is clearly identified as a non-detection and the MDL is

presented on the data reporting page. The laboratory MDLs and PQLs are determined in clean matrices under controlled conditions that may not be entirely reproducible with environmental samples. On a sample-specific basis, the analyte MDLs and PQLs are modified to account for dilution (to address high analyte concentration or matrix interference), subsample size that differs from the nominal subsample size, and percent moisture of solid samples. These sample-specific adjusted MDLs and PQLs are the sensitivity limits that should be reported by the laboratory in association with analytical results.

Analytical sensitivity is evaluated by comparing method PQLs and MDLs to PALs. ROD Table 17 (including Errata #1 and #2) establishes the PALs for the SIB Study Area COCs and ROD Table 21 (including Errata #1) establishes the PALs for the SIB Study Area PTW. Analytical sensitivity limits are compared to the PALs for project analytes in the method-specific Worksheet #15 tables.

### **12.1.2 Qualitative Data Quality Indicators**

The DQIs of representativeness and comparability have only a limited ability to be evaluated using QC analysis results. These DQIs are primarily controlled by project planning and execution. This project-specific UFP-QAPP addresses the performance requirements for these DQIs based on the existing SIB Project Area data and conditions.

#### **12.1.2.1 Representativeness**

Representativeness is the degree to which data accurately and precisely expresses a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Although representativeness is a qualitative measurement, it is evaluated through a multi-step process beginning with evaluation of precision and accuracy data. Project design is one of the critical inputs that determine if the data collected is representative of the population sampled. Representativeness is ensured by collecting enough samples of an environmental medium, properly chosen with respect to place and time. The precision of a representative set of samples reflects the degree of variability of the sampled medium as well as the effectiveness of the sampling techniques and laboratory analysis.

Representativeness of individual samples will be controlled by sample collection and handling in accordance with the requirements of Worksheets #14/#16 and the SOPs presented Appendix A of the FSP. The sample containers and preservation methods presented in Worksheets #19/#30 will be used to ensure that samples arriving at the laboratory retain the appropriate degree of representativeness. The holding times presented in Worksheets #19/#30 have been established to ensure that samples retain representativeness at the time of extraction and analysis.

Representativeness also will be assessed using field and laboratory blank samples. An MB will be analyzed with every analytical or preparation batch (as appropriate to the analytical method) to determine potential contamination introduced during routine laboratory procedures. Initial calibration blanks (ICBs) and continuing calibration blanks (CCBs) will be analyzed as required by analytical methods. TBs and EBs will be collected to assess potential contamination due to field conditions. The assessment of blank samples will determine if compounds detected in the environmental samples are site-related or have been introduced through shipping, storage, field procedures, or laboratory procedures.

### **12.1.2.2 Comparability**

Comparability expresses the confidence with which one dataset can be compared to another. Comparability also involves a multi-step evaluation and can be related to accuracy and precision as these quantities are measures of data reliability, as well as to sensitivity limits (MDL and PQL) for analytical methods. Data is comparable if site considerations, collection techniques, as well as measurement procedures, methods, and sensitivity limits are equivalent for the samples within a sample set.

For this project, sample collection is intended to fill data gaps or otherwise extend an existing dataset and comparability of analytical results from this PDI with results in the historical dataset is of great importance. Where possible, analytical methods used in previous sampling events will be used to support this PDI, and the analyses will be performed by the same project laboratories that have supported previous SIB Project Area sampling events. These laboratories are experienced in analyzing samples from SIB Project Area matrices and the project-specific data reporting requirements.

## **12.2 ELEMENTS OF QUALITY CONTROL**

A QC system is a set of internal procedures used by the field team and laboratory for assuring that the data output of a measurement system meets prescribed criteria for data quality. A well-designed internal QC program must be capable of controlling and measuring the quality of the data in terms of precision and accuracy. This section addresses QC procedures associated with field sampling and analytical efforts. Included are general QC considerations as well as specific QC checks that provide ongoing control and assessment of data quality in terms of precision and accuracy.

### **12.2.1 Field Quality Control**

Field QC samples are collected in the field and used to evaluate the validity of the field sampling effort. Field QC samples are collected for laboratory analysis to check sampling and analytical precision, accuracy, and representativeness. The following section discusses the types and purpose of field QC samples that will be collected for this project. The frequency of collection and approximate number of field QC samples is presented in Worksheet #20.

#### **12.2.1.1 Field Duplicates**

Field duplicates are additional samples collected at a sampling location from the bowl or container of field-composite material and then split into two unique samples to enable statistical analysis of the resulting data. Two sets of samples from a single source are prepared, labeled with unique sample numbers, and submitted to the laboratory.

#### **12.2.1.2 Equipment Blanks**

EBs are used to assess the introduction of chemical contaminants during sampling and field processing activities and to help determine if decontamination procedures are effective at removing contaminated material from non-dedicated sampling equipment. EBs will consist of rinsate blanks collected by pouring de-ionized water over or through decontaminated sampling equipment and collected in the appropriate sample containers. These samples will be analyzed

along with the associated field samples. EBs are not required to be collected from disposable field equipment or equipment dedicated to a single location (such as a dedicated groundwater monitoring pump). Field equipment rinsate blanks will be generated for all chemical parameter groups, with 1 EB being collected for every 20 analytical samples and submitted for analysis to the laboratory for the same constituents targeted in that day's sampling. The results of the analyses of these QC sample types will be used as independent, external checks on laboratory and field contamination sources.

### **12.2.2 Analytical Laboratory Quality Control**

The analytical laboratories QC procedures will be consistent with the requirements of the analytical methods and the laboratories SOPs (Worksheet #23 and Appendix A). The laboratory PMs will oversee the activities of analytical chemistry support staff employed on this project. Oversight will be achieved through on-site audits and reviews of analytical facilities prior to and during analysis of project samples (see Worksheet #31, #32, and #33). The frequencies of analytical QC samples and associated CA for discrepancies are shown in Worksheet #28.

Analytical laboratory QC samples are used to evaluate PARCCS parameters for the analytical results (Table 5). Analytical methods specify routine procedures that are required to evaluate whether data is within proper QC limits. Additional internal QC includes collection and analysis of field and laboratory QC samples, as described in the sections that follow.

#### **12.2.2.1 Method Blanks**

MBs are used to check for laboratory contamination and instrument bias. A method (or preparation) blank is prepared at the frequency specified by the referenced method, typically one per preparation batch (a preparation batch is defined as a group of samples prepared together within a 24-hour time frame, not to exceed 20 samples). An MB is prepared and processed using the same procedures and reagents as are used to prepare the field samples in the associated batch. The purpose of the MB is to ensure that contaminants are not introduced by the laboratory bottle ware, reagents, standards, personnel, or the sample preparation environment.

Some analytical methods (such as metals) require additional blanks to be analyzed before, during, and after the analytical sequence. These ICBs and CCBs are aliquots of laboratory-grade water injected into the instrument without preparation. ICBs/CCBs are used to verify and monitor the stability of the analytical system and are also used to ensure that samples with high analyte concentrations have not contaminated the analytical system.

#### **12.2.2.2 Matrix Spikes and Matrix Spike Duplicates**

MS/MSD duplicate pairs provide information to assess precision and accuracy. The MS is a replicate of an environmental sample to which known concentrations of target analytes have been added. The MS is carried through the entire analytical procedure, and the recovery of the analytes, expressed as %R, is calculated by comparison to the expected recovery (see Section 12.1.1.2). The MS is used to evaluate the effect of the sample matrix on the accuracy of the analysis. The MSD is a second replicate of an environmental sample that is also spiked with known concentrations of the same analytes used for the MS; the target analyte %Rs in the MSD are evaluated in the same

manner as for the MS. The recovered concentrations in the two spiked replicates are also compared to determine the effects of the matrix on the precision of the analysis, expressed as RPD (see Section 12.1.1.1). When an analytical method is expected to produce positive results for most analytes (such as metals in soil), it is acceptable for the laboratory to perform an MS only and use a laboratory duplicate to assess precision.

Although MS/MSD analyses are laboratory QC, additional sample volume is required to perform these QC checks and the expected number of MS/MSD pairs is also included in the summary of field QC samples presented in Worksheet #20.

#### **12.2.2.3 Laboratory Control Sample**

LCSs are used to monitor the laboratory's day-to-day performance of routine analytical methods independent of matrix effects and are prepared at a frequency of one per preparation batch. LCSs are spiked at known concentrations using standard solutions containing target parameters of interest (or a method-defined subset of parameters). The %R of these standards is quantitatively measured during analysis. Although not required, in practice laboratories may include an LCSD in an analytical batch. The %R for each LCSD is evaluated in the same manner as for LCSs, and the results of the LCS and LCSD are compared as a batch-specific evaluation of precision. Some methods utilize pre-defined acceptance criteria for evaluating LCS (and LCSD) %R; however, some methods use laboratory historical records to evaluate LCS performance and use statistical evaluation to establish laboratory-specific control limits.

#### **12.2.2.4 Surrogate Spikes**

Surrogate spike analyses provide information on a laboratory's ability to recover the analytes of interest. As required by the method, each sample, blank, QC sample, and standard is spiked with one or more surrogate compounds. These compounds are often deuterated, fluorinated, or brominated compounds that are unlikely to be found in the environment but have extraction and analytical properties similar to the target compounds for that method. The surrogate spike is added prior to sample preparation steps (except volatile organic compounds [VOCs] surrogates, which are added after sample dilution) and carried through the entire analytical procedure. Results are expressed as %R for each surrogate. Discrepancies in surrogate %Rs can be indicative of sample-specific matrix effects or more general analytical issues.

#### **12.2.2.5 Certified Reference Material**

Each laboratory will analyze certified reference materials (CRM) per analysis per matrix, if available, at a frequency of at least once at the beginning of each project task that has an analytical component. Otherwise, analysis of CRMs will be per the requirements of the analytical method and laboratory QA program as applicable. The CRM results will be assessed against the acceptance criteria provided by the CRM vendor.

#### **12.2.2.6 Method-Specific QC Requirements**

There are QC requirements that are applicable on a method-specific basis, such as internal standards for analysis for gas chromatography/mass spectrometry (GC/MS) methods or serial dilutions for metals analysis methods. Method-specific QC elements that are associated with

calibration or instrument setup and the associated CA for discrepancies are presented in Worksheet #24. Method-specific QC analyses associated with laboratory batches or individual sample analyses are presented in the method-specific Worksheet #12 tables, with associated CA requirements presented in Worksheet #28.

### **12.3 DATA QUALITY CATEGORIES**

There are two general categories of data that will be generated for use in project decision-making: (1) screening data and (2) definitive data. The data validation requirements for each matrix and analytical parameter and matrix are specific to each project data source and end use. These requirements are summarized in Section 11.6 of Worksheet #11. The full process is described in Worksheet #36. The data usability evaluation procedures are summarized in Worksheet #37.

#### **12.3.1 Screening Data**

Screening data is generated by rapid methods of analysis with less rigorous sample preparation, calibration, or QC requirements than are necessary to produce definitive data. Sample preparation steps may be restricted to simple procedures such as dilution with a solvent instead of elaborate extraction/digestion and cleanup. Screening data may provide analyte identification and quantitation, although the quantitation may be relatively imprecise. Screening data may be considered of unknown quality without corresponding definitive confirmation data. Several screening methods identified for use in this project have no corresponding definitive method and results from these methods will not require confirmation.

Some methods that routinely produce definitive data also can produce screening level data if the data validation process is not performed or is reduced. This does not necessarily indicate a lower level of data quality; it is an indication of the usability of the affected results. This reduced level of data validation will depend on the end use of the data and this determination is made on a project-specific basis. The analytical methods that will only be required to produce screening level data and the associated sample matrices are indicated in Worksheet #11, Worksheet #23, and Worksheet #36. For this project, data that is of screening level quality will either receive a data verification corresponding to Stage 1 validation or validation that includes only these screening level elements that correspond to Stage 2A data review. These stages are defined by EPA in *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (EPA, 2009). Use of data without or with reduced validation does not relieve these laboratories from conducting analyses in accordance with internal SOPs, method requirements, project requirements, and good overall analytical and professional practices.

#### **12.3.2 Definitive Data**

Definitive data is generated using rigorous analytical methods, such as approved EPA reference methods. The data can be generated in a mobile or fixed-base laboratory. Definitive data is analyte-specific, and both identification and quantitation are confirmed for each analyte. Definitive analytical methods have standardized QC and documentation requirements and produce data for which analytical error (bias) can be determined. For data to be classified as definitive, the data must be validated after the results are reported to verify that the appropriate QC measures were taken and were in control. Also, the sample must be collected in a manner that is representative of

current site conditions, as described in the field SOPs (Worksheet #21 and FSP Appendix A). Definitive data is not restricted in its use unless quality problems identified in the validation process require data qualification. The analytical methods that will be required to produce definitive level data are indicated in Worksheet #11, Worksheet #23, and Worksheet #36. For data to be considered definitive, it must undergo validation that corresponds to Stage 2B, Stage 3, or Stage 4 data review as defined by *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (EPA, 2009).

## **12.4 MEASUREMENT PERFORMANCE CRITERIA TABLES**

The data quality elements presented in the Worksheet #12 tables include data quality elements associated with one or more of the DQIs discussed in Section 12.1 and specific QC samples and analyses discussed in Section 12.2. The acceptance criteria presented in Worksheet #12 tables are linked to the data validation protocols. Each project laboratory is required to ensure compliance with method and SOP requirements regardless of the level of data validation that will be performed on the resulting data (see Worksheet #36). If a QC element does not meet control criteria and CA was not performed or was not effective, the appropriate qualifier will be applied to associated results during the data validation process. The overall impact of QC discrepancies, including data gaps resulting from rejected data points, will be assessed in accordance with Worksheet #37.

### **12.4.1 Blank Evaluation**

It should be noted that the Worksheet #12 tables present acceptance criteria for reporting data associated with low levels of blank contamination. It is acceptable for the laboratory to report analytical data with low levels of blank contamination meeting the Worksheet #12 acceptance criteria. However, during the data validation process, *all* detected values in blanks will be used to evaluate the associated sample data, *regardless of whether the reported blank results met the acceptance criteria presented in Worksheet #12*. This is the one of the few cases where QC data that meets *reporting* acceptance requirements may still result in qualification of the associated data.

### **12.4.2 Laboratory SOPs**

The Worksheet #12 worksheets identify the analytical methods using the reference identification used by EPA or other method source. Worksheet #23 identifies the project laboratory's SOPs for performing these methods by title, date, and revision. SOPs identified in Worksheet #23 are considered business confidential and can be produced if requested.

## WORKSHEET #12.1A

### MEASUREMENT PERFORMANCE CRITERIA: VOLATILE ORGANIC COMPOUNDS, SEMIVOLATILE ORGANIC COMPOUNDS, AND POLYCYCLIC AROMATIC HYDROCARBONS

Matrix: Solid (SVOCs and PAHs) and aqueous (VOCs, SVOCs, and PAHs)

Analytical Group/Method: GC/MS / SW-846 Methods 8260C (VOCs); 8270D (SVOCs); 8270-SIM (PAHs)

Concentration Level: Trace (VOCs); Low (SVOCs; PAHs in solids); Ultra-Low (PAHs in aqueous matrices)

DQI	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Precision (overall)	Field Duplicate	RPD $\leq 50\%$ (solid matrix) or $\leq 30\%$ (aqueous matrix) if both results $\geq 5x$ PQL <sup>1</sup>
Precision (analytical)	LCS/LCSD <sup>2</sup>	RPD limits presented in Worksheet #12.1b (VOCs), Worksheet #12.1c (SVOCs), and Worksheet #12.1d (PAHs)
Precision (analytical, matrix interference)	MS/MSD	
Accuracy (analytical)	LCS and LCSD <sup>2</sup>	%R limits presented in Worksheet #12.1b (VOCs), Worksheet #12.1c (SVOCs), and Worksheet #12.1d (PAHs)
Accuracy (analytical, matrix interference)	MS and MSD	
Accuracy (analytical, matrix interference)	Surrogate Spike	
Representativeness (field)	EB (Rinse)	Not detected > PQL
Representativeness (transport)	Temperature Blank	0°C to 6°C
Representativeness (analytical system)	Laboratory MB	No analytes detected > 1/2 the PQL
Sensitivity	MDL and PQL	Adjusted correctly for sample-specific factors (subsample size, moisture content, dilution)
Completeness	Calculation of field and analytical completeness	>90% completeness
Accuracy (analytical, matrix interference)	Internal standards <sup>3</sup>	Peak area within 50-200% of peak area in corresponding mid-point ICAL standard or CCV standard on days when ICAL is not performed.
		Peak retention time within $\pm 30$ seconds of peak retention time in corresponding mid-point ICAL standard or CCV standard on days when ICAL is not performed.
Sensitivity	MDL	MDL at or below the analyte-specific PALs listed in Worksheets #15.1, #15.2a and b, and #15.3a and b.
		Conducted and updated at least annually <sup>3</sup>
Sensitivity	PQL <sup>3</sup>	Established at or above the low point of calibration curve

<sup>1</sup> For low-level results (one or both detected values  $\leq 5x$  PQL) or when one result is a non-detection, the control limit is absolute difference  $\leq 2x$  PQL (solid matrix) or  $\leq$  PQL (aqueous matrix). Non-detected values will be assigned the nominal value of the MDL for making this comparison.

<sup>2</sup> LCSDs are not a method requirement; however, if LCSD results are reported, the LCSD%Rs and LCS/LCSD RPD will be evaluated.

<sup>3</sup> This method requirement will only be reviewed to complete definitive (Stage 4) data validation.

SIM = selected ion monitoring

PAH = polycyclic aromatic hydrocarbon

SVOC = semivolatile organic compound

VOC = volatile organic compound

**WORKSHEET #12.1B  
ANALYTE-SPECIFIC LIMITS FOR VOLATILE ORGANIC COMPOUNDS (8260C)**

<b>Chemical</b>	<b>CASRN</b>	<b>Solid Matrix Accuracy Control Limits (%R)</b>	<b>Solid Matrix Precision Control Limits (RPD)</b>	<b>Aqueous Matrix Accuracy Control Limits (%R)</b>	<b>Aqueous Matrix Precision Control Limits (RPD)</b>
Ethylbenzene	100-41-4	NA	NA	67-121	30
<b><i>Surrogates</i></b>					
4-Bromofluorobenzene	460-00-4	NA	NA	68-117	NA

CASRN = Chemical Abstracts Service registry number  
 NA = not applicable

**WORKSHEET #12.1C**  
**ANALYTE-SPECIFIC LIMITS FOR SEMIVOLATILE ORGANIC COMPOUNDS (8270D)**

<b>Chemical</b>	<b>CASRN</b>	<b>Solid Matrix Accuracy Control Limits (%R)</b>	<b>Solid Matrix Precision Control Limits (RPD)</b>	<b>Aqueous Matrix Accuracy Control Limits (%R)</b>	<b>Aqueous Matrix Precision Control Limits (RPD)</b>
bis(2-Ethylhexyl)phthalate	117-81-7	39-113	40	42-147	30
Pentachlorophenol	87-86-5	NA	NA	27-112	30
<b>Surrogates</b>					
2,4,6-Tribromophenol	118-79-6	NA	NA	35-132	NA
Terphenyl-d14	1718-51-0	30-102	NA	48-109	NA

**WORKSHEET #12.1D**

**ANALYTE-SPECIFIC LIMITS FOR POLYNUCLEAR AROMATIC HYDROCARBONS (8270D-SIM/8270-SIM-ULL)<sup>1</sup>**

<b>Chemical</b>	<b>CASRN</b>	<b>Solid Matrix Accuracy Control Limits (%R)</b>	<b>Solid Matrix Precision Control Limits (RPD)</b>	<b>Aqueous Matrix Accuracy Control Limits (%R)</b>	<b>Aqueous Matrix Precision Control Limits (RPD)</b>
2-Methylnaphthalene	91-57-6	43-92	40	42-108	30
Acenaphthene	83-32-9	44-95	40	58-98	30
Acenaphthylene	208-96-8	44-93	40	61-102	30
Anthracene	120-12-7	46-100	40	65-98	30
Benzo(a)anthracene	56-55-3	52-105	40	67-96	30
Benzo(a)pyrene	50-32-8	52-111	40	68-107	30
Benzo(b)fluoranthene	205-99-2	52-114	40	69-104	30
Benzo(g,h,i)perylene	191-24-2	45-107	40	61-110	30
Benzo(k)fluoranthene	207-08-9	52-112	40	68-108	30
Chrysene	218-01-9	51-110	40	67-105	30
Dibenz(a,h)anthracene	53-70-3	44-110	40	54-118	30
Fluoranthene	206-44-0	49-102	40	63-106	30
Fluorene	86-73-7	45-98	40	59-97	30
Indeno(1,2,3-cd)pyrene	193-39-5	44-117	40	61-115	30
Naphthalene	91-20-3	42-88	40	59-95	30
Phenanthrene	85-01-8	41-99	40	61-100	30
Pyrene	129-00-0	48-104	40	64-104	30
<b>Surrogates</b>					
2-Methylnaphthalene-d10	7297-45-2	50-150	NA	NA	NA
Fluoranthene-d10	93951-69-0	39-109	NA	39-110	NA
Fluorene-d10	81103-79-9	38-104	NA	42-131	NA
Terphenyl-d14	1718-51-0	38-113	NA	32-129	NA

<sup>1</sup> Both the SIM and the ultra-low level (ULL) modification to SIM are presented in ALS-Kelso SOP SVM-8270S (see Worksheet #23); solid matrix samples will be analyzed by the standard 8270-SIM procedures and aqueous matrix samples will be analyzed using the ULL modification presented in the SOP.

## WORKSHEET #12.2A

### MEASUREMENT PERFORMANCE CRITERIA: PCBs AS AROCLORS, HERBICIDES, AND TRIBUTYLTIN

Matrix: Solid (PCBs and tributyltin) and aqueous (PCBs, herbicides, and tributyltin)

Analytical Group/Method: GC/ECD / SW-846 Methods 8082A and 8151A; GC/FPD / Laboratory-developed method based on Krone-Unger

Concentration Level: Low

DQI	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Precision (overall)	Field Duplicate	RPD $\leq 50\%$ (solid matrix) or $\leq 30\%$ (aqueous matrix) if both results $\geq 5x$ PQL <sup>1</sup>
Precision (analytical)	LCS/LCSD <sup>2</sup>	RPD limits presented in Worksheet #12.2b (PCBs), Worksheet #12.2c (herbicides), and Worksheet #12.2d (tributyltin)
Precision (analytical, matrix interference)	MS/MSD	
Accuracy (analytical)	LCS and LCSD <sup>2</sup>	
Accuracy (analytical, matrix interference)	MS and MSD	
Accuracy (analytical, matrix interference)	Surrogate Spike	%R limits presented in Worksheet #12.2b, (PCBs), Worksheet #12.2c (herbicides), and Worksheet #12.2d (tributyltin)
Representativeness (field)	EB ((Rinse)	Not detected > PQL
Representativeness (transport)	Temperature Blank	0°C to 6°C
Representativeness (analytical system)	Laboratory MB	No analytes detected > 1/2 the PQL
Representativeness (matrix interference)	Method-specified matrix cleanup	Performed as required/requested to address challenging sample matrices and chromatographic interference
Sensitivity	MDL and PQL	Adjusted correctly for sample-specific factors (subsample size, moisture content, dilution)
Completeness	Calculation of field and analytical completeness	>90% completeness
Accuracy (analytical, matrix interference)	Second column/second detector quantification <sup>3</sup>	RPD $\leq 40\%$
Sensitivity	MDL	MDL at or below the analyte-specific PALs listed in Worksheets #15.4a and b, #15.5, and #15.6
		Conducted and updated at least annually <sup>3</sup>
Sensitivity	PQL <sup>3</sup>	Established at or above the low point of calibration curve

<sup>1</sup> For low-level results (one or both detected values  $\leq 5x$  PQL) or when one result is a non-detection, the control limit is absolute difference  $\leq 2x$  PQL (solid matrix) or  $\leq$  PQL (aqueous matrix). Non-detected values will be assigned the nominal value of the MDL for making this comparison.

<sup>2</sup> LCSDs are not a method requirement; however, if LCSD results are reported, the LCSD%Rs and LCS/LCSD RPD will be evaluated.

<sup>3</sup> This method requirement will only be reviewed to complete definitive (Stage 4) data validation.

°C = degrees Celsius

GC/ECD = gas chromatography/electron capture detector

GC/FPD = gas chromatography/flame photometric detector

PCBs = polychlorinated biphenyls

**WORKSHEET #12.2B**  
**ANALYTE-SPECIFIC LIMITS FOR POLYCHLORINATED BIPHENYLS (8082A)**

<b>Chemical</b>	<b>CASRN</b>	<b>Solid Matrix Accuracy Control Limits (%R)<sup>1</sup></b>	<b>Solid Matrix Precision Control Limits (RPD)<sup>1</sup></b>	<b>Aqueous Matrix Accuracy Control Limits (%R)<sup>1</sup></b>	<b>Aqueous Matrix Precision Control Limits (RPD)<sup>1</sup></b>
Aroclor 1016	12674-11-2	56-120	30	54-120	30
Aroclor 1221	11104-28-2	NA	NA	NA	NA
Aroclor 1232	11141-16-5	NA	NA	NA	NA
Aroclor 1242	53469-21-9	NA	NA	NA	NA
Aroclor 1248	12672-29-6	NA	NA	NA	NA
Aroclor 1254	11097-69-1	NA	NA	NA	NA
Aroclor 1260	11096-82-5	58-120	30	51-120	30
Aroclor 1262	37324-23-5	NA	NA	NA	NA
Aroclor 1268	11100-14-4	NA	NA	NA	NA
<b>Surrogates</b>					
Decachlorobiphenyl	2051-24-3	40-126	NA	29-120	NA
Tetrachloro-m-xylene	877-09-8	44-120	NA	32-120	NA

<sup>1</sup> Discrepancies in Aroclor 1016 results are also considered to affect the results for Aroclors 1221, 1232, and 1242; discrepancies in Aroclor 1260 results are also considered to affect the results for Aroclors 1248, 1254, 1262, and 1268.

**WORKSHEET #12.2C**  
**ANALYTE-SPECIFIC LIMITS FOR HERBICIDES (8151A)**

<b>Chemical</b>	<b>CASRN</b>	<b>Solid Matrix Accuracy Control Limits (%R)</b>	<b>Solid Matrix Precision Control Limits (RPD)</b>	<b>Aqueous Matrix Accuracy Control Limits (%R)</b>	<b>Aqueous Matrix Precision Control Limits (RPD)</b>
MCPP	93-65-2	NA	NA	16-141	30
<i>Surrogates</i>					
2,4-Dichlorophenylacetic acid	19719-28-9	NA	NA	17-113	NA

MCPP = methylchlorophenoxypropionic acid

**WORKSHEET #12.2D**  
**ANALYTE-SPECIFIC LIMITS FOR TRIBUTYLTIN (LABORATORY GC/FPD METHOD)**

<b>Chemical</b>	<b>CASRN</b>	<b>Solid Matrix Accuracy Control Limits (%R)</b>	<b>Solid Matrix Precision Control Limits (RPD)</b>	<b>Aqueous Matrix Accuracy Control Limits (%R)</b>	<b>Aqueous Matrix Precision Control Limits (RPD)</b>
Tributyltin	36643-28-4	10-122	40	32-122	30
<i>Surrogates</i>					
Tripropyltin	NA	10-120	NA	31-137	NA

## WORKSHEET #12.3A

### MEASUREMENT PERFORMANCE CRITERIA: PCBs AS CONGENERS

Matrix: Solid and aqueous  
Analytical Group/Method: HRGC/HRMS / EPA Method 1668C (EPA, 2010)  
Concentration Level: Low

DQI	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Precision (overall)	Field Duplicate	RPD $\leq 50\%$ (solid matrix) or $\leq 30\%$ (aqueous matrix) if both results $\geq 5x$ PQL <sup>1</sup>
Precision (analytical)	LCS/LCSD <sup>2</sup>	RPD $\leq 20\%$
Precision (analytical, matrix interference)	MS/MSD	RPD $\leq 25\%$
Accuracy (analytical)	LCS and LCSD <sup>2</sup>	%R limits presented for selected congeners in Worksheet #12.3b
Accuracy (analytical, matrix interference)	MS and MSD	
Representativeness (field)	EB (Rinse)	Not detected > PQL
Representativeness (transport)	Temperature Blank	0°C to 6°C
Representativeness (analytical system)	Laboratory MB	No analytes detected > 1/2 the PQL
Representativeness (matrix interference)	Method-specified matrix cleanup	Performed as required/requested to address challenging sample matrices and chromatographic interference
Sensitivity	MDL and PQL	Adjusted correctly for sample-specific factors (subsample size, moisture content, dilution)
Completeness	Calculation of field and analytical completeness	>90% completeness
Accuracy (analytical, matrix interference)	Target analyte identification criteria <sup>3</sup>	Method requirements for S/N, m/z, peak presence, and peak relative retention time are listed in Section 16 of method 1668C; all criteria must be met for a detected result to be confirmed.
Accuracy (analytical, matrix interference)	Labeled standards <sup>3</sup>	%R limits presented in Worksheet #12.3b
Accuracy (analytical, matrix interference)	Cleanup standards <sup>3</sup>	%R limits presented in Worksheet #12.3b
Sensitivity	EDLs <sup>3</sup>	Sample- and analyte-specific EDLs calculated and reported by method-required procedures
Sensitivity	MDL	MDL at or below the analyte-specific PALs listed in Worksheets #15.7a and b
Sensitivity	PQL <sup>3</sup>	Conducted and updated at least annually <sup>3</sup>
Sensitivity	PQL <sup>3</sup>	Established at or above the low point of calibration curve

<sup>1</sup> For low-level results (one or both detected values  $\leq 5x$  PQL) or when one result is a non-detection, the control limit is absolute difference  $\leq 2x$  PQL (solid matrix) or  $\leq$ PQL (aqueous matrix). Non-detected values will be assigned the nominal value of the MDL for making this comparison.

<sup>2</sup> LCSDs are not a method requirement; however, if LCSD results are reported, the LCSD%Rs and LCS/LCSD RPD will be evaluated.

<sup>3</sup> This method requirement will only be reviewed to complete definitive (Stage 4) data validation.

S/N = signal to noise ratio  
m/z = mass to charge ratio

**WORKSHEET #12.3B**  
**ANALYTE-SPECIFIC LIMITS FOR PCBs AS CONGENERS (1668C)**

Chemical	IUPAC Number <sup>1</sup>	CASRN	Soil/Sediment and Water LCS and MS/MSD Accuracy Control Limits (%R)	Soil/Sediment and Water Sample Accuracy Control Limits (%R)
2-MoCB	1	2051-60-7	60-135	NA
4-MoCB	3	2051-62-9	60-135	NA
2,2'-DiCB	4	13029-08-8	60-135	NA
4,4'-DiCB	15	2050-68-2	60-135	NA
2,2',6-TrCB	19	38444-73-4	60-135	NA
3,4,4'-TrCB	37	38444-90-5	60-135	NA
2,2',6,6'-TeCB	54	15968-05-5	60-135	NA
3,3',4,4'-TeCB	77	32598-13-3	60-135	NA
3,4,4',5-TeCB	81	70362-50-4	60-135	NA
2,2',4,6,6'-PeCB	104	56558-16-8	60-135	NA
2,3,3',4,4'-PeCB	105	32598-14-4	60-135	NA
2,3,4,4',5-PeCB	114	74472-37-0	60-135	NA
2,3',4,4',5-PeCB	118	31508-00-6	60-135	NA
2',3,4,4',5-PeCB	123	65510-44-3	60-135	NA
3,3',4,4',5-PeCB	126	57465-28-8	60-135	NA
2,2',4,4',6,6'-HxCB	155	33979-03-2	60-135	NA
2,3,3',4,4',5-HxCB/ 2,3,3',4,4',5'-HxCB	156/157 (coelution)	38380-08-4/ 69782-90-7	60-135	NA
2,3',4,4',5,5'-HxCB	167	52663-72-6	60-135	NA
3,3',4,4',5,5'-HxCB	169	32774-16-6	60-135	NA
2,2',3,4',5,6,6'-HpCB	188	74487-85-7	60-135	NA
2,3,3',4,4',5,5'-HpCB	189	39635-31-9	60-135	NA
2,2',3,3',5,5',6,6'-OcCB	202	2136-99-4	60-135	NA
2,3,3',4,4',5,5',6-OcCB	205	74472-53-0	60-135	NA
2,2',3,3',4,4',5,5',6-NoCB	206	40186-72-9	60-135	NA
2,2',3,3',4,4',5,5',6,6'-NoCB	208	52663-77-1	60-135	NA
DeCB	209	2051-24-3	60-135	NA

**WORKSHEET #12.3B (CONTINUED)**  
**ANALYTE-SPECIFIC LIMITS FOR PCBs AS CONGENERS (1668C)**

Chemical	IUPAC Number <sup>1</sup>	CASRN	Soil/Sediment and Water LCS and MS/MSD Accuracy Control Limits (%R)	Soil/Sediment and Water Sample Accuracy Control Limits (%R)
<b>Labeled Standards</b>				
<sup>13</sup> C <sub>12</sub> -2-MoCB	1L	234432-85-0	15-145	5-145
<sup>13</sup> C <sub>12</sub> -4-MoCB	3L	208263-77-8	15-145	5-145
<sup>13</sup> C <sub>12</sub> -2,2'-DiCB	4L	234432-86-1	15-145	5-145
<sup>13</sup> C <sub>12</sub> -4,4'-DiCB	15L	208263-67-6	15-145	5-145
<sup>13</sup> C <sub>12</sub> -2,2',6-TrCB	19L	234432-87-2	15-145	5-145
<sup>13</sup> C <sub>12</sub> -3,4,4'-TrCB	37L	208263-79-0	15-145	5-145
<sup>13</sup> C <sub>12</sub> -2,2',6,6'-TeCB	54L	234432-88-3	15-145	5-145
<sup>13</sup> C <sub>12</sub> -3,3',4,4'-TeCB	77L	105600-23-5	40-145	10-145
<sup>13</sup> C <sub>12</sub> -3,4,4',5-TeCB	81L	208461-24-9	40-145	10-145
<sup>13</sup> C <sub>12</sub> -2,2',4,6,6'-PeCB	104L	234432-89-4	40-145	10-145
<sup>13</sup> C <sub>12</sub> -2,3,3',4,4'-PeCB	105L	208263-62-1	40-145	10-145
<sup>13</sup> C <sub>12</sub> -2,3,4,4',5-PeCB	114L	208263-63-2	40-145	10-145
<sup>13</sup> C <sub>12</sub> -2,3',4,4',5-PeCB	118L	104130-40-7	40-145	10-145
<sup>13</sup> C <sub>12</sub> -2',3,4,4',5-PeCB	123L	208263-64-3	40-145	10-145
<sup>13</sup> C <sub>12</sub> -3,3',4,4',5-PeCB	126L	208263-65-4	40-145	10-145
<sup>13</sup> C <sub>12</sub> -2,2',4,4',6,6'-HxCB	155L	234432-90-7	40-145	10-145
<sup>13</sup> C <sub>12</sub> -2,3,3',4,4',5 -HxCB/ <sup>13</sup> C <sub>12</sub> -2,3,3',4,4',5'-HxCB	156L/157L (coelution)	208263-68-7/ 235416-30-5	40-145	10-145
<sup>13</sup> C <sub>12</sub> -2,3',4,4',5,5'-HxCB	167L	208263-69-8	40-145	10-145
<sup>13</sup> C <sub>12</sub> -3,3',4,4',5,5'-HxCB	169L	208263-70-1	40-145	10-145
<sup>13</sup> C <sub>12</sub> --2,2',3,4',5,6,6'-HpCB	188L	234432-91-8	40-145	10-145
<sup>13</sup> C <sub>12</sub> -2',3,3',4,4',5,5'-HpCB	189L	208263-73-4	40-145	10-145
<sup>13</sup> C <sub>12</sub> -2,2',3,3',5,5',6,6'-OxCB	202L	105600-26-8	40-145	10-145
<sup>13</sup> C <sub>12</sub> -2,3,3',4,4',5,5',6-OxCB	205L	234446-64-1	40-145	10-145
<sup>13</sup> C <sub>12</sub> -2,2',3,3',4,4',5,5',6-NoCB	206L	208263-75-6	40-145	10-145
<sup>13</sup> C <sub>12</sub> -2,2',3,3',4,5,5',6,6'-NoCB	208L	234432-92-9	40-145	10-145

**WORKSHEET #12.3B (CONTINUED)**  
**ANALYTE-SPECIFIC LIMITS FOR PCBs AS CONGENERS (1668C)**

Chemical	IUPAC Number <sup>1</sup>	CASRN	Soil/Sediment and Water LCS and MS/MSD Accuracy Control Limits (%R)	Soil/Sediment and Water Sample Accuracy Control Limits (%R)
<sup>13</sup> C <sub>12</sub> -DeCB	209L	105600-27-9	40-145	10-145
<b>Cleanup Standards</b>				
<sup>13</sup> C <sub>12</sub> -2,4,4'-TrCB	28L	208263-76-7	15-145	5-145
<sup>13</sup> C <sub>12</sub> -2,3,3',5,5'-PeCB	111L	235416-29-2	40-145	10-145
<sup>13</sup> C <sub>12</sub> -2,2',3,3',5,5',6-HpCB	178L	232919-67-4	40-145	10-145

<sup>1</sup> ID number assigned by the International Union of Pure and Applied Chemistry (IUPAC); the suffix "L" designates a <sup>13</sup>C-labeled analogue.

DeCB = decachlorobiphenyl  
 DiCB = dichlorobiphenyl  
 HpCB = heptachlorobiphenyl  
 HxCB = hexachlorobiphenyl  
 MoCB = monochlorobiphenyl  
 NoCB = nonachlorobiphenyl  
 OcCB = octachlorobiphenyl  
 PeCB = pentachlorobiphenyl  
 TeCB = tetrachlorobiphenyl  
 TrCB = trichlorobiphenyl

## WORKSHEET #12.4A

### MEASUREMENT PERFORMANCE CRITERIA: ORGANOCHLORINE PESTICIDES

Matrix: Solid and aqueous

Analytical Group/Method: Solid: GC/MS/MS / EPA Method 1699M (EPA, 2007); Aqueous, HVS PUF cartridges, and HVS solids: HRGC/HRMS / EPA Method 1699 (EPA, 2007)

Concentration Level: Low

DQI	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Precision (overall)	Field Duplicate	RPD $\leq 50\%$ (solid matrix) or $\leq 30\%$ (aqueous matrix) if both results $\geq 5x$ PQL <sup>1</sup>
Precision (analytical)	LCS/LCSD <sup>2</sup>	RPD limits presented in Worksheets #12.4b, #12.4c, and #12d
Precision (analytical, matrix interference)	MS/MSD	
Accuracy (analytical)	LCS and LCSD <sup>2</sup>	
Accuracy (analytical, matrix interference)	MS and MSD	%R limits presented in Worksheets #12.4b, #12.4c, and #12d
Representativeness (field)	EB (Rinse)	Not detected > PQL
Representativeness (transport)	Temperature Blank	0°C to 6°C
Representativeness (analytical system)	Laboratory MB	No analytes detected > ½ the PQL
Representativeness (matrix interference)	Method-specified matrix cleanup	Performed as required/requested to address challenging sample matrices and chromatographic interference
Sensitivity	MDL and PQL	Adjusted correctly for sample-specific factors (subsample size, moisture content, dilution)
Completeness	Calculation of field and analytical completeness	>90% completeness
Accuracy (analytical, matrix interference)	Labeled standards <sup>3</sup>	%R limits presented in Worksheets #12.4b, #12.4c, and #12d
Sensitivity	MDL	MDL at or below the analyte-specific PALs listed in Worksheets #15.8a and b Conducted and updated at least annually <sup>3</sup>
Sensitivity	PQL <sup>3</sup>	Established at or above the low point of calibration curve

<sup>1</sup> For low-level results (one or both detected values  $\leq 5x$  PQL) or when one result is a non-detection, the control limit is absolute difference  $\leq 2x$  PQL (solid matrix) or  $\leq$ PQL (aqueous matrix). Non-detected values will be assigned the nominal value of the MDL for making this comparison.

<sup>2</sup> LCSDs are not a method requirement; however, if LCSD results are reported, the LCSD %Rs and LCS/LCSD RPD will be evaluated.

<sup>3</sup> This method requirement will only be reviewed to complete definitive (Stage 4) data validation.

HVS = high volume sampling

PUF = polyurethane foam

**WORKSHEET #12.4B**  
**ANALYTE-SPECIFIC LIMITS FOR ORGANOCHLORINE PESTICIDES IN SOIL (1699M) – ALS KELSO**

Chemical	CASRN	Solid Matrix Accuracy Control Limits (%R)	Solid Matrix Precision Control Limits (RPD)	Quantitation Reference Standard
Aldrin	309-00-2	74-122	30	<sup>13</sup> C <sub>12</sub> -Aldrin
Dieldrin	60-57-1	62-131	30	<sup>13</sup> C <sub>12</sub> -Endrin
gamma-BHC (Lindane)	58-89-9	79-116	30	gamma-BHC-d6
<i>DDx components</i>				
2,4'-DDD	53-19-0	73-122	30	4,4'-DDD-d4
4,4'-DDD	72-54-8	74-117	30	4,4'-DDD-d4
2,4'-DDE	3424-82-6	54-145	30	4,4'-DDD-d4
4,4'-DDE	72-55-9	66-132	30	4,4'-DDD-d4
2,4'-DDT	789-02-6	77-118	30	4,4'-DDT-d4
4,4'-DDT	50-29-3	78-116	30	4,4'-DDT-d4
<i>Chlordane components</i>				
cis-Chlordane (alpha-Chlordane)	5103-71-9	74-130	30	<sup>13</sup> C <sub>10</sub> -Oxychlordane
trans-Chlordane (gamma-Chlordane)	5566-34-7	76-128	30	<sup>13</sup> C <sub>10</sub> -Oxychlordane
cis-Nonachlor	5103-73-1	69-134	30	<sup>13</sup> C <sub>10</sub> -Oxychlordane
trans-Nonachlor	39765-80-5	76-124	30	<sup>13</sup> C <sub>10</sub> -Oxychlordane
Oxychlordane	27304-13-8	59-141	30	<sup>13</sup> C <sub>10</sub> -Oxychlordane
<i>Labeled Standards</i>				
<sup>13</sup> C <sub>12</sub> -Aldrin	475274-95-4	10-143	NA	Pyrene-d10
4,4'-DDD-d4	93952-20-6S	32-134	NA	Pyrene-d10
4,4'-DDT-d4	93952-18-2S	14-157	NA	Pyrene-d10
<sup>13</sup> C <sub>12</sub> -Endrin	475274-99-8	23-160	NA	Pyrene-d10
gamma-BHC-d6	60556-82-3S	18-124	NA	Pyrene-d10
<sup>13</sup> C <sub>10</sub> -Oxychlordane	2483735-99-3	23-138	NA	Pyrene-d10
Pyrene-d10 (injection standard)	1718-52-1	NA	NA	NA

## WORKSHEET #12.4C

## ANALYTE-SPECIFIC LIMITS FOR ORGANOCHLORINE PESTICIDES IN WATER (1699) – ALS-BURLINGTON

Chemical	CASRN	Aqueous Matrix Accuracy Control Limits (%R)	Aqueous Matrix Precision Control Limits (RPD)	Quantitation Reference Standard
Aldrin	309-00-2	50-120	50	<sup>13</sup> C <sub>10</sub> -Oxychlorane
Hexachlorobenzene	118-74-1	10-150	50	<sup>13</sup> C <sub>6</sub> -Hexachlorobenzene
<i>DDx components</i>				
2,4'-DDD	53-19-0	50-120	50	<sup>13</sup> C <sub>12</sub> -4,4'-DDD
4,4'-DDD	72-54-8	42-120	50	<sup>13</sup> C <sub>12</sub> -4,4'-DDD
2,4'-DDE	3424-82-6	24-123	50	<sup>13</sup> C <sub>12</sub> -2,4'-DDE
4,4'-DDE	72-55-9	50-120	50	<sup>13</sup> C <sub>12</sub> -4,4'-DDE
2,4'-DDT	789-02-6	50-120	50	<sup>13</sup> C <sub>12</sub> -4,4'-DDD
4,4'-DDT	50-29-3	50-120	50	<sup>13</sup> C <sub>12</sub> -4,4'-DDT
<i>Chlordane components</i>				
cis-Chlordane (alpha-Chlordane)	5103-71-9	50-120	50	<sup>13</sup> C <sub>10</sub> -trans-Nonachlor
trans-Chlordane (gamma-Chlordane)	5566-34-7	50-120	50	<sup>13</sup> C <sub>10</sub> -trans-Nonachlor
cis-Nonachlor	5103-73-1	50-120	50	<sup>13</sup> C <sub>10</sub> -trans-Nonachlor
trans-Nonachlor	39765-80-5	50-120	50	<sup>13</sup> C <sub>10</sub> -trans-Nonachlor
Oxychlorane	27304-13-8	50-120	50	<sup>13</sup> C <sub>10</sub> -Oxychlorane
<i>Labeled Standards<sup>1</sup></i>				
<sup>13</sup> C <sub>6</sub> -Hexachlorobenzene	93952-14-8	5-120	NA	<sup>13</sup> C <sub>12</sub> -PCB-9
<sup>13</sup> C <sub>12</sub> -4,4'-DDD	NA	13-200 / 5-150	NA	<sup>13</sup> C <sub>12</sub> -PCB-101
<sup>13</sup> C <sub>12</sub> -2,4'-DDE	2483735-97-1	13-200 / 5-150	NA	<sup>13</sup> C <sub>12</sub> -PCB-101
<sup>13</sup> C <sub>12</sub> -4,4'-DDE	201612-50-2	26-169 / 21-125	NA	<sup>13</sup> C <sub>12</sub> -PCB-101
<sup>13</sup> C <sub>12</sub> -4,4'-DDT	104215-84-1	13-200 / 5-150	NA	<sup>13</sup> C <sub>12</sub> -PCB-101
<sup>13</sup> C <sub>10</sub> -trans-Nonachlor	1262969-06-1	13-149 / 14-136	NA	<sup>13</sup> C <sub>12</sub> -PCB-101
<sup>13</sup> C <sub>10</sub> -Oxychlorane	2483735-99-3	5-144 / 23-135	NA	<sup>13</sup> C <sub>12</sub> -PCB-52
<sup>13</sup> C <sub>12</sub> -PCB-9 (injection standard)	NA	NA	NA	NA
<sup>13</sup> C <sub>12</sub> -PCB-52 (injection standard)	208263-80-3	NA	NA	NA
<sup>13</sup> C <sub>12</sub> -PCB-101 (injection standard)	104130-39-4	NA	NA	NA

<sup>1</sup> Where two ranges are given, the first is applicable to LCSs and the second is applicable to environmental samples.

**WORKSHEET #12.4D**  
**ANALYTE-SPECIFIC LIMITS FOR ORGANOCHLORINE PESTICIDES IN HVS MEDIA (1699)-SGS**

Chemical	CASRN	Accuracy Control Limits (%R)	Precision Control Limits (RPD)	Quantitation Reference Standard
Dieldrin	60-57-1	50-120	50	<sup>13</sup> C <sub>12</sub> -Dieldrin
<i>DDx components</i>				
2,4'-DDD	53-19-0	50-120	50	<sup>13</sup> C <sub>12</sub> -2,4'-DDD
4,4'-DDD	72-54-8	50-120	50	<sup>13</sup> C <sub>12</sub> -4,4'-DDD
2,4'-DDE	3424-82-6	50-120	50	<sup>13</sup> C <sub>12</sub> -2,4'-DDE
4,4'-DDE	72-55-9	50-120	50	<sup>13</sup> C <sub>12</sub> -4,4'-DDE
2,4'-DDT	789-02-6	50-120	50	<sup>13</sup> C <sub>12</sub> -2,4'-DDT
4,4'-DDT	50-29-3	19-163	50	<sup>13</sup> C <sub>12</sub> -4,4'-DDT
<i>Labeled Standards<sup>1</sup></i>				
<sup>13</sup> C <sub>12</sub> -Dieldrin	475274-95-4	19-161 / 36-139	NA	<sup>13</sup> C <sub>12</sub> -PCB-97
<sup>13</sup> C <sub>12</sub> -2,4'-DDD	2483736-36-1	5-120	NA	<sup>13</sup> C <sub>12</sub> -PCB-97
<sup>13</sup> C <sub>12</sub> -4,4'-DDD	NA	5-120	NA	<sup>13</sup> C <sub>12</sub> -PCB-97
<sup>13</sup> C <sub>12</sub> -2,4'-DDE	2483735-97-1	5-120	NA	<sup>13</sup> C <sub>12</sub> -PCB-97
<sup>13</sup> C <sub>12</sub> -4,4'-DDE	201612-50-2	5-120	NA	<sup>13</sup> C <sub>12</sub> -PCB-97
<sup>13</sup> C <sub>12</sub> -2,4'-DDT	1396995-26-8	14-200 / 5-199	NA	<sup>13</sup> C <sub>12</sub> -PCB-97
<sup>13</sup> C <sub>12</sub> -4,4'-DDT	104215-84-1	13-200 / 5-120	NA	<sup>13</sup> C <sub>12</sub> -PCB-97
<sup>13</sup> C <sub>12</sub> -PCB-97 (cleanup standard)	NA	50-150	NA	<sup>13</sup> C <sub>12</sub> -PCB-101
<sup>13</sup> C <sub>12</sub> -PCB-101 (injection standard)	104130-39-4	NA	NA	NA

<sup>1</sup> Where two ranges are given, the first is applicable to LCSs and the second is applicable to environmental samples.

## WORKSHEET #12.5A MEASUREMENT PERFORMANCE CRITERIA: PCDD/PCDFs

Matrix: Solid and aqueous  
Analytical Group/Method: HRGC/HRMS / EPA Method 1613B (EPA, 2010)  
Concentration Level: Low

DQI	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Precision (overall)	Field Duplicate	RPD $\leq$ 50% (solid matrix) or $\leq$ 30% (aqueous matrix) if both results $\geq$ 5x PQL <sup>1</sup>
Precision (analytical)	LCS/LCSD <sup>2</sup>	RPD $\leq$ 20%
Precision (analytical, matrix interference)	MS/MSD	
Accuracy (analytical)	LCS and LCSD <sup>2</sup>	%R limits presented in Worksheet #12.5b
Accuracy (analytical, matrix interference)	MS and MSD	%R within 70-130% (CFA) or 80-120% (SGS)
Representativeness (field)	EB (Rinse)	Not detected > PQL
Representativeness (transport)	Temperature Blank	0°C to 6°C
Representativeness (analytical system)	Laboratory MB	No analytes detected > 1/2 the PQL
Representativeness (matrix interference)	Method-specified matrix cleanup	Performed as required/requested to address challenging sample matrices and chromatographic interference
Sensitivity	Results reported as EMPC	Ratio of quantification ion m/z outside the $\pm$ 15% from the theoretical ratio for the applicable homologue series
Sensitivity	MDL and PQL	Adjusted correctly for sample-specific factors (subsample size, moisture content, dilution)
Completeness	Calculation of field and analytical completeness	>90% completeness
Accuracy (analytical, matrix interference)	Second column/second detector quantification for 2,3,7,8-TCDF <sup>3</sup>	Quantify result from 2,3,7,8-TCDF-specific column
Accuracy (analytical, matrix interference)	Target analyte identification criteria <sup>3</sup>	Method requirements for S/N, m/z, peak presence, and peak relative retention time are listed in Section 16 of method 1613B; all criteria must be met for a detected result to be confirmed. If all criteria except m/z are met, report result as an EMPC.
Accuracy (analytical, matrix interference)	Labeled standards <sup>3</sup>	%R limits for samples presented in Worksheet #12.5b
Sensitivity	EDLs	Sample- and analyte-specific EDLs calculated and reported by method-required procedures <sup>3</sup>
		EDL at or below the analyte-specific PALs listed in Worksheets #15.9a and b
Sensitivity	Laboratory MDL determination <sup>3</sup>	Conducted and updated at least annually
Sensitivity	PQL <sup>3</sup>	Established at or above the low point of calibration curve

<sup>1</sup> For low-level results (one or both detected values  $\leq$ 5x PQL) or when one result is a non-detection, the control limit is absolute difference  $\leq$ 2x PQL (solid matrix) or  $\leq$ PQL (aqueous matrix). Non-detected values will be assigned the nominal value of the EDL for making this comparison.

<sup>2</sup> LCSDs are not a method requirement; however, if LCSD results are reported, the LCSD%Rs and LCS/LCSD RPD will be evaluated.

<sup>3</sup> This method requirement will only be reviewed to complete definitive (Stage 4) data validation.

EMPC = estimated maximum potential concentration

TCDF = tetrachlorodibenzofuran

**WORKSHEET #12.5B**  
**ANALYTE-SPECIFIC LIMITS FOR PCDD/PCDFs (1613B)**

<b>Chemical</b>	<b>CASRN</b>	<b>Soil/Sediment and Water LCS Accuracy Control Limits (%R)</b>	<b>Soil/Sediment and Water Sample Accuracy Control Limits (%R)</b>
2,3,7,8-TCDD	1746-01-6	67-158	NA
1,2,3,7,8-PeCDD	40321-76-4	70-142	NA
1,2,3,4,7,8-HxCDD	39227-28-6	70-164	NA
1,2,3,6,7,8-HxCDD	57653-85-7	76-134	NA
1,2,3,7,8,9-HxCDD	19408-74-3	64-162	NA
1,2,3,4,6,7,8-HpCDD	35822-46-9	70-140	NA
OCDD	3268-87-9	78-144	NA
2,3,7,8-TCDF	51207-31-9	75-158	NA
1,2,3,7,8-PeCDF	57117-41-6	80-134	NA
2,3,4,7,8-PeCDF	57117-31-4	68-160	NA
1,2,3,4,7,8-HxCDF	70648-26-9	72-134	NA
1,2,3,6,7,8-HxCDF	57117-44-9	84-130	NA
1,2,3,7,8,9-HxCDF	72918-21-9	78-130	NA
2,3,4,6,7,8-HxCDF	60851-34-5	70-156	NA
1,2,3,4,6,7,8-HpCDF	67562-39-4	82-122	NA
1,2,3,4,7,8,9-HpCDF	55673-89-7	78-138	NA
OCDF	39001-02-0	63-170	NA
<b>Labeled Standards</b>			
<sup>13</sup> C <sub>12</sub> -2,3,7,8-TCDD	76523-40-5	20-175	25-164
<sup>13</sup> C <sub>12</sub> -1,2,3,7,8-PeCDD	109719-79-1	21-227	25-181
<sup>13</sup> C <sub>12</sub> -1,2,3,4,7,8-HxCDD	109719-80-4	21-193	32-141
<sup>13</sup> C <sub>12</sub> -1,2,3,6,7,8-HxCDD	109719-81-5	25-163	28-130
<sup>13</sup> C <sub>12</sub> -1,2,3,4,6,7,8-HpCDD	109719-83-7	26-166	23-140
<sup>13</sup> C <sub>12</sub> -OCDD	114423-97-1	13-199	17-157
<sup>13</sup> C <sub>12</sub> -2,3,7,8-TCDF	89059-46-1	22-152	24-169
<sup>13</sup> C <sub>12</sub> -1,2,3,7,8-PeCDF	109719-77-9	21-192	24-185

**WORKSHEET #12.5B (CONTINUED)**  
**ANALYTE-SPECIFIC LIMITS FOR PCDD/PCDFs (1613B)**

Chemical	CASRN	Soil/Sediment and Water LCS Accuracy Control Limits (%R)	Soil/Sediment and Water Sample Accuracy Control Limits (%R)
<sup>13</sup> C <sub>12</sub> -2,3,4,7,8-PeCDF	116843-02-8	13-328	21-178
<sup>13</sup> C <sub>12</sub> -1,2,3,4,7,8-HxCDF	114423-98-2	19-202	26-152
<sup>13</sup> C <sub>12</sub> -1,2,3,6,7,8-HxCDF	116843-03-9	21-159	26-153
<sup>13</sup> C <sub>12</sub> -1,2,3,7,8,9-HxCDF	116843-04-0	17-205	29-147
<sup>13</sup> C <sub>12</sub> -2,3,4,6,7,8-HxCDF	116843-05-1	22-176	28-136
<sup>13</sup> C <sub>12</sub> -1,2,3,4,6,7,8-HpCDF	109719-84-8	21-158	28-143
<sup>13</sup> C <sub>12</sub> -1,2,3,4,7,8,9-HpCDF	109719-94-0	20-186	26-138
<b>Cleanup Standard</b>			
<sup>37</sup> Cl <sub>4</sub> -2,3,7,8-TCDD	85508-50-5	31-191	35-197

HpCDD = heptachlorodibenzo-p-dioxin  
 HpCDF = heptachlorodibenzofuran  
 HxCDD = hexachlorodibenzo-p-dioxin  
 HxCDF = hexachlorodibenzofuran  
 OCDD = octachlorodibenzo-p-dioxin  
 OCDF = octachlorodibenzofuran  
 PeCDD = pentachlorodibenzo-p-dioxin  
 PeCDF = pentachlorodibenzofuran  
 TCDD = tetrachlorodibenzo-p-dioxin

**WORKSHEET #12.6A**

**MEASUREMENT PERFORMANCE CRITERIA: METALS (ANALYSIS BY ARI)**

Matrix: Solid and aqueous

Analytical Group/Method: ICP-MS / SW-846 Method 6020B

Concentration Level: Low

DQI	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Precision (overall)	Field Duplicate	RPD $\leq 50\%$ if both results $\geq 5x$ PQL <sup>1</sup>
Precision (analytical)	Laboratory duplicate <sup>2</sup>	$\leq 20\%$ RPD if both results $\geq 5x$ PQL <sup>1</sup>
Precision (analytical)	LCS/LCSD <sup>3</sup>	RPD $\leq 20\%$
Precision (analytical, matrix interference)	MS/MSD	
Accuracy (analytical)	LCS and LCSD <sup>3</sup>	%R within 80-120%
Accuracy (analytical, matrix interference)	MS and MSD	%R within 75-125%
Accuracy (analytical, matrix interference)	Serial Dilution	Only required for elements that fail MS or MSD %R or MS/MSD RPD and are present at $\geq 25x$ PQL in parent sample; quantitation of 1:5 dilution analysis within %D $\leq 25\%$ of quantitation in undiluted sample.
Accuracy (analytical, matrix interference)	PDS (or post-digest MS)	Only required for elements that fail MS or MSD %R or MS/MSD RPD and the MS/MSD spike concentrations $>$ parent sample concentration; PDS %R between 75% and 125%.
Representativeness (field)	EB (Rinse)	Not detected $>$ PQL
Representativeness (analytical system)	Laboratory MB	No analytes detected $>$ $\frac{1}{2}$ the PQL
Sensitivity	MDL and PQL	Adjusted correctly for sample-specific factors (subsample size, moisture content, dilution)
Completeness	Calculation of field and analytical completeness	$>90\%$ completeness
Accuracy (analytical, matrix interference)	Internal standards <sup>4</sup>	Intensity within 70-125% of the intensity in the most recent ICB
Accuracy (analytical, matrix interference, interelement correction)	ICS A and ICS AB <sup>4</sup>	ICS A: Non-spiked analyte concentrations within $\pm 2x$ PQL ICS A and ICS AB: Spiked analyte concentrations within 80-120%
Sensitivity	MDL	MDL at or below the analyte-specific PALs listed in Worksheets #15.10a and b
		Conducted and updated at least annually <sup>4</sup>
Sensitivity	PQL <sup>4</sup>	Established at or above the low point of calibration curve

<sup>1</sup> For low-level results (one or both detected values  $\leq 5x$  PQL) or when one result is a non-detection, the control limit is absolute difference  $\leq 2x$  PQL. Non-detected values will be assigned the nominal value of the MDL for making this comparison.

<sup>2</sup> Either a laboratory duplicate, or an MSD must be performed as a precision check.

<sup>3</sup> LCSDs are not a method requirement; however, if LCSD results are reported, the LCSD%Rs and LCS/LCSD RPD will be evaluated.

<sup>4</sup> This method requirement will only be reviewed to complete definitive (Stage 4) data validation.

ICS = interference check solution

PDS = post-digestion spike

ICP-MS = inductively coupled plasma-mass spectrometry

**WORKSHEET #12.6B**

**MEASUREMENT PERFORMANCE CRITERIA: METALS (ANALYSIS BY ALS-KELSO)**

Matrix: Solid and aqueous

Analytical Group/Method: ICP-MS / SW-846 Method 6020A

Concentration Level: Low

DQI	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Precision (overall)	Field Duplicate	RPD $\leq$ 50% if both results $\geq$ 5x PQL <sup>1</sup>
Precision (analytical)	Laboratory duplicate <sup>2</sup>	$\leq$ 20% RPD if both results $\geq$ 5x PQL <sup>1</sup>
Precision (analytical)	LCS/LCSD <sup>3</sup>	RPD $\leq$ 20%
Precision (analytical, matrix interference)	MS/MSD	
Accuracy (analytical)	LCS and LCSD <sup>3</sup>	%R within 80-120%
Accuracy (analytical, matrix interference)	MS and MSD	%R within 75-125%
Accuracy (analytical, matrix interference)	Serial Dilution	Only required for elements that fail MS or MSD %R or MS/MSD RPD and are present at $\geq$ 25x PQL in parent sample; quantitation of 1:5 dilution analysis within %D $\leq$ 20% of quantitation in undiluted sample.
Accuracy (analytical, matrix interference)	PDS (or post-digest MS)	Only required for elements that fail MS or MSD %R or MS/MSD RPD; PDS %R between 75% and 125%.
Representativeness (field)	EB (Rinse)	Not detected > PQL
Representativeness (analytical system)	Laboratory MB	No analytes detected > 1/2 the PQL
Sensitivity	MDL and PQL	Adjusted correctly for sample-specific factors (subsample size, moisture content, dilution)
Completeness	Calculation of field and analytical completeness	>90% completeness
Accuracy (analytical, matrix interference)	Internal standards <sup>4</sup>	%R within 30-125%
Accuracy (analytical, matrix interference, interelement correction)	ICS A and ICS AB <sup>4</sup>	ICS A and ICS AB: Spiked analyte concentrations within 80-120%
Sensitivity	MDL	MDL at or below the analyte-specific PALs listed in Worksheets #15.10c and d
		Conducted and updated at least annually <sup>4</sup>
Sensitivity	PQL <sup>4</sup>	Established at or above the low point of calibration curve

<sup>1</sup> For low-level results (one or both detected values  $\leq$ 5x PQL) or when one result is a non-detection, the control limit is absolute difference  $\leq$ 2x PQL. Non-detected values will be assigned the nominal value of the MDL for making this comparison.

<sup>2</sup> Either a laboratory duplicate or an MSD must be performed as a precision check.

<sup>3</sup> LCSDs are not a method requirement; however, if LCSD results are reported, the LCSD %Rs and LCS/LCSD RPD will be evaluated.

<sup>4</sup> This method requirement will only be reviewed to complete definitive (Stage 4) data validation.

## WORKSHEET #12.7

### MEASUREMENT PERFORMANCE CRITERIA: MERCURY

Matrix: Solid and aqueous

Analytical Group/Method: CVAA / SW-846 Methods 7471B (solid) and 7470A (aqueous)

Concentration Level: Low

DQI	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Precision (overall)	Field Duplicate	RPD $\leq$ 50% if both results $\geq$ 5x PQL <sup>1</sup>
Precision (analytical)	LCS/LCSD <sup>2</sup>	RPD $\leq$ 20%
Precision (analytical, matrix interference)	MS/MSD	
Accuracy (analytical)	LCS and LCSD <sup>2</sup>	%R within 80-120%
Accuracy (analytical, matrix interference)	MS and MSD	%R within 75-125%
Representativeness (field)	EB (Rinse)	Not detected > PQL
Representativeness (analytical system)	Laboratory MB	No analytes detected > 1/2 the PQL
Sensitivity	MDL and PQL	Adjusted correctly for sample-specific factors (subsample size, moisture content, dilution)
Completeness	Calculation of field and analytical completeness	>90% completeness
Sensitivity	MDL	MDL at or below the analyte-specific PALs listed in Worksheets #15.7a and b
		Conducted and updated at least annually
Sensitivity	PQL <sup>3</sup>	Established at or above the low point of calibration curve

<sup>1</sup> For low-level results (one or both detected values  $\leq$ 5x PQL) or when one result is a non-detection, the control limit is absolute difference  $\leq$ 2x PQL. Non-detected values will be assigned the nominal value of the MDL for making this comparison.

<sup>2</sup> LCSDs are not a method requirement; however, if LCSD results are reported, the LCSD%Rs and LCS/LCSD RPD will be evaluated.

<sup>3</sup> This method requirement will only be reviewed to complete definitive (Stage 4) data validation.

CVAA = cold vapor atomic absorption

## WORKSHEET #12.8A MEASUREMENT PERFORMANCE CRITERIA: TPH

Matrix: Solid

Analytical Group/Method: GC/FID / Method NWTPH-Dx

Concentration Level: Low

DQI	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Precision (overall)	Field Duplicate	RPD $\leq 50\%$ if both results $\geq 5x$ PQL <sup>1</sup>
Precision (analytical)	Laboratory duplicate or LCS/LCSD <sup>2</sup>	RPD limits presented in Worksheet #12.8b
Precision (analytical, matrix interference)	MS/MSD	
Accuracy (analytical)	LCS and LCSD <sup>2</sup>	%R limits presented in Worksheet #12.8b
Accuracy (analytical, matrix interference)	MS and MSD	
Accuracy (analytical, matrix interference)	Surrogate Spike	
Representativeness (field)	EB (Rinse)	Not detected > PQL
Representativeness (transport)	Temperature Blank	0°C to 6°C
Representativeness (analytical system)	Laboratory MB	No analytes detected > 1/2 the PQL
Sensitivity	MDL and PQL	Adjusted correctly for sample-specific factors (subsample size, moisture content, dilution)
Completeness	Calculation of field and analytical completeness	>90% completeness
Sensitivity	MDL	MDL at or below the analyte-specific PALs listed in Worksheets #15.8a and b
		Conducted and updated at least annually
Sensitivity	PQL <sup>3</sup>	Established at or above the low point of calibration curve

<sup>1</sup> For low-level results (one or both detected values  $\leq 5x$  PQL) or when one result is a non-detection, the control limit is absolute difference  $\leq 2x$  PQL. Non-detected values will be assigned the nominal value of the MDL for making this comparison.

<sup>2</sup> LCSDs are required by Method NWTPH-Dx if laboratory duplicates are not performed.

<sup>3</sup> This method requirement will only be reviewed to complete definitive (Stage 4) data validation.

GC/FID = gas chromatography/flame ionization detector

TPH = total petroleum hydrocarbons

**WORKSHEET #12.8B**  
**ANALYTE-SPECIFIC LIMITS FOR TPH (NWTPH-Dx)**

<b>Chemical</b>	<b>CASRN</b>	<b>Solid Matrix Accuracy Control Limits (%R)</b>	<b>Solid Matrix Precision Control Limits (RPD)</b>	<b>Aqueous Matrix Accuracy Control Limits (%R)</b>	<b>Aqueous Matrix Precision Control Limits (RPD)</b>
Diesel range organics (C <sub>10</sub> -C <sub>25</sub> )	68334-30-5	42-134	40	NA	NA
Residual range organics (C <sub>25</sub> -C <sub>35</sub> )	Not available	48-141	40	NA	NA
<b>Surrogates</b>					
o-Terphenyl	84-15-1	50-150	NA	NA	NA
n-Triacontane	638-68-6	50-150	NA	NA	NA

**WORKSHEET #12.9**

**MEASUREMENT PERFORMANCE CRITERIA: TOTAL AND DISSOLVED ORGANIC CARBON**

Matrix: Solid (TOC) and aqueous (TOC and DOC)  
 Analytical Group/Method: Carbonaceous Analyzer / SW-846 Method 9060A  
 Concentration Level: Low

DQI	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Precision (overall)	Field Duplicate	RPD $\leq$ 50% (solid matrix) or $\leq$ 30% (aqueous matrix) if both results $\geq$ 5x PQL <sup>1</sup>
Precision (analytical)	LCS/LCSD <sup>2</sup>	RPD <20% (solid) or 17% (aqueous)
Precision (analytical, matrix interference)	MS/MSD	
Accuracy (analytical)	LCS and LCSD <sup>2</sup>	%R within 72-122% (solid) or 83-117% (aqueous)
Accuracy (analytical, matrix interference)	MS and MSD	
Representativeness (field)	EB (Rinse)	Not detected > PQL
Representativeness (analytical system)	Laboratory MB	No analytes detected > 1/2 the PQL
Sensitivity	MDL and PQL	Adjusted correctly for sample-specific factors (subsample size, moisture content, dilution)
Completeness	Calculation of field and analytical completeness	>90% completeness
Sensitivity	MDL	PQL at or below the analyte-specific PALs listed in Worksheet #15.13
		Conducted and updated at least annually <sup>3</sup>
Sensitivity	PQL <sup>3</sup>	Established at or above the low point of calibration curve

<sup>1</sup> For low-level results (one or both detected values  $\leq$ 5x PQL) or when one result is a non-detection, the control limit is absolute difference  $\leq$ 2x PQL (solid matrix) or  $\leq$ PQL (aqueous matrix). Non-detected values will be assigned the nominal value of the MDL for making this comparison.

<sup>2</sup> LCSDs are not a method requirement; however, if LCSD results are reported, the LCSD%Rs and LCS/LCSD RPD will be evaluated.

<sup>3</sup> This method requirement will only be reviewed to complete definitive (Stage 4) data validation.

DOC = dissolved organic carbon

TOC = total organic carbon

## WORKSHEET #12.10

### MEASUREMENT PERFORMANCE CRITERIA: GEOTECHNICAL PARAMETERS

The following analytical methods may be used to characterize geotechnical parameters collected to characterize solid and aqueous media at the SIB Project Area. These analyses, if performed, will be required to meet the requirements presented in the analytical methods and the laboratory SOPs, and no project-specific measurement performance criteria are presented.

Parameter	Matrix	Analytical Method <sup>1</sup>
Grain Size (fraction <75 µm)	Solid	ASTM D1140
Total Solids/Natural Moisture Content	Solid	ASTM D2216 <sup>2</sup>
Density (specimen)	Solid	ASTM D7263
Total Suspended Solids (TSS)	Aqueous	SM2540D
Total Solids	Aqueous and Solid	EPA Method 160.3 (EPA, 1971)
Particle Size (sieve)	Solid	ASTM D6913
Particle Size (hydrometer)	Solid	ASTM D422
Atterberg Limits	Solid	ASTM D4318
Specific Gravity (soil solids)	Solid	ASTM D854
Direct Shear Test	Solid	ASTM D3080
Consolidated Undrained Triaxial Test with Pore Pressure	Solid	ASTM D4767
Consolidation Tests	Solid	ASTM D2435

<sup>1</sup> Laboratory SOPs listed in QAPP Worksheet #23.

<sup>2</sup> The method used for geotechnical testing; laboratory-performed chemical analyses will also determine percent solids for moisture correction in accordance with the laboratory-specific SOPs presented in Worksheet #23.

µm = microns

ASTM = ASTM International

**WORKSHEET #12.11****MEASUREMENT PERFORMANCE CRITERIA: WASTE CHARACTERIZATION ANALYSES**

The following analytical methods may be used to characterize aqueous and solid investigation-derived waste (IDW) as required by disposal entities to ensure proper storage and disposal of this material. These analyses, if performed, will be required to meet the requirements presented in the analytical methods and the laboratory SOPs, and no project-specific measurement performance criteria are presented.

<b>Parameter</b>	<b>Matrix</b>	<b>Analytical Method<sup>1</sup></b>
PCBs	Water/Soil	SW8082A
pH	Water	SW9040C
	Soil	SW9045D
Ignitibility (Flash Point)	Water/Soil	SW1020
Percent Solids	Soil	ASTM D2216
Paint Filter Liquids Test	Soil	SW9095B
TCLP <sup>2</sup>	Soil	SW1311
VOCs <sup>3</sup>	Water and soil extract	SW8260C
SVOCs <sup>3</sup>	Water and soil extract	SW8270D
Organochlorine pesticides <sup>3</sup>	Water and soil extract	SW8081B
Metals <sup>3</sup>	Water and soil extract	SW6020B, SW7470A

<sup>1</sup> Laboratory SOPs listed in QAPP Worksheet #23.

<sup>2</sup> Prior to sampling IDW, it must be determined whether TCLP is appropriate. Consult the requirements of the waste disposal facility and applicable Federal, state, or local discharge permits or other requirements.

<sup>3</sup> Analyte lists as presented in 40 CFR 261.24.

SW = method from EPA's SW-846 methods compendium

TCLP = toxicity characteristic leaching procedure

**WORKSHEET #13**  
**SECONDARY DATA CRITERIA AND LIMITATIONS TABLE**

The secondary data that will be used for the SIB Project Area RD has been reviewed in the SAR (HGL, 2021b). This document includes evaluation of sources of contaminants to determine whether they have been adequately investigated and sufficiently controlled or considered such that the RD can proceed. In addition to the SAR, a PDI Work Plan (HGL, 2021c) has been prepared that will be used to direct the specific PDI sampling and analysis activities that are required to complete the data sets needed to complete the RD. Section 2.0 of the SAR and Section 2.0 of the PDI Work Plan identify existing data sources used for this project and evaluate the associated limitations and data gaps.

**WORKSHEETS #14 AND #16  
PROJECT TASKS AND SCHEDULE**

<b>Task Description</b>	<b>Responsible Party</b>	<b>Planned Start Date</b>	<b>Planned Completion Date</b>	<b>Activity/Deliverable</b>	<b>Deliverable Due Date</b>
Project Planning and Support	TIG Environmental	March 2021	March 2026	Quarterly Progress Reports	Quarterly Beginning April 2021
Community Involvement Support	Project RD Group	April 1, 2021	May 29, 2025	Preparation of Public Information Materials	TBD
	Project RD Group	July 1, 2021	July 1, 2025	Quarterly Public Meetings	TBD
	Project RD Group	July 30, 2021	March 12, 2026	Respond to EPA Comments or Questions on Public Information Materials	TBD
Sufficiency Assessment Report	HGL	January 29, 2021	April 1, 2021	25% Draft	April 2, 2021
	HGL	April 3, 2021	April 22, 2021	50% Draft	April 22, 2021
	HGL	April 23, 2021	May 12, 2021	75% Draft	May 12, 2021
	HGL	May 13, 2021	June 1, 2021	100% Draft	June 1, 2021
	Client	June 12, 2021	June 22, 2021	Client Review of 100% Draft SAR	June 22, 2021
	HGL	June 23, 2021	June 28, 2021	Address Client Comments and Issue Draft SAR to Stakeholders	June 28, 2021
	EPA and Other	June 29, 2021	July 19, 2021	Stakeholder Review of Draft SAR	July 19, 2021
	HGL	October 6, 2021	November 22, 2021	Address Stakeholder Comments and Issue Final SAR	November 22, 2021
PDI Work Plan	HGL	January 29, 2021	April 1, 2021	25% Draft PDI Work Plan	April 2, 2021
	HGL	April 3, 2021	April 22, 2021	50% Draft PDI Work Plan	April 22, 2021
	HGL	April 23, 2021	May 12, 2021	75% Draft PDI Work Plan	May 12, 2021

**WORKSHEETS #14 AND #16 (CONTINUED)**  
**PROJECT TASKS AND SCHEDULE**

<b>Task Description</b>	<b>Responsible Party</b>	<b>Planned Start Date</b>	<b>Planned Completion Date</b>	<b>Activity/Deliverable</b>	<b>Deliverable Due Date</b>
PDI Work Plan (continued)	HGL	May 13, 2021	June 1, 2021	100% Draft PDI Work Plan	June 1, 2021
	Client	June 12, 2021	June 22, 2021	Client Review of 100% Draft PDI Work Plan	June 22, 2021
	HGL	June 23, 2021	June 28, 2021	Address Client Comments and Issue Draft PDI Work Plan to Stakeholders	June 28, 2021
	EPA and Other	June 29, 2021	July 19, 2021	Stakeholder Review of Draft PDI Work Plan	July 19, 2021
	HGL	July 22, 2021	September 7, 2021	Address Stakeholder Comments and Issue Final PDI Work Plan	September 7, 2021
	HGL	January 29, 2021	April 1, 2021	25% Draft FSP	April 2, 2021
	HGL	April 3, 2021	April 22, 2021	50% Draft FSP	April 22, 2021
	HGL	April 23, 2021	May 12, 2021	75% Draft FSP	May 12, 2021
	HGL	May 13, 2021	June 1, 2021	100% Draft FSP	June 1, 2021
	Client	June 12, 2021	June 22, 2021	Client Review of 100% Draft FSP	June 22, 2021
	HGL	June 23, 2021	June 28, 2021	Address Client Comments and Issue Draft FSP to Stakeholders	June 28, 2021
	EPA and Other	June 29, 2021	July 19, 2021	Stakeholder Review of Draft FSP	July 19, 2021
	HGL	July 22, 2021	September 7, 2021	Address Stakeholder Comments and Issue Final FSP	September 7, 2021
	HGL	January 29, 2021	April 1, 2021	25% Draft UFP-QAPP	April 2, 2021
	HGL	April 3, 2021	April 22, 2021	50% Draft UFP-QAPP	April 22, 2021
	HGL	April 23, 2021	May 12, 2021	75% Draft UFP-QAPP	May 12, 2021
HGL	May 13, 2021	June 1, 2021	100% Draft UFP-QAPP	June 1, 2021	

**WORKSHEETS #14 AND #16 (CONTINUED)**  
**PROJECT TASKS AND SCHEDULE**

<b>Task Description</b>	<b>Responsible Party</b>	<b>Planned Start Date</b>	<b>Planned Completion Date</b>	<b>Activity/Deliverable</b>	<b>Deliverable Due Date</b>
PDI Work Plan (continued)	Client	June 12, 2021	June 22, 2021	Client Review of 100% Draft UFP-QAPP	June 22, 2021
	HGL	June 23, 2021	June 28, 2021	Address Client Comments and Issue Draft UFP-QAPP	June 28, 2021
	EPA and Other	June 29, 2021	July 19, 2021	Stakeholder Review Draft UFP-QAPP	July 19, 2021
	HGL	July 22, 2021	September 7, 2021	Address Stakeholder Comments and Issue Final UFP-QAPP	September 7, 2021
	HGL	January 29, 2021	April 1, 2021	25% Draft ERP	April 2, 2021
	HGL	April 3, 2021	April 22, 2021	50% Draft ERP	April 22, 2021
	HGL	April 23, 2021	May 12, 2021	75% Draft ERP	May 12, 2021
	HGL	May 13, 2021	June 1, 2021	100% Draft ERP	June 1, 2021
	Client	June 12, 2021	June 22, 2021	Client Review of 100% Draft ERP	June 22, 2021
	HGL	June 23, 2021	June 28, 2021	Address Client Comments and Issue Draft ERP	June 28, 2021
	EPA and Other	June 29, 2021	July 19, 2021	Stakeholder Review Draft ERP	July 19, 2021
	HGL	July 22, 2021	September 7, 2021	Address Stakeholder Comments and Issue Final ERP	September 7, 2021
	HGL	January 29, 2021	April 1, 2021	25% Draft Health and Safety Plan	April 2, 2021
	HGL	April 3, 2021	April 22, 2021	50% Draft Health and Safety Plan	April 22, 2021
	HGL	April 23, 2021	May 12, 2021	75% Draft Health and Safety Plan	May 12, 2021
	HGL	May 13, 2021	June 1, 2021	100% Draft Health and Safety Plan	June 1, 2021
	Client	June 12, 2021	June 22, 2021	Client Review of 100% Draft Health and Safety Plan	June 22, 2021

**WORKSHEETS #14 AND #16 (CONTINUED)**  
**PROJECT TASKS AND SCHEDULE**

<b>Task Description</b>	<b>Responsible Party</b>	<b>Planned Start Date</b>	<b>Planned Completion Date</b>	<b>Activity/Deliverable</b>	<b>Deliverable Due Date</b>
PDI Work Plan (continued)	HGL	June 23, 2021	June 28, 2021	Address Client Comments and Issue Draft Health and Safety Plan to Stakeholders	June 28, 2021
	EPA and Other	June 29, 2021	July 19, 2021	Stakeholder Review of Draft Health and Safety Plan to Stakeholders	July 19, 2021
	HGL	July 22, 2021	September 7, 2021	Address Stakeholder Comments and Issue Final Health and Safety Plan	September 7, 2021
PDI Field Efforts	HGL	January 3, 2022	February 16, 2022	Winter Fish Window	February 16, 2022
		July 1, 2022	October 10, 2022	Summer Fish Window	October 10, 2022
		June 6, 2022	February 7, 2023	Surface/Subsurface Sediment Contaminant Concentrations	February 7, 2023
		May 2, 2022	July 29, 2022	Porewater Upwelling Location Survey	July 29, 2022
		August 17, 2021	December 26, 2022	Stormwater Sampling	December 26, 2022
		December 31, 2021	March 31, 2022	Riverbank Characterization	March 31, 2022
		November 1, 2021	December 1, 2021	Bathymetric and Topographic Surveys	December 1, 2021
		December 31, 2021	July 29, 2022	Geotechnical Sampling	July 29, 2022
		December 31, 2021	March 31, 2022	Shoreline and Overwater Structure Inspections	March 31, 2022
		November 1, 2021	March 1, 2022	Existing Utilities and Debris Identification Surveys	March 1, 2022
		December 31, 2021	April 1, 2022	Hydrodynamics and Sediment Dynamics Measurements	April 1, 2022
		January 3, 2022	February 16, 2022	Habitat Conditions Survey	February 16, 2022
November 1, 2021	January 26, 2023	Engineering Studies	January 26, 2023		

**WORKSHEETS #14 AND #16 (CONTINUED)**  
**PROJECT TASKS AND SCHEDULE**

<b>Task Description</b>	<b>Responsible Party</b>	<b>Planned Start Date</b>	<b>Planned Completion Date</b>	<b>Activity/Deliverable</b>	<b>Deliverable Due Date</b>
PDI Field Efforts (continued)	HGL	March 2, 2022	June 30, 2022	Structure Condition Assessments	June 30, 2022
		November 1, 2021	January 28, 2022	Facility Owner/Operator Interviews	January 28, 2022
		May 31, 2022	January 26, 2023	Facility Future Use and RA Impact Evaluation	January 26, 2023
		September 28, 2022	December 27, 2022	Construction Sequencing and Phasing Assessment	December 27, 2022
		August 26, 2022	December 23, 2022	Dredging Study	December 23, 2022
		October 28, 2022	January 26, 2023	Constructability Assessment	January 26, 2023
		November 1, 2021	October 28, 2022	Recontamination Potential Evaluation	October 28, 2022
		December 31, 2021	August 30, 2022	Resuspension/Scour (1) - Natural Forces	August 30, 2022
		November 1, 2021	August 30, 2022	Resuspension/Scour (2) - Anthropogenic Forces	August 30, 2022
		March 31, 2022	August 26, 2022	Resuspension/Scour Pathways – Sediment Releases During Dredging	August 26, 2022
		July 1, 2022	October 28, 2022	Future Climate Change Effects on Recontamination Potential	October 28, 2022
		March 31, 2022	December 26, 2022	Cap Stability Evaluations	December 26, 2022
		September 27, 2022	January 25, 2023	Green Remediation Practice Evaluation	January 25, 2023
PDI Evaluation Report	HGL	July 22, 2022	June 6, 2023	Draft PDI Evaluation report	June 6, 2023
	Client	June 7, 2023	June 15, 2023	Client Review of Draft PDI Evaluation Report	June 15, 2023
	HGL	June 16, 2023	June 26, 2023	Address Client Comments and Issue Draft PDI Evaluation Report to Stakeholders	June 26, 2023

**WORKSHEETS #14 AND #16 (CONTINUED)  
PROJECT TASKS AND SCHEDULE**

<b>Task Description</b>	<b>Responsible Party</b>	<b>Planned Start Date</b>	<b>Planned Completion Date</b>	<b>Activity/Deliverable</b>	<b>Deliverable Due Date</b>
PDI Evaluation Report (continued)	EPA and Other	June 27, 2023	July 14, 2023	Stakeholder Review of Draft PDI Evaluation Report	July 14, 2023
	HGL	July 15, 2023	August 14, 2023	Address Stakeholder Comments and Issue Final PDI Evaluation Report	August 14, 2023
Basis of Design Report	HGL	June 9, 2023	September 6, 2023	Draft Basis of Design Report	September 6, 2023
	Client	September 8, 2023	September 18, 2023	Client Review of Internal Draft Basis of Design Report	September 18, 2023
	HGL	September 19, 2023	September 28, 2023	Address Client Comments and Issue Draft Basis of Design Report to Stakeholders	September 28, 2023
	EPA and Other	September 29, 2023	October 19, 2023	Stakeholder Review of Draft Basis of Design Report	October 19, 2023
	HGL	October 20, 2023	December 5, 2023	Address Stakeholder Comments and Issue Final Basis of Design Report	December 5, 2023
RD Work Plan	HGL	December 6, 2023	March 7, 2024	Draft RD Work Plan	March 7, 2024
	Client	March 8, 2024	March 18, 2024	Client Review of Draft RD Work Plan	March 18, 2024
	HGL	March 19, 2024	March 28, 2024	Address Client Comments and Issue Draft RD Work Plan to Stakeholders	March 28, 2024
	EPA and Other	March 29, 2024	April 18, 2024	Stakeholder Review of Draft RD Work Plan	April 18, 2024
	HGL	April 19, 2024	June 3, 2024	Address Stakeholder Comments and Issue Final RD Work Plan	June 3, 2024
Cap Treatability Study	HGL	June 23, 2022	September 26, 2022	Draft Design Package	September 26, 2022
	Client	September 29, 2022	October 13, 2022	Client Review of Draft Design Package	October 13, 2022
	HGL	October 14, 2022	October 24, 2022	Address Client Comments and Issue Draft Design Package to Stakeholders	October 24, 2022

**WORKSHEETS #14 AND #16 (CONTINUED)  
PROJECT TASKS AND SCHEDULE**

Task Description	Responsible Party	Planned Start Date	Planned Completion Date	Activity/Deliverable	Deliverable Due Date
Cap Treatability Study (continued)	EPA and Other	October 25, 2022	November 18, 2022	Stakeholder Review of Draft Design Package	November 18, 2021
	HGL	November 21, 2022	January 20, 2023	Address Stakeholder Comments and Issue Final Design Package	January 20, 2023
	HGL	July 23, 2023	May 1, 2024	Implementation	May 1, 2024
	HGL	May 2, 2024	August 1, 2024	Draft Evaluation Report	August 1, 2024
	Client	August 2, 2024	August 16, 2024	Client Review of Draft Evaluation Report	August 16, 2024
	HGL	August 19, 2024	August 28, 2024	Address Client Comments and Issue Draft Evaluation Report to Stakeholders	August 28, 2024
	EPA and Other	August 29, 2024	September 16, 2024	Stakeholder Review of Draft Evaluation Report	September 16, 2024
	HGL	September 17, 2024	November 15, 2024	Address Stakeholder Comments and Issue Final Evaluation Report	November 15, 2024
RD (50%)	HGL	June 4, 2024	March 6, 2025	Draft RD (50%)*	March 6, 2025
	EPA and Other	March 7, 2025	April 7, 2025	Stakeholder Review of Draft RD (50%)	April 7, 2025
Pre-Final RD (90%)	HGL	April 8, 2025	July 8, 2025	Draft RD (90%)*	July 8, 2025
	EPA and Other	July 9, 2025	August 7, 2025	Stakeholder Review of Draft RD (90%)	August 7, 2025
Final RD (100%)	HGL	August 8, 2025	November 6, 2025	Final RD (100%)*	November 6, 2025
	EPA and Other	November 7, 2025	December 9, 2025	Stakeholder Review of Final RD (100%)	December 9, 2025

Notes:

During the May 12, 2021, technical project planning meeting with EPA, it was noted that review timeframe for project stakeholders was not established and the sequence of the PDI field efforts was still being evaluated. Changes to the review timeframes or sequence of field efforts may impact the schedule dates listed above.

\*This deliverable consists of the Design Package, Emergency Response Plan, Institutional Controls Implementation and Assurance Plan, Waste Designation Memorandum, Biological Assessment Report, Clean Water Act Analysis Report, Project Area Monitoring Plan, Construction QA/QC Plan, Operation and Maintenance Plan and Manual, and Transportation and Off-Site Disposal Plan.

## **WORKSHEET #15**

### **PROJECT ACTION LIMITS AND LABORATORY-SPECIFIC DETECTION/QUANTITATION LIMITS**

The project-specific analytical method reference limits and evaluation tables for project sample analyses are presented in Worksheets #15.1 through #15.13. These worksheets include the project analyte lists, the sensitivity limits (MDLs and PQLs) achievable by the project laboratories. These worksheets also present the PALs, which are drawn from multiple sources in accordance with the ROD. These sources include:

- The CULs for riverbank soil/sediment and for surface water presented in Table 17 of the ROD,
- The RALs for sediment focused COCs presented in Table 21 of the ROD, and
- The PTW thresholds for the additional contaminants listed in Table 21 of the ROD.

These PALs have been updated to include Errata #1 and #2 issued by EPA in 2018 and 2020, respectively, and the modifications presented in the Explanation of Significant Differences (EPA, 2019).

Worksheets #15.1 through #15.13 also include those analytes identified as recontamination potential chemicals (RPCs) in solid matrices, as identified in Section 2.3 of the SAR. Worksheets #15.1 through #15.10 indicate whether each analyte is categorized as focused COC/PTW (collectively identified as focused COCs), RPC, or both. In addition to the focused COCs and RPCs, the worksheets include all analytes for which there are matrix-specific CULs listed in ROD Table 17 (identified as COCs).

Worksheet #15.14 presents the analyte lists, regulatory limits, and laboratory PQLs associated with IDW characterization analyses. The laboratory SOPs for the preparation and analytical methods associated with the limits presented in Worksheets #15.1 through #15.14 are listed in Worksheet #23 and are presented in Appendix A.

The laboratory is required to report concentrations at or greater than the MDL as detected results. Results reported as detections with quantitation below the corresponding PQL will be reported by the laboratory with the qualification of “J” to indicate that the result is considered an estimate due to being quantified below the calibrated range. Non-detected results and results below the corresponding detection limit will be reported by the laboratory as non-detected results quantitated as the MDL and qualified “U.” CFA will use EDLs in the place of MDLs for reporting data for PCDD/PCDFs by EPA Method 1613B. Laboratory-assigned qualifiers may be subsequently modified during the data validation process. Some analytes are required to be reported as a total (such as PCBs as Aroclors). These totals will be calculated from the individual component analyte results reported by the laboratory at the data management stage (see Worksheet #35).

In some cases, the laboratory’s MDL is greater than the matrix-specific CUL developed for a target analyte, which is indicated in the methods-specific tables by highlighting the affected CUL. In most cases where the laboratory limits do not meet the CULs, the analytical method selected to support this project is the most sensitive method commercially available and the sensitivity limits

provided by the laboratory are representative of the currently achievable analytical technical capabilities. In other cases, a less sensitive method (such as EPA Method 8082A for PCBs as Aroclors) will be used in conjunction with a more sensitive method. The sensitivity performance for the affected analytes does not meet one of the measurement performance criteria for MDLs (see Worksheet #12) and is a limitation on data usability for comparison to CULs; however, the site is fully characterized, and the analytical results will be of sufficient sensitivity to support RD to address areas of known contamination and the evaluation of recontamination potential from dredging operations.

The laboratory-specific sensitivity limits and control limits presented in the Worksheet #15 tables are subject to change over time based on periodic review at the laboratory. When sensitivity or control limits are updated, the laboratory will present the most up-to-date limits in the associated data reports and alert HGL that analyte-specific limits have been modified. Where changes in sensitivity limits cause an analyte's MDL or PQL to be raised above a PAL, the laboratory must notify HGL immediately. HGL will inform the CMT of this the potential impact on data usability and determine if additional action is required.

**WORKSHEET #15.1**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – VOCs IN WATER BY METHOD 8260C**

Analyte	CASRN	Category	ALS-Kelso Sensitivity Limits (µg/L)		Surface Water CUL (µg/L)
			MDL	PQL	
Ethylbenzene	100-41-4	COC	0.05	0.5	7.3

µg/L = micrograms per liter

**WORKSHEET #15.2A  
 PALS AND LABORATORY-SPECIFIC MDLs/PQLs – SVOCs IN SOIL/SEDIMENT BY METHOD 8270D**

Analyte	CASRN	Category	ALS-Kelso Sensitivity Limits (µg/kg)		Soil/Sediment CUL (µg/kg)	Focused COC RAL (µg/kg)
			MDL	PQL		
bis(2-Ethylhexyl)phthalate	117-81-7	COC, RPC	8.9	100	135	NA – Not Focused COC

**WORKSHEET #15.2B  
 PALS AND LABORATORY-SPECIFIC MDLs/PQLs – SVOCs IN WATER BY METHOD 8270D**

Analyte	CASRN	Category	ALS-Kelso Sensitivity Limits (µg/L)		Surface Water CUL (µg/L)
			MDL	PQL	
bis(2-Ethylhexyl)phthalate	117-81-7	COC	0.13	1.0	0.2
Pentachlorophenol	87-86-2	COC	0.34	1.0	0.03

**WORKSHEET #15.3A**

**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – PAHS IN SOIL/SEDIMENT BY METHOD 8270-SIM**

Analyte	CASRN	Category	ALS-Kelso Sensitivity Limits (µg/kg)		Benzo(a)pyrene TEF <sup>1</sup>	Soil/Sediment CUL (µg/kg)	Focused COC RAL (µg/kg)
			MDL	PQL			
2-Methylnaphthalene	91-57-6	NA <sup>2</sup>	0.39	5.0	--	--	--
Acenaphthene	83-32-9	NA <sup>2</sup>	0.76	5.0	--	--	--
Acenaphthylene	208-96-8	NA <sup>2</sup>	0.59	5.0	--	--	--
Anthracene	120-12-7	NA <sup>2</sup>	0.58	5.0	--	--	--
Benzo(a)anthracene	56-55-3	NA <sup>2</sup>	0.72	5.0	0.1	--	--
Benzo(a)pyrene	50-32-8	NA <sup>2</sup>	0.76	5.0	1	--	--
Benzo(b)fluoranthene	205-99-2	NA <sup>2</sup>	0.92	5.0	0.1	--	--
Benzo(g,h,i)perylene	191-24-2	NA <sup>2</sup>	0.85	5.0	0.01	--	--
Benzo(k)fluoranthene	207-08-9	NA <sup>2</sup>	0.87	5.0	0.1	--	--
Chrysene	218-01-9	NA <sup>2</sup>	0.8	5.0	0.001	--	--
Dibenz(a,h)anthracene	53-70-3	NA <sup>2</sup>	0.8	5.0	1	--	--
Fluoranthene	206-44-0	NA <sup>2</sup>	0.98	5.0	--	--	--
Fluorene	86-73-7	NA <sup>2</sup>	0.61	5.0	--	--	--
Indeno(1,2,3-cd)pyrene	193-39-5	NA <sup>2</sup>	0.87	5.0	0.1	--	--
Naphthalene	91-20-3	NA <sup>2,3</sup>	0.6	5.0	--	--	>140,000
Phenanthrene	85-01-8	NA <sup>2</sup>	1.4	5.0	--	--	--

**WORKSHEET #15.3A (CONTINUED)**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – PAHs IN SOIL/SEDIMENT BY METHOD 8270-SIM**

Analyte	CASRN	Category	ALS-Kelso Sensitivity Limits (µg/kg)		Benzo(a)pyrene TEF <sup>1</sup>	Soil/Sediment CUL (µg/kg)	Focused COC RAL (µg/kg)
			MDL	PQL			
Pyrene	129-00-0	NA <sup>2</sup>	0.76	5.0	--	--	--
cPAHs (BaP equivalents) <sup>4</sup>	NA	COC <sup>3</sup>	NA	NA	NA	774	774,000 <sup>5</sup>
Total PAHs	NA	Focused COC	NA	NA	NA	23,000	30,000 <sup>5</sup>

<sup>1</sup> TEFs presented in the ORNL Risk Assessment Information System, Section 2.8; only applicable to those PAHs defined as cPAHs.

<sup>2</sup> Not a COC or focused COC; used in the calculation of COC cPAHs or focused COC total PAHs.

<sup>3</sup> Not a focused COC; listed as an “Additional Contaminant” in Table 21 of the ROD.

<sup>4</sup> BaP equivalents are calculated for each sample by multiplying the concentration of each individual carcinogenic PAH by the associated TEF and summing across all cPAHs.

<sup>5</sup> PTW threshold listed in Table 21 of the ROD, as modified by the Explanation of Significant Differences (EPA, 2019).

-- = no PAL established

BaP = benzo(a)pyrene

cPAH = carcinogenic polycyclic aromatic hydrocarbons

ORNL = Oak Ridge National Laboratory

TEF = toxic equivalency factor (relative to listed analyte)

**WORKSHEET #15.3B**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – PAHs IN WATER BY METHOD 8270-SIM-ULL**

Analyte	CASRN	Category	ALS-Kelso Sensitivity Limits (ng/L)		Benzo(a)pyrene TEF <sup>1</sup>	Surface Water CUL (ng/L) <sup>2</sup>
			MDL	PQL		
2-Methylnaphthalene	91-57-6	Focused COC <sup>3</sup>	0.4	3.4	--	NA
Acenaphthene	83-32-9	Focused COC <sup>3</sup>	0.36	3.4	--	NA
Acenaphthylene	208-96-8	Focused COC <sup>3</sup>	0.37	3.4	--	NA
Anthracene	120-12-7	Focused COC <sup>3</sup>	0.29	3.4	--	NA
Benzo(a)anthracene	56-55-3	Focused COC	0.34	3.4	0.1	1.2
Benzo(a)pyrene	50-32-8	Focused COC	0.41	3.4	1	0.12
Benzo(b)fluoranthene	205-99-2	Focused COC	0.25	3.4	0.1	1.2
Benzo(g,h,i)perylene	191-24-2	Focused COC <sup>3</sup>	0.36	3.4	0.01	NA
Benzo(k)fluoranthene	207-08-9	Focused COC	0.41	3.4	0.1	1.3
Chrysene	218-01-9	Focused COC	0.65	3.4	0.001	1.3
Dibenz(a,h)anthracene	53-70-3	Focused COC	0.45	3.4	1	0.12
Fluoranthene	206-44-0	Focused COC <sup>3</sup>	0.46	3.4	--	NA
Fluorene	86-73-7	Focused COC <sup>3</sup>	0.42	3.4	--	NA
Indeno(1,2,3-cd)pyrene	193-39-5	Focused COC	0.44	3.4	0.1	1.2
Naphthalene	91-20-3	Focused COC	0.71	3.4	--	12,000
Phenanthrene	85-01-8	Focused COC <sup>3</sup>	0.72	3.4	--	NA
Pyrene	129-00-0	Focused COC <sup>3</sup>	0.78	3.4	--	NA
cPAHs (BaP equivalents) <sup>4</sup>	NA	Focused COC	NA	NA	NA	0.12
Total PAHs	NA	Focused COC <sup>3</sup>	NA	NA	NA	NA

<sup>1</sup> TEFs presented in the ORNL Risk Assessment Information System, Section 2.8; only applicable to those PAHs defined as cPAHs.

<sup>2</sup> The ROD presents the screening levels in µg/L; the PALs in this table have been converted to ng/L (1 µg/L = 1,000 ng/L) to match the units reported by the analytical laboratory.

<sup>3</sup> This analyte is not listed as a COC for surface water in ROD Table 17; it will be analyzed in aqueous samples to provide supplemental information to support RD decisions.

<sup>4</sup> BaP equivalents are calculated for each sample by multiplying the concentration of each individual carcinogenic PAH by the associated TEF and summing across all cPAHs.

ng/L = nanograms per liter

BaP = benzo(a)pyrene

**WORKSHEET #15.4A**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – PCBs IN SOIL/SEDIMENT BY METHOD 8082A**

Analyte	CASRN	Category	ARI Sensitivity Limits (µg/kg)		Soil/Sediment CUL (µg/kg)	Focused COC RAL (µg/kg)
			MDL	PQL		
Aroclor 1016	12674-11-2	Focused COC, RPC	1.56	4.0	--	See Total PCBs
Aroclor 1221	11104-28-2	Focused COC, RPC	1.56	4.0	--	See Total PCBs
Aroclor 1232	11141-16-5	Focused COC, RPC	1.56	4.0	--	See Total PCBs
Aroclor 1242	53469-21-9	Focused COC, RPC	1.56	4.0	--	See Total PCBs
Aroclor 1248	12672-29-6	Focused COC, RPC	1.56	4.0	--	See Total PCBs
Aroclor 1254	11097-69-1	Focused COC, RPC	1.56	4.0	--	See Total PCBs
Aroclor 1260	11096-82-5	Focused COC, RPC	0.589	4.0	--	See Total PCBs
Aroclor 1262	37324-23-5	Focused COC, RPC	0.589	4.0	--	See Total PCBs
Aroclor 1268	11100-14-4	Focused COC, RPC	0.589	4.0	--	See Total PCBs
Total PCBs	NA	Focused COC, RPC	NA	NA	9.0	75

**WORKSHEET #15.4B**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – PCBs IN WATER BY METHOD 8082A**

Analyte	CASRN	Category	ARI Sensitivity Limits (µg/L)		Surface Water CUL (µg/L)
			MDL	PQL	
Aroclor 1016	12674-11-2	Focused COC, RPC	0.00248	0.010	--
Aroclor 1221	11104-28-2	Focused COC, RPC	0.00248	0.010	--
Aroclor 1232	11141-16-5	Focused COC, RPC	0.00248	0.010	--
Aroclor 1242	53469-21-9	Focused COC, RPC	0.00248	0.010	--
Aroclor 1248	12672-29-6	Focused COC, RPC	0.00248	0.010	--
Aroclor 1254	11097-69-1	Focused COC, RPC	0.00248	0.010	--
Aroclor 1260	11096-82-5	Focused COC, RPC	0.00276	0.010	--
Aroclor 1262	37324-23-5	Focused COC, RPC	0.00276	0.010	--
Aroclor 1268	11100-14-4	Focused COC, RPC	0.00276	0.010	--
Total PCBs	NA	Focused COC, RPC	NA	NA	6.4E-6

**WORKSHEET #15.5**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – HERBICIDES IN WATER BY GC/ECD (8151A)**

Analyte	CASRN	Category	ALS-Kelso Sensitivity Limits (µg/L)		Surface Water CUL (µg/L)
			MDL	PQL	
MCPP	93-65-2	COC	14	100	16

**WORKSHEET #15.6A**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – TRIBUTYLtin IN SOIL BY GC/FPD**  
**(LABORATORY METHOD)**

Analyte	CASRN	Category	ALS-Kelso Sensitivity Limits (µg/kg)		Soil/Sediment CUL (µg/kg)	Focused COC RAL (µg/kg)
			MDL	PQL		
Tributyltin	36643-28-4	COC	0.43	1.0	3,080	--

**WORKSHEET #15.6B**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – TRIBUTYLtin IN WATER BY GC/FPD**  
**(LABORATORY METHOD)**

Analyte	CASRN	Category	ALS-Kelso Sensitivity Limits (µg/L)		Surface Water CUL (µg/L)
			MDL	PQL	
Tributyltin	36643-28-4	COC	0.012	0.05	0.063

## WORKSHEET #15.7A

## PALs AND LABORATORY-SPECIFIC MDLs/PQLs – PCB CONGENERS IN SOIL/SEDIMENT BY METHOD 1668C

Analyte <sup>1</sup>	CASRN	Category	CFA Sensitivity Limits (pg/g)		Soil/Sediment CUL (pg/g)	Focused COC RAL (pg/g)
			MDL	PQL		
MoCB 1	2051-60-7	Focused COC, RPC	1.00	2.00	--	--
MoCB 2	2051-61-8	Focused COC, RPC	1.00	2.00	--	--
MoCB 3	2051-62-9	Focused COC, RPC	1.00	2.00	--	--
DiCB 4	13029-08-08	Focused COC, RPC	1.00	2.00	--	--
DiCB 5	16605-91-7	Focused COC, RPC	1.00	2.00	--	--
DiCB 6	25569-80-6	Focused COC, RPC	1.00	2.00	--	--
DiCB 7	33284-50-3	Focused COC, RPC	1.00	2.00	--	--
DiCB 8	34883-43-7	Focused COC, RPC	1.00	2.00	--	--
DiCB 9	34883-39-1	Focused COC, RPC	1.00	2.00	--	--
DiCB 10	33146-45-1	Focused COC, RPC	1.00	2.00	--	--
DiCB 11	2050-67-1	Focused COC, RPC	2.00	10.0	--	--
DiCB 12/13	2974-92-7 / 2974-90-5	Focused COC, RPC	1.00	4.00	--	--
DiCB 14	34883-41-5	Focused COC, RPC	1.00	2.00	--	--
DiCB 15	2050-68-2	Focused COC, RPC	1.00	2.00	--	--
TrCB 16	38444-78-9	Focused COC, RPC	1.00	2.00	--	--
TrCB 17	37680-66-3	Focused COC, RPC	0.667	2.00	--	--
TrCB 18/30	37680-65-2 / 35693-92-6	Focused COC, RPC	1.33	4.00	--	--
TrCB 19	38444-73-4	Focused COC, RPC	0.667	2.00	--	--
TrCB 20/28	38444-84-7 / 7012-37-5	Focused COC, RPC	1.33	4.00	--	--
TrCB 21/33	55702-46-0 / 38444-86-9	Focused COC, RPC	1.33	4.00	--	--
TrCB 22	38444-85-8	Focused COC, RPC	0.667	2.00	--	--
TrCB 23	55720-44-0	Focused COC, RPC	0.667	2.00	--	--
TrCB 24	55702-45-9	Focused COC, RPC	0.667	2.00	--	--
TrCB 25	55712-37-3	Focused COC, RPC	0.667	2.00	--	--
TrCB 26/29	38444-81-4 / 15862-07-4	Focused COC, RPC	1.33	4.00	--	--
TrCB 27	38444-76-7	Focused COC, RPC	0.667	2.00	--	--
TrCB 31	16606-02-3	Focused COC, RPC	0.667	2.00	--	--
TrCB 32	38444-77-8	Focused COC, RPC	0.667	2.00	--	--
TrCB 34	37680-68-5	Focused COC, RPC	0.667	2.00	--	--
TrCB 35	37680-69-6	Focused COC, RPC	0.667	2.00	--	--
TrCB 36	38444-87-0	Focused COC, RPC	0.667	2.00	--	--

**WORKSHEET #15.7A (CONTINUED)**

**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – PCB CONGENERS IN SOIL/SEDIMENT BY METHOD 1668C**

Analyte <sup>1</sup>	CASRN	Category	CFA Sensitivity Limits (pg/g)		Soil/Sediment CUL (pg/g)	FOCUSED COC RAL (pg/g)
			MDL	PQL		
TrCB 37	38444-90-5	Focused COC, RPC	0.667	2.00	--	--
TrCB 38	53555-66-1	Focused COC, RPC	0.667	2.00	--	--
TrCB 39	38444-88-1	Focused COC, RPC	0.667	2.00	--	--
TeCB 40/71	38444-93-8 / 41464-46-4	Focused COC, RPC	1.33	4.00	--	--
TeCB 41	52663-59-9	Focused COC, RPC	1.33	4.00	--	--
TeCB 42	36559-22-5	Focused COC, RPC	1.00	2.00	--	--
TeCB 43	70362-46-8	Focused COC, RPC	1.33	4.00	--	--
TeCB 44/47/65	41464-39-5 / 33284-54-7 / 2437-79-8	Focused COC, RPC	3.33	6.00	--	--
TeCB 45/51	70362-45-7 / 68194-04-7	Focused COC, RPC	1.33	4.00	--	--
TeCB 46	41464-47-5	Focused COC, RPC	0.667	2.00	--	--
TeCB 48	70362-47-9	Focused COC, RPC	0.667	2.00	--	--
TeCB 49/69	41464-40-8 / 60233-24-1	Focused COC, RPC	1.33	4.00	--	--
TeCB 50/53	62796-65-0 / 41464-41-9	Focused COC, RPC	1.33	4.00	--	--
TeCB 52	35693-99-3	Focused COC, RPC	1.33	4.00	--	--
TeCB 54	15968-05-5	Focused COC, RPC	0.667	2.00	--	--
TeCB 55	74338-24-2	Focused COC, RPC	1.00	2.00	--	--
TeCB 56	41464-43-1	Focused COC, RPC	0.667	2.00	--	--
TeCB 57	70424-67-8	Focused COC, RPC	1.00	2.00	--	--
TeCB 58	41464-49-7	Focused COC, RPC	1.00	2.00	--	--
TeCB 59/62/75	74472-33-6 / 54230-22-7 / 32598-12-2	Focused COC, RPC	2.00	6.00	--	--
TeCB 60	33025-41-1	Focused COC, RPC	0.667	2.00	--	--
TeCB 61/70/74/76	33284-53-6 / 32598-11-1 / 32690-93-0 / 70362-48-0	Focused COC, RPC	2.67	8.00	--	--
TeCB 63	74472-34-7	Focused COC, RPC	0.667	2.00	--	--
TeCB 64	52663-58-8	Focused COC, RPC	1.00	2.00	--	--
TeCB 66	32598-10-0	Focused COC, RPC	1.00	2.00	--	--
TeCB 67	73575-53-8	Focused COC, RPC	1.00	2.00	--	--
TeCB 68	73575-52-7	Focused COC, RPC	0.667	2.00	--	--
TeCB 72	41464-42-0	Focused COC, RPC	0.667	2.00	--	--

**WORKSHEET #15.7A (CONTINUED)**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – PCB CONGENERS IN SOIL/SEDIMENT BY METHOD 1668C**

Analyte <sup>1</sup>	CASRN	Category	CFA Sensitivity Limits (pg/g)		Soil/Sediment CUL (pg/g)	FOCUSED COC RAL (pg/g)
			MDL	PQL		
TeCB 73	74338-23-1	Focused COC, RPC	1.00	2.00	--	--
TeCB 77 <sup>2</sup>	32598-13-3	Focused COC, RPC	0.667	2.00	--	--
TeCB 78	70362-49-1	Focused COC, RPC	0.667	2.00	--	--
TeCB 79	41464-48-6	Focused COC, RPC	0.667	2.00	--	--
TeCB 80	33284-52-5	Focused COC, RPC	0.667	2.00	--	--
TeCB 81 <sup>2</sup>	70362-50-4	Focused COC, RPC	0.667	2.00	--	--
PeCB 82	52663-62-4	Focused COC, RPC	1.00	2.00	--	--
PeCB 83	60145-20-2	Focused COC, RPC	1.00	2.00	--	--
PeCB 84	52663-60-2	Focused COC, RPC	1.00	2.00	--	--
PeCB 85/116/117	65510-45-4 / 18259-05-7 / 68194-11-6	Focused COC, RPC	2.00	6.00	--	--
PeCB 86/87/97/109/119/125	55312-69-1 / 38380-02-8 / 41464-51-1 / 74472-35-8 / 56558-17-9 / 74472-39-2	Focused COC, RPC	4.00	12.0	--	--
PeCB 88/91	55215-17-3 / 67194-05-8	Focused COC, RPC	1.33	4.00	--	--
PeCB 89	73575-57-2	Focused COC, RPC	0.667	2.00	--	--
PeCB 90/101/113	68194-07-0 / 37680-73-268194-10-5	Focused COC, RPC	2.00	6.00	--	--
PeCB 92	52663-61-3	Focused COC, RPC	1.00	2.00	--	--
PeCB 93/100	73575-56-1 / 39485-83-1	Focused COC, RPC	2.00	4.00	--	--
PeCB 94	73575-55-0	Focused COC, RPC	0.667	2.00	--	--
PeCB 95	38379-99-6	Focused COC, RPC	1.33	4.0	--	--
PeCB 96	73575-54-9	Focused COC, RPC	0.667	2.00	--	--
PeCB 98/102	60233-25-2 / 68194-06-9	Focused COC, RPC	1.33	4.00	--	--
PeCB 99	38380-01-7	Focused COC, RPC	1.33	4.00	--	--
PeCB 103	60145-21-3	Focused COC, RPC	0.667	2.00	--	--
PeCB 104	56558-16-8	Focused COC, RPC	0.667	2.00	--	--
PeCB 105 <sup>2</sup>	32598-14-4	Focused COC, RPC	1.00	2.00	--	--
PeCB 106	70424-69-0	Focused COC, RPC	1.00	2.00	--	--
PeCB 107	70424-68-9	Focused COC, RPC	0.667	2.00	--	--
PeCB 108/124	70362-41-3 / 70424-70-3	Focused COC, RPC	1.33	4.00	--	--

**WORKSHEET #15.7A (CONTINUED)**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – PCB CONGENERS IN SOIL/SEDIMENT BY METHOD 1668C**

Analyte <sup>1</sup>	CASRN	Category	CFA Sensitivity Limits (pg/g)		Soil/Sediment CUL (pg/g)	FOCUSED COC RAL (pg/g)
			MDL	PQL		
PeCB 110/115	38380-03-9 / 74472-38-1	Focused COC, RPC	2.67	8.00	--	--
PeCB 111	39635-32-0	Focused COC, RPC	0.667	2.00	--	--
PeCB 112	74472-36-9	Focused COC, RPC	1.33	4.00	--	--
PeCB 114 <sup>2</sup>	74472-37-0	Focused COC, RPC	0.667	2.00	--	--
PeCB 118 <sup>2</sup>	31508-00-6	Focused COC, RPC	1.33	4.00	--	--
PeCB 120	68194-12-7	Focused COC, RPC	0.667	2.00	--	--
PeCB 121	56558-18-0	Focused COC, RPC	0.667	2.00	--	--
PeCB 122	76842-07-4	Focused COC, RPC	0.667	2.00	--	--
PeCB 123 <sup>2</sup>	65510-44-3	Focused COC, RPC	0.667	2.00	--	--
PeCB 126 <sup>2</sup>	57465-28-8	Focused COC, RPC	0.667	2.00	--	--
PeCB 127	39635-33-1	Focused COC, RPC	0.667	2.00	--	--
HxCB 128/166	38380-07-3 / 41411-63-6	Focused COC, RPC	1.33	4.00	--	--
HxCB 129/138/163	55215-18-4 / 35065-28-2 / 74472-44-9	Focused COC, RPC	2.67	6.00	--	--
HxCB 130	52663-66-8	Focused COC, RPC	1.00	2.00	--	--
HxCB 131	61798-70-7	Focused COC, RPC	0.667	4.00	--	--
HxCB 132	38380-05-1	Focused COC, RPC	1.00	2.00	--	--
HxCB 133	35694-04-3	Focused COC, RPC	0.667	2.00	--	--
HxCB 134	52704-70-8	Focused COC, RPC	1.33	4.00	--	--
HxCB 135/151	52744-13-5 / 52663-63-5	Focused COC, RPC	1.33	4.00	--	--
HxCB 136	38411-22-2	Focused COC, RPC	0.667	2.00	--	--
HxCB 137	35694-06-5	Focused COC, RPC	1.33	4.00	--	--
HxCB 139/140	56030-56-9 / 59291-64-4	Focused COC, RPC	1.33	4.00	--	--
HxCB 141	52712-04-6	Focused COC, RPC	1.33	4.00	--	--
HxCB 142	41411-61-4	Focused COC, RPC	0.667	2.00	--	--
HxCB 143	68194-15-0	Focused COC, RPC	1.33	4.00	--	--
HxCB 144	68194-14-9	Focused COC, RPC	0.667	2.00	--	--
HxCB 145	74472-40-5	Focused COC, RPC	0.667	2.00	--	--
HxCB 146	51908-16-8	Focused COC, RPC	1.00	2.00	--	--
HxCB 147/149	68194-13-8 / 38380-04-0	Focused COC, RPC	2.00	4.00	--	--
HxCB 148	74472-41-6	Focused COC, RPC	0.667	2.00	--	--

**WORKSHEET #15.7A (CONTINUED)**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – PCB CONGENERS IN SOIL/SEDIMENT BY METHOD 1668C**

Analyte <sup>1</sup>	CASRN	Category	CFA Sensitivity Limits (pg/g)		Soil/Sediment CUL (pg/g)	FOCUSED COC RAL (pg/g)
			MDL	PQL		
HxCB 150	68194-08-1	Focused COC, RPC	1.00	2.00	--	--
HxCB 152	68194-09-2	Focused COC, RPC	0.667	2.00	--	--
HxCB 153/168	35065-27-1 / 59291-65-5	Focused COC, RPC	2.00	4.00	--	--
HxCB 154	30145-22-4	Focused COC, RPC	0.667	2.00	--	--
HxCB 155	33979-03-2	Focused COC, RPC	0.667	2.00	--	--
HxCB 156 <sup>2</sup> /157 <sup>2</sup>	38380-08-4 / 69782-90-7	Focused COC, RPC	1.33	2.00	--	--
HxCB 158	74472-42-7	Focused COC, RPC	0.667	2.00	--	--
HxCB 159	39635-35-3	Focused COC, RPC	0.667	2.00	--	--
HxCB 160	41411-62-5	Focused COC, RPC	0.667	2.00	--	--
HxCB 161	74472-43-8	Focused COC, RPC	1.00	2.00	--	--
HxCB 162	39635-34-2	Focused COC, RPC	1.00	2.00	--	--
HxCB 164	74472-45-0	Focused COC, RPC	0.667	2.00	--	--
HxCB 165	74472-46-1	Focused COC, RPC	0.667	2.00	--	--
HxCB 167 <sup>2</sup>	52663-72-6	Focused COC, RPC	0.667	2.00	--	--
HxCB 169 <sup>2</sup>	62774-16-6	Focused COC, RPC	1.00	2.00	--	--
HpCB 170	35065-30-6	Focused COC, RPC	0.667	2.00	--	--
HpCB 171/173	52663-71-5 / 68194-16-1	Focused COC, RPC	1.33	4.00	--	--
HpCB 172	52663-74-8	Focused COC, RPC	1.00	2.00	--	--
HpCB 174	38411-25-5	Focused COC, RPC	1.33	4.00	--	--
HpCB 175	40186-70-7	Focused COC, RPC	1.00	2.00	--	--
HpCB 176	52663-65-7	Focused COC, RPC	0.667	2.00	--	--
HpCB 177	52663-70-4	Focused COC, RPC	1.00	2.00	--	--
HpCB 178	52663-67-9	Focused COC, RPC	1.33	4.00	--	--
HpCB 179	52663-64-6	Focused COC, RPC	0.667	2.00	--	--
HpCB 180/193	35065-29-3 / 69782-91-8	Focused COC, RPC	2.00	4.00	--	--
HpCB 181	74472-47-2	Focused COC, RPC	1.00	2.00	--	--
HpCB 182	60145-23-5	Focused COC, RPC	0.667	2.00	--	--
HpCB 183/185	52663-69-1 / 52712-05-7	Focused COC, RPC	1.33	4.00	--	--
HpCB 184	74472-48-3	Focused COC, RPC	0.667	2.00	--	--
HpCB 186	74472-49-4	Focused COC, RPC	0.667	2.00	--	--
HpCB 187	52663-68-0	Focused COC, RPC	1.00	2.00	--	--

**WORKSHEET #15.7A (CONTINUED)**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – PCB CONGENERS IN SOIL/SEDIMENT BY METHOD 1668C**

Analyte <sup>1</sup>	CASRN	Category	CFA Sensitivity Limits (pg/g)		Soil/Sediment CUL (pg/g)	FOCUSED COC RAL (pg/g)
			MDL	PQL		
HpCB 188	74487-85-7	Focused COC, RPC	0.667	2.00	--	--
HpCB 189 <sup>2</sup>	39635-31-9	Focused COC, RPC	0.667	2.00	--	--
HpCB 190	41411-64-7	Focused COC, RPC	1.00	2.00	--	--
HpCB 191	74472-50-7	Focused COC, RPC	0.667	2.00	--	--
HpCB 192	74472-51-8	Focused COC, RPC	0.667	2.00	--	--
OcCB 194	35694-08-7	Focused COC, RPC	0.667	2.00	--	--
OcCB 195	52663-78-2	Focused COC, RPC	1.00	2.00	--	--
OcCB 196	42740-50-1	Focused COC, RPC	0.667	2.00	--	--
OcCB 197/200	33091-17-7 / 52663-73-7	Focused COC, RPC	1.33	4.00	--	--
OcCB 198/199	68194-17-2 / 52663-75-9	Focused COC, RPC	1.33	4.00	--	--
OcCB 201	40186-71-8	Focused COC, RPC	0.667	2.00	--	--
OcCB 202	2136-99-4	Focused COC, RPC	1.00	2.00	--	--
OcCB 203	52663-76-0	Focused COC, RPC	1.33	4.00	--	--
OcCB 204	74472-52-9	Focused COC, RPC	1.00	2.00	--	--
OcCB 205	74472-53-0	Focused COC, RPC	0.667	2.00	--	--
NoCB 206	40186-72-9	Focused COC, RPC	1.00	2.00	--	--
NoCB 207	52663-79-3	Focused COC, RPC	0.667	2.00	--	--
NoCB 208	52663-77-1	Focused COC, RPC	0.667	2.00	--	--
DeCB 209	2051-24-3	Focused COC, RPC	0.667	2.00	--	--
Total PCBs	NA	Focused COC, RPC	NA	NA	9,000 <sup>(3)</sup>	75,000 <sup>(3)</sup>

<sup>1</sup> Multiple congeners listed on the same line indicate coeluting compounds that cannot be chromatographically separated.

<sup>2</sup> PCB congener listed by the World Health Organization as exhibiting dioxin-like toxicity.

<sup>3</sup> The ROD presents the screening levels in µg/kg; the PALS in this table have been converted to pg/g (1 µg/kg = 1,000 pg/g) to match the units reported by the analytical laboratory.

pg/g = picograms per gram

**WORKSHEET #15.7B**

**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – PCB CONGENERS IN WATER BY METHOD 1668C**

Analyte <sup>1</sup>	CASRN	Category	CFA Sensitivity Limits (pg/L)		Surface Water CUL (pg/L)
			MDL	PQL	
MoCB 1	2051-60-7	Focused COC, RPC	6.66	20.0	--
MoCB 2	2051-61-8	Focused COC, RPC	6.66	20.0	--
MoCB 3	2051-62-9	Focused COC, RPC	6.66	20.0	--
DiCB 4	13029-08-08	Focused COC, RPC	6.66	20.0	--
DiCB 5	16605-91-7	Focused COC, RPC	6.66	20.0	--
DiCB 6	25569-80-6	Focused COC, RPC	6.66	20.0	--
DiCB 7	33284-50-3	Focused COC, RPC	6.66	20.0	--
DiCB 8	34883-43-7	Focused COC, RPC	6.66	20.0	--
DiCB 9	34883-39-1	Focused COC, RPC	6.66	20.0	--
DiCB 10	33146-45-1	Focused COC, RPC	6.66	20.0	--
DiCB 11	2050-67-1	Focused COC, RPC	6.66	50.0	--
DiCB 12/13	2974-92-7 / 2974-90-5	Focused COC, RPC	13.3	40.0	--
DiCB 14	34883-41-5	Focused COC, RPC	6.66	20.0	--
DiCB 15	2050-68-2	Focused COC, RPC	6.66	20.0	--
TrCB 16	38444-78-9	Focused COC, RPC	6.66	20.0	--
TrCB 17	37680-66-3	Focused COC, RPC	6.66	20.0	--
TrCB 18/30	37680-65-2 / 35693-92-6	Focused COC, RPC	13.3	40.0	--
TrCB 19	38444-73-4	Focused COC, RPC	6.66	20.0	--
TrCB 20/28	38444-84-7 / 7012-37-5	Focused COC, RPC	13.3	40.0	--
TrCB 21/33	55702-46-0 / 38444-86-9	Focused COC, RPC	13.3	40.0	--
TrCB 22	38444-85-8	Focused COC, RPC	6.66	20.0	--
TrCB 23	55720-44-0	Focused COC, RPC	6.66	20.0	--
TrCB 24	55702-45-9	Focused COC, RPC	6.66	20.0	--
TrCB 25	55712-37-3	Focused COC, RPC	6.66	20.0	--
TrCB 26/29	38444-81-4 / 15862-07-4	Focused COC, RPC	13.3	40.0	--
TrCB 27	38444-76-7	Focused COC, RPC	6.66	20.0	--
TrCB 31	16606-02-3	Focused COC, RPC	6.66	20.0	--
TrCB 32	38444-77-8	Focused COC, RPC	6.66	20.0	--
TrCB 34	37680-68-5	Focused COC, RPC	6.66	20.0	--
TrCB 35	37680-69-6	Focused COC, RPC	6.66	20.0	--
TrCB 36	38444-87-0	Focused COC, RPC	6.66	20.0	--

**WORKSHEET #15.7B (CONTINUED)**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – PCB CONGENERS IN WATER BY METHOD 1668C**

Analyte <sup>1</sup>	CASRN	Category	CFA Sensitivity Limits (pg/L)		Surface Water CUL (pg/L)
			MDL	PQL	
TrCB 37	38444-90-5	Focused COC, RPC	6.66	20.0	--
TrCB 38	53555-66-1	Focused COC, RPC	6.66	20.0	--
TrCB 39	38444-88-1	Focused COC, RPC	6.66	20.0	--
TeCB 40/71	38444-93-8 / 41464-46-4	Focused COC, RPC	13.3	40.0	--
TeCB 41	52663-59-9	Focused COC, RPC	6.66	20.0	--
TeCB 42	36559-22-5	Focused COC, RPC	6.66	20.0	--
TeCB 43	70362-46-8	Focused COC, RPC	6.66	20.0	--
TeCB 44/47/65	41464-39-5 / 2437-79-8 / 33284-54-7	Focused COC, RPC	20.0	60.0	--
TeCB 45/51	70362-45-7 / 68194-04-7	Focused COC, RPC	13.3	40.0	--
TeCB 46	41464-47-5	Focused COC, RPC	6.66	20.0	--
TeCB 48	70362-47-9	Focused COC, RPC	6.66	20.0	--
TeCB 49/69	41464-40-8 / 60233-24-1	Focused COC, RPC	13.3	40.0	--
TeCB 50/53	62796-65-0 / 41464-41-9	Focused COC, RPC	13.3	40.0	--
TeCB 52	35693-99-3	Focused COC, RPC	6.66	20.0	--
TeCB 54	15968-05-5	Focused COC, RPC	6.66	20.0	--
TeCB 55	74338-24-2	Focused COC, RPC	6.66	20.0	--
TeCB 56	41464-43-1	Focused COC, RPC	6.66	20.0	--
TeCB 57	70424-67-8	Focused COC, RPC	6.66	20.0	--
TeCB 58	41464-49-7	Focused COC, RPC	6.66	20.0	--
TeCB 59/62/75	74472-33-6 / 54230-22-7 / 32598-12-2	Focused COC, RPC	20.0	60.0	--
TeCB 60	33025-41-1	Focused COC, RPC	6.66	20.0	--
TeCB 61/70/74/76	33284-53-6 / 32598-11-1 / 32690-93-0 / 70362-48-0	Focused COC, RPC	26.6	80.0	--
TeCB 63	74472-34-7	Focused COC, RPC	6.66	20.0	--
TeCB 64	52663-58-8	Focused COC, RPC	6.66	20.0	--
TeCB 66	32598-10-0	Focused COC, RPC	6.66	20.0	--
TeCB 67	73575-53-8	Focused COC, RPC	6.66	20.0	--
TeCB 68	73575-52-7	Focused COC, RPC	6.66	20.0	--
TeCB 72	41464-42-0	Focused COC, RPC	6.66	20.0	--

**WORKSHEET #15.7B (CONTINUED)**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – PCB CONGENERS IN WATER BY METHOD 1668C**

Analyte <sup>1</sup>	CASRN	Category	CFA Sensitivity Limits (pg/L)		Surface Water CUL (pg/L)
			MDL	PQL	
TeCB 73	74338-23-1	Focused COC, RPC	6.66	20.0	--
TeCB 77 <sup>2</sup>	32598-13-3	Focused COC, RPC	6.66	20.0	--
TeCB 79	41464-48-6	Focused COC, RPC	6.66	20.0	--
TeCB 78	70362-49-1	Focused COC, RPC	6.66	20.0	--
TeCB 80	33284-52-5	Focused COC, RPC	6.66	20.0	--
TeCB 81 <sup>2</sup>	70362-50-4	Focused COC, RPC	6.66	20.0	--
PeCB 82	52663-62-4	Focused COC, RPC	6.66	20.0	--
PeCB 83	60145-20-2	Focused COC, RPC	6.66	20.0	--
PeCB 84	52663-60-2	Focused COC, RPC	6.66	20.0	--
PeCB 85/116/117	65510-45-4 / 18259-05-7 / 68194-11-6	Focused COC, RPC	20.0	60.0	--
PeCB 86/87/97/109/119/125	55312-69-1 / 38380-02-8 / 41464-51-1 / 74472-35-8 / 56558-17-9 / 74472-39-2	Focused COC, RPC	40.0	120	--
PeCB 88/91	55215-17-3 / 67194-05-8	Focused COC, RPC	13.3	40.0	--
PeCB 89	73575-57-2	Focused COC, RPC	6.66	20.0	--
PeCB 90/101/113	68194-07-0 / 37680-73-2 / 68194-10-5	Focused COC, RPC	20.0	60.0	--
PeCB 92	52663-61-3	Focused COC, RPC	6.66	20.0	--
PeCB 93/100	73575-56-1 / 39485-83-1	Focused COC, RPC	13.3	40.0	--
PeCB 94	73575-55-0	Focused COC, RPC	6.66	20.0	--
PeCB 95	38379-99-6	Focused COC, RPC	6.66	20.0	--
PeCB 96	73575-54-9	Focused COC, RPC	6.66	20.0	--
PeCB 98/102	60233-25-2 / 68194-06-9	Focused COC, RPC	13.3	40.0	--
PeCB 99	38380-01-7	Focused COC, RPC	6.66	20.0	--
PeCB 103	60145-21-3	Focused COC, RPC	6.66	20.0	--
PeCB 104	56558-16-8	Focused COC, RPC	6.66	20.0	--
PeCB 105 <sup>2</sup>	32598-14-4	Focused COC, RPC	6.66	20.0	--
PeCB 106	70424-69-0	Focused COC, RPC	6.66	20.0	--
PeCB 107	70424-68-9	Focused COC, RPC	6.66	20.0	--
PeCB 108/124	70362-41-3 / 70424-70-3	Focused COC, RPC	13.3	40.0	--

**WORKSHEET #15.7B (CONTINUED)**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – PCB CONGENERS IN WATER BY METHOD 1668C**

Analyte <sup>1</sup>	CASRN	Category	CFA Sensitivity Limits (pg/L)		Surface Water CUL (pg/L)
			MDL	PQL	
PeCB 110/115	38380-03-9 / 74472-38-1	Focused COC, RPC	13.3	40.0	--
PeCB 111	39635-32-0	Focused COC, RPC	6.66	20.0	--
PeCB 112	74472-36-9	Focused COC, RPC	6.66	20.0	--
PeCB 114 <sup>2</sup>	74472-37-0	Focused COC, RPC	6.66	20.0	--
PeCB 118 <sup>2</sup>	31508-00-6	Focused COC, RPC	6.66	20.0	--
PeCB 120	68194-12-7	Focused COC, RPC	6.66	20.0	--
PeCB 122	76842-07-4	Focused COC, RPC	6.66	20.0	--
PeCB 121	56558-18-0	Focused COC, RPC	6.66	20.0	--
PeCB 123 <sup>2</sup>	65510-44-3	Focused COC, RPC	6.66	20.0	--
PeCB 126 <sup>2</sup>	57465-28-8	Focused COC, RPC	6.66	20.0	--
PeCB 127	39635-33-1	Focused COC, RPC	6.66	20.0	--
HxCB 128/166	38380-07-3 / 41411-63-6	Focused COC, RPC	13.3	40.0	--
HxCB 129/138/163	55215-18-4 / 35065-28-2 / 74472-44-9	Focused COC, RPC	20.0	60.0	--
HxCB 130	52663-66-8	Focused COC, RPC	6.66	20.0	--
HxCB 131	61798-70-7	Focused COC, RPC	6.66	20.0	--
HxCB 132	38380-05-1	Focused COC, RPC	6.66	20.0	--
HxCB 133	35694-04-3	Focused COC, RPC	6.66	20.0	--
HxCB 134	52704-70-8	Focused COC, RPC	6.66	20.0	--
HxCB 135/151	52744-13-5 / 52663-63-5	Focused COC, RPC	13.3	40.0	--
HxCB 136	38411-22-2	Focused COC, RPC	6.66	20.0	--
HxCB 137	35694-06-5	Focused COC, RPC	6.66	20.0	--
HxCB 139/140	56030-56-9 / 59291-64-4	Focused COC, RPC	13.3	40.0	--
HxCB 141	52712-04-6	Focused COC, RPC	6.66	20.0	--
HxCB 142	41411-61-4	Focused COC, RPC	6.66	20.0	--
HxCB 143	68194-15-0	Focused COC, RPC	6.66	20.0	--
HxCB 144	68194-14-9	Focused COC, RPC	6.66	20.0	--
HxCB 145	74472-40-5	Focused COC, RPC	6.66	20.0	--
HxCB 146	51908-16-8	Focused COC, RPC	6.66	20.0	--
HxCB 147/149	68194-13-8 / 38380-04-0	Focused COC, RPC	13.3	40.0	--
HxCB 148	74472-41-6	Focused COC, RPC	6.66	20.0	--

**WORKSHEET #15.7B (CONTINUED)**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – PCB CONGENERS IN WATER BY METHOD 1668C**

Analyte <sup>1</sup>	CASRN	Category	CFA Sensitivity Limits (pg/L)		Surface Water CUL (pg/L)
			MDL	PQL	
HxCB 150	68194-08-1	Focused COC, RPC	6.66	20.0	--
HxCB 152	68194-09-2	Focused COC, RPC	6.66	20.0	--
HxCB 153/168	35065-27-1 / 59291-65-5	Focused COC, RPC	13.3	40.0	--
HxCB 154	30145-22-4	Focused COC, RPC	6.66	20.0	--
HxCB 155	33979-03-2	Focused COC, RPC	6.66	20.0	--
HxCB 156 <sup>2</sup> /157 <sup>2</sup>	38380-08-4 / 69782-90-7	Focused COC, RPC	13.3	40.0	--
HxCB 158	74472-42-7	Focused COC, RPC	6.66	20.0	--
HxCB 159	39635-35-3	Focused COC, RPC	6.66	20.0	--
HxCB 160	41411-62-5	Focused COC, RPC	6.66	20.0	--
HxCB 161	74472-43-8	Focused COC, RPC	6.66	20.0	--
HxCB 162	39635-34-2	Focused COC, RPC	6.66	20.0	--
HxCB 164	74472-45-0	Focused COC, RPC	6.66	20.0	--
HxCB 165	74472-46-1	Focused COC, RPC	6.66	20.0	--
HxCB 167 <sup>2</sup>	52663-72-6	Focused COC, RPC	6.66	20.0	--
HxCB 169 <sup>2</sup>	62774-16-6	Focused COC, RPC	6.66	20.0	--
HpCB 170	35065-30-6	Focused COC, RPC	6.66	20.0	--
HpCB 171/173	52663-71-5 / 68194-16-1	Focused COC, RPC	13.3	40.0	--
HpCB 172	52663-74-8	Focused COC, RPC	6.66	20.0	--
HpCB 174	38411-25-5	Focused COC, RPC	6.66	20.0	--
HpCB 175	40186-70-7	Focused COC, RPC	6.66	20.0	--
HpCB 176	52663-65-7	Focused COC, RPC	6.66	20.0	--
HpCB 177	52663-70-4	Focused COC, RPC	6.66	20.0	--
HpCB 178	52663-67-9	Focused COC, RPC	6.66	20.0	--
HpCB 179	52663-64-6	Focused COC, RPC	6.66	20.0	--
HpCB 180/193	35065-29-3 / 69782-91-8	Focused COC, RPC	13.3	40.0	--
HpCB 181	74472-47-2	Focused COC, RPC	6.66	20.0	--
HpCB 182	60145-23-5	Focused COC, RPC	6.66	20.0	--
HpCB 183/185	52663-69-1 / 52712-05-7	Focused COC, RPC	13.3	40.0	--
HpCB 184	74472-48-3	Focused COC, RPC	6.66	20.0	--
HpCB 186	74472-49-4	Focused COC, RPC	6.66	20.0	--
HpCB 187	52663-68-0	Focused COC, RPC	6.66	20.0	--

**WORKSHEET #15.7B (CONTINUED)**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – PCB CONGENERS IN WATER BY METHOD 1668C**

Analyte <sup>1</sup>	CASRN	Category	CFA Sensitivity Limits (pg/L)		Surface Water CUL (pg/L)
			MDL	PQL	
HpCB 188	74487-85-7	Focused COC, RPC	6.66	20.0	--
HpCB 189 <sup>2</sup>	39635-31-9	Focused COC, RPC	6.66	20.0	--
HpCB 190	41411-64-7	Focused COC, RPC	6.66	20.0	--
HpCB 191	74472-50-7	Focused COC, RPC	6.66	20.0	--
HpCB 192	74472-51-8	Focused COC, RPC	6.66	20.0	--
OcCB 194	35694-08-7	Focused COC, RPC	6.66	20.0	--
OcCB 195	52663-78-2	Focused COC, RPC	6.66	20.0	--
OcCB 196	42740-50-1	Focused COC, RPC	6.66	20.0	--
OcCB 197/200	33091-17-7 / 52663-73-7	Focused COC, RPC	13.3	40.0	--
OcCB 198/199	68194-17-2 / 52663-75-9	Focused COC, RPC	13.3	40.0	--
OcCB 201	40186-71-8	Focused COC, RPC	6.66	20.0	--
OcCB 202	2136-99-4	Focused COC, RPC	6.66	20.0	--
OcCB 203	52663-76-0	Focused COC, RPC	6.66	20.0	--
OcCB 204	74472-52-9	Focused COC, RPC	6.66	20.0	--
OcCB 205	74472-53-0	Focused COC, RPC	6.66	20.0	--
NoCB 206	40186-72-9	Focused COC, RPC	6.66	20.0	--
NoCB 207	52663-79-3	Focused COC, RPC	6.66	20.0	--
NoCB 208	52663-77-1	Focused COC, RPC	6.66	20.0	--
DeCB 209	2051-24-3	Focused COC, RPC	6.66	20.0	--
Total PCBs	NA	Focused COC, RPC	NA	NA	6.4 <sup>(3)</sup>

<sup>1</sup> Multiple congeners listed on the same line indicate coeluting compounds that cannot be chromatographically separated; congeners are listed in expected order of elution from the chromatographic column.

<sup>2</sup> PCB congener listed by the World Health Organization as exhibiting dioxin-like toxicity.

<sup>3</sup> The ROD presents the screening levels in µg/L; the PALS in this table have been converted to pg/L (1 µg/L = 1E6 pg/L) to match the units reported by the analytical laboratory.  
pg/L = picograms per liter

## WORKSHEET #15.7C

## PALs AND LABORATORY-SPECIFIC MDLs/PQLs – PCB CONGENERS IN HVS EXTRACTS BY METHOD 1668C

Analyte <sup>1</sup>	CASRN	Category	SGS Sensitivity Limits (pg/sample)		Soil/Sediment CUL (pg/g)	Focused COC RAL (pg/g)
			MDL	PQL		
MoCB 1	2051-60-7	Focused COC, RPC	NA <sup>2</sup>	20	--	--
MoCB 2	2051-61-8	Focused COC, RPC	NA <sup>2</sup>	20	--	--
MoCB 3	2051-62-9	Focused COC, RPC	NA <sup>2</sup>	20	--	--
DiCB 4	13029-08-08	Focused COC, RPC	NA <sup>2</sup>	20	--	--
DiCB 5	16605-91-7	Focused COC, RPC	NA <sup>2</sup>	20	--	--
DiCB 6	25569-80-6	Focused COC, RPC	NA <sup>2</sup>	20	--	--
DiCB 7	33284-50-3	Focused COC, RPC	NA <sup>2</sup>	20	--	--
DiCB 8	34883-43-7	Focused COC, RPC	NA <sup>2</sup>	20	--	--
DiCB 9	34883-39-1	Focused COC, RPC	NA <sup>2</sup>	20	--	--
DiCB 10	33146-45-1	Focused COC, RPC	NA <sup>2</sup>	20	--	--
DiCB 11	2050-67-1	Focused COC, RPC	NA <sup>2</sup>	20	--	--
DiCB 12/13	2974-92-7 / 2974-90-5	Focused COC, RPC	NA <sup>2</sup>	40	--	--
DiCB 14	34883-41-5	Focused COC, RPC	NA <sup>2</sup>	20	--	--
DiCB 15	2050-68-2	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TrCB 16	38444-78-9	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TrCB 17	37680-66-3	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TrCB 18/30	37680-65-2 / 35693-92-6	Focused COC, RPC	NA <sup>2</sup>	40	--	--
TrCB 19	38444-73-4	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TrCB 20/28	38444-84-7 / 7012-37-5	Focused COC, RPC	NA <sup>2</sup>	40	--	--
TrCB 21/33	55702-46-0 / 38444-86-9	Focused COC, RPC	NA <sup>2</sup>	40	--	--
TrCB 22	38444-85-8	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TrCB 23	55720-44-0	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TrCB 24	55702-45-9	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TrCB 25	55712-37-3	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TrCB 26/29	38444-81-4 / 15862-07-4	Focused COC, RPC	NA <sup>2</sup>	40	--	--
TrCB 27	38444-76-7	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TrCB 31	16606-02-3	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TrCB 32	38444-77-8	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TrCB 34	37680-68-5	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TrCB 35	37680-69-6	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TrCB 36	38444-87-0	Focused COC, RPC	NA <sup>2</sup>	20	--	--

**WORKSHEET #15.7C (CONTINUED)**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – PCB CONGENERS IN SOIL/SEDIMENT BY METHOD 1668C**

Analyte <sup>1</sup>	CASRN	Category	SGS Sensitivity Limits (pg/sample)		Soil/Sediment CUL (pg/g)	Focused COC RAL (pg/g)
			MDL	PQL		
TrCB 37	38444-90-5	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TrCB 38	53555-66-1	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TrCB 39	38444-88-1	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TeCB 40/71	38444-93-8 / 41464-46-4	Focused COC, RPC	NA <sup>2</sup>	40	--	--
TeCB 41	52663-59-9	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TeCB 42	36559-22-5	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TeCB 43	70362-46-8	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TeCB 44/47/65	41464-39-5 / 33284-54-7 / 2437-79-8	Focused COC, RPC	NA <sup>2</sup>	60	--	--
TeCB 45	70362-45-7	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TeCB 46	41464-47-5	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TeCB 48	70362-47-9	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TeCB 49/69	41464-40-8 / 60233-24-1	Focused COC, RPC	NA <sup>2</sup>	40	--	--
TeCB 50/53	62796-65-0 / 41464-41-9	Focused COC, RPC	NA <sup>2</sup>	40	--	--
TeCB 51	68194-04-7	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TeCB 52	35693-99-3	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TeCB 54	15968-05-5	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TeCB 55	74338-24-2	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TeCB 56	41464-43-1	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TeCB 57	70424-67-8	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TeCB 58	41464-49-7	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TeCB 59/62/75	74472-33-6 / 54230-22-7 / 32598-12-2	Focused COC, RPC	NA <sup>2</sup>	60	--	--
TeCB 60	33025-41-1	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TeCB 61/70/74/76	33284-53-6 / 32598-11-1 / 32690-93-0 / 70362-48-0	Focused COC, RPC	NA <sup>2</sup>	80	--	--
TeCB 63	74472-34-7	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TeCB 64	52663-58-8	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TeCB 66	32598-10-0	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TeCB 67	73575-53-8	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TeCB 68	73575-52-7	Focused COC, RPC	NA <sup>2</sup>	20	--	--

**WORKSHEET #15.7C (CONTINUED)**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – PCB CONGENERS IN SOIL/SEDIMENT BY METHOD 1668C**

Analyte <sup>1</sup>	CASRN	Category	SGS Sensitivity Limits (pg/sample)		Soil/Sediment CUL (pg/g)	Focused COC RAL (pg/g)
			MDL	PQL		
TeCB 72	41464-42-0	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TeCB 73	74338-23-1	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TeCB 77 <sup>3</sup>	32598-13-3	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TeCB 78	70362-49-1	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TeCB 79	41464-48-6	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TeCB 80	33284-52-5	Focused COC, RPC	NA <sup>2</sup>	20	--	--
TeCB 81 <sup>3</sup>	70362-50-4	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 82	52663-62-4	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 83	60145-20-2	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 84	52663-60-2	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 85/116	65510-45-4 / 18259-05-7	Focused COC, RPC	NA <sup>2</sup>	40	--	--
PeCB 86/87/97/109/119/125	55312-69-1 / 38380-02-8 / 41464-51-1 / 74472-35-8 / 56558-17-9 / 74472-39-2	Focused COC, RPC	NA <sup>2</sup>	120	--	--
PeCB 88	55215-17-3	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 89	73575-57-2	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 90/101/113	68194-07-0 / 37680-73-2 / 68194-10-5	Focused COC, RPC	NA <sup>2</sup>	60	--	--
PeCB 91	67194-05-8	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 92	52663-61-3	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 93/100	73575-56-1 / 39485-83-1	Focused COC, RPC	NA <sup>2</sup>	40	--	--
PeCB 94	73575-55-0	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 95	38379-99-6	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 96	73575-54-9	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 98	60233-25-2	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 99	38380-01-7	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 102	68194-06-9	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 103	60145-21-3	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 104	56558-16-8	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 105 <sup>3</sup>	32598-14-4	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 106	70424-69-0	Focused COC, RPC	NA <sup>2</sup>	20	--	--

**WORKSHEET #15.7C (CONTINUED)**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – PCB CONGENERS IN SOIL/SEDIMENT BY METHOD 1668C**

Analyte <sup>1</sup>	CASRN	Category	SGS Sensitivity Limits (pg/sample)		Soil/Sediment CUL (pg/g)	Focused COC RAL (pg/g)
			MDL	PQL		
PeCB 107	70424-68-9	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 108/124	70362-41-3 / 70424-70-3	Focused COC, RPC	NA <sup>2</sup>	40	--	--
PeCB 110	38380-03-9	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 111	39635-32-0	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 112	74472-36-9	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 114 <sup>3</sup>	74472-37-0	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 115	74472-38-1	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 117	68194-11-6	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 118 <sup>3</sup>	31508-00-6	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 120	68194-12-7	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 121	56558-18-0	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 122	76842-07-4	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 123 <sup>3</sup>	65510-44-3	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 126 <sup>3</sup>	57465-28-8	Focused COC, RPC	NA <sup>2</sup>	20	--	--
PeCB 127	39635-33-1	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 128/166	38380-07-3 / 41411-63-6	Focused COC, RPC	NA <sup>2</sup>	40	--	--
HxCB 129/138/163	55215-18-4 / 35065-28-2 / 74472-44-9	Focused COC, RPC	NA <sup>2</sup>	60	--	--
HxCB 130	52663-66-8	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 131	61798-70-7	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 132	38380-05-1	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 133	35694-04-3	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 134	52704-70-8	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 135/151	52744-13-5 / 52663-63-5	Focused COC, RPC	NA <sup>2</sup>	40	--	--
HxCB 136	38411-22-2	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 137	35694-06-5	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 139/140	56030-56-9 / 59291-64-4	Focused COC, RPC	NA <sup>2</sup>	40	--	--
HxCB 141	52712-04-6	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 142	41411-61-4	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 143	68194-15-0	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 144	68194-14-9	Focused COC, RPC	NA <sup>2</sup>	20	--	--

**WORKSHEET #15.7C (CONTINUED)**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – PCB CONGENERS IN SOIL/SEDIMENT BY METHOD 1668C**

Analyte <sup>1</sup>	CASRN	Category	SGS Sensitivity Limits (pg/sample)		Soil/Sediment CUL (pg/g)	Focused COC RAL (pg/g)
			MDL	PQL		
HxCB 145	74472-40-5	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 146	51908-16-8	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 147/149	68194-13-8 / 38380-04-0	Focused COC, RPC	NA <sup>2</sup>	40	--	--
HxCB 148	74472-41-6	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 150	68194-08-1	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 152	68194-09-2	Focused COC, RPC	NA <sup>2</sup>	40	--	--
HxCB 153/168	35065-27-1 / 59291-65-5	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 154	30145-22-4	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 155	33979-03-2	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 156 <sup>3</sup> /157 <sup>3</sup>	38380-08-4 / 69782-90-7	Focused COC, RPC	NA <sup>2</sup>	40	--	--
HxCB 158	74472-42-7	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 159	39635-35-3	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 160	41411-62-5	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 161	74472-43-8	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 162	39635-34-2	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 164	74472-45-0	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 165	74472-46-1	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 167 <sup>3</sup>	52663-72-6	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HxCB 169 <sup>3</sup>	62774-16-6	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HpCB 170	35065-30-6	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HpCB 171/173	52663-71-5 / 68194-16-1	Focused COC, RPC	NA <sup>2</sup>	40	--	--
HpCB 172	52663-74-8	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HpCB 174	38411-25-5	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HpCB 175	40186-70-7	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HpCB 176	52663-65-7	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HpCB 177	52663-70-4	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HpCB 178	52663-67-9	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HpCB 179	52663-64-6	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HpCB 180/193	35065-29-3 / 69782-91-8	Focused COC, RPC	NA <sup>2</sup>	40	--	--
HpCB 181	74472-47-2	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HpCB 182	60145-23-5	Focused COC, RPC	NA <sup>2</sup>	20	--	--

**WORKSHEET #15.7C (CONTINUED)**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – PCB CONGENERS IN SOIL/SEDIMENT BY METHOD 1668C**

Analyte <sup>1</sup>	CASRN	Category	SGS Sensitivity Limits (pg/sample)		Soil/Sediment CUL (pg/g)	Focused COC RAL (pg/g)
			MDL	PQL		
HpCB 183	52663-69-1	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HpCB 184	74472-48-3	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HpCB 185	52712-05-7	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HpCB 186	74472-49-4	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HpCB 187	52663-68-0	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HpCB 188	74487-85-7	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HpCB 189 <sup>3</sup>	39635-31-9	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HpCB 190	41411-64-7	Focused COC, RPC	NA <sup>2</sup>	20	--	--
HpCB 191	74472-50-7	Focused COC, RPC	NA <sup>e</sup>	20	--	--
HpCB 192	74472-51-8	Focused COC, RPC	NA <sup>2</sup>	20	--	--
OcCB 194	35694-08-7	Focused COC, RPC	NA <sup>2</sup>	20	--	--
OcCB 195	52663-78-2	Focused COC, RPC	NA <sup>2</sup>	20	--	--
OcCB 196	42740-50-1	Focused COC, RPC	NA <sup>2</sup>	20	--	--
OcCB 197	33091-17-7	Focused COC, RPC	NA <sup>2</sup>	20	--	--
OcCB 198/199	68194-17-2 / 52663-75-9	Focused COC, RPC	NA <sup>2</sup>	40	--	--
OcCB 200	52663-73-7	Focused COC, RPC	NA <sup>2</sup>	20	--	--
OcCB 201	40186-71-8	Focused COC, RPC	NA <sup>2</sup>	20	--	--
OcCB 202	2136-99-4	Focused COC, RPC	NA <sup>2</sup>	20	--	--
OcCB 203	52663-76-0	Focused COC, RPC	NA <sup>2</sup>	20	--	--
OcCB 204	74472-52-9	Focused COC, RPC	NA <sup>2</sup>	20	--	--
OcCB 205	74472-53-0	Focused COC, RPC	NA <sup>2</sup>	20	--	--
NoCB 206	40186-72-9	Focused COC, RPC	NA <sup>2</sup>	20	--	--
NoCB 207	52663-79-3	Focused COC, RPC	NA <sup>2</sup>	20	--	--
NoCB 208	52663-77-1	Focused COC, RPC	NA <sup>2</sup>	20	--	--
DeCB 209	2051-24-3	Focused COC, RPC	NA <sup>2</sup>	20	--	--
Total PCBs	NA	Focused COC, RPC	NA	NA	9,000 <sup>(4)</sup>	75,000 <sup>(4)</sup>

<sup>1</sup> Multiple congeners listed on the same line indicate coeluting compounds that cannot be chromatographically separated.

<sup>2</sup> SGS PCB congener data is not reported nor assessed based on MDLs; non-detected results will be reported to the sample-specific EDL.

<sup>3</sup> PCB congener listed by the World Health Organization as exhibiting dioxin-like toxicity.

<sup>4</sup> CUL and RAL presented for informational purposes but are not applicable to non-site stormwater sources. The stormwater PCB load will be calculated using the metered volume of water sampled and will be used to supplement RD decisions to address recontamination potential.

pg/sample = picograms per sample

**WORKSHEET #15.8A**  
**PALS AND LABORATORY-SPECIFIC MDL/PQLS – ORGANOCHLORINE PESTICIDES IN**  
**SOIL/SEDIMENT BY METHOD 1699M**

Analyte	CASRN	Category	ALS-Kelso Sensitivity Limits (µg/kg)		Soil/Sediment CUL (µg/kg)	Focused COC RAL (µg/kg)
			MDL	PQL		
Total DDx	NA	Focused COC, RPC	NA	NA	6.1	160
<i>DDx components</i>						
2,4'-DDD	53-19-0	Focused COC, RPC	0.063	0.1	114 (total DDDs)	see Total DDx
4,4'-DDD	72-54-8	Focused COC, RPC	0.035	0.1		see Total DDx
2,4'-DDE	3424-82-6	Focused COC, RPC	0.079	0.1	50 (total DDEs)	see Total DDx
4,4'-DDE	72-55-9	Focused COC, RPC	0.070	0.1		see Total DDx
2,4'-DDT	789-02-6	Focused COC, RPC	0.094	0.1	246 (total DDTs)	see Total DDx
4,4'-DDT	50-29-3	Focused COC, RPC	0.047	0.1		see Total DDx
Aldrin	309-00-2	COC	0.079	0.1	2.0	NA – Not Focused COC
Dieldrin	60-57-1	RPC	0.011	0.05	0.07	NA – Not Focused COC
Lindane (gamma-BHC)	58-89-9	COC	0.031	0.1	5.0	NA – Not Focused COC
Total Chlordanes	NA	RPC	NA	NA	1.4	NA – Not Focused COC
<i>Chlordane components</i>						
cis-Chlordane (alpha-Chlordane)	5103-71-9	RPC	0.062	0.1	--	NA – Not Focused COC
trans-Chlordane (gamma-Chlordane)	5566-34-7	RPC	0.064	0.1	--	NA – Not Focused COC
cis-Nonachlor	5103-73-1	RPC	0.097	0.1	--	NA – Not Focused COC
trans-Nonachlor	39765-80-5	RPC	0.058	0.1	--	NA – Not Focused COC
Oxychlordane	27304-13-8	RPC	0.13	0.2	--	NA – Not Focused COC

**WORKSHEET #15.8B**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – ORGANOCHLORINE PESTICIDES IN**  
**WATER BY METHOD 1699**

Analyte	CASRN	Category	ALS-Burlington Sensitivity Limits (ng/L)		Surface Water CUL <sup>1</sup> (ng/L)
			MDL	PQL	
Aldrin	309-00-2	NA <sup>2</sup>	0.11	0.4	7.7E-4
Hexachlorobenzene	118-74-1	NA <sup>2</sup>	0.16	0.4	0.029
DDx	NA	Focused COC, RPC	NA	NA	10
<i>DDx components</i>					
2,4-DDD	53-19-0	Focused COC, RPC	0.13	0.4	0.031 (total DDDs)
4,4'-DDD	72-54-8	Focused COC, RPC	0.10	0.4	
2,4-DDE	3424-82-6	Focused COC, RPC	0.10	0.4	0.018 (total DDEs)
4,4'-DDE	72-55-9	Focused COC, RPC	0.08	0.4	
2,4-DDT	789-02-6	Focused COC, RPC	0.18	0.4	0.022 (total DDTs)
4,4'-DDT	50-29-3	Focused COC, RPC	0.05	0.4	
Chlordanes	NA	NA <sup>2</sup>	NA	NA	0.081
<i>Chlordane components</i>					
cis-Chlordane (alpha-Chlordane)	5103-71-9	NA	0.04	0.4	NA
trans-Chlordane (gamma-Chlordane)	5566-34-7	NA	0.03	0.4	NA
cis-Nonachlor	5103-73-1	NA	0.02	0.4	NA
trans-Nonachlor	39765-80-5	NA	0.20	0.4	NA
Oxychlordane	27304-13-8	NA	0.02	0.4	NA

<sup>1</sup> The ROD presents the screening levels in µg/L; the PALS in this table have been converted to ng/L (1 µg/L = 1,000 ng/L) to match the units reported by the analytical laboratory.

<sup>2</sup> Listed in Table 17 of the ROD, but not an RPC or focused COC. This compound will only be reported for analyses performed on dredge elutriate testing (DRET) extracts to evaluate the potential for contamination of surface waters during dredging operations.

ng/L = nanograms per liter

**WORKSHEET #15.8C**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – ORGANOCHLORINE PESTICIDES IN**  
**HVS EXTRACTS BY METHOD 1699**

Analyte	CASRN	Category	SGS Sensitivity Limits (pg/sample)		Soil/Sediment CUL <sup>2</sup> (µg/kg)	Focused COC RAL <sup>2</sup> (µg/kg)
			MDL <sup>1</sup>	PQL		
Total DDx	NA	Focused COC, RPC	NA	NA	6.1	160
<i>DDx components</i>						
2,4'-DDD	53-19-0	Focused COC, RPC	NA	2,000	114 (total DDDs)	see Total DDx
4,4'-DDD	72-54-8	Focused COC, RPC	NA	2,000		see Total DDx
2,4'-DDE	3424-82-6	Focused COC, RPC	NA	1,000	50 (total DDEs)	see Total DDx
4,4'-DDE	72-55-9	Focused COC, RPC	NA	1,000		see Total DDx
2,4'-DDT	789-02-6	Focused COC, RPC	NA	2,000	246 (total DDTs)	see Total DDx
4,4'-DDT	50-29-3	Focused COC, RPC	NA	2,000		see Total DDx
Dieldrin	60-57-1	COC, RPC	NA	1,000	0.07	NA – Not Focused COC

<sup>1</sup> SGS pesticides data is not reported nor assessed based on MDLs; non-detected results will be reported to the sample-specific EDL.

<sup>2</sup> CULs and RALs presented for informational purposes but are not applicable to non-site stormwater sources. The stormwater pesticides load will be calculated using the metered volume of water sampled and will be used to supplement remedial design decisions to address recontamination potential.  
 pg/sample = picograms per sample

**WORKSHEET #15.9A**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – PCDDs/PCDFs IN SOIL/SEDIMENT BY METHOD 1613B**

Analyte <sup>2</sup>	CASRN	CFA Sensitivity Limits <sup>1</sup> (pg/g)		2,3,7,8-TCDD TEF <sup>3</sup>	Soil/Sediment CUL <sup>4</sup> (pg/g)	Focused COC RAL <sup>4</sup> (pg/g)
		EDL	PQL			
2,3,7,8-TCDD	1746-01-6	0.121	1.00	1.0	0.2	0.6
1,2,3,7,8-PeCDD	40321-76-4	0.0708	5.00	1.0	0.2	0.8
1,2,3,4,7,8-HxCDD	39227-28-6	0.107	5.00	0.1	NA	NA – Not Focused COC
1,2,3,6,7,8-HxCDD	57653-85-7	0.108	5.00	0.1	NA	NA – Not Focused COC
1,2,3,7,8,9-HxCDD	19408-74-3	0.119	5.00	0.1	NA	NA – Not Focused COC
1,2,3,4,6,7,8-HpCDD	35822-46-9	0.144	5.00	0.01	NA	NA – Not Focused COC
OCDD	3268-87-9	0.253	10	0.0003	NA	NA – Not Focused COC
2,3,7,8-TCDF	51207-31-9	0.112	1.00	0.1	0.40658	600 <sup>5</sup>
1,2,3,7,8-PeCDF	57117-41-6	0.0636	5.00	0.03	NA	NA – Not Focused COC
2,3,4,7,8-PeCDF	57117-31-4	0.0607	5.00	0.3	0.3	200
1,2,3,4,7,8-HxCDF	70648-26-9	0.0673	5.00	0.1	0.4	800 <sup>5</sup>
1,2,3,6,7,8-HxCDF	57117-44-9	0.0657	5.00	0.1	NA	NA – Not Focused COC
1,2,3,7,8,9-HxCDF	72918-21-9	0.0977	5.00	0.1	NA	NA – Not Focused COC
2,3,4,6,7,8-HxCDF	60851-34-5	0.0692	5.00	0.1	NA	NA – Not Focused COC
1,2,3,4,6,7,8-HpCDF	67562-39-4	0.0790	5.00	0.01	NA	NA – Not Focused COC
1,2,3,4,7,8,9-HpCDF	55673-89-7	0.133	5.00	0.01	NA	NA – Not Focused COC
OCDF	39001-02-0	0.251	10	0.0003	NA	NA – Not Focused COC
2,3,7,8-TCDD TEQ <sup>6</sup>	NA	NA	NA	NA	10	0.6 <sup>7</sup>

<sup>1</sup> EDLs will be calculated on a sample-specific basis; the EDLs presented in this worksheet are representative of CFA analytical capabilities. CFA is in the process of integrating new standards into their calibration that will also lower the PQLs for both water and soil media and expects these lower calibrated ranges will be available before project sampling begins.

<sup>2</sup> Although only select PCDD/PCDFs are focused COCs, PTW, or RPCs, all congeners with a TEF will be reported for all samples.

<sup>3</sup> The TEF for human toxicity developed by the World Health Organization in 2005 and adopted by EPA in 2007.

<sup>4</sup> The ROD presents the screening levels in µg/kg; the PALS in this table have been converted to pg/g (1 µg/kg = 1,000 pg/g) to match the units reported by the analytical laboratory.

<sup>5</sup> PTW threshold listed in Table 21 of the ROD.

<sup>6</sup> 2,3,7,8-TCDD TEQs are calculated for each sample by multiplying the concentration of each individual congener by the associated TEF and summing across all congeners.

<sup>7</sup> ROD Table 21 does not list a soil/sediment RAL for 2,3,7,8-TCDD equivalents; the 2,3,7,8-TCDD soil/sediment RAL has been used as a proxy for 2,3,7,8-TCDD equivalents.

TEQ = toxic equivalent

**WORKSHEET #15.9B**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – PCDDs/PCDFs IN WATER BY METHOD 1613B**

Analyte <sup>1</sup>	CASRN	CFA Sensitivity Limits <sup>2</sup> (pg/L)		2,3,7,8-TCDD TEF <sup>3</sup>	Surface Water CUL <sup>4</sup> (pg/L)
		EDL	PQL		
2,3,7,8-TCDD	1746-01-6	1.0	10.0	1.0	NA
1,2,3,7,8-PeCDD	40321-76-4	5.0	50.0	1.0	NA
1,2,3,4,7,8-HxCDD	39227-28-6	5.0	50.0	0.1	NA
1,2,3,6,7,8-HxCDD	57653-85-7	5.0	50.0	0.1	NA
1,2,3,7,8,9-HxCDD	19408-74-3	5.0	50.0	0.1	NA
1,2,3,4,6,7,8-HpCDD	35822-46-9	5.0	50.0	0.01	NA
OCDD	3268-87-9	10	100	0.0003	NA
2,3,7,8-TCDF	51207-31-9	1.0	10.0	0.1	NA
1,2,3,7,8-PeCDF	57117-41-6	5.0	50.0	0.03	NA
2,3,4,7,8-PeCDF	57117-31-4	5.0	50.0	0.3	NA
1,2,3,4,7,8-HxCDF	70648-26-9	5.0	50.0	0.1	NA
1,2,3,6,7,8-HxCDF	57117-44-9	5.0	50.0	0.1	NA
1,2,3,7,8,9-HxCDF	72918-21-9	5.0	50.0	0.1	NA
2,3,4,6,7,8-HxCDF	60851-34-5	5.0	50.0	0.1	NA
1,2,3,4,6,7,8-HpCDF	67562-39-4	5.0	50.0	0.01	NA
1,2,3,4,7,8,9-HpCDF	55673-89-7	5.0	50.0	0.01	NA
OCDF	39001-02-0	10	100	0.0003	NA
2,3,7,8-TCDD TEQ <sup>5</sup>	NA	NA	NA	NA	5.1E-4

<sup>1</sup> Although only select PCDD/PCDFs are focused COCs, PTW, or RPCs, all congeners with a TEF will be reported for all samples.

<sup>2</sup> EDLs will be calculated on a sample-specific basis; the EDLs presented in this worksheet are representative of CFA analytical capabilities. CFA is in the process of integrating new standards into their calibration that will also lower the PQLs for both water and soil media and expects these lower calibrated ranges will be available before project sampling begins.

<sup>3</sup> The TEF for human toxicity developed by the World Health Organization in 2005 and adopted by EPA in 2007.

<sup>4</sup> The ROD presents the screening levels in µg/L; the PALS in this table have been converted to pg/L (1 µg/L = 1E+6 pg/L) to match the units reported by the analytical laboratory.

<sup>5</sup> 2,3,7,8-TCDD equivalents are calculated for each sample by multiplying the concentration of each individual congener by the associated TEF and summing across all congeners.

## WORKSHEET #15.9C

## PALs AND LABORATORY-SPECIFIC MDLs/PQLs – PCDDs/PCDFs IN HVS EXTRACTS BY METHOD 1613B

Analyte <sup>1</sup>	CASRN	SGS Sensitivity Limits (pg/sample)		2,3,7,8-TCDD TEF <sup>3</sup>	Soil/Sediment CUL <sup>4</sup> (pg/g)	Focused COC RAL <sup>4</sup> (pg/g)
		MDL <sup>2</sup>	PQL			
2,3,7,8-TCDD	1746-01-6	NA	10	1.0	0.2	0.6
1,2,3,7,8-PeCDD	40321-76-4	NA	50	1.0	0.2	0.8
1,2,3,4,7,8-HxCDD	39227-28-6	NA	50	0.1	NA	NA – Not Focused COC
1,2,3,6,7,8-HxCDD	57653-85-7	NA	50	0.1	NA	NA – Not Focused COC
1,2,3,7,8,9-HxCDD	19408-74-3	NA	50	0.1	NA	NA – Not Focused COC
1,2,3,4,6,7,8-HpCDD	35822-46-9	NA	50	0.01	NA	NA – Not Focused COC
OCDD	3268-87-9	NA	100	0.0003	NA	NA – Not Focused COC
2,3,7,8-TCDF	51207-31-9	NA	10	0.1	0.40658	600
1,2,3,7,8-PeCDF	57117-41-6	NA	50	0.03	NA	NA – Not Focused COC
2,3,4,7,8-PeCDF	57117-31-4	NA	50	0.3	0.3	200
1,2,3,4,7,8-HxCDF	70648-26-9	NA	50	0.1	0.4	800
1,2,3,6,7,8-HxCDF	57117-44-9	NA	50	0.1	NA	NA – Not Focused COC
1,2,3,7,8,9-HxCDF	72918-21-9	NA	50	0.1	NA	NA – Not Focused COC
2,3,4,6,7,8-HxCDF	60851-34-5	NA	50	0.1	NA	NA – Not Focused COC
1,2,3,4,6,7,8-HpCDF	67562-39-4	NA	50	0.01	NA	NA – Not Focused COC
1,2,3,4,7,8,9-HpCDF	55673-89-7	NA	50	0.01	NA	NA – Not Focused COC
OCDF	39001-02-0	NA	100	0.0003	NA	NA – Not Focused COC
2,3,7,8-TCDD TEQ <sup>5</sup>	NA	NA	NA	NA	10	0.6 <sup>6</sup>

<sup>1</sup> Although only select PCDD/PCDFs are focused COCs, PTW, or RPCs, all congeners with a TEF will be reported for all samples.

<sup>2</sup> SGS PCDD/PCDF data is not reported nor assessed based on MDLs; non-detected results will be reported to the sample-specific EDL.

<sup>3</sup> The TEF for human toxicity developed by the World Health Organization in 2005 and adopted by EPA in 2007.

<sup>4</sup> CULs and RALs presented for informational purposes but are not applicable to non-site stormwater sources. The stormwater PCDD/PCDF load will be calculated using the metered volume of water sampled and will be used to supplement RD decisions to address recontamination potential.

<sup>5</sup> 2,3,7,8-TCDD TEQs are calculated for each sample by multiplying the concentration of each individual congener by the associated TEF and summing across all congeners.

<sup>6</sup> ROD Table 21 does not list a soil/sediment RAL for 2,3,7,8-TCDD equivalents; the 2,3,7,8-TCDD soil/sediment RAL has been used as a proxy for 2,3,7,8-TCDD equivalents.

**WORKSHEET #15.10A  
 PALS AND LABORATORY-SPECIFIC MDLs/PQLs – METALS IN SOIL/SEDIMENT BY METHOD 6020B**

Analyte	CASRN	Category	ARI Sensitivity Limits (mg/kg)		Soil/Sediment CUL (mg/kg)	Focused COC RAL (mg/kg)
			MDL	PQL		
Arsenic	7440-38-2	COC, RPC	0.038	0.20	3	NA – Not Focused COC
Cadmium	7440-43-9	COC	0.04	0.10	0.51	NA – Not Focused COC
Copper	7440-50-8	COC	0.35	0.50	359	NA – Not Focused COC
Lead	7439-92-1	COC	0.052	0.10	196	NA – Not Focused COC
Zinc	7440-66-6	COC	3.17	6.0	459	NA – Not Focused COC

mg/kg = milligrams per kilogram

**WORKSHEET #15.10B  
 PALS AND LABORATORY-SPECIFIC MDLs/PQLs – METALS IN WATER BY METHOD 6020B**

Analyte	CASRN	Category	ARI Sensitivity Limits (µg/L)		Surface Water CUL (µg/L)
			MDL	PQL	
Arsenic	7440-38-2	COC	0.0373	0.20	0.018 <sup>1</sup>
Chromium	7440-47-3	COC	0.26	0.50	100
Copper	7440-50-8	COC	0.35	0.50	2.74
Zinc	7440-66-6	COC	2.92	6.0	36.5

<sup>1</sup> ARI has a Method 6020B modification that allows for a 2x or a 5x concentration of samples to improve sensitivity. However, performing this modification requires samples that do not have elevated mineral concentrations. ARI's experience with stormwater samples indicates that it is unlikely that this modification will be available, but ARI will evaluate samples that are non-detect for arsenic on a sample-specific basis to determine if concentrated analysis is practical.

**WORKSHEET #15.10C  
 PALS AND LABORATORY-SPECIFIC MDLs/PQLs – METALS IN HVS SEDIMENT BY METHOD 6020A**

Analyte	CASRN	Category	ALS-Kelso Sensitivity Limits (mg/kg)		Soil/Sediment CUL <sup>1</sup> (mg/kg)	Focused COC RAL <sup>1</sup> (mg/kg)
			MDL	PQL		
Arsenic	7440-38-2	COC, RPC	0.06	0.5	3	NA – Not Focused COC
Cadmium	7440-43-9	COC	0.007	0.02	0.51	NA – Not Focused COC
Copper	7440-50-8	COC	0.04	0.1	359	NA – Not Focused COC
Lead	7439-92-1	COC	0.02	0.05	196	NA – Not Focused COC
Zinc	7440-66-6	COC	0.2	0.5	459	NA – Not Focused COC

<sup>1</sup> CULs and RALs presented for informational purposes but are not applicable to non-site stormwater sources. The stormwater metals load will be calculated using the metered volume of water sampled and will be used to supplement RD decisions to address recontamination potential.

**WORKSHEET #15.10D  
 PALS AND LABORATORY-SPECIFIC MDLs/PQLs – METALS IN WATER BY METHOD 6020A**

Analyte	CASRN	Category	ALS-Kelso Sensitivity Limits (µg/L)		Surface Water CUL <sup>1</sup> (µg/L)
			MDL	PQL	
Arsenic	7440-38-2	COC	0.09	0.5	0.018 <sup>1</sup>
Chromium	7440-47-3	COC	0.03	0.2	100
Copper	7440-50-8	COC	0.05	0.1	2.74
Zinc	7440-66-6	COC	0.5	0.2	36.5

<sup>1</sup> CULs and RALs presented for informational purposes but are not applicable to non-site stormwater sources. The stormwater metals load will be calculated using the metered volume of water sampled and will be used to supplement RD decisions to address recontamination potential.

**WORKSHEET #15.11A**  
**PALS AND LABORATORY-SPECIFIC MDLS/PQLS – MERCURY IN SOIL/SEDIMENT BY METHOD 7471B**

Analyte	CASRN	Category	ARI Sensitivity Limits (mg/kg)		Soil/Sediment CUL (mg/kg)	Focused COC RAL (mg/kg)
			MDL	PQL		
Mercury	7439-97-6	COC, RPC	0.00525	0.025	0.085	NA – Not Focused COC

**WORKSHEET #15.11B**  
**PALS AND LABORATORY-SPECIFIC MDLS/PQLS – MERCURY IN HVS SEDIMENT BY METHOD 7471B**

Analyte	CASRN	Category	ALS-Kelso Sensitivity Limits (mg/kg)		Soil/Sediment CUL <sup>1</sup> (mg/kg)	Focused COC RAL <sup>1</sup> (mg/kg)
			MDL	PQL		
Mercury	7439-97-6	COC, RPC	0.02	0.2	0.085	NA – Not Focused COC

<sup>1</sup> CULs and RALs presented for informational purposes but are not applicable to non-site stormwater sources. The stormwater mercury load will be calculated using the metered volume of water sampled and will be used to supplement RD decisions to address recontamination potential.

**WORKSHEET #15.12**

**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – TPH-DIESEL IN SOIL/SEDIMENT BY METHOD NWTPH-Dx**

Analyte	CASRN	Category	ALS-Kelso Sensitivity Limits (mg/kg)		Soil/Sediment CUL (mg/kg)	Focused COC RAL (mg/kg)
			MDL	PQL		
Diesel range organics (C <sub>10</sub> -C <sub>25</sub> )	68334-30-5	COC, RPC	0.79	25	91	NA – Not Focused COC
Residual range organics (C <sub>25</sub> -C <sub>35</sub> )	Not available	NA <sup>1</sup>	2.9	100	--	NA – Not Focused COC

<sup>1</sup>Not a COC; data will be used to determine the presence of additional petroleum products beyond the diesel range.

**WORKSHEET #15.13A  
PALS AND LABORATORY-SPECIFIC MDLS/PQLS – TOC IN SOIL/SEDIMENT BY METHOD 9060A**

Analyte	CASRN	Category	ALS-Kelso Sensitivity Limits (%)		Soil/Sediment CUL (%)	Focused COC RAL (%)
			MDL	PQL		
TOC	7440-44-0	NA <sup>1</sup>	0.02	0.10	NA	NA – Not Focused COC

<sup>1</sup> This analyte will be reported for all solid matrix samples collected in association with focused COC/PTW or RPCs to provide supplemental data to support risk evaluation.

**WORKSHEET #15.13B  
PALS AND LABORATORY-SPECIFIC MDLS/PQLS – TOC AND DOC IN WATER BY METHOD 9060A**

Analyte	CASRN	Category	ALS-Kelso Sensitivity Limits (%)		Surface Water CUL (%)
			MDL	PQL	
DOC	7440-44-0	NA <sup>1</sup>	0.07	0.5	NA
TOC	7440-44-0	NA <sup>1</sup>	0.07	0.5	NA

<sup>1</sup> This analyte will be reported for all solid matrix samples collected in association with focused COC/PTW or RPCs to provide supplemental data to support risk evaluation.

**WORKSHEET #15.14**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – WASTE CHARACTERIZATION**  
**ANALYSES**

Method	Analyte	Regulatory Limit (mg/L)	ALS-Kelso PQL (mg/L)
<i>Analysis of Aqueous Waste and Solid Waste Extracts for Toxicity Characteristic</i>			
8260C	1,1-Dichloroethene	0.7	0.0005
	1,2-Dichloroethane	0.5	0.0005
	2-Butanone (methyl ethyl ketone)	200	0.020
	Benzene	0.5	0.0005
	Carbon tetrachloride	0.5	0.0005
	Chlorobenzene	100	0.0005
	Chloroform	6.0	0.0005
	Tetrachloroethene	0.7	0.0005
	Trichloroethene	0.5	0.0005
	Vinyl chloride	0.2	0.0005
8270D	Cresol (methylphenol)	200	0.0005 (2-methylphenol) 0.0005 (4-methylphenol)
	2,4-Dinitrotoluene	0.13	0.0002
	Hexachlorobenzene	0.13	0.0002
	Hexachlorobutadiene	0.5	0.0002
	Hexachloroethane	3.0	0.0002
	Nitrobenzene	2.0	0.0002
	Pentachlorophenol	100	0.001
	Pyridine	5.0	0.005
8081B	2,4,5-Trichlorophenol	400	0.0005
	2,4,6-Trichlorophenol	2.0	0.0005
	gamma-BHC (lindane)	0.4	0.00001
	Chlordane	0.03	0.00001 (alpha-chlordane) 0.00001 (gamma-chlordane)
	Endrin	0.02	0.00001
	Heptachlor + heptachlor epoxide	0.008	0.00001 (heptachlor) 0.00001 (heptachlor epoxide)
	Methoxychlor	10	0.00001
6020A	Toxaphene	0.5	0.0005
	Arsenic	5.0	0.0005
	Barium	100	0.00005
	Cadmium	1.0	0.00002
	Chromium	5.0	0.0002
	Lead	5.0	0.00002
	Selenium	1.0	1.0
	Silver	5.0	0.00002
7470A	Mercury	0.2	0.0002
<i>Corrosivity Characteristic</i>			
9040C	pH (aqueous)	pH <2 (acidic) or pH >12.5 (basic)	NA
9045D	pH (solid)		
<i>Ignitability Characteristic</i>			
1010A/1020A	Flash point (aqueous)	<60 °C (<140 °F)	NA
1010A	Ignitability (solid)	NA	NA

**WORKSHEET #15.14 (CONTINUED)**  
**PALS AND LABORATORY-SPECIFIC MDLs/PQLs – WASTE CHARACTERIZATION**  
**ANALYSES**

Method	Analyte	Regulatory Limit (mg/L)	ALS-Kelso PQL (mg/L)
<i>PCB Analyses to Comply with TSCA Waste Characterization Requirements</i>			
8082A	PCBs, total (aqueous)	50	0.0002 (Aroclor-1016) 0.0004 (Aroclor-1221) 0.0002 (Aroclor-1232) 0.0002 (Aroclor-1242) 0.0002 (Aroclor-1248) 0.0002 (Aroclor-1254) 0.0002 (Aroclor-1260) 0.0002 (Aroclor-1262) 0.0002 (Aroclor-1268)
	PCBs, total (soil) (in mg/kg)	50	0.0001 (Aroclor-1016) 0.0002 (Aroclor-1221) 0.0001 (Aroclor-1232) 0.0001 (Aroclor-1242) 0.0001 (Aroclor-1248) 0.0001 (Aroclor-1254) 0.0001 (Aroclor-1260) 0.0001 (Aroclor-1262) 0.0001 (Aroclor-1268)

mg/L = milligrams per liter

TSCA = Toxic Substances Control Act

**WORKSHEET #17**  
**SAMPLING DESIGN AND RATIONALE**

The sampling design and rationale is the subject of the FSP (HGL, 2021a). The design has been developed to meet the DQOs described in Worksheet #11 and includes sampling surface and subsurface soil and sediment, sediment DRET extracts, stormwater, and stormwater solids. Waste characterization samples also will be collected, as needed. Sampling methods, IDs, and location descriptions are provided in Section 4.0 of the FSP. Sample containers, preservation requirements, and hold times are outlined in Worksheet #19/#30, and sample handling and custody procedures are detailed in Worksheet #26/#27.

**WORKSHEET #18**  
**SAMPLING LOCATIONS AND METHODS/SOP REQUIREMENTS TABLES**

Sampling locations and methods/SOP requirements for the SIB PDI are presented in Section 4.0 of the FSP (HGL, 2021a). The SOPs applicable to the field sampling effort are presented in Appendix A of the FSP.

## **WORKSHEETS #19 AND #30**

### **SAMPLE CONTAINERS, PRESERVATION, AND HOLD TIMES**

The following table includes analytical methods used for the PDI field investigation; the associated SOPs are listed in Worksheet #23. Prior to sampling, the project laboratory will be provided with the list of analyses to be performed and required turnaround times. The field sampling team should work with the project laboratory to identify samples for analytical methods that can be combined in the same sampling container to optimize sampling time and reduce shipping costs and sample waste.

Holding times expressed in hours should be measured from the time of collection to the time of preparation or analysis. Holding times expressed in days should be evaluated based on number of calendar days elapsed, with the sampling date considered day “0.”

Sample locations, ID numbers, and medium-specific analyses are presented in Section 4.0 of the FSP (HGL, 2021a). Anticipated concentration levels will likely be low for identified constituents. If a sheen or odor is noted at a sample location, then the sample will be flagged on the CoC as “high” concentration.

## WORKSHEET #19 AND 30.1

### SAMPLE CONTAINERS, PRESERVATION, AND HOLD TIMES

Matrix	Parameter	Analytical and Preparation Method/SOP Reference	Containers	Preservation Requirements	Maximum Holding Time	Archive Holding Time <sup>1</sup>	Laboratory
Grab Sediment and Soil – Chemical Analyses <sup>2</sup>	SVOCs	8270D (SVM-8270L) and 3451 (EXT-3541)	4 oz glass jar	Cool $\leq 6^{\circ}\text{C}$	14 days to prepare and 40 days from extraction to analysis	Freeze to $-10^{\circ}\text{C}$ for up to 1 year	ALS-Kelso
	PAHs	8270D-SIM (SVM-8270S) and 3541 (EXT-3541)	4 oz glass jar	Cool $\leq 6^{\circ}\text{C}$	14 days to prepare and 40 days from extraction to analysis	Freeze to $-10^{\circ}\text{C}$ for up to 1 year	ALS-Kelso
	PCBs (as Aroclors)	8082A (403S) and 3546 (3304S)	4 oz glass jar	Cool $\leq 6^{\circ}\text{C}$	None for extraction; 40 days from extraction to analysis	Freeze to $-10^{\circ}\text{C}$ for up to 1 year	ARI
	PCBs (as congeners)	1668C (CF-OA-E-01 and CF-OA-E-03)	4 oz glass jar	Cool $\leq 6^{\circ}\text{C}$	1 year to prepare and 1 year from extraction to analysis	Freeze to $-10^{\circ}\text{C}$ for up to 1 year	CFA
	Organochlorine pesticides	1699M (SVM-PESTMS2) and 3541 (EXT-3541)	4 oz glass jar	Cool $\leq 6^{\circ}\text{C}$	14 days to prepare and 40 days from extraction to analysis	Freeze to $-10^{\circ}\text{C}$ for up to 1 year	ALS-Kelso
	PCDD/PCDFs	1613B (CF-OA-E-01 and CF-OA-E-02)	4 oz glass jar	Cool $\leq 6^{\circ}\text{C}$ , store in dark below $-10^{\circ}\text{C}$	1 year to prepare and 1 year from extraction to analysis	Freeze to $-10^{\circ}\text{C}$ for up to 1 year	CFA
	TPH-Diesel	NWTPH-Dx (PET-SVF) and 3550C (EXT-3550)	4 oz glass jar	Cool $\leq 6^{\circ}\text{C}$	14 days to prepare and 40 days from extraction to analysis	Freeze to $-10^{\circ}\text{C}$ for up to 1 year	ALS-Kelso
	Metals and mercury	Metals: 6020B (543S) and 3050B (509S) Mercury: 7471B (547S/532S)	4 oz glass jar	Cool $\leq 6^{\circ}\text{C}$	180 days (metals); 28 days (mercury)	Freeze to $-10^{\circ}\text{C}$ for up to 2 years (metals) or 180 days (mercury)	ARI
	Tributyltin	Laboratory-modified Krone-Unger (SOC-BUTYL/ EXT-OSWT)	4 oz glass jar	Cool $\leq 6^{\circ}\text{C}$	14 days to prepare and 40 days from extraction to analysis	Freeze to $-10^{\circ}\text{C}$ for up to 1 year	ALS-Kelso
TOC	9060A (GEN-ASTM)	4 oz glass jar	Cool $\leq 6^{\circ}\text{C}$ , store in dark below $-10^{\circ}\text{C}$	14 days to prepare and 40 days from extraction to analysis	Freeze to $-10^{\circ}\text{C}$ for up to 1 year	ALS-Kelso	

**WORKSHEET #19 AND 30.1 (CONTINUED)**  
**SAMPLE CONTAINERS, PRESERVATION, AND HOLD TIMES**

Matrix	Parameter	Analytical and Preparation Method/SOP Reference	Containers	Preservation Requirements	Maximum Holding Time	Archive Holding Time <sup>1</sup>	Laboratory	
Bulk Sediment for DRET	Grain size	ASTM D422	8 oz glass jar	Cool ≤6°C	28 days	Freeze to -10°C for up to 1 year	ALS-Kelso	
	Total solids	SM 2440G	8 oz glass jar	Cool ≤6°C	7 days	Freeze to -10°C for up to 1 year	ALS-Kelso	
	TOC	9060A (GEN-ASTM)	4 oz glass jar	Cool ≤6°C, store in dark below -10°C	14 days to prepare and 40 days from extraction to analysis	Freeze to -10°C for up to 1 year	ALS-Kelso	
	DRET	NA <sup>3</sup>		2 x 8 oz. glass jars	Cool ≤6°C	14 days (organics); 180 days (metals)	Freeze to -10°C for up to 1 year	ALS-Kelso
		1143		1 x 8 oz. glass jars	Cool ≤6°C	14 days (organics); 180 days (metals)	Freeze to -10°C for up to 1 year	ARI
		GL-GC-E-127		1 x 8 oz. glass jars	Cool ≤6°C	14 days (organics); 180 days (metals)	Freeze to -10°C for up to 1 year	GEL (for CFA)
Bulk Site Water for DRET	DRET	NA <sup>3</sup>	2 x 5-gallon cubitainers	Cool ≤6°C	7 days (organics); 180 days (metals)	NA	ALS-Kelso	
		1143	1 x 5 L cubitainer	Cool ≤6°C	7 days (organics); 180 days (metals)	NA	ARI	
		GL-GC-E-127	1 x 5 L cubitainer	Cool ≤6°C	7 days (organics); 180 days (metals)	NA	GEL (for CFA)	
DRET Extracts	VOCs	8260C (VOC-8260)	NA <sup>4</sup>	NA <sup>4</sup>	14 days	NA	ALS-Kelso	
	SVOCs	8270D (SVM-8270L) and 3510C (EXT-3510)	NA <sup>4</sup>	NA <sup>4</sup>	7 days to prepare and 40 days from extraction to analysis	NA	ALS-Kelso	
	PAHs	8270D-SIM (SVM-8270S) and 3520C (EXT-3520)	NA <sup>4</sup>	NA <sup>4</sup>	7 days to prepare and 40 days from extraction to analysis	NA	ALS-Kelso	
	PCBs (as Aroclors)	8082A (403S) and 3510C (3311S)	NA <sup>4</sup>	NA <sup>4</sup>	None for extraction; 40 days from extraction to analysis	NA	ARI	
	PCBs (as congeners)	1668C (CF-OA-E-01 and CF-OA-E-03)	NA <sup>4</sup>	NA <sup>4</sup>	1 year to prepare and 40 days from extraction to analysis	NA	CFA	

### WORKSHEET #19 AND 30.1 (CONTINUED) SAMPLE CONTAINERS, PRESERVATION, AND HOLD TIMES

Matrix	Parameter	Analytical and Preparation Method/SOP Reference	Containers	Preservation Requirements	Maximum Holding Time	Archive Holding Time <sup>1</sup>	Laboratory
DRET Extracts	Herbicides	8151A (SOC-8151)	NA <sup>4</sup>	NA <sup>4</sup>	7 days to prepare and 40 days from extraction to analysis	NA	ALS-Kelso
	Tributyltin	Laboratory-modified Krone-Unger (SOC-BUTYL/ EXT-OSWT)	NA <sup>4</sup>	NA <sup>4</sup>	7 days to prepare and 40 days from extraction to analysis	NA	ALS-Kelso
	Organochlorine pesticides	1699 (BU-TM-1103 and BU-TP-2103)	NA <sup>4</sup>	NA <sup>4</sup>	7 days to prepare and 40 days from extraction to analysis	NA	ALS-Burlington
	PCDD/PCDFs	1613B (CF-OA-E-01 and CF-OA-E-02)	NA <sup>4</sup>	NA <sup>4</sup>	30 days to prepare and 45 days from extraction to analysis	NA	CFA
	Metals	6020B (543S) and 3010A (536S)	NA <sup>4</sup>	NA <sup>4</sup>	180 days	NA	ARI
HVS Media	PUF Cartridges	SOP Ultra-trace Extraction	PUF cartridge	Cool ≤6°C	14 days to extraction	Freeze to -10°C for up to 1 year	SGS
	Filter disks	SOP Ultra-trace Extraction	Place filters in 8 oz. glass jars.	Cool ≤6°C	14 days to extraction	Freeze to -10°C for up to 1 year	SGS
PUF and Filter Extracts	PCBs (as congeners)	1668C (HRMS PCBs)	NA <sup>4</sup>	NA <sup>4</sup>	40 days from extraction to analysis	NA	SGS
	Organochlorine pesticides	1699 (HRMS OCPs)	NA <sup>4</sup>	NA <sup>4</sup>	40 days from extraction to analysis	NA	SGS
	PCDD/PCDFs	1613B (DC_364.14)	NA <sup>4</sup>	NA <sup>4</sup>	45 days from extraction to analysis	NA	SGS
HVS Bulk Samples	NA	NA	1 x 5-gallon carboy	NA	7 days to centrifuging	NA	ALS-Kelso
	Total solids	EPA 160.3 (GEN-160.3)	250 mL PE bottle	Cool ≤6°C	7 days	NA	ALS-Kelso
	TOC	9060A (GEN-TOC)	250 mL PE bottle	Cool ≤6°C; H <sub>2</sub> SO <sub>4</sub> to pH ≤2	28 days	NA	ALS-Kelso
	DOC	9060A (GEN-TOC)	<b>Collect in an unreserved bottle. Field filter (0.45 µm filter) before acid preservation.</b>			NA	ALS-Kelso
		250 mL PE bottle	Cool ≤6°C; H <sub>2</sub> SO <sub>4</sub> to pH ≤2	28 days			

**WORKSHEET #19 AND 30.1 (CONTINUED)**  
**SAMPLE CONTAINERS, PRESERVATION, AND HOLD TIMES**

Matrix	Parameter	Analytical and Preparation Method/SOP Reference	Containers	Preservation Requirements	Maximum Holding Time	Archive Holding Time <sup>1</sup>	Laboratory
Centrifuged HVS Stormwater	VOCs	8260C (VOC-8260)	NA <sup>4</sup>	NA <sup>4</sup>	14 days	NA	ALS-Kelso
	SVOCs	8270D (SVM-8270L) and 3510C (EXT-3510)	NA <sup>4</sup>	NA <sup>4</sup>	7 days to prepare and 40 days from extraction to analysis	NA	ALS-Kelso
	PAHs	8270D-SIM (SVM-8270S) and 3520C (EXT-3520)	NA <sup>4</sup>	NA <sup>4</sup>	7 days to prepare and 40 days from extraction to analysis	NA	ALS-Kelso
	Herbicides	8151A (SOC-8151)	NA <sup>4</sup>	NA <sup>4</sup>	7 days to prepare and 40 days from extraction to analysis	NA	ALS-Kelso
	Tributyltin	Laboratory-modified Krone-Unger (SOC-BUTYL/ EXT-OSWT)	NA <sup>4</sup>	NA <sup>4</sup>	7 days to prepare and 40 days from extraction to analysis	NA	ALS-Kelso
	Metals	6020A (MET-6020) and 3005A (MET-DIG)	NA <sup>4</sup>	NA <sup>4</sup>	180 days	NA	ALS-Kelso
	TSS	SM2540D (GEN-TSS)	NA <sup>4</sup>	NA <sup>4</sup>	7 days	NA	ALS-Kelso
Centrifuged HVS Sediments	SVOCs	8270D (SVM-8270L) and 3451 (EXT-3541)	NA <sup>4</sup>	NA <sup>4</sup>	14 days to prepare and 40 days from extraction to analysis	Freeze to -10°C for up to 1 year	ALS-Kelso
	PAHs	8270D-SIM (SVM-8270S) and 3541 (EXT-3541)	NA <sup>4</sup>	NA <sup>4</sup>	14 days to prepare and 40 days from extraction to analysis	Freeze to -10°C for up to 1 year	ALS-Kelso
	TPH-Diesel	NWTPH-Dx (PET-SVF) and 3550C (EXT-3550)	NA <sup>4</sup>	NA <sup>4</sup>	14 days to prepare and 40 days from extraction to analysis	Freeze to -10°C for up to 1 year	ALS-Kelso
	Metals and mercury	Metals: 6020A (Met-6020) and 3050B (MET-3050B) Mercury: 7471B (MET-7471)	NA <sup>4</sup>	NA <sup>4</sup>	180 days (metals); 28 days (mercury)	Freeze to -10°C for up to 2 years (metals) or 180 days (mercury)	ALS-Kelso
	Tributyltin	Laboratory-modified Krone-Unger (SOC-BUTYL/ EXT-OSWT)	NA <sup>4</sup>	NA <sup>4</sup>	14 days to prepare and 40 days from extraction to analysis	Freeze to -10°C for up to 1 year	ALS-Kelso
	TOC	9060A (GEN-ASTM)	NA <sup>4</sup>	NA <sup>4</sup>	28 days	Freeze to -10°C for up to 1 year	ALS-Kelso

**WORKSHEET #19 AND 30.1 (CONTINUED)**  
**SAMPLE CONTAINERS, PRESERVATION, AND HOLD TIMES**

<b>Matrix</b>	<b>Parameter</b>	<b>Analytical and Preparation Method/SOP Reference</b>	<b>Containers</b>	<b>Preservation Requirements</b>	<b>Maximum Holding Time</b>	<b>Archive Holding Time<sup>1</sup></b>	<b>Laboratory</b>
Grab Soil and Sediment – Geotechnical Tests	Grain Size (fraction <75 µm)	ASTM D1140 (O-29)	Shelby tube	None	None	None	Northwest Testing
	Total Solids/ Natural Moisture Content	ASTM D2216 (O-55)	Shelby tube	None	None	None	Northwest Testing
	Density (specimen)	ASTM D7263 (O-28)	Shelby tube	None	None	None	Northwest Testing
	Particle size (sieve)	ASTM D6913 (O-41)	Shelby tube	None	None	None	Northwest Testing
	Particle size (hydrometer)	ASTM D422 (O-23)	Shelby tube	None	None	None	Northwest Testing
	Atterberg Limits	ASTM D4318 (O-4)	Shelby tube	None	None	None	Northwest Testing
	Specific Gravity (soil solids)	ASTM D854 (O-43)	Shelby tube	None	None	None	Northwest Testing
	Direct Shear Test	ASTM D3080 (O-16)	Shelby tube	None	None	None	Northwest Testing
	Consolidated Undrained Triaxial Test with Pore Pressure	ASTM D4767 (O-47)	Shelby tube	None	None	None	Northwest Testing
	Consolidation Tests	ASTM D2435 (O-14)	Shelby tube	None	None	None	Northwest Testing
Aqueous, including field blanks	VOCs	8260C (VOC-8260)	3 x 40 mL glass, Teflon septum	Cool ≤6°C, HCl to pH ≤2	14 days	NA	ALS-Kelso
	SVOCs	8270D (SVM-8270L) and 3520C (EXT-3520)	2 x 1 L amber glass	Cool ≤6°C	7 days to prepare and 40 days from extraction to analysis	NA	ALS-Kelso
	PAHs	8270D-SIM (SVM-8270S) and 3520C (EXT-3520)	2 x 1 L amber glass	Cool ≤6°C	7 days to prepare and 40 days from extraction to analysis	NA	ALS-Kelso

**WORKSHEET #19 AND 30.1 (CONTINUED)**  
**SAMPLE CONTAINERS, PRESERVATION, AND HOLD TIMES**

Matrix	Parameter	Analytical and Preparation Method/SOP Reference	Containers	Preservation Requirements	Maximum Holding Time	Archive Holding Time <sup>1</sup>	Laboratory	
Aqueous, including field blanks (continued)	PCBs (as Aroclors)	8082A (403S) and 3510C (3311S)	2 x L amber glass	Cool ≤6°C	None for extraction; 40 days from extraction to analysis	NA	ARI	
	PCBs (as congeners)	1668C (CF-OA-E-01 and CF-OA-E-03)	2 x L amber glass	Cool ≤6°C	1 year to prepare and 40 days from extraction to analysis	NA	CFA	
	Organochlorine pesticides	1699 (BU-TM-1103 and BU-TP-2103)	2 x L amber glass	Cool ≤6°C	7 days to prepare and 40 days from extraction to analysis	NA	ALS-Burlington	
	PCDD/PCDFs	1613B (CF-OA-E-01 and CF-OA-E-02)	2 x L amber glass	Cool ≤6°C	30 days to prepare and 45 days from extraction to analysis	NA	CFA	
	Metals	Metals: 6020B (543S) and 3010A (536S)	500 mL PE bottle	HNO <sub>3</sub> to pH ≤2	180 days	NA	ARI	
	Tributyltin	Laboratory-modified Krone-Unger (SOC-BUTYL/ EXT-OSWT)	2 x L amber glass	Cool ≤6°C	7 days to prepare and 40 days from extraction to analysis	NA	ALS-Kelso	
	TOC	9060A (GEN-TOC)	250 mL PE bottle	Cool ≤6°C; H <sub>2</sub> SO <sub>4</sub> to pH ≤2	28 days	NA	ALS-Kelso	
	DOC	9060A (GEN-TOC)	<b>Collect in an unpreserved bottle. Field filter (0.45 μm filter) before acid preservation.</b>				NA	ALS-Kelso
			250 mL PE bottle	Cool ≤6°C; H <sub>2</sub> SO <sub>4</sub> to pH ≤2	28 days			
TSS	SM2540D (GEN-TSS)	1 L PE bottle	Cool ≤6°C	7 days	NA	ALS-Kelso		

**WORKSHEET #19 AND 30.1 (CONTINUED)**  
**SAMPLE CONTAINERS, PRESERVATION, AND HOLD TIMES**

Matrix	Parameter	Analytical and Preparation Method/SOP Reference	Containers	Preservation Requirements	Maximum Holding Time	Archive Holding Time <sup>1</sup>	Laboratory
Wastewater <sup>4</sup> (continued)	VOCs	8260C (VOC-8260)	3 x 40-mL glass VOA vials, Teflon septum	Cool $\leq 6^{\circ}\text{C}$ ; zero headspace; HCl to pH $\leq 2$	14 days; 7 days if unpreserved with acid	NA	ALS-Kelso
	SVOCs	8270D (SVM-8270L) and 3510C (EXT-3510)	2 x 1 L amber glass	Cool $\leq 6^{\circ}\text{C}$	7 days to prepare and 40 days from extraction to analysis	NA	ALS-Kelso
	Organochlorine pesticides	8081B (SOC-8081) and 3510C (EXT-3510)	2 x 1 L amber glass	Cool $\leq 6^{\circ}\text{C}$	7 days to prepare and 40 days from extraction to analysis	NA	ALS-Kelso
	PCBs	8082A (SOC-8082AR) and 3520C (EXT-3520)	2 x 1 L amber glass	Cool $\leq 6^{\circ}\text{C}$	None for extraction; 40 days from extraction to analysis	NA	ALS-Kelso
	Metals and mercury	Metals: 6020B (MET-6020) and 3005A (MET-DIG); Mercury: 7470A (MET-7470A)	500 mL PE bottle	$\text{HNO}_3$ to pH $\leq 2$	180 days (metals); 28 days (mercury)	NA	ALS-Kelso
	pH	9040C (GEN-PHW)	250-mL PE bottle	None	24 hours	NA	ALS-Kelso
	Flash point	1020 (GEN-1020)	250-mL amber glass	Cool $\leq 6^{\circ}\text{C}$	NA	NA	ALS-Kelso
Waste Solids <sup>2</sup>	PCBs	8082A (SOC-8082AR) and 3541 (EXT-3541)	4 oz. glass jar	Cool $\leq 6^{\circ}\text{C}$	None for extraction; 40 days from extraction to analysis	NA	ALS-Kelso
	TCLP (zero headspace extraction)	1311 (EXT-ZHE)	4 oz. glass jar, Teflon septum, zero headspace	Cool $\leq 6^{\circ}\text{C}$	14 days	NA	ALS-Kelso

### WORKSHEET #19 AND 30.1 (CONTINUED) SAMPLE CONTAINERS, PRESERVATION, AND HOLD TIMES

Matrix	Parameter	Analytical and Preparation Method/SOP Reference	Containers	Preservation Requirements	Maximum Holding Time	Archive Holding Time <sup>1</sup>	Laboratory
Waste Solids <sup>2</sup>	TCLP/Paint filter	1311 (SOP includes 9095B) (MET-TCLP)	2 x 8-oz. glass jars	Cool ≤6°C	14 days (SVOCs and pesticides); 180 days (metals); 28 days (mercury)	NA	ALS-Kelso
	Ignitability	1020 (GEN-1020)	Subsample from paint filter test jar	Cool ≤6°C	7 days	NA	ALS-Kelso
	pH	9045D (GEN-PHS)	Subsample from paint filter test jar	Cool ≤6°C	7 days	NA	ALS-Kelso
Waste solid extracts	VOCs	8260C (VOC-8260)	NA <sup>4</sup>	NA <sup>4</sup>	14 days	NA	ALS-Kelso
	SVOCs	8270D (SVM-8270L) and 3510C (EXT-3510)	NA <sup>4</sup>	NA <sup>4</sup>	7 days to prepare and 40 days from extraction to analysis	NA	ALS-Kelso
	Organochlorine pesticides	8081B (SOC-8081) and 3510C (EXT-3510)	NA <sup>4</sup>	NA <sup>4</sup>	7 days to prepare and 40 days from extraction to analysis	NA	ALS-Kelso
	Metals and mercury	6020B (MET-6020) and 7470A (MET-7470A)	NA <sup>4</sup>	NA <sup>4</sup>	180 days (metals); 28 days (mercury)	NA	ALS-Kelso

<sup>1</sup> Material to be archived includes excess sample material, containerized samples submitted but put on hold, or samples submitted as cores.

<sup>2</sup> Analysis of solid matrix samples will also include percent solids determination performed on a subsample from one of the submitted sample containers (see Worksheet #23).

<sup>3</sup> The laboratory procedure is a non-standard guidance document (see Worksheet #23).

<sup>4</sup> DRET, HVS, and TCLP extracts and material subsampled by the laboratory from bulk samples will be containerized, preserved, and stored in accordance with the laboratory's associated analytical method SOPs.

<sup>5</sup> If aqueous wastes containing an observable nonaqueous phase are encountered, the laboratory will be contacted to provide appropriate sampling protocols and containers.

HCl = hydrochloric acid

HNO<sub>3</sub> = nitric acid

L = liter

mL = milliliter

oz = ounce

PE = polyethylene

SM = standard methods for the evaluation of water and wastewater

VOA = volatile organic analysis

**WORKSHEET #19 AND 30.2**  
**PROJECT LABORATORY IDENTIFICATION**

<b>Matrix</b>	<b>Analytical SOP</b>	<b>Data Package Turnaround Time</b>	<b>Laboratory/ Organization</b>	<b>Backup Laboratory/ Organization</b>	<b>Sample Delivery Method</b>	<b>Certifications Required</b>
Sediment/Soil	Per Worksheet #19/30.1	15 business days	ALS Environmental 1317 South 13 <sup>th</sup> Avenue Kelso, WA 98626 (360) 577-7222	TBD <sup>1</sup>	Courier	NELAC (Expires 2/10/2022)
Stormwater and Aqueous QC						
Wastewater and Waste Soil						
Sediment/Soil	Per Worksheet #19/30.1	15 business days	Analytical Resources, Inc. 4611 S. 134 <sup>th</sup> Place, Suite 100 Tukwila, WA 98168-3240 (206) 695-6200	TBD <sup>1</sup>	FedEx	NELAC (Expires 5/12/2022)
Stormwater and Aqueous QC						
Sediment/Soil	Per Worksheet #19/30.1	15 business days	Cape Fear Analytical, LLC 3306 Kitty Hawk Road, Suite 120 Wilmington, NC 28405 (910) 795-0421	TBD <sup>1</sup>	FedEx	NELAC (Expires 8/31/2021; extension pending)
Stormwater and Aqueous QC						
Stormwater – PUF cartridges and filter media	Per Worksheet #19/30.1	15 business days	SGS North America, Inc. 5500 Business Dr. Wilmington, NC 28405 (910) 350-1903	TBD <sup>1</sup>	FedEx	NELAC (Expires 6/30/2022)
Sediment for DRET extraction	Per Worksheet #19/30.1	15 business days	GEL Laboratories, LLC <sup>2</sup> 2040 Savage Road Charleston, SC 29407 (843) 556-8171	TBD <sup>1</sup>	FedEx	NA
Sediment/Soil	Per Worksheet #19/30.1	15 business days	Northwest Testing, Inc. 9120 SW Pioneer Ct Wilsonville, OR 97070 (503) 682-1880	TBD	FedEx	A2LA (Expires 12/31/2022)

<sup>1</sup> Temporary backup analytical services will be requested on an as-needed basis from the listed project supporting laboratories and the associated laboratory networks. Should a project laboratory need to be replaced on a permanent basis, this will be done through HGL's contracting procedures.

<sup>2</sup> CFA is affiliated with GEL; the Charleston, SC facility of GEL will perform the DRET extraction and provide the extracts to CFA for analysis.

A2LA = American Association for Laboratory Accreditation

GEL = GEL Laboratories, LLC

NELAC = National Environmental Laboratories Accreditation Conference

## WORKSHEET #20 FIELD QC SUMMARY

Unless otherwise noted, all field and QC samples listed below will be analyzed for the complete method analyte lists for solid and aqueous samples presented in the method- and matrix-specific tables in Worksheet #15. Field duplicate pairs will be collected at a rate of approximately 1 per 20 field samples. MS/MSD pairs will be collected at a rate of approximately 1 per 20 samples. EBs will be collected at a rate of 1 per 20 samples, with a minimum of one per week per equipment type; however, if samples are collected from sampling ports, dedicated equipment, or equipment that will not be reused, EBs will not be required. The frequency of collection will apply to each sampling event. No field QC samples will be collected in association with IDW characterization sampling or other samples for which the results will receive no validation (such as the geotechnical parameters listed in Worksheet #12.10).

The identification of field QC samples will be performed using the protocols described in Section 4.7.2 of the FSP (HGL, 2021a).

Analysis	SOP Reference <sup>1</sup>	Samples <sup>2</sup>	Field Duplicates	MS/MSD	TBs	EBs	Ambient Blanks	Total QC Samples <sup>3</sup>	Total Samples to Laboratory
<i>Surface Sediment Samples</i>									
SVOCs	SVM-8270L	5	1	1 / 1	0	1	0	4	9
PAHs	SVM-8270S	5	1	1 / 1	0	1	0	4	9
PCBs as Aroclors	403S	5	1	1 / 1	0	1	0	4	9
PCBs as Congeners	CF-OA-E-003	1	1	1 / 1	0	1	0	4	5
Pesticides	SVM-PESTMS2	5	1	1 / 1	0	1	0	4	9
PCDD/PCDFs	CF-OA-E-002	5	1	1 / 1	0	1	0	4	9
TPH-Diesel	PET-SVF	5	1	1 / 1	0	1	0	4	9
Metals	543S	5	1	1 / 1	0	1	0	4	9
Mercury	547S	5	1	1 / 1	0	1	0	4	9
Tributyltin	SOC-BUTYL	5	1	1 / 1	0	1	0	4	9
TOC	GEN-ASTM	5	1	1 / 1	0	1	0	4	9
<i>Sediment Core Samples (includes surface interval at selected locations)</i>									
SVOCs	SVM-8270L	1010	51	51 / 51	0	51	0	204	1214
PAHs	SVM-8270S	1010	51	51 / 51	0	51	0	204	1214
PCBs as Aroclors	403S	1010	51	51 / 51	0	51	0	204	1214
PCBs as Congeners	CF-OA-E-003	253	13	13 / 13	0	13	0	52	305

**WORKSHEET #20 (CONTINUED)**  
**FIELD QC SUMMARY**

<b>Analysis</b>	<b>SOP Reference<sup>1</sup></b>	<b>Samples<sup>2</sup></b>	<b>Field Duplicates</b>	<b>MS/MS D</b>	<b>TBs</b>	<b>EBs</b>	<b>Ambient Blanks</b>	<b>Total QC Sample s<sup>3</sup></b>	<b>Total Samples to Laboratory</b>
Pesticides	SVM-PESTMS2	1010	51	51 / 51	0	51	0	204	1214
PCDD/PCDFs	CF-OA-E-002	1010	51	51 / 51	0	51	0	204	1214
TPH-Diesel	PET-SVF	1010	51	51 / 51	0	51	0	204	1214
Metals	543S	1010	51	51 / 51	0	51	0	204	1214
Mercury	547S	1010	51	51 / 51	0	51	0	204	1214
Tributyltin	SOC-BUTYL	1010	51	51 / 51	0	51	0	204	1214
TOC	GEN-ASTM	1010	51	51 / 51	0	51	0	204	1214
<b><i>DRET Extracts<sup>4</sup></i></b>									
VOCs	VOC-8260	3	1	1 / 1	1	1	0	5	8
SVOCs	SVM-8270L	3	1	1 / 1	0	1	0	4	7
PAHs	SVM-8270S	3	1	1 / 1	0	1	0	4	7
PCBs as Aroclors	403S	3	1	1 / 1	0	1	0	4	7
PCBs as Congeners	CF-OA-E-003	1	1	1 / 1	0	1	0	4	7
Herbicides	SOC-8151	3	1	1 / 1	0	1	0	4	7
Tributyltin	SOC-BUTYL	3	1	1 / 1	0	1	0	4	7
Pesticides	BU-TM-1103	3	1	1 / 1	0	1	0	4	7
PCDD/PCDFs	CF-OA-E-002	3	1	1 / 1	0	1	0	4	7
Metals	543S	3	1	1 / 1	0	1	0	4	7
<b><i>Surface and Shallow Core Riverbank Samples</i></b>									
SVOCs	SVM-8270L	300	15	15 / 15	0	15	0	60	360
PAHs	SVM-8270S	300	15	15 / 15	0	15	0	60	360
PCBs as Aroclors	403S	300	15	15 / 15	0	15	0	60	360
PCBs as Congeners	CF-OA-E-003	75	4	4 / 4	0	4	0	16	91
Pesticides	SVM-PESTMS2	300	15	15 / 15	0	15	0	60	360
PCDD/PCDFs	CF-OA-E-002	300	15	15 / 15	0	15	0	60	360
Tributyltin	SOC-BUTYL	300	15	15 / 15	0	15	0	60	360

**WORKSHEET #20 (CONTINUED)**  
**FIELD QC SUMMARY**

Analysis	SOP Reference <sup>1</sup>	Samples <sup>2</sup>	Field Duplicates	MS/MSD	TBs	EBs	Ambient Blanks	Total QC Samples <sup>3</sup>	Total Samples to Laboratory
Metals	543S	300	15	15 / 15	0	15	0	60	360
Mercury	547S	300	15	15 / 15	0	15	0	60	360
TPH-Diesel	PET-SVF	300	15	15 / 15	0	15	0	60	360
TOC	GEN-ASTM	300	15	15 / 15	0	15	0	60	360
<i>Stormwater Samples – HVS PUF Cartridges (totals for three events)</i>									
PCBs as Congeners	HRMS PCBs	15	0	0 / 0	0	3 <sup>(5)</sup>	3 <sup>(6)</sup>	9	24
Pesticides	HRMS OCPs	15	0	0 / 0	0	3 <sup>(5)</sup>	3 <sup>(6)</sup>	9	24
PCDD/PCDFs	DC_364	15	0	0 / 0	0	3 <sup>(5)</sup>	3 <sup>(6)</sup>	9	24
<i>Stormwater Samples – HVS Filtered Sediments (totals for three events)</i>									
PCBs as Congeners	HRMS PCBs	15	3	3 / 3	0	3	0	12	27
Pesticides	HRMS OCPs	15	3	3 / 3	0	3	0	12	27
PCDD/PCDFs	DC_364	15	3	3 / 3	0	3	0	12	27
<i>Stormwater Samples – HVS Bulk Stormwater (totals for three events)</i>									
VOCs	VOC-8260	15	3	3 / 3	3	3	0	15	30
SVOCs	SVM-8270L	15	3	3 / 3	0	3	0	12	27
PAHs	SVM-8270S	15	3	3 / 3	0	3	0	12	27
Herbicides	SOC-8151	15	3	3 / 3	0	3	0	12	27
Tributyltin	SOC-BUTYL	15	3	3 / 3	0	3	0	12	27
Metals	MET-6020	15	3	3 / 3	0	3	0	12	27
TOC	GEN-TOC	15	3	3 / 3	0	3	0	12	27
DOC	GEN-TOC	15	3	3 / 3	0	3	0	12	27
TSS	GEN-TSS	15	3	3 / 3	0	3	0	12	27

**WORKSHEET #20 (CONTINUED)**  
**FIELD QC SUMMARY**

Analysis	SOP Reference <sup>1</sup>	Samples <sup>2</sup>	Field Duplicates	MS/MSD	TBs	EBs	Ambient Blanks	Total QC Samples <sup>3</sup>	Total Samples to Laboratory
<b><i>Stormwater Samples – HVS Bulk Solids (centrifuged from bulk stormwater) (totals for three events)</i></b>									
SVOCs	SVM-8270L	15	0	3 / 3	0	0	0	3	21
PAHs	SVM-8270S	15	0	3 / 3	0	0	0	4	21
TPH-Diesel	PET-SVF	15	0	3 / 3	0	0	0	4	21
Tributyltin	SOC-BUTYL	15	0	3 / 3	0	0	0	4	21
Metals	MET-6020	15	0	3 / 3	0	0	0	4	21
Mercury	MET-7470A	15	0	3 / 3	0	0	0	4	21
TOC	GEN-ASTM	15	0	3 / 3	0	0	0	4	21
Total Solids	GEN-160.3	15	0	3 / 3	0	0	0	4	21
<b><i>Stormwater: In-Line Solids and Manual Grab Sediment Samples</i></b>									
SVOCs	SVM-8270L	33	3	3 / 3	0	1 <sup>(7)</sup>	0	10	43
PAHs	SVM-8270S	33	3	3 / 3	0	1 <sup>(7)</sup>	0	10	43
PCBs as Aroclors	403S	33	3	3 / 3	0	1 <sup>(7)</sup>	0	10	43
PCBs as Congeners	CF-OA-E-003	10	3	3 / 3	0	1 <sup>(7)</sup>	0	10	20
Pesticides	SVM-PESTMS2	33	3	3 / 3	0	1 <sup>(7)</sup>	0	10	43
PCDD/PCDFs	CF-OA-E-002	33	3	3 / 3	0	1 <sup>(7)</sup>	0	10	43
Tributyltin	SOC-BUTYL	33	3	3 / 3	0	1 <sup>(7)</sup>	0	10	43
Metals	543S	33	3	3 / 3	0	1 <sup>(7)</sup>	0	10	43
Mercury	547S	33	3	3 / 3	0	1 <sup>(7)</sup>	0	10	43
TPH-Diesel	PET-SVF	33	3	3 / 3	0	1 <sup>(7)</sup>	0	10	43
TOC	GEN-ASTM	33	3	3 / 3	0	1 <sup>(7)</sup>	0	10	43
<b><i>Stormwater: Aqueous Grab Samples (totals for three events)</i></b>									
VOCs	VOC-8260	18	3	3 / 3	3	3	0	15	33
SVOCs	SVM-8270L	18	3	3 / 3	3	3	0	15	33
PAHs	SVM-8270S	18	3	3 / 3	3	3	0	15	33
PCBs as Aroclors	403S	18	3	3 / 3	3	3	0	15	33
PCBs as Congeners	CF-OA-E-003	6	3	3 / 3	3	3	0	15	21
Herbicides	SOC-8151	18	3	3 / 3	3	3	0	15	33
Tributyltin	SOC-BUTYL	18	3	3 / 3	3	3	0	15	33

**WORKSHEET #20 (CONTINUED)**  
**FIELD QC SUMMARY**

<b>Analysis</b>	<b>SOP Reference<sup>1</sup></b>	<b>Samples<sup>2</sup></b>	<b>Field Duplicates</b>	<b>MS/MSD</b>	<b>TBs</b>	<b>EBs</b>	<b>Ambient Blanks</b>	<b>Total QC Samples<sup>3</sup></b>	<b>Total Samples to Laboratory</b>
Pesticides	BU-TM-1103	18	3	3 / 3	3	3	0	15	33
PCDD/PCDFs	CF-OA-E-002	18	3	3 / 3	3	3	0	15	33
Metals	543S	18	3	3 / 3	3	3	0	15	33
TOC	GEN-TOC	18	3	3 / 3	3	3	0	15	33
DOC	GEN-TOC	18	3	3 / 3	3	3	0	15	33
TSS	GEN-TSS	18	3	3 / 3	3	3	0	15	33

<sup>1</sup> Reference analytical method SOPs in Worksheet #23.

<sup>2</sup> Projected sample locations are shown in the FSP; the number of samples shown is the expected number and subject to change based on subsurface conditions at each location.

<sup>3</sup> The number of field QC samples will be adjusted based on the actual number of field samples collected.

<sup>4</sup> The laboratory will prepare a sample and associated QC for each soil-to-water ratio by weight selected for extraction; see FSP Section 4.2.5.

<sup>5</sup> One breakthrough sample collected per sampling event; samples will be collected using dedicated pumps and conventional EBs are not required.

<sup>6</sup> Submitted from the field as an unused PUF cartridge.

<sup>7</sup> Equipment blanks will only be collected in association with the 11 grab samples from manholes and outfalls; equipment blanks are not required in association with samples from the trap stations.

**WORKSHEET #21**  
**FIELD SOP REFERENCES TABLE**

The field SOPs that will be used by the HGL team are included in Appendix A of the FSP (HGL, 2021a) and will be available to the field sampling teams.

<b>Company</b>	<b>SOP Number</b>	<b>Title</b>	<b>Date Approved</b>
HydroGeoLogic, Inc.	300.04	Field Logbook Use and Maintenance	November 20, 2019
HydroGeoLogic, Inc.	403.02	Hand-Operated Auger Soil Sampling	August 1, 2019
HydroGeoLogic, Inc.	403.03	Soil or Sediment Sample Compositing	August 1, 2019
HydroGeoLogic, Inc.	403.04	Direct-Push Technology Soil and Groundwater Sampling	June 18, 2020
HydroGeoLogic, Inc.	403.06	Surface and Shallow Depth Soil Sampling	June 24, 2020
HydroGeoLogic, Inc.	403.07	Geologic Borehole Logging	November 20, 2019
HydroGeoLogic, Inc.	403.08	Sediment Sampling	March 25, 2020
HydroGeoLogic, Inc.	411.02	Sampling Equipment Cleaning and Decontamination	June 18, 2020
HydroGeoLogic, Inc.	411.03	Subsurface Utility Avoidance	September 29, 2020
Pacific Groundwater Group	A-1	Hydrocarbon Field Screening	2018
Pacific Groundwater Group	A-2	PID Screening and Calibration Procedures	October 2018
Pacific Groundwater Group	A-3	Sampling Photography	July 2018
Pacific Groundwater Group	A-4	Storm Drain Sampling	January 12, 2021
Gravity Marine Consulting	A-5	Gravity Marine HVS	January 15, 2021
Pacific Groundwater Group	A-6	In-Line Sediment Trap	January 12, 2021
Pacific Groundwater Group	A-7	Horizontal and Vertical Control	June 2018
Gravity Marine	SW-27	High-Volume Storm Water Sampling for Analysis of Compounds with Low Detection Limits	April 22, 2021

**WORKSHEET #22**

**FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION TABLE**

Field measurement apparatus used by subcontracted consultants, such as bathymetry, will be calibrated and maintained in accordance with their internal procedures and SOPs (see FSP Appendix A [HGL, 2021a]).

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	CA <sup>2</sup>	Responsible Person	SOP Reference <sup>3</sup>
ORP meter <sup>1</sup>	NA	NA	Single standard calibration check	NA	Daily, before sampling	Two successive reading within $\pm 10$ mV	Recalibrate instrument	Field sampling team	402.01
	Sensitivity verification	NA	NA	NA	Daily, before sampling	ORP should decrease as pH is increased	If ORP increases, correct the polarity of electrodes. If ORP still does not decrease, clean electrodes and repeat procedure.	Field sampling team	402.01
Turbidity meter <sup>1</sup>	Single standard calibration with formazin standard per instrument range used	NA	NA	NA	Daily, before sampling	$\pm 5$ units, 0–100 range; $\pm 0.5$ units, 0–20 range; $\pm 0.2$ units, 0–1 range	Recalibrate instrument	Field sampling team	402.01
Dissolved oxygen meter <sup>1</sup>	NA	NA	Function check	NA	Daily, before sampling	Meter reads $8\% \pm 2\%$	Replace instrument	Field sampling team	402.01

**WORKSHEET #22 (CONTINUED)**  
**FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION TABLE**

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	CA <sup>2</sup>	Responsible Person	SOP Reference <sup>3</sup>
Aqueous pH meter <sup>1</sup>	2-point calibration with pH buffers	NA	NA	NA	Daily, before sampling	±0.05 pH units for every buffer	If calibration is not achieved, check meter, buffer solutions, and probe; replace if necessary and repeat calibration.	Field sampling team	402.01
Conductance meter <sup>1</sup>	Calibration with potassium chloride standard	NA	NA	NA	Daily, before sampling	±5%	If calibration is not achieved, check meter, standards, probe, and recalibrate.	Field sampling team	402.01
PID	NA	NA	Calibration check with ambient air and 100 ppm isobutylene	NA	Daily, before sampling	Response within 10% of expected value	Adjust instrument settings, recheck.	Field sampling team	A-3
Flow meter	NA	NA	Flow rate check	NA	Every 15 minutes of HVS sample collection	±5% (±0.075 L/min)	Adjust flow rate to 1.5 L/min	Field sampling team	SW-27

<sup>1</sup> Direct reading from real-time probe associated with a flow-through cell.

<sup>2</sup> If CA does not solve the problem, the equipment will be removed from service and replaced until it has been repaired.

<sup>3</sup> See Worksheet #21, Field SOP References Table.

mV = millivolt

ORP = oxidation-reduction potential

ppm = parts per million

**WORKSHEET #23**  
**ANALYTICAL SOP REFERENCES TABLE**

The project analytical SOPs listed below are presented in Appendix A. Laboratory SOPs are subject to periodic review and revision and the laboratory will use the most recent SOP versions at the time of analysis.

Reference Number	Title, Revision Date, and/or Number <sup>1</sup>	Definitive or Screening Data	Instrument	Organization Performing Analysis	Modified for Project Work? <sup>2</sup>
<i>Laboratory Analytical Methods – Environmental Samples</i>					
VOC-8260	Volatile Organic Compounds by GC/MS, Revision 21.0; 10/5/2020	Screening <sup>3</sup>	GC/MS	ALS-Kelso	N
SVM-8270L	Semi-Volatile Organic Compounds by GC/MS Low Level Procedure, Revision 11.0; 12/2/2020	Screening <sup>3</sup>	GC/MS	ALS-Kelso	N
SVM-8270S	Semi-Volatile Organic Compounds by GC/MS Selective Ion Monitoring, Revision 9.0; 12/2/2020	Screening <sup>3</sup>	GC/MS	ALS-Kelso	Y <sup>4</sup>
403S	Polychlorinated Biphenyls (Aroclor) Analysis, Revision 26; 2/11/2020	Screening <sup>3</sup>	GC/ECD	ARI	N
SOC-8151	Chlorinated Herbicides, Revision 19.0; 12/2/2020	Screening <sup>3</sup>	GC/ECD	ALS-Kelso	N
SOC-BUTYL	Butyltins, Revision 16.0; 12/2/2020	Screening <sup>3</sup>	GC/FPD	ALS-Kelso	N
CF-OA-E-003	Analysis of Polychlorinated Biphenyls (PCBs) by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS), Revision 9; 3/26/2021	Screening <sup>3</sup>	HRGC/HRMS	CFA	N
HRMS PCBs	Analysis of Polychlorinated Biphenyls, Revision 17; 2/13/2020	Screening <sup>3</sup>	HRGC/HRMS	SGS	N
SVM-PESTMS2	Chlorinated Pesticides by GC/MS/MS, Revision 7.0; 4/22/2021	Screening <sup>3</sup>	GC/MS/MS	ALS-Kelso	N
BU-TM-1103	OCP Instrumental Method – HRMS, Version 9.0; 7/7/2020	Screening <sup>3</sup>	HRGC/HRMS	ALS-Burlington	N
HRMS OCPs	Analysis of Pesticides by HRGC/HRMS, Revision 11; 2/12/2020	Screening <sup>3</sup>	HRGC/HRMS	SGS	N
CF-OA-E-002	Analysis of Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans (PCDDS/PCDFs) by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS), Revision 20; 3/26/2021	Screening <sup>3</sup>	HRGC/HRMS	CFA	N
Dioxin/Furan	Analysis of Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans, Revision 14; 1/8/2021	Screening <sup>3</sup>	HRGC/HRMS	SGS	N
543S	Metals Analysis – NexIon ICP-MS, Version 004.1; 6/1/2020	Screening <sup>3</sup>	ICP-MS	ARI	N
547S	Mercury Cold Vapor Analysis, Version 001; 3/27/2019	Screening <sup>3</sup>	CVAA	ARI	N
MET-6020	Determination of Metals and Trace Elements by Inductively Coupled Plasma-Mass Spectrometry, Revision 19.0; 12/2/2020	Screening <sup>3</sup>	ICP-MS	ALS-Kelso	N
MET-7470	Mercury in Liquid Waste, Revision 20.0; 2/5/2021	Screening <sup>3</sup>	CVAA	ALS-Kelso	N
MET-7471	Mercury in Solid and Semi-Solid Waste, Revision 21.0; 12/4/2020	Screening <sup>3</sup>	CVAA	ALS-Kelso	N

**WORKSHEET #23 (CONTINUED)**  
**ANALYTICAL SOP REFERENCES TABLE**

Reference Number	Title, Revision Date, and/or Number <sup>1</sup>	Definitive or Screening Data	Instrument	Organization Performing Analysis	Modified for Project Work? <sup>2</sup>
PET-SVF	Analysis of Water, Solids, and Soluble Waste Samples for Semi-Volatile Fuel Hydrocarbons, Revision 17.0; 12/2/2020	Screening <sup>3</sup>	GC/FID	ALS-Kelso	N
GEN-ASTM	Total Carbon in Soil, Revision 14.0; 10/30/2020	Screening <sup>3</sup>	Carbonaceous analyzer/infrared detector	ALS-Kelso	N
GEN-TOC	Total and Dissolved Organic Carbon (TOC, DOC), Total Inorganic Carbon (TIC), and Total Carbon (TC) in Water	Screening <sup>3</sup>	Carbonaceous analyzer/infrared detector	ALS-Kelso	N
<b>Other Laboratory Methods – Environmental Samples</b>					
GEN-TSS	Solids, Total Suspended (TSS), Revision 14.0; 6/10/2019	Screening	Gravimetric	ALS-Kelso	N
SOIL-SOLIDS	Total, Fixed, and Volatile Solids in Solid and Semisolid Samples, Revision 2.0; 1/22/2021	Screening	Gravimetric	ALS-Kelso	N
GEN-160.3	Total Solids, Revision 16.0; 7/20/2020	Screening	Gravimetric	ALS-Kelso	N
1023S	Total Solids, Version 003; 9/23/2020	Screening	Gravimetric	ARI	N
CF-OA-E-020	Percent Moisture, Revision 6; 8/19/2019	Screening	Gravimetric	CFA	N
<b>Laboratory Analytical Methods – IDW Samples</b>					
VOC-8260	Volatile Organic Compounds by GC/MS, Revision 21.0; 10/5/2020	Screening <sup>5</sup>	GC/MS	ALS-Kelso	N
SVM-8270L	Semi-Volatile Organic Compounds by GC/MS Low Level Procedure, Revision 11.0; 12/2/2020	Screening <sup>5</sup>	GC/MS	ALS-Kelso	N
SOC-8081	Organochlorine Pesticides by Gas Chromatography, Revision 22.0; 2/18/2021	Screening <sup>5</sup>	GC/ECD	ALS-Kelso	N
SOC-8082AR	PCBs as Aroclors, Revision 20.0; 12/2/2020	Screening <sup>5</sup>	GC/ECD	ALS-Kelso	N
MET-6020	Determination of Metals and Trace Elements by Inductively Coupled Plasma-Mass Spectrometry, Revision 19.0; 12/2/2020	Screening <sup>5</sup>	ICP-MS	ALS-Kelso	N
MET-7470A	Mercury in Liquid Waste, Revision 20.0; 2/5/2021	Screening <sup>5</sup>	CVAA	ALS-Kelso	N
GEN-PHW	PH in Water, Revision 17.0; 2/18/2021	Screening	pH Probe	ALS-Kelso	N
GEN-PHS	PH in Soil, Revision 17.0; 2/17/2021	Screening	pH Probe	ALS-Kelso	N
GEN-1020	Flashpoint Determination – Setaflash, Revision 10.0; 2/10/2019	Screening	Seta Flash Closed Sup Tester	ALS-Kelso	N
SOIL-SOLIDS	Total, Fixed, and Volatile Solids in Solid and Semisolid Samples, Revision 2.0; 1/22/2021	Screening	Gravimetric	ALS-Kelso	N
<b>Laboratory Preparation Methods</b>					
NA	Non-Standard Testing Procedure Summary for Elutriate Preparations, Revision 2; 3/23/2020	Sediment extraction	NA	ALS-Kelso	Y <sup>6</sup>
1143	Effluent Elutriate Test, Revision 001; 9/20/2021 (draft in review)	Sediment extraction	NA	ARI	Y <sup>6</sup>

**WORKSHEET #23 (CONTINUED)**  
**ANALYTICAL SOP REFERENCES TABLE**

<b>Reference Number</b>	<b>Title, Revision Date, and/or Number<sup>1</sup></b>	<b>Definitive or Screening Data</b>	<b>Instrument</b>	<b>Organization Performing Analysis</b>	<b>Modified for Project Work?<sup>2</sup></b>
GL-GC-E-127	Modified Elutriate Test, Revision 7; July 2018	Sediment extraction	NA	GEL	Y <sup>6</sup>
MET-TCLP <sup>7</sup>	Metals and Semi-volatiles TCLP Extraction, Revision 11.0; 2/9/2021	Waste Extraction	NA	ALS-Kelso	N
EXT-ZHE	Zero Headspace Extraction (EPA Method 1311), Revision 1.0; 2/12/2021	Waste Extraction	NA	ALS-Kelso	N
EXT-3510	Separatory Funnel Liquid-Liquid Extraction, Revision 14.0; 11/30/2020	Preparation	NA	ALS-Kelso	N
EXT-3520	Continuous Liquid-Liquid Extraction, Revision 19.0; 11/30/2020	Preparation	NA	ALS-Kelso	N
EXT-3535	Solid Phase Extraction, Revision 8.0; 10/25/2019	Preparation	NA	ALS-Kelso	N
EXT-3541	Automated Soxhlet Extraction, Revision 13.0; 11/30/2020	Preparation	NA	ALS-Kelso	N
EXT-3550	Ultrasonic Extraction, Revision 15.0; 2/11/2021	Preparation	NA	ALS-Kelso	N
MET-DIG	Metals Digestion of Aqueous Samples, Revision 20.0; 13/4/2020	Preparation	NA	ALS-Kelso	N
MET-3050B	Metals Digestion, Revision 18.0; 12/4/2020	Preparation	NA	ALS-Kelso	N
EXT-OSWT	Extraction Method for Organotins in Sediment, Water and Tissue, Revision 12.0; 11/30/2020	Preparation	NA	ALS-Kelso	N
BU-TP-2103	OCP & Toxaphene Prep, version 6; 10/5//2018	Preparation	NA	ALS-Burlington	N
3304S	Extraction of Soil/Sediment Samples Using Sonication or Microwave (MARS), Revision 6.2; 10/26/2020	Preparation	NA	ARI	Y – use Method 3546
Ultra-trace Extraction	Extraction of Various Matrices, Revision 6; 6/2/2020	Preparation	NA	SGS	N
3311S	Extraction of Aqueous Samples using Separatory Funnel or Continuous Liquid-Liquid Extraction, Revision 004.4; 2/12/2020	Preparation	NA	ARI	Y – use Method 3510C
3327S	Shared Task Instructions for Water Soil/Sed and Tissues Using SOPs 3304S, 3311S or 3328S, Revision 3.1; 10/23/2019	Cleanup	NA	ARI	N
CF-OA-E-001	Dioxin/Furan/PCB Congener Sample Processing, Revision 25; 6/17/2020	Preparation	NA	CFA	N
509S	Metals Sample Preparation Method 3050B (SWN), Version 011.1; 2/22/2017	Preparation	NA	ARI	N
536S	Metals Sample Preparation Method 200.8 / 3010A, Version 007.1; 2/23/2017	Preparation	NA	ARI	N
532S	Metals Sample Preparation Mercury EPA Method 7471B, Version 008.1; 2/23/2017	Preparation	NA	ARI	N

**WORKSHEET #23 (CONTINUED)**  
**ANALYTICAL SOP REFERENCES TABLE**

Reference Number	Title, Revision Date, and/or Number <sup>1</sup>	Definitive or Screening Data	Instrument	Organization Performing Analysis	Modified for Project Work? <sup>2</sup>
<i>Geotechnical Tests</i>					
O-29	Amount of Material in Soils Finer than the No. 200 Sieve; 1/7/2016	Screening	NA	Northwest Testing	N
O-55	Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass; 9/18/2020	Screening	NA	Northwest Testing	N
O-28	Moisture Content and In Place by Drive Cylinder; 5/27/2016	Screening	NA	Northwest Testing	N
O-41	Sieve Analysis and Material Finer than No. 200 Sieve Washing; 5/24/2012	Screening	NA	Northwest Testing	N
O-23	Standard Test Method for Particle Size Analysis of Soils; 2/12/2012	Screening	NA	Northwest Testing	N
O-4	Atterberg Limits; 3/17/2020	Screening	NA	Northwest Testing	N
O-43	Specific Gravity of Soils; 1/15/2003	Screening	NA	Northwest Testing	N
O-16	Direct Shear Test of Soils Under Consolidated Drained Conditions; 10/6/2010	Screening	NA	Northwest Testing	N
O-47	Triaxial Testing Consolidation Data; 5/31/2012	Screening	NA	Northwest Testing	N
O-14	One-Dimensional Consolidation Properties of Soils; 5/28/2015	Screening	NA	Northwest Testing	N

<sup>1</sup> SOPs are reviewed/revised annually. The current version will be followed at the time of sample receipt.

<sup>2</sup> If method modifications are required to support project work, these modifications must be noted and a full description of the modification, including detailed instructions for field and laboratory personnel, must accompany the SOPs included in Appendix A.

<sup>3</sup> Data validated to EPA Stage 2A will be of screening data quality; 10% of results will be validated to Stage 4 and will be considered to be of definitive data quality (see Worksheet #11 Section 11.6, Worksheet #12 Section 12.3, and Worksheet #36).

<sup>4</sup> The laboratory will use the SOP modifications required to achieve the sensitivity limits presented in Worksheet #15.3a and #15.3b.

<sup>5</sup> Although this method can produce definitive data; when used for IDW characterization, screening level data will be sufficient to meet project DQOs.

<sup>6</sup> Project-specific soil mass to water ratios will be selected based on the ratios expected during dredging activities.

<sup>7</sup> This SOP also includes procedures for performing the paint filter test (Method 9095B).

## WORKSHEET #24 ANALYTICAL INSTRUMENT CALIBRATION TABLE

The CA required in this worksheet will be the responsibility of the bench analysts and the laboratory section manager responsible for each method. Calibration results that are outside the control criteria should trigger CA, unless the discrepancy introduces a potential high bias and associated results are non-detections. Where an instrumental problem cannot be resolved by CA/routine maintenance, the affected instrument must be removed from service. Following necessary repairs, the instrument will be recalibrated and determined to be fully functional before being cleared for return to service.

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria <sup>1</sup>	CA	SOP Reference <sup>2</sup>
GC/MS and GC/MS-SIM	Instrument tuning with 4-bromofluorobenzene	Prior to ICAL; every 12 hours of instrument operation	Ion peaks meet method requirements	1) <b>Halt analytical sequence</b> 2) Evaluate system 3) Retune and recalibrate as necessary	VOC-8260
	Instrument tuning with DFTPP	Prior to ICAL; every 12 hours of instrument operation	Ion peaks meet method requirements	1) <b>Halt analytical sequence</b> 2) Evaluate system 3) Retune and recalibrate as necessary	SVM-8270L
			DDT breakdown $\leq 20\%$ Benzidine and pentachlorophenol tailing factor $\leq 2$ .		
	Instrument tuning with DFTPP	Prior to ICAL; every 12 hours of instrument operation	Ion peaks meet method requirements Pentachlorophenol tailing factor $\leq 2$ .	1) <b>Halt analytical sequence</b> 2) Evaluate system 3) Retune and recalibrate as necessary	SVM-8270S
	Five-point ICAL for target analytes (six points required for quadratic); lowest concentration standard at or below the PQL.	ICAL prior to sample analysis	Each analyte must meet one of the three options below: Option 1: %RSD for each analyte $\leq 20\%$ ; Option 2: linear least squares regression for each analyte: $r^2 \geq 0.99$ ; Option 3: non-linear least squares regression (quadratic) for each analyte: $r^2 \geq 0.99$ .	1) Evaluate system 2) Recalibrate as necessary	VOC-8260 SVM-8270L SVM-8270S

**WORKSHEET #24 (CONTINUED)**  
**ANALYTICAL INSTRUMENT CALIBRATION TABLE**

<b>Instrument</b>	<b>Calibration Procedure</b>	<b>Frequency of Calibration</b>	<b>Acceptance Criteria<sup>1</sup></b>	<b>CA</b>	<b>SOP Reference<sup>2</sup></b>
GC/MS and GC/MS-SIM (continued)			If option 2 or 3 is used, the re-quantification of the low-level standard should be within $\pm 30\%$ of the true value.		
			Method-defined minimum mean RRF requirements met for each analyte	1) Evaluate system 2) Recalibrate as necessary	VOC-8260 SVM-8270L SVM-8270S
	ICV (must be from a second source)	Following ICAL	%R = 70 to 130%	1) Evaluate system 2) Recalibrate as necessary	VOC-8260 SVM-8270L SVM-8270S
	CCV	Every 12 hours, after instrument tune	RRT within $\pm 0.06$ RRT units for each analyte and surrogate (it is acceptable to update RRT windows using the CCV)  Reported analytes and surrogates within $\pm 20\%$ of true value.  Internal standard retention time within $\pm 30$ seconds and peak area within 50 to 200% of retention time and peak area in the midpoint standard of the corresponding ICAL	1) Evaluate system 2) Clean system 3) Recalibrate, if necessary 4) Reanalyze affected samples since the last in-control CCV	VOC-8260 SVM-8270L SVM-8270S
			Target analyte method defined minimum RRF requirement met	1) Evaluate system 2) Recalibrate, if necessary 3) Reanalyze affected samples since the last in-control CCV	VOC-8260 SVM-8270L SVM-8270S
GC/ECD	Five-point ICAL for Aroclors 1016 and 1260 (six points required for curve)	ICAL prior to sample analysis	For each Aroclor: Mean %RSD of absolute value of calibration factors for each peak $\leq 20\%$ or $r^2 \geq 0.99$ for each peak (surrogates only)	1) Evaluate system 2) Recalibrate as necessary	403S

**WORKSHEET #24 (CONTINUED)**  
**ANALYTICAL INSTRUMENT CALIBRATION TABLE**

<b>Instrument</b>	<b>Calibration Procedure</b>	<b>Frequency of Calibration</b>	<b>Acceptance Criteria<sup>1</sup></b>	<b>CA</b>	<b>SOP Reference<sup>2</sup></b>
GC/ECD (continued)	ICV (must be from a second source)	Following ICAL	%R = 80 to 120%	1) Evaluate system 2) Recalibrate as necessary	403S
	Retention time verification	Update at start of run or daily	Standards within retention time window	1) Correct problem 2) Reanalyze samples analyzed since the last retention time check	403S
	CCV	Before sample analysis, after every 10 samples, and at the end of the analysis sequence	For each Aroclor: mean of absolute values of each peak %D ≤20%	1) Evaluate system 2) Clean system 3) Reanalyze affected samples since the last in-control CCV	403S
	Five-point initial calibration for target analytes (six points required for quadratic); lowest concentration standard at or below the PQL.	Initial calibration prior to sample analysis	Each analyte %RSD for each analyte ≤20%; Option 2: linear least squares regression for each analyte: $r^2 \geq 0.99$ ; Option 3: non-linear least squares regression (quadratic) for each analyte: $r^2 \geq 0.99$ .	1) Evaluate system 2) Recalibrate as necessary	SOC-8151
	ICV (must be from a second source)	Following ICAL	%R = 80 to 120%	1) Evaluate system 2) Recalibrate as necessary	SOC-8151
	Retention time verification	Update at start of run or daily	Standards within retention time window	1) Correct problem 2) Reanalyze samples analyzed since the last retention time check	SOC-8151
	CCV	Before sample analysis, after every 10 samples, and at the end of the analysis sequence	%R = 80 to 120%	1) Evaluate system 2) Clean system 3) Reanalyze affected samples since the last in-control CCV	SOC-8151

**WORKSHEET #24 (CONTINUED)**  
**ANALYTICAL INSTRUMENT CALIBRATION TABLE**

<b>Instrument</b>	<b>Calibration Procedure</b>	<b>Frequency of Calibration</b>	<b>Acceptance Criteria<sup>1</sup></b>	<b>CA</b>	<b>SOP Reference<sup>2</sup></b>
GC/FPD	Five-point initial calibration for target analytes (six points required for quadratic); lowest concentration standard at or below the PQL.	Initial calibration prior to sample analysis	Each analyte %RSD for each analyte $\leq 25\%$ ; Option 2: linear least squares regression for each analyte: $r^2 \geq 0.99$ ; Option 3: non-linear least squares regression (quadratic) for each analyte: $r^2 \geq 0.99$ .	1) Evaluate system 2) Recalibrate as necessary	SOC-BUTYL
			If option 2 or 3 is used, the requantification of the low-level standard should be within $\pm 30\%$ of the true value.		
	ICV (must be from a second source)	Following ICAL	%R = 75 to 125%	1) Evaluate system 2) Recalibrate as necessary	SOC-BUTYL
	CCV	Before sample analysis, after every 10 samples, and at the end of the analysis sequence	%R = 75 to 125%	1) Evaluate system 2) Clean system 3) Reanalyze affected samples since the last in-control CCV	SOC-BUTYL
	Retention time verification	Each CCV	Standards within retention time window	1) Correct problem 2) Reanalyze samples analyzed since the last retention time check	SOC-BUTYL
HRGC/HRMS	Resolution check with perfluorokerosene	Prior to calibration; at the beginning and the end of each 12-hour period of analysis	Resolving power $\geq 10,000$ for high-mass peak m/z 380.9760 using low-mass peak 304.9824 as reference	1) <b>Halt analytical sequence</b> 2) Evaluate system 3) Retune and recalibrate as necessary	CF-OA-E-003
			Peak width for m/z 380.9760 $\leq 100$ ppm at 5% peak maximum		
			Tune instrument to resolving power of at least 10,000 at m/z 330.9792		

**WORKSHEET #24 (CONTINUED)**  
**ANALYTICAL INSTRUMENT CALIBRATION TABLE**

<b>Instrument</b>	<b>Calibration Procedure</b>	<b>Frequency of Calibration</b>	<b>Acceptance Criteria<sup>1</sup></b>	<b>CA</b>	<b>SOP Reference<sup>2</sup></b>
HRGC/HRMS (continued)	GC column performance check	At the beginning of each 12-hour sequence	Chromatographic separation between congeners 34-TrCB and 23-TrCB, and between congeners 187-HxCB and 182-HxCB <40%  156-HxCB and 157-HxCB must co-elute within 2 seconds	1) <b>Halt analytical sequence</b> 2) Evaluate system 3) Retune and recalibrate as necessary	CF-OA-E-003
	Five-point ICAL for target analytes (six points required for curve)	Initially; thereafter, as the continuing calibration fails	%RSD ≤20% for each analyte and labeled standard  Ion abundance ratios in accordance with criteria in Table 8 of Method 1668C; and S/N ≥15 for target analyte ions	1) Evaluate system 2) Recalibrate as necessary	CF-OA-E-003
	CCV	Every 12 hours, after instrument tune	%R = 75 to 125% (target PCBs); %R = 50 to 145% (extraction standards); %R = 75 to 125% (cleanup standards 111L and 178L); %R = 65 to 135% (cleanup standard 28L)	1) Evaluate system 2) Clean system 3) Reanalyze affected samples since the last in-control CCV	CF-OA-E-003
HRGC/HRMS	Resolution check with perfluorokerosene	Prior to calibration; at the beginning and the end of each 12-hour period of analysis	Resolving power ≥10,000 for high-mass peak m/z 380.9760 using low-mass peak 304.9824 as reference	1) <b>Halt analytical sequence</b> 2) Evaluate system 3) Retune and recalibrate as necessary	HRMS PCBs
	Five-point ICAL for target analytes (six points required for curve)	Initially; thereafter, as the continuing calibration fails	%RSD ≤20% for each analyte and labeled standard  Ion abundance ratios within 15% of theoretical ratio and S/N ≥10:1 for target analyte ions	1) Evaluate system 2) Recalibrate as necessary	HRMS PCBs

**WORKSHEET #24 (CONTINUED)**  
**ANALYTICAL INSTRUMENT CALIBRATION TABLE**

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria <sup>1</sup>	CA	SOP Reference <sup>2</sup>
HRGC/HRMS (continued)	ICV/CCV	ICV: After ICAL CCV: Every 12 hours, after instrument tune	%R = 75 to 125% (target PCBs); %R = 50 to 145% (extraction standards); %R = 75 to 125% (cleanup standards 111L and 178L); %R = 65 to 135% (cleanup standard 28L)  First and last PCB eluters within homologue retention time windows; ion abundance ratios within 15% of theoretical ratio; and S/N ≥10:1 for target analyte ions	1) Evaluate system 2) Recalibrate as necessary	HRMS PCBs
	Ending (Back) CCV	At end of each 12-hour sequence	RPD ≤20% from opening CCV for unlabeled compounds (≤30% for labeled compounds)	1) Evaluate system 2) Recalibrate as necessary	HRMS PCBs
GC/MS/MS	Instrument tuning with DFTPP	Prior to ICAL; every 12 hours of instrument operation	Ion peak ratios meet acceptance requirements for monitored m/z ion transitions: 442→198 = 1.000 (base transition) 443→198 = 4.557-11.374 198→110 = 1.380-3.834 255→186 = 1.545-5.505 127→77 = 10.211-34.819	1) <b>Halt analytical sequence</b> 2) Evaluate system 3) Retune and recalibrate as necessary	PESTMS2

**WORKSHEET #24 (CONTINUED)**  
**ANALYTICAL INSTRUMENT CALIBRATION TABLE**

<b>Instrument</b>	<b>Calibration Procedure</b>	<b>Frequency of Calibration</b>	<b>Acceptance Criteria<sup>1</sup></b>	<b>CA</b>	<b>SOP Reference<sup>2</sup></b>
GC/MS/MS (continued)	DDT-endrin breakdown check	Prior to ICAL; every 12 hours of instrument operation	DDT degradation $\leq 20\%$ Endrin degradation $\leq 20\%$	1) <b>Halt analytical sequence</b> 2) Evaluate system 3) Retune and recalibrate as necessary	PESTMS2
	Five-point ICAL for target analytes (six points required for quadratic); lowest concentration standard at or below the PQL.	ICAL prior to sample analysis	Each analyte %RSD for each analyte $\leq 20\%$ ; Option 2: linear least squares regression for each analyte: $r^2 \geq 0.99$ ; Option 3: non-linear least squares regression (quadratic) for each analyte: $r^2 \geq 0.99$ .  RRF $\geq 0.01$ for all target analytes and labeled standards	1) Evaluate system 2) Recalibrate as necessary	PESTMS2
			If option 2 or 3 is used, the re-quantification of the low-level standard should be within $\pm 30\%$ of the true value.		
	ICV (must be from a second source)	Following ICAL	%R = 75 to 125%	1) Evaluate system 2) Recalibrate as necessary	PESTMS2
CCV	Every 12 hours of instrument operation	%R = 75 to 125%  Internal standard <sup>13</sup> C <sub>12</sub> -PCB-52: Retention time within $\pm 30$ seconds and peak area within 50 to 200% of retention time and peak area in the midpoint standard of the corresponding ICAL	1) Evaluate system 2) Clean system 3) Recalibrate, if necessary 4) Reanalyze affected samples since the last in-control CCV	PESTMS2	

**WORKSHEET #24 (CONTINUED)**  
**ANALYTICAL INSTRUMENT CALIBRATION TABLE**

<b>Instrument</b>	<b>Calibration Procedure</b>	<b>Frequency of Calibration</b>	<b>Acceptance Criteria<sup>1</sup></b>	<b>CA</b>	<b>SOP Reference<sup>2</sup></b>
HRGC/HRMS	Resolution check with perfluorokerosene	Prior to calibration; at the beginning and the end of each shift	Resolving power $\geq 8,000$ throughout the mass range	1) <b>Halt analytical sequence</b> 2) Evaluate system 3) Retune and recalibrate as necessary	BU-TM-1103
	GC column performance check	Prior to calibration; every 12 hours	Valley height between 4,4'-DDD and 2,4'-DDT <60% of shorter peak	1) <b>Halt analytical sequence</b> 2) Service or replace column	BU-TM-1103
	Detection limit check	Prior to calibration	Beginning of each ICAL	1) Evaluate system 2) Clean system	BU-TM-1103
	Five-point ICAL for target analytes (six points required for curve)	Initially; thereafter, as needed to re-establish calibration control or after major maintenance	%RSD $\leq 20\%$ for each analyte with a labeled analogue  %RSD $\leq 35\%$ for each analyte without a labeled analogue	1) Evaluate system 2) Recalibrate as necessary	BU-TM-1103
	ICV	After each ICAL	%R = 75 to 125% (70 to 130% for labelled standards)	1) Evaluate system 2) Recalibrate as necessary	BU-TM-1103
	CCV	Every 12 hours, after instrument tune	<ul style="list-style-type: none"> <li>• %R = 75 to 125% (70 to 130% for labelled standards)</li> <li>• Retention time of each analyte <math>\pm 15</math> sec of that in the initial calibration</li> <li>• All target S/N <math>\geq 10:1</math></li> <li>• Ion ratio <math>\pm 25\%</math> of theoretical ratio for each analyte and labeled standard</li> </ul>	1) Evaluate system 2) Clean system 3) Reanalyze affected samples since the last in-control CCV	BU-TM-1103
	Breakdown standard	Every 12 hours, after CCV	Endrin and DDT breakdown <20%	1) Evaluate system 2) Clean system 3) Reanalyze affected samples since the last in-control standard	BU-TM-1103

**WORKSHEET #24 (CONTINUED)**  
**ANALYTICAL INSTRUMENT CALIBRATION TABLE**

<b>Instrument</b>	<b>Calibration Procedure</b>	<b>Frequency of Calibration</b>	<b>Acceptance Criteria<sup>1</sup></b>	<b>CA</b>	<b>SOP Reference<sup>2</sup></b>
HRGC/HRMS	Resolution check with perfluorokerosene	Prior to calibration; at the beginning and the end of each shift	Resolving power $\geq 8,000$ at reference signals close to m/z ratios of interest	1) <b>Halt analytical sequence</b> 2) Evaluate system 3) Retune and recalibrate as necessary	HRMS OCPs
	Five-point ICAL for target analytes (six points required for curve)	Initially; thereafter, as needed to re-establish calibration control or after major maintenance	<ul style="list-style-type: none"> <li>• %RSD <math>\leq 20\%</math> for each analyte and <math>\leq 50\%</math> for extraction standards</li> <li>• All target S/N <math>\geq 10:1</math></li> <li>• Ion ratio <math>\pm 2\%</math> of theoretical ratio for each analyte and labeled standard</li> </ul>	1) Evaluate system 2) Recalibrate as necessary	HRMS OCPs
	CCV	Every 12 hours, after instrument tune	<ul style="list-style-type: none"> <li>• %R = 70-130% (25-175% for extraction standards)</li> <li>• First and last eluters within homologue retention time windows</li> <li>• All target S/N <math>\geq 10:1</math></li> <li>• Ion ratio <math>\pm 20\%</math> of theoretical ratio for each analyte and labeled standard</li> </ul>	1) Evaluate system 2) Clean system 3) Reanalyze affected samples since the last in-control CCV	HRMS OCPs
	Breakdown standard	Every 12 hours, after CCV	DDT breakdown $< 20\%$	1) Evaluate system 2) Clean system 3) Reanalyze affected samples since the last in-control standard	HRMS OCPs

**WORKSHEET #24 (CONTINUED)**  
**ANALYTICAL INSTRUMENT CALIBRATION TABLE**

<b>Instrument</b>	<b>Calibration Procedure</b>	<b>Frequency of Calibration</b>	<b>Acceptance Criteria<sup>1</sup></b>	<b>CA</b>	<b>SOP Reference<sup>2</sup></b>
HRGC/HRMS	Resolution check with perfluorokerosene	Prior to calibration; at the beginning and the end of each 12-hour period of analysis	Resolving power $\geq 10,000$ for high-mass peak m/z 380.9760 using low-mass peak 304.9824 as reference  Peak width for m/z 380.9760 $\leq 100$ ppm at 5% peak maximum	1) <b>Halt analytical sequence</b> 2) Evaluate system 3) Retune and recalibrate as necessary	CF-OA-E-002
	GC column performance check	At the beginning and end of each 12-hour sequence	Chromatographic separation between 2,3,7,8-TCDD and unlabeled TCDD congeners resolved $\leq 25\%$	1) <b>Halt analytical sequence</b> 2) Evaluate system 3) Retune and recalibrate as necessary	CF-OA-E-002
			Chromatographic separation between 2,3,7,8-TCDF and unlabeled TCDF congeners resolved $\leq 25\%$ in confirmatory system		
			Absolute retention time of $^{13}\text{C}_{12}$ -1,2,3,4-TCDD must exceed 25.0 minutes on the primary GC column in use, and 15.0 minutes on the confirmatory GC column		
Five-point ICAL for target analytes (six points required for curve)	Initially; thereafter, as the continuing calibration fails	%RSD $\leq 20\%$ for each analyte; %RSD $\leq 35\%$ for each labeled standard  Ion abundance ratios in accordance with criteria in Table 9 of Method 1613B; and S/N $\geq 15$ for target analyte ions	1) Evaluate system 2) Recalibrate as necessary	CF-OA-E-002	

**WORKSHEET #24 (CONTINUED)**  
**ANALYTICAL INSTRUMENT CALIBRATION TABLE**

<b>Instrument</b>	<b>Calibration Procedure</b>	<b>Frequency of Calibration</b>	<b>Acceptance Criteria<sup>1</sup></b>	<b>CA</b>	<b>SOP Reference<sup>2</sup></b>
HRGC/HRMS (continued)	ICV (must be from a second source)	Following ICAL	%D ≤25% for each analyte; %D ≤30% for OCDF	1) Correct problem 2) Reanalyze ICV 3) Recalibrate as necessary	CF-OA-E-002
	CCV	At the beginning of each 12-hour period, and at the end of each analytical sequence.	Ion abundance ratios in accordance with criteria in Table 6 of Method 1613B	1) Evaluate system <sup>4</sup> 2) Correct problem 3) Recalibrate if necessary 4) Reanalyze affected samples since the last in-control CCV	CF-OA-E-002
HRGC/HRMS	Resolution check with perfluorokerosene	Prior to calibration; at the beginning and the end of each 12-hour period of analysis	Resolving power ≥10,000 at reference signals close to m/z ratios of interest	1) <b>Halt analytical sequence</b> 2) Evaluate system 3) Retune and recalibrate as necessary	Dioxin/ Furan
	Five-point ICAL for target analytes (six points required for curve)	Initially; thereafter, as the continuing calibration fails	%RSD ≤20% for each analyte; %RSD ≤35% for each labeled standard  Ion abundance ratios within 15% of theoretical ratios; S/N ≥10 for target analyte ions	1) Evaluate system 2) Recalibrate as necessary	Dioxin/ Furan
	ICV (must be from a second source)	Following ICAL	%D ≤20% for each analyte; %D ≤30% for labeled standard  Ion abundance ratios within 15% of theoretical ratios; S/N ≥10 for target analyte ions	1) Correct problem 2) Reanalyze ICV 3) Recalibrate as necessary	Dioxin/ Furan
	CCV	At the beginning of each 12-hour period, and at the end of each analytical sequence.	%D ≤25% for each analyte; %D ≤30% for OCDF  Ion abundance ratios within 15% of theoretical ratios; S/N ≥10 for target analyte ions	1) Evaluate system <sup>4</sup> 2) Correct problem 3) Recalibrate if necessary 4) Reanalyze affected samples since the last in-control CCV	Dioxin/ Furan

**WORKSHEET #24 (CONTINUED)**  
**ANALYTICAL INSTRUMENT CALIBRATION TABLE**

<b>Instrument</b>	<b>Calibration Procedure</b>	<b>Frequency of Calibration</b>	<b>Acceptance Criteria<sup>1</sup></b>	<b>CA</b>	<b>SOP Reference<sup>2</sup></b>
ICP-MS	Instrument tuning	Before ICAL	Mass calibration $\leq 0.1$ atomic mass unit from the true value; resolution $< 0.9$ atomic mass unit full width at 10% peak height	1) Retune instrument 2) Reanalyze tuning solution	543S MET-6020
	ICAL	Daily multipoint calibration	$r \geq 0.995$	1) Evaluate system 2) Recalibrate	543S
	ICV; must be from a second source	Following ICAL, before sample analysis	%R = 90% to 110%	1) Evaluate system 2) Recalibrate as necessary	543S MET-6020
	ICB	Following ICV	No target analytes with absolute value $\geq \frac{1}{2}$ PQL	1) Evaluate system 2) Recalibrate as necessary	543S MET-6020
	Low-level check standard (CRI)	Following ICB	%R = 50% to 150%	1) Evaluate system 2) Recalibrate as necessary	543S
	ICS A	Following CRI	Spiked analytes: Within 20% of expected value Non-spiked analytes: Absolute value $< 2x$ PQL	1) Terminate analysis and correct problem 2) Reanalyze ICS 3) Reanalyze affected samples	543S MET-6020
	ICS AB	Following ICS A	Spiked analytes within 20% of expected value	1) Terminate analysis and correct problem 2) Reanalyze ICS 3) Reanalyze affected samples	543S MET-6020

**WORKSHEET #24 (CONTINUED)**  
**ANALYTICAL INSTRUMENT CALIBRATION TABLE**

<b>Instrument</b>	<b>Calibration Procedure</b>	<b>Frequency of Calibration</b>	<b>Acceptance Criteria<sup>1</sup></b>	<b>CA</b>	<b>SOP Reference<sup>2</sup></b>
ICP-MS (continued)	CCV	After every 10 samples, and at the end of the analysis sequence	%R = 90% to 110%	1) Repeat calibration 2) Reanalyze samples since last successful CCV	543S MET-6020
	CCB	After every CCV	No target analytes with absolute value $\geq \frac{1}{2}$ PQL	1) Correct problem 2) Analyze calibration blank and previous 10 samples	543S MET-6020
CVAA	ICAL	Daily multipoint calibration	$r \geq 0.995$ or $r^2 \geq 990$	1) Evaluate system 2) Recalibrate	543S
			Re-quantified value within $\pm 10\%$ or true value ( $\pm 30\%$ for low standard)		
			$r \geq 0.995$	1) Evaluate system 2) Recalibrate	MET-7470 MET-7471
	ICV; must be from a second source	Following ICAL, before sample analysis	%R = 90% to 110%	1) Evaluate system 2) Recalibrate as necessary	543S MET-7470 MET-7471
	ICB	Following ICV	No target analytes with absolute value $\geq \frac{1}{2}$ PQL	1) Evaluate system 2) Recalibrate as necessary	543S MET-7470 MET-7471
	Detection limit standard (CRA)	Following ICB	%R = 70% to 130%	1) Evaluate system 2) Recalibrate as necessary	543S MET-7470 MET-7471
	CCV	After every 10 samples, and at the end of the analysis sequence	%R = 80% to 120%	1) Repeat calibration 2) Reanalyze samples since last successful CCV	543S
			%R = 90% to 110%	1) Repeat calibration 2) Reanalyze samples since last successful CCV	MET-7470 MET-7471
CCB	After every CCV	No target analytes with absolute value $\geq \frac{1}{2}$ PQL	1) Correct problem 2) Analyze calibration blank and previous 10 samples	543S MET-7470 MET-7471	

**WORKSHEET #24 (CONTINUED)**  
**ANALYTICAL INSTRUMENT CALIBRATION TABLE**

<b>Instrument</b>	<b>Calibration Procedure</b>	<b>Frequency of Calibration</b>	<b>Acceptance Criteria<sup>1</sup></b>	<b>CA</b>	<b>SOP Reference<sup>2</sup></b>
Carbonaceous analyzer/infrared detector	Establish baseline	Daily before sample analyses	The mean signal from three empty sample boats	1) Evaluate system 2) Recalibrate	GEN-ASTM
	CCV	After baseline set, after every 10 samples, and at the end of the analysis sequence	%R = 80% to 120%	1) Repeat calibration 2) Reanalyze samples since last successful CCV	GEN-ASTM
	CCB	After every CCV	No target analytes with absolute value $\geq$ PQL	1) Correct problem 2) Analyze calibration blank and previous 10 samples	GEN-ASTM

%RSD = percent relative standard deviation  
 BFB = 4-bromofluorobenzene  
 DFTPP = decafluorotriphenylphosphine  
 ICV = initial calibration verification  
 RRF = relative response factor  
 RRT = relative retention time

**WORKSHEET #25**  
**ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE,**  
**TESTING, AND INSPECTION**

Analytical instrument testing, inspection, maintenance, setup, and calibration will be conducted in accordance with the QC requirements identified in each laboratory's SOPs. In addition, each of the specified analytical methods provides protocols for proper instrument calibration, setup, and critical operating parameters.

Preventive maintenance in the laboratory will be the responsibility of the laboratory personnel and analysts. At a minimum, the preventative maintenance schedules contained in the EPA methods, laboratory SOPs, and in the equipment manufacturer's instructions will be followed. This maintenance includes routine care and cleaning of instruments, and inspection and monitoring of the carrier gases, reagents, solvents, reference materials, and glassware used in analysis. The laboratory bench chemists and section managers will document maintenance of instruments and procedures in maintenance log/record books. Each of the laboratories has SOPs for preventive maintenance that are contained in their individual QA manuals (Appendix A).

If an analytical instrument malfunctions and cannot be substituted or repaired within sample hold times or data delivery times, the laboratory will contact the HGL project chemist to allow for the investigation of sending the samples to an alternative laboratory or use of an alternative methodology that will provide comparable results.

**WORKSHEETS #26 AND #27**  
**SAMPLE HANDLING, CUSTODY, AND DISPOSAL**

Sample shipment procedures will include overnight shipment by commercial courier or direct transport by commercial courier. When samples are collected on a Friday, the FTL will coordinate with the laboratory to ensure that samples can be received and properly handled at the laboratory on Saturday. Note that HGL is indicated as the responsible party in its role as the lead contractor; the individuals and organizations referenced in this worksheet are identified in Worksheet #3/5.

<b>Sample Collection, Packaging, and Shipment</b>
Sample Collection (Personnel/Organization): On-site Staff/HGL
Sample Packaging (Personnel/Organization): On-site Staff/HGL
Coordination of Shipment (Personnel/Organization): FTL/HGL; Sample Receipt Manager/Laboratory
Type of Shipment/Carrier: See Worksheet #19/30.2.
Field Sample Storage (number of days from sample collection): Samples will be held in the field when necessary. Holding times must not be compromised by holding samples in the field.
Special Sample Shipment Considerations: See introductory text.
<b>Sample Receipt and Analysis</b>
Sample Receipt (Personnel/Organization): Sample Management Staff/Laboratory
Sample Custody and Storage (Personnel/Organization): Sample Management Staff/Laboratory
Sample Preparation (Personnel/Organization): Organic Preparation Staff, Inorganic Preparation Staff, and Bench Chemists/Laboratory
Sample Determinative Analysis (Personnel/Organization): Bench Chemists/Laboratory
<b>Sample Archiving</b>
Sample Extract/Digestate Storage (number of days from extraction/digestion): For 6 months from data report release.
Sample Storage: Excess sample material will be archived at $\leq -10^{\circ}\text{C}$ for 1 year unless otherwise directed by the HGL PM.
Biological Sample Storage (number of days from sample collection): Not applicable
<b>Sample Disposal</b>
Personnel/Organization: Sample Management Staff/Laboratory
Number of Days from Analysis: Archived material will be retained no less than 1 year from data report release unless otherwise directed by the HGL PM.

**WORKSHEETS #26 AND #27 (CONTINUED)**  
**SAMPLE HANDLING, CUSTODY, AND DISPOSAL**

**Sample Custody Requirements**

**Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to the laboratory):**

HGL will maintain CoC records for samples and field QC samples. A sample is defined as being under a person's custody if any of the following conditions exist: (1) it is in his or her possession; (2) it is in his or her view after being in the individual's possession; (3) it was in his or her possession and is locked up; or (4) it is in a designated secure area after being in his or her possession.

Procedures to ensure the custody and integrity of the samples begin at the time of sampling and continue through transport, sample receipt, preparation, analyses, storage, data generation, reporting, and sample disposal. Records concerning the custody and condition of the samples are maintained in the field and laboratory records. Sample containers will be sealed in a manner that will prevent tampering or indicate tampering, should it occur. In no instance will sample containers be sealed with tape.

Sample Labeling: Each sample and field QC sample will have a unique sample ID number assigned in accordance with the sample ID protocols presented in Section 4.7.2 of the FSP (HGL, 2021a). The following information will be included on the label:

- Project ID,
- Sample ID,
- Type of sample matrix,
- Preservative added,
- Date and time of collection,
- Required analytical methods, and
- Sampler's initials.

The sample labels will be placed on the sample containers so as not to obscure QA/QC data on the bottles. Sample information will be printed in a legible manner using a permanent (indelible) ink marker or will be preprinted. Field ID must be sufficient to enable cross referencing with the appropriate sample documentation forms. CoC forms will be completed at the time of collection, including required information and ensuring that the CoC information matches the information on the sample labels.

Sample Packaging: Preservation reagents will be added to sample containers before or immediately after collection of the sample, as indicated in Worksheet #19/30.1. The samples will immediately be placed on ice and will be kept chilled during the workday until packaged for shipment to the laboratory.

**WORKSHEETS #26 AND #27 (CONTINUED)**  
**SAMPLE HANDLING, CUSTODY, AND DISPOSAL**

**Sample Custody Requirements (continued)**

Sample coolers will be supplied by the laboratory. When packaging samples for shipment, the cooler drainage plug will be closed, and the cap will be sealed in place with duct tape. Sample containers will be placed inside sealed plastic bags as a precaution against cross-contamination caused by leakage or breakage. Bagged sample containers will be placed in the coolers in such a manner as to eliminate the chance of breakage during shipment. Ice in plastic bags will be placed in the coolers to keep the samples at 6 °C or less throughout shipment. Each cooler will include a temperature blank, consisting of a 125-mL PE bottle filled with tap water and identified as a temperature blank. Prior to sealing the cooler, the sampler's copy of the CoC forms will be detached and provided to the FTL for the project file. The remaining portion of the completed CoC forms will be attached to the underside of the cooler lid in a sealed plastic bag. The cooler will then be taped shut and at least two completed custody seals will be affixed across the gap between the lid and body of the cooler.

Sample Shipment: Samples collected in the field will be shipped to the laboratory as expeditiously as possible. Sample shipment will be performed in accordance with applicable U.S. Department of Transportation regulations. The samples will be shipped to the laboratory by the procedures identified in this worksheet. Arrangements will be made between HGL and each laboratory POC for samples that are to be delivered to a laboratory on a weekend so that sample condition and holding times are not compromised.

**Laboratory Sample Custody Procedures (receipt of samples, archiving, and disposal):**

The assigned sample custodian(s) and staff are responsible for samples received at the laboratory. In addition to receiving samples, the sample receipt staff is also responsible for documentation of sample receipt and storage before and after sample analysis. Summaries of the minimum laboratory receipt procedures are as follows:

- Upon receipt, sign, date, and document the time of sample receipt on the airbills or other shipping manifests received from the couriers.
- Sign the CoC form assuming custody of the samples. If a CoC form is not received with a set of samples, the laboratory will immediately notify the HGL PM or Sampling and Analysis Coordinator.
- Inspect the sample cooler for integrity and then document the following information:
  - Type of courier and whether the samples were shipped, or hand delivered (copies of the airbills are maintained).
  - Availability and condition of custody information.
  - Sample temperature.
  - If the temperature of the samples upon receipt at the laboratory exceeds the temperature requirements, individual sample containers will be measured. Exceedances will be documented in laboratory records, and the laboratory must contact the HGL PM or Sampling and Analysis Coordinator immediately and document decisions regarding the potentially affected samples.
  - Presence of leaking or broken containers and indication of sample preservation.
- Verify that the holding time has not been exceeded. If a sample has exceeded holding time, the HGL PM or Sampling and Analysis Coordinator must be notified.
- Match the sample container information (e.g., sample tag/label), CoC records, and pertinent information associated with the sample. The sample custodian then verifies sample identity to ensure that information is correct. Inconsistencies are resolved with HGL through the laboratory PM. CA measures are documented before sample analysis proceeds.

**WORKSHEETS #26 AND #27 (CONTINUED)**  
**SAMPLE HANDLING, CUSTODY, AND DISPOSAL**

**Sample Custody Requirements (continued)**

Samples and extracts will be archived at the laboratory in accordance with this worksheet. The laboratory also is responsible for the proper management and disposal of sample residuals and extracts, following applicable Federal, state, and local laws; rules; and regulations.

**Sample ID Procedures:**

Field samples and field QC samples will receive a unique sample ID designation as detailed in FSP Section 4.7.2. Sample IDs will clearly differentiate field QC samples (including duplicates and MS/MSDs) and IDW samples from environmental samples.

**CoC Procedures:**

Documentation of the CoC of the samples is necessary to demonstrate that the integrity of the samples has not been compromised between collection and delivery to the laboratory. A CoC record to document the transfer of custody from the field to the laboratory will accompany each sample cooler. Information requested in the CoC record will be completed. In addition, the airbill number assigned by the overnight courier will be listed on the CoC record or the general logbook. One copy of the CoC form will be retained by the samplers and placed in the project records file. The remaining pages will be sealed in a plastic bag and placed inside of the cooler (attached to the underside of the lid). Upon receipt at the laboratory, the CoC forms will be completed, and a cooler receipt form will be completed. It is the responsibility of the laboratory to document the condition of custody seals and sample integrity upon receipt.

The following sample-specific information concerning the sample will be documented on each CoC form:

- Unique sample ID number;
- Date and time of sample collection;
- Designation of MS/MSD;
- Preservative used;
- Analyses required;
- Name of collector(s);
- Serial numbers of custody seals and transportation cases, if used;
- Custody transfer signatures and dates and times of sample transfer from the field to transporters and to the laboratory or laboratories; and
- Bill of lading or transporter tracking number, if applicable.

In addition to the information above, the field team will record the source of sample (including name, location, and sample type) and location-specific QC (such as field duplicates and ambient blanks) in the field logbook at the time of collection. Sample-specific information also will be recorded on sample-specific sample collection sheets and retained in the project file. Pertinent field data, such as groundwater stabilization parameters, will be recorded in the field logbook and on preprinted forms and retained in the project file.

## WORKSHEET #28 ANALYTICAL QC AND CA

The following tables provide general guidance for the evaluation of QC analyses and the implementation of CA for out-of-control situations. The method-specific acceptance criteria are presented in the applicable tables in Worksheet #12 and Worksheet #15. QC results that are outside the control criteria should trigger CA, unless the discrepancy introduces a potential high bias and associated results are non-detections. The laboratory analyst and the laboratory section manager will be responsible for initiating and completing CA associated with QC discrepancies.

**WORKSHEET #28.1**  
**METHOD QC TABLE – GC/MS, GC/ECD, AND GC/FPD METHODS**

QC Element	Frequency	Method/SOP QC Acceptance Limits	CA	DQI
<b>General QC Elements</b>				
MB	Every analytical batch (maximum of 20 samples)	Target analytes not detected $>1/2$ PQL or $>1/10$ the amount measured in a sample or $1/10$ the regulatory limit (whichever is greater)	1) Rerun 2) Evaluate batch 3) Reanalyze or qualify results, as necessary	Representativeness
LCS (and LCSD, if performed)	Every analytical batch (maximum of 20 samples)	Analyte-specific %R and RPD acceptance criteria	1) Rerun 2) Evaluate batch 3) Reanalyze or qualify results, as necessary	Accuracy (and Precision)
MS/MSD	As indicated on CoC forms, and as required for batch control	Analyte-specific %R and RPD acceptance criteria (%R results NA if parent sample concentration $\geq 4x$ the spike level)	1) Evaluate MS/MSD to assess matrix interference 2) Evaluate batch and qualify results as necessary	Accuracy and Precision
Surrogate Recovery	Every sample	Surrogate-specific %R acceptance criteria	1) Rerun 2) Reanalyze or qualify results, as necessary	Accuracy
<b>Method-Specific Elements – GC/MS Methods 8260C, 8270D, and 8270D-SIM</b>				
Internal Standard Performance	Every sample	Peak area within 50-200% of the peak area in the corresponding CCV	1) Rerun 2) Reanalyze or qualify results, as necessary	Accuracy
		Retention time within $\pm 30$ seconds of the corresponding CCV		
RRT Position	Detected sample results	RRT within $\pm 0.06$ RRT units from the established RRT for each analyte and surrogate	1) Correct problem 2) Recalibrate instrument 3) Reanalyze results, as necessary	Analyte Identification
Mass spectrometer results	Positive results must be confirmed	Spectral match to reference spectrum	1) Analyst must evaluate results to confirm identification if spectral match does not meet criteria 2) Section manager must review analyst's determination	Analyte Identification

**WORKSHEET #28.1 (CONTINUED)**  
**METHOD QC TABLE – GC/MS, GC/ECD, GC/FPD, AND GC/FID METHODS**

QC Element	Frequency	Method/SOP QC Acceptance Limits	CA	DQI
<b><i>Method-Specific QC Elements – GC/ECD Methods 8082A and 8151A and GC/FPD Organotin Method (ALS-Kelso SOP SOC-BUTYL)</i></b>				
Retention time window position	Once per ICAL and at the beginning of the analytical shift	Peaks associated with positive results must elute within the established retention time window.	1) Correct problem 2) Recalibrate instrument 3) Reanalyze results, as necessary	Analyte Identification
Confirmation column	Positive results must be confirmed	Result not confirmed using second column or detector	1) Analyst must evaluate data to determine if unconfirmed result is a detection 2) Section manager must review analyst's determination	Analyte Identification
		Results between primary and second column RPD ≤40%	1) Analyst must select result to report in accordance with method requirements and laboratory SOP 2) Section manager must review analyst's determination	Analyte Identification
<b><i>Method-Specific QC Elements – GC/FID Method NWTPH-Dx</i></b>				
Laboratory Duplicate	One per 10 environmental samples; if there is insufficient sample material to perform laboratory duplicates at the required rate, the laboratory will analyze an LCSD in the affected preparation batch (maximum of 20 samples).	RPD ≤ method criteria if both results >5x the PQL; absolute difference <PQL for evaluation of low-level results (<5x PQL)	1) Rerun 2) Evaluate batch 3) Qualify sample results, as appropriate	Precision

**WORKSHEET #28.2**  
**METHOD QC TABLE – HRGC/HRMS AND GC/MS/MS ANALYSES**

QC Element	Frequency	Project-specific Performance Criteria	CA	DQI
<b>General QC Elements</b>				
MB	Every analytical batch (maximum of 20 samples)	Target analytes not detected $\geq \frac{1}{2}$ LOQ or $\geq 1/10$ the amount measured in a sample or $1/10$ the PAL (whichever is greater)	1) Rerun 2) Evaluate batch 3) Reanalyze or qualify results as necessary	Representativeness
LCS (and LCSD, if performed)	Every analytical batch (maximum of 20 samples)	Analyte-specific %R and RPD acceptance criteria	1) Rerun 2) Evaluate batch 3) Reanalyze or qualify results as necessary	Accuracy (and Precision)
MS/MSD	As indicated on CoC forms, and as required for batch control	Analyte-specific %R and RPD acceptance criteria (%R discrepancies NA if parent sample concentration $\geq 4x$ the spike level)	1) Evaluate MS/MSD to assess matrix interference 2) Evaluate batch and qualify results as necessary	Accuracy and Precision
<b>Method-Specific Elements – HRGC/HRMS Method 1668C (CFA SOP CF-OA-E-003)</b>				
Labeled Standards	Every sample	%R for each labeled standard in the original sample (prior to dilutions) must be within method criteria	1) Evaluate potential for matrix effects 2) Re-extract or dilute and reanalyze; or qualify results as necessary	Accuracy
Ion Abundance Ratio	Positive results	Ion abundance ratios for each PCB, labeled standard, and internal standard within the theoretical ratio window presented in Table 8 of Method 1668C.	1) Evaluate potential for matrix effects 2) Re-extract or dilute and reanalyze; or qualify results as necessary	Analyte Identification
S/N	Positive results	S/N for the GC peak at each exact m/z must be greater than or equal to 2.5 for each target analyte detected in a sample extract	1) Evaluate potential for matrix effects 2) Re-extract or dilute and reanalyze; or qualify results as necessary	Analyte Identification
RRT	Positive results	Target analytes, labeled standards, and internal standards meet the relative retention time windows calculated based on absolute retention times calculated using the most recent GC column performance check standard	1) Evaluate potential for matrix effects 2) Re-extract or dilute and reanalyze; or qualify results as necessary	Analyte Identification

**WORKSHEET #28.2 (CONTINUED)**  
**METHOD QC TABLE – HRGC/HRMS AND GC/MS/MS ANALYSES**

QC Element	Frequency	Project-specific Performance Criteria	CA	DQI
<b>Method-Specific Elements – HRGC/HRMS Method 1668C (SGS SOP HRMS PCBs)</b>				
Labeled Standards	Every sample	%R for each labeled standard in the original sample (prior to dilutions) must be within method criteria	1) Evaluate potential for matrix effects 2) Re-extract or dilute and reanalyze; or qualify results as necessary	Accuracy
Ion Abundance Ratio	Positive results	Ion abundance ratios for each PCB, labeled standard, and internal standard within 15% of the expected ratio.	1) Evaluate potential for matrix effects 2) Re-extract or dilute and reanalyze; or qualify results as necessary	Analyte Identification
S/N	Positive results	S/N for the GC peak at each exact m/z must be greater than or equal to 2.5 for each target analyte detected in a sample extract	1) Evaluate potential for matrix effects 2) Re-extract or dilute and reanalyze; or qualify results as necessary	Analyte Identification
Absolute Retention Time	Positive results	Both identification peaks associated with each quantified compound must be present and maximize within $\pm 2$ seconds of each other; retention time for congeners within $-1$ to $+3$ seconds of corresponding labeled standard	1) Evaluate potential for matrix effects 2) Re-extract or dilute and reanalyze; or qualify results as necessary	Analyte Identification
<b>Method-Specific QC Elements – HRGC/HRMS Method 1613B</b>				
Labeled Standards	Every sample	%R for each labeled standard in the original sample (prior to dilutions) must be within method criteria	1) Evaluate potential for matrix effects 2) Re-extract or dilute and reanalyze; or qualify results as necessary	Accuracy
Ion Abundance Ratio	Positive results	Ion abundance ratios for each target compound, labeled standard, and internal standard within $\pm 15\%$ of the theoretical ratio. Both identification peaks associated with each quantified compound must be present and maximize within $\pm 2$ seconds	1) Evaluate potential for matrix effects 2) Re-extract or dilute and reanalyze; or qualify results as necessary	Analyte Identification
S/N	Positive results	S/N for the GC peak at each exact m/z must be greater than or equal to 2.5 for each target analyte detected in a sample extract, and greater than or equal to 10 in the calibration and verification standards	1) Evaluate potential for matrix effects 2) Re-extract or dilute and reanalyze; or qualify results as necessary	Analyte Identification

**WORKSHEET #28.2 (CONTINUED)**  
**METHOD QC TABLE – HRGC/HRMS AND GC/MS/MS ANALYSES**

QC Element	Frequency	Project-specific Performance Criteria	CA	DQI
RRT (CFA SOP CF-OA-E-002)	Positive results	Target analytes, labeled standards, and internal standards meet the relative retention time windows presented CFA SOP Table 9	1) Evaluate potential for matrix effects 2) Re-extract or dilute and reanalyze; or qualify results as necessary	Analyte Identification
Absolute Retention Time (SGS SOP Dioxin/Furan)	Positive results	Target analytes, labeled standards, and internal standards retention time within 2 seconds of retention time in associated column performance standard mix; target congeners retention time within 0 to +2 seconds of corresponding labeled standard	1) Evaluate potential for matrix effects 2) Re-extract or dilute and reanalyze; or qualify results as necessary	Analyte Identification
Confirmation Analysis	Positive results for 2,3,7,8-TCDF	If the primary column used for analysis cannot achieve specificity for 2,3,7,8-TCDF, confirmation analysis on a dissimilar column must be performed.	1) If 2,3,7,8-TCDF result is not confirmed, report both results and narrate.	Analyte Identification
<b>Method-Specific QC Elements – HRGC/HRMS Method 1699 (ALS-Burlington SOP BU-TM-1103)</b>				
Labeled Standards	Every sample	%R for each labeled standard in the original sample (prior to dilutions) must be within method criteria	1) Evaluate potential for matrix effects 2) Re-extract or dilute and reanalyze; or qualify results as necessary	Accuracy
Ion Abundance Ratio	Positive results	Ion abundance ratios for each target compound, labeled standard, and internal within $\pm 25\%$ of the theoretical ratio or $\pm 15\%$ of the abundance in the most recent CS4 standard analysis. Both identification peaks associated with each quantified compound must be present and maximize within $\pm 2$ seconds	1) Evaluate potential for matrix effects 2) Re-extract or dilute and reanalyze; or qualify results as necessary	Analyte Identification
S/N	Positive results	S/N for the GC peak at each exact m/z must be greater than or equal to 2.5 for each target analyte detected in a sample extract, and greater than or equal to 10 in the calibration and verification standards.	1) Evaluate potential for matrix effects 2) Re-extract or dilute and reanalyze; or qualify results as necessary	Analyte Identification

**WORKSHEET #28.2 (CONTINUED)**  
**METHOD QC TABLE – HRGC/HRMS AND GC/MS/MS ANALYSES**

QC Element	Frequency	Project-specific Performance Criteria	CA	DQI
Retention Time	Positive results	Analytes with a labeled analogue: within -1/+3 seconds of the labelled standard. Analytes without a labeled analogue: within $\pm 0.01$ RRT units of the RRT in the most recent CS4 standard analysis.	1) Evaluate potential for matrix effects 2) Re-extract or dilute and reanalyze; or qualify results as necessary	Analyte Identification
<b>Method-Specific QC Elements – HRGC/HRMS Method 1699 (SGS North America SOP HRMS OCPs)</b>				
Labeled Standards	Every sample	%R for each labeled standard in the original sample (prior to dilutions) must be within method criteria	1) Evaluate potential for matrix effects 2) Re-extract or dilute and reanalyze; or qualify results as necessary	Accuracy
Ion Abundance Ratio	Positive results	Ion abundance ratios for each target compound, labeled standard, and internal within $\pm 20\%$ of the theoretical ratio. Both identification peaks associated with each quantified compound must be present and maximize within $\pm 2$ seconds of each other	1) Evaluate potential for matrix effects 2) Re-extract or dilute and reanalyze; or qualify results as necessary	Analyte Identification
S/N	Positive results	S/N for the GC peak at each exact m/z must be greater than or equal to 2.5 for each target analyte detected in a sample extract, and greater than or equal to 10 in the calibration and verification standards.	1) Evaluate potential for matrix effects 2) Re-extract or dilute and reanalyze; or qualify results as necessary	Analyte Identification
Retention Time	Positive results	Analytes within the retention time window established using the most recent CS3 standard analysis.	1) Evaluate potential for matrix effects 2) Re-extract or dilute and reanalyze; or qualify results as necessary	Analyte Identification

**WORKSHEET #28.2 (CONTINUED)**  
**METHOD QC TABLE – HRGC/HRMS AND GC/MS/MS ANALYSES**

QC Element	Frequency	Project-specific Performance Criteria	CA	DQI
<i>Method-Specific QC Elements – GC/MS/MS Method 1699M</i>				
Labeled Standards	Every sample	%R for each labeled standard in the original sample (prior to dilutions) must be within method criteria	1) Evaluate potential for matrix effects 2) Re-extract or dilute and reanalyze; or qualify results as necessary	Accuracy
RRT Position	Detected sample results	RRT within $\pm 0.06$ RRT units from the established RRT for each analyte and labeled standard	1) Correct problem 2) Recalibrate instrument 3) Reanalyze results, as necessary	Analyte Identification
Mass spectrometer results	Positive results must be confirmed	Ratio of the quantitation transition/qualifier transition agrees within 30% of the ratio of these transitions in the reference spectrum	1) Analyst must evaluate results to confirm identification if spectral match does not meet criteria 2) Section manager must review analyst's determination	Analyte Identification

**WORKSHEET #28.3**  
**METHOD QC TABLE – METALS AND WET CHEMISTRY METHODS**

QC Element	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	DQI
<b>General QC Elements</b>				
MB	Every preparation batch (maximum of 20 samples)	Analytes not detected $> \frac{1}{2}$ PQL or $> \frac{1}{10}$ the amount measured in a sample or $\frac{1}{10}$ the regulatory limit (whichever is greater); no negative values $>  PQL $	1) Rerun 2) Evaluate batch 3) Redigest affected samples or qualify results, as appropriate	Representativeness
LCS (and LCSD, if performed)	Every preparation batch (maximum of 20 samples)	Analyte-specific %R and RPD acceptance criteria	1) Rerun 2) Evaluate batch 3) Reanalyze or qualify results, as necessary	Accuracy (and Precision)
MS (and MSD, if performed)	Every preparation batch (maximum of 20 samples)	Analyte-specific %R and RPD acceptance criteria (%R NA if parent sample concentration $\geq 4x$ the spike level)	1) Rerun 2) Evaluate batch 3) Qualify sample results, as appropriate	Accuracy/Bias and Precision
Laboratory Duplicate (if performed)	Every preparation batch (maximum of 20 samples)	RPD $\leq$ method criteria if both results $> 5x$ the PQL; absolute difference $< PQL$ for evaluation of low-level results ( $< 5x$ PQL)	1) Rerun 2) Evaluate batch 3) Qualify sample results, as appropriate	Precision
<b>Method-Specific QC Elements for ICP-MS Method 6020B</b>				
Serial Dilution	Only required if MS or MSD %R fails and parent sample concentration $\geq 25x$ PQL	ARI: %D $\leq 25\%$ for analytes present in the parent sample at concentrations $\geq 25x$ PQL ALS-Kelso: %D $\leq 20\%$ for analytes present in the parent sample at concentrations $\geq 25x$ PQL	1) Evaluate PDS results; if PDS results are in control for analytes with a serial dilution discrepancy, report data; otherwise: 2) Rerun 3) Evaluate batch 4) Qualify sample results as appropriate	Accuracy
PDS	Only required if MS or MSD %R fails and parent sample concentration $<$ spiked concentration	%R = 75-125%	1) Rerun 2) Evaluate batch 3) Qualify sample results as appropriate	Accuracy
Internal Standards	Every sample	Peak intensity $\geq 30\%$ the intensity in the ICB	1) Examine most recent clean matrix analysis for systematic problems 2) Evaluate potential for matrix effects 3) Re-extract or dilute and reanalyze 4) If system problem is suspected, halt analysis, maintain system, and recalibrate	Accuracy

**WORKSHEET #28.3 (CONTINUED)**  
**METHOD QC TABLE – METALS AND WET CHEMISTRY METHODS**

QC Element	Frequency	Project-specific Performance Criteria	CA	DQI
<i>Method-Specific QC Elements for CVAA Method 7470A and 7471B</i>				
No additional items				
<i>Method-Specific QC Elements for Carbonaceous Analyzer Method 9060A</i>				
No additional items				

## WORKSHEET #29 PROJECT DOCUMENTS AND RECORDS

The following is a list of the kinds of project records that should be used and maintained, as well as of the personnel responsible for generating and verifying each record. Records should be maintained in the HGL, laboratory, and other subcontractor (such as construction, design, or data validation firms) project files for a minimum of 5 years or longer as required by the contract. Project documentation, including field data, laboratory data, and electronic files will be maintained in accordance with the Project Data Management Plan described in Section 9.0 of the FSP and the Programmatic Data Management Plan (EPA, 2020a).

Record	Generation	Verification
<b><i>Sample Collection Documents and Records</i></b>		
Field notes (bound logbook)	Field staff	FTL
Sample documentation forms	Field staff	FTL
Tailgate safety meeting forms	SSHO	Corporate H&S Manager
CoC records	Field staff	FTL
Airbills	Field staff	FTL
Custody seals	Field staff	FTL
CA forms	PM	Project QA Officer
Photographs	Field staff	PM
GIS data	Field staff	Data Manager
Telephone logs, emails, faxes, and correspondence	Field staff	FTL
<b><i>On-Site Analysis Documents and Records</i></b>		
Equipment calibration logs	Field Staff	FTL
Equipment maintenance, testing, and inspection logs	Field Staff	FTL
Equipment calibration logs	Field Staff	FTL
Field sampling data sheets	Field Staff	FTL
Waste disposal records	FTL	PM
<b><i>Off-Site Analysis Documents and Records</i></b>		
Sample receipt, custody, and tracking records	Sample Receipt Staff	Laboratory PM
Standard traceability logs	Analytical Staff	Section Manager/QA Manager
Equipment calibration logs	Analytical Staff	Section Manager/QA Manager
Sample preparation logs	Analytical Staff	Section Manager/QA Manager
Analytical run logs	Analytical Staff	Section Manager/QA Manager
Equipment maintenance, testing, and inspection logs	Analytical Staff	Section Manager/QA Manager
Analytical discrepancy forms	Analytical Staff	Section Manager/QA Manager

**WORKSHEET #29 (CONTINUED)**  
**PROJECT DOCUMENTS AND RECORDS**

Record	Generation	Verification
Reported analytical results	Analytical Staff	Section Manager/QA Manager
Reported results for standards, QC checks, and QC samples	Analytical Staff	Section Manager/QA Manager
Data package completeness checklists	Analytical Staff/Section Manager	Laboratory PM/QA Manager
Sample disposal records	Assigned Laboratory Staff	Laboratory Operations Manager/QA Manager
Extraction and cleanup records	Analytical Staff	Section Manager/QA Manager
Raw data (stored electronically)	Analytical Staff	Database Manager/QA Manager
EDDs	Laboratory Database Manager	Data Manager
Telephone logs, emails, faxes, and correspondence	Laboratory PM	Laboratory Operations Manager
<b><i>Data Assessment Documents and Records</i></b>		
Data validation reports	Data Validator	Data Validation PM/Project Chemist
Database QC spreadsheets	Project Staff	Data Manager
Data usability assessments	Project Chemist	PM
Telephone logs, emails, faxes, and correspondence	Project Staff	PM
<b><i>Deliverables</i></b>		
Project planning documents, including Sufficiency Assessment, Data Gap Analysis, FSP, UFP-QAPP, Health and Safety Plan	PM and Design Team	QA Officer
Project deliverables, including project management reports; PDI Evaluation Report; Basis of Design Report; RD Work Plan; Treatability Study Reports; and Preliminary (30%), Pre-Final (95%), and Final (100%) RDs with supporting plans, evaluations, and reports	PM and Design Team	QA Officer
Telephone logs, emails, faxes, and correspondence	All project staff	PM
Permits	FTL	PM
Maps and figures	Graphics Staff	PM
EDDs	Project Database Staff	Data Manager

H&S = health and safety

## WORKSHEETS #31, 32, AND 33 ASSESSMENTS AND CA

The planned project assessment activities are described below. In addition to the planned activities listed below, all on-site workers will monitor project activities on an ongoing basis to ensure compliance with project plans, good work practices, and H&S requirements. If a non-conforming or unsafe condition is observed, all site workers have the authority to stop work until the condition is addressed.

### ASSESSMENTS:

Assessment Type	Responsible Personnel and Organization	Number and Frequency	Estimated Dates	Assessment Deliverable	Deliverable Due Date
Review of FSP, UFP-QAPP, SOPs, and Health and Safety Plan with field staff.	FTL	Prior to sampling startup and with new field staff prior to assignment	January-February and July-October 2022	Completed acknowledgment signature pages	48 hours following assessment
Ongoing review to ensure that work is being performed in accordance with project planning documents	FTL	Ongoing during fieldwork phases	January-February and July-October 2022	Daily progress reports	24 hours following conclusion of business day
Logbook and field form review	FTL	Daily	January-February and July-October 2022	NA: corrections will be made directly to reviewed documents	24 hours following assessment
Laboratory Assessment for Appropriate Certifications, Capacity, and QAPP Review with staff.	HGL Chemistry QA Manager	Prior to sampling mobilization and as new laboratories are contracted	June 2021	Receipt of copies of certifications. Email traffic concerning lab capacity prior to sampling startup. QAPP sign-off sheet received from laboratory.	48 hours following assessment
On-Site Laboratory Audit	HGL Project QA Officer	During initial sampling events at SIB Project Area	July 2022	Laboratory audit report	Preliminary assessment: 5 business days after audit conclusion Final Report: 20 business days after audit conclusion

**WORKSHEETS #31, 32, AND 33 (CONTINUED)  
ASSESSMENTS AND CA**

**ASSESSMENTS:**

<b>Assessment Type</b>	<b>Responsible Personnel and Organization</b>	<b>Number and Frequency</b>	<b>Estimated Dates</b>	<b>Assessment Deliverable</b>	<b>Deliverable Due Date</b>
On-Site Field Audit	HGL Project QA Officer	During initial sampling events at SIB Project Area	July 2022	Field audit report	Preliminary assessment: 5 business days after audit conclusion Final Report: 20 business days after audit conclusion
Tailgate safety meeting	FTL	Daily	January-February and July-October 2022	Verbal debriefing and daily sign-off log. If a safety incident occurs, a Supervisor Injury Employee Report is completed.	Weekly; safety incidents will be reported to the PM and Corporate H&S Manager immediately
Field sampling and CoC form review against QAPP requirements	HGL Sample Coordinator	Daily	January-February and July-October 2022	Corrections will be made directly to reviewed documents; communication may be in the form of email.	24 hours following assessment
Data validation	Data validation subcontractor	Per sample delivery group	February-April and August-December 2022	Communication may be in the form of email traffic clarification of the analytical report or Cas because of deficiencies identified in the validation process.	24 hours following assessment
Laboratory report deliverables and analytical results against QAPP requirements	HGL Chemistry QA Manager	As discrepancies are identified in the validation process	January-February and July-October 2022	Memorandum or email to PM and Laboratory PM	72 hours following assessment

**WORKSHEETS #31, 32, AND 33 (CONTINUED)**  
**ASSESSMENTS AND CA**

The responsibilities for assessment response and implementation of corrective action are described below. In all cases, corrective action will be monitored and assessed by different personnel than those tasked with implementing the corrective action. The project QA Officer, who is independent from the project management and execution team, has the final authority to determine if corrective action has been satisfactorily implemented, except for H&S corrective action, which is under the final authority of the Corporate H&S Manager.

**ASSESSMENT RESPONSE AND CA:**

<b>Assessment Type</b>	<b>Individual(s) Notified of Findings</b>	<b>Assessment Response Documentation</b>	<b>Nature of the Deficiencies Documentation</b>	<b>Time Frame for Response</b>	<b>Responsibility for Implementing CA</b>	<b>Responsibility for Monitoring CA</b>
Review of QAPP, SOPs, and Site Safety and Health Plan with Field Staff	FTL	Completed acknowledgement signature pages	Daily Activity Reports	24 hours following assessment	FTL	HGL PM
Ongoing review to ensure that work is performed in accordance with QAPPs.	HGL PM	Interim CA documented pending final approval	Daily QC Reports	By close of same business day	FTL	HGL PM and QA Officer
Logbook and Field Form Review	FTL	Corrections will be made directly to reviewed documents	Daily QC Reports	NA	FTL	HGL PM
Laboratory Assessment for Appropriate Certifications, Capacity, and QAPP Review with Staff	HGL Chemistry QA Manager	Response to email or memorandum	Readiness Review	48 hours after notification	Laboratory PM	HGL Chemistry QA Manager
Tailgate Safety Meeting	FTL	Included as part of the process of the Supervisor Injury Employee Report	Data QC Reports	24 hours after notification	HGL PM	HGL Corporate H&S Manager
Field Sampling and CoC Form Review Against QAPP Requirements	HGL Sampling and Analysis Coordinator	Response to email	Data QC Reports	48 hours after notification	FTL	HGL PM

**WORKSHEETS #31, 32, AND 33 (CONTINUED)  
ASSESSMENTS AND CA**

**ASSESSMENT RESPONSE AND CA:**

<b>Assessment Type</b>	<b>Individual(s) Notified of Findings</b>	<b>Assessment Response Documentation</b>	<b>Nature of the Deficiencies Documentation</b>	<b>Time Frame for Response</b>	<b>Responsibility for Implementing CA</b>	<b>Responsibility for Monitoring CA</b>
Data Validation	HGL Chemistry QA Manager	If required, laboratory reports will be amended, and corrections noted in the analytical narrative and contained with the validation report.	Data Validation Reports	1 business week	HGL PM	HGL Chemistry QA Manager
Laboratory Report Deliverables and Analytical Results Against QAPP Requirements	HGL Chemistry QA Manager	If required, laboratory reports will be amended, and corrections noted in the analytical narrative.	Data Validation Reports	72 hours after notification	Laboratory PM	Laboratory QA Manager HGL Chemistry QA Manager

**WORKSHEET #34**  
**DATA VERIFICATION AND VALIDATION INPUTS**

This worksheet lists the inputs that will be used during data verification and validation. Inputs include planning documents, field records, and laboratory records. Data verification is a check that specified activities involved in collecting and analyzing samples have been completed and documented, and that the necessary records (objective evidence) are available to proceed to data validation. Data validation is the evaluation of conformance to stated requirements, including those in the contract, methods, SOPs, and planning documents.

<b>Item</b>	<b>Description</b>	<b>Data Generated Internally or Externally</b>	<b>Verification (completeness)</b>	<b>Validation (conformance to specifications)</b>
<b>Planning Documents/Records</b>				
<b>1</b>	Approved UFP-QAPP and FSP	<b>Internally</b>	<b>X</b>	
<b>2</b>	Contract	<b>Internally</b>	<b>X</b>	
<b>4</b>	Field SOPs	<b>Internally</b>	<b>X</b>	
<b>5</b>	Laboratory SOPs	<b>Internally</b>	<b>X</b>	
<b>Field Records</b>				
<b>6</b>	Field logbooks	<b>Internally</b>	<b>X</b>	<b>X</b>
<b>7</b>	Field equipment calibration records	<b>Internally</b>	<b>X</b>	<b>X</b>
<b>8</b>	CoC forms	<b>Internally</b>	<b>X</b>	<b>X</b>
<b>9</b>	Sampling diagrams/surveys	<b>Internally</b>	<b>X</b>	<b>X</b>
<b>10</b>	Drilling/coring logs	<b>Internally</b>	<b>X</b>	<b>X</b>
<b>11</b>	Geophysics reports	<b>Internally</b>	<b>X</b>	<b>X</b>
<b>12</b>	Relevant correspondence	<b>Internally</b>	<b>X</b>	<b>X</b>
<b>13</b>	Change orders/deviations	<b>Internally</b>	<b>X</b>	<b>X</b>
<b>14</b>	Field audit reports	<b>Internally</b>	<b>X</b>	<b>X</b>
<b>15</b>	Field CA reports	<b>Internally</b>	<b>X</b>	<b>X</b>
<b>16</b>	Project-specific access and badging records	<b>Internally</b>	<b>X</b>	<b>X</b>
<b>17</b>	Project-specific safety training records	<b>Internally</b>	<b>X</b>	<b>X</b>
<b>18</b>	Equipment inspection records	<b>Internally</b>	<b>X</b>	<b>X</b>
<b>Analytical Data Package</b>				
<b>19</b>	Cover sheet (laboratory identifying information)	<b>Externally</b>	<b>X</b>	<b>X</b>
<b>20</b>	Case narrative	<b>Externally</b>	<b>X</b>	<b>X</b>
<b>21</b>	Internal laboratory CoC	<b>Externally</b>	<b>X</b>	<b>X</b>
<b>22</b>	Sample receipt records	<b>Externally</b>	<b>X</b>	<b>X</b>
<b>23</b>	Sample chronology (e.g., dates and times of receipt, preparation, and analysis)	<b>Externally</b>	<b>X</b>	<b>X</b>
<b>24</b>	Communication records	<b>Externally</b>	<b>X</b>	<b>X</b>
<b>25</b>	MDL/PQL establishment and verification	<b>Externally</b>	<b>X</b>	<b>X</b>
<b>26</b>	Standards Traceability	<b>Externally</b>	<b>X</b>	<b>X</b>
<b>27</b>	Instrument calibration records	<b>Externally</b>	<b>X</b>	<b>X</b>
<b>28</b>	Definition of laboratory qualifiers	<b>Externally</b>	<b>X</b>	<b>X</b>
<b>29</b>	Results reporting forms	<b>Externally</b>	<b>X</b>	<b>X</b>
<b>30</b>	QC sample results	<b>Externally</b>	<b>X</b>	<b>X</b>
<b>31</b>	CA reports	<b>Externally</b>	<b>X</b>	<b>X</b>
<b>32</b>	Raw data	<b>Externally</b>	<b>X</b>	<b>X</b>
<b>33</b>	EDD	<b>Externally</b>	<b>X</b>	<b>X</b>

**WORKSHEET #35**  
**DATA VERIFICATION PROCEDURES**

Verification Input	Description	Responsible for Verification
CoC (shipping)	CoC forms will be reviewed upon completion and verified against the packed sample coolers and project sampling requirements. This QC check will be verified by initialing the CoC form next to the shipper's signature. A copy of the CoC form will be retained in the project file and the original and one copy will be taped inside the cooler in a waterproof bag.	FTL
Log review	Log reviews will be performed daily. This review will be performed to verify that field monitoring equipment was maintained, calibrated, and operated properly. In addition, the review will verify that required information has been correctly documented in the field logbooks and sample documentation sheets.	FTL
CoC (receipt)	CoC forms will be reviewed and compared to cooler contents. Discrepancies (sample bottles, sample IDs, requested methods) will be communicated to the Laboratory PM for resolution with the HGL Sampling and Analysis Coordinator, FTL, and PM.	Laboratory Sample Receipt Manager Laboratory PM
Analytical data report	Data used to prepare analytical data reports will be reviewed at multiple levels throughout the laboratory. The requirements for this review process are described in each laboratory's quality manual. No data reports will be delivered to HGL without the necessary internal approval.	Laboratory QA Manager
Analytical data report	A review will be conducted to ensure that the appropriate analytical sample fractions have been submitted, appropriate sample IDs have been used, and the correct analytical methods have been used.	HGL Sampling and Analysis Coordinator
Analytical data report <sup>1</sup>	Analytical reports will be reviewed to ensure that required forms, case narratives, samples, CoC forms, logbooks, and raw data have been included.	Data Validator
EDD (export)	Laboratory analytical data and geotechnical testing results will be reported in an EDD that is compatible with the EquIS data management program using the valid values presented in Appendix A of the Program Data Management Plan (EPA, 2020a).	Laboratory Database Manager
EDD (import)	EDD nonconformances from the laboratory will be reviewed and addressed before the data is processed further. The EDD also will be reviewed to ensure it is in the correct format and it contains the correct valid values. Errors or warnings are addressed before processing the data further.	HGL Data Manager
Project database	Results requiring reporting as totals will be calculated in accordance with Section 6 and Table A-2 of the Program Data Management Plan and will be entered into the database. Data qualifiers identified by the data validation reports will be applied to a working output file and imported into the database. Data modified by manual entry will receive a 100% QC check for accuracy and completeness. Prior to final approval, each EDD output will receive a 10% QC check of electronically reported results against the hard copy laboratory reports. EDD outputs to the Portland Harbor Interim Database will be formatted in accordance with the requirements of the EDD Specifications included as Attachment A to the Program Data Management Plan.	HGL Data Manager

<sup>1</sup> This verification step is performed as part of the data validation process described in Worksheet #36.

## WORKSHEET #36 DATA VALIDATION PROCEDURES

Analytical methods that will be used and the level of data quality (screening or definitive) that the data review process will be required to support are identified below.

Validation Stage	Matrix	Analytical SOP <sup>1</sup>	Validation Criteria	Data Validator
<b>Data Review Step Iia</b>				
Data Verification	All	All	Package Completeness Holding Times: Worksheet #19/#30 Narrative: Additional items noted for resolution or clarification	Ecochem or LDC staff validator
Data Validation – Screening (Stage 2A)	Sediment, soil, DRET extracts, and stormwater	See Worksheet #23 method category “Laboratory Analytical Methods – Environmental Samples”	<u>SDGs representing 90% of results</u> : Data quality elements as defined for Stage 2A data validation in EPA, 2009 DQIs: General and method-specific criteria presented in Worksheets #12, #15, and #28 Qualification: EPA CLP NFG <sup>2</sup> and EPA Region 10 Guidance (EPA, 2014)	Ecochem or LDC staff validator
Data Validation – Definitive (Stage 4)			<u>SDGs representing 10% of results</u> : Data quality elements as defined for Stage 4 data validation in EPA, 2009 DQIs: General and method-specific criteria presented in Worksheets #12, #15, #24, and #28 Qualification: EPA CLP NFG <sup>2</sup> and EPA Region 10 Guidance (EPA, 2014)	Ecochem or LDC staff validator
<b>Data Review Step Iib</b>				
Senior Review	All	All	See Worksheet #37	HGL Chemistry QA Manager
Overall Assessment	All	All	See Worksheet #37	HGL PM

<sup>1</sup> Refer to Worksheet #23.

<sup>2</sup> National Functional Guidelines for Organic Superfund Methods Data Review (EPA, 2020b), National Functional Guidelines for Inorganic Superfund Methods Data Review (EPA, 2020c), and National Functional Guidelines for High Resolution Superfund Methods Data Review (EPA, 2020d).

CLP = Contract Laboratory Program

NFG = National Functional Guidelines

**WORKSHEET #36 (CONTINUED)**  
**DATA VALIDATION PROCEDURES**

An overview of the data validation process is presented in the following table.

<b>Validation Stage</b>	<b>Validation Input</b>	<b>Description</b>	<b>Person Responsible for Validation</b>
<b><i>Data Review Step Iia</i></b>			
Data Verification	Laboratory data reports (see Worksheet #35)	The validator will verify data package completeness, review case narratives, evaluate sample delivery and condition, and evaluate preparation and analysis holding times (Worksheet #19/#30).	Ecochem or LDC staff validator
Data Validation	Laboratory data reports	The data validator will perform an evaluation of sample- and batch-related QC results as required for each method as applicable for the stage of data validation. The validation protocols in the NFG will be modified as necessary to accommodate differences between the requirements for analysis performed in accordance with the CLP SOW and the requirements for analyses using the non-CLP methods used for this project.	Ecochem or LDC staff validator
<b><i>Data Review Step Iib</i></b>			
Senior Review	Data validation reports	Senior review of reports to approve of validation results and final qualifiers; overall evaluation of analytical performance against QAPP requirements.	HGL Chemistry QA Manager
Overall Assessment	Project documentation (Worksheet #31/#32/#33)	Complete project dataset and documentation: Determine whether the sampling plan was executed as specified (that is, the number, location, and type of field samples were collected and analyzed as specified in the work plan); evaluate whether sampling procedures were followed with respect to equipment and proper sampling support (for example, techniques, equipment, decontamination, volume, temperature, and preservatives).	HGL PM

## WORKSHEET #37 DATA USABILITY ASSESSMENT

**Summarize the usability assessment process and the procedures, including interim steps and statistics, equations, and computer algorithms that will be used:**

The data assessment team will perform the operations summarized in Worksheets #35 and #36 to evaluate sampling team and laboratory compliance with the requirements with this QAPP and other project planning documents. Evaluation activities will be documented in the QA reports listed in Worksheet #29 and will be used to assess the usability of project data in levels of detail ranging from an analyte- and sample-specific basis to the overall dataset for the sampling event. The PARCCS DQIs and formulas used to evaluate data quality are presented in Worksheet #12, with the accuracy and sensitivity requirements presented on an analyte- and matrix-specific basis in the Worksheet #15 tables.

**Describe the evaluative procedures used to assess overall measurement error associated with the project:**

The assessment will include an evaluation of the QC elements relating to DQIs precision, accuracy, representativeness, comparability, completeness (both sample collection and analytical), and sensitivity (see Worksheet #12). Data that is rejected during the validation process in accordance with the data qualification conventions (Worksheet #36) will be evaluated against the project DQOs (Worksheet #11) by the HGL Chemistry QA Manager to determine if rejection is the appropriate final decision for the affected data. In addition, the HGL Chemistry QA Manager will evaluate DQI performance to determine whether any data points are of insufficient quality for the intended use, even if the affected results did not require rejection under the validation conventions. The impact of data gaps resulting from sampling incompleteness or rejected data will be evaluated in a data quality evaluation included as an appendix to the PDI Evaluation Report.

**Identify the personnel responsible for performing the usability assessment:**

Project team PMs, project chemists, and data managers identified in Worksheet #3/#5.

**Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:**

Evaluation activities will be documented in the QA reports listed in Worksheet #29. Project deliverables that present analytical data will include a section addressing data quality and any limitations or gaps in the data set that were identified during the data evaluation process and the potential impact on decision making.

## REFERENCES

- Butler, Virginia L., 2004. *Where Have All the Native Fish Gone? The Fate of Fish That Lewis and Clark Encountered on the Lower Columbia River*. Oregon Historical Quarterly 105(3):438-463.
- David Evans and Associates, Inc. (DEA), 2002a. Lower Willamette River Multibeam Bathymetric Survey Report, December 2001/January 2002. Draft. Prepared for Striplin Environmental Associates, Olympia, WA. David Evans and Associates, Inc., Portland, OR. April 26.
- DEA, 2002b. Willamette River Acoustic Doppler Current Profiler Survey Results, April 2002. Prepared for Striplin Environmental Associates, Inc., Olympia, WA. David Evans and Associates, Inc., Portland, OR.
- Ellis Ecological Services, 2002. Portland Harbor Superfund Site Technical Memorandum: Juvenile Salmonid Residence Time in Portland Harbor. Draft. Ellis Ecological Services, Inc., Estacada, OR. February 15.
- Foth, 2021. Final Pre-Design Investigation Work Plan, River Mile 9 West - Portland Harbor Superfund Site, Portland, Oregon, Project I.D.: 18F008. February.
- GeoSea Consulting, 2001. A Sediment Trend Analysis (STA) of the Lower Willamette River. Draft Report. GeoSea Consulting Ltd., Brentwood Bay, BC, Canada. April.
- HydroGeoLogic, Inc. (HGL), 2021a. *Field Sampling Plan, Remedial Design Services, Swan Island Basin Project Area, Portland Harbor Superfund Site, Portland, Multnomah County, Oregon, CERCLA Docket No. 10-2021-01*. June.
- HGL, 2021b. *Sufficiency Assessment Report, Remedial Design Services, Swan Island Basin Project Area, Portland Harbor Superfund Site, Portland, Multnomah County, Oregon, CERCLA Docket No. 10-2021-01*. June.
- HGL, 2021c. *Pre-Design Investigation Work Plan, Remedial Design Services, Swan Island Basin Project Area, Portland Harbor Superfund Site, Portland, Multnomah County, Oregon, CERCLA Docket No. 10-2021-01*. June.
- Intergovernmental Data Quality Task Force (IDQTF), 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs, Version 1*. March.
- IDQTF, 2012. *Uniform Federal Policy for Quality Assurance Project Plans, Optimized UFP-QAPP Worksheets*. March.
- Pacific Groundwater Group (PGG), 2018. Quality Assurance Project Plan, Swan Island Lagoon, Sediment Sampling Investigation, Portland Harbor Superfund Site.

- Roy F. Weston, Inc., 1998. Portland Harbor Sediment Investigation Report, Multnomah County, Oregon. 04000-019-036-AACE. WR-WSI98. Prepared for the U.S. Environmental Protection Agency and Oregon Department of Environmental Quality, Portland, OR. May.
- Saleeby, Becky Margaret, 1983. Prehistoric Settlement Patterns in the Portland Basin of the Lower Columbia River: Ethnohistoric, Archaeological, and Biogeographic Perspectives. Unpublished Ph.D. dissertation, Department of Anthropology, University of Oregon, Eugene.
- Striplin Environmental Associates, Inc. (SEA), 2002a. Integration of Sediment Trend Analysis (STA®) Survey Results with Historic Bathymetry in the Lower Willamette River. Draft. Prepared for the Lower Willamette Group, Portland, OR. Striplin Environmental Associates, Inc., Olympia, WA. April 26.
- SEA, 2002b. Sediment Profile Image Survey of the Lower Willamette River. Prepared for the Lower Willamette Group, Portland, OR. Striplin Environmental Associates, Inc., Olympia, WA. April 26.
- U.S. Environmental Protection Agency (EPA), 1971. Residue, Total (Gravimetric, Dried at 103-105 °C).
- EPA, 1994. Method 1613 Revision B, Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution HRGC/HRMS. October.
- EPA, 2001. *Requirements for Quality Assurance Project Plans*. QA/R-5, EPA/240/B-01/003. March.
- EPA, 2002. *Guidance for Quality Assurance Project Plans*. QA/G-5, EPA/240/R-02/009. December.
- EPA, 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4, EPA/240/B-06/001. February.
- EPA, 2007. Method 1699: Pesticides in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS. December.
- EPA, 2009. *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use*. January.
- EPA, 2010. Method 1668C, Chlorinated Biphenyl Congeners in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS. April.
- EPA, 2014. R10 Data Validation and Review Guidelines for Polychlorinated Dibenzo-p- Dioxin and Polychlorinated Dibenzofuran Data (PCDD/PCDF) Using Method 1613B, and SW846 Method 8290A. EPA-910-R-14-003. May.

- EPA, 2015. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA publication SW-846, Third Edition, through Final Update V. August.
- EPA, 2016a. Final Remedial Investigation Report, Portland Harbor RI/FS. EPA Region 10, Seattle, Washington. February.
- EPA, 2016b. Draft Final Feasibility Study, Portland Harbor RI/FS. EPA Region 10 (with CDM Smith), Seattle, Washington. February.
- EPA, 2017. Record of Decision, Portland Harbor Superfund Site (including 2018 and 2020 errata sheets), Portland Oregon. EPA Region 10, Seattle, Washington. January.
- EPA, 2019. Explanation of Significant Differences, Portland Harbor Superfund Site, Portland, Oregon. EPA Region 10, Seattle, Washington. December.
- EPA, 2020a. Program Data Management Plan: Portland Harbor Remedial Design Investigation, Portland Harbor Superfund Site, Portland, Oregon.
- EPA, 2020b. National Functional Guidelines for Organic Superfund Methods Data Review. OLEM 9240.0-51/EPA 540-R-20-005. November.
- EPA, 2020c. National Functional Guidelines for Inorganic Superfund Methods Data Review. OLEM 9240.1-66/EPA 540-R-20-006. November.
- EPA, 2020d. National Functional Guidelines for High Resolution Superfund Methods Data Review. OLEM 9240.1-65/EPA 540-R-20-007. November.
- EPA, 2021. Administrative Settlement Agreement and Order on Consent for Remedial Design of Site-Wide Institutional Controls Implementation and Assurance Plan and Information Management Plan. EPA Region 10, Seattle, Washington. November.

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## **APPENDIX A**

### **LABORATORY INFORMATION**

- A.1 ALS Environmental-Kelso**
- A.2 Analytical Resources, Inc.**
- A.3 Cape Fear Analytical**
- A.4 Northwest Testing, Inc.**
- A.5 SGS North America, Inc.**

## **APPENDIX A.1**

### **ALS Environmental-Kelso and Burlington Laboratory Information**



**Burlington  
Test Method**

ID: BU-TM-1103 v09 OCP  
Date: 7-Jul-2020  
Page: 1 of 46

## OCP Instrumental Method - HRMS

### Document Authorization

Authorized By: \_\_\_\_\_ Date: \_\_\_\_\_  
Quality Authorization

Authorized By: \_\_\_\_\_ Date: \_\_\_\_\_  
Technical Authorization

### Implementation Authorization

Authorized By: \_\_\_\_\_ Effective Date: \_\_\_\_\_  
Laboratory Manager



**Burlington  
Test Procedure**

ID: BU-TP-2103 v06 OCP & Toxaphene Prep  
Date: 5-Oct-2018  
Page: 1 of 25

**OCP & Toxaphene Prep**

CONFIDENTIAL

**Document Authorization**

Authorized By: \_\_\_\_\_ Date: \_\_\_\_\_  
Quality Authorization

Authorized By: \_\_\_\_\_ Date: \_\_\_\_\_  
Technical Authorization

**Implementation Authorization**

Authorized By: \_\_\_\_\_ Effective Date: \_\_\_\_\_  
Laboratory Manager



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## **NON-STANDARD TESTING PROCEDURE SUMMARY**

For

### **ELUTRIATE PREPARATIONS**

Revision: 2  
March 23, 2020

Prepared by: Jeff Coronado

#### **SCOPE AND APPLICATION**

The removal of sediments from waterways by dredging generates concern about the possible release of contaminants into the water column. This document describes three commonly used procedures for estimating the magnitude of this release; Effluent Elutriate Procedure (EET, formerly Modified Elutriate Test, MET), Standard Elutriate Test (SET, a.k.a. Open Water Elutriate, OWE), and Dredge Elutriate Procedure (DRET).

#### **SUMMARY OF PROCEDURES**

Sediment and water from a dredging site are combined in ratios prescribed in each procedure, and mixed for a specified period of time mechanically or by aeration. The resulting slurry is then allowed to settle. The supernatant (elutriate) is then removed by siphoning. "Total" analysis may then be performed on the elutriate as is, or if "Dissolved" analysis are needed an aliquot of the elutriate is filtered through a 0.45 $\mu$ m filter for inorganic analysis while a separate aliquot is centrifuged at high speed then decanted for organic analysis.

#### **EQUIPMENT AND SUPPLIES**

1. 8.7 Liter Glass Cylinder and glass watch glasses.
2. Mechanical Mixer, with stainless steal mixing rod.
3. Stainless Steal spoon and Stainless Steal mixing bowl.
4. Compressed Air and Teflon Tubing.



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5. Balance able to weigh to the nearest 0.01 gram.
6. 5 gallon glass carboy
7. Vacuum or pressure filtration equipment.
8. High speed centrifuge capable of spinning 1 L bottles.
9. 1L polycarbonate centrifuge bottles.
10. 0.45-micron membrane filters
11. Glass and plastic bottles appropriate for the testing being conducted on the final elutriate.

## **PROCEDURE**

### **Initial Sample Preparation**

Initial sample preparation is identical for all three elutriate tests.

Bulk sediment is typically received in Teflon bags. Remove each sample from the bag and transfer to a stainless steel mixing bowl or large mixing pot, depending on the sample size.

Manually mix the sample with a large stainless steel spoon or mixing paddle, removing any large artifacts such as rocks, pieces of wood, plastic, etc.

Aliquot the mixed sample to glass jars with Teflon lined lids as follows:

- 32 oz. – Elutriate Testing
- 16 oz. – Archive at -20°C
- 8 oz. – Total Analyses (Organics, Metals, and General Chemistry parameters)

### **Effluent Elutriate Test (EET)**

The EET is performed with a slurry concentration (i.e. sediment to site water ration) of 150 g/L (dry weight basis).



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Determine the bulk density of the sediment (dry weight basis) using ASTM Method E-1109-86, or equivalent.

Calculate the volume of sediment and the corresponding volume of site water required to prepare 8.0 L of slurry using the following equations:

$$A = [(8.0) (150)] \div B$$

$$C = 8.0 - A$$

Where:

A = Volume of Sediment, in L (as rec'd basis)

8.0 = Volume of Elutriation Slurry, in L

150 = Target Concentration of Slurry, in g of dry sediment/L of slurry

B = Bulk Density of Sediment, in g/L (equivalent dry wt. basis)

C = Volume of Site Water, in L

Add the calculated volumes of sediment and site water to the elutriation cylinder (note: CAS custom manufactured cylinders have a total capacity of approximately 8.7 L).

Assemble motor mixer with stainless steel paddle mixer then mechanically mix the sediment/water slurry for 5 minutes. The slurry should be mixed to a uniform consistency, with no unmixed agglomerations of sediment.

Remove the mixing apparatus and secure a Teflon aeration tube to the top of the elutriation cylinder with a clamp, ensuring the end of the tube reaches the bottom of the cylinder. Cover the cylinder with a large watch glass for the duration of aeration and settling.

Pass compressed air through the tube with a flow rate such that the slurry is vigorously mixed for 1 hour.

Note: aeration is used as the means of mixing to ensure that oxidizing conditions will be present in the supernatant during the subsequent settling phase.

Remove the tubing and allow the aerated slurry to settle for 24 hours. Samples that are slow to settle may require increased settling time, or other actions, to



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produce adequate elutriate volume. Refer to the section on Settling Time Anomalies for further guidance.

After settling an interface is usually evident between the supernatant water and the more concentrated settled material below the interface. Using a Teflon tube, siphon the supernatant at a point midway between the water surface and interface. Care must be taken not to re-suspend settled material.

Siphon the supernatant into a 5 gal. glass carboy then mix to ensure complete uniformity.

If total analysis is requested sub-aliquot final elutriate (mixed supernatant) to containers appropriate for the testing being conducted.

If dissolved analysis is requested filter aliquots for metals and other inorganic analytes through 0.45 $\mu$ m membrane filters, then aliquot to appropriate containers. For dissolved organic analysis transfer an aliquot of elutriate to a polycarbonate bottle, centrifuge at 10,000 times gravity, then decant to appropriate containers. (Sample used for organic analysis should not be filtered because of the tendency of these analytes to adsorb on the filter.)

### **Standard Elutriate Test (SET)**

The SET elutriation is performed with a sediment-to-water ratio of 1:4 on a volume basis at room temperature ( $22 \pm 2^\circ\text{C}$ ).

Subsample approximately 1 L of well mixed sediment and transfer to an elutriation cylinder.

Add a volume of site water equal to 4 times the volume of sediment added in previous step.

Vigorously stir the slurry with a mechanical mixer for 30 minutes. At 10 minute intervals stir the mixture manually to ensure complete mixing.

After the 30 minute mixing period allow the slurry to settle for one hour. Cover the cylinder with a large watch glass during the settling period. Samples that are slow to settle may require increased settling time, or other actions, to produce adequate elutriate volume. Refer to the section on Settling Time Anomalies for further guidance.



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Siphon the supernatant into a 5 gallon glass carboy, taking care not to disturb the settled material. Mix to ensure the elutriate is completely uniform.

Transfer the elutriate to polycarbonate bottles and centrifuge at 2000 rpm for 30 minutes (until visually clear).

Transfer the elutriate to containers appropriate to the testing being conducted.

### **Dredge Elutriate Test (DRET)**

The DRET is performed with a slurry concentration (i.e. sediment to site water ration) of 1 to 10 g/L (dry weight basis). When not specified in the project set-up use 10 g/L.

Determine the bulk density of the sediment (dry weight basis) using ASTM Method E-1109-86, or equivalent.

Calculate the volume of sediment and site water required using the following equations:

$$A = [(8.0) (X)] \div B$$

$$C = 8.0 - A$$

Where:

A = Volume of Sediment, in L (as rec'd basis)

8.0 = Volume of Elutriation Slurry, in L

X = Target Concentration of Slurry, in g of dry sediment/L of slurry

B = Bulk Density of Sediment, in g/L (equivalent dry wt. basis)

C = Volume of Site Water, in L

Add the calculated volumes of sediment and site water to the elutriation cylinder (note: CAS custom manufactured cylinders have a total capacity of approximately 8.7 L).

Assemble motor mixer with stainless steel paddle mixer then mechanically mix the sediment/water slurry for 5 minutes. The slurry should be mixed to a uniform consistency, with no unmixed agglomerations of sediment.



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Remove the mixing apparatus and secure a Teflon aeration tube to the top of the elutriation cylinder with a clamp, ensuring the end of the tube reaches the bottom of the cylinder. Cover the cylinder with a large watch glass for the duration of aeration and settling.

Pass compressed air through the tube with a flow rate such that the slurry is vigorously mixed for 1 hour.

Note: aeration is used as the means of mixing to ensure that oxidizing conditions will be present in the supernatant during the subsequent settling phase.

Remove the tubing and allow the aerated slurry to settle for 1 hour. Samples that are slow to settle may require increased settling time, or other actions, to produce adequate elutriate volume. Refer to the section on Settling Time Anomalies for further guidance.

After settling an interface is usually evident between the supernatant water and the more concentrated settled material below the interface. Using a Teflon tube, siphon the supernatant at a point 2 inches above the interface. Care must be taken not to re-suspend settled material.

Siphon the supernatant into a 5 gal. carboy then mix to ensure complete uniformity.

Split the elutriate for total and dissolved analysis. Aliquot the fraction for total analysis to containers appropriate for the testing being conducted.

Filter aliquots for metals and other inorganic analytes through 0.45 $\mu$ m membrane filters, then transfer to appropriate containers. For dissolved organic analysis transfer an aliquot of elutriate to a polycarbonate bottle, centrifuge at 10,000 times gravity, then decant to appropriate containers. (Sample used for organic analysis should not be filtered because of the tendency of these analytes to adsorb on the filter.)

### **Settling Time Anomalies**

Samples with a silt/clay fraction that is slow to settle are occasionally encountered. In these instances obtaining adequate elutriate volume to perform the required testing can be difficult. Three options are available when this situation is encountered. The final



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solution may require a combination of all three. In all cases when deviation from the settling protocols are needed the client must be consulted regarding corrective action.

1. The prescribed settling time can be extended. In some instances additional settling time will provide adequate volume, however some samples show little additional settling with time.
2. If adequate sediment and site water is available additional elutriates can be set up of the impacted sample(s). The subsequent elutriates can then be combined to provide sufficient volume for testing.
3. In cases where dissolved analyses are being performed aliquots of the elutriate from below the settling interface can be taken and centrifuged. The resulting elutriate can then be used for the analysis of dissolved organic compounds or filtered through a 0.45µm membrane filter for metals and other inorganic analytes.



## Separatory Funnel Liquid-Liquid Extraction

DOCUMENT ID: EXT-3510 REVISION 14.0

Prepared By:   
Organics Manager, Jonathon Walter

Date: 12/1/2020

Prepared By:   
Quality Assurance Manager, Kurt Clarkson

Date: 12/1/2020

Approved By:   
Laboratory Director, Charles (Pat) Byrne

Date: 12-1-20



## 1) Scope & Applicability

- 1.1 This procedure uses techniques described in EPA Method 3510C for extracting nonvolatile and semi-volatile organic compounds from aqueous samples. The procedure also describes concentration techniques suitable for preparing the extract for the appropriate determinative methods.
- 1.2 This method is applicable to the isolation and concentration of water insoluble and slightly water soluble organics in preparation for a variety of determinative methods which use chromatographic procedures.

## 2) Summary of Procedure

- 2.1 A measured volume of sample, usually 100mL-1000mL, is serially extracted at a specified pH with Dichloromethane or Hexane using a separatory funnel.
- 2.2 The extract is dried, concentrated, and (if necessary) exchanged to an appropriate solvent for the determinative procedure. The extract may undergo additional cleanup steps defined in other procedures.

## 3) Definitions

- 3.1 For general definitions applicable to most analyses refer to the SOP for *Sample Batches*, ADM-BATCH.

## 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. The department supervisor/manager or designee performs final review and sign-off of the data.

## 5) Interferences

- 5.1 Phthalate esters can pose difficulties when performing sample extractions for Organochlorine pesticides, PCBs, and other semi-volatile organics. Phthalates are easily extracted or leached from materials containing plastics during laboratory operations. Interferences from phthalates can best be minimized by avoiding contact with any plastic materials.
- 5.2 Routine cleaning of the extraction glassware is necessary. Refer to the SOP for Organic Extractions Glassware Cleaning.

## 6) Safety

- 6.1 All appropriate safety precautions for handling solvents, reagents and samples must be taken when performing this procedure as referenced in the ALS Kelso Chemical Hygiene Plan and in the ALS Kelso Lab Waste Management Plan.

## 7) Sample Collection, Containers, Preservation, and Storage

- 7.1 Refer to the applicable section in the determinative SOP for sample collection,



preservation, and holding times.

- 7.2 The extract holding time is 40 days from sample preparation to analysis for most methods; however the determinative SOP must be consulted.

## 8) Standards, Reagents, and Consumable Materials

- 8.1 Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Refer to the SOP Reagent/Standards Login and Tracking for the complete procedure and documentation requirements.
- 8.2 All prepared reagents should be stored in glass to prevent the leaching of contaminants from plastic containers.
- 8.3 Organic-free reagent water - All references to water in this method refer to organic-free reagent water, as defined in Chapter One of SW-846.
- 8.4 Sodium hydroxide solution (10N), NaOH. Dissolve 40 g NaOH in organic-free reagent water and dilute to 100 ml.
- 8.5 Sodium Chloride (granular), NaCl.
- 8.6 Sodium sulfate (granular, anhydrous), Na<sub>2</sub>SO<sub>4</sub>. Purify by heating at 400°C for 4 hours in a shallow tray.
- 8.7 Sulfuric acid solution (1:1 v/v), H<sub>2</sub>SO<sub>4</sub>, purchased. Specific projects may require the use of concentrated HCl.
- 8.8 Extraction/exchange solvents
- 8.8.1 Dichloromethane, CH<sub>2</sub>Cl<sub>2</sub> - Pesticide quality or equivalent.
  - 8.8.2 Hexane - Pesticide quality or equivalent.
  - 8.8.3 2-Propanol, CH<sub>3</sub>CH(OH)CH<sub>3</sub> - Pesticide quality or equivalent.
  - 8.8.4 Acetonitrile, CH<sub>3</sub>CN - Pesticide quality or equivalent.
- 8.9 Methyl t-butyl ether (MTBE), Pesticide quality or equivalent.

## 9) Apparatus and Equipment

- 9.1 Separatory funnel – Appropriate size, with Teflon stopcock.
- 9.2 Drying column - modified funnel with ground glass bottom. Glass wool is at bottom covered by sulfate.
- 9.3 Kuderna-Danish (K-D) apparatus (Kontes K-570025-0500).
- 9.3.1 Concentrator tube - 10 ml, graduated (Kontes K-570050-1025 or equivalent). A ground-glass stopper is used to prevent evaporation of extracts.
  - 9.3.2 Evaporation flask - 500 ml (Kontes K-570001-500 or equivalent). Attach to concentrator tube with springs, clamps, or equivalent.



- 9.3.3 Snyder column - Three ball macro (Kontes K-503000-0121 or equivalent).
- 9.3.4 Springs - 1/2 inch (Kontes K-662750 or equivalent).
- 9.4 Boiling chips - Pre-cleaned via DCM rinse, approximately 10/40 mesh (silicon carbide or equivalent).
- 9.5 Water bath - Heated, with concentric ring cover, capable of temperature control ( $\pm 5^{\circ}\text{C}$ ). The bath should be used in a hood.
- 9.6 Vials - 2 ml, glass with Teflon lined screw-caps or crimp tops.
- 9.7 pH indicator paper - pH range including the desired extraction pH.
- 9.8 Erlenmeyer fleaker - 250 ml.
- 9.9 Syringe - appropriate size syringe or Eppendorf.
- 9.10 Graduated cylinder - Appropriate size, Class A or validated general lab grade
- 9.11 Graduated pipettes, appropriate size.
- 9.12 Rotary Agitator- 12 and 24 Place Variable Speed Motor.

## 10) Preventative Maintenance

- 10.1 Routine cleaning of the extraction glassware is necessary. Refer to the SOP for Organic Extractions Glassware Cleaning.

## 11) Procedure

- 11.1 Test-specific benchsheets are attached. These benchsheets list such information as solvents, solvent exchanges, weights, and volumes specified for the determinative method. Use the correct benchsheet and record all extraction and sample information. To assist the analyst, a brief description of the procedure is given on the backside of the benchsheet.
- 11.2 Procedure for Sample Extraction
  - 11.2.1 Evaluate each sample for settled solid material or sediment.
    - 11.2.1.1 If the sample contains a small amount of material that will not interfere with the separatory funnel extraction, or the material can be suspended in the aqueous layer by shaking, shake the sample to mix the material into the sample and analyze the entire sample. Mark the sample meniscus on each bottle and proceed to the In-Bottle spiking below.
    - 11.2.1.2 If the amount of material is enough to interfere with sample extraction or functioning of the separatory funnel, the Project Manager should be notified to determine the procedure to be used. In this situation the default procedure is to *completely* decant the liquid portion of the sample (without shaking the sample or after re-settling) into a graduated cylinder to measure the volume. It must be documented on the benchsheet when decanting is performed. Proceed to the Graduated Cylinder spiking below.



- 11.2.2 One set of QC containing matrix spike, duplicate matrix spike, lab control sample and method blank is done for every 20 samples.

**Note:** It is important that the correct spiking process be used. Addition of surrogate and spike is routinely witnessed by a second analyst to assure completeness. Refer to the SOP for the *Addition of Spikes and Surrogates* (EXT-SAS) for general practices and witnessing procedures. Also:

11.2.2.1 Make sure the tip of the spiking pipette or syringe is just below the surface of the sample. The spiking solution should go into the sample, not disperse on top of it.

11.2.2.2 Make sure the body of a plastic pipette/pipettor does not touch the inside of the bottle or graduated cylinder.

### 11.2.3 In-Bottle Spiking

11.2.3.1 Add the surrogate spiking solution into the sample in the bottle.

11.2.3.2 For the LCS and sample(s) in each analytical batch selected for matrix spiking, add the prescribed volume matrix spiking standard into the sample bottle.

**Note:** When spiking into the sample bottle, if the bottle has been filled to the top such that there is no room for the spiking solutions, pipet a small amount of the sample into its separatory funnel prior to spiking.

11.2.3.3 Transfer the sample to the separatory funnel by pouring the entire contents into the funnel (nominally 1L bottle, or smaller). Rinse the sample bottle with a portion of extraction solvent and add the rinsate to the funnel.

**NOTE:** When measuring out the correct volume to add to the units, be sure to measure the volume of organic free DI water for the LCS and the MB prior to the sample. In this manner less glassware will be generated for the glasswasher.

11.2.3.4 Measure and record the sample volume by filling the bottle to the mark with water and measuring the volume with a Class A TC graduated cylinder. Record the sample volume on the benchsheet.

11.2.4 Graduated Cylinder Spiking - used if a portion of the sample was transferred to a graduated cylinder due to solids content (section 11.2.1.2).

11.2.4.1 Record the sample volume on the benchsheet.

11.2.4.2 Add the surrogate spiking solution into the sample in the graduated cylinder.



- 11.2.4.3 For the LCS and sample(s) in each analytical batch selected for matrix spiking, add the prescribed volume matrix spiking standard into the designated sample that was transferred to a graduated cylinder. The LCS is a volume of organic free DI water added to a graduated cylinder.
- 11.2.4.4 Transfer the sample to the separatory funnel by pouring the entire contents into the funnel. Rinse the graduated cylinder with the extraction solvent, but do not rinse the sample bottle containing the remaining solid material. The remaining solid material may be analyzed separately (depending on the Project Manager's instructions) and any remaining target analytes in the solid portion will be accounted for in that analysis.
- 11.3 Check the pH of the sample by spotting a wide-range pH strip with the sample using a Pasteur pipette. If necessary, adjust the pH for the specific determinative method that will be used to analyze the extract. Adjustments in pH are made by using sodium hydroxide solution and/or sulfuric acid solution. Specific projects may require the use of concentrated HCl.
- 11.4 Add 15-60 ml of the appropriate solvent to the separatory funnel.

NOTE: Dichloromethane creates excessive pressure very rapidly; therefore, initial venting should be done immediately after the separatory funnel has been sealed and inverted once. Venting of the separatory funnel should be into a hood to avoid needless exposure of the analyst to solvent vapors.
- 11.5 Seal and shake the separatory funnel venting to release excess pressure. Once vented, the separatory funnels are shaken or tumbled for 1-2 minutes.
- 11.6 Allow the organic layer to separate from the water phase. If the emulsion is more than one-third the size of the solvent layer, the analyst may employ mechanical techniques to complete the phase separation. The optimum technique depends upon the sample and may include stirring, filtration of the emulsion through glass wool, centrifugation, or other physical methods. Collect the solvent extract in a fleaker. If the emulsion cannot be broken, transfer the sample, solvent, and emulsion into the extraction chamber of a continuous extractor and proceed as described in Method 3520, Continuous Liquid - Liquid Extraction or contact the Project Manager.
- 11.7 Repeat the extraction two more times using fresh portions of solvent. Combine the three solvent extracts.
- 11.8 If further pH adjustment and extraction is required, adjust the pH of the aqueous phase to the desired pH. Serially extract three times with 15-60 ml of appropriate solvent, as outlined in Sections 11.4 through 11.6.
- 11.9 Perform the concentration using the Kuderna-Danish (K-D) Technique.
  - 11.9.1 Assemble a Kuderna-Danish (K-D) concentrator by attaching a 10 ml concentrator tube to a 500 ml funnel evaporation flask and rinsing 3 times with DCM. Dry the extract by passing it through a drying column



containing anhydrous sodium sulfate. Collect the dried extract in a K-D concentrator. Rinse the Erlenmeyer flask, which contained the solvent extract and add it to the column to complete the quantitative transfer, ensuring to rinse the funnel.

- 11.9.2 Add one or two clean boiling chips to the flask and attach a three ball Snyder column. Pre-wet the Snyder column by adding about 1 ml of Dichloromethane to the top of the column. Place the K-D apparatus on a hot water bath (15-20°C above the boiling point of the solvent) so that the concentrator tube is partially immersed in the hot water and the entire lower rounded surface of the flask is bathed with hot vapor. Adjust the vertical position of the apparatus and the water temperature as required to complete the concentration in 10-20 minutes. At the proper rate of distillation the balls of the column will actively chatter, but the chambers will not flood. When the apparent volume of liquid reaches 10 ml, remove the K-D apparatus from the water bath and allow it to drain and cool for at least 10 minutes.
- 11.9.3 If a solvent exchange is required, momentarily remove the Snyder column, add 15 ml of the exchange solvent, a new boiling chip, and reattach the Snyder column. Concentrate the extract, raising the temperature of the water bath, if necessary, to maintain proper distillation.
- 11.9.4 Remove the Snyder column and rinse the flask and its lower joints into the concentrator tube with 1-2 ml of Dichloromethane or exchange solvent. If sulfur crystals are a problem, proceed to Method 3660 for cleanup. The extract may be further concentrated by using the technique outlined in the next section or adjusted to 10.0 ml with the solvent last used. Measure the final extract volume using a 10mL graduated pipette.
- 11.10 If further concentration is needed, nitrogen blow-down or micro-Snyder techniques are used to adjust the extract to the final volume required.
  - 11.10.1 Place the concentrator tube in a warm water bath (approximately 35°C) or at room temperature and evaporate the solvent volume to the required level using a gentle stream of clean, dry nitrogen (filtered through a column of activated carbon). Do not let the sample go dry. Alternatively a micro-Snyder can be used to concentrate to desired volume.

**CAUTION:** Do not use plasticized tubing between the carbon trap and the sample.
  - 11.10.2 The internal wall of the tube must be rinsed down several times with the appropriate solvent during the operation. During evaporation, the solvent level in the tube must be positioned to prevent water from condensing into the sample (i.e., the solvent level should be below the level of the water bath). Under normal operating conditions, the extract should not be allowed to become dry.



**CAUTION:** When the volume of solvent is reduced below 1 ml, semivolatiles may be lost.

11.11 Take to final volume and transfer the concentrated extract to a labeled autosampler vial (with a Teflon lined screw-cap or crimp top) or storage vial. Measure the final extract volume using a 1mL graduated pipette. The extracts obtained may now be analyzed for the target analytes using the appropriate determinative technique. The extract holding time is 40 days from sample preparation to analysis.

## 12) QA/QC Requirements

12.1 Ongoing QC Samples required are described in the ALS-Kelso Quality Assurance Manual and in the SOP for Sample Batches. Additional QC Samples may be required in project specific quality assurance plans (QAPP). Refer to the SOP for the determinative method for minimum QC requirements.

12.2 Any reagent blanks, laboratory control samples, or matrix spike samples should be subjected to exactly the same analytical procedures as those used on actual samples.

## 13) Data Reduction and Reporting

13.1 Preparation of all samples must be documented on a bench sheet. All information regarding the sample(s) extracted, aliquoted, QC spiked, extraction steps, etc. must be documented by the person(s) performing the extraction. Bench sheets are completed and a batch lot number is assigned. The Manufacturer's lot numbers or ID's for the reagents are added to bench sheets.

13.2 The bench sheet must be reviewed by the extraction lead, supervisor, or instrument lab analyst. The instrument lab analyst should sign-off on the bench sheet, thus accepting custody of the extracts.

13.3 Following primary data review, all data is reviewed by a secondary analyst. Refer to the SOP for *Laboratory Data Review Process* (ADM-DREV) for details. The person responsible for final review of the bench sheet should assess the overall validity and quality of the results.

## 14) Contingencies for Handling Out-of-Control or Unacceptable Data

14.1 Refer to the SOP for Nonconformance and Corrective Action (ADIN-NCAR) for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

## 15) Method Performance

15.1 Refer to the reference method for additional method performance data available.

## 16) Pollution Prevention and Waste Management

16.1 The laboratory will comply with all Federal, State and local regulations governing



waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Lab Waste Management Plan.

17) **Training**

- 17.1 All analysts performing this analysis are required to read and understand this SOP.
- 17.2 Training is documented following the *Employee Training and New Employee Orientation* (ADM-TRAIN).

18) **Method Modifications**

- 18.1 There are no known modifications in this laboratory standard operating procedure from the reference method.

19) **References**

- 19.1 EPA 40 CFR Part 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act; Final Rule and Interim Final Rule and Proposed Rule," March 12, 2007.
- 19.2 EPASW846, Test Methods for Evaluating Solid Waste, Third Edition, Update III, December 1996, Method 3510C, Revision 3
- 19.3 TNI Standard, Volume 1- 2009, TNI Standard, Volume 1 -2016.
- 19.4 DoD Quality Systems Manual for Environmental Laboratories, current version.

20) **Changes Since Last Revision**

Summary of Revision Changes			
Revision Number	Effective Date	Document Editor	Description of Changes
14.0	11/30/2020	T. Caron	Updated The SOP to the current ALS version/format. Sections 11.10 and 11.10.1: Updated concentration procedures. Section 19.0: Updated references.

21) **Attachments, Tables, and Appendices**

21.1 Active Benchsheets

- 21.1.1 [R:\Extractions\Active Benchsheets\3510\3510\\_Fuels-Water.pdf](R:\Extractions\Active Benchsheets\3510\3510_Fuels-Water.pdf).
- 21.1.2 [R:\Extractions\Active Benchsheets\3510\3510\\_TCLP\\_PestPCB.pdf](R:\Extractions\Active Benchsheets\3510\3510_TCLP_PestPCB.pdf).
- 21.1.3 <R:\Extractions\Active Benchsheets\3510\Add Prep 3510 1,4 dioxane.pdf>.
- 21.1.4 [R:\Extractions\Active Benchsheets\3510\Add Prep 3510 DIMP HCL \(SVM\).pdf](R:\Extractions\Active Benchsheets\3510\Add Prep 3510 DIMP HCL (SVM).pdf).
- 21.1.5 <R:\Extractions\Active Benchsheets\3510\Add Prep 3510 TCLP.pdf>.
- 21.1.6 [R:\Extractions\Active Benchsheets\3510\Entrix 3510 prep sheet coextract \(alkanes\).pdf](R:\Extractions\Active Benchsheets\3510\Entrix 3510 prep sheet coextract (alkanes).pdf).
- 21.1.7 [R:\Extractions\Active Benchsheets\3510\Method\\_WIDROAlphaPinene\\_Fuels.pdf](R:\Extractions\Active Benchsheets\3510\Method_WIDROAlphaPinene_Fuels.pdf).



## Continuous Liquid-Liquid Extraction

DOCUMENT ID: EXT-3520, REV 19.0

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Approved By:   
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Date: 12-1-20



## 1) Scope & Applicability

- 1.1 This procedure uses techniques described in EPA Method 3520C for extracting nonvolatile and semi-volatile organic compounds from aqueous samples.
- 1.2 This method is applicable to the isolation and concentration of water insoluble and slightly water soluble organics in preparation for a variety of determinative methods which use chromatographic procedures. Refer to the determinative procedure to determine if this procedure is suitable for the analysis being performed.
- 1.3 Continuous Liquid - Liquid Extraction may be used when a solute is to be transferred from one solvent into another. This procedure involves multiple extractions using immiscible solvents. The solvent is reused as the condensate from a total reflux.
- 1.4 In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPP's supersede method specified requirements. An example of this are projects falling under DOD ELAP. QC requirements defined in the SOP *Department of Defense Projects - Laboratory Practices and Project Management* (ADM-DOD) may supersede the requirements defined in this SOP.

## 2) Summary of Procedure

- 2.1 A measured volume of sample is placed in a continuous liquid-liquid extractor, pH adjusted (if necessary), and extracted with an organic solvent for a determined period of time. In this procedure, the extracting solvent has a higher density than that of the aqueous solution being extracted, allowing the reflux of the heavier extracting solvent to be diverted through the sample, extracting the solute, and then siphoned back into the boiling flask.
- 2.2 The extract is dried, concentrated, and (if necessary) exchanged to an appropriate solvent for the determinative procedure. The extract may undergo additional clean-up steps defined in other procedures.

## 3) Definitions

- 3.1 For general definitions applicable to most analyses refer to the SOP for *Sample Batches*, ADM-BATCH.

## 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. The department supervisor/manager or designee performs final review and sign-off of the data.
- 4.2 It is the responsibility of the department supervisor/manager to document analyst training and method proficiency, as described in the SOP *Employee Training and Orientation* (ADM-TRAIN).



## 5) Interferences

- 5.1 Phthalate esters can pose difficulties when performing sample extractions for organochlorine pesticides, PCBs, and other semi-volatile organics. Phthalates are easily extracted or leached from materials containing plastics during laboratory operations. Interferences from phthalates can best be minimized by avoiding contact with any plastic materials.
- 5.2 Rinse the bottom of the reflux condenser with  $\text{CH}_2\text{Cl}_2$  and/or Acetone to eliminate any possible contaminants from entering the extractor.
- 5.3 Rinse all glass surfaces involved in the extraction process thoroughly with  $\text{CH}_2\text{Cl}_2$  (reagent grade or re-distilled). Three rinses are usually adequate.

## 6) Safety

- 6.1 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.
- 6.2 This method uses Dichloromethane (DCM), a known human carcinogen. Viton brand gloves should be used while rinsing, pouring or transferring the solvent.

## 7) Sample Collection, Containers, Preservation, and Storage

- 7.1 Refer to the applicable section in the determinative SOP for sample collection, preservation, and holding times.
- 7.2 The extract holding time is 40 days from sample preparation to analysis unless otherwise specified in the analytical method.

## 8) Standards, Reagents, and Consumable Materials

- 8.1 Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination.
- 8.2 Reagents and Standards must comply with the traceability, labeling and documentation practices specified in the SOPs *Making Entries onto Analytical Records*; and *Reagent and Standards Login and Tracking* (ADM-RLT). The manufacturer lot number of solvents, reagents, standards and supplies used in an extraction procedure shall be recorded on the each analytical record (bench sheet and/or in a logbook).
- 8.3 All stocks, working solutions and sample dilutions should be prepared using deionized water (DI) conforming to ASTM Type I or ASTM Type II reagent water and deemed organic free. For more information on reagent water generation, refer to the related SOP, Operation and Maintenance of Laboratory Reagent Water Systems.
- 8.4 Sodium sulfate (granular or powder, anhydrous),  $\text{Na}_2\text{SO}_4$ . Purify by heating at  $400^\circ\text{C}$  for 4 hours in a shallow tray and rinsing with DCM.
- 8.5 Dichloromethane (DCM) - Pesticide grade or redistilled if batch testing determines that the solvent is suitable for use.
- 8.6 Hexane,  $\text{C}_6\text{H}_{14}$ . Pesticide quality or equivalent.



- 8.7  $\text{H}_3\text{CCH}_2\text{CH}(\text{CH}_3)_2$ . Pesticide quality or equivalent.
- 8.8 Acetone  $\text{CH}_3\text{COCH}_3$  - Pesticide grade or equivalent
- 8.9 Sodium hydroxide solution (10N), NaOH. Dissolve 40 g NaOH in organic-free reagent water and dilute to 100 ml.
- 8.10 Sodium sulfate (granular, anhydrous),  $\text{Na}_2\text{SO}_4$ . Purify by heating at 400°C for 4 hours in a shallow tray and DCM rinsed.
- 8.11 Sulfuric acid solution (1:1 v/v),  $\text{H}_2\text{SO}_4$ .

## 9) Apparatus and Equipment

- 9.1 Continuous liquid/liquid extraction body.
- 9.2 500 ml round bottom flask
- 9.3 Graduated cylinder, 1 liter, Class A, TC
- 9.4 Stir rod, pH paper, and narrow range pH paper.
- 9.5 Allihn condenser
- 9.6 Boiling chips - Approximately 10/40 mesh (silicon carbide or equivalent). Rinsed with DCM using a large modified funnel with a frit prior to use.
- 9.7 Graduated pipettes, 1, 2 and 5mL. Pipets are pre-tested by lot for bias and precision.

## 10) Preventative Maintenance

- 10.1 Routine cleaning of the extraction glassware is necessary. Refer to the SOP for Organic Extractions Glassware Cleaning.

## 11) Procedure

- 11.1 Test-specific benchsheets are referenced. These benchsheets list such information as solvents, solvent exchanges, weights, and volumes specified for the determinative method. Use the correct benchsheet and record all extraction and sample information. To assist the analyst, a brief description of the procedure is given on the backside of the benchsheet.
- 11.2 Rinse the entire unit thoroughly (in the hood) with DCM and wearing proper PPE, discarding the rinse into a DCM rinse container. Add 3 or 4 boiling chips to the flask and attach the flask to the bottom of the unit. Add ~500 ml of extraction solvent to the body of the extractor in preparation for the addition of the sample. Place on grid clamping device and tighten retaining chain when the desired height is attained. Rinse a 1 liter graduated cylinder with DCM which will be used for the addition of the water or sample to the body of the extractor.
- 11.3 Procedure for Sample Extraction
  - 11.3.1 Evaluate each sample for settled solid material or sediment.
    - 11.3.1.1 If the sample contains a small amount of material that will not interfere with the functioning of the continuous extractor, or the material can be suspended in the aqueous layer by shaking, shake



the sample to mix the material into the sample and analyze the entire sample. Mark the sample meniscus on each bottle and proceed to the In-Bottle spiking below.

11.3.1.2 If the amount of material is enough to interfere with sample extraction, the Project Manager should be notified to determine the procedure to be used. In this situation the default procedure is to completely decant the liquid portion of the sample (without shaking the sample or after re-settling) into a graduated cylinder to measure the volume. It must be documented on the benchsheet when decanting is performed. Proceed to the Graduated Cylinder spiking below.

11.3.2 Refer to the determinative SOP (see Table 1 for a list of applicable SOPs) for the preparation, concentration, storage, and expiration for the surrogate, LCS, and MS spiking solutions. These SOPs also list the resulting final spike concentrations. Each standard should be brought to room temperature before using.

**Note:** It is important that the correct spiking process be used. Addition of surrogate and spike is routinely witnessed by a second analyst to assure completeness. Refer to the SOP for the *Addition of Spikes and Surrogates* (EXT-SAS) for general practices and witnessing procedures. Also:

- Make sure the tip of the spiking pipette or syringe is just below the surface of the sample. The spiking solution should go into the sample, not disperse on top of it.
- Make sure the body of a plastic pipette/pipettor does not touch the inside of the bottle or graduated cylinder.

### 11.3.3 In-Bottle Spiking

11.3.3.1 Add the surrogate spiking solution into the batch QC and sample(s).

11.3.3.2 For the LCS and sample(s) in each analytical batch selected for matrix the sample bottle.

11.3.3.3 Transfer the sample to the extraction apparatus by pouring the entire contents into the continuous body (nominally 1 L bottle, or smaller). Rinse the sample bottle with a portion of extraction solvent and add the rinsate to the extractor.

11.3.3.4 Measure and record the sample volume by filling the bottle to the mark with water and measuring the volume with a Class A TC graduated cylinder. Record the sample volume on the benchsheet.

11.3.4 Graduated Cylinder Spiking – used if a portion of the sample was transferred to a graduated cylinder due to solids content (section 11.3.1).

11.3.4.1 Record the sample volume on the benchsheet.



- 11.3.4.2 Add the surrogate spiking solution into the sample in the graduated cylinder.
- 11.3.4.3 For the LCS and sample(s) in each analytical batch selected for matrix spiking, add the prescribed volume of matrix spiking standard into the designated sample that was transferred to a graduated cylinder. The LCS is a volume of organic free DI water added to a graduated cylinder.
- 11.3.4.4 Transfer the sample to the extraction apparatus by pouring the entire contents into the continuous body. Rinse the graduated cylinder with the extraction solvent, but do not rinse the sample bottle containing the remaining solid material. The remaining solid material may be analyzed separately (depending on the Project Manager's instructions) and any remaining target analytes in the solid portion will be accounted for in that analysis.

**NOTE:** When adding organic free DI water or sample to the mouth of the extractor body, be careful not to pour the volume down the side arm siphon.

- 11.3.5 Check the pH of the sample with narrow-range pH paper and adjust the pH, if necessary, to the pH indicated below, using 1:1 (v/v) sulfuric acid or 10N sodium hydroxide. Add 0.5 mL of the appropriate solution initially to samples that require adjustment. Check the pH with narrow range pH paper to ensure the pH is between 1 and 2 or >11. If the initial addition is insufficient to achieve the target pH, the analyst can then proceed with the addition of additional solution in increments of 0.5 mL until the desired pH is achieved. The samples must be mixed thoroughly after each addition of acid or base before checking the pH. Record the pH on the benchsheet.

<u>DETERMINATIVE PROCEDURE</u>	<u>INITIAL EXTRACTION PH</u>	<u>SECONDARY EXTRACTION PH</u>
ORGANOCHLORINE PESTICIDES (8081), (608)	5-9	None
PCBS AS AROCLORS (8082), (608)	5-9	None
SOCs BY GC/MS (8270)	<2	>11
SIM PAH	As Received*	None

\* - "As received" pH is used for SIM PAH analyses or other PAH-specific tests based on Method 8100 extraction pH listed in EPA Method 3520C. The sample pH is measured and recorded but no pH adjustment is made.

- 11.3.6 Adjust the volume in the extractor body to reach the cycling volume point, with extracting solvent (There should be a minimum of 300 ml of CH<sub>2</sub>Cl<sub>2</sub> in the boiling flask. If not, add additional DI water).
- 11.3.7 Attach the reflux condenser to the unit, turn on and raise temperature



setting until unit is cycling properly (2 to 3 drips of solvent per second).

- 11.3.8 Make sure that each continuous liquid - liquid extractor is cycling properly. For proper operation, the water flow must be continuous from the top outlet of the condensers and the condenser must be cold to the touch before extraction begins.
- 11.3.9 Cycle the unit for an 18-24 hour time period. Method 8270LL and 625LL analyses are light-sensitive: cover the extraction flasks completely with aluminum foil.
- 11.3.10 After the cycling period is completed, shut off all of the temperature controls and allow the unit to cool completely. Remove the reflux condenser from the extractor body and clamp securely to the grid apparatus. Remove the extractor body from the grid apparatus, being careful not to spill the extract in the flask.
- 11.3.11 Method 8270 and 625 analyses only: Cap and store the initial extract. Repeat sections 11.3.5 through 11.3.9 using a new aliquot of extraction solvent and making the secondary pH adjustment (pH >11) as specified in the method (see Table 1 of EPA Method 3520C for 8270).
- 11.3.12 Decant off the remaining extraction solvent from the body of the extractor into the correct waste disposal container, and dump the remaining sample into a collection bucket/sink for neutralization (samples at neutral pH do not need neutralized).
- 11.3.13 Rinse the body of the extractor thoroughly in hot tap water before returning to the glasswasher.
- 11.3.14 Pour the remaining extract from the 500 ml flask into a pre-rinsed K-D apparatus through a funnel containing glass wool and anhydrous sodium sulfate. Add one boiling chip to the K-D apparatus and attach a  $\text{CH}_2\text{Cl}_2$  rinsed Snyder column to the top of the K-D apparatus. Place the K-D apparatus on the S-evap. Set to the proper temperature.

**Method 8270 and 625 Analyses Only:** Pour (combine) the initial extraction (acid side) and secondary extract (base side) through a funnel containing glass wool and anhydrous sodium sulfate into a K-D apparatus.

- 11.4 Concentrate the extract to approximately 5-10 mL. Remove the K-D apparatus from the SVAP and allow to cool. Disassemble the K-D apparatus. Depending on the determinative method, the extract may be further concentrated, solvent exchanged, or adjusted to the necessary volume with the solvent last used. For solvent exchange, continue to section 11.5, if further concentration is required; nitrogen blowdown technique (11.6) is used to adjust the extract to the final volume.
- 11.5 Solvent exchange is required for certain analyses in order to obtain a final extract in a solvent compatible with the analytical system used. Exchange solvents are used as listed below.



<u>Determinative Method</u>	<u>Exchange Solvent Required for Analysis</u>	<u>Exchange Solvent Required for Cleanup</u>
8081	Hexane	Hexane
608	Hexane	Hexane
8082	Hexane	Hexane
8270	none	-

#### 11.6 Nitrogen Blowdown Technique

- 11.6.1 Place the concentrator tube in a warm water bath at  $< 35^{\circ}\text{C}$  and evaporate the solvent volume to the required level using a gentle stream of clean, dry nitrogen (filtered through a column of activated carbon). **Do not let the sample go dry.**

**CAUTION:** Do not use plasticized tubing between the carbon trap and the sample.

- 11.6.2 The internal wall of the tube must be rinsed down several times with the appropriate solvent during the operation. During evaporation, the solvent level in the tube must be positioned to prevent water from condensing into the sample (i.e., the solvent level should be below the level of the water bath). Under normal operating conditions, the extract should not be allowed to become dry.

**CAUTION:** When the volume of solvent is reduced below 1 ml, semi-volatile analytes may be lost.

- 11.7 Measure the final extract volume using an appropriate graduated pipet. Transfer the concentrated extract to the appropriate labeled autosampler vial or storage vial. The extracts obtained may now be analyzed for the target analytes using the appropriate determinative technique. The extract holding time is 40 days from sample preparation to analysis

### 12) QA/QC Requirements

- 12.1 Refer to the SOP for the determinative method and *SOP for Sample Batches* (ADM-BATCH) for minimum QC requirements. Project-specific batching protocols may also be required.
- 12.2 Any reagent blanks, laboratory control samples, or matrix spike samples should be subjected to exactly the same analytical procedures as those used on actual samples.
- 12.3 The QC solutions required by the method must be added as described in the analytical method. The amount and identification of QC solutions added must be documented on the bench sheet. Any reagent blanks, laboratory control samples, or matrix spike samples should be subjected to exactly the same analytical procedures as those used on actual samples.

### 13) Data Reduction and Reporting

- 13.1 Preparation of all samples must be documented on a bench sheet. All information regarding the sample(s) extracted, aliquoted, QC spiked, extraction steps, etc. must be documented by the person(s) performing the extraction. Bench sheets are completed



and a batch lot number is assigned. The Manufacturer's lot numbers or ID's for the reagents are added to bench sheets.

- 13.2 The bench sheet must be reviewed by the extraction lead, supervisor, or instrument lab analyst. The instrument lab analyst should sign-off on the bench sheet, thus accepting custody of the extracts.
- 13.3 Following primary data review, all data is reviewed by a secondary analyst. Refer to the *SOP for Laboratory Data Review Process (ADM-DREV)* for details. The person responsible for final review of the bench sheet should assess the overall validity and quality of the results.

#### 14) Contingencies for Handling Out-of-Control or Unacceptable Data

- 14.1 Refer to the SOP for Nonconformance and Corrective Action (ADIN-NCAR) for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

#### 15) Method Performance

- 15.1 Available method performance data is given in the reference method. In addition, this procedure was validated through single laboratory studies of accuracy and precision as specified in the determinative procedures.

#### 16) Pollution Prevention and Waste Management

- 16.1 The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Lab Waste Management Plan.

#### 17) Training

- 17.1 All analysts performing this analysis are required to read and understand this SOP.
- 17.2 Training is documented following the *Employee Training and New Employee Orientation (ADM-TRAIN)*.

#### 18) Method Modifications

- 18.1 There are no known modifications in this laboratory standard operating procedure from the reference method.

#### 19) References

- 19.1 EPA SW-846, Test Methods for Evaluating Solid Waste, Third Edition, Update III, December 1996, Method 3520C, Revision 3
- 19.2 DoD Quality Systems Manual for Environmental Laboratories, Current Version.
- 19.3 TNI Standard, Volume 1- 2009, 2016.
- 19.4 ISO/IEC 17025:2017 American National Standard, General requirements for the competence of testing and calibration laboratories.

#### 20) Changes Since Last Revision



<b>Summary of Revision Changes</b>			
Revision Number	Effective Date	Document Editor	Description of Changes
19.0	11/30/2020	T. Caron	Updated SOP signatories and ALS SOP format.

21) **Attachments, Tables, and Appendices**

- 21.1 Table 1 - Applicable Determinative SOPS.
- 21.2 Appendix A - Links to Extractions Benchsheets.



**TABLE 1**  
**APPLICABLE DETERMINATIVE SOPS**

CONGENER-SPECIFIC DETERMINATION OF PCBs BY GG/ECD	SOC-8082Co
ORGANOCHLORINE PESTICIDES BY GAS CHROMATOGRAPHY: CAPILLARY COLUMN TECHNIQUE	SOC-8081
PCBS AS AROCLORS	SOC-8082Ar
POLYNUCLEAR AROMATIC HYDROCARBONS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY SIM	SVM-8270P
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS	SVM-8270C
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS - LOW LEVEL PROCEDURE	SVM-8270L
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS SELECTED ION MONITORING	SVM-8270S
ORGANOCHLORINE PESTICIDES AND PCBs	SOC-608
ORGANOCHLORINE PESTICIDES BY GAS CHROMATOGRAPHY	SOC-608.3



## APPENDIX A

### TEST SPECIFIC BENCH SHEETS

[R:\Extractions\Active Benchsheets\3520\3520\\_Water\\_608.doc](R:\Extractions\Active Benchsheets\3520\3520_Water_608.doc)

[R:\Extractions\Active Benchsheets\3520\3520\\_Water\\_PestPCBCon.doc](R:\Extractions\Active Benchsheets\3520\3520_Water_PestPCBCon.doc)

<R:\Extractions\Active Benchsheets\3520\Additional Prep Information for 625-LL.doc>

[R:\Extractions\Active Benchsheets\3520\3520\\_8270&SIM-Water.pdf](R:\Extractions\Active Benchsheets\3520\3520_8270&SIM-Water.pdf)

i



## Solid Phase Extraction

DOCUMENT ID: EXT 3535 REV 8.0

Prepared By:   
Sample Prep Manager, Jonathon Walter

Date: 10/11/19

Prepared By:   
Quality Assurance Manager, Carl Degner

Date: 10/14/19

Approved By:   
General Manager, Ambrose Hughey

Date: 10/16/19



## 1) Scope & Applicability

- 1.1. This procedure uses techniques described in EPA 3535A for extracting nonvolatile and semivolatile organic compounds from aqueous samples. The procedure also describes concentration techniques suitable for preparing the extract for the appropriate determinative methods. Currently, the procedure is used for preparation of samples for methods 8081, 8082, 8270, OC Pest-MS2, OP Pest-MS2, 1,4-Dioxane, and Nonylphenols.
- 1.2. This method is applicable to the isolation and concentration of water insoluble and slightly water soluble organics in preparation for a variety of determinative methods which use chromatographic procedures. The procedure may be applied to other methods providing that the analyst demonstrates the ability of the procedure to give data of acceptable quality in that method.
- 1.3. In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPP's supersede method specified requirements. An example of this are projects falling under DOD ELAP. QC requirements defined in the SOP *Department of Defense Projects - Laboratory Practices and Project Management* (ADM-DOD/ADM-DOD5) may supersede the requirements defined in this SOP.

## 2) Summary of Procedure

- 2.1 Sample preparation procedures vary by analyte group. Extraction of some groups require that the pH of the sample be adjusted to a specified value prior to extraction. Other groups do not require a pH adjustment.
- 2.2 Following any necessary pH adjustment, a measured volume of sample is extracted by passing it through the solid-phase extraction medium (disks or cartridges), which is held in an extraction device designed for vacuum filtration of the sample.
- 2.3 Target analytes are eluted from the solid-phase media using an appropriate solvent, which is collected in a receiving vessel. The resulting solvent extract is dried using sodium sulfate and concentrated, as needed.
- 2.4 As necessary for the specific analysis, the concentrated extract may be exchanged into a solvent compatible with subsequent cleanup procedures or determinative procedures for the measurement of the target analytes.

## 3) Definitions

- 3.1 Batch - A batch of samples is a group of environmental samples that are prepared and/or analyzed together as a unit with the same process and personnel using the same lot(s) of reagents. It is the basic unit for analytical quality control.
  - 3.1.1 Preparation Batch - A preparation batch is composed of one to twenty field samples, all of the same matrix, and with a maximum time between the start of processing of the first and last samples in the batch to be 24 hours.
  - 3.1.2 Analysis Batch - Samples are analyzed in a set referred to as an analysis sequence. The sequence begins with instrument calibration (initial or continuing verification) followed by sample extracts interspersed with calibration standards (CCBs, CCVs, etc.) The sequence ends when the set of samples has been injected or when qualitative and/or quantitative QC criteria indicate an out-of-control situation.



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3.2 Sample

3.2.1 Field Sample - An environmental sample collected and delivered to the laboratory for analysis; a.k.a., client's sample.

3.2.2 Laboratory Sample - A representative portion, aliquot, or subsample of a field sample upon which laboratory analyses are made and results generated.

3.3 Quality System Matrix - The matrix of an environmental sample is distinguished by its physical and/or chemical state and by the program for which the results are intended. The following sections describe the matrix distinctions. These matrices shall be used for purpose of batch and quality control requirements.

3.3.1 Aqueous - Any groundwater sample, surface water sample, effluent sample, and TCLP or other extract. Specifically excluded are samples of the drinking water matrix and the saline/estuarine water matrix...

3.3.2 Saline/Estuarine water - Any aqueous sample from an ocean or estuary or other salt-water source.

3.3.3 Non-aqueous Liquid - Any organic liquid with <15% settleable solids.

3.4 Liquid-Solid Extraction - A solute is transferred from one solvent into another via partitioning between liquid and solid phases. Initially, the solutes have a higher affinity for the solid than the aqueous solution being extracted. The solutes are then extracted from the solid phase with an organic solvent, in which the solutes have a higher affinity for than the solid phase.

3.5 Matrix Spike/Duplicate Matrix Spike (MS/DMS) Analysis - In the matrix spike analysis, predetermined quantities of target analytes are added to a sample matrix prior to sample preparation and analysis. The purpose of the matrix spike is to evaluate the effects of the sample matrix on the method used for the analysis. Duplicate samples are spiked, and analyzed as a MS/DMS pair. Percent recoveries are calculated for each of the analytes detected. The relative percent difference (RPD) between the duplicate spikes (or samples) is calculated and used to assess analytical precision. The concentration of the spike should be at the mid-point of the calibration range or at levels specified by a project analysis plan.

3.6 Laboratory Duplicates (DUP) - Duplicates are additional replicates of samples that are subjected to the same preparation and analytical scheme as the original sample. The relative percent difference (RPD) between the sample and its duplicate is calculated and used to assess analytical precision.

3.7 Surrogate - Surrogates are organic compounds which are similar to analytes of interest in chemical composition, extraction and chromatography, but which are not normally found in environmental samples. The purpose of the surrogates is to evaluate the preparation and analysis of samples. These compounds are spiked into all blanks, standards, samples and spiked samples prior to extraction and analysis. Percent recoveries are calculated for each surrogate.

3.8 Method Blank (MB) - The method blank is an artificial sample composed of analyte-free water or solid matrix and is designed to monitor the introduction of artifacts into the analytical process. The method blank is carried through the entire analytical procedure.

3.9 Laboratory Control Samples (LCS) - The LCS is an aliquot of analyte free water or analyte free solid to which known amounts target analytes are added. The LCS is prepared and analyzed in exactly the same manner as the samples. The percent

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recovery is compared to established limits and assists in determining whether the batch is in control.

#### 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. The department supervisor/manager or designee performs final review and sign-off of the data.
- 4.2 It is the responsibility of the department supervisor/manager to document analyst training and method proficiency as referenced in *Employee Training and Orientation* (ADM-TRAIN).

#### 5) Interferences

- 5.1 The decomposition of some analytes has been demonstrated under basic extraction conditions. Organochlorine pesticides may dechlorinate and phthalate esters may hydrolyze. The rates of these reactions increase with increasing pH and reaction times.
- 5.2 Bonded-phase silica (e.g., C18) will hydrolyze on prolonged exposure to aqueous samples with pH less than 2 or greater than 9. Hydrolysis will increase at the extremes of this pH range and with longer contact times. Hydrolysis may reduce extraction efficiency or cause baseline irregularities. Styrene divinylbenzene (SDB) extraction disks should be considered when hydrolysis is a problem, although pH range with these disks is not unlimited.
- 5.3 Phthalates are a ubiquitous laboratory contaminant. Glass or Teflon extraction apparatus should be used for this method wherever possible because phthalates are used as release agents when molding rigid plastic (e.g., PVC) and as plasticizers for flexible tubing. A method blank should be analyzed, demonstrating that there is no contamination of the sodium sulfate or other reagents listed in this method.
- 5.4 Sample particulates may clog the solid-phase media and result in extremely slow sample extractions. Use of an appropriate filter aid will result in shorter extractions without loss of method performance if clogging is a problem. Even when a filter aid is employed, this method may not be appropriate for aqueous samples with high levels of suspended solids (>1%), as the extraction efficiency may not be sufficient, given the small volumes of solvents employed and the short contact time.

#### 6) Safety

- 6.1 All appropriate safety precautions for handling solvents, reagents and samples must be taken when performing this procedure. This includes the use of personal protective equipment, such as, safety glasses, lab coat and the correct gloves.
- 6.2 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.
- 6.3 This method uses Dichloromethane, a known human carcinogen. Refer to the methylene chloride policy document, ENV-HSE-NA-EX-006-EN for proper handling.

#### 7) Sample Collection, Containers, Preservation, and Storage

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- 7.1 Refer to the applicable section in the determinative SOP for sample collection, preservation, and holding times.
- 7.2 The appropriate sample volume may vary with the intended use of the results and, in general, is the volume necessary to provide the analytical sensitivity necessary to meet the objectives of the project. Under ideal conditions, the sample should be collected by completely filling the container. The sample should generally be collected without additional volume and with little or no headspace. Thus, a 1 L sample is collected in a 1 L container, a 250 mL sample is collected in a 250 mL container, not a 1 L container, etc.

## 8) Apparatus and Equipment

- 8.1 Solid phase extraction manifold
  - 8.1.1 Horizon Technologies SPE-DEX controller and SPE-DEX 4790 extractors.
  - 8.1.2 J.T. Baker Speedisk Expanded Extraction Station.
  - 8.1.3 Vac Elut SPS 24 Extraction Station.
  - 8.1.4 Additional equivalent extraction stations may be used if available.
- 8.2 N-EVAP – Nitrogen evaporation apparatus.
- 8.3 Vacuum system – Capable of maintaining approximately 66 cm of mercury.
- 8.4 Graduated cylinders, 1 Liter, Class A, TC.

## 9) Standards, Reagents, and Consumable Materials

- 9.1 Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Standards, reagents and consumable material documentation shall indicate traceability to purchased neat materials or compounds. Refer to the SOP *Reagent/Standards Login and Tracking* (ADM-RTL) for the complete procedure and documentation requirements.
- 9.2 Organic-free reagent water - All references to water in this method refer to organic-free reagent water, as defined in Chapter One of SW-846.
- 9.3 Sodium sulfate (granular, anhydrous), Na<sub>2</sub>SO<sub>4</sub>. Purify by heating at 400°C for 4 hours in a shallow tray and rinsed with DCM.
- 9.4 Extraction/conditioning/exchange solvents
  - 9.4.1 Methylene chloride - Pesticide quality or equivalent reagent grade
  - 9.4.2 Hexane - Pesticide quality or equivalent.
  - 9.4.3 Acetonitrile- HPLC quality or equivalent.
  - 9.4.4 Methanol - HPLC quality or equivalent.
  - 9.4.5 Acetone - Pesticide quality or equivalent.
  - 9.4.6 Diethyl Ether - Pesticide quality or equivalent.
  - 9.4.7 Methyl tert-Butyl Ether (MTBE) - Pesticide quality or equivalent.
  - 9.4.8 Celite 545 – J.T. Baker filter aid.
- 9.5 Solid-phase extraction disks and cartridges



- 9.5.1 J.T. Baker Speedisk 50-mm, or equivalent. Disks are also available in 47-mm and 90-mm diameters, composed of a variety of solid-phase materials. Other solid phases may be employed, provided that adequate performance is demonstrated for the analytes of interest.
  - 9.5.1.1 C18 Speedisk – 50mm C18 extraction disk.
  - 9.5.1.2 DVB Speedisk – 50mm divinylbenzene extraction disk.
  - 9.5.1.3 Oil & Grease Speedisk – 50mm extraction disk for EPA method 1664.
  - 9.5.1.4 Atlantic DVB SPE Disk.
  - 9.5.1.5 Atlantic C18 SPE Disk
- 9.5.2 Waters Porapak RDX SPE cartridges.
- 9.5.3 J.T. Baker C-18 SPE cartridges.
- 9.5.4 Waters AC-2 SepPak
- 9.6 pH indicator paper - pH range including the desired extraction pH.
- 9.7 Autosampler vials - 2 ml, glass with Teflon lined screw-caps or crimp tops.
- 9.8 VOA vials (40 ml) with Teflon Lined Septum.
- 9.9 1000mL Pre-cleaned amber bottles
- 9.10 Graduated pipettes, 1, 2 and 5mL.
- 9.11 Horizon Vortex Dry Disk – 65 mm.

## 10) Preventive Maintenance

- 10.1 All maintenance activities are recorded in a maintenance logbook kept for each instrument. Pertinent information (serial numbers, instrument I.D., etc.) must be in the logbook. The entry in the log must include: date of event, the initials of who performed the work, and a reference to analytical control.
- 10.2 SPE-DEX 4790 Shutdown Procedure
  - 10.2.1 Load an empty disk holder cup onto the platform with the support screen but no disk.
  - 10.2.2 Attach a collection vessel by twisting it a quarter turn to ensure a vacuum tight seal that is snug but not over tight. Use a retaining clip to hold it in place.
  - 10.2.3 Pour hot water into the empty disk holder with support screen and fill half way. While holding down the ABORT key, press the PURGE key. Release once the run light goes on. This will flush and clean the elute check valve from any solvent or debris.
  - 10.2.4 Turn off the vacuum pump and vent it by disconnecting the line on the waste bottle.
  - 10.2.5 Turn off the gas supply.
  - 10.2.6 Turn off the power supply.
  - 10.2.7 Routine cleaning of the extraction glassware is necessary. Refer to EXT-GC, *Organic Extractions Glassware Cleaning*.

## 11) Procedure



- 11.1 The procedures for solid-phase extraction are similar for most analytes. General procedures for sample preparation, pH adjustment, preparation of the extraction apparatus, and extract concentration that apply to all target analytes are described. The procedures for disk washing, disk conditioning, sample extraction, and sample elution vary depending on the target analyte group. Conditions for specific analyte groups and methods are included in test-specific benchsheets attached. These benchsheets also list such information as solvents, solvent exchanges, weights, and volumes specified for the determinative method. Use the correct benchsheet and record all extraction and sample information. To assist the analyst, a brief description of the procedure is given on the backside of the benchsheet.
- 11.2 Specific procedures described in this SOP were developed for a nominal sample size of 1 Liter. Smaller sample volumes can be used as long as analytical sensitivity is not compromised and/or when high levels of the target analytes are anticipated. However, such samples are best collected in an appropriately-sized container.
- 11.3 Prior to extraction, the analyst must evaluate the sample for applicability of the procedure.
- 11.3.1 Target analytes may be bound in the particulate matter in the sample. Sample preparation procedures must ensure that any particulates in the original sample are included in the sample aliquot that is extracted. If the sample contains excessive particulates, alternate procedures should be considered.
- 11.3.2 This method may not be appropriate for aqueous samples with greater than 1% solids, as such samples can be difficult to filter and the extraction efficiency may be reduced as a result of the small volumes of solvents employed and the short contact time. If the particulate load significantly slows or prevents filtration, alternate procedures should be considered.
- 11.3.3 Target analytes may preferentially adhere to the surfaces of the sample container. Bottle rinses are required. As a result, it is not appropriate to extract only part of the sample from a sample container, e.g., 250 mL from a 1-L sample bottle. This process must be approved by the PC and client.
- 11.4 Disk/cartridges preparation
- 11.4.1 Prior to use, the extraction disks/cartridges must undergo washing steps, usually with different solvents. The steps involved depend on the analytes of interest and the sample matrix (See appendix). Wash the extraction apparatus and disk with the volume of the solvent listed in the appendix. Pull a small amount of solvent through the disk with a vacuum. Turn off the vacuum and allow the disk to soak for the time specified in the appendix.
- 11.4.2 Pull the remaining solvent through the disk and allow disk to dry. These steps may need repeated depending on analytes of interest, and whether more than one washing solvent is required (See appendix).
- 11.4.3 The extraction disks are composed of hydrophobic materials that will not allow water to pass efficiently unless they are pre-wetted with a water-miscible solvent before sample extraction. This step is referred to as conditioning, and the solvent used is dependent on the analytes of interest (see appendix).
- NOTE:** For some disks, beginning with the conditioning step, it is CRITICAL that the disk NOT go dry until after the extraction steps are completed. Should a disk accidentally go dry during the conditioning steps, the conditioning steps for that disk MUST be repeated prior to addition of the sample.



11.4.4 For manual SPE, add the conditioning solvent to the extraction apparatus. Apply a vacuum until a few drops of solvent pass through the disk, ensuring that the disk is soaked with solvent. Turn off the vacuum and allow the disk to soak in the solvent for the time listed in the appendix. Once the soaking time is over, apply the vacuum again, drawing all but a thin layer of solvent through the disk. Stop the vacuum just before the disk goes dry. These steps may need repeated depending on analytes of interest, and whether more than one conditioning solvent is required.

## 11.5 Sample Preparation

11.5.1 Mark the level of the sample on the outside of the sample container for later determination of the sample volume used. Shake the container with the cap tightly sealed, to ensure that any particulate matter is evenly distributed throughout the sample. Measure and record the sample volume by filling the bottle to the mark then measuring with a Class A (TC) graduated cylinder.

11.5.2 Prepare a method blank and LCS from a 1L volume of organic-free reagent water, or a volume of reagent water similar to that being used for the samples (e.g., a 250-mL blank should be used when the sample size is 250 mL, etc.). The blank should be prepared in a 1L amber bottle, graduated cylinder, beaker, or other suitable container. Refer to the determinative SOP (see Table 1 for a list of applicable SOPs) for the preparation, concentration, storage, and expiration for the surrogate, LCS, and MS spiking solutions. These SOPs also list the resulting final spike concentrations.

11.5.3 Add any surrogate standards listed in the determinative method to the samples, method blank, and to the other QC samples. Add any spiking standards listed in the determinative method to the appropriate QC samples. Surrogates and spiking compounds are added to the sample in the original container. The container is then recapped and shaken to mix the spiked analytes into the sample.

11.5.4 The extraction of some groups of analytes requires that the pH of the sample be adjusted to a specified value.

11.5.4.1 When pH adjustment is necessary, it should be performed after the surrogates and matrix spiking compounds (if applicable) have been added and mixed with the sample so that they are affected by the pH in the same manner as the target analytes. This step is performed in the original sample container using the method-specified acid or base.

11.5.4.2 Check the pH of the sample by inserting a clean disposable pipette into the water sample and transferring a drop of water onto the pH paper. If necessary, adjust the pH to the range required for specific analysts of internist.

11.5.5 Assemble a manifold for multiple extractions using the appropriate cartridges or disks following the manufacturer's recommendations.

11.5.6 If samples contain significant quantities of particulates, the use of a filter aid or pre-filter is advisable for disk extractions. J.T. Baker Celite 545, or equivalent is recommended. Add approximately 1g to each sample or ~ 3g to each disk prior to washing steps.

11.5.7 After performing the washing and conditioning steps, pour the sample into the reservoir and, under full vacuum, filter it as quickly as the vacuum will allow (or as specified in the appendix).



- 11.5.8 After the sample has passed through the solid-phase media, dry the disk by maintaining vacuum for time specified in the appendix.
- 11.5.9 Remove the entire standard filter assembly from the manifold and insert a collection vial (already in position when using the Horizon System). The collection vial should have sufficient capacity to hold all of the elution solvents. The drip tip of the filtration apparatus should be seated sufficiently below the neck of the collection vial to prevent analyte loss due to splattering when vacuum is applied.

DETERMINATIVE PROCEDURE	INITIAL EXTRACTION pH	SECONDARY EXTRACTION pH
ORGANOCHLORINE PESTICIDES (8081)	2.5	None
PCBS AS AROCLORS (8082)	2.5	None
PCB CONGENERS (8082)	2.5	None
PAHs BY GC/MS (8270-SIM)	5-9	None
CHLORINATED PESTICIDES BY GC/MS/MS	2.5	None
ORGANOPHOSPHORUS PESTICIDES BY GC/MS/MS	5-9	None
1,4-Dioxane	As received	None

- 11.5.10 An initial elution with a water-miscible solvent, i.e., acetone, methanol or acetonitrile, improves the recovery of analytes trapped in water-filled pores of the sorbent. Use of a water miscible solvent is particularly critical when methylene chloride is used as the second elution solvent. With the collection vial in place, add the volume of elution solvent listed in the appendix to the sample bottle. The solvent is then poured from the bottle onto the extraction disk. Allow the solvent to spread out evenly across the disk, then quickly turn the vacuum on and off to pull the first drops of solvent through the disk. Allow the disk to soak for the periods indicated in the appendix.
- 11.5.11 Rinse the sample bottle with the second solvent listed in the appendix. Transfer this solvent rinse to the extraction disk. If needed, use a disposable pipette to rinse the sides of the extraction apparatus with solvent from the bottle. Draw about half of the solvent through the disk and then release the vacuum. Allow the remaining elution solvent to soak the disk and particulates for the time specified in the appendix before drawing the remaining solvent through the disk under vacuum. When using a filtration aid, adjust the volume of elution solvent so that the entire filtration bed is initially submerged. Repeat the bottle rinsing step as listed in the appendix, continuing to collect the solvent in the vial.
- 11.5.12 Dry the combined extracts in the collection vial by passing the extract through dry disk or syringe packed with sodium sulfate, then quantitatively transferring the extract to an additional collection vial or culture tube. The procedure for using dry disk is included in Appendix A. Alternative drying techniques may be employed if analyte recovery is unaffected.



11.5.13 The extract may now be subjected to cleanup using the appropriate determinative technique(s). Refer to the applicable SOPs.

11.5.14 After drying the extract, and any additional cleanup, perform the nitrogen blowdown (see below) to evaporate the solvent to the appropriate final volume. Measure the final volume with the appropriate graduated pipet (8.10). Transfer extract to a labeled autosampler vial, cap and store as per analytical method. The extract holding time is 40 days from sample preparation to analysis.

#### 11.6 Nitrogen concentration Technique Using N-Vap

11.6.1 Place the concentrator tube in a warm water bath (approximately 35°C) and evaporate the solvent volume to the required level using a gentle stream of clean, dry nitrogen (filtered through a column of activated carbon). **Do not let the sample go dry.**

**CAUTION:** Do not use plasticized tubing between the carbon trap and the sample.

11.6.2 The internal wall of the tube must be rinsed down several times with the appropriate solvent during the operation. During evaporation, the solvent level in the tube must be positioned to prevent water from condensing into the sample (i.e., the solvent level should be below the level of the water bath). Under normal operating conditions, the extract should not be allowed to become dry.

**CAUTION:** When the volume of solvent is reduced below 1 ml, semi-volatile analytes may be lost.

#### 11.7 Nitrogen Concentration Technique Using Turbo-Vap

11.7.1 Turn on the power to the Turbo-Vap and set water bath temperature to < 32°C. Set the nitrogen regulator between 8-10 psi.

11.7.2 Place the collector from the Dry-Disk into the Turbo-Vap and evaporate the solvent volume to the required level using a gentle stream of clean, dry nitrogen (filtered through a column of activated carbon). **Do not let the sample go dry.**

11.7.3 The internal wall of the tube must be rinsed down several times with the appropriate solvent during the operation if exchanging solvents. Concentrate to slightly less than the determinative methods final volume.

### 12) QA/QC Requirements

12.1 Refer to the SOP for the determinative method and *SOP for Sample Batches* for minimum QC requirements. Project-specific batching protocols may also be required.

12.2 Any reagent blanks, laboratory control samples, or matrix spike samples should be subjected to exactly the same extraction procedures as those used on actual samples.

12.3 The QC solutions required by the method must be added as described in the analytical method. The amount and identification of QC solutions added must be documented on the bench sheet. Any reagent blanks, laboratory control samples, or matrix spike samples should be subjected to exactly the same analytical procedures as those used on actual samples.

### 13) Data Reduction and Reporting



- 13.1 Preparation of all samples must be documented on a bench sheet. All information regarding the sample(s) extracted, aliquoted, QC spiked, extraction steps, etc. must be documented by the person(s) performing the extraction.
- 13.2 The bench sheet must be reviewed by the extraction lead, supervisor, or instrument lab analyst. The instrument lab analyst should sign-off on the bench sheet, thus accepting custody of the extracts.

#### 14) Method Performance

- 14.1 Available method performance data is given in the reference method. In addition, this procedure was validated through single laboratory studies of accuracy and precision as specified in the determinative procedures.

#### 15) Pollution Prevention and Waste Management

- 15.1 It is the laboratory's practice to minimize the amount of solvents, acids and reagent used to perform this method wherever feasible. Standards are prepared in volumes consistent with methodology and only the amount needed for routine laboratory use is kept on site. The threat to the environment from solvent and reagents used in this method can be minimized when recycled or disposed of properly.
- 15.2 The laboratory will comply with all Federal, State and local regulations governing waste restrictions as specified in the ALS Lab Waste Management Plan.
- 15.3 This method uses Methylene Chloride and any waste generated from this solvent must be placed in the collection cans in the lab. The solvent will then be added to the hazardous waste storage area and recycled off site.
- 15.4 This method uses non-halogenated solvents and any waste generated from this solvent must be placed in the collection cans in the lab. The solvent will then be added to the hazardous waste storage area and disposed of in accordance with Federal and State regulations

#### 16) Corrective Actions for Out-of-Control Data or Unacceptable Data

- 16.1 Refer to the SOP for *Nonconformance and Corrective Action Procedures* (ADM-NCAR) for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.
- 16.2 Handling out-of-control or unacceptable data
  - 16.2.1 On-the-spot corrective actions that are routinely made by analysts and result in acceptable analyses should be documented as normal operating procedures, and no specific documentation need be made other than notations in laboratory maintenance logbooks, run logs, for example.
  - 16.2.2 Some examples when documentation of a nonconformity is required using a Nonconformity and Corrective Action Report (NCAR):
    - Quality control results outside acceptance limits for accuracy and precision.
    - Method blanks or continuing calibration blanks (CCBs) with target analytes above acceptable levels.
    - Sample holding time missed due to laboratory error or operations.
    - Deviations from SOPs or project requirements.
    - Laboratory analysis errors impacting sample or QC results.



- Miscellaneous laboratory errors (spilled sample, incorrect spiking, etc.).
- Sample preservation or handling discrepancies due to laboratory or operations error.
- Customer inquiries concerning data quality or services (when applicable). NCAR not required for simple corrections with no impact to the client.
- Data errors reported to clients, non-conforming re-checks.
- Deficiencies found during internal or external audits.
- Login errors or shipping errors.
- IT issues if there is a significant impact to a client.
- Turnaround time complaints.

## 17) Training

### 17.1 Training outline

17.1.1 Review literature (see references section). Read and understand the SOP. Also review the applicable SDSs for all reagents and standards used. Following the reviews, observe the procedure as performed by an experienced analyst at least three times.

17.1.2 The next training step is to assist in the procedure under the guidance of an experienced analyst. During this period, the analyst is expected to transition from a role of assisting, to performing the procedure with minimal oversight from an experienced analyst.

17.1.3 Perform initial precision and recovery (IPR) study as described above for water samples. Summaries of the IPR are reviewed and signed by the supervisor. Copies may be forwarded to the employee's training file. For applicable tests, IPR studies should be performed in order to be equivalent to NELAC's Initial Demonstration of Capability.

### 17.2 Training is documented following *Employee Training and Orientation* (ADM-TRAIN).

17.2.1 When the analyst training is documented by the supervisor on internal training documentation forms, the supervisor is acknowledging that the analyst has read and understands this SOP and that adequate training has been given to the analyst to competently perform the analysis independently.

## 18) References and Related Documents

- 18.1 EPA 40 CFR Part 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act; National Primary drinking Water Regulations: and National Secondary drinking Water Regulations: analysis and Sampling Procedures. March 12, 2007
- 18.2 EPASW846, Test Methods For Evaluating Solid Waste, Draft Update IVA, November 2000, Method 3535A, Revision 1.
- 18.3 Determination of 1,4-Dioxane in Drinking Water by Solid Phase Extraction (SPE) and Gas Chromatography/Mass Spectrometry (GC/MS) with Selected Ion Monitoring (SIM). EPA Method 522, Version 1.0, September, 2008, National Exposure Research Laboratory Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio 45268.
- 18.4 Quality Systems Manual for Environmental Laboratories current version.
- 18.5 TNI Standard, Volume 1- 2009
- 18.6 Procedural Change Request dated 9/3/2019 (JW).



## 19) Summary of Changes

Summary of Revision Changes			
Revision Number	Effective Date	Document Editor	Description of Changes
8.0	10/25/201910/25/2019	T. Caron	Reformatted SOP to current ALS format. Minor typographical, grammatical, and formatting revisions. Section 1: Updated Scope and Application Section 5: Updated dated section to current safety practices.; Added DCM safety related to DCM. Section 6: Updates Apparatus and Equipment list. Section 9: Standards, reagents and consumables have been updated. Section 11: Extraction technique and procedural changes to reflect current practice. Tables and Appendices have been updated to reflect current information and determinative SOPs. Hyperlinks to Analytical benchsheets have been added into the SOP. Attachment A: SPE Parameters have been updated.

## 20) Attachments and Appendices

- 20.1 Table 1: Applicable Determinative SOPs.
- 20.2 Appendix A: Dry Disc Procedure.
- 20.3 Attachment A: Test-Specific SPE Parameters.

## 21) Applicable Benchsheets

- 21.1 [R:\Extractions\Active Benchsheets\3535\3535\\_1,4-Dioxane-Water.pdf](R:\Extractions\Active Benchsheets\3535\3535_1,4-Dioxane-Water.pdf)
- 21.2 [R:\Extractions\Active Benchsheets\3535\3535\\_Nonlyphenol-Water.pdf](R:\Extractions\Active Benchsheets\3535\3535_Nonlyphenol-Water.pdf)
- 21.3 [R:\Extractions\Active Benchsheets\3535\3535\\_OC Pest MS-Water.pdf](R:\Extractions\Active Benchsheets\3535\3535_OC Pest MS-Water.pdf)
- 21.4 [R:\Extractions\Active Benchsheets\3535\3535\\_OP Pest MS-Water.pdf](R:\Extractions\Active Benchsheets\3535\3535_OP Pest MS-Water.pdf)
- 21.5 [R:\Extractions\Active Benchsheets\3535\3535\\_OTTO Fuel-Water.pdf](R:\Extractions\Active Benchsheets\3535\3535_OTTO Fuel-Water.pdf)
- 21.6 [R:\Extractions\Active Benchsheets\3535\3535\\_PBDE-Water.pdf](R:\Extractions\Active Benchsheets\3535\3535_PBDE-Water.pdf)
- 21.7 [R:\Extractions\Active Benchsheets\3535\3535\\_PestPCBCon-Water.pdf](R:\Extractions\Active Benchsheets\3535\3535_PestPCBCon-Water.pdf)



**TABLE 1**  
**APPLICABLE DETERMINATIVE SOPs**

ORGANOCHLORINE PESTICIDES BY GAS CHROMATOGRAPHY: CAPILLARY COLUMN TECHNIQUE	SOC-8081
PCBS AS AROCLORS	SOC-8082A
POLYNUCLEAR AROMATIC HYDROCARBONS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY SIM	SVM-8270P
CONGENER-SPECIFIC DETERMINATION OF PCBS BY GC/ECD	SOC-8082C
CHLORINATED PESTICIDES BY GC/MS/MS	SVM-PESTMS2
ORGANOPHOSPOROUS PESTICIDES BY GC/MS/MS	SVM-OPPESTMS2
ENDOCRINE DISTUPTING COMPOUNDS BY DERIVATIVATION AND GC/MS	SVM-EDC
ADD SEMIVOLATILE ORGANIC COMOUNDS BY GC/MS SELECTIVE ION MONITORING EPA METHOD 8270D	SVM-8270S
DETERMINATION OF OTTO FUELS IN WATER.	SOC-OTTO



### APPENDIX A Dry Disk Procedure

1. Turn on vacuum to the Horizon dry disk manifold, attach flasks and remove glass cup.
2. Rinse screen with acetone followed by DCM.
3. Rinse glass cup with acetone followed by DCM.
4. Carefully place dry disk membrane on the screen. Take care in handling the disk membrane so as to not tear or scratch the Teflon.
5. Place glass cup on sick/screen and tighten by screwing down.
6. Rinse glass cup and disk with DCM.
7. Rinse glass cup and disk with hexane or the extraction solvent if not hexane.
8. Remove waste collection flask and attach collector. TILT
9. Pour the entire contents of the collected extract onto the top of the disk and apply vacuum. Transfer the sample label from the VOA vial to the collector.
10. Rinse the empty VOA vial 3 times with Hexane or the extraction solvent if not hexane, adding each rinse to the dry disk.
11. Rinse the dry disk apparatus and glass cup and allow all the solvent to pass through. Do not let the remaining water sit on the filter with the vacuum on, as the disk will become permeable after several minutes.
12. Place the sample into the turbo-vap and concentrate to approximately 1 ml.



**Attachment A**  
**Test-Specific SPE Parameters**

**OTTO Solid Phase Extraction Parameters**

**Purge Method Number** **8332**

**Initial purge before loading method**

Step	Solvent	Soak Time (mins)	Dry Time (mins)
Prewet 1	Hexane	0:00	0:30
Prewet 2	Methanol	0:00	0:30
Prewet 3	DI Water	0:00	0:30
<b>Sample Processing</b>			
<b>Air Dry</b>			0:00
Rinse 1	Acetone	0:00	0:30
Rinse 2	Hexane	0:00	0:30

**Extraction Method Number**

**8331**

**Disk Type**

**DVB-H<sub>2</sub>O Phobic**

**Sample pH**

**Neutral**

Step	Solvent	Soak Time (mins)	Dry Time (mins)
Prewet 1	Hexane	2:00	0:30
Prewet 2	Methanol	2:00	0:30
Prewet 3	DI Water	1:00	0:30
Prewet 4	DI Water	1:00	0:00
<b>Sample Processing</b>			
<b>Air Dry</b>			1:00
Rinse 1	Acetone	0:30	0:30
Rinse 2	Hexane	2:00	2:00

**Purge Method Number**

**8333**

**Between sample purge**

Step	Solvent	Soak Time (mins)	Dry Time (mins)
<b>Air Dry</b>			0:00
Rinse 1	Acetone	0:00	0:30
Rinse 2	Hexane	0:00	0:30

**OC Pest MS Solid Phase Extraction Parameters****Purge Method Number 8081.4****Initial purge before loading method**

Step	Solvent	Soak Time (mins)	Dry Time (mins)
Prewet 1	DCM	0:05	0:10
Prewet 2	Acetone	0:05	0:10
Prewet 3	Methanol	0:05	0:10
Prewet 4	DI Water	0:05	0:10
<b>Sample Processing</b>			
<b>Air Dry</b>			0:00
Rinse 1	Acetone	0:05	0:10
Rinse 2	Hexane	0:05	0:10
Rinse 3	Hexane	0:05	0:10

**Extraction Method Number****8081.6****Disk Type****DVB-H<sub>2</sub>O Phobic****Sample pH****5-9**

Step	Solvent	Soak Time (mins)	Dry Time (mins)
Prewet 1	DCM	1:30	0:30
Prewet 2	DCM	1:30	0:30
Prewet 3	Acetone	1:30	0:30
Prewet 4	Methanol	1:30	0:10
Prewet 5	DI Water	0:10	0:05
<b>Sample Processing</b>			
<b>Air Dry</b>			5:00
Rinse 1	Acetone	1:00	1:00
Rinse 2	Hexane	1:00	1:00
Rinse 3	Hexane	1:00	1:00

**Purge Method Number****8081.8****Between sample purge**

Step	Solvent	Soak Time (mins)	Dry Time (mins)
<b>Air Dry</b>			0:00
Rinse 1	Acetone	0:05	0:10
Rinse 2	Hexane	0:05	0:10
Rinse 3	Hexane	0:05	0:10
Rinse 3	Hexane	0:05	0:10

**Recovery Method Number****911**

Use this program to restart extraction on a disk that has already loaded the sample, but has stopped or timed out. Before starting this program, you must remove the water from the disk, so that the thermal sensors are exposed. When the sample resumes loading, slowly add the water back onto the disk.			
Step	Solvent	Soak Time (mins)	Dry Time (mins)
<b>Air Dry</b>			3:00
Rinse 1	Acetone	1:00	1:00
Rinse 2	Hexane	1:00	1:00
Rinse 3	Hexane	1:00	1:00
Rinse 4	Hexane	1:00	1:00

**PBDE Solid Phase Extraction Parameters****Purge Method Number 8081.4****Initial purge before loading method**

Step	Solvent	Soak Time (mins)	Dry Time (mins)
Prewet 1	DCM	0:05	0:10
Prewet 2	Acetone	0:05	0:10
Prewet 3	Methanol	0:05	0:10
Prewet 4	DI Water	0:05	0:10
<b>Sample Processing</b>			
<b>Air Dry</b>			0:00
Rinse 1	Acetone	0:05	0:10
Rinse 2	Hexane	0:05	0:10
Rinse 3	Hexane	0:05	0:10

**Extraction Method Number 7233****Disk Type****DVB-H<sub>2</sub>O Phobic****Sample pH****2 using H<sub>2</sub>SO<sub>4</sub>**

Step	Solvent	Soak Time (mins)	Dry Time (mins)
Prewet 1	DCM	1:30	0:30
Prewet 2	Acetone	1:30	0:30
Prewet 3	Methanol	1:30	0:10
Prewet 4	DI Water	0:10	0:10
<b>Sample Processing</b>			
<b>Air Dry</b>			5:00
Rinse 1	Acetone	1:30	1:00
Rinse 2	Hexane	2:00	1:00
Rinse 3	Hexane	2:00	1:00

**Purge Method Number 8081.8****Between sample purge**

Step	Solvent	Soak Time (mins)	Dry Time (mins)
<b>Air Dry</b>			0:00
Rinse 1	Acetone	0:05	0:10
Rinse 2	Hexane	0:05	0:10
Rinse 3	Hexane	0:05	0:10
Rinse 3	Hexane	0:05	0:10

**Recovery Method Number 911**

Use this program to restart extraction on a disk that has already loaded the sample, but has stopped or timed out. Before starting this program, you must remove the water from the disk, so that the thermal sensors are exposed. When the sample resumes loading, slowly add the water back onto the disk.			
Step	Solvent	Soak Time (mins)	Dry Time (mins)
<b>Air Dry</b>			3:00
Rinse 1	Acetone	1:00	1:00
Rinse 2	Hexane	1:00	1:00
Rinse 3	Hexane	1:00	1:00
Rinse 4	Hexane	1:00	1:00

**Nonylphenol Solid Phase Extraction Parameters****Purge Method Number 8270.9****Initial purge before loading method**

Step	Solvent	Soak Time (mins)	Dry Time (mins)
Prewet 1	DCM	0:00	0:05
Prewet 2	Acetone	0:00	0:05
Prewet 4	DI Water	0:00	0:05
<b>Sample Processing</b>			
<b>Air Dry</b>			0:00
Rinse 1	DCM	0:05	0:10
Rinse 2	Acetone	0:05	0:15

**Extraction Method Number 8270.2****Disk Type DVB-H<sub>2</sub>O Phobic****Sample pH 2**

Step	Solvent	Soak Time (mins)	Dry Time (mins)
Prewet 1	DCM	1:00	0:30
Prewet 2	Acetone	1:00	0:30
Prewet 3	DI Water	1:00	0:30
Prewet 4	DI Water	0:00	0:00
<b>Sample Processing</b>			
<b>Air Dry</b>			0:00
Rinse 1	Acetone	3:00	0:10
Rinse 2	DCM	3:00	0:10
Rinse 3	DCM	1:00	0:10
Rinse 4	DCM	1:00	0:10
Rinse 5	DCM	1:00	0:10
Rinse 6	DCM	1:00	0:10
Rinse 7	DCM	1:00	0:10
Rinse 8	DCM	1:00	0:30

**Purge Method Number 8270.6****Between sample purge**

Step	Solvent	Soak Time (mins)	Dry Time (mins)
<b>Air Dry</b>			0:00
Rinse 1	Acetone	0:05	0:10
Rinse 2	DCM	0:05	0:15
Rinse 3	DCM	0:05	0:15
Rinse 3	DCM	0:05	0:15

**Recovery Method Number 911.2**

Use this program to restart extraction on a disk that has already loaded the sample, but has stopped or timed out. Before starting this program, you must remove the water from the disk, so that the thermal sensors are exposed. When the sample resumes loading, slowly add the water back onto the disk.

Step	Solvent	Soak Time (mins)	Dry Time (mins)
<b>Air Dry</b>			5:00
Rinse 1	Acetone	1:00	3:00
Rinse 2	DCM	1:00	1:00
Rinse 3	DCM	1:00	1:00
Rinse 4	DCM	1:00	1:00

**OP Pest MS Solid Phase Extraction Parameters****Purge Method Number 8141.2****Initial purge before loading method**

Step	Solvent	Soak Time (mins)	Dry Time (mins)
Prewet 1	Acetone	0:00	0:05
Prewet 2	Methanol	0:00	0:05
Prewet 3	DI Water	0:00	0:05
<b>Sample Processing</b>			
<b>Air Dry</b>			0:00
Rinse 1	Acetone	0:00	0:05
Rinse 2	DCM	0:00	0:05
Rinse 3	DCM	0:00	0:05
Rinse 4	DCM	0:00	0:15

**Extraction Method Number 8141.4****Disk Type DVB-H<sub>2</sub>O Phobic****Sample pH 5-9**

Step	Solvent	Soak Time (mins)	Dry Time (mins)
Prewet 1	Acetone	1:00	1:30
Prewet 2	Methanol	1:00	0:00
Prewet 3	DI Water	1:00	0:00
<b>Sample Processing</b>			
<b>Air Dry</b>			3:00
Rinse 1	Acetone	1:00	1:00
Rinse 2	DCM	1:00	1:00
Rinse 3	DCM	1:30	2:00
Rinse 4	DCM	1:30	2:00
Rinse 5	DCM	1:30	2:00

**Purge Method Number 8141.3****Between sample purge**

Step	Solvent	Soak Time (mins)	Dry Time (mins)
<b>Air Dry</b>			0:00
Rinse 1	Acetone	0:00	0:05
Rinse 2	DCM	0:00	0:05
Rinse 3	DCM	0:00	0:05
Rinse 3	DCM	0:00	0:15

**Recovery Method Number 911.2**

Use this program to restart extraction on a disk that has already loaded the sample, but has stopped or timed out. Before starting this program, you must remove the water from the disk, so that the thermal sensors are exposed. When the sample resumes loading, slowly add the water back onto the disk.

Step	Solvent	Soak Time (mins)	Dry Time (mins)
<b>Air Dry</b>			5:00
Rinse 1	Acetone	1:00	3:00
Rinse 2	DCM	1:00	1:00
Rinse 3	DCM	1:00	1:00
Rinse 4	DCM	1:00	1:00

**PCB, Cong & Pest Solid Phase Extraction Parameters****Purge Method Number 8081.4****Initial purge before loading method**

Step	Solvent	Soak Time (mins)	Dry Time (mins)
Prewet 1	DCM	0:05	0:10
Prewet 2	Acetone	0:05	0:10
Prewet 3	Methanol	0:05	0:10
Prewet 4	DI Water	0:05	0:10
<b>Sample Processing</b>			
<b>Air Dry</b>			0:00
Rinse 1	Acetone	0:05	0:10
Rinse 2	Hexane	0:05	0:10
Rinse 3	Hexane	0:05	0:10

**Extraction Method Number 8100****Disk Type Atlantic C-18****Sample pH 2.5 using H<sub>2</sub>SO<sub>4</sub>**

Step	Solvent	Soak Time (mins)	Dry Time (mins)
Prewet 1	DCM	1:30	0:30
Prewet 2	DCM	1:30	0:30
Prewet 3	Acetone	1:30	0:30
Prewet 4	Methanol	1:30	0:10
Prewet 5	DI Water	0:10	0:10
<b>Sample Processing</b>			
<b>Air Dry</b>			0:30
Rinse 1	Acetone	1:00	0:30
Rinse 2	DCM	1:00	0:30
Rinse 3	Hexane	1:00	0:30
Rinse 3	Hexane	1:00	1:00

**Purge Method Number 8081.8****Between sample purge**

Step	Solvent	Soak Time (mins)	Dry Time (mins)
<b>Air Dry</b>			0:00
Rinse 1	Acetone	0:05	0:10
Rinse 2	Hexane	0:05	0:10
Rinse 3	Hexane	0:05	0:10
Rinse 3	Hexane	0:05	0:10

**Recovery Method Number 911.3**

Use this program to restart extraction on a disk that has already loaded the sample, but has stopped or timed out. Before starting this program, you must remove the water from the disk, so that the thermal sensors are exposed. When the sample resumes loading, slowly add the water back onto the disk.

Step	Solvent	Soak Time (mins)	Dry Time (mins)
<b>Air Dry</b>			1:00
Rinse 1	Acetone	1:00	0:30
Rinse 2	DCM	1:00	0:30
Rinse 3	Hexane	1:00	0:30
Rinse 4	Hexane	1:00	1:00



## Automated Soxhlet Extraction

DOCUMENT ID: EXT-3541, REV 13.0

Prepared By:   
Organics Manager, Jonathon Walter

Date: 12/1/2020

Prepared By:   
Quality Assurance Manager, Kurt Clarkson

Date: 12/1/2020

Approved By:   
Laboratory Director, Charles Pat) Byrne

Date: 12-1-20



## 1) Scope & Applicability

- 1.1 This procedure uses techniques described in EPA Method 3541 for extracting nonvolatile and semi-volatile organic compounds from solids such as soils, sediments, sludges, wastes, and tissues.
- 1.2 This method is applicable to the isolation and concentration of water insoluble and slightly water soluble organics in preparation for a variety of chromatographic procedures.
- 1.3 In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPP's supersede method specified requirements. An example of this are projects falling under DoD ELAP. QC requirements defined in the SOP *Department of Defense Projects – Laboratory Practices and Project Management* (ADM-DOD/ADM-DOD5) may supersede the requirements defined in this SOP.

## 2) Summary of Procedure

- 2.1 This procedure describes the automated Soxhlet extraction process. The Soxhlet extraction ensures constant contact of the sample matrix with the extraction solvent over a period of time. The solid sample is mixed with anhydrous sodium sulfate, placed in an extraction thimble above a plug of glass wool, and extracted using an appropriate solvent on a Soxtherm extractor for a prescribed amount of time.
- 2.2 Following the extraction period, the resulting extract is then dried if necessary, concentrated, and as necessary, exchanged into a solvent compatible with the cleanup or determinative step being employed.

## 3) Definitions

- 3.1 For general definitions applicable to most analyses refer to the SOP for *Sample Batches*, ADM-BATCH.

## 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.
- 4.2 It is the responsibility of the department supervisor/manager to document analyst training and method proficiency, as described in the determinative method, and in the SOP for *Employee Training and Orientation*.

## 5) Interferences

- 5.1 Phthalate esters can pose difficulties when performing sample extractions for organochlorine pesticides, PCBs, and other semi-volatile organics. Phthalates are easily extracted or leached from materials containing plastics during laboratory operations.



Interferences from phthalates can best be minimized by avoiding contact with any plastic materials.

- 5.2 Contamination by carryover can occur whenever high-concentration and low-concentration samples are sequentially analyzed. All apparatus must be cleaned prior to use on individual samples.
- 5.3 Soap residue, which results in a basic pH on glassware surfaces, may cause degradation of certain analytes. Specifically, Aldrin, Heptachlor, and most OP pesticides will degrade in this situation. All glassware must be rinsed very carefully to avoid this problem.
- 5.4 Refer to SW-846 Method 3500 for additional discussion of interferences. Additional cleanup procedures are described in the applicable ALS SOP.

## 6) Safety

- 6.1 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.
- 6.2 This method uses Dichloromethane, a known human carcinogen. Refer to the methylene chloride policy document, ENV-HSE-NA-EX-006-EN for proper handling.

<G:\SAFETY\TRAINING\Methylene Chloride\Methylene Chloride - NA 031419.pdf>

## 7) Sample Collection, Containers, Preservation, and Storage

- 7.1 Refer to the applicable section in the determinative SOP for sample collection, preservation, and holding times.
- 7.2 The extract holding time is 40 days from sample preparation to analysis unless otherwise specified in the analytical method.

## 8) Standards, Reagents, and Consumable Materials

- 8.1 Pesticide grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Refer to the SOP *Reagent/Standards Login and Tracking* (ADM-RTL) for the complete procedure and documentation requirements.
- 8.2 Reagents and Standards must comply with the traceability, labeling and documentation practices specified in the SOPS *Making Entries onto Analytical Records*; and *Reagent and Standards Login and Tracking* (ADM-RLT). The manufacturer lot number of solvents, reagents, standards and supplies used in an extraction procedure shall be recorded on the each analytical record (bench sheet and/or in a logbook).
- 8.3 Organic-free reagent water. All references to water in this method refer to organic-free reagent water, as defined in Chapter One of SW-846.



- 8.4 Sodium sulfate (granular, anhydrous),  $\text{Na}_2\text{SO}_4$ . Purify by heating at  $400^\circ\text{C}$  for 4 hours in a shallow tray and rinsed with DCM.
- 8.5 Matrix sand. Purify by heating at  $400^\circ\text{C}$  for 4 hours.
- 8.6 Corn oil
- 8.7 Blank tissue matrix. Analyte free ground turkey or equivalent
- 8.8 Extraction Solvents - Samples are extracted using one of the following solvent systems:
  - 8.8.1 Acetone/Hexane (1:1) (v/v),  $\text{CH}_3\text{COCH}_3/\text{C}_6\text{H}_{14}$ . Pesticide quality or equivalent. Soil, sediment, and aqueous sludge samples.
  - 8.8.2 Dichloromethane/Acetone (1:1 v/v),  $\text{CH}_2\text{Cl}_2/\text{CH}_3\text{COCH}_3$ . Pesticide quality or equivalent. Soil, sediment, and aqueous sludge samples.
- 8.9 Dichloromethane (DCM),  $\text{CH}_2\text{Cl}_2$ . Pesticide quality or equivalent. Other miscellaneous sample matrices.

## 9) Apparatus and Equipment

- 9.1 Soxtherm automated extraction system
  - 9.1.1 Extraction unit controller
  - 9.1.2 Beakers, 54 x 130 mm
  - 9.1.3 Thimbles, 33 mm inner diameter, glass or cellulose
  - 9.1.4 Metal thimble holder
- 9.2 Chiller unit
- 9.3 Boiling chips - Teflon, pre-cleaned by rinsing or extraction.
- 9.4 Water bath - Heated, with concentric ring cover, capable of temperature control ( $\pm 5\text{C}$ ). The bath should be used in a hood.
- 9.5 Vials - Glass, 2 mL capacity, with Teflon lined screw or crimp top.
- 9.6 Glass wool - contaminant free.
- 9.7 Disposable glass Pasteur pipet and bulb.
- 9.8 Apparatus for grinding.
- 9.9 Analytical balance - 0.01 g.
- 9.10 Test tubes



- 9.11 N-Evap™ concentrator with nitrogen source
- 9.12 Turbovap™
- 9.13 Graduated pipettes, 0.5, 1, 2 and 5 mL. Pipettes are pre-tested by lot for accuracy.

## 10) Preventative Maintenance

- 10.1 Routine cleaning of the extraction apparatus is necessary, including all parts exposed to contact with samples, especially extraction thimbles and the Soxtherm apparatus.
- 10.2 The operating temperature of the soxtherm is verified every quarter (March, June, September, and December) with a NIST traceable digital thermometer and probe.
  - 10.2.1 The soxtherm temperature is set at the controller to heat up to the extraction temperature of 140°C. Once the control box reads 140°C the probe is placed directly on each individual heating surface and the temperature is recorded in the soxtherm maintenance logbook (SVMP-SOX-01). Based on a statistical analysis of the results of prior quarterly monitoring, results should fall within limits of 119-141°C.
  - 10.2.2 If the verification is outside of the specified temperature range for any heating position the verification should be re-performed to confirm. If the position reads within the range an additional check for proper cycling is made. If the second verification was acceptable and cycling is correct, the position is considered operational. If the position continues to read outside the range corrective action is necessary, typically in the form of repair of the unit. The position is to be labeled or tagged as "Out of Service" until the problem is corrected and proper temperature verified.
- 10.3 The extraction time on the controller is verified quarterly by recording the start and stop times of an extraction and recording in the soxtherm maintenance logbooks.

## 11) Procedure

- 11.1 Record all extraction and sample information on the applicable benchsheet. To assist the analyst, a brief description of the procedure is given on the backside of the benchsheet. See Attachment A
- 11.2 Sample extraction and extract concentration
  - 11.2.1 Pre-rinse glassware (beaker, thimble with glass wool, and metal clip) before use. To clean the glassware place approximately 75 mL of dichloromethane in beaker and run a short extraction program. Example 10 min. boil time, 1 reduction A, 10 min. extraction, 1 reduction B, 30 min. solvent cooling, temp. 140°C.
  - 11.2.2 Refer to the determinative SOP (see Table 1 for a list of applicable SOPs) for the preparation, concentration, storage, and expiration for the surrogate, LCS, and MS spiking solutions. These SOPs also list the resulting final spike concentrations.



- 11.2.3 Blend the specified sample amount with as little sodium sulfate as possible, so as not to overload the extraction thimble, but still achieve sample drying. The type of sodium sulfate used is dependent upon the method. See Table 2 for further details on which type of sulfate to use.
- 11.2.4 The composition of the MB and LCS is prepared is dependent upon the method. See Table 2 for further details.
- 11.2.5 The MB and LCS is handled in the same manner as the client samples (i.e. drying in hood or any other temporary storage location).
- 11.2.6 Transfer the dry sample into the thimble that contains a plug of glass wool to prevent the sample from dropping into the beaker. Use a second thimble to prevent overfilling or over packing the thimble.
- 11.2.7 Rinse each sample beaker with a small amount of dichloromethane and transfer rinsate to thimble. Perform rinse three times to ensure quantitative transfer.
- 11.2.8 Add the surrogate standard spiking solution onto the samples. For the sample(s) in each analytical batch selected for QC spiking (LCS and MS samples), add the appropriate volume of the appropriate spiking standard. Each standard should be brought to room temperature before using. Addition of surrogate and spike is routinely witnessed by a second analyst to assure completeness. Also, the witness should immediately follow the spiking of each sample with the addition of a small amount of dichloromethane.
- 11.2.9 Add enough dichloromethane or appropriate extraction solvent to cover each sample. This will allow sample to remain covered by solvent during the entire boiling step. If the samples do not equally fill the thimbles feel free to mix and match sample and dichloromethane amounts so that all samples on a single extraction unit have about the same solvent level. Each unit can run a separate program, but a single unit does not allow multiple programs. In the program this step is referred to as boiling time.
- 11.2.10 The boiling step is set to be an hour. During this time the solvent will boil through and over the sample. The majority of the extraction will occur in this step. The temperature of the hot plates should be set for 140°C for dichloromethane and DCM/ACE. When the boiling time is completed the soxtherm needs to be programmed for the proper number of solvent reductions. Solvent reductions happen in 15 mL increments as the calibrated cup is filled by the condensing solvent. When programming the number of reductions the original amount of solvent needs to be taken into consideration. The aim of this step is to bring the solvent level below the tip of the thimble with 50 mL of being the desired amount. In the soxtherm program this is referred to as solvent reduction A.
- 11.2.11 Once the solvent level is below the thimble the extraction time can start. This lasts 1 hour. During this step the solvent drips through the sample to rinse through any remaining analytes. When this is done reduction B can



begin. This step should take the solvent level to the desired amount of  $\geq 10$  mL. Care should be taken during this step, since each beaker seals differently. Some beakers seal very well and others allow more solvent losses. Also all samples are not created equal. Some samples will trap more solvent than others.

11.2.12 If the solvent level has reached the desired stopping point before the programmed numbers of reductions are completed, remove the beaker and immediately cover with foil until cooled. Conversely, if the solvent level of the samples on an instrument is higher than desired, additional solvent reductions can be programmed. Once the desired solvent amount has been reached, remove the beaker and immediately cover with foil.

11.2.13 Nitrogen blowdown is used to further concentrate the extract and to adjust the extract to the final volume. If solvent exchange is required (e.g. GC-ECD analyses) it is done at this point.

11.2.13.1 Using the N-Evap™ or Turbovap™, place the concentrator tube in a warm water bath (approximately 35°C) and evaporate the solvent volume to the required level using a gentle stream of clean, dry nitrogen (filtered through a column of activated carbon).

**CAUTION: Do not use plasticized tubing between the carbon trap and the sample.**

11.2.13.2 The internal wall of the tube must be rinsed down several times with the appropriate final solvent during the operation. During evaporation, the solvent level in the tube must be positioned to prevent water from condensing into the sample (i.e., the solvent level should be below the level of the water bath). The volume of extract in the tube must be monitored during blow down to avoid loss of more volatile analytes. Under normal operating conditions, the extract should not be allowed to become dry.

**CAUTION: When the volume of solvent is reduced below 1 mL, semi-volatile analytes may be lost.**

11.2.13.3 Adjust the extract final volume to the prescribed volume with the solvent last used. Measure the final extract volume using a 0.5, 1, or 2 mL graduated pipette, depending on the test.

11.2.14 If extract cleanup is to be performed, concentrate the extract to the appropriate volume. Proceed to the applicable cleanup procedure and SOP.

11.3 During the final volume step, transfer the extracts to an appropriate storage or autosampler vial. Label the vial with the sample or QC identification and store in the extract storage area. The extracts obtained may now be analyzed for the target analytes



using the appropriate determinative technique. The extract holding time is 40 days from sample preparation to analysis.

## 12) QA/QC Requirements

- 12.1 Refer to the SOP for the determinative method and SOP for Sample Batches (ADM\_BATCH) for minimum QC requirements. Project-specific batching protocols may also be required.
- 12.2 The QC solutions required by the method must be added as described in the analytical method. The amount and identification of QC solutions added must be documented on the bench sheet. Any reagent blanks, laboratory control samples, or matrix spike samples should be subjected to exactly the same analytical procedures as those used on actual samples.

## 13) Data Reduction and Reporting

- 13.1 Preparation of all samples must be documented on a bench sheet. All information regarding the sample(s) extracted, aliquoted, QC spiked, extraction steps, etc. must be documented by the person(s) performing the extraction. Bench sheets are completed and a batch lot number is assigned. The Manufacturer's lot numbers or ID's for the reagents are added to bench sheets.
- 13.2 The bench sheet must be reviewed by the extraction lead, supervisor, or instrument lab analyst. The instrument lab analyst should sign-off on the bench sheet, thus accepting custody of the extracts.
- 13.3 The transfer of custody of completed extracts shall be documented by recording the date, time and extractionist's signature onto the analytical record. The instrument lab analyst shall accept custody of the sample extract(s) by endorsing the analytical record with accompanying date and time, establishing custody for those specific extracts. For additional information refer to the SOP for *Sample Tracking and Internal Chain of Custody*, SMO-SCOC.

## 14) Contingencies for Handling Our-of-Control or Unacceptable Data

- 14.1 Refer to the SOP for *Non Conformance and Corrective Action Procedures* (ADM-NCAR) for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

## 15) Method Performance

- 15.1 Available method performance data is given in the reference method. In addition, this procedure was validated through single laboratory studies of accuracy and precision as specified in the determinative procedures.

## 16) Pollution Prevention and Waste Management

- 16.1 The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Lab Waste Management Plan.
- 16.2 This method uses Dichloromethane and any waste generated from this solvent must be placed in the collection cans in the lab. The solvent will then be added to the hazardous waste storage area and recycled off site.



- 16.3 This method uses non-halogenated solvents and any waste generated from this solvent must be placed in the collection cans in the lab. The solvent will then be added to the hazardous waste storage area and disposed of in accordance with Federal and State regulations.

### 17) Training

- 17.1 All analysts performing this analysis are required to read and understand this SOP.  
17.2 Training is documented following the *Employee Training and New Employee Orientation* (ADM-TRAIN).

### 18) Method Modifications

- 18.1 There are no known modifications in this laboratory standard operating procedure from the reference method.

### 19) References

- 19.1 EPA SW-846, Test Methods For Evaluating Solid Waste, Third Edition, Update II, September 1994, Method 3541, Revision 0.  
19.2 EPA SW-846, Test Methods For Evaluating Solid Waste, Third Edition, Update IV, February 2007, Method 3500C, Revision 3.  
19.3 TNI Standard, Volume 1- 2009, 2016.  
19.4 DoD Quality Systems Manual for Environmental Laboratories Version current version  
19.5 ISO/IEC 17005:2017 American National Standard, General requirements for the competence of testing and calibration laboratories.

### 20) Changes since Last Revision

Summary of Revision Changes			
Revision Number	Effective Date	Document Editor	Description of Changes
13.0	11/30/2020	T. Caron	Updated SOP signatories and ALS SOP formatting.

### 21) Attachments, Tables, and Appendices

- 21.1 Appendix A –Test Specific Benchsheet(s).  
21.2 Table 1: Applicable Determinative SOPs.  
21.3 Table 2: Soxtherm Method Aid.



## APPENDIX A

### TEST SPECIFIC BENCH SHEET(S)

[R:\Extractions\Active Benchsheets\3541\3541\\_8270-Solids.pdf](R:\Extractions\Active Benchsheets\3541\3541_8270-Solids.pdf)

[R:\Extractions\Active Benchsheets\3541\3541\\_Fuels-Tissue.pdf](R:\Extractions\Active Benchsheets\3541\3541_Fuels-Tissue.pdf)

[R:\Extractions\Active Benchsheets\3541\3541\\_Lipids-Tissue.pdf](R:\Extractions\Active Benchsheets\3541\3541_Lipids-Tissue.pdf)

[R:\Extractions\Active Benchsheets\3541\3541\\_PCB\\_Wipes-Filter-Puffs.pdf](R:\Extractions\Active Benchsheets\3541\3541_PCB_Wipes-Filter-Puffs.pdf)

[R:\Extractions\Active Benchsheets\3541\3541\\_PestPCB-Soil.pdf](R:\Extractions\Active Benchsheets\3541\3541_PestPCB-Soil.pdf)



**TABLE 1**

**APPLICABLE DETERMINATIVE SOPs**

POLYNUCLEAR AROMATIC HYDROCARBONS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY SIM	SVM-8270P
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS	SVM-8270D
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS - LOW LEVEL PROCEDURE	SVM-8270L
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS SELECTED ION MONITORING	SVM-8270S
ORGANOCHLORINE PESTICIDES BY GAS CHROMATOGRAPHY: CAPILLARY COLUMN TECHNIQUE	SOC-8081
PCBS AS AROCLORS	SOC-8082Ar
CONGENER SPECIFIC DETERMINATION OF PCB BY GC/ECD	SOC-8082Co
CHLORINATED PHENOLICS BY IN-SITU ACETYLATION AND GC/MS	SVM-1653A
DETERMINATION OF NITROGEN OR PHOSPHORUS CONTAINING PESTICIDES	SOC-8141
NONYLPHENOLS ISOMERS AND NONYLPHENOL ETHOXYLATES	SVM-NONYL
CHLORINATED PESTICIDES BY GC/MS/MS, EPA METHOD 1699 MODIFIED	SVM-PESTM2



**TABLE 2**  
Soxtherm Method Aid

Method	Matrix	Target amount	MB	LCS
8081	Tissue	20g	Granular Sulfate	Granular Sulfate
8082	Tissue	20g	Granular Sulfate	Granular Sulfate
8082-Con	Tissue	20g	Granular Sulfate	Granular Sulfate
8081	Soil	10g	Granular Sulfate	Granular Sulfate
8082	Soil	10g	Granular Sulfate	Granular Sulfate
8081-L	Soil	20g	Granular Sulfate	Granular Sulfate
8082-L	Soil	20g	Granular Sulfate	Granular Sulfate
8082-Con	Soil	20g	Granular Sulfate	Granular Sulfate
8015	Soil	20g	Granular Sulfate	Granular Sulfate
8015 co-extract	Soil	20g	Granular Sulfate	Granular Sulfate
Lipids	Tissue	10g	Granular Sulfate	Granular Sulfate
8270 Pest OP	Soil	10g	Granular Sulfate	Granular Sulfate
8270 Pest OP	Tissue	5g	Granular Sulfate	Granular Sulfate
8270 OC Pest	Soil	10g	Granular Sulfate	Granular Sulfate
8270 OC Pest	Tissue	2g	Granular Sulfate	Granular Sulfate
PAH ALK	Soil	10g	Granular Sulfate	Granular Sulfate
PAH ALK co-extract	Soil	20g	Granular Sulfate	Granular Sulfate



TABLE 2-cont.

Method	Matrix	Target amount	MB	LCS
PAH ALK	Tissue	10g	Granular Sulfate	Granular Sulfate
SIM PAH	Soil/ Paperboard	10g	Granular Sulfate	Granular Sulfate
SIM PAH ULL	Solids	20g	Granular Sulfate	Granular Sulfate
SIM PAH	Tissue	10g	Granular Sulfate	Granular Sulfate
SIM PAH ULL	Tissue	10g	Granular Sulfate	Granular Sulfate
SIM PAH PCP	Soil/Tissue	10g	Granular Sulfate	Granular Sulfate
Nonylphenols	Solids	10g	Granular Sulfate	Granular Sulfate
Nonylphenols	Paperboard	1g	Granular Sulfate	Granular Sulfate
PBDE/PBB	Soil/Tissue	10g	Granular Sulfate	Granular Sulfate
PBDE/PBB	Paperboard	1g	Granular Sulfate	Granular Sulfate
8270	Soil/ Paperboard	20g	Granular Sulfate	Granular Sulfate
8270 LL	Soil	30g	Granular Sulfate	Granular Sulfate
8270 SIM	Tissue	5g	Granular Sulfate	Granular Sulfate

**NOTE:** South Carolina requires the use of a matrix different than what is listed in the table for QC associated with EPA Method 8270D. For work originating in South Carolina, the matrix for the MB and LCS is to be comprised of Matrix Sand + Granular Sulfate.



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## ULTRASONIC EXTRACTION, EPA 3550C

DOCUMENT ID: EXT-3550, REVISION 15.0

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Signature on file.

Date: 2/15/2021

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Date: 2/15/2021

Approved By: Laboratory Director, Charles (Pat) Byrne  
Signature on file.

Date: 2/15/2021

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## 1) Scope & Applicability

- 1.1 This procedure uses techniques described in EPA Method 3550C for extracting nonvolatile and semi-volatile organic compounds from solids such as soil, sediment, sludge, waste, and tissue.
- 1.2 This method is applicable to the isolation and concentration of water insoluble and slightly water soluble organics in preparation for a variety of chromatographic procedures. The low concentration method (individual components of <20 mg/Kg) uses a larger sample size and a more rigorous extraction procedure.
- 1.3 In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPP's supersede method specified requirements. An example of this are projects falling under DoD ELAP. QC requirements defined in the SOP *Department of Defense Projects - Laboratory Practices and Project Management*, may supersede the requirements defined in this SOP.

## 2) Summary of Procedure

- 2.1 A sample is mixed with anhydrous sodium sulfate to form a free flowing powder. The sample is solvent extracted three times using ultrasonic extraction. The ultrasonic process ensures intimate contact of the sample matrix with the extraction solvent. The solvents used for extraction and concentration are dependent on the analysis being performed. A portion of the extract is removed for cleanup and/or analysis.
- 2.2 It is highly recommended that the extracts be cleaned up prior to analysis. Refer to appropriate cleanup and methods SOPs.

## 3) Definitions

- 3.1 For laboratory definitions applicable to most analyses, refer to the SOP for *Sample Batches* (ADM-BATCH).

## 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. The department supervisor/manager or designee performs final review and sign-off of the data.
- 4.2 It is the responsibility of the department supervisor/manager to document analyst training and method proficiency, as described in the *Employee Training and Orientation* (ADM-TRAIN).

## 5) Interferences

- 5.1 Phthalate esters can pose difficulties when performing sample extractions for organochlorine pesticides, PCBs, and other semi-volatile organics. Phthalates

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are easily extracted or leached from materials containing plastics during laboratory operations. Interferences from phthalates can best be minimized by avoiding contact with any plastic materials.

- 5.2 Contamination by carryover can occur whenever high-concentration and low-concentration samples are sequentially analyzed. All apparatus must be cleaned prior to use on individual samples.
- 5.3 Refer to SW-846 Method 3500 for additional discussion of interferences. Additional cleanup procedures are described in the applicable ALS SOP.

## 6) Safety

- 6.1 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.
- 6.2 This method uses Dichloromethane, a known human carcinogen. Viton brand gloves should be used while rinsing, pouring or transferring the solvent.

## 7) Sample Collection, Containers, Preservation, and Storage

- 7.1 Refer to the applicable section in the determinative SOP (see Table 1) and method for sample collection, preservation, and holding times. Also, refer to the introductory material in SW-846, Organic Analysis, -Section 4.

## 8) Standards, Reagents, and Consumable Materials

- 8.1 Pesticide grade inorganic chemicals shall be used in all tests. Other grades may be used, provided it is first confirmed that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination or introducing interferences.
- 8.2 Organic-free reagent water. This may be deionized water or tap water if it has been determined to be free of interferences and trace levels or target analytes.
- 8.3 Sodium sulfate (anhydrous),  $\text{Na}_2\text{SO}_4$ . Purify by heating at  $400^\circ\text{C}$  for 4 hours in a shallow tray or crucible, or by pre-cleaning the sodium sulfate with methylene chloride. If the sodium sulfate is pre-cleaned with methylene chloride, a method blank must be analyzed, demonstrating that there is no interference from the sodium sulfate.
- 8.4 Extraction solvents.
  - 8.4.1 Low concentration soil/sediment and aqueous sludge samples shall be extracted using a solvent system that gives optimum, reproducible recovery for the matrix/analyte combination to be measured.
  - 8.4.2 Methylene chloride:Acetone,  $\text{CH}_2\text{Cl}_2:\text{CH}_3\text{COCH}_3$  (1:1, v:v). Pesticide quality or equivalent. Other solvent ratios can be used if acceptable method performance is demonstrated.
  - 8.4.3 Methylene chloride,  $\text{CH}_2\text{Cl}_2$ . Pesticide quality or equivalent.
  - 8.4.4 Hexane,  $\text{C}_6\text{H}_{14}$ . Pesticide quality or equivalent.
- 8.5 Exchange solvents.

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8.5.1 Hexane, C<sub>6</sub>H<sub>14</sub>. Pesticide quality or equivalent.

## 9) Apparatus and Equipment

9.1 Ultrasonic preparation - A horn type device equipped with a titanium tip, or a device that will give equivalent performance, shall be used. The horn should be tuned prior to sample extraction. (See Attached Tuning Procedure - Appendix A) Ultrasonic Disrupter - The disrupter must have a minimum power wattage of 300 watts, with pulsing capability. A device designed to reduce the cavitation sound is recommended. Follow the manufacturer's instructions for preparing the disrupter for extraction of samples with low and medium/high concentration. Use a 3/4" horn for the low concentration method and a 1/8" tapered microtip attached to a 1/2" horn for the medium/high concentration method.

9.2 Ultrasonic Disrupter - The disrupter must have a minimum power wattage of 300 watts, with pulsing capability. A device designed to reduce the cavitation sound is recommended. Follow the manufacturer's instructions for preparing the disrupter for extraction of samples with low and medium/high concentration. Use a 3/4" horn for the low concentration method and a 1/8" tapered microtip attached to a 1/2" horn for the medium/high concentration method.

9.3 Sonabox - Recommended with above disrupters for decreasing cavitation sound (Heat Systems - Ultrasonics, Inc., Model 432B or equivalent).

9.4 Pasteur glass pipettes - 1 mL and 5 mL disposable.

9.5 Beakers - 250 or 400 mL.

9.6 Vacuum filtration apparatus.

9.7 Drying funnel - modified funnel with Pyrex glass wool at bottom.

**NOTE:** Fritted glass discs are difficult to decontaminate after highly contaminated extracts have been passed through. Columns without frits may be purchased. Use a small pad of Pyrex glass wool to retain the adsorbent. Prewash the glass wool pad with elution solvent prior to packing the column with adsorbent.

9.8 Kuderna-Danish (K-D) apparatus.

9.8.1 Concentrator tube - 10 mL, graduated (Kontes K-570050-1025 or equivalent). A ground glass stopper is used to prevent evaporation of extracts.

9.8.2 Evaporation flask - 500 mL (Kontes K-570001-500 or equivalent). Attach to concentrator tube with springs, clamps, or equivalent.

9.8.3 Snyder column - Three ball macro (Kontes K-503000-0121 or equivalent).

9.8.4 Springs or clips for attaching concentrator tubes.

9.8.5 Boiling chips - Pre-cleaned by rinsing with DCM, approximately 10/40 mesh (silicon carbide or equivalent).

9.8.6 Water bath - Heated, with concentric ring cover, capable of temperature control ( $\pm 5^{\circ}\text{C}$ ). The bath should be used in a hood.

9.8.7 Balance - Top loading, capable of accurately weighing to the nearest 0.001 g.



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- 9.8.8 Vials - 2 mL, for GC autosampler, with Teflon lined screw caps or crimp tops.
- 9.8.9 Glass vials - 40 mL, with Teflon lined screw caps.
- 9.8.10 Spatula - Stainless steel or Teflon.
- 9.8.11 Syringes - appropriate size for QC spiking.
- 9.9 Ultrasonic Bath- Have large transducer areas and tanks that produce a high-powered ultrasonic intensity throughout the entire oscillating tank. Constant power and automatic frequency control ensure optimum distribution of ultrasonic energy and reproducible results.

## 10) Preventative Maintenance

- 10.1 Routine cleaning of the extraction apparatus is necessary, including all parts exposed to contact with samples, especially ultrasonic horn cells.
- 10.2 The ultrasonic horn must be tuned prior to use. Proper operation of the horn is critical in achieving good method performance. Refer to the manufacturer's specifications in Appendix A.

## 11) Procedure

- 11.1 All extraction and sample information is recorded on the applicable bench sheet.
- 11.2 Sample aliquots are prepared by the appropriate groups according to the SOPs: SOILPREP-ALIQUOT and SOILPREP-SUBS.
- 11.3 In certain cases, sample results are desired based on dry weight basis. Refer to the SOP for *Total Solids* (SOILPREP-SOLIDS). If the determination is performed by the organics preparation personnel, a portion of the sample for this determination should be weighed out at the same time as the portion used for analytical determination.
- 11.4 Nonporous or wet samples (gummy or clay type) that do not have a free flowing sandy texture must be mixed with anhydrous sodium sulfate to facilitate drying, using a spatula. After addition of sodium sulfate, the sample should be free flowing.
- 11.5 Add amount of surrogate standards specified on the appropriate benchsheet referenced in Section 19.7 to all samples, spikes, standards, and blanks. For the LCS and sample(s) in each analytical batch selected for matrix spiking, add the specified amount of matrix spike standard as specified on the appropriate benchsheet referenced in Section 19.7.
- 11.6 Extraction method for samples by sonic horn:
  - 11.6.1 Immediately add enough extraction solvent specified on the appropriate benchsheet referenced in Section 19.7 to cover the sample by one inch.
  - 11.6.2 Place the bottom surface of the tip of the disrupter horn about 1/2 in. below the surface of the solvent, but above the sediment layer. Addition of a small amount of extraction solvent may be needed to ensure proper horn operation.
  - 11.6.3 Extract for 3 minutes. Sonifier settings are Output of 4, Duty Cycle of 70%. Branson settings are Amplitude 80%, Pulse On 1.5 seconds, Pulse Off 1.5 seconds.



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- 11.6.4 Assemble a Kuderna-Danish (K-D) concentrator by attaching a 10 mL concentrator tube to a 500 mL evaporator flask.
- 11.6.5 Decant and filter extracts into a K-D apparatus using vacuum filtration and a modified funnel, covering the glass wool with sodium sulfate.
- 11.6.6 Repeat the extraction two or more times with two additional 100 mL (or more if needed) portions of solvent. Decant off the solvent into the K-D apparatus through the modified funnel after each ultrasonic extraction. On the final ultrasonic extraction, pour the entire sample into the modified funnel and rinse with extraction solvent. Rinse 3 times with DCM.
- 11.6.7 Add one to two clean boiling chips to the evaporation flask and attach a three ball Snyder column. Place the K-D apparatus on the S-Evap so that the concentrator tube is partially immersed in the hot water bath (70-75°C) and the entire lower rounded surface of the flask is bathed with hot vapor. Adjust the vertical position of the apparatus and the water temperature, as required, to complete the concentration in 10-15 minutes. At the proper rate of distillation the balls of the column will actively chatter, but the chambers will not flood with condensed solvent. When the apparent volume of liquid reaches 5 mL, remove the K-D apparatus and allow it to drain and cool for at least 10 minutes.
- 11.6.8 If a solvent exchange is required on the S-Evap, add ~15 mL of the exchange solvent through the Snyder column. This solvent exchange should be performed in a hood with the extract near room temperature. Concentrate the extract by raising the temperature of the water bath, if necessary, to maintain proper distillation. When the apparent volume again reaches 10 mL, remove the K-D apparatus and allow it to drain and cool for at least 10 minutes.
- 11.6.9 Remove the Snyder column and rinse the flask and its lower joints into the concentrator tube with 10 mL of methylene chloride or exchange solvent. If sulfur crystals are a problem, proceed to Method 3660 for cleanup. The extract may be further concentrated by using the nitrogen blowdown technique or adjusted to 10.0 mL with the solvent last used.
- 11.6.10 Nitrogen Blowdown Technique
- 11.6.10.1 Place the concentrator tube in N-evap and evaporate the solvent volume to the required level using a gentle stream of clean, dry nitrogen (filtered through a column of activated carbon).
- CAUTION:** Do not use plasticized tubing between the carbon trap and the sample.
- 11.6.10.2 A solvent exchange may be performed at this step by rinsing with the appropriate exchange solvent. During evaporation, the solvent level in the tube must be positioned to prevent water from condensing into the sample. The volume of extract in the tube must be monitored during blowdown to avoid loss of more volatile analytes. Under normal operating conditions, the extract should not be allowed to become dry.
- CAUTION:** When the volume of solvent is reduced below 1 mL, semi-volatile analytes may be lost.
- 11.6.11 Bring the extract to the prescribed final volume and transfer the concentrated extract to the appropriate labeled autosampler vial or storage vial. The extracts



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obtained may now be analyzed for the target analytes using the appropriate determinative technique.

11.7 Extraction method for samples by sonic bath for 1,4-Dioxane.

11.7.1 Add exactly 10 mL of methylene chloride to each sample and seal with a VOA vial cap. If 10 mL will not adequately cover the sample, add 20 mL of DCM (final volume will need to be adjusted later to achieve a 10 mL true final volume). Mark the meniscus.

11.7.2 Place the VOA vials in a sonic bath and sonicate for 30 minutes. Make sure the water level in the bath is above or at least level with the solvent in the VOA vials to ensure proper extraction.

11.7.3 After extraction, pull off exactly 1 mL and place into a labeled autosampler vial for analysis. The extracts obtained may now be analyzed for the target analytes using the appropriate determinative technique.

11.7.3.1 It may be necessary to centrifuge the sample and/or filter the extract into the vial to remove soil particles from the extract. If necessary, filter about 2 mL of extract through a 0.45  $\mu$ m filter on a disposable syringe and place exactly 1 mL of the filtered extract into a vial for analysis for a True Final Volume of 10 mL. If a higher initial volume was required, pull off the appropriate volume and concentrate to 1 mL on the N-Evap under a gentle stream of nitrogen with the temperature <35°C to achieve a True Final Volume of 10 mL.

## 12) QA/QC Requirements

12.1 Refer to the SOP for the determinative method and SOP for *Sample Batches* (ADM\_BATCH) for minimum QC requirements. Project-specific batching protocols may also be required.

12.2 The QC solutions required by the method must be added as described in the analytical method. The amount and identification of QC solutions added must be documented on the bench sheet. Any reagent blanks, laboratory control samples, or matrix spike samples should be subjected to exactly the same analytical procedures as those used on actual samples.

## 13) Data Reduction and Reporting

13.1 Preparation of all samples must be documented on a bench sheet. All information regarding the sample(s) extracted, aliquoted, QC spiked, extraction steps performed, etc. must be documented by the person(s) performing the extraction.

13.2 The bench sheet must be reviewed by the extraction lead, supervisor, or instrument lab analyst. The instrument lab analyst should sign-off on the bench sheet, thus accepting custody of the extracts.

## 14) Method Performance

14.1 Available method performance data is given in the reference method. In addition, this procedure was validated through single laboratory studies of accuracy and precision as specified in the determinative procedures.

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## 15) Pollution Prevention and Waste Management

- 15.1 The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Lab Waste Management Plan.
- 15.2 All extracted soil samples are collected in a labeled waste container for disposal in accordance with applicable state and federal regulations governing waste management.

## 16) Contingencies for Handling Our-of-Control or Unacceptable Data

- 16.1 Refer to the SOP for *Non Conformance and Corrective Action*, for procedures for corrective action.
- 16.2 Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

## 17) Training

- 17.1 All analysts performing this analysis are required to read and understand this SOP.
- 17.2 Training is documented following the *Employee Training and New Employee Orientation* (ADM-TRAIN).

## 18) Method Modification

- 18.1 There are no known modifications in this laboratory standard operating procedure from the reference method.

## 19) References

- 19.1 EPA SW-846, Test Methods For Evaluating Solid Waste, Third Edition, Update III, December 1996, Method 3550B, Revision 2
- 19.2 EPA SW-846, Test Methods For Evaluating Solid Waste, Third Edition, Update II, September 1994, Method 3550A, Revision 1
- 19.3 EPA SW-846, Test Methods For Evaluating Solid Waste, Third Edition, Update III, December 1996, Method 3500B, Revision 2.
- 19.4 TNI Standard, Volume 1- 2009 & 2016.
- 19.5 DoD Quality Systems Manual, Current Version.
- 19.6 ISO/IEC 17025: 2017.
- 19.7 Appendix A, Sonic Horn Tuning Procedures.
- 19.8 Extractions Benchsheets:
  - 19.8.1 [R:\Extractions\Active Benchsheets\3550\3550\\_Fuel-Soil.pdf](R:\Extractions\Active Benchsheets\3550\3550_Fuel-Soil.pdf)
  - 19.8.2 [R:\Extractions\Active Benchsheets\3550\3550M\\_1,4-Dioxane-Soil.pdf](R:\Extractions\Active Benchsheets\3550\3550M_1,4-Dioxane-Soil.pdf)
  - 19.8.3 [R:\Extractions\Active Benchsheets\3550\3550M\\_PBDE-Misc Solid.pdf](R:\Extractions\Active Benchsheets\3550\3550M_PBDE-Misc Solid.pdf)



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20) **Changes Since Last Revision**

Revision Number	Effective Date	Document Editor	Description of Changes
15.0	2/18/2021	T. Caron	Updated SOP signatories. Minor typographical changes to improve readability and consistency, not affecting technical content. Section 8.3: Removed the word powdered. Section 9.8.11: Removed the use of pipettes. Section 19: Updated references. Procedural change form from JM dated 2.11.2021.

21) **Attachments, Tables, and Appendices**

- 21.1 Table1: Applicable Determinative SOPs.
- 21.2 Appendix A Sonic Horn Tuning Procedures



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**Table 1**  
**Applicable Determinative SOPs**

Semivolatile Organic Compounds by GC/MS/Selected Ion Monitoring	SVM-8270S
Polybrominated Diphenyl Ethers (PBDEs) and Polybrominated Biphenyls (PBBs)	SVM-ROHS
Analysis of Waters, Solids, and Soluble Waste Samples for Semi-Volatile Fuel Hydrocarbons	PET-SVF
Analysis of Water and Solid Samples for Total Petroleum Hydrocarbons	PET-TPH
Analysis of Solid and Aqueous Samples for State of Wisconsin Diesel Range Organics	PET-WIDRO



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## Appendix A Sonic Horn Tuning Procedures

### 1. Tekmar Model 501:

Tuning optimizes performance and insures maximum transfer of energy by matching the frequency of the power supply to that of the converter/probe assembly. The power supply should be tuned 1) every time a new probe or accessory is used, 2) on occasions to compensate for the frequency variation caused by cavitation erosion, 3) following 10 minutes of continuous operation and 4) when the sample temperature is significantly higher or lower than room temperature.

The piezoelectric crystal within the converter is part of the circuitry which control s the frequency at 20 kHz. Any changes in the crystal's capacitance resulting from a variation in temperature will cause the equipment to operate in an out-of-tune condition. For reliable performance and equipment protection, it is important that the unit be tuned after the probe temperature has had a chance to stabilize. When relocating the Ultrasonic Processor from a very cold or very hot environment, allow 30 minutes for the unit to stabilize before operating. Continuous operation causes temperature elevation in the sample. This increase in temperature is transmitted through the probe to the crystal assembly. Always tune the power supply after the probe has reached operating temperatures. When working with low or high temperature samples, immerse the probe in the sample for a few minutes, withdraw the probe from the sample, then tune the power supply.

**IMPORTANT:** *Tuning must be performed in air with the probe out of the sample. While tuning, do not allow the probe to contact anything.*

To tune the power supply, proceed as follows:

- 1.1. Ensure that the probe or microtip is not immersed in the sample and that it does not come in contact with anything. If a cup horn is used, make sure that the water has been drained out of it. If a flow through cell is used, make sure that the sample has been drained out of it.
- 1.2. Set PULSER to OFF.
- 1.3. Set AMPLITUDE control to "100" (to "40" when using a microtip).

**CAUTION:** When tuning a microtip, never allow vibration in air for more than 10 seconds. With a microtip, never allow the AMPLITUDE control to be set above the microtip limit "40". Ignoring these instructions will cause the microtip to fracture.

- 1.4. Set ON/OFF power switch to ON. The switch will illuminate.
- 1.5. Depress the TUNE switch and rotate the TUNER clockwise or counterclockwise until a minimum (not maximum) reading (usually less than 20) is obtained on the POWER MONITOR. If the minimum reading cannot be obtained, the probe, cup horn, tip, microtip, extender, or accessory is loose or out of resonance, or the power supply or converter require servicing. A loose probe will usually generate a loud, piercing sound.

NOTE:



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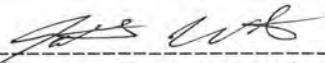
- The probe is tuned to vibrate at a specific frequency – 20 kHz  $\pm$ 50 Hz. If the resonant frequency of the probe has changed, due to cavitation erosion or fracturing, minimum reading will not be obtained. If minimum reading cannot be obtained, check the instrument without the probe to determine which component might be defective. If proper tuning is obtained using the converter without the probe, the probe is defective and should be changed.
  - A loose probe will usually generate a loud piercing sound.
  - Since the amplitude required is application dependent and subject to the volume and composition of the sample, it is recommended that the amplitude be first set at mid-range, then empirically determined and optimized while the samples is being processed.
- 1.6. Set the AMPLITUDE control to “20” when working with a microtip, and “50” when working with any other probe or accessory.
- 1.7. With a dual output 600 watt Ultrasonic Processor, if two converters are going to be used simultaneously, connect at this time the second converter cable to the right converter connector.
2. Branson Model 450:
- 2.1. To determine if the equipment is operating properly, proceed as follows:
- Mount ½” disruptor horn (with flat tip if tapped) to converter.
  - Set Output Control to 5, Timer to HOLD and ON/OFF switch to ON.
  - Record meter reading with horn in air
    - Meter Reading\_\_\_\_\_
    - Horn Size\_\_\_\_\_
  - Fill 500 mL Pyrex beaker to 500 mL level with room temperature tap water.
  - Immerse horn tip halfway to 250 mL mark. Set ON/OFF switch to On and record reading.
    - Meter Reading\_\_\_\_\_

Perform this test and compare readings periodically to ensure that the equipment is operating satisfactorily. A variation of 10 between the first and second readings is acceptable. If readings are not within tolerance, refer to Trouble Analysis Chart, section 5.



## EXTRACTION METHOD FOR ORGANOTINS IN SEDIMENT, WATER AND TISSUE

DOCUMENT ID: EXT-OSWT, REV 12.0

Prepared By:   
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Date: 12/1/2020

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Date: 12/1/2020

Approved By:   
Laboratory Director, Charles (Pat) Byrne

Date: 12-1-20



## 1) Scope & Applicability

- 1.1 This procedure is used to extract selected butyltins from sediments, water and tissues. The procedure is a preparative step for determination of butyltins by gas chromatography (SOP SOC-BUTYL). The procedure can also be applied to porewater samples.
- 1.2 In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPP's supersede method specified requirements. An example of this are projects falling under DOD ELAP. QC requirements defined in the SOP *Department of Defense Projects – Laboratory Practices and Project Management* (ADM-DOD/ADM-DOD5) may supersede the requirements defined in this SOP.

## 2) Summary of Procedure

- 2.1 Butyltin compounds are extracted with an organic solvent using the technique suitable for the sample matrix. Sediment and tissue samples are extracted by tumbling. Water samples are extracted by liquid-liquid extraction. Extracts are then derivitized to their hexyl form using hexylmagnesiumbromide. After derivitization, extracts from sediment and water samples are cleaned up with silica and alumina; tissue sample extracts are cleaned up with Florisil. Extracts are then taken to final volume and analyzed by GC/FPD.

## 3) Definitions

- 3.1 For environmental laboratory quality definitions, guidance on analytical calibration and sample batches, refer to the SOP for Sample Batches, ADM-BATCH.

## 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.
- 4.2 It is the responsibility of the department supervisor/manager to document analyst training and method proficiency.

## 5) Interferences

- 5.1 Solvents, reagents, glassware, and other sample processing hardware may yield discrete artifacts and/or elevated baselines, causing misinterpretation of the chromatograms. All of these materials must be demonstrated to be free from interferences, under the conditions of the analysis, by running blanks

## 6) Safety



- 6.1 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.

## 7) Sample Collection, Containers, Preservation, and Storage

- 7.1 Refer to the applicable section in the analytical and/or extraction SOP for collection, preservation, and holding times.

## 8) Standards, Reagents, and Consumable Materials

- 8.1 Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Standards, reagents and consumable material documentation shall indicate traceability to purchased reagents or compounds. Refer to the SOP *Reagent/Standards Login and Tracking* (ADM-RTL) for the complete procedure and documentation requirements.
- 8.2 All stocks, working solutions and sample dilutions should be prepared using deionized water (DI) conforming to ASTM Type I or ASTM Type II reagent water. For more information on reagent water generation, refer to the related SOP, Operation and Maintenance of Laboratory Reagent Water Systems.
- 8.3 Solvents: Dichloromethane (DCM), hexane, pentane, methanol, and anhydrous diethyl ether (J.T. Baker).
- 8.4 Tropolone in dichloromethane (DCM) - 0.1% (w/v) solution is prepared by adding 1 g tropolone per liter of DCM.
- 8.5 Tropolone in hexane - 0.1% (w/v) solution is prepared by adding 1 g tropolone per liter of hexane.
- 8.6 Tropolone in water - 0.01% (w/v) solution is prepared by adding 0.4 g tropolone and 40 mL concentrated HCl to 4 L of reagent water.
- 8.7 Reagent water
- 8.8 D.I. Water
- 8.9 Sodium sulfate, Granular
- 8.10 Concentrated HCl.
- 8.11 Fisher PrepSepR® 1 g silica cartridges, or equivalent.
- 8.12 Fisher PrepSepR® 1 g alumina cartridges, or equivalent.
- 8.13 Magnesium turnings (from Fisher). It is recommended to investigate the use of semiconductor grade magnesium if blank contamination (tin) is exhibited.
- 8.14 Bromohexane (from Fluka).
- 8.15 Florisil cartridges (CPI).
- 8.16 Surrogate and spiking solutions--see SOP SOC-BUTYL.
- 8.17 Hexylmagnesiumbromide -  $\text{CH}_3(\text{CH}_2)_5\text{MgBr}$  (Grignard). Prepare as follows:



- 8.17.1 All glassware used in Grignard preparation is baked at least 4 hours at  $\geq 100^{\circ}\text{C}$  to remove water. Glassware is assembled while still warm.
- 8.17.2 Add 14 g of magnesium to the three necked flask during assembly. The condenser is placed in the middle neck of the flask with a drying tube at the top of the condenser. A glass stopper is put in one neck of the flask, with the 125 mL addition funnel in the last flask opening. The addition funnel contains 38 mL bromohexane in 95 mL anhydrous ether, and is topped with a drying tube.
- 8.17.3 Add 4 mL bromohexane and 10 mL ether to the flask. A glass rod is used to crush 2 or 3 Mg chips. A hot water bath may be used to help reaction start. After reaction has started, hot water bath is removed.
- 8.17.4 Once reaction is started, the bromohexane solution in the addition funnel is added at a rate of about 3 drops per second. Once nearly all of the bromohexane/ether solution has been added, an additional 95 mL of anhydrous ether and 38 mL of bromohexane are added to the addition funnel (in that order). Once all bromohexane solution has been added, the hot water bath is returned and reaction is refluxed for at least one hour. Grignard solution is now ready to use.
- 8.17.5 Grignard has a 6 month expiration from time of preparation. Due to the reactive nature of Grignard reagent, it should be checked for reactivity prior to continued use. A derivatization blank, a 1 ppm standard, and a 10 ppm standard are typically prepared ahead of sample derivatization to assure the purity and reactivity of each batch of Grignard.
- 8.18 Acetone solution of dimethyldioxirane (DMD) – Dimethyldioxirane (DMD) is synthesized from acetone by reacting it with sodium monoperoxysulfate in a chilled water solution at a pH of between 7 and 8. An acetone solution of DMD is distilled from the resultant mixture under a mild vacuum and collected with the assistance of a dry ice-solvent bath. Refer to Appendix A for details of preparation of DMD.

## 9) Apparatus and Equipment

- 9.1 Materials used in sediment, tissue and water extractions.
- 9.2 pH paper, 0 - 14 range
- 9.3 16 x 150 mm and 25 x 150 mm disposable glass culture tubes with Teflon lined screw caps
- 9.4 0.5 mL, 1 mL, 2 mL, 5 mL, and 10 mL serological pipettes
- 9.5 Pasteur pipettes
- 9.6 2 mL glass vials with Teflon lined crimp-top caps
- 9.7 Nitrogen evaporator
- 9.8 Centrifuge - capable of handling glassware in 7.1.2.
- 9.9 Vacuum pump and manifold
- 9.10 Kuderna-Danish (K-D) apparatus



- 9.10.1 Concentrator tube - 10 mL, graduated.
- 9.10.2 Evaporation flask - 250 mL. Attach to concentrator tube with springs, clamps or equivalent.
- 9.10.3 Three-ball Snyder column.
- 9.10.4 Springs - 1/2 inch.
- 9.10.5 Boiling chips - Pre-cleaned via Soxhlet extraction, approximately 10/40
- 9.10.6 Mesh (silicon carbide or equivalent).
- 9.10.7 Water bath - Heated, with concentric ring cover, capable of temperature
- 9.10.8 Control ( $\pm 5^{\circ}\text{C}$ ). The bath should be used in a hood.
- 9.11 Materials for extraction of sediments
  - 9.11.1 250 mL Teflon bottles with Teflon screw caps
  - 9.11.2 Tumbler, capable of holding twelve 250 mL Teflon bottles
  - 9.11.3 Modified vacuum filtration funnel
  - 9.11.4 Whatman No. 41 filter paper
  - 9.11.5 Polypropylene funnels
  - 9.11.6 Scoopulas
  - 9.11.7 400 mL beakers
- 9.12 Materials for extraction of waters
  - 9.12.1 Continuous liquid/liquid extraction body
  - 9.12.2 500 mL round bottom flask, with green Keck clip
  - 9.12.3 1000 mL graduated cylinder
  - 9.12.4 Stir rod and pH paper
  - 9.12.5 Allihn condensor
- 9.13 Porewater sample preparation
  - 9.13.1 Polycarbonate centrifuge bottles, 1 L.
  - 9.13.2 Water-from-sand apparatus



- 9.13.3 Large spoon
- 9.13.4 Nitrogen Hood
- 9.13.5 Refrigerated Centrifuge capable of handling 1 L bottles
- 9.14 Materials for extraction of tissues
  - 9.14.1 Vortex for VOA vials
  - 9.14.2 Tumbler for VOA vials
  - 9.14.3 40 mL and 60 mL VOA vials with Teflon lined septa and screw caps
- 9.15 Materials for Grignard preparation
  - 9.15.1 500 mL round bottom three necked flask with glass stoppers
  - 9.15.2 30 cm condenser
  - 9.15.3 125 mL addition funnel
  - 9.15.4 Two drying tubes filled with drierite® and plugged with glass wool
  - 9.15.5 Glass rod
  - 9.15.6 Hot water bath
  - 9.15.7 100 mL graduated cylinders
  - 9.15.8 150 mL glass beaker.

## 10) Preventative Maintenance

- 10.1 All maintenance activities are recorded in a maintenance logbook kept for each instrument. Pertinent information (serial numbers, instrument I.D., etc.) must be in the logbook. This includes the routine maintenance described herein. The entry in the log must include: date of event, the initials of who performed the work, and a reference to analytical control.

## 11) Procedure

- 11.1 Extraction of Organotins from Sediments
  - 11.1.1 Refer to the SOPs Aliquoting of Samples (SOILPREP-ALIQUOT) and Subsampling and Compositing of Samples (SOILPREP-SUBS) for sample aliquoting. If sufficient holding time permits, air dry the sample in the hood. Acidify with 2 mL concentrated HCl and mix the sample thoroughly. Mix samples with adequate sodium sulfate to dry sample. The method blank and laboratory control sample are made from an equal amount of sodium sulfate. Add sample to a 0.1% tropolone rinsed 250 mL Teflon bottle and add appropriate surrogate and spike. Add more acid if



necessary. Add enough 0.1% tropolone/DCM solution to cover sample with at least 1/2" of solvent (approximately 150 mL).

- 11.1.2 Wrap Teflon tape around threads of bottle. Pinch bottle in center and cap. If the bottle does not stay pinched then remove cap, add more Teflon tape and pinch and cap again. If the bottles stay pinched then they are sealed completely and won't leak on the tumbler. Tumble the sample(s) for 16-24 hours.
  - 11.1.3 Pour the sample into a modified funnel with glass wool and sulfate that is unbaked. Filter by vacuum into a 250 mL KD flask. Evaporate the extract on a water bath (75°C) to approximately 10-20 mL. Add approximately 10-20 mL hexane while on the S-EVAP and allow DCM to evaporate until only hexane remains.
  - 11.1.4 Using the N-Evap, concentrate the extract to approximately 3 mL. Add 2 mL of reagent water and vortex. Centrifuge to separate precipitates. Using a Pasteur pipet and pentane, quantitatively transfer the extract (solvent) layer to a 2nd culture tube. Evaporate extract down to approximately 2 mL.
  - 11.1.5 Add 2 mL of Grignard reagent to the culture tube and vortex on a table top vortexer for 45 minutes. Place the test tubes in an ice bath and add concentrated HCL slowly (dropwise) until there is no reaction. Then while vortexing (hand vortexer) add, in turn, 1 mL HCL, 1 mL DI Water, 1 mL HCL, 1 mL DI Water then finish with 1 mL HCL..
  - 11.1.6 Transfer the top (clear) hexane layer to a new test tube. On an N-Evap concentrate to 1-2 mL. Take the extract to a 4 mL final volume and remove 1 mL for cleanup. Add 1 mL DMD to this aliquot, vortex 3 minutes. Solvent exchange to hexane then add a small amount of unbaked granular sulfate to remove any water left behind by the DMD.
  - 11.1.7 Using the vacuum or positive pressure manifold, set up alumina/silica cartridges and condition with 5 mL hexane. Discard hexane. Place samples in cartridges and bring down to almost dry, and elute with 6 mL of pentane, allowing this to go dry. Take extracts to a 1.0 mL final volume in hexane, and place in a 2 mL vial.
- 11.2 Extraction of Porewater from sediments
- 11.2.1 All labware must be rinsed with 10% HCl followed by DI water prior to use. Labware must be dry prior to further rinsing. Air drying is best for polycarbonate labware; methanol may be used if time is limited. All polycarbonate labware must be rinsed with 0.1% w/v tropolone in hexane followed by hexane; all other labware must be rinsed with 0.1% w/v tropolone in Dichloromethane followed by Dichloromethane.
  - 11.2.2 Very sandy sediments often do not yield sufficient volumes of water. For the samples, it will be necessary to employ at least two water-from-sand recovery apparatuses; make a note of this as these samples will be exposed to the atmosphere.



- 11.2.3 Use 1000 mL of reagent water for the method blank and centrifuge along with the samples.
  - 11.2.4 Centrifuge the balanced bottles opposite each other for 30 minutes at 1000 -3000 G. (1100-3250 RPM for a 10 inch rotor radius).
  - 11.2.5 Decant the water into clean polycarbonate centrifuge bottles and balance as above.
  - 11.2.6 Centrifuge the samples a second time at 3000 G.
  - 11.2.7 Decant the water from the centrifuge bottles into polycarbonate sample bottles. If the sediment is re-suspended during the decantation, the samples must be centrifuged again before decanting.
  - 11.2.8 Add 0.5-1 mL of concentrated hydrochloric acid to each sample bottle to preserve them and store at or below 4°C.
  - 11.2.9 Some projects may require samples to be filtered prior to preservation and storage. Check project specific requirements to see when filtration is necessary. Samples must be filtered using 0.4 µm polycarbonate filters in porcelain Buchner funnels. The samples are filtered into polycarbonate Erlenmeyer flasks.
  - 11.2.10 Extract the recovered porewater following the procedure in section 11.3.
- 11.3 Extraction of Organotins from Water
- 11.3.1 Rinse all labware once with 0.1% hydrochloric acid (HCl), then deionized water, then acetone. Next rinse once with 0.1% tropolone in DCM followed two times with DCM.
  - 11.3.2 Refer to the SOP for *Continuous Liquid-Liquid Extraction* (SOP EXT-3520). Add 500 mL of DCM to the extractor. Measure and transfer 500 mL of sample to the extractor. Set up the method blank, laboratory control sample, and spike the samples, using 500 mL DI Water. Add surrogate and matrix spikes as appropriate.
  - 11.3.3 Add 500 mL of 100 ppm tropolone in 0.1% HCl in reagent water. Follow the instructions for continuous liquid-liquid extraction.  
  
**Note:** For porewater samples, the available sample volume is typically limited to 500 mL or less. Determine the amount of sample available and adjust the volume extracted accordingly. Adjust the amount of reagents and surrogate and matrix spike amounts accordingly.
  - 11.3.4 Make sure that the continuous liquid - liquid extractor is receiving adequate flow for cooling, and that the units are cycling properly. Check the chiller for proper temperature and operation. (Condensers should be cold to the touch before extraction begins).



- 11.3.5 Cycle the unit for 18-24 hours.
- 11.3.6 Transfer the extract (DCM) to a 250 mL KD flask. Evaporate the extract on a water bath (<75°C) to approximately 20 mL. Add approximately 10 mL hexane, allow to S-Evap until all the DCM has been removed.
- 11.3.7 Transfer the extract to a culture tube and, using the N-Evap, blow down the extract to approximately 2 mL.
- 11.3.8 Add 2 mL Grignard, and vortex every 5 minutes over a 45 minute period. Add concentrated HCl slowly, vortexing as needed, until there is no reaction and hexane layer is clear.
- 11.3.9 Clean up using alumina and silica cartridge as described in section 11.1.6 and take to 1.0 mL (nominal) final volume.
- 11.4 Extraction of Organotins from Tissue
  - 11.4.1 Mix sample thoroughly and weigh approximately 10 g into a 40 mL VOA vial. Add surrogate and matrix spikes. Acidify with 10mL of 1.5M HCl. Add 10mL of 0.1% tropolone/DCM. Tumble for 1 hour. Centrifuge the extract and transfer tropolone/DCM layer to a culture tube. Repeat two more times with addition of tropolone/DCM each time. Add about 2g of unbaked granular sulfate to remove any remaining water.
  - 11.4.2 Evaporate the extract to 5 mL on the N-evap. Transfer extract off of the sulfate and transfer to a 15 mL culture tube. Add approximately 1 mL of hexane, evaporate to 2 mL, add 10 mL more hexane, evaporate to 2 mL and repeat the addition of hexane two more times.
  - 11.4.3 Continue with Grignard derivitization and take to final volume using a 6g Florisil and silica gel cartridge. Using the vacuum manifold, set up the Florisil/Silica gel cartridges and condition with 5 mL of Hexane. Discard Hexane. Place samples in cartridges and bring down to almost dry, and elute with 10 mL of Pentane. Discard this 10 mL fraction and elute with an additional 10 mL of Pentane. Take the second 10 mL fraction to a 1.0 mL final volume in Hexane, and place in a 2 mL vial.

## 12) QA/QC Requirements

- 12.1 This procedure shall operate under the formal Quality Assurance Program established at ALS and must maintain records that define the quality of data that is generated. Data shall be compared to established criteria in order to determine if the results of the analyses meet the performance characteristics of the method.
- 12.2 All measurements are to be recorded in the applicable logbook or benchsheets as described above. Entries into logbooks are to be performed in accordance with the *SOP for Making Entries Onto Analytical Records*.
- 12.3 The QC samples required for the extraction batch is described in the *Butyltins* SOP (SOC-BUTYL) and the SOP for *Sample Batches* (ADM-BATCH). Any method blanks



or laboratory control samples should be subjected to exactly the same procedures as those used in actual samples.

- 12.4 Follow the applicable quality control guidelines outlined in *Butyltins* SOP (SOC-BUTYL).
- 12.5 The laboratory must follow all quality control requirements outlined in Appendix F of the *DoD Quality Systems Manual for Environmental Laboratories* (current version) for samples submitted for DoD ELAP projects. See the current version of *Department of Defense Projects Laboratory Practices and Project Management*.

### 13) Data Reduction and Reporting

#### 13.1 Data Review

- 13.1.1 Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the *SOP for Laboratory Data Review Process (ADM-DREV)* for details. The person responsible for final review of the data report and/or data package should assess the overall validity and quality of the results and provide any appropriate comments and information to the Project Manager for inclusion in the report narrative.
- 13.1.2 It is the analyst's responsibility to review analytical data to ensure that all quality control requirements have been met for each sample batch or analytical run.

### 14) Contingencies for Handling Out-of-Control or Unacceptable Data

- 14.1 Refer to the SOP for *Non Conformance and Corrective Action* for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

### 15) Method Performance

- 15.1 Refer to the reference method for additional method performance data available.

### 16) Pollution Prevention and Waste Management

- 16.1 The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Lab Waste Management Plan.

### 17) Training

- 17.1 All analysts performing this analysis are required to read and understand this SOP.
- 17.2 Training is documented following the *Employee Training and New Employee Orientation* (ADM-TRAIN).



18) **Method Modifications**

- 18.1 There are no known modifications in this laboratory standard operating procedure from the reference method.

19) **References**

- 19.1 TNI Quality Standards, 2009, 2016.
- 19.2 ANSI/ISO/IEC 17005:2005 American National Standard, General requirements for the *competence of testing and calibration laboratories*.
- 19.3 ALS-Kelso Quality Assurance Manual.
- 19.4 DoD Quality Systems Manual for Environmental Laboratories, Version 5.0, 5.1".
- 19.5 Unger, M.A.; MacIntyre, W.G. Greaves, J.; Huggett, R.J., GC Determination of Butyltins in Natural Waters by Flame Photometric Detection of Hexyl Derivatives with Mass Spectrometric Confirmation, *Chemosphere*, 1986, 15 (4): 461-470
- 19.6 Krone, C.A.; Brown, D.W.; Burrows, D.G.; Bogar, R.G.; Chan, S.; Varanasi, U., *A Method for Analysis of Butyltin Species and Measurement of Butyltins in Sediment and English Sole Livers from Puget Sound*, Environmental Conservation Division, Northwest and Alaska Fisheries Center, National Marine Fisheries Service, NOAA, November, 1988.
- 19.7 Stallard, M.O.; Cola, S.Y.; Dooley, C.A.; *Optimization of Butyltin Measurements for Seawater, Tissue, and Marine Sediment Samples*, *Applied Organometallic Chemistry* (1989)3, 105-114.
- 19.8 Analytical Worksheets
  - 19.8.1 [R:\Extractions\Active Benchsheets\OSWT\Method\\_Soil\\_Organotins.doc](R:\Extractions\Active Benchsheets\OSWT\Method_Soil_Organotins.doc).
  - 19.8.2 [R:\Extractions\Active enchsheets\OSWT\Method\\_Tissue\\_Organotins.doc](R:\Extractions\Active enchsheets\OSWT\Method_Tissue_Organotins.doc)
  - 19.8.3 <R:\Extractions\Active Benchsheets\OSW.T>.
- 19.9 Methylene chloride policy document, ENV-HSE-NA-EX-006-EN for proper handling. [G:\SAFETY\TRAINING\Methylene\\_Chloride\Methylene\\_Chloride - NA 031419.pdf](G:\SAFETY\TRAINING\Methylene_Chloride\Methylene_Chloride - NA 031419.pdf).

20) **Changes Since Last Revision**

Summary of Revision Changes			
Revision Number	Effective Date	Document Editor	Description of Changes
12.0	11/30/2020	T.Caron	Updated SOP signatories and ALS SOP formatting.

21) **Attachments, Tables, and Appendices**

- 21.1 DMD Preparation.



## Preparation of DMD

### 1) Standards, Reagents and Consumable Materials

- 1.1 Reagent grade acetone.
- 1.2 Reagent grade sodium bicarbonate
- 1.3 Oxone™ (sodium monoperoxysulfate mixture), from Aldrich.

### 2) Apparatus and Equipment

- 2.1 3 liter, 2-necked, round-bottomed reaction flask with PTFE stoppers
- 2.2 U-tube (i.d. 20-25 mm)
- 2.3 500 mL, 2-necked collection flask
- 2.4 250 mL graduated cylinder
- 2.5 150 mL beaker
- 2.6 Glass funnel
- 2.7 Vacuum pump with gauge
- 2.8 Magnetic stir plate with pear-shaped stir bar
- 2.9 Dry ice-acetone or dry ice-ethanol bath
- 2.10 Water ice-DI water bath
- 2.11 2 - 12 inch distillation columns
- 2.12 Aluminum foil

### 3) Procedure

- 3.1 Equip a 3 liter, 2-necked, round-bottomed reaction flask with an efficient magnetic stirrer. Attach the 12 inch distillation columns to the 500 mL 2-neck collection flask. A U-tube connects the reaction flask to the collection flask at one of the distillation columns. A vacuum pump hose is attached to the top of the second distillation column.
- 3.2 The collection flask must be chilled throughout synthesis and distillation to  $-78^{\circ}\text{C}$  by immersion in a dry ice-acetone bath (ethanol may be substituted for acetone in the dry ice bath).
- 3.3 While stirring, 250 mL Reagent water, 60 g reagent grade sodium bicarbonate and 250 mL reagent grade acetone are introduced into the reaction flask in that order. The reagent mixture is chilled to  $5-10^{\circ}\text{C}$  throughout reagent addition and DMD synthesis by immersing the bottom third of the reaction flask in an ice-DI water bath. The reaction flask mixture is stirred vigorously throughout reagent addition, synthesis and distillation.
- 3.4 120 g of Oxone™ is added to the reaction flask. The flask is then sealed.



- 3.5 Fifteen minutes following the addition of Oxone™, a vacuum of 80-100 Torr is applied, and the ice-DI water bath is removed. Be careful not to interrupt the stirring of the reaction mixture for longer than a few seconds, if at all, otherwise it is very difficult to start stirring again.
- 3.6 Encourage flow of the distillate toward the collection flask by loosening one of the stoppers on the reaction flask slightly. A small piece of aluminum foil may be used to maintain the gap between the stopper and the joint, if necessary. Distill for at least 2 hours. An acetone solution of DMD will accumulate in the chilled collection flask. Much of the DMD will accumulate as a white solid at the neck and bottom of the collection flask, and at the base of the distillation column.
- 3.7 After distillation is complete, turn vacuum pump off. Disconnect the vacuum pump from collection flask. Disconnect the U-tube from the distillation column and remove the distillation column and flask together. Allow the distillation column and flask to warm to around 0°C; any solid DMD will dissolve with swirling. Rinse the distillation column with a few mLs of reagent grade acetone, collecting the rinse with the distillate. About 120-150 mL of approximately 0.08M DMD in acetone, a very slightly yellow solution, should be recovered. The solution is transferred to clean, amber bottles, and stored at less than -10°C. Label containers with reagent ID and date of preparation.



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## Zero Headspace Extraction (EPA Method 1311)

DOCUMENT ID: EXT-ZHE, REVISION 1.0

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Prepared By: Organics Manager, Jonathon Walter  
Signature on file.

Date: 2/15/2021

Prepared By: Quality Assurance Manager, Kurt Clarkson  
Signature on file.

Date: 2/15/2021

Approved By: Laboratory Director, Charles (Pat) Byrne  
Signature on file.

Date: 2/15/2021

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## 1) Scope & Applicability

1.1 This procedure describes the Zero Headspace Extraction (ZHE) sample preparation by EPA Method 1311. The procedure applies to solid and liquid matrices as defined in method 1311. The preparation technique is used in determining leachable characteristics of volatile organic compounds from the sample.

## 2) Summary of Procedure

2.1 The sample is characterized as to its moisture content, size, physical state and miscibility in water (in cases of liquid samples). As needed, procedures are employed to physically reduce the sample size to accommodate the extraction device, to segregate liquid from solid matrices, and to separate biphasic mixtures of a liquid sample. The solid material is leached with twenty times its weight using a mildly acidic extraction fluid. Following extraction, the leachate is either analyzed for volatile organic compounds or, if an aqueous filtrate was collected prior to extraction, it is combined with the aqueous filtrate then analyzed for volatile organic compounds. Non-aqueous filtrates are stored for separate analysis, in which case the results are mathematically combined with those obtained from analysis of the leachate.

## 3) Definitions

3.1 For laboratory definitions applicable to most analyses, refer to the SOP for *Sample Batches* (ADM-BATCH).

## 4) Responsibilities

4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.

4.2 It is the responsibility of the department supervisor/manager to document analyst training. Documenting ongoing method proficiency is also the responsibility of the department supervisor/manager. Refer to *Employee Training and New Employee Orientation* (ADM-TRAIN).

## 5) Interferences

5.1 Some samples such as paints, thick oils or fine particulates may cause clogging of the filter device. These samples may require the use of a stainless steel filter disc in place of the standard glass fiber filter. The stainless steel filter disk cannot generally be adequately cleaned once it has been used for filtration of extremely difficult samples.

## 6) Safety

6.1 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.

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- 6.2 This method may use Methylene Chloride, a known human carcinogen. Viton brand gloves should be used while rinsing, pouring or transferring the solvent.
- 6.3 Sodium Hydroxide (NaOH) is a strong caustic and a severe health and contact hazard. Use nitrile or latex gloves while handling pellets or preparing solutions.
- 6.4 The procedure requires the use of a high-pressure nitrogen tank and pressurized apparatus. Care should be taken when moving cylinders and pressurizing the extraction device. Gas cylinders must be secured to a wall or an immovable counter with a double chain or a cylinder clamp at all times.

## 7) Sample Collection, Containers, Preservation, and Storage

- 7.1 Samples should be collected (received) in glass jars with a minimum of headspace and care taken to minimize the loss of volatile analytes. Sample are collected in Teflon lined capped vials and stored at  $4 \pm 2^{\circ}\text{C}$  until analysis.
- 7.2 Holding Times: The ZHE extraction must be started within 14 days from sample collection. The ZHE extract must be analyzed within 14 days from the end of the ZHE extraction.

## 8) Standards, Reagents, and Consumable Materials

- 8.1 Compressed Gas: nitrogen is recommended
- 8.2 Glacial Acetic Acid: ACS reagent grade or equivalent.
- 8.3 Sodium Hydroxide: 1N, prepared from ACS reagent grade
- 8.4 Reagent Water: ASTM Type II or equivalent, free of volatile contaminants (laboratory deionized water meets these criteria)
- 8.5 Extraction Fluid (#1): Add 5.7 ml glacial acetic acid ( $\text{CH}_3\text{CH}_2\text{OOH}$ ) to 500 ml of reagent water; add 64.3 ml of 1N sodium hydroxide (NaOH); dilute to 1 liter. When correctly prepared the pH of this fluid will be  $4.93 \pm 0.05$ . Record date prepared and pH in the preparation log.
- 8.6 Glass Fiber Filter: effective pore size of 0.6 - 0.8  $\mu\text{m}$ .
- 8.7 Methanol: high purity, free of volatile contaminants
- 8.8 Stainless Steel Filter: manufactured and distributed by Associated Design and Manufacturing (Alexandria, VA) to be used as a substitute to the standard glass fiber filters and stainless steel filter support when filtering extremely viscous wastes such as thick oils or paint wastes.
- 8.9 Tedlar Bags
- 8.10 VOA Vials: 20 ml or 40 ml capacity, pre-preserved with HCl.

## 9) Apparatus and Equipment

- 9.1 Balance: accurate to within 0.1 gram
- 9.2 Beaker or Erlenmeyer flask (various sizes ranging from 100 mL to 500 mL)
- 9.3 Brushes or scouring pads: for cleaning of ZHE units
- 9.4 Extraction Device (Rig, piston, o-rings, filter support): zero headspace extraction vessels manufactured and distributed through Associated Design and



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Manufacturing (Alexandria, VA) or Millipore Corporation (Bedford, MA) meet the design requirements for the procedure.

- 9.5 Glass Syringe (50 ml)
- 9.6 Graduated Cylinders: various sizes (250 mL - 1000 mL)
- 9.7 Drying Oven: capable of maintaining a constant temperature of  $100 \pm 20^{\circ}\text{C}$
- 9.8 Magnetic Stirrer and Stir Bar
- 9.9 pH Meter: accurate to  $\pm 0.05$  units at  $25^{\circ}\text{C}$
- 9.10 Separatory Funnel: 1 or 2 liter
- 9.11 Squeeze Bottles: suitable for methanol and deionized water
- 9.12 Stainless Steel Scoopula
- 9.13 Luer lock adaptor: Adaptor is attached to ZHE outlet valve and screwed directly onto a Tedlar bag to enable minimal exposure to atmosphere during transfer of extraction fluid.
- 9.14 Stainless steel Gas-Tight syringe, 600mL, Associated Design and Manufacturing Company.
- 9.15 Tumbler: Agitation devices manufactured and distributed by Associated Design and Manufacturing (Alexandria, VA) meet minimum requirements for the procedure.
- 9.16 Watch Glass
- 9.17 Stopwatch, preferably digital for tumbler rotation checks.

## 10) Preventative Maintenance

- 10.1 Maintenance is typically limited to routine cleaning and inspection of the ZHE apparatus and equipment. Extraction devices should be thoroughly cleaned and rinsed as described below. All O-rings having gouges or scratches significant enough to compromise the seal of the ZHE apparatus must be discarded.
- 10.2 Cleaning ZHE Units.
  - 10.2.1 ZHE units should be emptied of extracted contents in a fume hood. Open pressure release valve. Open top flange and remove filter supports. Decant unfiltered liquid into the sink or waste bucket. Tap extracted solids into a separate waste bucket or tray. Non-aqueous liquid wastes should be emptied on an absorbent pad. Aqueous wastes and remaining extraction fluid may be rinsed down the sink with the water running. Allow all extracted wastes to vent in the fume hood for several hours prior to disposal or bag all extract waste and remove from the lab to a ventilated waste disposal area.
  - 10.2.2 Rinse ZHE unit with tap water and remove piston. Some units are equipped with a low backpressure release valve that allows the pistons to be forced out of the rig by applying pressure through the pressurization valve. Other units require that the pistons be knocked out with a mallet. If you are unsure as to which unit is equipped with



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the low backpressure release valve, do not use pressurized gas to remove pistons.

- 10.2.3 Inspect the piston o-rings for embedded soil, sand, or waste material. Remove o-rings to facilitate cleaning if necessary.
- 10.2.4 Wash all internal surfaces with hot, soapy water. Rinse three times with warm tap water. Rinse three times with deionized water. Air dry.
- 10.2.5 Some wastes will leave a film or residue on the surface of the ZHE unit. These must be cleaned with an appropriate organic solvent. If methanol does not remove the residue, a more compatible solvent such as acetone or methylene chloride can be used. However, if a solvent other than methanol is used, the ZHE unit must be baked at  $100 \pm 20^{\circ}\text{C}$  for four hours prior to use.
- 10.3 The ZHE unit should be checked for leaks after every extraction. After collection of the extract, pressurize to 50psi. Leak-check by either checking the pressure gauge on the unit for loss of pressure (after allowing it to stand for 1 hour), or submerge it in water and check for air bubbles escaping from any of the fittings. If pressure is lost, check all fittings and inspect and replace O-rings, if necessary. Retest the device. If leakage problems cannot be solved, take the unit out of service. Any maintenance tasks performed on leaking vessels must be recorded in the appropriate log book.
- 10.4 Tumbler rotation should be routinely checked to verify proper rotation speed. Measure and record on the bench sheet the tumbler rotation (RPM) when the tumbling is in process.

## 11) Procedure

NOTE: All procedures involving exposure of the waste to the air should be conducted in a hood and in a manner as to reduce loss of volatile compounds.

- 11.1 Preliminary Evaluations: Given the wide range of sample types encountered, some degree of analyst's judgment is necessary when determining if a sample is capable of releasing liquid or not. But in cases when the analyst encounters complex sample types their supervisor or a senior analyst should be consulted for advice. The preliminary evaluation includes, the determination of the percent solids, separation of biphasic liquids, and particle size reduction.
  - 11.1.1 Determine the % filterable solids and % dry solids.
    - 11.1.1.1 If the sample contains moisture that which may produce liquids when subjected to pressure filtration, the following steps are taken. If not, proceed to the particle size reduction section (11.1.6).
    - 11.1.1.2 Pre-weigh the filter on a watch glass and the container that will receive the filtrate. Record the masses.
    - 11.1.1.3 Assemble the ZHE unit and filter as per the manufacturer's instructions.
    - 11.1.1.4 Weigh out 100 grams of the sample and record the mass.



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- 11.1.1.5 Allow slurries to settle prior to filtration, centrifuge to aid in filtration if necessary.
- 11.1.1.6 Quantitatively transfer the waste to the ZHE unit (both the liquid and the solid). After that has been completed, make sure that the outlet valve is closed. Apply gentle pressure (<10 psi) to the ZHE unit, then open the valve to begin collecting the filtrate, if no solution has passed through the filter for two minutes, increase the pressure in increments of 10 psi until air passes through the filter or 50 psi is reached. Use only one filter. The portion remaining on the filter is considered the solid phase.
- 11.1.1.7 Determine the weight of the liquid phase by weighing the filtrate container and subtracting the initial mass of the container.
- 11.1.1.8 Subtract the mass of the liquid from the mass of sample filtered to get the mass of the solid phase.
- 11.1.1.9 Calculate the percent filterable solids.

$$\%Filterable\_solids = \frac{Weight\_of\_solid}{Total\_weight\_of\_waste} \times 100$$

- 11.1.2 If the percent solids is <0.5%, then the filtered sample is considered to be the leachate, and no further analysis is required. The filtrate is stored at 0-6°C until VOC analysis is performed. If the sample is >0.5% solids, go to section 11.1.3. If sample is exactly 0.5% solids, consult Project Manager on how to proceed.

- 11.1.2.1 In standard cases (i.e. liquids which will not pass through the filter are not present) remove the solid phase and the filter from the filtration apparatus; else continue to the particle size reduction section (11.1.6).
- 11.1.2.2 Dry the solid phase with the filter at 100 ± 20°C until two successive weight measurements yield the same value within ±1%. Record the final mass.

Note: If the amount of material remaining on the filter will obviously yield solids >50%, note this on the extraction bench sheet, skip the drying step, and proceed to section 11.1.6 and subsequent extraction with this aliquot of waste.

- 11.1.2.3 Calculate the percent dry solids.

$$\%Dry\_solids = \frac{Wt\_of\_dry\_waste + filter}{Initial\_weight\_of\_waste} \times 100$$

- 11.1.3 The following steps (11.1.3.1-11.1.3.3) are for determination of % dry solids only. The % dry solids determination will only be needed on samples that are not obviously >0.5% dry solids. These samples will appear as liquids with some solid matter in the container. The % dry solids determination as performed by other departments (Metals



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usually) may be used. In this case % dry solids would not have to be performed by the Extractions department.

11.1.3.1 Carefully remove the filter from the filter assembly and place it on the watch glass that was weighed with the filter in step 11.1.1.2.

11.1.3.2 Place the filter with watch glass in a drying oven and dry for 24 hours. A drying period of 24 hours is not needed if successive weights of the filter and watch glass produce % dry solids within 1% RPD. The filter and watch glass must be in the drying oven for two hours before the first weighing and an interval of one hour must pass between each weighing.

11.1.3.3 Calculate the percent dry solids.

$$\%Dry\_solids = \frac{Final\_filter\_wt - Initial\_filter\_wt}{Total\_wt\_of\_sample} \times 100$$

11.1.4 If percent dry solids are greater than 0.5%, the calculated percent dry solids are used in determining sample amounts for ZHE preparation. If percent dry solids are less than 0.5%, no further analysis is required. The filtrate is defined as the leachate. Store at  $4 \pm 2^{\circ}C$  until VOC analysis is performed in either a VOA vial under zero headspace or in a Tedlar bag. Prepare one filter blank at a rate of one per batch or every 20 (or fewer) samples processed.

11.1.5 Separation of biphasic liquids.

11.1.5.1 Consult the Project Chemist to determine if the client wants both phases analyzed, or if only one of the phases is of interest.

11.1.5.2 Determine phase compatibility. Using a pipette, transfer a few drops of each phase to a small beaker of water. Water miscible phases are identified as “aqueous”. Non-water miscible phases are identified as “non-aqueous”.

11.1.5.3 If both phases are to be analyzed, measure the volume of each phase of the sample into a graduated cylinder (this procedure should be done while the sample is cold). Record these values on the bench sheet. Separate the phases and collect in separate glass containers with minimal headspace. Depending on the client’s needs, results may be reported separately, or as a volume weighted average concentration. Continue with percent solids determination (Section 11.1.1).

11.1.6 Particle Size Reduction (this procedure should be done while the sample is cold)

11.1.6.1 Particle size reduction is required if the solid portion of the waste is larger than 1 cm at its most narrow dimension or has a surface area smaller than  $3.1\text{ cm}^2$ . Surface area criteria are meant for filamentous (e.g. paper, cloth, and similar) waste



materials. Actual measurement of surface area is not required nor recommended.

- 11.1.6.2 Prepare solid wastes by crushing, cutting or grinding. Equipment should be cooled to 4°C if possible. The procedures used to reduce particle size should not generate heat as a result of friction or pressure. Perform the procedure quickly and immediately proceed to the extraction procedure following particle size reduction.

## 11.2 ZHE Leaching Procedure

- 11.2.1 If the liquid phase is non-aqueous as determined in section 11.1.5.2, it must be collected separate from the aqueous leachate. If the liquid phase is aqueous, it will be combined with the leachate following the extraction.

- 11.2.2 If the sample contains between 0.5% and 5% filterable solids, weigh 500 grams for extraction. If the sample contains  $\geq 5\%$  filterable solids the sample mass used for extraction is calculated as follows:

$$\frac{25}{\%Solids} \times 100$$

- 11.2.3 Assemble the ZHE unit. Transfer the entire sample into the ZHE unit. If the remaining residue is greater than 1% of the total sample weight, subtract this amount from the sample amount. Record the sample amount to the nearest 0.1 gram.

- 11.2.4 If during the Preliminary Evaluation (section 11.1) it is determined that the sample is capable of releasing liquid, assemble the top flange and pressurize the unit to 10 psi (make sure the outlet valve on tip of flange is closed before pressurizing unit. Attach the Tedlar bag. Slowly open the outlet valve and begin collecting filtrate. Continue to filter the liquid in 10 psi increments until a maximum pressure of 50 psi is maintained for a period of 2 minutes with no liquid being filtered from the unit. Sample filtrate that is non-aqueous liquid may be stored in either a Tedlar bag (pre-weighed) or VOA vial (pre-weighed) under zero headspace. Regardless of the storage container the weight of the non-aqueous liquid must be recorded for use in the sample volume-weighted average calculation if analysis of separate phases is required. Sample filtrate that is aqueous liquid will be combined with extract in a later step. Store the filtrate at  $4 \pm 2^\circ\text{C}$ .

- 11.2.5 Measure the pH of the extraction fluid on the day of use and record on the ZHE benchsheet prior to proceeding with the volume determination performed in the next step.

- 11.2.6 Determine the appropriate volume (in mL) of extraction fluid to add to the ZHE unit.

$$\frac{20 \times \text{Percent Solids} \times \text{Wt. of waste filtered}}{100}$$



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- 11.2.7 With the ZHE in the vertical position, attach a line from the extraction fluid reservoir to the liquid inlet/outlet valve. The line used shall contain fresh extraction fluid and should be pre-flushed with fluid to eliminate any air pockets in the line. Release gas pressure on the ZHE piston (from the gas inlet/outlet valve), open the liquid inlet/outlet valve, and begin transferring extraction fluid (by pumping or similar means) into the ZHE. Continue pumping extraction fluid into the ZHE until the appropriate amount of fluid has been introduced into the device. If the calculated amount of extraction fluid will not fit into the extraction unit, add the maximum amount possible and document the amount added.
- 11.2.8 After the extraction fluid has been added, immediately close the liquid inlet/outlet valve and disconnect the extraction fluid line. Check the ZHE to ensure that all valves are in their closed positions. Manually rotate the device end-over-end 2 or 3 times. Reposition the ZHE in the vertical position with the liquid inlet/outlet valve on top. Pressurize the ZHE to 5-10 psi (if necessary) and slowly open the liquid inlet/outlet valve to bleed out any headspace (into a hood) that may have been introduced due to the addition of extraction fluid. This bleeding shall be done quickly and shall be stopped at the first appearance of liquid from the valve. Re-pressurize the ZHE with 5-10 psi and check all ZHE fittings to ensure that they are closed.
- 11.2.9 Close the pressure release valve. Tighten all flanges and valves and pressurize the unit to approximately 10-20 psi. Manually rotate the unit 2-3 times. Open the outlet valve and slowly bleed off excess air from the unit. Close the outlet valve at the first appearance of liquid. Adjust the pressure to 5-10 psi. Tumble the unit for  $18 \pm 2$  hours. Room temperature should be maintained at  $23 \pm 2^\circ$  C. Record the start time and initial temperature on the bench sheet. Measure and record on the bench sheet the tumbler rotation (RPM). Include the temperature graph from Check Point showing room temperature ( $^\circ$ C) while the tumbling is in process.
- 11.2.10 Prepare one extraction blank at a rate of one per batch or every 20 samples processed (if batch size is greater than 20 samples).
- 11.2.11 Turn agitator off. Record stop time. Quickly open and close the pressure release valve. Escape of gas indicates that pressure has been maintained. If no gas escapes the pressure has not been maintained and the extraction must be repeated. Failure to maintain a temperature of  $23 \pm 2^\circ$  C will also result in re-extraction.
- 11.2.12 If a solid-liquid separation was performed and an aqueous filtrate was collected, collect the entire leachate in the Tedlar Bag containing the initial filtrate. Otherwise, collect at least one (two if volume permits) VOA vials of leachate. The leachate needs to have pH checked and recorded. The pH measurement must take place before preservation. Addition of the matrix spike solution must take place before the leachate or leachate/filtrate is preserved. Transfer the leachate to two VOA vials (volume permitting), one pre-preserved with HCL, using a 50 ml syringe that needs no Luer lock adaptor to attach to the outlet valve assembly. Leachate or leachate/filtrate needs to be preserved before



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storing in the refrigerator. Preservation is accomplished by adding the leachate or leachate/filtrate to a VOA vial containing 0.5 mL of 1:1 HCL solution. Non-aqueous filtrate produced in step 11.2.4 must be analyzed separately from leachate. Store leachate at  $4 \pm 2^{\circ}\text{C}$ .

11.2.13 All completed paperwork is reviewed by the supervisor or a trained analyst.

## 12) QA/QC Requirements

### 12.1 Initial Precision and Recovery Validation

12.1.1 The accuracy and precision of the procedure must be validated before analyses of samples begin, or whenever significant changes to the procedures have been made. To do this, four replicates of a spiked blank matrix are prepared and analyzed. Results are compared to method criteria. Refer to the determinative method.

### 12.2 Method Detection Limits and Method Reporting Limits

12.2.1 Method detection limits and method reporting limits are based on the determinative procedure. Results for TCLP-ZHE analyses are not routinely reported to the MDL and therefore a separate MDL study is not required.

### 12.3 Method Blanks

12.3.1 A minimum of one Method Blank must be prepared with each batch or with every 20 (or fewer) samples processed. If a Method Blank contains a positively identified target analyte above the MRL, all samples that contain that analyte will be re-extracted, unless the sample results are greater than 20x the level detected in the Method Blank.

12.3.2 The ZHE units used for method blanks are tracked to ensure that out of all ZHE units in use, each unit is used for a method blank a minimum of one time per 20 uses. This is monitored in the lab by rotating the ZHE units used to prepare Method Blanks. Each ZHE unit is labeled with an identification number (inscribed on the unit's body, piston, top flange and bottom flange). Record which unit is used for blank preparation on the bench sheet, and in the extraction fluid preparation log for each run. When setting up a new batch, choose the next ZHE unit in the blank rotation for the method blank.

12.3.3 Unless the Method Blank contamination can be linked to a highly contaminated sample prepared in the batch (i.e., the contamination is the result of volatile transfer from sample to blank during the batch set-up and not as a result of a contaminated ZHE unit), all units resulting in positive ID of a target analyte that was detected in the blank must be thoroughly cleaned and tested before extracting additional samples. Document the verification analysis in the extract fluid preparation log.

## 13) Data Reduction and Reporting

13.1 No data reduction or evaluation steps specific to the ZHE process are required. However, calculations and entries on bench sheets should be checked for



correctness. Review of bench sheets should be documented as part of the data review process for the determinative analysis.

- 13.2 Any sample handling performed as a result of an unusual matrix should be described in the narrative comments accompanying the final report.
- 13.3 If individual phases (aqueous vs. non-aqueous liquid) are to be analyzed separately, determine the volume of the individual phases (to  $\pm 0.5\%$ ), conduct the appropriate analysis, and combine the results mathematically by a volume-weighted average:

$$\text{Concentration} = \frac{(V1)(C1) + (V2)(C2)}{V1 + V2}$$

Where:

V1=the volume of the first phase (L)

C1=the concentration of the analyte of concern in the first phase (mg/L)

V2=the volume of the second phase (L)

C2=the concentration of the analyte of concern in the 2nd phase (mg/L)

#### 14) Method Performance

- 14.1 Refer to the reference method for additional method performance data available.
- 14.2 Available method performance data is given in the reference method. In addition, this procedure was validated through single laboratory studies of accuracy and precision as specified in Section 12. Method Reporting Limits are established for this method based on regulatory action levels and as specified in the ALS Quality Assurance Manual.

#### 15) Pollution Prevention and Waste Management

- 15.1 The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Lab Waste Management Plan.

#### 16) Contingencies for Handling Our-of-Control or Unacceptable Data

- 16.1 Refer to the SOP for *Non Conformance and Corrective Action*, for procedures for corrective action.
- 16.2 Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

#### 17) Training

- 17.1 All analysts performing this analysis are required to read and understand this SOP.
  - 17.1.1 Training is documented following the *Employee Training and New Employee Orientation* (ADM-TRAIN).

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## 18) Method Modification

18.1 There are no known modifications in this laboratory standard operating procedure from the reference method.

## 19) References

19.1 EPA Method 1311, SW-846 Update I. “Toxicity Characteristic Leaching Procedure”, USEPA, July, 1992.

19.2 TNI Standard, Volume 1- 2009 & 2016.

19.3 DoD Quality Systems Manual, Current Version.

19.4 ISO/IEC 17025: 2017.

19.5 Extractions Benchsheet – This document is used in the laboratory to support this procedure and is reviewed at the same time this SOP is reviewed each year.

<R:\Extractions\Active Benchsheets\SVM\ZERO HEADSPACE EXTRACTION.doc>.

## 20) Changes Since Last Revision

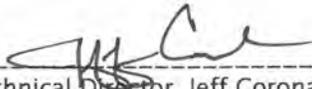
Revision Number	Effective Date	Document Editor	Description of Changes
1.0	3/06/2019	T. Caron	Admin Changes only not affecting technical content.
1.0	2/12/2021	Jose Martinez	Documented date of annual SOP Review, updated SOP signatories; boiler plate standard paragraphs have been updated to reflect current practices.
			Review and Approval Statement for: EXT-ZHE Revision 1.0, certifying there are no technical changes are needed at this time.



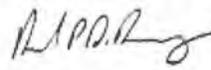
## Total Solids

DOCUMENT ID: GEN-160.3 REVISION 16.0

Prepared By:

  
-----  
Technical Director, Jeff Coronado

Date: 7/13/20

  
Quality Assurance Manager, Bob Di Rienzo

Date: 7/20/2020\_\_\_\_\_

Approved By:

  
-----  
Laboratory Director, Charles Byrne

Date: 7-14-2020

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## 1) Scope & Applicability

- 1.1 This procedure is used to determine total solids using Standard Methods 2540 B-2011 and EPA Method 160.3 and is applicable to drinking, surface, and saline waters, domestic and industrial wastes.
- 1.2 The practical range of the determination is from 5 mg/L to 20,000 mg/L in water. The Method Detection Limit (MDL) is 5 mg/L using 40mL of sample.
- 1.3 For other sample matrices treated on a weight/weight basis, the working range can be as low as 2-100% dry solids. However, samples with less than 5-10% solids are generally treated as water samples.
- 1.4 In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPP's supersede method specified requirements. An example of this are projects falling under DoD ELAP. QC requirements defined in the SOP *Department of Defense Projects - Laboratory Practices and Project Management*, may supersede the requirements defined in this SOP.

## 2) Summary of Procedure

- 2.1 EPA 160.3, 2540 B -2011: A well-mixed sample is quantitatively transferred to a pre-weighed, evaporating dish/crucible and evaporated to dryness at 103 - 105°C. The vessel is weighed and the weight of the residue calculated. Results are reported in mg/L for water.

## 3) Definitions

- 3.1 Total solids - the residue left in the pan or vessel after evaporation of a sample and its subsequent drying in an oven at a defined temperature.
- 3.2 Total volatile solids, also known as volatile residue, is defined as the residue obtained from the determination of total, filterable or non-filterable residue ignited at 550°C in a muffle furnace.
- 3.3 Dry solids are defined as the amount of solid remaining after evaporating off all liquid contained within the sample.
- 3.4 For additional Sample Batch and sample matrix definitions, refer to the SOP for *Sample Batches*, ADM-BATCH.

## 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory.

## 5) Interferences

- 5.1 For water samples, non-representative particulates such as leaves, sticks, fish and lumps of fecal matter should be excluded from the sample if it is determined that

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their inclusion is not desired in the final result. However, for other matrices, these particles may be included if they are considered representative of the material undergoing other associated analyses.

- 5.2 Samples containing HF will react with the porcelain crucibles causing a significant weight loss and artificially high results. When analyzing samples containing HF, special Teflon™ crucibles should be used and samples should be evaporated in a ventilation hood to dryness.
- 5.3 The temperature at which the residue is dried has an important bearing on sample results, because weight losses due to the volatilization of organic matter and gases from heat-induced chemical decomposition depend on temperature and time of heating.
- 5.4 Each sample requires close attention to desiccation after drying. Minimize opening the desiccator because moist air enters.
- 5.5 To aid in quality assurance, analyze samples in duplicate. Dry samples to a constant weight. This entails multiple drying-cooling-weighing cycles for each determination.

## 6) Safety

- 6.1 Chemicals, reagents and standards must be handled as described in the ALS Kelso Chemical Hygiene Plan and in SDSs where available.

## 7) Sample Collection, Containers, Preservation, and Storage

- 7.1 Sample bottles should be plastic and must be thoroughly cleaned and rinsed prior to use.
- 7.2 A minimum of 100 mL of sample should be collected for water samples.
- 7.3 Store samples at  $\leq 6^{\circ}$  C and analyzed within 7 days from date of sample collection for water samples.

## 8) Standards, Reagents, and Consumable Materials

- 8.1 Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Refer to the SOP Reagent/Standards Login and Tracking for the complete procedure and documentation requirements.
- 8.2 All stocks, working solutions and sample dilutions should be prepared using deionized water (DI) conforming to ASTM Type I or ASTM Type II reagent water. For more information on reagent water generation, refer to the related SOP, Operation and Maintenance of Laboratory Reagent Water Systems.

## 9) Apparatus and Equipment

- 9.1 Glass vials, 60 mL volume.
- 9.2 Desiccators, containing desiccant.
- 9.3 Drying oven(s), for operation at 103-105°C and at 180 °C

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9.3.1 Ovens housing an internal temperature recorder/display as part of its operational system are calibrated twice per year by an external, accredited calibration service.

9.3.2 Oven temperature may be monitored by using a thermometer immersed in sand, or other suitable solid material, in a vessel in the oven. The liquid in glass thermometer is verified annually using a reference traceable to NIST.

9.4 Analytical balance capable of weighing to 0.01 mg.

9.5 Glass cylinders.

## 10) Preventative Maintenance

10.1 All maintenance activities are recorded in a maintenance logbook kept for each instrument. Pertinent information (serial numbers, instrument I.D., etc.) must be in the logbook. This includes the routine maintenance described herein. The entry in the log must include: date of event, the initials of who performed the work, and a reference to analytical control.

10.2 Multi-point balance calibration verifications are required for each day the balance is used. The NELAC Quality System Standards and DoD Quality System Manual require that the balance verifications be performed *prior to use* on each day of use. The calibration verification weights must bracket the range of use. For additional information, refer to the SOP *Documenting Laboratory Balance and Temperature Checks* (ADM-BAL).

10.3 A bound logbook or an electronic record is used to record all balance measurements in real time. Format the analytical record such that the date, initials, balance I.D., weight set ID, measurements, and specifications for the check weights are listed for each balance. Entries into logbooks are to be performed in accordance with the SOP for *Making Entries Onto Analytical Records*.

## 11) Procedure

11.1 Heat the clean glass vials (60 mL) to 103-105°C for a minimum of one hour. Cool, and desiccate. Weigh and store in desiccator until ready for use.

11.2 Total Solids Determination

11.2.1 Transfer a measured aliquot of the well mixed sample into the pre-weighed glass vials (100 mL). Wide-bore pipette tips must be used.

11.2.2 Choose an aliquot of sample sufficient to contain a residue of at least 25 mg. To obtain a measurable residue, successive aliquots of sample may be added to the same dish.

11.2.3 Weigh and evaporate to dryness in a drying oven.

11.2.4 If evaporation is performed in a drying oven, the temperature should be lowered to approximately 98°C to prevent boiling and splattering of the sample.

11.2.5 Dry the evaporated sample for at least 1 hour at 103-105°C.

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- 11.2.6 Transfer samples to a desiccator for final cooling in a dry atmosphere to balance temperature.
- 11.2.7 Weigh samples and record on bench sheet. Return the samples to the 103-105 ° C oven for 1 hour.
- 11.2.8 Repeat the cycle of drying at 103-105°C, cooling, desiccating and weighing until a constant weight is obtained or until loss of weight is less than 4% of the previous weight, or 0.5mg, whichever is less. If not, repeat the cycle of drying, cooling, desiccating and weighing to achieve a constant weight within the referenced acceptance criteria.

## 12) QA/QC Requirements

- 12.1 Prior to, and after each analysis batch, a balance calibration verification (CCV) is performed using at least 2 weights that bracket the sample weight use range. The serial number(s) of the weights used for the CCV determination must be recorded with the analytical record.
- 12.2 Prior to, and after each analysis batch, balance calibration verification is performed using weights bracketing the sample weights (sample + pan). Balance calibration verification measured weights must be  $\pm 0.5\%$  of the true value.
- 12.3 Ongoing QC Samples required are described in the ALS-Kelso Quality Assurance Manual and in the SOP for *Sample Batches* (ADM-BATCH). Additional QC Samples may be required in project specific quality assurance plans (QAPP). For example projects managed under the DOD ELAP must follow requirements defined in the *DoD Quality Systems Manual for Environmental Laboratories*. General QA requirements for DoD QSM are defined in the laboratory SOP, *Department of Defense Projects - Laboratory Practices and Project Management*. General QC requirements are:
- 12.4 Method Blank
  - 12.4.1 A method blank is extracted and analyzed with every batch of 20 (or fewer) samples or one per desiccator, to demonstrate that there are no method interferences. If the method blank shows any hits above the reporting limit, corrective action must be taken. Corrective action includes recalculation, reanalysis, system cleaning, or re-extraction and reanalysis. For some project specific needs, exceptions may be noted and method blank results above the MRL may be reported for common lab contaminants.
- 12.5 Laboratory Control Sample
  - 12.5.1 Run a laboratory control sample (LCS) per batch of 20 (or fewer) samples. For the LCS, a certified quality control standard is purchased from APG as a solid material. Add the standard to DI water in a 1L volumetric flask and dilute to volume (for APG, add all of the material provided). The LCS will be approximately 1000 mg/L, with exact values specified by lot number. Analyze as described above.

Calculate the LCS recovery as follows:



$$\%R = X/TV \times 100$$

Where X = Concentration of the analyte recovered  
TV = True value of amount spiked

12.5.2 The acceptance criteria are given in the ALS Kelso DQO Table. If the LCS fails acceptance criteria, corrective action must be taken. Corrective action includes recalculation, reanalysis.

## 12.6 Sample Duplicate

12.6.1 Run one duplicate per batch of ten samples. The RPD should be  $\leq 5\%$ . This statistically derived acceptance limit is subject to change as limits are updated. For Puget Sound Estuary Program protocols, perform a triplicate analysis per batch of 10 samples. The RSD should be  $\leq 20\%$ .

Calculate Relative Percent Difference (RPD) as:

$$\%RPD = \frac{|R1 - R2|}{(R1 + R2)/2} \times 100$$

Where R1= Higher Result  
R2= Lower Result

## 13) Reporting

### 13.1 Calculations

13.1.1 For water samples, calculate total residue as follows:

$$\text{Total residue, mg / L} = \frac{(A - B) \times 1,000}{C}$$

Where:

A = weight of sample + dish in mg  
B = weight of dish in mg  
C = volume of sample in mL

### 13.2 Reporting

13.2.1 Refer to ADM-RG, Data Reporting and Report Generation for reporting guidelines.

13.2.2 Reports are generated in the ALS LIMS by compiling the SMO login, sample prep database, instrument date, and client-specified report requirements (when specified). The forms generated may be ALS

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standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.

13.2.3 Record all measurements.

13.2.4 Report water results in mg/L total solids using whole numbers. The Method Reporting Limit is 5mg/L.

### 13.3 Data Review and Assessment

13.3.1 Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the *SOP for Laboratory Data Review Process (ADM-DREV)* for details. The person responsible for final review of the data report and/or data package should assess the overall validity and quality of the results and provide any appropriate comments and information to the Project Manager to inclusion in the report narrative.

## 14) Method Performance

14.1 Refer to the reference method for additional method performance data available.

## 15) Pollution Prevention and Waste Management

15.1 The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Lab Waste Management Plan.

## 16) Contingencies for Handling Out-of-Control or Unacceptable Data

16.1 Refer to the *SOP for Nonconformity and Corrective Action (ADM-NCAR)* for corrective action procedures and to document the proper actions for out of control events.

## 17) Training

17.1 All analysts performing this analysis are required to read and understand this SOP.

17.2 Training is documented following the *Employee Training and New Employee Orientation (ADM-TRAIN)*.

## 18) Method Modifications

18.1 There are no known modifications in this laboratory standard operating procedure from the reference method.

## 19) References

19.1 Standard Methods for the Examination of Water and Wastewater, 22nd Ed.

19.2 Total Solids Dried at 103-105°C, SM 2540 B-2011.

19.3 Residue, Total, Method 160.3 EPA 600/4-79-020.



- 19.4 TNI Standard, Volume 1- 2009, TNI Standard, Volume 1 -2016.
- 19.5 DoD Quality Systems Manual for Environmental Laboratories Current Version.

20) **Changes Since Last Revision**

Summary of Revision Changes			
Revision Number	Effective Date	Document Editor	Description of Changes
16.0	7/20/2020	T. Caron	Updated The SOP to the current ALS version/format. Updated SM 2540E to 2011 standard. Section 1: Removed the modification for soils and semisolids using 2540G. Minor edits performed in Sections 8 and 11. Includes reference to the STARLIMS auto set of 100 mL volume.

21) **Attachments, Tables, and Appendices**

- 21.1 Not applicable.



## FLASHPOINT DETERMINATION - SETAFLASH EPA METHOD 1020

DOCUMENT ID: GEN-1020, REV 10.0

Prepared By: Jeff Coronado  
Technical Director, Jeff Coronado

Date: 1/21/19

Prepared By: Carl Degner  
Quality Assurance Manager, Carl Degner

Date: 1/22/19

Approved By: A. K. Hughey  
General Manager, Ambrose Hughey

Date: 1/23/19



## ALS-Kelso SOP Annual Review Statement

SOP Code: GEN-1020

Revision: 10.0

An annual review of the SOP listed was completed on (date): 02/24/20

The SOP reflects current practices and requires no procedural changes.

Supervisor: TH Date: 02/24/20

Revision of the SOP is needed to reflect current practices. Draft revisions are listed below.

SOP Section Number	Description of Revision Needed	Date Procedure Change Implemented	Supervisor Initials Indicating Approval of Revision



## ALS-Kelso SOP Annual Review Statement

SOP Code: GEN-1020

Revision: 10.0


Attach additional pages or information if necessary

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## 1) Scope & Applicability

- 1.1 This Standard Operating Procedure (SOP) describes the procedure used to determine flashpoint by EPA Method 1020A. The procedure uses the Seta Flash Closed Cup Tester to determine the flashpoint of soil, liquid, and water matrices.
- 1.2 This procedure is applicable to materials with flashpoints between 20°C and 110°C.
- 1.3 In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP specific requirements to the laboratory. In general, project specific QAPPs supersede method specified requirements. An example of this are projects falling under DoD ELAP. QC requirements defined in the SOP *Department of Defense Projects – Laboratory Practices and Project Management* (ADM-DOD5) may supersede the requirements defined in this SOP.

## 2) Summary of Procedure

- 2.1 A sample portion is placed in a Setaflash® closed cup tester or its equivalent, and heated, using a flame applied to it at regular intervals, until a flash is observed or the sample heats to greater than 110°C.

## 3) Definitions

- 3.1 Batch - A batch of samples is a group of environmental samples that are prepared and/or analyzed together as a unit with the same process and personnel using the same lot(s) of reagents. It is the basic unit for analytical quality control.
  - 3.1.1 Preparation Batch - A preparation batch is composed of one to twenty field samples, all of the same matrix, and with a maximum time between the start of processing of the first and last samples in the batch to be 24 hours.
  - 3.1.2 Analysis Batch - Samples are analyzed in a set referred to as an analysis sequence. The sequence begins with instrument calibration (initial or continuing verification) followed by sample extracts interspersed with calibration standards (CCBs, CCVs, etc.) The sequence ends when the set of samples has been injected or when qualitative and/or quantitative QC criteria indicate an out-of-control situation.
- 3.2 Sample
  - 3.2.1 Field Sample - An environmental sample collected and delivered to the laboratory for analysis; a.k.a., client's sample.
  - 3.2.2 Laboratory Sample - A representative portion, aliquot, or subsample of a field sample upon which laboratory analyses are made and results generated.
- 3.3 Quality System Matrix - The *matrix* of an environmental sample is distinguished by its physical and/or chemical state and by the program for which the results are

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intended. The following sections describe the matrix distinctions. These matrices shall be used for purpose of batch and quality control requirements.

- 3.3.1 Aqueous - Any groundwater sample, surface water sample, effluent sample, and TCLP or other extract. Specifically excluded are samples of the drinking water matrix and the saline/estuarine water matrix.
- 3.3.2 Non-aqueous Liquid - Any organic liquid with <15% settleable solids.
- 3.3.3 Solids - Any solid sample such as soil, sediment, sludge, and other materials with >15% settleable solids.
- 3.3.4 Chemical waste - Any sample of a product or by-product of an industrial process that results in a matrix not described in one of the matrices. These can be such matrices as non-aqueous liquids, solvents, oil, etc.
- 3.3.5 Miscellaneous matrices - Samples of any composition not listed. These can be such matrices as plant material, paper/paperboard, wood, auto fluff, mechanical parts, filters, wipes, etc. Such samples shall be batched/grouped according to their specific matrix.
- 3.4 Laboratory Duplicates (DUP) - Duplicates are additional replicates of samples that are subjected to the same preparation and analytical scheme as the original sample. The relative percent difference (RPD) between the sample and its duplicate is calculated and used to assess analytical precision.
- 3.5 Method Blank (MB) - The method blank is an artificial sample composed of analyte-free water or solid matrix and is designed to monitor the introduction of artifacts into the analytical process. The method blank is carried through the entire analytical procedure.
- 3.6 Laboratory Control Samples (LCS) - The LCS is an aliquot of analyte free water or analyte free solid to which known amounts target analytes are added. The LCS is prepared and analyzed in exactly the same manner as the samples. The percent recovery is compared to established limits and assists in determining whether the batch is in control.

#### 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.
- 4.2 It is the responsibility of the department supervisor/manager to document analyst training. Documenting method proficiency, as described in the ALS-Kelso *SOP for*

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*Training Procedure* (ADM-TRAIN), is also the responsibility of the department supervisor/manager.

## 5) Interferences

- 5.1 Water will create a false flash at approx. 55° - 68°C. The analyst must be sure to recognize the difference between water BLOWING a flame out, and volatiles SUCKING a flame in.
- 5.2 Interferences and artifacts can be introduced into the procedure from field samples. Ensure that these interferences are minimized by cleaning the apparatus after each determination.

## 6) Safety

- 6.1 All appropriate safety precautions for handling solvents, reagents and samples must be taken when performing this procedure. This includes the use of personal protective equipment, such as, safety glasses, lab coat and the correct gloves.
- 6.2 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.

## 7) Sample Collection, Containers, Preservation, and Storage

- 7.1 Sample Collection
  - 7.1.1 Samples may be collected in any labeled glass container suitable for environmental samples. Care should be taken not to spill the sample onto the exterior of the container.
- 7.2 Sample Preservation and storage
  - 7.2.1 Water and soil samples should be iced or refrigerated at  $4 \pm 2^{\circ}\text{C}$  from time of collection until analysis. Miscellaneous waste samples may be stored refrigerated or at room temperature. If the waste may result in cross-contamination of other refrigerated samples, storage outside the refrigerated areas is advised.

## 8) Standards, Reagents, and Consumable Materials

- 8.1 Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Refer to the *SOP Reagent/Standards Login and Tracking (ADM-RTL)* for the complete procedure and documentation requirements.
- 8.2 All stocks, working solutions and sample dilutions should be prepared using deionized water (DI) conforming to ASTM Type I or ASTM Type II reagent water. For more information on reagent water generation, refer to the related SOP, Operation and Maintenance of Laboratory Reagent Water Systems.

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8.3 p-Xylene (flashpoint of 25.5°C)

8.4 1-Butanol

8.5 Ice.

## 9) Apparatus and Equipment

9.1 Seta Flash Closed Cup Tester, STANHOPE-SETA, SETAFLASH SERIES 3, MODEL 32000-0, SN"7069.

9.2 Scoopulas

9.3 Barometer

9.4 Transfer pipette

## 10) Preventative Maintenance

10.1 All maintenance activities are recorded in a maintenance logbook kept for each instrument. Pertinent information (serial numbers, instrument I.D., etc.) must be in the logbook. This includes the routine maintenance described herein. The entry in the log must include: date of event, the initials of who performed the work, corrective action and a reference to analytical control.

10.2 The unit's internal thermometer shall be verified at a minimum, annually using a NIST traceable reference thermometer. The Calibration Mode is only accessible from power up. The procedure is carried out via the panel controls and requires a NIST Reference Thermometer and some thermos-conductive paste. The Tester is provided with an aperture at the right hand side of the cup/heating block assembly for insertion of the thermometer, allowing accurate verification and calibration of the cup/heating block assembly temperature. Refer to the Calibration section of the Operating and Instruction Manual associated with the unit.

10.3 In the event of a problem, please check the items specified in the Small Scale Diagnostic Checklist, the Manufacturer's Fault Finding Guide and the recommended service and maintenance schedule in Attachment A.

10.4 For additional maintenance and repair, for example, replacing a flash detector probe, the sample well "O" ring seal, gas canister and tubing or the lid shutter assembly, refer to the referenced STANHOPE-SETA MODEL: 32000-00, Installation, Operating and Maintenance Instructions Manual

## 11) Procedure

11.1 Record all measurements on the appropriate benchsheet. The analysis sequence starts with a p-xylene calibration check and a 1-butanol calibration check followed by a method blank and up to 20 field samples, including one sample duplicate every 10 samples.

11.2 General procedure for flashpoint determination

11.2.1 Record the barometer reading.

11.2.2 Turn on the Setaflash® unit. Push and hold the temperature adjust button and turn knob to 20°C.

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- 11.2.3 Add test or calibration material to cup.
- 11.2.4 If the sample does not appear to flash or ignite, proceed to the next step. If the sample appears to ignite, before increasing the temperature, place < 1.0mL of sample in an aluminum weigh dish in the hood. Apply a flame to this sample. If the sample ignites, immediately extinguish the flame and record the temperature as <20°C.
- 11.2.5 Apply the flame to the sample at 20°C intervals until a flash is observed or the unit reaches 110°C.
- 11.2.6 If no flash was observed, retest using the timer at 110°C. If no flash is still observed, record >110°C. Note: p-xylene should flash at 27°C and 1-butanol should flash at 37°C.
- 11.2.7 If a flash was observed, turn off the unit, empty sample out of the cup and cool cup down (with ice) to approximately 10°F below observed flash temperature.
- 11.2.8 Use the timer and apply the flame at to the sample at 1°C intervals until a flash is observed or the unit reaches 110°C.
- 11.2.9 If no flash was observed, record >110°C.
- 11.2.10 If a flash was observed, record the temperature.
- 11.2.11 Turn off the unit; wash the cup with deionized water; place refuse in a sealable, plastic bag.
- 11.3 Calibration check and method blank procedure
  - 11.3.1 For the calibration check, add 2 mL of p-Xylene directly into the cup of the Seta flash unit and close the lid.
  - 11.3.2 Follow the general procedure for flashpoint determination.
  - 11.3.3 Analyze a 2 mL portion of 1-butanol and record the results.
  - 11.3.4 For the method blank, pipette 2 mL of DI Water into the Seta Flash instead of p-xylene.
- 11.4 Sample analysis procedure
  - 11.4.1 Place approximately 2 mL or 2 g of sample into the Seta Flash cup.
  - 11.4.2 Follow the previously described procedure for flashpoint determination.
- 11.5 At end of run sequence, record the Barometer reading.

## 12) QA/QC Requirements

- 12.1 This method shall operate under the formal Quality Assurance Program established at ALS and must maintain records that define the quality of data that is generated. Data shall be compared to established criteria in order to determine



if the results of the analyses meet the performance characteristics of the method. It is required that an initial demonstration of capability and periodic analysis of laboratory reagent blanks, laboratory fortified blanks, and other QC solutions as a continuing check on performance. The accuracy and precision of the procedure must be validated before analyses of samples begin, or whenever significant changes to the procedures have been made.

- 12.2 The Method Reporting Limits (MRLs) used at ALS are the routinely reported lower limits of quantitation which take into account day-to-day fluctuations in instrument sensitivity as well as other factors. These MRLs are the levels to which ALS routinely reports results in order to minimize false positive or false negative results. The MRL is normally two to ten times the method detection limit.
- 12.3 Ongoing QC Samples required are described in the ALS-Kelso Quality Assurance Manual and in the SOP for Sample Batches. Additional QC Samples may be required in project specific quality assurance plans (QAPP). General QA requirements for DoD QSM are defined in the laboratory SOP, Department of Defense Projects - Laboratory Practices and Project Management (ADM-DOD5). General QC Samples are:

#### 12.3.1 Method Blank

12.3.1.1 A method blank is extracted and analyzed with every batch of 20 (or fewer) samples to demonstrate that there are no method interferences. If the method blank shows any hits above the reporting limit, corrective action must be taken. Corrective action includes recalculation, reanalysis, system cleaning, or re-extraction and reanalysis. For some project specific needs, exceptions may be noted and method blank results above the MRL may be reported for common lab contaminants.

- 12.3.2 Sample Duplicates - One sample per batch of 10 or fewer samples must be analyzed in duplicate. Relative Percent Difference must be  $\leq 20\%$ .

Calculate Relative Percent Difference (RPD) as:

$$RPD = \frac{|R1 - R2|}{(R1 + R2)/2} \times 100$$

Where  $R1$  = Result for the sample

$R2$  = Result for the sample duplicate

- 12.4 Due to the nature of the test, the determination of method detection limits, and the analysis of matrix spike or LCS samples is not applicable.

### 13) Data Reduction and Reporting

- 13.1 Calculate the flashpoint as follows:

$$\text{Flashpoint} = A + 0.06(760 - B)$$

Where: A = Observed flashpoint

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B = Average Barometric Pressure (mm Hg).

### 13.2 Data Reporting

13.2.1.1 It is the analyst's responsibility to review analytical data to ensure that all quality control requirements have been met for each analytical run. Results for QC analyses are calculated and recorded as specified in this SOP. QC results are entered on the analytical spreadsheet for corresponding samples. All data will be initialed, dated and attached to required data quality worksheet.

13.2.1.2 Reports are generated in the ALS LIMS by compiling the SMO login, sample prep database, instrument date, and client-specified report requirements (when specified). This compilation is then transferred to a file which [REDACTED] uses to generate a report. The forms generated may be ALS standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.

### 13.3 Data Review and Assessment

13.3.1 Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the *SOP for Laboratory Data Review Process* (ADM-DREV) for details. The person responsible for final review of the data report and/or data package should assess the overall validity and quality of the results and provide any appropriate comments and information to the Project Manager to inclusion in the report narrative.

## 14) Contingencies for Handling Out-of-Control or Unacceptable Data

14.1 Refer to the SOP for *Non Conformance and Corrective Action* for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

### 14.2 Handling out-of-control or unacceptable data

14.2.1 On-the-spot corrective actions that are routinely made by analysts and result in acceptable analyses should be documented as normal operating procedures, and no specific documentation need be made other than notations in laboratory maintenance logbooks, run logs, for example.

14.2.2 Some examples when documentation of a nonconformity is required using a Nonconformity and Corrective Action Report (NCAR):

- Quality control results outside acceptance limits for accuracy and precision.
- Method blanks or continuing calibration blanks (CCBs) with target analytes above acceptable levels.
- Sample holding time missed due to laboratory error or operations.

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- Deviations from SOPs or project requirements.
- Laboratory analysis errors impacting sample or QC results.
- Miscellaneous laboratory errors (spilled sample, incorrect spiking, etc.).
- Sample preservation or handling discrepancies due to laboratory or operations error.
- Customer inquiries concerning data quality or services (when applicable). NCAR not required for simple corrections with no impact to the client.
- Data errors reported to clients, non-conforming re-checks.
- Deficiencies found during internal or external audits.
- Login errors or shipping errors.
- IT issues if there is a significant impact to a client.
- Turnaround time complaints.

## 15) Method Performance

15.1 Refer to the reference method for additional method performance data available.

## 16) Pollution Prevention and Waste Management

16.1 It is the laboratory's practice to minimize the amount of solvents, acids and reagent used to perform this method wherever feasible. Standards are prepared in volumes consistent with methodology and only the amount needed for routine laboratory use is kept on site. The threat to the environment from solvent and reagents used in this method can be minimized when recycled or disposed of properly.

16.2 The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Lab Waste Management Plan.

16.3 This method uses non-halogenated solvents. Waste solvents generated through the lab ware cleaning, sample prep, and LC mobile phase usage are collected in containers near the point of creation. They are then stored at a satellite storage center in the OLC lab which is transferred weekly to the main facility waste management area. The waste solvent will then be added to the hazardous waste storage area and disposed of in accordance with Federal and State regulations

## 17) Training

17.1 Training outline

17.1.1 Review literature (see References section). Review the SOP. Also review safety procedures. Following these reviews, observe the procedure performed by an experienced analyst at least three times. .

17.1.2 The next training step is to assist in the procedure under the guidance of an experienced analyst. During this period, the analyst is expected to transition from a role of assisting, to performing the procedure with minimal oversight from an experienced analyst.

17.1.3 Perform initial precision and recovery (IPR) study as described above for



water samples. Summaries of the IPR are reviewed and signed by the supervisor. Copies may be forwarded to the employee's training file. For applicable tests, IPR studies should be performed in order to be equivalent to TNI's Initial Demonstration of Capability.

- 17.2 Training is documented following the *ALS-Kelso Training Procedure (ADM-TRAIN)*.
- 17.3 When the analyst training is documented by the supervisor on internal training documentation forms, the supervisor is acknowledging that the analyst has read and understands this SOP and that adequate training has been given to the analyst to competently perform the analysis independently.

## 18) Method Modifications

- 18.1 Not applicable.

## 19) References

- 19.1 DoD Quality Systems Manual for Environmental Laboratories Current Version.
- 19.2 TNI Standard, Volume 1- 2009, TNI Standard, Volume 1- 2016.
- 19.3 Setafash® Closed-Cup Method for Determining Ignitability, Method 1020A, Revision 1, July, 1992, EPA SW-846 Final Update I.  
STANHOPE-SETA MODEL: 32000-00, Installation, Operating and Maintenance Instructions Manual.

## 20) Changes since Last Revision

Summary of Revision Changes			
Revision Number	Effective Date	Document Editor	Description of Changes
10.0	2/10/2019	T.Caron	Reformatted SOP to current ALS branding;

## 21) Attachments, Tables, and Appendices

- 21.1 Attachment A: Small scale diagnostic checklist.
- 21.2 Attachment B: Table of Corrective Actions.
- 21.3 Attachment C: Internal Thermometer Calibration Procedure.



ATTACHMENT A



Small Scale Diagnostic Checklist

In the event of a problem, please check the following items: General

Is the instrument level and situated in a draft free area?	
Have you obtained good results when verifying with a Certified Reference Material (CRM)? (Certified Reference Material 99878-3)	
Has the correct size sample been used when testing?	
Has the sample been tested at the correct temperature?	
If applicable, when running an equilibrium test, was the correct test duration used? (Please be advised this will vary depending on the sample size)	
Has the instrument been maintained in accordance with the routine maintenance schedule? (Checks: O-ring and tubing for damage. Clean: Cup, Lid and Shutter)	
Is the Flash Detector damaged? (Visually inspect to ensure the tip is not bent and that the two wires are connected to the small soldered ball)	
Is the correct O-ring fitted?	
Is the O-ring sealing on the lid?	
If applicable, is the ignitor wire undamaged and dipping to the correct depth?	
If applicable, is the flame size correct and dipping to the correct depth?	
Is the unit correcting the flash point correctly in comparison to the barometric pressure?	
Is the syringe being removed from the lid and shutter once the sample has been injected?	



ATTACHMENT A (Cont.)

Service & Maintenance Schedule			
	After Test	6 Monthly	Annually
Wipe clean the Sample Cup	●	●	
Wipe clean the O-ring	●	●	
Wipe clean the Lid and Shutter	●	●	
Visually inspect the Sample Cup O-ring	●	●	
Wipe the exterior of the Bath clean of spillages, splashes and residues		●	
Calibrate the pressure		●	
Clean the injection port			
Clean / replace the syringe			
Calibrate the temperature			●
Service and calibration			●



FAULT	POSSIBLE CAUSE	USER REMEDY (section)
Erroneous temperature display or other	Random program error	Try switching off unit for 5 seconds and switching back on again
No illumination on panel display when power is switched on	No power to the Tester	Check that the power supply is available and switched on (2.3)
	Fuse failed	Check fuse on rear panel (2.3)
	Wrong voltage setting	Check voltage setting (both voltage selectors) (2.3)
LED on panel remains off when cup temperature exceeds 55°C	LED failed	Return to factory for repair
	Circuit board failed	Return to factory for repair
LED on panel constantly lit but cup/heating block assembly fails to	Faulty circuit board	Return to factory for repair
Difficult to light gas supply	Gas flow rate erratic	Adjust control valve on gas canister (3.2.2)
	Gas leaking from tube	Inspect silicone rubber tubing and replace if necessary (9.3)
	Gas canister low or empty (flame very small)	Refill gas canister (2.6)
Flash point value too low	Sample contaminated	Check sample for contamination and clean sample cup, filler orifice, Hd and shutter where appropriate
	Test flame incorrect size	Check that test jet is set correctly (compare with flame size mark engraved on top of
Flash point value too high	Poor sample preparation Vapor leakage	Prepare fresh sample
		Inspect lid and shutter for slide wear (9.4)
	Test flame incorrect size	Check condition of O-ring seal and replace if necessary (9.2)  Check that test jet is set correctly (compare with flame size mark engraved on top of
Gas supply fails to turn off	On/off gas valve obstructed	Replace gas canister assembly (9.3)
	On/off gas valve broken	Replace gas canister assembly (9.3)
Flash detector probe does not detect a flash or display shows message 'O/C'	Probe not plugged into socket at rear Faulty probe Faulty circuit board	Plug in probe (9.1) Replace probe (9.1) Return to factory for repair
Unable to calibrate, temperature unstable	Faulty circuit board	Return to factory for repair
	Faulty heater	Return to factory for repair



## ATTACHMENT C

Pubn:- 32000H0H

### 4. CALIBRATION

The Calibration Mode is only accessible from power up. The Setaflash Series 3 Flash Point Testers are calibrated for temperature using a single point method. The procedure is carried out via the panel controls and only requires a reference thermometer and some thermo-conductive paste. The Tester is provided with an aperture at the right hand side of the cup/heating block assembly for insertion of the thermometer, allowing accurate verification and calibration of the cup/heating block assembly temperature.

- (1) Insert some thermo conductive paste into the aperture on the right hand side of the cup/heating block, and then insert a 0 - 110°C calibrated reference thermometer (Seta 13751-0 recommended) as far into the cup/heating block as it will go.
- (2) Press and hold down the set temperature  and set timer  buttons simultaneously whilst switching on the Tester. The display will momentarily show:-

Version Vx.xx

(x.xx is the software version)  
followed by:-

Calibrate mode  
please wait..

- (3) Release both buttons. The cup/heating block assembly will heat up to 55°C as measured by the Setaflash Flash Point Tester.
- (4) When the Setaflash measures the temperature of the cup/heating block assembly as 55°C the display will change to show:-

Calibrate mode  
please wait 300

and commence to countdown to zero.

- (5) When the countdown reaches zero, the temperature of the cup/heating block assembly has stabilised. An audible warning (beep) will be heard and the display will change to show:-

Thermometer T? >  
55.0°C

- (6) Wait until the calibration thermometer reading is stable. This may take several more minutes.
- (7) Rotate the control knob clockwise or anti clockwise until the temperature as measured by the thermometer is shown in the second line of the display. One "click" of the knob will change the temperature of the cup/heating block assembly by approximately 0.1°C.
- (8) Press the set timer button . The display will change to show:-

SWITCH OFF

- (9) Switch the Setaflash Tester off, using the power switch on the rear of the tester.



*ATTACHMENT C (Cont.)*

- (10) Check that the calibration has been successful by repeating steps (2) to (6). The display and thermometer should show the temperature of the cup/heating block assembly as 55.0°C ( $\pm 0.1^\circ\text{C}$ )
- (a) If the calibration appears correct, switch the Setaflash Tester off using the power switch at the rear of the tester and remove the thermometer.
  - (b) If the calibration is incorrect, carry out steps (2) to (10) to repeat the calibration procedure.

**Note:** If repeated attempts at calibration are unsuccessful, refer to Section 8 - FAULT FINDING.



## Total Carbon in Soil

DOCUMENT ID: GEN-ASTM, REVISION 14.0

Prepared By:   
Inorganics Manager, Jeff Coronado

Date: 10/23/20

Prepared By:   
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Date: 10/23/20

Approved By:   
Laboratory Director, Charles (Pat) Byrne

Date: 10/23/2020

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## 1) Scope & Applicability

- 1.1 This procedure is applicable to the determination of Total Carbon, Total Organic Carbon (TOC), and Total Inorganic Carbon using ASTM Method D4129-05 or EPA Method 9060A modified for soil and sediment matrices (Puget Sound Estuary Program and Lloyd Kahn). Total organic carbon is a measure of the total amount nonvolatile, partially volatile and particulate organic compounds in a sample. The sample should be acidified to remove inorganic carbon (carbonates, bicarbonates, free CO<sub>2</sub> etc.), prior to analysis. Total Carbon (TC) results are determined by analysis of an untreated, non-acidified, sample. Total Inorganic Carbon (TIC) can be determined by difference, subtracting TOC from TC.
- 1.2 This method is applicable to all soils and sediments and most matrices that can be dried and ground to a fine powder.
- 1.3 Results are reported as percent (%) carbon, and the applicable range is the MDL to 100%. The Method Reporting Limit (MRL) for TOC is 0.05% dry weight basis by methods ASTM D4129-05, PSEP, and Lloyd Kahn. The MRL for TOC by EPA 9060A is 0.1%. Equivalent nomenclature for MRL includes Estimated Quantitation Limit (EQL). Therefore, MRL=EQL. The Method Detection Limit (MDL) has been determined at 0.02%
- 1.4 In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPP's supersede method specified requirements. An example of this are projects falling under DoD ELAP. QC requirements defined in the SOP *Department of Defense Projects - Laboratory Practices and Project Management*, may supersede the requirements defined in this SOP.

## 2) Summary of Procedure

- 2.1 Samples are combusted in an oxygen atmosphere to convert organic and inorganic forms of carbon to CO<sub>2</sub>. The combustion temperature is selected to completely oxidize all carbon forms. The combustion product gases are swept through a barium chromate catalyst/scrubber to ensure that all of the carbon is oxidized to CO<sub>2</sub>. Other potentially interfering product gases such as SO<sub>2</sub>, SO<sub>3</sub>, HX, and NO<sub>x</sub> are removed from the gas stream in a series of chemical scrubbers. By ASTM Method D4129-05 the CO<sub>2</sub> is then swept to the coulometer where it is detected by automatic, coulometric titration, with coulometric end point indication. If performing EPA Method 9060A, the CO<sub>2</sub> is determined using an infrared detector.
- 2.2 The coulometer cell is filled with a partially aqueous medium containing ethanolamine and a colorimetric indicator. When a gas stream passes through the solution, CO<sub>2</sub> is quantitatively absorbed. CO<sub>2</sub> reacts with the ethanolamine to form a strong titratable acid which caused the indicator to fade. The titration current automatically turns on and electrically generates base to return the solution to its original color.

## 3) Definitions

- 3.1 For laboratory definitions applicable to most analyses, refer to the SOP for [Sample Batches](#).

## 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of

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the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. The department supervisor/manager or designee performs final review and sign-off of the data.

- 4.2 It is the responsibility of the department supervisor/manager to document analyst training and method proficiency as referenced in *Employee Training and Orientation*, ADM-TRAIN.

## 5) Interferences

- 5.1 Acidic and other gases, including SO<sub>2</sub>, SO<sub>3</sub>, H<sub>2</sub>S, HCl, HBr, HI, Cl<sub>2</sub>, and NO<sub>x</sub> can be effectively removed using scrubbers such as KI, Ag<sub>2</sub>SO<sub>4</sub>, AgNO<sub>3</sub>, and MnO<sub>2</sub>.
- 5.2 Volatile organics may be lost in the decarbonization process.

## 6) Safety

- 6.1 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.
- 6.2 Hydrochloric and/or Nitric Acid are used in this method. These acids are extremely corrosive and care must be taken while handling them. A face shield should be used while pouring acids. And safety glasses should be worn while working with the solutions. Lab coat and gloves should always be worn while working with these solutions.
- 6.3 Do not attempt to combust large samples of organic or other materials that will react with pure oxygen. Such samples can cause the pyrolysis tube to explode.

## 7) Sample Collection, Containers, Preservation, and Storage

- 7.1 Samples should be collected in plastic bottles. There are no requirements for chemical preservation.
- 7.2 Samples should be stored refrigerated at 4 ± 2°C. Samples must be analyzed within 28 days of sampling. If the samples are frozen the holding time is extended to 6 months.

## 8) Apparatus and Equipment

- 8.1 Induction furnace, Coulometrics Incorporated with CO<sub>2</sub> coulometer.
- 8.2 Combustion furnace with IR detector (Analytik Jena Multi EA 4000) with autosampler.
- 8.3 Analytical balance, 0.1 mg accuracy.
- 8.4 Desiccator.
- 8.5 Quartz combustion boats.
- 8.6 Sample scoop.
- 8.7 Porcelain boats. Glass ladles and miscellaneous laboratory glassware.

## 9) Standards, Reagents, and Consumable Materials

- 9.1 Reagents



9.1.1 Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Standards, reagents and consumable material documentation shall indicate traceability to purchased neat materials or compounds. Refer to the SOP *Reagent/Standards Login and Tracking* (ADM-RTL) for the complete procedure and documentation requirements.

9.1.2 Reagents and Standards must comply with the traceability, labeling and documentation practices specified in the SOPs: *Making Entries onto Analytical Records, Quality of Reagents and Standards* and *Reagent and Standards Login and Tracking* (ADM-RLT).

## 9.2 Standards

9.2.1 ASTM D4129, PSEP and Lloyd Kahn:

9.2.1.1 Urea - 20% carbon - use 10 mg for the CCV and 5 mg for the MS/MSD.

9.2.2 EPA 9060A

9.2.2.1 Calcium Carbonate ( $\text{CaCO}_3$ ) - 12% carbon - use 25 mg for the CCV and the MS/MSD.

9.2.3 Nutrients in Soil, purchased standard with a known TOC value (typically ERA #542).

9.2.3.1 ASTM 4129, PSEP, and Lloyd Kahn - use 50 mg for the LCS.

9.2.3.2 EPA 9060A. - Use 250 mg for LCS.

## 9.3 Reagents

9.3.1 Hydrochloric acid, 50% and 10%.

9.3.1.1 10%: Bring 20mL HCl to 200mL final volume.

9.3.1.2 50%: Bring 100mL HCl to 200mL final volume.

9.3.2 Carbon Cathode Solution. Dimethyl Sulfoxide; DMSO. Purchased from Coulometrics Inc. as a prepared solution. Used for coulometer solution.

9.3.3 Anode Solution. Dimethyl Sulfoxide and potassium iodide. Purchased from Coulometrics Inc. as prepared solution.

9.3.4 Manganese dioxide. Gas scrubber solution.

9.3.5 Potassium Hydroxide. Gas scrubber solution.

9.3.6 Potassium Iodide. Anode chemical.

9.3.7 Magnesium Perchlorate desiccant.

9.3.8 Halogen Absorber, silver.

9.3.9 Oxygen, Compressed gas, 4.3 UHP purity or better.

## 10) Preventive Maintenance

10.1 All maintenance activities are recorded in a maintenance logbook kept for each instrument. Pertinent information (serial numbers, instrument I.D., etc.) must be in the logbook. This includes the routine maintenance described herein. The entry in the log

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must include: date of event, the initials of who performed the work, and a reference to analytical control.

10.2 Maintenance is performed as follows:

<u>Maintenance Item</u>	<u>Frequency</u>
Cell	Clean daily with methanol and water to clean frit
Mg Perchlorate Scrubber	change daily
KOH Scrubber	change monthly
NOX scrubber	change as needed
Repack Pre-combustion Column	as needed
Repack Combustion Column	as needed
Repack Halogen Scrubber	as needed

10.3 Check oven temperature with high temperature thermocouple thermometer on a quarterly (three month) basis. Temperature reading should be within  $\pm 5\%$  of instrument temperature reading. If reading is outside specification, appropriate steps must be taken to bring temperature to within acceptable limits. Any actions taken must be documented in maintenance logbook.

## 11) Procedure

### 11.1 ASTM Method D4129-05, PSEP, and Lloyd Kahn.

#### 11.1.1 Sample Preparation.

11.1.1.1 Turn furnace on to  $\approx 1000^{\circ}\text{C}$ . Allow furnace to warm-up for about 1/2 hours. Turn on oxygen to  $\approx 5$  psi and 75 to 125 ml/min at flowmeter.

11.1.1.2 Clean quartz boats. Scrape out old sample and rinse boats with DI water. Place boats in crucible and muffle for at least 10-15 minutes. Remove boats and place in desiccator until ready for use.

11.1.1.3 Samples should be dried at  $70^{\circ}\text{C}$  and homogenized prior to analysis. Homogenization of dried solid sample should include grinding with a mortar and pestle or shatter box. A shatter box should be used with a larger sample size (i.e. 20+ grams) if the sample exhibits a high degree of heterogeneity. Samples should be ground to a fine, homogenous, powder.

11.1.1.4 Ground samples must be stored in individual sealed vials. In addition, sample vials analyzed under PSEP methodology must be stored in a desiccator prior to sample analysis.

11.1.1.5 As a rule, the darker (or closer to black) a sample is, the more carbon it contains. Place a small portion of sample on a watch glass. Add 1 drop of 10% HCl. Watch for effervescence or bubbling. If bubbles are present, the sample contains inorganic carbon ( $\text{CO}_3$ ). If sample bubbles, reduce sample size to prevent sample from bubbling out of boat. If sample is dark, wood product or sludge reduce sample volume to 5 - 10mg. Normal sample volume = 50mg. After boats are loaded with sample add 1 to 2 drops 10% HCl to each sample, LCS, and method blank. Place boats in  $70^{\circ}\text{C}$  oven to dry. If samples bubbled when acid was added, add 1 to 2 drops more acid and dry at  $70^{\circ}\text{C}$ . Continue acidifying and drying until samples no longer bubble.

#### 11.1.2 Apparatus Preparation.



- 11.1.2.1 Fill cell with carbon cathode solution to 100 - 125 ml, drop in stir bar. Place cell top on snug.
- 11.1.2.2 Cover bottom of anode cell with KI. About 2 small scoops.
- 11.1.2.3 Add carbon anode solution to cell such that when anode is inserted in the anode cell, the anode solution level is the same as the cathode solution level.
- 11.1.2.4 Place cell in coulometer cell holder.
- 11.1.2.5 Turn on detector lamp and stir plate. (Power on).
- 11.1.2.6 Turn adjust knob to 122 (all the way to the right) then turn back down to 100. Rotate cell until maximum transmittance is obtained.
- 11.1.2.7 With oxygen bubbling to cell and maximum transmittance obtained, turn on the current to the anode and cathode. The carbon cathode solution will begin to titrate to a blue color.
- 11.1.2.8 Change Magnesium Perchlorate desiccant daily.
- 11.1.2.9 The instrument is now ready to run.
- 11.1.3 Calibration and Standardization.
- 11.1.3.1 Burn both ladles for five minutes each to remove any residual TOC.
- 11.1.3.2 Establish baseline.
- 11.1.3.3 Burn three empty boats five minutes each. The average of the three runs is the baseline.
- 11.1.4 Analysis.
- 11.1.4.1 Place one platinum or quartz boat in a ladle. Simultaneously insert the sample into the furnace, press the reset button on the coulometer and start the timer for five minutes.
- 11.1.4.2 After five minutes, obtain a reading from the instrument. Remove the ladle from the furnace. (Occasionally, a high sample may require longer than 5 minutes to complete the titration).
- 11.1.4.3 Load the other ladle with the next platinum (or quartz) boat. Remove the ladle in use from the inlet port and insert the next ladle.
- 11.1.4.4 Repeat the analysis steps until all the samples are analyzed.
- 11.2 EPA Method 9060A – IR detection
- 11.2.1 Sample Preparation.
- 11.2.1.1 Samples are homogenized and aliquoted into labeled aluminum pans. The samples are dried in a 70°C oven and then ground into a powder with a mortar and pestle or shatter box. The ground samples should be stored in labeled vials.
- 11.2.1.2 Weigh 250 mg of ground sample into a pre-muffled porcelain boat. Weigh to the nearest 0.1 mg. A smaller portion can be weighed if high carbon content is suspected so that the calibration range is not exceeded.



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11.2.1.3 Acidify all samples with 10% HCl and dry in a 70°C oven. Continue to acidify and dry each sample until bubbling stops. Once the samples stop reacting with the HCl, they are ready for analysis.

#### 11.2.2 Instrument Preparation.

11.2.2.1 The instrument needs to be calibrated once a year. The instrument may need to be recalibrated sooner if CCVs or LCSs continue to fail without resolution or if major maintenance has been performed. To calibrate for the full range of the instrument, 2 or 3 calibration curves are analyzed in succession. The instrument software will link up to 3 overlapping calibration curves. Each calibration curve should be spiked with at least five differing amounts of the following standards:

11.2.2.1.1 High-range curve: CaCO<sub>3</sub> (12% carbon), purchased powder.

11.2.2.1.2 Low-range curve: 1000 mg/L KHP (0.1% carbon), dilute 0.2128 g KHP to 100 mL with DI water.

11.2.2.1.3 Mid-range curve (if needed): 10,000 mg/L KHP (1% carbon), dilute 2.128 g KHP to 100mL with DI water.

11.2.2.2 Change desiccant daily. Change scrubbers and oxygen tank as needed. Make sure there is at least 500 psi of oxygen available for a full run of 20 samples.

11.2.2.3 Open flow on the oxygen tank. Turn the power “on” to each of the three instrument modules, and initialize the instrument. The instrument’s pump will engage once the 1100°C operating temperature is reached. Allow the instrument to sit idle at operating temperature to allow for the IR detector to stabilize. Adjust the pump flow as needed to maintain a flow reading of around 100 for the “Actual – swinging in” reading in the status window.

11.2.2.4 Set up a sequence by opening “Analysis Sequence – new” in the “Sequence” tab. Name the run as the date of analysis. Add the sample names and QC in the correct order of analysis. Enter all sample weights. Add around 25 mg of calcium carbonate to each CCV boat. CCB boats are left empty. Spike each MS/MSD with around 25 mg of calcium carbonate. Add the spike amount to the bench sheet.

11.2.2.5 Place all sample boats on the autosampler, matching their autosampler position on to the correct assigned analysis position. The first position is labeled as “Clean” and will burn off the carbon on the hook before reading samples.

11.2.2.6 Approve the samples and weights by selecting the “Enable all sequence entries” tab and choose “OK” to close the window.

11.2.2.7 Open the “Start Measurement” icon. Select the name/date of the current run, select “OK” and then select “Start Measurement”.

11.2.2.8 Once the run is complete, select all samples from the run in the “Results” window and print.

## 12) QA/QC Requirements



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- 12.1 This method shall operate under the formal Quality Assurance Program established at ALS and must maintain records that define the quality of data that is generated. Data shall be compared to established criteria in order to determine if the results of the analyses meet the performance characteristics of the method. It is required that an initial demonstration of capability and periodic analysis of laboratory reagent blanks, laboratory fortified blanks, and other QC solutions as a continuing check on performance. The accuracy and precision of the procedure must be validated *before* analyses of samples begin, or whenever significant changes to the procedures have been made.
- 12.2 Initial Precision and Recovery Validation
- 12.2.1 Four LCS's are prepared and analyzed. The RSD should be <20% and average recovery must be within LCS recovery limits (see laboratory DQO Tables).
- 12.3 Method Detection Limits and Method Reporting Limits
- 12.3.1 A method detection limit (MDL) study must be undertaken before analysis of samples can begin. To establish detection limits that are precise and accurate, the analyst must perform the following procedure. Analyze a minimum of seven spiked blank replicates at a level near the MRL. Follow the procedures starting in Section 11 to analyze the samples. Refer to *Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Quantification*. The MDL study must be performed or verified periodically, as required by the SOP.
- 12.3.2 Calculate the average concentration found (x) in the sample concentration, and the standard deviation of the concentrations for each analyte. Calculate the MDL for each analyte using the correct T value for the number of replicates.
- 12.3.3 Limits of Quantification (LOQ)
- 12.3.4 The laboratory establishes a LOQ for each analyte as the lowest reliable laboratory reporting concentration or in most cases the lowest point in the calibration curve which is less than or equal to the desired regulatory action levels, based on the stated project requirements. Analysis of a standard or extract prepared at the lowest point calibration standard provides confirmation of the established sensitivity of the method. The LOQ recoveries should be within 50-150% of the true values to verify the data reporting limit. Refer to *Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Quantification*.
- 12.3.5 The Method Reporting Limits (MRLs) used at ALS are the routinely reported lower limits of quantitation which take into account day-to-day fluctuations in instrument sensitivity as well as other factors. These MRLs are the levels to which ALS routinely reports results in order to minimize false positive or false negative results. The MRL is normally two to ten times the method detection limit.
- 12.4 Ongoing QC Samples required are described in the ALS Kelso Quality Assurance Manual and in the SOP *Sample Batches* (ADM-BATCH). Additional QC Samples may be required in project specific quality assurance plans (QAPP). For example projects managed under the DoD ELAP must follow requirements defined in the DoD *Quality Systems Manual for Environmental Laboratories*. General QA requirements for DoD QSM are defined in the laboratory SOP *Department of Defense Projects - Laboratory Practices and Project Management* (ADM-DOD).
- 12.5 The QC criteria discussed in the following sections are summarized in Table 1.



- 12.5.1 Laboratory Control Sample (LCS)- An LCS must be analyzed with each batch of 20 or fewer samples.
- 12.5.1.1 ASTM Method D4129-05, PSEP and Lloyd Kahn: analyze 50 mg of the purchased standard. The acceptance criteria for the LCS are listed in Table 1.
- 12.5.1.2 EPA 9060: analyze 250 mg of the purchased standard. The acceptance criteria for the LCS are listed in Table 1.
- 12.5.2 Method Blank (MB) - Analyze one method blank per batch of 20 or fewer samples. Add one to two drops of 10% HCl to an empty boat and place the boat in a 70°C oven to dry.
- 12.5.2.1 ASTM Method D4129-05, PSEP and Lloyd Kahn: Method Blank must be <0.05% carbon.
- 12.5.2.2 EPA 9060: Method Blank must be < 0.1% carbon.
- 12.5.3 Continuing Calibration Verification (CCV) A CCV must be analyzed every ten samples, bracketing the beginning and the end of each analytical run.
- 12.5.3.1 ASTM Method D4129-05 PSEP and Lloyd Kahn: analyze 10mg urea. The CCV acceptance recovery is 90-110%.
- 12.5.3.2 EPA 9060: 25 mg of CaCO<sub>3</sub>. The CCV acceptance recovery is 90-110%.
- 12.5.4 Continuing Calibration Blank (CCB) - A CCB must be analyzed following every CCV.
- 12.5.5 Sample Replicates (Duplicates and Triplicates):
- 12.5.5.1 ASTM Method D4129 and EPA 9060: One duplicate sample per batch of 20 or fewer samples.
- 12.5.5.2 TOC analysis by PSEP methodology requires one sample to be analyzed in triplicate per batch of 20 or fewer samples.
- 12.5.5.3 Lloyd Kahn: One sample must be analyzed in quadruplicate per batch of twenty or fewer samples.
- 12.5.6 Matrix Spike/Matrix Spike Duplicate (MS/MSD)) - shall be analyzed with each batch of 20 or fewer samples.
- 12.5.7 Refer to Table 1 and the ALS Kelso DQO Table for up to date acceptance criteria and corrective actions

### 13) Data Reduction and Reporting

#### 13.1 Data Review and Assessment

- 13.1.1 It is the analyst's responsibility to review analytical data to ensure that all quality control requirements have been met for each analytical run. Results for QC analyses are calculated and recorded as specified in this SOP. Average, RPD, spike level and spike recovery are entered on the analytical spreadsheet for corresponding samples. All data will be initialed, dated and attached to required data quality worksheet.
- 13.1.2 Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the *SOP for Laboratory Data Review Process* (ADM-DREV) for



details. The person responsible for final review of the data report and/or data package should assess the overall validity and quality of the results and provide any appropriate comments and information to the Project Manager for inclusion in the report narrative.

### 13.2 Data Reporting

13.2.1 Refer to the SOP for *Data Reporting and Report Generation* (ADM-RG) for reporting guidelines.

13.2.2 For final reports, the method is reported as ASTM Method D4129 Modified or EPA Method 9060A Modified.

13.2.3 ASTM Method D4129-05, PSEP and Lloyd Kahn: Calculate % carbon as follows:

$$\%Carbon = \frac{(Gross\ reading - baseline\ \mu g)(0.1)}{mg\ sample\ analyzed}$$

13.2.4 Total organic carbon is reported as % carbon, normally on a dry weight basis. Results may be reported on an as received basis.

13.2.5 For duplicate analyses, calculate relative percent difference as follows:

$$RPD = \frac{S_1 - S_2}{Avg} * 100$$

Where  $S_1$  = Sample with higher value

$S_2$  = Sample with lower value

$Avg$  = Average of the two sample values.

13.2.6 Calculate percent recovery as follows:

$$\%R = \frac{X - X_i}{TV} * 100$$

Where  $X$  = Concentration of the analyte recovered

$X_i$  = Concentration of unspiked analyte

$TV$  = True Value of amount spiked

13.2.7 The analyst enters data directly into ALSLIMS templates. An Analytical Results Summary is generated for that analytical batch showing all QC and sample results. After primary and secondary review, final reports are generated in ALSLIMS or Labcoat™ by compiling the SMO login, sample prep database, instrument date, and client-specified report requirements (when specified). The forms generated may be ALS standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.

13.2.8 As an alternative, reports are generated using [REDACTED] templates located in R:\Wet\FORMS\DOD. The analyst should choose the appropriate form and QC pages to correspond to required tier level and deliverables requirements. The results are then transferred, by hand or electronically, to the templates.

## 14) Method Performance



- 14.1 The accuracy and precision of the procedure must be validated before analysis of samples begins, or whenever significant changes to the procedures have been made. To do this, four LCS aliquots are prepared and analyzed. The average percent recovery must meet the laboratory control sample acceptance limits.
- 14.2 The method detection limit (MDL) is established using the procedure described in the *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification*. Method Reporting Limits are established for this method based on MDL studies and as specified in the ALS Quality Assurance Manual.

## 15) Pollution Prevention and Waste Management

- 15.1 The laboratory will comply with all Federal, State and local regulations governing waste restrictions as specified in the ALS Lab Waste Management Plan.

## 16) Corrective Actions for Out-of-Control Data or Unacceptable Data

- 16.1 Refer to the SOP for *Nonconformance and Corrective Action Procedures* (ADM-NCAR) for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

## 17) Training

- 17.1 All analysts performing this analysis are required to read and understand this SOP.
- 17.2 Training is documented following the *Employee Training and New Employee Orientation* (ADM-TRAIN).

## 18) References and Related Documents

- 18.1 Coulometrics Inc. Instruction Manual, Model 5020.
- 18.2 Total Organic Carbon (TOC), Conventional Sediment Variables, Puget Sound Estuary Program, March 1986.
- 18.3 Determination of Total Organic Carbon in Sediment, Lloyd and Kahn, U.S.E.P.A Region II, July 1988.
- 18.4 ASTM Method D4129-05.
- 18.5 Total Organic Carbon (TOC) in Soil: EPA SW-846 Method 9060A Revision 1, November 2004.
- 18.6 DoD Quality Systems Manual for Environmental Laboratories Version 4.2/5.0/5.1.
- 18.7 TNI Standard, Volume 1- 2009.
- 18.8 Analytical Worksheet: <R:\WET\ANALYSES\TOC\TEMPLATE>.
- 18.9 Procedural Change Form date 6/14/19.
- 18.10 DOD Quality Systems Manual for Environmental Laboratories Version 4.2/5.0/5.1.1.
- 18.11 TNI Standard, Volume 1- 2009.
- 18.12 ISO/IEC 17025: 2017.



### 19) Summary of Changes

Revision Number	Effective Date	Document Editor	Description of Changes
14.0	10/30/2020	T. Caron	Reformatted SOP to current ALS format. Minor typographical, grammatical, and formatting changes. Updated signatories. Section 7.2: Updated sample storage and holding time (frozen samples).

### 20) Attachments, Tables, and Appendices

20.1 Table 1: Summary of Corrective Actions.



**Table 1**

<b>Summary of Corrective Actions</b>				
<b>Method Reference</b>	<b>Control</b>	<b>Specification and Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action</b>
ASTM D4129 PSEP Lloyd Kahn EPA 9060A	CCV	Verify calibration by analyzing prior to samples, after every 10 analysis and after the last sample	±10%	Re-analyze all samples affected.
ASTM D4129 PSEP Lloyd Kahn EPA 9060A	LCS	Include with each analysis batch (up to 20 samples)	See DQO Tables	Re-analyze all samples affected.
ASTM D4129 PSEP Lloyd Kahn EPA 9060A	Method Blank	Include with each analysis batch (up to 20 samples)	< 0.05%	If target exceeds 0.05%, clean boats and re-analyze.
ASTM D4129 PSEP Lloyd Kahn EPA 9060A	Matrix Spike/Matrix Spike Duplicate	Include with each analysis batch (up to 20 samples)	See DQO Tables	Evaluate data to determine if there is a matrix effect or analytical error
ASTM D4129 EPA 9060A	Sample Duplicates	Include with each analysis batch (up to 20 samples)	≤ 20 % RPD	Re-homogenize and re-analyze if result is > 5 X the MRL
PSEP	Sample Triplicate	Include with each analysis batch (up to 20 samples)	≤ 20 % RSD	Re-homogenize and re-analyze if result is > 5 X the MRL
Lloyd Kahn	Sample Quadruplicate	Include with each analysis batch (up to 20 samples)	≤ 20 % RPD	Re-homogenize and re-analyze if result is > 5 X the MRL



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## PH in Soils and Solids

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DOCUMENT ID: GEN-PHS REV 17.0

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Approved By: Inorganics Manager, Jeff Coronado  
Signature on file.

Date: 2/17/2021

Approved By: Quality Assurance Manager, Kurt Clarkson  
Signature on file.

Date: 2/17/2021

Approved By: Laboratory Director, Charles (Pat) Byrne  
Signature on file.

Date: 2/17/2021

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## 1) Scope & Applicability

- 1.1 This procedure is used to determine pH in soil, solid, and certain waste samples using EPA Methods 9045C and 9045D.
- 1.2 When used to determine pH in multiphase wastes, the procedure is applicable if the aqueous phase constitutes less than 20% of the total volume of the waste.
- 1.3 In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPP's supersede method specified requirements. An example of this are projects falling under DOD ELAP. QC requirements defined in the SOP *Department of Defense Projects - Laboratory Practices and Project Management* (ADM-DOD5) may supersede the requirements defined in this SOP.

## 2) Summary of Procedure

- 2.1 The pH is determined by potentiometric measurement of a soil slurry or aqueous solution using a standard combination glass pH electrode and pH meter
- 2.2 The procedure uses methodology described in EPA Methods 9045C, 9045D, WDOE Test Method, and Oregon State Soil Methods.

## 3) Definitions

- 3.1 For laboratory definitions applicable to most analyses, refer to the SOP for [Sample Batches](#).

## 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. The department supervisor/manager or designee performs final review and sign-off of the data.
- 4.2 It is the responsibility of the department supervisor/manager to document analyst training and method proficiency as referenced in *Employee Training and Orientation*, ADM-TRAIN.

## 5) Interferences

- 5.1 Samples with extreme pH results may give incorrect readings on the meter. Samples with a high sodium concentration and pH > 10 can cause error. Using a "low sodium error" electrode (such as Orion 8165, 8172 or equivalent) eliminates this issue to a pH of 12. If the pH is greater than 12, the sodium content of the sample may need to be determined and the pH result may need correction. Strong acid solutions with pH < 1 may give incorrect high pH readings.
- 5.2 Samples containing oil may coat the electrode and cause a sluggish response or inaccurate reading. If an electrode becomes coated with a material which cannot be rinsed off, the electrode can be cleaned with an ultrasonic bath, be washed with

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detergent and rinsed then placed in 1:1 HCl so that the lower third of the electrode is submerged, then rinsed thoroughly with water.

5.3 Temperature fluctuations will cause instrument errors.

## 6) Safety

6.1 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.

## 7) Sample Collection, Containers, Preservation, and Storage

7.1 Sample bottles can either be glass or plastic and must be thoroughly cleaned and rinsed prior to use.

7.2 Samples must be stored refrigerated at 4°C ( $\pm$  2°C). Although there is no holding time established for soils, samples should be analyzed as soon as possible.

## 8) Apparatus and Equipment

8.1 Orion Dual Star pH meter, SN E09484, or equivalent.

8.2 Combination electrode for pH with temperature probe, such as Orion 8165, 8172 or equivalent.

8.3 Conductivity jars, 50 ml.

8.4 Analytical balance capable of weighing 0.1 g.

8.5 Paint filters.

8.6 Erlenmeyer flasks, 250 ml.

8.7 Water bath capable of maintaining a constant temperature of 25°C. One large for all samples and buffers and one smaller bath for analyzing samples at 25°C  $\pm$  1°C.

8.8 Standard stir plate and submersible stir plate and stir bars.

8.9 Eight ounce or 16 ounce juice bottles and caps.

8.10 Wrist action shaker..

## 9) Standards, Reagents, and Consumable Materials

9.1 Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Standards, reagents and consumable material documentation shall indicate traceability to purchased neat materials or compounds. Refer to the SOP *Reagent/Standards Login and Tracking* (ADM-RLT) for the complete procedure and documentation requirements.

9.2 All stocks, working solutions and sample dilutions should be prepared using deionized water (DI) conforming to ASTM Type I or ASTM Type II reagent water. For more information on reagent water generation, refer to the related SOP, Operation and Maintenance of Laboratory Reagent Water Systems.

9.3 Standards

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- 9.4 pH buffers: 1.00, 4.00, 7.00, 10.00, 12.45, (true value of buffers at 25° C).
- 9.5 Commercially available solutions should be validated and traceable to NIST standards and are recommended for routine use..

## 10) Preventive Maintenance

- 10.1 The probe should contain filling solution past the coils to ensure accurate readings. Filling solution should be a non-AgCl containing solution.
- 10.2 Cleaning the probe
  - 10.2.1 The probe should be emptied and refilled with filling solution once a week.
  - 10.2.2 The glass bulb should be cleaned every other week, or more, by placing it in a beaker with approximately 40 ml of 0.1N HCl and allowed to sit while stirring for approximately 5 minutes. Then rinse the probe with DI water 3 times and blot with a Kimwipe®.
  - 10.2.3 f the coils are no longer orange it means the electrode's ion reservoir is empty and it needs to be replaced.

## 11) Procedure

- 11.1 Calibration
  - 11.1.1 All buffers are placed in the conductivity jars and stored in the large 25° C waterbath. All readings need to be within 1° C of the buffered temperatures.
  - 11.1.2 Buffer in conductivity jars to be replaced with buffer from the primary container daily.
  - 11.1.3 Once a manufacture's bottle of buffer is open it's good for 3 months, because it becomes contaminated with carbon dioxide.
  - 11.1.4 Perform calibration daily. Record calibration; buffer checks and buffer temperatures in instrument logbook or benchsheet with date and analyst's initials.
  - 11.1.5 The slope of the calibration points should be between 92 and 102% or within the range set by the probe manufacturer. The meter displays the slope of calibration.
  - 11.1.6 If the slope exceeds the above end points either the buffer(s) is contaminated or the probe is no longer functioning properly.
  - 11.1.7 Replace buffers, rewarm and then re calibrate.
  - 11.1.8 Clean the probe with 0.1 N HCl, rinse and blot dry with a Kimwipe®.
- 11.2 Orion Dual Star pH Meter Calibration
  - 11.2.1 Select "cal" (f2 key)



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- 11.2.2 Rinse electrode and immerse electrode into the 4.00 pH solution.
  - 11.2.3 Select "start" (f3 key).
  - 11.2.4 When stable, change the default value to 4.00.
  - 11.2.5 Select "accept" (f2 key).
  - 11.2.6 Select "next" (f2 key).
  - 11.2.7 Rinse electrode and immerse into the 7.00 pH solution.
  - 11.2.8 Select "start" (f3 key).
  - 11.2.9 When stable, select "accept"(f2 key).Default value is 7.00.
  - 11.2.10 Select "next" (f2 key).
  - 11.2.11 Rinse electrode and immerse into the 10.00pH solution.
  - 11.2.12 Select "start" (f3 key).
  - 11.2.13 When stable, change the default value to 10.00.
  - 11.2.14 Select "accept" (f2 key).
  - 11.2.15 Add 1.00 and 12.45 pH buffers if needed, remembering to change the default value to the true value.
  - 11.2.16 Once all required calibration buffers have been added, select "cal done" (f3 key).
  - 11.2.17 Record "average slope value", buffer temperatures and analysis times on the pH bench sheet.
  - 11.2.18 Select "log/print"(f2 key) to save calibration data and exit calibration screen.
  - 11.2.19 To calibrate the "channel2" electrode, select the "channel "button to switch to channel 2 and repeat the above steps.
  - 11.2.20 **Note:** Initial calibration is performed using the 4.00, 7.00, and 10.00 buffers. If any subsequent sample pH is outside the calibration range (greater than 10.00 or less than 4.00), the 1.00 and/or 12.45 buffers are added to the calibration and the applicable samples are reanalyzed.
  - 11.2.21 Following the instrument calibration, a pH 4.00, 7.00 or 10.00 check standard is analyzed. The acceptance criterion is  $\pm 0.05$  pH units of the true value. If the standard is outside of these acceptance limits, the buffer is rechecked once. If it is still outside the  $\pm 0.05$  pH unit limit, the instrument is recalibrated. The same check standard is repeated every 10 pH measurements and must meet the same acceptance criteria. When the sample pH is  $\geq 12.00$  analyze the pH 12.45 buffer as the buffer check standard. If a check fails, reanalyze the check. If it fails again, recalibrate instrument, perform check analysis, and reanalyze all samples back to the previous passing check.
- 11.3 Soil samples preparation for EPA Methods 9045C and 9045D.



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- 11.3.1 Weigh out 10g of soil into a beaker. Add 10mL of reagent water, cover, and shake samples for 30 minutes on the wrist action shaker. Alternative sample volumes may be used as long as soil: water ratios remain the same. Additional dilutions may be performed if working with hygroscopic soils and salts, or other problematic matrices.
- 11.3.2 Let the soil suspension stand for 1 hour to allow for settling. Alternatively, filter or centrifuge off the aqueous phase for pH determination.
- 11.3.3 Setup electrodes in clamps so that when the electrode is lowered into the beaker, the electrode will be immersed just deep enough in the supernatant solution to establish a good electrical contact through the ground-glass joint or fiber capillary hole. Immerse the electrode in samples in this manner.
- 11.4 Waste material preparation for EPA Methods 9045C and 9045D.
  - 11.4.1 Wastes may be solids, sludges, or non-aqueous liquids. For multi-phase wastes by method 9045D, a determination of the percentage of the sample that is non-aqueous must be made. This can be calculated from a % solids determination. If the non-aqueous phase is > 20%, continue with this section. If the non-aqueous phase is < 20%, analyze the sample by EPA Method 9040C see also SOP GEN-pHW.
  - 11.4.2 Weigh out 20g of waste sample into a beaker. Add 20mL of reagent water, cover, and shake samples for 30 minutes on the wrist action shaker. Alternative sample volumes may be used as long as solid::water ratios remain the same. Additional dilutions may be performed if working with hygroscopic soils and salts, or other problematic matrices.
  - 11.4.3 Let the waste suspension stand for 15 minutes to allow for settling. Alternatively, filter or centrifuge off the aqueous phase for pH determination.
  - 11.4.4 If the waste absorbs all the reagent water, begin the test again with 20g waste and 40mL of water.
  - 11.4.5 If the supernatant is multi-phasic, decant the oily phase and perform the pH determination on the aqueous phase.
  - 11.4.6 Setup electrodes in clamps so that when the electrode is lowered into the beaker, the electrode will be immersed just deep enough in the supernatant solution to establish a good electrical contact through the ground-glass joint or fiber capillary hole. Immerse the electrode in samples in this manner.
- 11.5 Sample preparation for Washington DOE Test Method.
  - 11.5.1 Weigh three, 50.0g aliquots of each sample into either 3, 8-ounce or 3, 16-ounce juices bottles and add 50mL of D.I. water to each and cap tightly. Each sample is analyzed in triplicate.
  - 11.5.2 Place all bottles on the wrist action shaker for 30 minutes. The speed of the shaker should be adjusted so that the sample and water have maximum



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contact time however the shaking action should not be so vigorous as to cause absorption of CO<sub>2</sub> into the sample.

11.5.3 Filter the liquid through a paint filter into a clean conductivity jar for analysis.

#### 11.6 Oregon State Soil Methods sample preparation

11.6.1 Weigh 20.0g of soil into a beaker and add 40mL of D.I. water.

11.6.2 Stir the suspension 2-3 times over a 30-minute period.

11.6.3 Analyze the supernatant.

#### 11.7 Sample Analysis

11.7.1 Rinse and blot electrode, then immerse into the sample. Press pH and record the pH when stabilized, record the temperature to the nearest °C. Remove electrodes from sample after each measurement and rinse 3 times with D.I. water.

11.7.2 Regardless of the method employed, all pH readings must be within 2°C of the temperature of the buffer solutions.

11.7.3 If the pH of the sample is  $\geq 11.00$  control the temperature of the samples to  $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$ .

## 12) QA/QC Requirements

12.1 This method shall operate under the formal Quality Assurance Program established at ALS and must maintain records that define the quality of data that is generated. Data shall be compared to established criteria in order to determine if the results of the analyses meet the performance characteristics of the method. It is required that an initial demonstration of capability and periodic analysis of laboratory reagent blanks, laboratory fortified blanks, and other QC solutions as a continuing check on performance. The accuracy and precision of the procedure must be validated *before* analyses of samples begin, or whenever significant changes to the procedures have been made.

12.2 A buffer check is analyzed after every 10 readings. For buffer checks, use either pH 4.00 or 10.00, choosing whichever standard brackets the majority of the previous samples with pH 7.00. The buffer check should be within 0.05 pH units of the true value.

12.3 A Laboratory Control Sample (LCS) is analyzed at a frequency of one per 20 samples. The LCS is a purchase reference material. The Certified Value and Acceptance Limits listed on the vendor's Certificate of Analysis are to be used to evaluate the LCS recovery. Analyze the LCS prior to the sample set. The LCS is prepared identically to associated samples and documented on the analytical. Worksheet If the LCS is outside of the acceptance limits, recalibrate the instrument.

12.4 A duplicate sample is analyzed at a frequency of 10% of the samples, with acceptance criteria of 10% RPD between the two readings. If the duplicate is outside of these



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limits, the sample is reanalyzed. Duplicates are documented on the benchsheet. For duplicate analyses, calculate relative percent difference as follows:

$$RPD = \frac{S_1 - S_2}{Avg} * 100$$

Where S1 = Sample with higher value  
S2 = Sample with lower value  
Avg. = Average of the two sample values

- 12.5 For DOE/pH, all samples are analyzed in triplicate and the logarithmic average is reported.
- 12.6 Sum the antilog of the three pH readings obtained in section 11.5, divide by 3 then take the log.

Example:

Three pH readings obtained: 1.5    1.6    2.5

antilog(1.5) + antilog(1.6) + antilog(2.5) =  
31.62 + 39.81 + 316.23 = 387.66  
387.66 ÷ 3 = 129.22  
log(129.22) = 2.11  
pH(average) = 2.11.

### 13) Data Reduction and Reporting

#### 13.1 Data Review and Assessment

13.1.1 Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the *SOP for Laboratory Data Review Process (ADM-DREV)* for details. The person responsible for final review of the data report and/or data package should assess the overall validity and quality of the results and provide any appropriate comments and information to the Project Manager for inclusion in the report narrative.

13.1.2 It is the analyst's responsibility to review analytical data to ensure that all quality control requirements have been met for each analytical run. Results for QC analyses are calculated and recorded as specified in this SOP. Average, RPD, spike level and spike recovery are entered on the analytical spreadsheet for corresponding samples. All data will be initialed, dated and attached to required data quality worksheet.

#### 13.2 Reporting

13.2.1 Refer to the SOP for *Data Reporting and Report Generation (ADM-RG)* for reporting guidelines

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13.2.2 The analyst enters data directly into ALSLIMS templates. An Analytical Results Summary is generated for that analytical batch showing all QC and sample results. After primary and secondary review, final reports are generated in ALSLIMS by compiling the SMO login, sample prep database, instrument date, and client-specified report requirements (when specified). The forms generated may be ALS standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.

13.2.3 The pH is reported as pH units. Values are reported to 0.01 pH units.

13.2.4 The benchsheets should be in use at all times during pH analysis.

#### 14) Method Performance

14.1 This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional method performance data available.

#### 15) Pollution Prevention and Waste Management

15.1 It is the laboratory's practice to minimize the amount of solvents, acids and reagent used to perform this method wherever feasible. Standards are prepared in volumes consistent with methodology and only the amount needed for routine laboratory use is kept on site. The threat to the environment from solvent and reagents used in this method can be minimized when recycled or disposed of properly.

15.2 The laboratory will comply with all Federal, State and local regulations governing waste restrictions as specified in the ALS Lab Waste Management Plan.

#### 16) Corrective Actions for Out-of-Control Data or Unacceptable Data

16.1 Refer to the SOP for *Nonconformance and Corrective Action Procedures* (ADM-NCAR) for procedures for corrective action.

16.2 Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

#### 17) Training

17.1 All analysts performing this analysis are required to read and understand this SOP.

17.2 Training is documented following the *Employee Training and New Employee Orientation* (ADM-TRAIN).

17.3 It is required that an initial demonstration of capability and periodic analysis of laboratory reagent blanks, laboratory fortified blanks, and other QC solutions as a continuing check on performance.

#### 18) References and Related Documents

18.1 Method 9045, Revision 4, EPA SW-846, Test Methods For Evaluating Solid Waste, Third Edition, Update IIIIB, November 2004.

18.2 Method 9045C Revision3 January 1995.

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- 18.3 Method 83-13, State of Washington, Department of Ecology.
- 18.4 Oregon State University, Methods of Soil Analysis Used in the Soil Testing Laboratory at Oregon State University.
- 18.5 Quality Systems Manual for Environmental Laboratories Current Version.
- 18.6 TNI Standard, Volume 1- 2009; 2016.
- 18.7 ISO/17025:2017 American National Standard, General Requirements for the Competence of Testing and Calibration Laboratories.

## 19) Summary of Changes

Summary of Revision Changes			
Revision Number	SOP Review	Document Editor	Description of Changes
17.0		T. Caron	Admin Changes only not affecting technical content. Documented date of annual SOP Review, updated SOP signatories; boiler plate standard paragraphs have been updated to reflect current practices. Section 18.0: Updated References.
17.0	J Coronado 2/17/2021		Reviewed and approved; no technical changes at this time.

## 20) Attachments and Appendices

- 20.1 Not Applicable



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## PH in Water

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DOCUMENT ID: GEN-PHW REV 17.0

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Approved By: Inorganics Manager, Jeff Coronado  
Signature on file.

Date: 2/17/2021

Approved By: Quality Assurance Manager, Kurt Clarkson  
Signature on file.

Date: 2/17/2021

Approved By: Laboratory Director, Charles (Pat) Byrne  
Signature on file.

Date: 2/17/2021

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## 1) Scope & Applicability

- 1.1 This procedure is used to measure the pH of aqueous samples using SM 4500-H+B-2011, EPA 150.1 and EPA 9040C.
- 1.2 The 9040C procedure may be used to determine pH in most aqueous samples including multiphase wastes where the aqueous phase constitutes 20% or more of the total volume of the waste. The corrosivity of concentrated acids and bases cannot be measured. The pH measurement requires some water content.
- 1.3 The EPA 150.1 procedure is applicable to drinking, surface, and saline waters, domestic and industrial wastes and acid rain (atmospheric deposition).
- 1.4 In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPP's supersede method specified requirements. An example of this are projects falling under DOD ELAP. QC requirements defined in the SOP *Department of Defense Projects - Laboratory Practices and Project Management* (ADM-DOD/ADM-DOD5) may supersede the requirements defined in this SOP.

## 2) Summary of Procedure

- 2.1 The pH is determined by potentiometric measurement, using a standard combination glass pH electrode and a pH/specific ion meter. The measuring device is calibrated using a series of standard solutions of known pH.

## 3) Definitions

- 3.1 For laboratory definitions applicable to most analyses, refer to the SOP for [Sample Batches](#).

## 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. The department supervisor/manager or designee performs final review and sign-off of the data.
- 4.2 It is the responsibility of the department supervisor/manager to document analyst training and method proficiency as referenced in *Employee Training and Orientation*, ADM-TRAIN.

## 5) Interferences

- 5.1 Samples with extreme pH results may give incorrect readings on the meter. Samples with a high sodium concentration and pH > 10 can cause error. Using a "low sodium error" electrode (such as Orion 8165, 8172 or equivalent) eliminates this issue to a pH of 12. If the pH is greater than 12, the sodium content of the sample may need to be determined and the pH result may need correction. Strong acid solutions with pH < 1 may give incorrect high pH readings.

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- 5.2 Samples containing oil may coat the electrode and cause a sluggish response or inaccurate reading.
- 5.3 For acid rain samples it is most important that the magnetic stirrer is not used. Instead, swirl the sample gently for a few seconds after the introduction of the electrode(s). Allow the electrode(s) to equilibrate. The air-water interface should not be disturbed while measurement is being made. If the sample is not in equilibrium with the atmosphere, pH values will change as the dissolved gases are either absorbed or desorbed. Record sample pH and temperature.

## 6) Safety

- 6.1 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.

## 7) Sample Collection, Containers, Preservation, and Storage

- 7.1 Samples may be collected in plastic bottles and should not be preserved.
- 7.2 Samples should be stored at 0-6°C.
- 7.3 Reference methods state that samples should be analyzed “immediately” or “Analyzed as soon as possible preferably in the field at the time of sampling.” Samples submitted to the laboratory should be analyzed as soon as possible. Those analyzed later than 24 hours from receipt should be flagged as exceeding holding time.

## 8) Apparatus and Equipment

- 8.1 Orion Dual Star pH meter, SN E09484, or equivalent.
- 8.2 Combination electrode for pH with temperature probe, such as Orion 8157 or equivalent.
- 8.3 Conductivity jars, 50 ml.
- 8.4 Water bath capable of maintaining a constant temperature of 25°C. One large for all samples and buffers and one smaller bath for analyzing samples at 25°C ± 1°C.
- 8.5 Standard stir plate and submersible stir plate and stir bars

## 9) Standards, Reagents, and Consumable Materials

- 9.1 Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Standards, reagents and consumable material documentation shall indicate traceability to purchased neat materials or compounds. Refer to the SOP *Reagent/Standards Login and Tracking*, for the complete procedure and documentation requirements.
- 9.2 All stocks, working solutions and sample dilutions should be prepared using deionized water (DI) conforming to ASTM Type I or ASTM Type II reagent water. For more information on reagent water generation, refer to the related SOP, Operation and Maintenance of Laboratory Reagent Water Systems.
- 9.3 pH buffers: 1.00, 4.00, 7.00, 10.00, 12.45, (true value of buffers at 25° C).



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9.4 Commercially available solutions should be validated and traceable to NIST standards and are recommended for routine use.

## 10) Preventive Maintenance

10.1 The probe should contain filling solution past the coils to ensure accurate readings. Filling solution should be a non-AgCl containing solution.

10.2 Cleaning the probe.

10.2.1 The glass bulb should be cleaned every other week, or more, by placing it in a beaker with approximately 40 ml of 0.1N HCl and allowed to sit while stirring for approximately 5 minutes. Then rinse the probe with DI water 3 times and blot with a Kimwipe®.

10.2.2 If the coils are no longer orange it means the electrode's ion reservoir is empty and it needs to be replaced.

## 11) Procedure

11.1 Calibration

11.1.1 All buffers are placed in the conductivity jars and stored in the large 25° C waterbath. All readings need to be within 1° C of the buffered temperatures.

11.1.2 Buffer in conductivity jars to be replaced with buffer from the primary container daily.

11.1.3 Once a manufacture's bottle of buffer is open it's good for 3 months, because it becomes contaminated with carbon dioxide.

11.1.4 Perform calibration daily. Record calibration; buffer checks and buffer temperatures in instrument logbook or benchsheet with date and analyst's initials.

11.1.5 The slope of the calibration points should be between 92 and 102% or within the range set by the probe manufacturer. The meter displays the slope of calibration.

11.1.6 If the slope exceeds the above end points either the buffer(s) is contaminated or the probe is no longer functioning properly.

11.1.6.1 Clean the probe, replace buffers, rewarm and then re calibrate.

11.1.6.2 .If the slope still fails after cleaning, replace the probe.

11.2 Orion Dual Star pH meter Calibration

11.2.1 Select "cal" (f2 key)

11.2.2 Rinse electrode and immerse electrode into the 4.00 pH solution.

11.2.3 Select "start" (f3 key).

11.2.4 When stable, change the default value to 4.00.



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- 11.2.5 Select "accept" (f2 key).
- 11.2.6 Select "next" (f2 key).
- 11.2.7 Rinse electrode and immerse into the 7.00 pH solution.
- 11.2.8 Select "start" (f3 key).
- 11.2.9 When stable, select "accept"(f2 key).Default value is 7.00.
- 11.2.10 Select "next" (f2 key).
- 11.2.11 Rinse electrode and immerse into the 10.00pH solution.
- 11.2.12 Select "start" (f3 key).
- 11.2.13 When stable, change the default value to 10.00.
- 11.2.14 Select "accept" (f2 key).
- 11.2.15 Add 1.00 and 12.45 pH buffers if needed, remembering to change the default value to the true value.
- 11.2.16 Once all required calibration buffers have been added, select "cal done" (f3 key).
- 11.2.17 Record "average slope value", buffer temperatures and analysis times on the pH bench sheet.
- 11.2.18 Select "log/print"(f2 key) to save calibration data and exit calibration screen.
- 11.2.19 To calibrate the "channel2" electrode, select the "channel "button to switch to channel 2 and repeat the above steps.
- 11.2.20 **Note:** Initial calibration is performed using the 4.00, 7.00, and 10.00 buffers. If any subsequent sample pH is outside the calibration range (greater than 10.00 or less than 4.00), the 1.00 and/or 12.45 buffers are added to the calibration and the applicable samples are reanalyzed.
- 11.2.21 Following the instrument calibration, a pH 4.00, 7.00 or 10.00 check standard is analyzed. The acceptance criterion is  $\pm 0.05$  pH units of the true value. If the standard is outside of these acceptance limits, the buffer is rechecked once. If it is still outside the  $\pm 0.05$  pH unit limit, the instrument is recalibrated. The same check standard is repeated every 10 pH measurements and must meet the same acceptance criteria. When the sample pH is  $\geq 12.00$  analyze the pH 12.45 buffer as the buffer check standard. If a check fails, reanalyze the check. If it fails again, recalibrate instrument, perform check analysis, and reanalyze all samples back to the previous passing check.

### 11.3 Sample Preparation

- 11.3.1 Place enough sample or buffer to cover the tip of the pH probe into a conductivity jar. Cap the jar and place it into the 25°C water bath. Generally the samples or buffers will reach 25°C in about 30 minutes, however, if the sample is colder it may require more time in the water bath to reach 25°C.



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11.3.2 For multi-phase wastes a determination of the percentage of the sample that is aqueous must be made. This can be calculated from a %solids determination. If the aqueous phase is > 20%, continue with the analysis. If the aqueous phase is < 20%, analyze the sample by the soil procedure (SOP GEN-pHS).

#### 11.4 Sample Analysis

11.4.1 For SM 4500-H+B-2011: Single analysis and a Duplicate Sample every ten samples.

11.4.2 For 9040C and 150.1 all samples must be analyzed in duplicate and the measured pH values must be < 0.1 pH units between the two readings. If the duplicate is outside of this limit, the sample is reanalyzed. Duplicates are documented on the benchsheet.

11.4.3 Rinse and blot electrode, then immerse into the sample. Press pH and record the pH when stabilized, record the temperature to the nearest °C. Remove electrodes from sample after each measurement and rinse 3 times with D.I. water.

11.4.4 All pH readings must be within 2°C of the temperature of the buffer solutions.

11.4.5 If the pH of the sample is  $\geq 11.00$  control the temperature of the samples to  $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$ .

## 12) QA/QC Requirements

12.1 This method shall operate under the formal Quality Assurance Program established at ALS and must maintain records that define the quality of data that is generated. Data shall be compared to established criteria in order to determine if the results of the analyses meet the performance characteristics of the method. It is required that an initial demonstration of capability and periodic analysis of laboratory reagent blanks, laboratory fortified blanks, and other QC solutions as a continuing check on performance. The accuracy and precision of the procedure must be validated *before* analyses of samples begin, or whenever significant changes to the procedures have been made.

12.2 A buffer check is analyzed after every 10 readings. For buffer checks, use either pH 4.00 or 10.00, choosing whichever standard brackets the majority of the previous samples with pH 7.00. The buffer check should be within 0.05 pH units of the true value.

12.3 A Laboratory Control Sample (LCS) is analyzed at a frequency of one per 20 samples. The LCS is a purchase reference material. The Certified Value and Acceptance Limits listed on the vendor's Certificate of Analysis are to be used to evaluate the LCS recovery. Analyze the LCS prior to the sample set. The LCS is prepared identically to associated samples and documented on the analytical. Worksheet If the LCS is outside of the acceptance limits, recalibrate the instrument.

12.4 For SM 4500 H+B-2011, a duplicate sample is analyzed at a frequency of 10% of the samples, with acceptance criteria of 10% RPD between the two readings.

12.5 For 9040C and 150.1, all samples must be analyzed in duplicate and give results of < 0.1 pH units between the two readings. If the duplicate is outside of this limit, the

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sample is reanalyzed. Duplicates are documented on the benchsheet. If the duplicate is outside of these limits, the sample is reanalyzed. Duplicates are documented on the benchsheet. For duplicate analyses, calculate relative percent difference as follows:

$$RPD = \frac{S_1 - S_2}{Avg} * 100$$

Where S1 = Sample with higher value  
 S2 = Sample with lower value  
 Avg. = Average of the two sample values

### 13) Data Reduction and Reporting

#### 13.1 Data Review and Assessment

13.1.1 Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the *SOP for Laboratory Data Review Process* (ADM-DREV) for details. The person responsible for final review of the data report and/or data package should assess the overall validity and quality of the results and provide any appropriate comments and information to the Project Manager for inclusion in the report narrative.

13.1.2 It is the analyst's responsibility to review analytical data to ensure that all quality control requirements have been met for each analytical run. Results for QC analyses are calculated and recorded as specified in this SOP. Average, RPD, spike level and spike recovery are entered on the analytical spreadsheet for corresponding samples. All data will be initialed, dated and attached to required data quality worksheet.

#### 13.2 Reporting

13.2.1 Refer to the *SOP for Data Reporting and Report Generation* (ADM-RG) for reporting guidelines

13.2.2 The analyst enters data directly into ALSLIMS templates. An Analytical Results Summary is generated for that analytical batch showing all QC and sample results. After primary and secondary review, final reports are generated in ALSLIMS by compiling the SMO login, sample prep database, instrument date, and client-specified report requirements (when specified). The forms generated may be ALS standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.

### 14) Method Performance

14.1 This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional method performance data available.

### 15) Pollution Prevention and Waste Management



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15.1 The laboratory will comply with all Federal, State and local regulations governing waste restrictions as specified in the ALS Lab Waste Management Plan.

## 16) Corrective Actions for Out-of-Control Data or Unacceptable Data

16.1 Refer to the SOP for *Nonconformance and Corrective Action Procedures* (ADM-NCAR) for procedures for corrective action.

16.2 Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

## 17) Training

17.1 All analysts performing this analysis are required to read and understand this SOP.

17.2 Training is documented following the *Employee Training and New Employee Orientation* (ADM-TRAIN).

17.3 It is required that an initial demonstration of capability and periodic analysis of laboratory reagent blanks, laboratory fortified blanks, and other QC solutions as a continuing check on performance.

## 18) References and Related Documents

18.1 Method 9040C, Revision 3, EPA SW-846, Test Methods For Evaluating Solid Waste, Third Edition, Update IIIB, November 2004.

18.2 Standard Method 4500 H<sup>+</sup> B-2011.

18.3 EPA Method 150.1, approved for NPDES (Editorial revision 1978, 1982).

18.4 Quality Systems Manual for Environmental Laboratories, current version.

18.5 TNI Standard, Volume 1- 2009; 2016.

18.6 ISO/17025:2017 American National Standard, General Requirements for the Competence of Testing and Calibration Laboratories.

## 19) Summary of Changes

Revision Number	SOP REVIEW	Document Editor	Description of Changes
17.0		T. Caron	Admin Changes only not affecting technical content. Documented date of annual SOP Review, updated SOP signatories; boiler plate standard paragraphs have been updated to reflect current practices.
17.0	J Coronado 2/17/2021		Reviewed and approved; no technical changes at this time

## 20) Attachments and Appendices

20.1 Not Applicable



**TOTAL AND DISSOLVED ORGANIC CARBON (TOC, DOC), TOTAL INORGANIC CARBON (TIC), AND TOTAL CARBON (TC) IN WATER**

**SM 5310C-2011; EPA 9060A; EPA 415.1**

**DOCUMENT I.D. GEN-TOC**

Prepared By:   
Department Manager, Jeff Coronado

Date: 1/4/19

Prepared By:   
Quality Assurance Manager, Carl Degner

Date: 1/4/19

Approved By:   
General Manager, Ambrose Hughey

Date: 1/4/19

Doc Control ID:	_____	Archived Date:	_____
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## ALS-Kelso SOP Annual Review Statement

**SOP Code: GEN-TOC**

Revision: 15

An annual review of the SOP listed was completed on (date): **02/26/20**

The SOP reflects current practices and requires no procedural changes.

Supervisor: TH Date: 02/26/20

Revision of the SOP is needed to reflect current practices. Draft revisions are listed below.

SOP Section Number	Description of Revision Needed	Date Procedure Change Implemented	Supervisor Initials Indicating Approval of Revision



## ALS-Kelso SOP Annual Review Statement

**SOP Code: GEN-TOC**

Revision: 15

An annual review of the SOP listed was completed on (date): \_\_\_\_\_

The SOP reflects current practices and requires no procedural changes.

Supervisor:            Date:

Revision of the SOP is needed to reflect current practices. Draft revisions are listed below.

<b>SOP Section Number</b>	<b>Description of Revision Needed</b>	<b>Date Procedure Change Implemented</b>	<b>Supervisor Initials Indicating Approval of Revision</b>
7.6	Add: Samples must be filtered and preserved within 48 hours of collection.	08/23/19	JC

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## 1) Scope & Applicability

- 1.1 This procedure is applicable to the determination of Total Organic Carbon (TOC) in drinking, surface and saline waters, domestic and industrial wastewater using methods EPA 9060A, EPA 415.1, and Standard Methods 5310C-2011. The procedure may also be extended to certain domestic or industrial wastes.
- 1.2 This procedure may be modified for quantification of Dissolved Organic Carbon (DOC) where
- 1.3 DOC is determined from a filtered sample.
- 1.4 Normal operating parameters (i.e. 1 ml sample loop) yield a Method Reporting Limit (MRL) of 0.5 mg/L C. A 5 ml sample loop may be used to lower the MRL to 0.1 mg/L C. The data quality objectives for target analytes in water are presented in Table 2 and in the ALS Kelso DQO Table.
- 1.5 In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPP's supersede method specified requirements. An example of this are projects falling under DOD ELAP. QC requirements defined in the SOP *Department of Defense Projects - Laboratory Practices and Project Management (ADM-DOD)* may supersede the requirements defined in this SOP.

## 2) Summary of Procedure

- 2.1 Total Organic Carbon (TOC) is determined by measuring carbon dioxide released by chemical oxidation of the non-purgeable organic carbon in the sample. After the sample has been acidified and purged of inorganic carbon, sodium persulfate, a strong oxidizer, is added. This oxidant quickly reacts with non-purgeable organic carbon in the sample at 100°C to form carbon dioxide. When the reaction is complete, the carbon dioxide is purged from the solution, concentrated by trapping then thermally desorbed (200°C) and carried into a non-dispersive infrared detector that has been calibrated to directly display the mass of carbon dioxide detected. The resulting carbon mass in the form of carbon dioxide is the equivalent to the mass of organic carbon originally in the sample.
- 2.2 Total Inorganic Carbon is determined by carbon dioxide released by acidification of a sample. The pH of the sample is lowered; the carbonate and bicarbonate ions are then converted to carbon dioxide. This carbon dioxide is purged from the solution, concentrated by trapping, and detected as described for TOC.

## 3) Definitions

- 3.1 Batch - A batch of samples is a group of environmental samples that are prepared and/or analyzed together as a unit with the same process and personnel using the same lot(s) of reagents. It is the basic unit for analytical quality control.
  - 3.1.1 Preparation Batch - A preparation batch is composed of one to twenty field samples, all of the same matrix, and with a maximum time between the start



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of processing of the first and last samples in the batch to be 24 hours.

3.1.2 Analysis Batch - Samples are analyzed in a set referred to as an analysis sequence. The sequence begins with instrument calibration (initial or continuing verification) followed by sample extracts interspersed with calibration standards (CCBs, CCVs, etc.) The sequence ends when the set of samples has been injected or when qualitative and/or quantitative QC criteria indicate an out-of-control situation.

3.2 Sample

3.2.1 Field Sample - An environmental sample collected and delivered to the laboratory for analysis; a.k.a., client's sample.

3.2.2 Laboratory Sample - A representative portion, aliquot, or subsample of a field sample upon which laboratory analyses are made and results generated.

3.3 Quality System Matrix - The *matrix* of an environmental sample is distinguished by its physical and/or chemical state and by the program for which the results are intended. The following sections describe the matrix distinctions. These matrices shall be used for purpose of batch and quality control requirements.

3.3.1 Aqueous - Any groundwater sample, surface water sample, effluent sample, and TCLP or other extract. Specifically excluded are samples of the drinking water matrix and the saline/estuarine water matrix.

3.3.2 Drinking water - Any aqueous sample that has been designated a potable or potential potable water source.

3.3.3 Saline/Estuarine water - Any aqueous sample from an ocean or estuary or other salt-water source.

3.4 Method Blank (MB) - a solution of the laboratory prepared deionized water that is carried through analysis like a sample, to serve as a measure of contamination associated with laboratory storage, preparation, or instrumentation.

3.5 Filtration Blank - The filtration blank is an artificial sample composed of analyte-free water and is designed to monitor the introduction of artifacts into the filtration process. The filtration blank is carried through the entire filtration procedure.

3.6 Laboratory Control Samples (LCS) - The LCS is an aliquot of analyte free water or analyte free solid to which known amounts target analytes are added. The LCS is prepared and analyzed in exactly the same manner as the samples. The percent recovery is compared to established limits and assists in determining whether the batch is in control.

3.7 Sample Duplicate - a second aliquot of a sample that is treated exactly the same throughout laboratory analytical procedures. The purpose is to verify the precision associated with the laboratory procedures. Matrix Spike - aliquots of sample to which known amounts of an analyte of interest has been added. These are treated exactly the same throughout laboratory analytical procedures. The purpose of a matrix spike is to determine whether the sample matrix contributes bias to the analytical results.



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- 3.8 Calibration Standards - a solution of analytes prepared in the laboratory from stock standard solutions, diluted as needed, and used to calibrate the instrument response with respect to analytical concentration.
- 3.9 Independent Verification Standard (ICV) - A mid-level standard injected into the instrument after the calibration curve and prepared from a different source than the initial calibration standards. This is used to verify the validity of the initial calibration standards. The LCS when prepared from a different source will also serve as the ICV.
- 3.10 Laboratory Control Standards (LCS) - a solution of analytes prepared in the laboratory from stock standard solutions purchased or prepared independently from calibration standards.
- 3.11 Continuing calibration blank (CCB) - a blank solution of deionized water. CCB's are analyzed to verify that the instrument has not become contaminated during the course of the analytical run.
- 3.12 Continuing calibration verification standard (CCV) - a solution of prepared in the laboratory at approximately the midpoint of calibration curves. CCV's are analyzed to verify that the instrument performance has not changed during the course of the analytical run.
- 3.13 Rinse Blank (RB) - a solution of the laboratory prepared deionized water that is carried through analysis like a sample, to serve as a measure of carry-over from the previous sampling and analytical run.

#### 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. The department supervisor/manager or designee performs final review and sign-off of the data.
- 4.2 It is the responsibility of the department supervisor/manager to document analyst training. Documenting method proficiency is also the responsibility of the department supervisor/manager or designee.

#### 5) Interferences

- 5.1 Carbonate and bicarbonate carbon are interferences under the terms of this test and must be removed or accounted for in the final calculations
- 5.2 This procedure is applicable only to homogenous samples that can be injected reproducibly by microliter type syringe or pipette. The opening of the syringe or pipette limits the size of particles which may be included in the samples. The Teledyne TOC Fusion™ analyzer can analyze samples with suspended solids up to 500 microns diameter.
- 5.3 Positive bias may be caused by contaminants in the gas, dilution water, reagents, glassware, or other sample processing hardware. The use of high purity reagents and gases help minimize interference problems. Materials may be demonstrated to be free from interference by running reagent blanks
- 5.4 Interference by non-CO<sub>2</sub> gases: The infrared detector is sensitized to carbon dioxide and accomplishes virtually complete rejection of response from other gases which absorb energy in the infrared region. Trapping and desorption of carbon dioxide on



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the molecular sieve trap isolates the component of interest and allows the complete absence of interference in the system from gases other than carbon dioxide.

### 6) Safety

- 6.1 All appropriate safety precautions for handling solvents, reagents and samples must be taken when performing this procedure. This includes the use of personal protective equipment, such as, safety glasses, lab coat and the correct gloves.
- 6.2 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.
- 6.3 Sodium Persulfate is a strong oxidizer and should be handled with extreme care.
- 6.4 Phosphoric Acid is a corrosive material should be handled with extreme care.
- 6.5 Potassium Biphthalate and Sodium Carbonate are chemical irritants and may cause eye burns.

### 7) Sample Collection, Containers, Preservation, and Storage

- 7.1 For most accurate analyses, sampling containers should be free of organic contaminants.
- 7.2 Sampling and storage of samples in glass bottles is preferable. If this is not feasible, sampling and storage in plastic bottles such as conventional polyethylene and cubitainers is permissible if it is established that the containers do not contribute contaminating organics to the samples.
  - 7.2.1 **Note:** A brief study performed at the EPA Laboratory indicated that distilled water stored in new, one quart cubitainers did not show any increase in organic carbon after two weeks exposure.
- 7.3 For samples requiring very low-level TOC analysis (below about 500 ppb C) attention to limiting contamination may be required. If possible, rinse bottles with sample before filling and carry field blanks through sampling procedure to check for any contamination that may occur. Collect and store samples in glass bottles protected from sunlight and seal with TFE-backed septa. Use certified clean sample vials for sampling and analysis. However if certified clean containers are not available or are found to be cleaned insufficiently further cleaning may be required. If necessary before use, wash bottles with acid, seal with Aluminum foil, and bake at 400°C for at least one hour. Wash un-cleaned TFE septa with detergent, rinse repeatedly with organic free water, and wrap in aluminum foil and bake at 100°C for one hour. Check performance of new or cleaned septa by running appropriate blanks. Preferably use thick silicone rubber-backed TFE septa with open ring caps to produce a positive seal. Less rigorous cleaning may be acceptable if the concentration range is relatively high. Check bottle blanks to determine effectiveness or necessity of cleaning.



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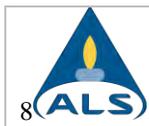
- 7.4 Because of the possibility of oxidation or bacterial decomposition of certain components in aqueous samples, the time between sample collection and analysis should be minimized. In addition, the samples should be kept cool (4°C) and protected from sunlight and atmospheric oxygen.
- 7.5 In situations where analysis cannot be performed within two hours (2 hours) of sampling, the sample must be acidified (pH < 2) with Phosphoric or Sulfuric acid. Once preserved, samples must be analyzed within 28 days. Note that acid preservation invalidates any inorganic carbon determination on the samples.
- 7.6 Samples requiring DOC analyses should be filtered through a prewashed 0.45 micron glass microfiber membrane filter prior to acid preservation. A DI water filter blank should also be included with the filtration batch to determine potential for sample contamination from filter or filtration apparatus.

### 8) Apparatus and Equipment

- 8.1 TOC analyzer: Teledyne -Tekmar, Model TOC Fusion, S/N: US10165001.
- 8.2 Whatman 0.45µm glass microfiber membrane filter, or equivalent.

### 9) Standards, Reagents, and Consumable Materials

- 9.1 Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Standards, reagents and consumable material documentation shall indicate traceability to purchased reagents or compounds. Refer to the SOP *Reagent/Standards Login and Tracking* (ADM-RTL) for the complete procedure and documentation requirements.
- 9.2 All stocks, working solutions and sample dilutions should be prepared using deionized water (DI) conforming to ASTM Type I or ASTM Type II reagent water. For more information on reagent water generation, refer to the related SOP, Operation and Maintenance of Laboratory Reagent Water Systems.
- 9.3 Potassium Biphthalate (KHP) stock solutions:
- 9.3.1 1000 ppm C stock solution is prepared by adding 2.128 g of KHP (previously dried to a constant weight at 105°C) into a 1000 ml volumetric flask. Dilute to volume with reagent water. Solution contains 1.0 ug C per ul.
- 9.3.2 5000 ppm C stock solution is prepared by adding 10.64 g of KHP (previously dried to a constant weight at 105°C) into a 1000 ml volumetric flask. Dilute to volume with reagent water. Solution contains 5.0 ug C per ul.
- Note:** Stock solution has a shelf life of six months after preparation. Sodium oxalate and acetic acid are not recommended as stock solutions.
- 9.3.3 Calibration standards used are 5 ppm and 50 ppm. The instrument is configured to make Standard dilutions.
- 9.3.4 Sodium Carbonate Stock solution (1000 ppm C) - Prepare stock solution by adding 8.826 g of Na<sub>2</sub>CO<sub>3</sub> (previously dried to a constant mass at 105°C) to a



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1000 ml volumetric flask. Dilute to volume with reagent water. Solution contains 1.0 ug C per ul.

- 9.3.5 Sodium Persulfate - Prepare solution of sodium persulfate by dissolving 100g  $\text{Na}_2\text{S}_2\text{O}_8$  into (852 mL DI  $\text{H}_2\text{O}$  plus 36 mL  $\text{H}_3\text{PO}_4$ ), then purge with  $\text{N}_2$  for 30 minutes before use. Reagent has a shelf life of one month.
- 9.3.6 Phosphoric Acid (21%) - Prepare 21% by volume solution of phosphoric acid by adding 150 mL of ACS reagent grade 85%  $\text{H}_3\text{PO}_4$  to 450 mL reagent water. Reagent has a shelf life of one month.
- 9.3.7 Continuing Calibration Verification (CCV) - The CCV is prepared by diluting 10.0 mLs of 5000 ppm TOC stock solution 1000 mLs of deionized water in a Class "A" volumetric flask. Resulting concentration is 50.0 ppm. The instrument runs the CCV check standard at a 1:2 dilution (25 ppm).
- 9.3.8 Laboratory Control Sample (LCS) - The LCS is prepared from an ERA QC - Plus Demand solution. The true value is determined based on the lot number of the standard.
- 9.3.9 Gas Service: Nitrogen.

## 10) Preventive Maintenance

### 10.1 Daily Maintenance Checks

- 10.1.1 Verify the gas source is supplying an input pressure of 50 psi.
- 10.1.2 Verify that there is ample persulfate available for sample analysis. Verify that the persulfate has not expired.
- 10.1.3 Verify that there is ample acid available for sample analysis. Verify that the acid has not expired. Make sure the DI water supply is sufficient for sample analysis.
- 10.1.4 After the UV lamp has warmed up for 15 minutes, verify that the detector baseline is within the range of 0-5 Absorbance units (Abs). Perform the Detector Offset function if necessary.
- 10.1.5 Verify that the waste container has sufficient volume to contain the waste generated.

### 10.2 Weekly Maintenance Checks

- 10.2.1 Check the copper side of the halogen scrubber. When copper is discolored completely, replace both the copper and tin in the scrubber.
- 10.2.1 Make sure the two screws that attach the 7-port Valve to the Syringe Pumper are tight.

### 10.3 Monthly Maintenance Checks

- 10.3.1 Inspect and clean the reactor and sparger if necessary.
- 10.3.2 Flush sample transfer line with generous amounts of DI water. Inspect the



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permeation dryer for damage and water accumulation.

### 10.4 Semi-Annually Maintenance Checks

10.4.1 Replace the O-rings in the UV reactor vessel.

10.5 For additional information refer to the Fusion™ Preventative Maintenance section of the User Manual, Page 8-2.

## 11) Procedure

### 11.1 TOC analyzer: Teledyne -Tekmar, Model TOC Fusion - Preparation and Analysis

11.1.1 Perform the required daily maintenance checks.

11.1.2 If the TOC TekLink™ software is not already in operation, launch the TOC TekLink™ software.

11.1.3 Login with the User Name: (Fusion 1) and Password: (Fusion1), and connect into the Fusion program.

11.1.4 Open the daily startup schedule, save the schedule to reflect the current date (m/d/y/, make any necessary adjustments, and click “Ready”.

- TOC/DOC daily startup schedule: CAS\_SALT\_010711.
- Extended Reaction (for salt water) daily startup schedule, Extended Reaction 021711.
- TIC/DIC daily startup schedule: IC 030411.
- TOC Low Level daily startup schedule: CAS\_High\_Sensitivity.

11.1.5 After the UV lamp has warmed up for 15 minutes, verify that the detector baseline is within the range of the 0-5 Absorbance units (Abs). Perform the Detector Offset function if necessary.

*Note: If the instrument is allowed to sit idle for 20 minutes, it will automatically switch to standby mode.*

11.1.6 Click the start button to start the sequence.

11.1.7 The schedule should contain three Cleans, one Reagent/Acid Blank, and one rinse blank before the first CCV.

11.1.8 Scan the samples barcode into the Run Sequence and load the samples into the carousel. Ensure that the sample’s position on the schedule matches the number on the carousel.

11.1.9 An initial CCV is run after the Rinse Blank and must be analyzed following every tenth injection and at the end of the run. The CCV is a 25.0 ppm TOC Standard made from stock KHP solution. Recovery must be **90–110%** of the value (**91–106% for Arizona** samples). For low level analyses (i.e. 0.1 ppm MRL), the CCV is a 5.0 ppm standard. Calculate the CCV recovery as follows:

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$$\%R = X/TV \times 100$$

Where X = Measured concentration of the CCV  
TV = True value of CCV

- 11.1.10 A Continuing Calibration Blanks (CCB) must be analyzed every 10 injections. CCB measured concentrations must be less than the MRL.
- 11.1.11 Sample Analysis
  - 11.1.11.1 Once the UV lamp has warmed up for 15 minutes, and the detector baseline is within the range of 0.5 Absorbance units (Abs), the instrument is ready for analysis.
  - 11.1.11.2 Load samples vials into the autosampler carousel according to the analytical run sequence shown below. Thoroughly shake TOC samples before loading. Click the start button on the schedule to begin analysis.
- 11.1.12 When performing method 5310C and EPA 415.1, analyze all environmental samples in duplicate. .
- 11.1.13 When performing method 9060A, analyze all samples in quadruplicate.

## 12) Quality Assurance/Quality Control Requirements

### 12.1 Initial Precision and Recovery Validation

- 12.1.1 The ability of each analyst/instrument to generate acceptable accuracy and precision must be validated and documented before analysis of samples begins, or whenever significant changes to the procedures have been made. To do this, four water samples are spiked with the LCS spike solution, then prepared and analyzed. Method criteria must be met for these results.

### 12.2 Method Detection Limits and Method Reporting Limits

- 12.2.1 A method detection limit (MDL) study must be undertaken before analysis of samples can begin. To establish detection limits that are precise and accurate, the analyst must perform the following procedure. Spike seven blank matrix (water or soil) samples with MDL spiking solution at a level below the MRL. Follow the analysis procedures to analyze the samples.
- 12.2.2 Calculate the average concentration found (x) in µg/mL, and the standard deviation of the concentrations (s) in µg/mL for each analyte. Calculate the MDL for each analyte. Refer to the ALS SOP *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification (CE-QA011)*. The MDL study must be verified annually.

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### 12.3 Limits of Quantification (LOQ)

12.3.1 The laboratory must establish a LOQ for each analyte as the lowest reliable laboratory reporting concentration or in most cases the lowest point in the calibration curve which is less than or equal to the desired regulatory action levels, based on the stated project requirements. Analysis of a standard or extract prepared at the lowest point calibration standard provides confirmation of the established sensitivity of the method. Refer to the ALS SOP *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification* (CE-QA011).

12.3.2 The Method Reporting Limits (MRLs) used at ALS are the routinely reported lower limits of quantitation which take into account day-to-day fluctuations in instrument sensitivity as well as other factors. These MRLs are the levels to which ALS routinely reports results in order to minimize false positive or false negative results. The MRL is normally two to ten times the method detection limit.

12.4 Ongoing QC Samples each sample batch (20 or fewer samples) required are described in the ALS-Kelso Quality Assurance Manual and in the SOP for Sample Batches. Additional QC Samples may be required in project specific quality assurance plans (QAPP). General QC Samples are:

#### 12.4.1 Method Blank (MB)

12.4.1.1 A method blank is extracted and analyzed daily with every batch of 20 (or fewer) samples to demonstrate that there are no method interferences. If the method blank shows any hits above the reporting limit, corrective action must be taken. Corrective action includes recalculation, reanalysis, system cleaning, or re-extraction and reanalysis. For some project specific needs, exceptions may be noted and method blank results above the MRL may be reported for common lab contaminants.

#### 12.4.2 Laboratory Control Sample (LCS)

12.4.2.1 A Laboratory Control Sample (LCS) for SM 5310C and EPA 415.1 must be analyzed with each batch of 20 or fewer samples. The LCS is prepared from a standard which is an independent source from the calibration standards. Acceptance criteria are given in Table 2. This statistically derived acceptance limit is subject to change as limits are updated.

12.4.2.2 When performing Method 9060 analysis, the second source LCS must be analyzed every 15 samples rather than every 20 samples.

12.4.2.3 Calculate the LCS recovery as follows:

$$\%R = X/TV \times 100$$

Where X = Concentration of the analyte recovered  
TV = True value of amount spiked

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12.4.3 Sample Duplicates (DUP)

12.4.3.1 A sample duplicate or matrix spike duplicate (MSD) must be analyzed with every analytical batch.

12.4.3.2 Calculate Relative Percent Difference (RPD) as:

$$\%RPD = \frac{|R1 - R2|}{(R1 + R2) / 2} \times 100 \quad \text{Where R = Result}$$

12.4.3.3 The RPD is calculated as follows:

$$\frac{Hi - Lo}{Avg.} \times 100$$

12.4.4 The percent RPD for EPA 9060A and EPA 415.1 must be  $\leq 20\%$ . This statistically derived acceptance limit is subject to change as limits are updated. For SM 5310C, all duplicates must be within **10%** RPD.

Relative Percent Difference calculation:

$$\%RPD = \frac{(S - D)}{((S + D)/2)}$$

where: S = Initial sample result  
D = Duplicate sample result

12.4.5 Matrix Spikes

12.4.5.1 For SM 5310C and EPA 415.1, analyze one matrix spike sample (MS) for every analytical batch of twenty samples.

12.4.5.2 Method 9060A analyze one matrix spike sample (MS) for every analytical batch of ten samples.

12.4.5.3 Spike 50 ul of 5000 ppm KHP stock solution to 10.0 mLs of sample. For low level analysis, spike 50 ul of 1000 ppm KHP stock solution to 10.0 mLs of sample. Acceptance criteria are given in Table 2. This statistically derived acceptance limit is subject to change as limits are updated.

Calculate percent recovery as follows:

$$Matrix\ Spike\ Recovery = \frac{Spiked\ Sample - Sample}{Spike\ Added} \times 100$$

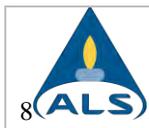
13) Data Reduction and Reporting (or Documentation and Records)

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- 13.1 Refer to the SOP for Data Reporting and Report Generation for reporting guidelines.
- 13.2 Preliminary results are reviewed to determine if dilutions are required. Sample information is transferred to an [REDACTED] spreadsheet for calculations (see R:\WET\ANALYSES\TOC\DATA). Instrument baseline is determined by taking the average of all Method Blanks, CCB's, (see R:\WET\ANALYSES\TOC\TOC\_CBA1.SPD ). Sample concentration is corrected by subtracting calculated blank average (CBA) from instrument response. Concentration and sample identification number are highlighted for reporting purposes.
- 13.3 For 5310C, report the result from a single analysis. For 9060A, report both the average and the range from the quadruplicate analyses.
- 13.4 It is the operators' responsibility to review analytical data to ensure that all quality control requirements have been met for each analytical run. Results for QC analyses are calculated and recorded as specified in procedures section of the SOP. Average, RPD, spike level and spike recovery are entered on spreadsheet (see append. B) for corresponding samples. All data will be initialed, dated and attached to required data quality worksheet.
- 13.5 Reports are generated in the ALS LIMS by compiling the SMO login, sample prep database, instrument date, and client-specified report requirements (when specified). This compilation is then transferred to a file which [REDACTED] uses to generate a report. The forms generated may be ALS standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.
- 13.6 As an alternative, reports are generated using [REDACTED] templates located in R:\WET\FORMS. The analyst should choose the appropriate form and QC pages to correspond to required tier level and deliverables requirements. The results are then transferred, by hand or electronically, to the templates the saved to R:\WET\WIP.
- 13.7 Data Review and Assessment
- 13.7.1 Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the *SOP for Laboratory Data Review Process* for details. The person responsible for final review of the data report and/or data package should assess the overall validity and quality of the results and provide any appropriate comments and information to the Project Chemist to inclusion in the report narrative.

## 14) Method Performance

- 14.1 The accuracy and precision of the procedure must be validated before analysis of samples begins, or whenever significant changes to the procedures have been made. To do this, four LCS aliquots are prepared and analyzed. The average percent recovery must meet the laboratory control sample acceptance limits.
- 14.2 The method detection limit (MDL) is established using the procedure described in the SOP CE-QA011, *Performing Method Detection Limit Studies and Establishing Limits of*



*Detection and Quantification.* Method Reporting Limits are established for this method based on MDL studies and as specified in the ALS Quality Assurance Manual.

## 15) Pollution Prevention and Waste Management

- 15.1 It is the laboratory's practice to minimize the amount of solvents, acids and reagent used to perform this method wherever feasible. Standards are prepared in volumes consistent with methodology and only the amount needed for routine laboratory use is kept on site. The threat to the environment from solvent and reagents used in this method can be minimized when recycled or disposed of properly.
- 15.2 The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Lab Waste Management Plan.

## 16) Corrective Actions for Out-of-Control Data or Unacceptable Data

- 16.1 Refer to the SOP for *Non Conformance and Corrective Action* (CE-QA008) for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.
- 16.2 Handling out-of-control or unacceptable data
- 16.2.1 On-the-spot corrective actions that are routinely made by analysts and result in acceptable analyses should be documented as normal operating procedures, and no specific documentation need be made other than notations in laboratory maintenance logbooks, run logs, for example.
- 16.2.2 Some examples when documentation of a nonconformity is required using a Nonconformity and Corrective Action Report (NCAR):
- Quality control results outside acceptance limits for accuracy and precision.
  - Method blanks or continuing calibration blanks (CCBs) with target analytes above acceptable levels.
  - Sample holding time missed due to laboratory error or operations.
  - Deviations from SOPs or project requirements.
  - Laboratory analysis errors impacting sample or QC results.
  - Miscellaneous laboratory errors (spilled sample, incorrect spiking, etc.).
  - Sample preservation or handling discrepancies due to laboratory or operations error.
  - Customer inquiries concerning data quality or services (when applicable). NCAR not required for simple corrections with no impact to the client.
  - Data errors reported to clients, non-conforming re-checks.
  - Deficiencies found during internal or external audits.
  - Login errors or shipping errors.
  - IT issues if there is a significant impact to a client.
  - Turnaround time complaints.

## 17) Training



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- 17.1 Review literature Review this SOP. Also review the applicable SDS for all reagents and standards used. Following these reviews, observe the procedure performed by an experienced analyst.
- 17.2 The next training step is to assist in the procedure under the guidance of an experienced analyst. During this period, the analyst is expected to transition from a role of assisting, to performing the procedure with minimal oversight from an experienced analyst.
- 17.3 Perform initial precision and recovery (IPR) study as described above for water samples. Summaries of the IPR are reviewed and signed by the supervisor. Copies may be forwarded to the employee's training file. For applicable tests, IPR studies should be performed in order to be equivalent to NELAC's Initial Demonstration of Capability.
- 17.4 Training is documented following the *ALS-Kelso Training Procedure* (ADM-TRAIN). When the analyst training is documented by the supervisor on internal training documentation forms, the supervisor acknowledges that the analyst has read and understands this SOP and that adequate training has been given to the analyst to competently perform the analysis independently.

### 18) Method Modifications

- 18.1 There are no known modifications in this laboratory standard operating procedure from the reference method.

### 19) Summary of Changes

- 19.1 Reformatted SOP to current ALS format.
- 19.2 Updated safety references and definitions.
- 19.3 Miscellaneous format revisions and typographical/grammatical corrections.
- 19.4 Section 8: Model 1010 Total Organic Carbon Analyzer: removed from the equipment list and when referenced in the SOP.  
TOC analyzer: Teledyne -Tekmar, Model TOC Fusion, - was added into numerous sections throughout the SOP.
- 19.5 Section 9: Updated calibration standards; sodium persulfate preparation; removed the ICV from the analysis.
- 19.6 Section 11: Numerous edits throughout the section.
- 19.7 Added EPA 415.1 into the SOP, which had previously been previously removed.

### 20) References and Related Documents

- 20.1 U.S. Environmental Protection Agency, Total Organic Carbon, Method 9060A, Revision 1 November 2004.
- 20.2 Total Organic Carbon, Combustion-Infrared Method, and 5310C. Standard Methods for the Examination of Water and Wastewater, 20th ed., 1998.
- 20.3 Organic Carbon, Total (Combustion Or Oxidation), Method 415.1. <G:\QA\Methods\EPA\415.1.pdf>.

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- 20.4 TNI Standard, Volume 1- 2009.
- 20.5 DoD Quality Systems Manual for Environmental Laboratories. Current version.
- 20.6 Updated Table 1.



**TABLE 1: Summary of Corrective Actions**

Method Reference	Control	Specification and Frequency	Acceptance Criteria	Corrective Action
SM 5310C 9060, 415.1	Linearity verification	Annually	$R^2 \geq 0.995$	Correct problem then repeat ICAL
SM 5310C 9060, 415.1	ICV	After ICAL, prior to sample analysis	90-110%	Correct problem and verify second source standard; rerun second source verification; If fails, correct problem and repeat initial calibration.
SM 5310C 9060, 415.1	CCV	Prior to sample analysis, every 10 injections and end	$\pm 10\%$ Diff	Correct problem then repeat CCV or repeat ICAL
SM 5310C 9060, 415.1	CCB	Prior to sample analysis, every 10 injections and end	<MRL	If target exceeds MRL, reanalyze to determine if instrument was cause.
SM 5310C 9060, 415.1	Method Blank	Include with each analysis batch (up to 20 samples)	<MRL	If target exceeds MRL, reanalyze to determine if instrument was cause. If still noncompliant then: Re-extract or reanalyze samples containing contaminate, unless samples contain > 20x amount in blank.
SM 5310C, 415.1	Laboratory Control Sample	Include with each analysis batch (up to 20 samples)	See DQO	If exceeds limits, re-extract and re-analyze
9060	Laboratory Control Sample	Include with each analysis batch (up to 15 samples)	See DQO	If exceeds limits, re-extract and re-analyze
SM 5310C, 415.1	Matrix Spike	Include with each analysis batch (up to 20 samples)	See DQO	Evaluate data to determine if there is a matrix effect or analytical error
9060	Matrix Spike	Include with each analysis batch (up to 10 samples)	See DQO	Evaluate data to determine if there is a matrix effect or analytical error
SM 5310C, 415.1	Sample Duplicates	All samples in batch	$\leq 10\%$ RPD	Re-homogenize and re-analyze if result is > 5 X the MRL
415.1	Sample Duplicates	All samples in batch	$\leq 20\%$ RPD	Re-homogenize and re-analyze if result is > 5 X the MRL
9060	Sample Quadruplicate	All samples in batch	$\leq 20\%$ RSD	Re-homogenize and re-analyze if result is > 5 X the MRL

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## Solids, Total Suspended (TSS)

DOCUMENT ID: GEN-TSS REV 14.0

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Approved By: Inorganics Manager, Jeff Coronado  
Signature on file.

Date: 2/18/2021

Approved By: Quality Assurance Manager, Kurt Clarkson  
Signature on file.

Date: 2/18/2021

Approved By: Laboratory Director, Charles (Pat) Byrne  
Signature on file.

Date: 2/18/2021

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## 1) Scope & Applicability

- 1.1 This procedure is used to determine suspended solids using 2540 D-2011. The procedure tests for material in a well-mixed sample that is filtered through a glass fiber filter and is retained on the filter and dried to a constant weight at 103-105°C.
- 1.2 This method is applicable to drinking, surface, and saline waters, domestic and industrial wastes.
- 1.3 Using 200 mL of sample, the practical range of determination is 5 mg/L to 20,000 mg/L. using 500 mL of sample, the range of determination is expanded down to 2 mg/L.
- 1.4 The Method Detection Limit (MDL) is a function of the sample volume used and range of the balance. The MDL is 5 mg/L using 200 mL of sample. Using 500 mL of sample, the MDL is 2 mg/L.
- 1.5 In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPP's supersede method specified requirements. An example of this are projects falling under DOD ELAP. QC requirements defined in the SOP *Department of Defense Projects - Laboratory Practices and Project Management*, may supersede the requirements defined in this SOP.

## 2) Summary of Procedure

- 2.1 A well-mixed sample is filtered through a SSI Accudisk™ 1.5 µm binderless, borosilicate glass fiber filter, pre-washed, prepared and pre-weighed by the manufacturer, (in accordance with SM 2540D), and the residue retained on the filter is dried to a constant weight at 103-105°C. The increased weight of the filter represents the total suspended solids.
- 2.2 The alternative procedure uses glass fiber filter discs, 42.5 mm, Whatman GF/C or equivalent,
- 2.3 When pre-washed, prepared and pre-weighed filters are not in use. Refer to the procedure on the preparation of glass-fiber filter disks..

## 3) Definitions

- 3.1 For laboratory definitions applicable to most analyses, refer to the SOP for [Sample Batches](#).

## 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. The department supervisor/manager or designee performs final review and sign-off of the data.
- 4.2 It is the responsibility of the department supervisor/manager to document analyst

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training and method proficiency as referenced in *Employee Training and Orientation*, ADM-TRAIN.

## 5) Interferences

- 5.1 Non-representative particulates such as leaves, sticks, fish and lumps of fecal matter should be excluded if it is determined that their inclusion is not desired in the final result.
- 5.2 Excessive residue on the filter may form a water-entrapping crust. Limit the sample size to that yielding no more than 200 mg residue.
- 5.3 For samples high in total dissolved solids, thoroughly wash the filter to ensure removal of dissolved material.
- 5.4 Prolonged filtration times resulting from filter clogging may produce high results because of increased colloidal materials captured on the clogged filter.
- 5.5 Filtration apparatus, filter material, pre-washing, post-washing, and drying temperature are specified because they can affect the results.

## 6) Safety

- 6.1 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.

## 7) Sample Collection, Containers, Preservation, and Storage

- 7.1 Samples should be collected in pre-cleaned plastic sample bottles and must be iced or refrigerated at 0-6°C from time of collection until preparation or analysis.
- 7.2 Water samples must be analyzed within 7 days of sampling.

## 8) Apparatus and Equipment

- 8.1 SSI Accudisk™ (Part No. 425TSS-AD) 1.5 µm binderless, borosilicate glass fiber filter, pre-washed, prepared and weighed by the manufacturer, in accordance with SM 2540D for use in determining Total Suspended Solids (TSS).
- 8.2 Magnetic Filtration Apparatus.
- 8.3 Suction Flask, 1 Liter.
- 8.4 Drying Oven.
- 8.5 Desiccator.
- 8.6 Forceps.
- 8.7 Graduated Cylinder.
- 8.8 Analytical Balance, capable of weighing to 0.1 mg.
- 8.9 Balance calibration verification weights, ASTM Class 1 (or equivalent): 0.01 g, 1 g, 10 g, and 100 g.

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8.10 Alternative Procedure: Glass fiber filter discs, 42.5 mm, Whatman GF/C or equivalent may be used when pre-washed and pre-weighed filters are not in use.

## 9) Standards, Reagents, and Consumable Materials

### 9.1 Reagents

9.1.1 Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Refer to the SOP *Reagent/Standards Login and Tracking* (ADM-RLT) for the complete procedure and documentation requirements.

9.1.2 All stocks, working solutions and sample dilutions should be prepared using deionized water (DI) conforming to ASTM Type I or ASTM Type II reagent water. For more information on reagent water generation, refer to the related SOP, Operation and Maintenance of Laboratory Reagent Water Systems.

### 9.2 Standards

9.2.1 Stock standard solutions may be purchased from a number of vendors. All standards purchased from vendors must be traceable to NIST or A2LA certified reference materials. Purchased standards are prepared in DI water. The vendor-assigned expiration date is used.

9.2.2 Laboratory Control Sample (LCS) – Prepared from ERA, QC Plus-solids, and Catalog No. 4033.

9.2.2.1 The LCS is prepared by transferring a container of QC Plus – Solids, to 1000 mL volumetric flask. This is done by wetting the contents of the vial with about 2 mL of DI water and transferring the wetted solids standard to a 1000 mL volumetric flask to which 100 – 200 mL of DI water has been previously added. Rinse the standards container 3 times with DI water to ensure all contents are transferred to the volumetric flask. Bring up to 1000 mL in the volumetric flask with DI water.

9.2.2.2 Document the preparation of the LCS solution in a reagent log book. The true value or concentration is calculated from the standards certificate of analysis. This standard is good for 7 days and is stored at 0-6°C.

## 10) Preventive Maintenance

10.1 Multi-point balance calibration verifications are required for each day the balance is used. The NELAC Quality System Standards and DoD Quality System Manual require that the balance verifications be performed prior to use on each day of use. The

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calibration verification weights must bracket the range of use. For additional information, refer to the SOP *Documenting Laboratory Balance and Temperature Checks* (ADM-BAL).

- 10.2 A bound logbook is used to record all balance measurements. Format the logbook such that the date, initials, balance I.D., weight set ID, measurements, and specifications for the check weights are listed for each balance. Record each calibration verification measurement in the logbook. Entries into logbooks are to be performed in accordance with the SOP for *Making Entries Onto Analytical Records*.
- 10.3 The laboratory utilizes an external calibration service that is ISO 17025 accredited to perform primary calibration and re-certification of ovens housing an internal temperature recorder/display as part of its operational system. A copy of the external calibration service's scope of accreditation is on file in the QA department. For support equipment calibration and/or re-certification frequency, refer to the SOP *Support Equipment Monitoring and Calibration* (ADM-SEMC).

## 11) Procedure

- 11.1 Selections of sample volume - For clean samples, choose a sample volume of 200 mL. If during filtration of the initial volume, the filtration rate drops rapidly, or if filtration time exceeds 5 to 10 minutes, the sample volume should be decreased. A smaller sample volume may be used initially if it is apparently visible that the TSS concentration will be high. For samples associated with Wisconsin DNR regulations, a 500 mL sample must be used.

**Note:** Although very unusual, if a small volume is used that requires sample transfer by other means than a graduated cylinder, use a pipette. In this case, if suspended solids are present use a wide-bore pipette.

- 11.1.1 If pre-washed, dried and pre-weighed Accudisk™ filters are used, the filter weights may be scanned into the TSS benchsheet using the hand-held scanner.
- 11.1.2 The Accudisk™ filters are supplied in individual aluminum pans labeled with the weight of the filter. Scan the barcode on the side of the individual aluminum pan. The computer will record the individual pan number and the initial filter weight in the appropriate highlighted ██████ cell for the scanned information, and will populate cells for individual pan numbers and initial filter weights.
- 11.2 Assemble the filtering apparatus and begin suction. Wet the filter with a small volume of distilled water to seat it to fritted support.
- 11.3 Shake the sample vigorously and transfer the pre-determined sample volume selected to the filter using a graduated cylinder.
- 11.4 Filter the sample through the Accudisk™ filter (or by means of the alternative filtration method as described).
- 11.5 With suction on, wash the graduated cylinder, filter, non-filterable residue and filter funnel wall with three portions of distilled water allowing complete drainage between



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washing. Remove all traces of water by continuing to apply vacuum after water has passed through.

**Note:** Total volume of wash water used should equal approximately 30 mL.

- 11.6 Carefully remove the filter from the filter support. Dry overnight at 103-105°C. Cool in a desiccator and weigh.
- 11.7 Return the filters to the oven and dry at least one hour at 103-105°C. Cool in a desiccator and weigh. The weight must agree with the first weight, within 0.5 mg. Repeat cycle of drying, cooling, desiccating and weighing until the weight change is within 0.5 mg.
- 11.8 Instructions for 24 hour rush samples:
  - 11.8.1 Dry at least one hour at 103-105°C. Samples high in suspended solids may need a longer drying period.
  - 11.8.2 Cool in desiccator and weigh.
  - 11.8.3 Repeat cycle of drying, cooling, desiccating and weighing until the weight change is within 0.5 mg.
- 11.9 Record the balance I.D. used for all weightings on the bench sheet.
- 11.10 Alternative procedure when pre-washed and weighted filters are not in use.
- 11.11 Preparation of glass fiber filter disc - Place the disc on membrane filter apparatus. While vacuum is on, wash the disc with three successive 20 mL volumes of distilled water. Remove all traces of water by continuing to apply vacuum after water has passed through. Discard washings. Remove filter from the apparatus and place in a petri dish. Dry the filters in an oven at 103-105°C for one hour. Remove to a desiccator and cool for at least 30 minutes. Weigh immediately before use. Note: The filter should be handled with forceps at all times.

## 12) QA/QC Requirements

- 12.1 Ongoing QC Samples required are described in the ALS-Kelso Quality Assurance Manual and in the SOP for *Sample Batches* (ADM-BATCH). Additional QC Samples may be required in project specific quality assurance plans (QAPP). For example projects managed under the DOD ELAP must follow requirements defined in the DoD *Quality Systems Manual for Environmental Laboratories*. General QA requirements for DoD QSM are defined in the laboratory SOP, *Department of Defense Projects - Laboratory Practices and Project Management*. General QC requirements are:
  - 12.1.1 Prior to, and after each analysis batch, balance calibration verification (CCV) is performed using weights bracketing the sample weights. A system of documentation (logbook, benchsheet, etc.) must be established for recording the serial number of the Weight Set used for CCV verification.
  - 12.1.2 Prior to, and after each analytical batch, drying oven temperature check(s) and



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time(s) shall be recorded on the benchsheet.

#### 12.1.3 QC Samples Required:

12.1.3.1 Run a Laboratory Control Sample per analytical batch of 20 samples. Calculate the LCS recovery as follows:

$$\%R = X/TV \times 100$$

Where X = Concentration of the analyte recovered  
TV = True value of amount spiked

12.1.3.2 Run a Method Blank every ten samples.

12.1.3.3 Run one duplicate per batch of ten samples.

#### 12.2 Acceptance Criteria

12.2.1 Balance calibration verification measured weights must be  $\pm 0.5\%$  of the true value.

12.2.2 The Method Blank should be < MRL.

12.2.3 Duplicates should have an RPD  $\pm 5\%$ .

Calculate Relative Percent Difference (RPD) as:

$$\%RPD = \frac{|R1 - R2|}{(R1 + R2)/2} \times 100$$

Where R1= Higher Result  
R2= Lower Result

### 13) Data Reduction and Reporting

13.1 Calculate TSS as follows:

$$mg \text{ total suspended solids} / L = \frac{(A - B) \times 1000}{\text{sample volume, mL}}$$

Where: A = weight of dried residue + filter, mg  
B = weight of pre-washed filter, mg.

13.2 Data Review and Assessment

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13.2.1 Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the *SOP for Laboratory Data Review Process (ADM-DREV)* for details. The person responsible for final review of the data report and/or data package should assess the overall validity and quality of the results and provide any appropriate comments and information to the Project Manager for inclusion in the report narrative.

13.2.2 It is the analyst's responsibility to review analytical data to ensure that all quality control requirements have been met for each analytical run. Results for QC analyses are calculated and recorded as specified in this SOP. Average, RPD, spike level and spike recovery are entered on the analytical spreadsheet for corresponding samples. All data will be initialed, dated and attached to required data quality worksheet.

### 13.3 Reporting

13.3.1 Refer to the SOP for *Data Reporting and Report Generation (ADM-RG)* for reporting guidelines

13.3.2 The analyst enters data directly into ALSLIMS templates. An Analytical Results Summary is generated for that analytical batch showing all QC and sample results. After primary and secondary review, final reports are generated in ALSLIMS by compiling the SMO login, sample prep database, instrument date, and client-specified report requirements (when specified). The forms generated may be ALS standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.

13.3.3 Report in mg/L Total Suspended Solids using whole numbers.

13.3.4 The Method Reporting Limit is 5 mg/L for 200 mL samples and 2 mg/L for 500 mL samples.

13.3.5 The final report is reviewed by the department manager or designee.

## 14) Method Performance

14.1 This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional method performance data available.

## 15) Pollution Prevention and Waste Management

15.1 The laboratory will comply with all Federal, State, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS-Kelso Lab Waste Management Plan.

## 16) Corrective Actions for Out-of-Control Data or Unacceptable Data

16.1 Refer to the SOP for *Nonconformance and Corrective Action Procedures (ADM-NCAR)* for procedures for corrective action.

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16.2 Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

## 17) Training

17.1 All analysts performing this analysis are required to read and understand this SOP.

17.2 Training is documented following the *Employee Training and New Employee Orientation* (ADM-TRAIN).

17.3 It is required that an initial demonstration of capability and periodic analysis of laboratory reagent blanks, laboratory fortified blanks, and other QC solutions as a continuing check on performance.

## 18) Method Modifications

18.1 There are no known notifications in this laboratory standard operating procedure or from the referenced method.

## 19) References and Related Documents

19.1 Method 2540 D-2011, Standard Methods for the Examination of Water and Wastewater

19.2 Analytical Benchsheet: <R:\WET\ANALYSES\SOLIDS\TEMPLATE\TEMPLATES FOR SOLIDS>

19.3 DoD Quality Systems Manual for Environmental Laboratories, current version.

19.4 TNI Standard EL-V1-2009, Management and Technical Requirements for Laboratories Performing Environmental Analysis.

19.5 ISO/17025:2017 American National Standard, General Requirements for the Competence of Testing and Calibration Laboratories.

## 20) Summary of Changes

Revision Number	SOP Review	Document Editor	Description of Changes
14.0		T. Caron	Admin Changes only not affecting technical content. Documented date of annual SOP Review, updated SOP signatories; boiler plate standard paragraphs have been updated to reflect current practices. Section 19: Updated References.
14.0	J Coronado 2/18/2021		Reviewed and approved; no technical changes at this time.

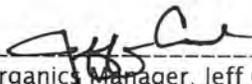
## 21) Attachments and Appendices

21.1 Not Applicable.

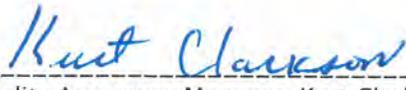


## Metals Digestion

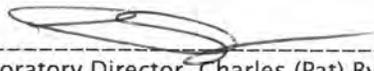
DOCUMENT ID: MET-3050B, REV. 18.0

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Approved By:   
Quality Assurance Manager, Kurt Clarkson

Date: 12/1/2020

Approved By:   
Laboratory Director, Charles (Pat) Byrne

Date: 12-1-20



## 1) Scope & Applicability

- 1.1 This procedure describes Method 3050B for acid digestion of sediments, sludges, and soil samples for analysis by ICP-OES (Methods 6010 and 200.7), and ICP-MS (Methods 200.8 and 6020). This procedure is not a total digestion technique, but extracts “environmentally available” elements from the sample of interest.
- 1.2 In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP specific requirements to the laboratory. In general, project specific QAPPs supersede method specified requirements. An example of this are projects falling under DOD ELAP. QC requirements defined in the SOP *Department of Defense Projects – Laboratory Practices and Project Management*, may supersede the requirements defined in this SOP.

## 2) Summary of Procedure

- 2.1 One-gram equivalent dry weight sediment, sludge, or soil samples are digested with repeated additions of nitric acid (HNO<sub>3</sub>) and hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>). Hydrochloric acid (HCl) is added to the initial digestate and the sample is refluxed prior to dilution to a final volume of 100 mL.

## 3) Definitions

- 3.1 For laboratory definitions applicable to most analyses, refer to the SOP for *Sample Batches*.

## 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.
- 4.2 It is the responsibility of the department supervisor/manager to document analyst training and method proficiency, as described in the *SOP Employee Training and Orientation*.

## 5) Interferences

- 5.1 Refer to the determinative method for a discussion of interferences.

## 6) Safety

- 6.1 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Kelso Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.
- 6.2 Hydrochloric and/or Nitric Acid are used in this method. These acids are extremely corrosive and care must be taken while handling them. A face shield should be used while pouring acids. And safety glasses should be worn while working with the solutions. Lab coat and gloves should always be worn while working with these solutions.



## 7) Sample Collection, Containers, Preservation, and Storage

- 7.1 Samples may be collected in plastic or glass jars. Non-aqueous samples are refrigerated at  $4 \pm 2^\circ\text{C}$  from receipt until analysis.
- 7.2 The recommended holding time is 6 months from the day of sampling.

## 8) Apparatus and Equipment

- 8.1 125 mL plastic cup beaker cup - Environmental Express®.
- 8.2 Plastic watch glasses - Environmental Express®.
- 8.3 Block Digester, calibrated to maintain  $95 \pm 2^\circ\text{C}$ .
- 8.4 Laboratory balance, top-loader capable of reading 0.01 g.
- 8.5 USS # 10 sieve.
- 8.6 Infrared Thermometer.

## 9) Standards, Reagents, and Consumable Materials

- 9.1 Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Refer to the SOP: *Reagent and Standards Login and Tracking*, for the complete procedure and documentation requirements.
- 9.2 All stocks, working solutions and sample dilutions should be prepared using deionized water (DI) conforming to ASTM Type I or ASTM Type II reagent water. For more information on reagent water generation, refer to the related SOP, Operation and Maintenance of Laboratory Reagent Water Systems.
- 9.3 Reagent water - ASTM Type I water (resistivity  $\geq 18 \text{ M}\Omega\text{-cm}$ , conductivity  $\leq 0.056 \text{ uS/cm}$ ).
- 9.4 Concentrated Nitric Acid - J.T. Baker "Instra-analyzed", Trace Metals Grade.
- 9.5 "Concentrated Hydrochloric Acid - J.T. Baker, "Baker Analyzed" ACS Reagent.
- 9.6 Hydrogen Peroxide (30%) - EMD GR ACS.
- 9.7 Standards
  - 9.7.1 Stock standards may be purchased from a number of vendors. All reference standards, where possible, must be traceable to SI units or NIST certified reference materials. The vendor assigned expiration date is used.
  - 9.7.2 Metals spiking solutions: Five spiking solutions are needed to prepare the matrix spike sample; SS1, SS2, SS3, SS4, and SS5.
  - 9.7.3 Follow the formulations laid out on the "Metals Spike Form. These solutions are prepared in acid rinsed Class A volumetric flasks using purchased custom mixed standards or 1000 ppm single analyte standards. Aliquots are made using acid rinsed Class A volumetric pipettes of the appropriate size.
  - 9.7.4 SS1 ( Al, Ag, Ba, Be, Cd, Co, Cr, Cu, Fe, Pb, Mn, Ni, Sb, V, and Zn): Fill a 1000 mL volumetric flask approximately half full with reagent water, add 50 mL of nitric acid and mix. Next add 100 mL of the custom mixed standard (CAS-CAL-14) purchased from "Inorganic Ventures". In addition add 50 mL of 1000 ppm



Antimony (use the Antimony standard that does not contain HCL.) Dilute to volume with reagent water, mix thoroughly and transfer to a 1000 mL Teflon bottle for storage. The solution expiration date is determined by the earliest expiration date of any single component in the solution.

- 9.7.5 SS2 (As, Cd, Cu, Pb, Se, Tl): Fill a 500 mL volumetric flask approximately half full with reagent water, add 25 mL of nitric acid and mix. Next add 2.0 mL each of 1000 ppm Arsenic, Cadmium, Copper, Lead, Selenium, and Thallium. Dilute to volume with reagent water, mix thoroughly and transfer to a 500 mL Teflon bottle for storage. The solution expiration date is determined by the earliest expiration date of any single component in the solution.
- 9.7.6 S3 (As, Se, Tl, and Hg): Fill a 500 mL volumetric flask approximately half full with reagent water, add 25 mL of nitric acid and mix. Next add 50 mL each of 1000 ppm Arsenic and Selenium. Next add 10 mL of 1000 ppm Thallium. Add 6.0 mL of 1000 ppm Hg. Dilute to volume with reagent water, mix thoroughly and transfer to a 500 mL Teflon bottle for storage. The solution expiration date is determined by the earliest expiration date of any single component in the solution.
- 9.7.7 SS4 (B, Mo,U): Fill a 500 mL volumetric flask approximately half full with reagent water, add 25 mL of nitric acid and mix. Next add 25 mL of 1000 ppm Boron, 50mL of 1000 ppm Molybdenum and 10 mL of 1000 ppm Uranium. Dilute to volume with reagent water, mix thoroughly and transfer to a 500 mL Teflon bottle for storage. The solution's expiration date is determined by the earliest expiration date of any single component in the solution.
- 9.7.8 SS5 (K, Na, Mg, Ca): Fill a 200 mL volumetric flask approximately half full with reagent water add 10.0 mL of nitric acid and mix. Next add 20 mL each of 10,000 ppm Potassium, Sodium, Magnesium and Calcium. Dilute to volume with reagent water, mix thoroughly and transfer to a 250 mL Teflon bottle for storage. The solution's expiration date is determined by the earliest expiration date of any single component in the solution.
- 9.8 Metals reference material (ERA Priority PollutnT/CLP Inorganic Soil) for use as the laboratory control sample. The expiration date is assigned by the manufacturer.
- 9.9 Teflon beads, Teflon boiling chips, or other suitable blank material.

## 10) Preventative Maintenance

- 10.1 All maintenance activities are recorded in a maintenance logbook kept for each instrument. Pertinent information (serial numbers, instrument I.D., etc.) must be in the logbook. This includes the routine maintenance described herein. The entry in the log must include: date of event, the initials of who performed the work, and a reference to analytical control.
- 10.2 Maintenance for this procedure is generally limited to glassware cleaning, pipette monitoring, and hot plate calibration. Procedures for glassware washing are described in the SOP for *Metals Laboratory Glassware Cleaning*. Procedures for pipette monitoring are given in the SOP *Checking Volumetric Labware*.
- 10.3 Each block digester is uniquely identified and the temperature is verified with each batch of samples. The temperature is turned to the 95°C setting and the block is allowed to come to temperature. The analyst will verify that the block gives a temperature of  $95 \pm 2^\circ\text{C}$  using a semi-annually-calibrated traceable handheld infrared



thermometer. If not at the right temperature, the thermostat is adjusted until the IR thermometer reads  $95 \pm 2^\circ\text{C}$ .

## 11) Procedure

- 11.1 Record all digestion and sample information on the applicable benchsheet.
- 11.2 Mix the sample thoroughly to achieve homogeneity. Sieve if necessary using a USS #10 sieve.
- 11.3 It can be difficult to obtain a representative sample with wet or damp materials. As per Method 3050B, wet samples may be dried, crushed, and ground to reduce subsample variability, however, drying is not recommended since drying may affect the extraction of the analytes of interest in the sample.
- 11.4 Weigh approximately 1 g of sample into a 125 mL plastic beaker cup and record the weight to the nearest 0.01 g. For sludge's and sediments that have high moisture content, use more sample. A plastic 10.0 mL disposable pipette is used to measure 10.0 mL of sample. The volume and weight of the pipetted sample is recorded. In cases where the sludge is very thick a 10.0 mL graduated cylinder may be used. The objective is to use about 1 g of dry weight sample. This will achieve a lower detection limit needed for most projects. At this point add the appropriate spiking solutions directly onto the designated spike sample prior to addition of reagents.
- 11.5 Add 5ml reagent water and 5ml concentrated  $\text{HNO}_3$ . Place in a hot block, cover and reflux (without boiling) at  $95^\circ\text{C}$  for 10 to 15 minutes. Allow the sample to cool. Add 5ml of concentrated  $\text{HNO}_3$ , cover and reflux for 30 minutes. If brown fumes are generated, indicating oxidation of the sample by  $\text{HNO}_3$ , repeat the addition of 5ml of  $\text{HNO}_3$  and reflux over and over until no brown fumes are given off. Digest for 45 minutes or until the Brown fumes have ceased.  

<sup>1</sup>Note: The  $95^\circ\text{C}$  hot block temperature must be monitored and documented on a per batch basis.

<sup>2</sup>Note: All Wisconsin samples must digest for 2 hours after generation of brown fumes has ceased.

<sup>3</sup>Note: Wipe samples do not require the final two hour digestion.
- 11.6 Cool the sample and add 3 mL of 30%  $\text{H}_2\text{O}_2$ . Cover and heat to start the peroxide reaction. Care must be taken to ensure that losses do not occur due to excessive effervescence. Heat in the hot block until effervescence subsides. Remove from hot block and cool the beaker.
- 11.7 Continue to add 30%  $\text{H}_2\text{O}_2$  in 3 mL aliquots with warming until the effervescence is minimal, or until the general sample appearance is unchanged. Do not add more than 10 mL of 30%  $\text{H}_2\text{O}_2$ . When the peroxide additions are complete cover the sample with a watch glass and continue heating the acid-peroxide digestate until the volume has been reduced to approximately 5-10 mL or heat at  $95 \pm 2^\circ\text{C}$  without boiling for 2 hours. Do not let the samples go to dryness, by ensuring the solution covers the bottom of the vessel at all times.
  - 11.7.1 Add 10 mL of concentrated HCl. Cover and reflux for 15 minutes at  $95 \pm 2^\circ\text{C}$ . After cooling, the samples may be diluted to 100 mL with ASTM Type I reagent water (resistivity  $>18 \text{ M}\Omega\text{-cm}$ , conductivity  $<0.056 \text{ uS/cm}$ ) in a 125 mL plastic beaker cup.



- 11.8 Particulates in the digestates that may clog the nebulizer are allowed to settle overnight, or the digestates may be centrifuged.
- 11.9 To improve the solubility for Antimony, Barium, Lead and Silver, the following modification of the digestion procedure may be used as directed by the client or project manager.
- 11.10 Weigh (to the nearest 0.01 g) 1.00 g of sample into a 125 mL plastic cup. For sludges and sediments that have high moisture content, use more sample. The objective is to use about 1 g of dry weight sample.
- 11.11 Add 2.5 mL HNO<sub>3</sub> and 10 mL HCl and cover with a watch glass. Reflux for 15 minutes.
- 11.12 Filter the digestate through Whatman No. 41 or equivalent filter paper and collect in a 100 mL volumetric flask. Wash the filter paper, while still in the funnel, with no more than 5 mL of hot (95°C) HCl, and then with 20 mL of hot (95°C) reagent water. Collect washing in the same volumetric flask.
  - 11.12.1 Remove the filter and residue from the funnel, and place them back in the beaker. Add 5 mL HCl, cover and heat at 95 ± 5°C until the filter paper dissolves. Remove from the heat and wash the cover and sides with reagent water.
  - 11.12.2 Filter the residue and collect the filtrate in the same 100 mL flask. Allow to cool, then dilute to volume.
  - 11.12.3 If precipitation occurs in the flask upon cooling, do not dilute to volume. Instead, add up to 10 mL of HCl to dissolve the precipitate. After precipitate is dissolved, dilute to volume with water.

## 12) QA/QC Requirements

- 12.1 Initial Precision and Recovery Validation
  - 12.1.1 The accuracy and precision of the procedure must be validated before analyses of samples begin, or whenever significant changes to the procedures have been made. To do this, four blank matrix samples are spiked with the LCS spike solution, then prepared and analyzed.
- 12.2 Monitor Hot Blocks and Hotplates on a per batch basis. Report all deficiencies to the Lab Manager. Corrective action must be taken.
- 12.3 Digest one laboratory control sample with each batch. Weigh 1.00 g of the current lot of Environmental Resource Associates PriorityPollutant/CLP Inorganic Soil prepared reference material into a 150 mL beaker and digest as per the procedure.
- 12.4 Digest one preparation blank (method blank) per digestion batch, or per 20 samples whichever is more frequent. For the method blank, use Teflon beads, Teflon boiling chips, or other suitable solid blank material and follow the digestion procedures.
- 12.5 Digest one duplicate and one spiked sample with each sample matrix. Prepare one duplicate and spike sample per each digestion batch, or per twenty samples whichever is more frequent. At times, specific samples will be assigned as duplicates of spikes depending on client requirements.
- 12.6 Soil spikes for ICP and ICP-MS are prepared by adding 2.0 mL of SS1, and 1.0 mL of SS3, SS4 and SS5 directly to the sample aliquot, prior to the addition of any water or acid. Fill out a spiking data sheet and keep it with the digestion data sheets.



### 13) Data Reduction and Reporting

- 13.1 Digestion data sheets including weights and volumes used and reagents/acids are completed and a prep run number or batch lot number is assigned and attached to the data sheet. The lot numbers for the reagents used are added to the digestion data sheet.
- 13.2 Spiking sheets are included.
- 13.3 Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the SOP for *Laboratory Data Review Process* (ADM-DREV) for details. The person responsible for final review of the data report and/or data package should assess the overall validity and quality of the results and provide any appropriate comments and information to the Project Manager to inclusion in the report narrative.
  - 13.3.1 It is the analyst's responsibility to review analytical data to ensure that all quality control requirements have been met for each analytical run. Results for QC analyses are calculated and recorded as specified in this SOP. Average, RPD, spike level and spike recovery are entered on the analytical spreadsheet for corresponding samples. All data will be initialed, dated and attached to required data quality worksheet.

### 14) Contingencies for Handling Out-of-Control or Unacceptable Data

- 14.1 Refer to the SOP for *Nonconformance and Corrective Action Procedures* for corrective action.
- 14.2 Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

### 15) Method Performance

- 15.1 Available method performance data is given in the reference method. In addition, this procedure was validated through single laboratory studies of accuracy and precision as in the determinative procedure. The method detection limit(s) and method reporting limit(s) are established for the determinative procedure. See *Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Quantitation*.

### 16) Pollution Prevention and Waste Management

- 16.1 It is the laboratory's practice to minimize the amount of solvents, acids and reagent used to perform this method wherever feasible. Standards are prepared in volumes consistent with methodology and only the amount needed for routine laboratory use is kept on site. The threat to the environment from solvent and reagents used in this method can be minimized when recycled or disposed of properly.
- 16.2 The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Lab Waste Management Plan.
- 16.3 This method uses acid. Waste acid is hazardous to the sewer system and to the environment. All acid waste must be neutralized prior to disposal down the drain. The neutralization step is considered hazardous waste treatment and must be documented on the treatment by generator record. See the ALS Chemical Hygiene Plan for details.



### 17) Training

- 17.1 All analysts performing this analysis are required to read and understand this SOP. Training is documented following the *Employee Training and New Employee Orientation* (ADM-TRAIN).

### 18) Method Modifications

- 18.1 The method uses 2 mL of water and 3 mL of H<sub>2</sub>O<sub>2</sub>. The lab does not add the 2 mL of water. 3.0 mL aliquots of 30% H<sub>2</sub>O<sub>2</sub> in lieu of 1.0 mL aliquots are added subsequently.

### 19) References

- 19.1 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. EPA SW-846, 3rd Edition, Final Update III, Method 3050B, December 1996.
- 19.2 DoD Quality Systems Manual for Environmental Laboratories current version.
- 19.3 TNI Standard, Volume 1- 2009.
- 19.4 METALS SPIKING SOLUTIONS CONCENTRATIONS FORM: [R:\ICP\MISC\DIGFORMS\SpikeForms\SPKFORM\\_CURRENT.xls](R:\ICP\MISC\DIGFORMS\SpikeForms\SPKFORM_CURRENT.xls).
- 19.5 ISO/IEC 17025: 2017 American National Standard, General requirements for the competence of testing and calibration laboratories.

### 20) Changes Since Last Revision

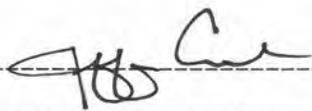
Summary of Revision Changes			
Revision Number	Effective Date	Document Editor	Description of Changes
18.0	12/4/2020	T CARON	Updated SOP signatories. Section: Updated equipment to reflect current procedure. Section 10 & 11: Added the use of an infrared thermometer to verify hot block operating temperature. :



## DETERMINATION OF METALS AND TRACE ELEMENTS BY INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETRY

DOCUMENT ID: MET-6020, REV 19.0

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Date: 12/2/2020

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Date: 12/2/20

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## 1) Scope & Applicability

- 1.1 This procedure is used to determine the concentrations of certain elements in water, soil, tissues, aqueous and non-aqueous wastes, and sediment samples using EPA Method 6020B. The Kelso DQO table indicates analytes that are typically determined by this procedure and lists the standard Method Reporting Limits (MRLs) for each analyte in water and soil. Project-specific MRLs may apply, and if lower than standard MRLs, it is demonstrated through method detection limit determinations and analysis of MRL standards that the MRL is achievable. Method Detection Limits are referenced in the laboratory DQO tables and may change as new studies are performed.
- 1.2 The complexity of the technique generally requires outside study of appropriate literature as well as specialized training by a qualified spectroscopist. The scope of this document does not allow for the in-depth descriptions of the relevant spectroscopic principles required for gaining a complete level of competence in this scientific discipline.
- 1.3 In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPP's supersede method specified requirements. An example of this are projects falling under DoD ELAP. QC requirements defined in the SOP *Department of Defense Projects – Laboratory Practices and Project Management* (ADM-DOD5) may supersede the requirements defined in this SOP.

## 2) Summary of Procedure

- 2.1 Prior to analysis, samples must be digested using appropriate sample preparation methods. The digestate is analyzed for the elements of interest using ICP-mass spectrometry (ICP-MS).
- 2.2 Methods 6020B describe the multi-elemental determination of analytes by ICP-MS. The method measures ions produced by a radio-frequency inductively coupled plasma. Analyte species originating in a liquid are nebulized and the resulting aerosol transported by argon gas into the plasma torch. The ions produced are entrained in the plasma gas and introduced, by means of an interface, into a mass spectrometer. The ions produced in the plasma are sorted according to their mass-to-charge ratios and quantified with a channel electron multiplier. Interferences must be assessed and valid corrections applied or the data flagged to indicate problems. Interference correction must include compensation for background ions contributed by the plasma gas, reagents, and constituents of the sample matrix.

## 3) Definitions

- 3.1 For environmental laboratory quality definitions, guidance on analytical calibration and sample batches, refer to the SOP for Sample Batches, ADM-BATCH.

## 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP

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and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.

- 4.2 It is the responsibility of the department supervisor/manager to document analyst training and method proficiency, as described in the ALS-Kelso *SOP for Training Procedure* (ADM-TRAIN).

## 5) Interferences

- 5.1 Isobaric elemental interferences in ICP-MS are caused by isotopes of different elements forming atomic ions with the same nominal mass-to-charge ratio (m/z). A data system must be used to correct for these interferences. This involves determining the signal for another isotope of the interfering element and subtracting the appropriate signal from the analyte isotope signal. Attention should be given to circumstances where very high ion currents at adjacent masses may contribute to ion signals at the mass of interest. Matrices exhibiting a significant problem of this type may require resolution improvement, matrix separation, or analysis using another isotope.
- 5.2 Isobaric molecular and doubly-charged ion interferences in ICP-MS are caused by ions consisting of more than one atom or charge, respectively. Most isobaric interferences that could affect ICP-MS determinations have been identified in the literature. Refer to Method 6020B for further discussion.

## 6) Safety

- 6.1 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.
- 6.2 Nitric Acid and Hydrochloric Acid is used in this method. These acids are extremely corrosive and care must be taken while handling them. A face shield, safety goggles, lab coat and gloves must be used while pouring acids. When working with solutions less than 20%, then a lab coat, goggles and gloves must always be worn.
- 6.3 High Voltage - The RF generator supplies up to 2000 watts to maintain an ICP. The power is transferred through the load coil located in the torch box. Contact with the load coil while generator is in operation will likely result in death. When performing maintenance on the RF generator, appropriate grounding of all HV capacitors must be performed as per manufacturer.
- 6.4 UV Light - The plasma is an intense source of UV emission, and must not be viewed with the naked eye. Protective lenses are in place on the instrument. Glasses with special protective lenses are available when direct viewing of the plasma is necessary.

## 7) Sample Collection, Containers, Preservation, and Storage

- 7.1 Aqueous samples are typically collected in plastic containers. Aqueous samples are preserved with nitric acid (pH<2), then stored at room temperature from

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receipt until digestion. Soil or solid samples may be collected in plastic or glass jars. Non-aqueous samples are refrigerated at  $4 \pm 2^{\circ}\text{C}$  from receipt until digestion.

- 7.2 Samples are prepared via procedures in SOPs MET-DIG, MET-3020A, MET-3050, MET-3051M, MET-3052M, or MET-TDIG depending on matrix and project specifications.
- 7.3 Digestates are stored in the appropriate containers. Following analysis, digestates are stored until all results have been reviewed. Digestates are neutralized prior to disposal through the sewer system, 2 weeks after data is reviewed.

## 8) Standards, Reagents, and Consumable Materials

- 8.1 All standards are prepared from NIST traceable standards. The expiration dates are assigned according to the EPA method and the vendor's assigned expiration dates.

- 8.1.1 1000 ppm Single Element Stock Standard Solutions: Each stock standard is stored at room temperature on shelves located in room 113 of the metals lab. The manufacturer, lot number, and expiration date of each stock standard is recorded in a bound logbook also located in room 113. Additionally each stock standard is given a unique, identifying name.

- 8.1.2 Intermediate Standard Solutions: Intermediate mixed stock solutions are made from the individual stock standards described above. The individual component of each mixed solution is recorded in a bound logbook located in the ICP-MS laboratory and mixed solution is given a unique, identifying name. The expiration date for the intermediate standard is the earlier of any one of its stock components.

- 8.1.3 Calibration Standards: Calibration standards are made fresh daily from the intermediate standard solutions. Each individual intermediate standard used in the calibration standard is recorded in a bound logbook located in the ICP-MS laboratory, and the calibration standard solution is given a unique, identifying name. The calibration standards unique name is used on the raw data to link the data to the subsequent prepared standards and ultimately the original purchased stock standard.

- 8.2 Standards Preparation

- 8.2.1 Expiration of all standard solutions defaults to the earliest expiration date of an individual component unless otherwise specified.

- 8.2.2 Calibration Standards

The calibration standard is prepared from two intermediate stock solutions. These solutions are prepared in acid rinsed 1000 mL Class A volumetric flasks following the formulations laid out on the attached example standard sheet (see Attachments). The working calibration standard is made daily by aliquoting 2.5 mL of each of the intermediate solutions in to a 100 mL Class A volumetric flask and diluting to volume with DI water and the appropriate acid(s). This standard is also used as

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the Continuing Calibration Verification (CCV).

### 8.2.3 Initial Calibration Verification (ICV)

8.2.3.1 The ICV intermediate stock solution is prepared in an acid rinsed 100 mL Class A volumetric flask. The solution is prepared by adding 2.0 mL of Inorganic Ventures QCP-CICV-1, 1.0 mL of QCP-CICV-3, 0.5 mL of 1000 ppm Boron, Bismuth, Molybdenum, Strontium, Titanium, and Uranium stock solutions, 0.25 mL of 1000 ppm Antimony stock solution and diluting to volume with the appropriate acid matrix.

8.2.3.2 The working ICV solution is prepared by aliquoting 0.5 mL of the mixed ICV intermediate solution and 0.25 mL of 10 ppm Tin standard into an acid rinsed 100 mL Class A volumetric flask and diluting to volume with the appropriate acid matrix.

**NOTE:** The ICV solution is not at the midpoint of the linear range which may be as high as 1000 µg/L for some elements. The ICV solution used is a premixed standard purchased from Inorganic Ventures and contains the elements of interest between 2.5 and 100 µg/L. This solution provides calibration confirmation at more representative levels, given that most ICP-MS analyses are quantifying analytes in the low-ppb to sub-ppb range.

### 8.2.4 Interference Check Solutions (ICSA and ICSAB)

8.2.4.1 The ICSA is prepared in an acid rinsed 50 mL Class B volumetric flask by aliquoting 1.0 mL of Elements ICSAm (CS-CAK02) and 0.250 mL of 10 ppm molybdenum solutions and diluting to volume with the appropriate acid matrix.

8.2.4.2 The ICSAB is prepared in an acid rinsed 50 mL Class B volumetric flask by aliquoting 1.0 mL of Elements ICSAm (CS-CAK02), 0.125 mL of Inorganic Ventures 6020ICS-9B, and 0.250 mL of 10 ppm Molybdenum solutions and diluting to volume with the appropriate acid matrix.

8.2.5 Post-digestion spikes are performed by adding appropriate amounts of the calibration intermediate solutions to aliquots of the sample digestate. The volumes of each standard used vary based on the native concentrations found in the field samples. Refer to the post-digestion spike in Section 12 for details.

8.2.6 Refer to the appropriate digestion SOP for details of LCSW and matrix spike solution composition and preparation.

### 8.2.7 Tuning / Mass Calibration Solution

8.2.7.1 A 1 ppm intermediate solution containing Be, Bi, Ce, Co, In, Li, Pb, Mg, and U is prepared by adding 1.0 mL of each from 1000

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ppm stock standards to an acid rinsed 1000 mL volumetric flask and diluting to volume with 1% nitric acid. The expiration date for the intermediate solution is the earlier of any one of its stock components.

8.2.7.2 The working solution is prepared in depending upon the instrument:

- For the Agilent: a 10 ppb tune/mass calibration solution is prepared by adding 10 mL of intermediate solution to an acid rinsed 1000 mL volumetric flask and diluting to volume with the appropriate acid matrix.
- For the NexION (K-ICP-MS-04) instrument a 2.0 ppb tune/mass calibration solution is prepared by adding 2.0 mL of intermediate solution to an acid rinsed 1000 mL volumetric flask and diluting to volume with the appropriate acid matrix.

The expiration date for this solution is taken from the intermediate stock above.

8.3 Internal Standards Stock Solution – Prepare solutions by adding appropriate amounts of each 1000 ppm single element stock solution to an acid rinsed 1000 mL volumetric flask and diluting to volume with 1% nitric. The internal standard solution is teed in by the peristaltic pump and used for the entire analytical sequence. The typical solutions are:

- Agilent Instrument: 1 ppm, Sc, Y, Ge, Ce, Tm, In, Lu, Th; 0.2 ppm <sup>6</sup>Li.
- NexION instrument: 30 ppb In, Tm, Lu, Th; 60 ppb <sup>6</sup>Li, Rh, Au; 75 ppb Sc; 100 ppb Ga, Y; 500 ppb Ge.

8.4 Additional Reagents

8.4.1 Reagent water, ASTM Type II.

8.4.2 All stocks, working solutions and sample dilutions should be prepared using deionized water (DI) conforming to ASTM Type I or ASTM Type II reagent water. For more information on reagent water generation, refer to the related SOP, Operation and Maintenance of Laboratory Reagent Water Systems.

8.4.3 “OmniTrace Ultra” Concentrated Nitric Acid (EM Science # NX0408-2).

8.4.4 Argon (Airgas Industrial Grade – 99.999% pure, bulk delivered).

## 9) Apparatus and Equipment

9.1 ICP/MS Instruments

9.1.1 Instrument: NexION 300D  
Nebulizer: PFA-ST Microflow  
Spray Chamber: Cyclonic, Peltier-cooled  
Cones: Nickel Sampler (1.0 mm orifice)

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Nickel Skimmer (0.75 mm orifice)

9.1.2 Instrument: Agilent 7700  
Nebulizer: MicroMist  
Spray Chamber: Double Pass quartz spray chamber  
Cones: Nickel Sampler (1.0 mm orifice)  
Nickel Skimmer (0.75 mm orifice)

9.1.3 Instrument: Agilent 7800  
Nebulizer: MicroMist  
Spray Chamber: Cyclonic, Peltier-cooled  
Cones: Nickel Sampler (1.0 mm orifice)  
Nickel Skimmer (0.75 mm orifice)

## 10) Preventative Maintenance

10.1 All maintenance is documented in the instrument logbook. ALS/Kelso maintains a service contract with the instrument manufacturer that allows for an unlimited number of service calls and full reimbursement of all parts and labor.

10.2 Most routine maintenance and troubleshooting is performed by ALS staff. Preventive maintenance activities listed below should be performed when needed as determined by instrument performance (i.e. stability, sensitivity, etc.) or by visual inspection. Other maintenance or repairs may, or may not require factory service, depending on the nature of the task.

- cone removal and cleaning
- removal and cleaning of ICP glassware and fittings
- checking and cleaning RF contact strips
- checking air filters and cleaning if necessary
- checking the oil mist filters and cleaning if necessary
- checking the rotary pump oil and adding or changing if necessary
- removal and cleaning of extraction lens
- removal and cleaning of ion lens stack
- replace the electron multiplier as necessary

## 11) Procedure

11.1 Refer to method 6020B and the instrument manuals for detailed instruction on implementation of the following daily procedures preceding an analytical run.

11.2 The following parameters are monitored to assure awareness of changes in the instrumentation that serve as signals that optimum performance is not being achieved, or as indicators of the physical condition of certain consumable components (i.e. EMT and cones).

11.2.1 Multiplier Voltages

11.2.2 Gas Flows - Coolant Ar

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11.2.3 The nebulizer and auxiliary flows are adjusted later as part of the optimizing procedure.

### 11.3 Optimization

#### 11.3.1 Gas Flows

11.3.1.1 Allow a period of not less than 30 minutes for the instrument to warm up.

11.3.1.2 Aspirate a mixed tune solution into the plasma and monitor the instrument output signal at mass 115 on the rate meter. Adjust the nebulizer and auxiliary flows to obtain maximum signal. Adjust the tension screw on the peristaltic pump to obtain minimum noise in the analytical signal. Record flow rates and note any large variances.

Note: Significant differences in flow rates will be observed for different torches and cones.

#### 11.3.2 Tuning

11.3.2.1 Ion Lens Setting - While monitoring the output signal of a mixed tune solution at mass 115 on the rate meter, adjust the ion lenses to obtain maximum sensitivity. Refer to the instrument manual for details on performing the adjustments.

11.3.2.2 Mass Calibration - Aspirate the tune / mass calibration solution described in section 8.2.7.2 and perform the mass calibration using the instrument's Mass Calibration program. (Refer to the instrument manual for details pertaining to the mass calibration procedure.) The acceptance criteria for the mass calibration is  $<0.1$  amu from the true value. If the mass calibration fails criteria re-tune the instrument and perform the mass calibration procedure again.

11.3.2.3 Resolution Check - Using the spectra created during the mass calibration procedure; perform the resolution check to assure the resolution is less than 0.9 AMU at 5% peak height. If the resolution does not pass criteria adjust the instrument's resolution settings, run a new scan of the mass calibration solution and recheck.

11.3.2.4 Stability Check - Using the tune / mass calibration solution, perform a short-term stability check as per EPA Method 6020B. The relative standard deviations of five scans for each element in the tune solution must be  $< 5\%$ . If the test does not pass criteria determine the cause (i.e. dirty cones, improper tune, etc.) correct the problem and re-run the test.

### 11.4 Analytical Run



11.4.1 Calibrate the instrument using a calibration blank (Standard 0), composed of reagent water, the appropriate acid matrix, and the working calibration standard (8.2.2). The masses typically monitored and those used for quantification are listed in Table 2. These masses are set as defaults in the instrument's analytical procedures. To begin select the correct method. Nebulize Standard 0 (Blank) into the plasma. Allow 1-2 minutes for system to equilibrate prior to establishing baseline. Follow directions on computer screen to perform standardization. Nebulize the working calibration standard into the plasma. The operator must sign and date the first page of standardization.

11.4.2 After the first CCB and before the ICS standards a LLCCV standard, at or below the LOQ, is analyzed. The LLCCV must recover between  $\pm 20\%$ .

11.4.3 Perform the analysis in the order listed below.

Initial Calibration Verification (ICV)  
Continuing Calibration Verification (CCV)  
Initial Calibration Blank (ICB)  
Continuing Calibration Blank (CCB)  
LLCCV  
ICSA  
ICSAB  
Analyze 10 Samples  
CCV  
CCB  
Analyze 10 Samples  
CCV  
CCB

Repeat sequence as required to complete analytical run, analyzing CCVs/CCBs every 10 analyses and at the end of the run.

11.4.4 Water samples with silver concentrations greater than 100 ug/L require confirmation from the original sample container to ensure silver has not been lost through precipitation in the digestate.

## 12) QA/QC Requirements

### 12.1 Initial Precision and Recovery Validation

12.1.1 The accuracy and precision of the procedure must be validated before analysis of samples begins, or whenever significant changes to the procedures have been made. To do this, four LCS aliquots are prepared and analyzed. The average percent recovery of for each analyte must be 85-115% (for water, and within the LCS limits for soils) and the RSD <20%.

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## 12.2 Method Detection Limits

12.2.1 A method detection limit (MDL) study must be undertaken before analysis of samples can begin. Refer to *Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Quantification* (ADM-MDL) for details of performing the MDL study.

12.2.2 Calculate the average concentration found (x) and the standard deviation of the concentrations for each analyte. Calculate the MDL for each analyte using the correct T value for the number of replicates. MDL's must be verified annually or whenever there is a significant change in the background or instrument response.

12.3 The LLQC is verified initially by the analysis of at least 7 replicate samples, spiked at the LLOQ. In most cases, the mean recovery should be  $\pm 35\%$  of the true value and the RSD should be  $< 20\%$ .

12.4 IDLs should be determined at least once using new equipment, or after major instrument maintenance. The IDL is determined as the mean of the blank results + three times the standard deviation of 10 replicate analyses of the reagent blank solution.

12.5 Method 6020B requires that the linear range for each wavelength be verified on a daily basis. The linear range verification must recover within 10% of the true value and can be analyzed anywhere within a particular run. If a linear range verification is not analyzed for a specific element, the highest calibration range becomes the linear range. All reporting sample measurements must fall within the linear range.

12.6 The Initial Calibration Verification (ICV) standard is analyzed immediately after calibration. The results of the ICV must agree within  $\pm 10\%$  of the expected value. If the control limits are exceeded, the problem will be identified and the instrument recalibrated.

12.7 A Continuing Calibration Verification (CCV) is analyzed after calibration then every 10 samples thereafter with a final CCV closing the final samples of the analytical run.

12.7.1 The results of the CCV must agree within  $\pm 10\%$  of the expected value.

12.7.2 If the control limits are exceeded, the problem will be identified and corrective action taken. The instrument recalibrated. The previous 10 samples must be reanalyzed.

12.8 A Continuing Calibration Blank (CCB) is analyzed after calibration then every 10 samples thereafter with a final CCB closing the final samples of the analytical run.

12.8.1 The CCB measured values must be less than the MRL / LOQ for each element for standard applications. Other project-specific criteria may apply (for DoD QSM projects CCB can have no analytes  $>$  the LOD).



- 12.9 The ICSA and ICSAB solutions are analyzed after calibration and before any field samples. The solutions are then reanalyzed every 12 hours. Results of the ICSA are used by the analyst to identify the impact of potential interferences on the quality of the data. Based on these results appropriate action should be taken when interferences are suspected in a field sample including, but not limited to, selecting an alternative isotope for quantification, manual correction of the data, elevating the MRL, selection of an alternative method (e.g. optical ICP) or flagging the result as estimated when no other action is possible. Results for the spiked analytes in the ICSAB solution must agree with  $\pm 20\%$  of the expected value.

#### INTERFERENCE CHECK SAMPLE COMPONENTS AND CONCENTRATIONS

	<u>Solution A</u> <u>Concentrations (mg/L)</u>	<u>Solution B</u> <u>Concentrations (mg/L)</u>
Al	20.0	20.0
Ca	60.0	60.0
Fe	50.0	50.0
Mg	20.0	20.0
Na	50.0	50.0
P	20.0	20.0
K	20.0	20.0
S	20.0	20.0
C	40.0	40.0
Cl	424	424
Mo	0.05	0.05
Ti	0.40	0.40
As	0.0	0.025
Cd	0.0	0.025
Cr	0.0	0.050
Co	0.0	0.050
Cu	0.0	0.050
Mn	0.0	0.050
Ni	0.0	0.050
Se	0.0	0.025
Ag	0.0	0.0125
V	0.0	0.050
Zn	0.0	0.025

**NOTE:** The concentration of interfering elements in the ICSA and ICSAB solutions are spiked at levels 5 times lower than recommended in Table 1 of Method 6020B. Running the full strength solutions as described in 6020B introduces too much material approximately 0.35 % dissolved solids into the ICP-MS system when trying to conduct low level analysis. Since the ICP-MS instrumentation is able to handle a maximum of 0.2% solids, the 6020B ICSA solution is higher in interfering components than any sample that would run through the instrument. However, the ICS solutions will be analyzed at levels that will provide approximately 0.1% dissolved solids.

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- 12.10 Internal standards are used to correct for physical interferences. Masses used as internal standards include;  $^{71}\text{Ga}$ ,  $^{72}\text{Ge}$ ,  $^{115}\text{In}$ ,  $^6\text{Li}$ ,  $^{175}\text{Lu}$ ,  $^{103}\text{Rh}$ ,  $^{45}\text{Sc}$ ,  $^{232}\text{Th}$ , and  $^{89}\text{Y}$ . These internal standards are used in combination to cover the appropriate mass ranges. Internal standard correction is applied to the analytical isotopes by direct correlation of analyte to IS (Agilent), (NexION). This function is performed in real-time by the instruments operating system. Internal standards must be run within 50 AMU of the masses that are analyzed. Internal standard recoveries must fall between 30% and 125%. If not, then the sample must be reanalyzed after a fivefold or greater dilution has been performed.
- 12.11 A method blank is digested and analyzed with every batch of 20 (or fewer) samples to demonstrate that there are no method interferences. If the method blank shows any hits above the MRL for standard applications, or  $> \frac{1}{2}$  the LOQ for DoD projects or  $> 1/10$  the sample result, corrective action must be taken. The MB can only be rerun once. Corrective action includes recalculation, reanalysis, system cleaning, or re-extraction and re-analysis,
- 12.12 Laboratory Control Samples are analyzed at a frequency of 5% or one per batch, whichever is greater. Refer to the current ALS-Kelso DQO spreadsheets for the LCS limits. For method 6020B, the LCS recovery limits are 80-120%. If statistical in-house limits are used, they must fall within the 80-120% range. Project, QAPP, or client-specific control limits may supersede the limits listed, but laboratory limits should be consistent with specified limits in order to establish that the specified limits can be achieved. If the control limits are exceeded, the associated batch of samples will be re-digested and reanalyzed.
- 12.13 A duplicate is digested one per batch, or per 20 samples (i.e. 5%). The duplicate RPD limits is  $\leq 20\%$ . Project, QAPP, or client-specific control limits may supersede the limits listed. If the control limits are exceeded, the samples will be re-digested and reanalyzed, unless sample non-homogeneity is established as the cause. In these instances, the data and the report will be flagged accordingly.
- 12.14 A Matrix Spike sample is digested one per batch, or per 20 samples (i.e. 5%). Default spike concentrations are listed in the sample digestion SOPs. Spike concentrations may be adjusted to meet project requirements. The matrix spike recovery will be calculated while the job is in progress. Where specified by project requirements, a matrix spike duplicate may be required. Matrix spike recovery criteria are derived from lab data. For Method 6020B, the recovery limits are 75-125%. If statistical in-house limits are used, they must fall within the 75-125% range. In some cases, project-specific QC limits may be required. Unless specified otherwise, for DoD QSM projects the project LCS criteria will be used for evaluation of matrix spikes. If an analyte recovery is outside acceptance limits proceed with the additional quality control tests described in sections 12.13 and 12.14. Based on results of these tests, the physical nature of the sample (e.g. homogeneity), and any specific project requirements, a determination can then be made as to appropriate corrective action (e.g. re-digestion, reporting with a qualifier, alternative methodologies, etc.). If the analyte concentration is  $> 4x$  the spike level the spike control limit is no longer applicable and no action is required. For specifics on the preparation and composition of matrix spike solutions refer to the appropriate digestion SOP.



**Note:** For DoD projects a MS/MSD is required with every extraction batch. The %RSD should be < 20%.

- 12.15 Post Digestion Spike Test: The post digestion spike test is performed whenever matrix spike or replicate criteria are exceeded. An analyte spike is added to a portion of a prepared sample, or its dilution, and should be recovered to within 75% to 125% of the known value. If this spike fails, then the dilution test should be run on this sample. If both the matrix spike and the post digestion spike fail, then matrix effects are confirmed. For DOD QSM 5.0 the post digestion spike shall be recovered to within 80-120% of the known value.
- 12.16 Dilution Test: The dilution test is performed whenever matrix spike or replicate criteria and post digestion spike criteria are exceeded. For sample concentrations that are sufficiently high (minimally, a factor of 25 times greater than the LOQ), the analysis of a fivefold (1+4) dilution must agree within  $\pm 20\%$  of the original determination. If the dilution test fails then a chemical or physical effect should be suspected. Corrective action can include additional dilution of the sample, the use of alternate methodologies, etc. or the data can be flagged and reported. The exact course of action will be dependent on the nature of the samples and project requirements and should be discussed with the project manager.
- 12.17 Instrument blanks should be evaluated for potential carryover and rinse times need to bring the analyte signal to within the CCB criteria. Results from instrument blanks run after standards or control samples should be used to establish levels at which carryover in samples may occur. Samples exhibiting similar effects of carryover should be reanalyzed.

### 13) Data Reduction and Reporting

#### 13.1 Calculations

13.1.1 Calculate sample results using the data system printouts and digestion information. The digestion and dilution information is entered into the data system. The data system then uses the calculations below to generate a sample result.

13.1.2 Aqueous samples are reported in  $\mu\text{g/L}$ :

$$\mu\text{g/L (Sample)} = C^* \times \text{Digestion Dilution Factor} \times \text{Post Digestion Dilution Factor.}$$

$C^*$ = Concentration of analyte as measured at the instrument in  $\mu\text{g/L}$  (in digestate).

13.1.3 Solid samples are reported in  $\text{mg/Kg}$ :

$$\text{mg/Kg (Sample)} = C^* \times \text{Post Digestion Dilution Factor} \times \frac{\text{Digestion Vol. (ml)}}{\text{Sample wt. (g)}} \times \frac{1\text{mg}}{1000\mu\text{g}} \times \frac{1\text{L}}{1000\text{ml}} \times \frac{1000\text{g}}{1\text{Kg}}$$

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C\*= Concentration of analyte as measured at the instrument in µg/L (in digestate).

NOTE: If results are to be reported on a dry weight basis, determine the dry weight of a separate aliquot of the sample, using the SOP for Total Solids.

13.2 Common isobaric interferences are corrected using equations equivalent to those listed in EPA Methods 6020B and 200.8. Monitoring of multiple isotopes for a single element provides a mechanism for identifying isobaric interferences. Refer to the Interferences section of EPA methods for additional descriptions of possible interferences and the mechanisms required for adequately compensating for their effects.

### 13.3 Data Review and Reporting

13.3.1 The ICP-MS operator reviews the MS data and signs and dates the Data Review Form. A qualified senior staff spectroscopist performs a secondary review of the data and the Data Review Form is signed and dated. The data is scanned for later compiling.

13.3.2 The data is saved on the local hard drive and is also copied to the appropriate directory on the network. The data directories are located at r:\icp\wip\data. The data is kept on the local directory for 1 month. The network files are periodically backed up on disc or network tape.

13.3.3 For “non-production” work (such as method development or research/development studies) the analyses are performed under the direction of a senior spectroscopist. All associated data is scrutinized by the senior spectroscopist. Original raw data and associated records are archived in the analytical project file.

13.3.4 The final review and approval of all data is performed by qualified spectroscopists.

## 14) Contingencies for Handling Out-of-Control or Unacceptable Data

14.1 Refer to the SOP for *Non Conformance and Corrective Action* for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

## 15) Method Performance

15.1 This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional method performance data available.

15.2 The method detection limit (MDL) is established using the procedure described in the SOP, *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification*. Method Reporting Limits are established for this

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method based on MDL studies and as specified in the ALS Quality Assurance Manual.

## 16) Pollution Prevention and Waste Management

16.1 The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Lab Waste Management Plan.

## 17) Training

17.1 All analysts performing this analysis are required to read and understand this SOP.

17.2 Training is documented following the *Employee Training and New Employee Orientation* (ADM-TRAIN).

## 18) Method Modifications

18.1 There are no known modifications in this laboratory standard operating procedure from the reference method.

## 19) References

19.1 USEPA, Test Methods for Evaluation Solid Waste, SW-846, Update V, Method 6020B, Revision 2, July 2014.

19.2 Agilent and Thermo Elemental Instrument Manuals.

19.3 TNI Quality Standards, 2009, 2016.

19.4 DoD Quality Systems Manual for Environmental Laboratories, Current version.

19.5 ANSI/ISO/IEC 17005:2005/2017 American National Standard, General requirements for the competence of testing and calibration laboratories

## 20) Changes Since Last Revision

Summary of Revision Changes			
Revision Number	Effective Date	Document Editor	Description of Changes
19	12/2/20	T.Caron	Reformatted SOP to current ALS branding. Minor typographical changes to improve readability and consistency, not affecting technical content. Added section 11.4.

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## 21) Attachments, Tables, and Appendices

- 21.1 Tables 1A, 1B, and 1C – MRLs for analyte matrix combinations.
- 21.2 Table 2: Target Element Masses.
- 21.3 Attachment A – Example Standard Sheets.



**TABLE 1A**  
Target Analyte MRLs - Soil

<b>METHOD</b>	<b>PREP METHOD</b>	<b>ANALYTE</b>	<b>MATRIX</b>	<b>MRL mg/kg</b>
6020B	EPA 3050B	Aluminum	Soil	2
6020B	EPA 3050B	Antimony	Soil	0.05
6020B	EPA 3050B	Arsenic	Soil	0.5
6020B	EPA 3050B	Barium	Soil	0.05
6020B	EPA 3050B	Beryllium	Soil	0.02
6020B	EPA 3050B	Bismuth	Soil	0.05
6020B	EPA 3050B	Boron	Soil	0.5
6020B	EPA 3050B	Cadmium	Soil	0.02
6020B	EPA 3050B	Chromium	Soil	0.2
6020B	EPA 3050B	Cobalt	Soil	0.02
6020B	EPA 3050B	Copper	Soil	0.1
6020B	EPA 3050B	Lead	Soil	0.05
6020B	EPA 3050B	Manganese	Soil	0.05
6020B	EPA 3050B	Molybdenum	Soil	0.05
6020B	EPA 3050B	Nickel	Soil	0.2
6020B	EPA 3050B	Selenium	Soil	1
6020B	EPA 3050B	Silver	Soil	0.02
6020B	EPA 3050B	Thallium	Soil	0.02
6020B	EPA 3050B	Tin	Soil	0.1
6020B	EPA 3050B	Uranium	Soil	0.02
6020B	EPA 3050B	Vanadium	Soil	0.2
6020B	EPA 3050B	Zinc	Soil	0.5



**TABLE 1B**  
Target Analyte MRLs – Water

<b>METHOD</b>	<b>PREP METHOD</b>	<b>ANALYTE</b>	<b>MATRIX</b>	<b>MRL µg/L</b>
6020B	MET-DIG (CLP)	Aluminum	Water	4
6020B	MET-DIG (CLP)	Antimony	Water	0.05
6020B	MET-DIG (CLP)	Arsenic	Water	0.5
6020B	MET-DIG (CLP)	Barium	Water	0.05
6020B	MET-DIG (CLP)	Beryllium	Water	0.02
6020B	MET-DIG (CLP)	Bismuth	Water	0.05
6020B	MET-DIG (CLP)	Boron	Water	2
6020B	MET-DIG (CLP)	Cadmium	Water	0.02
6020B	MET-DIG (CLP)	Chromium	Water	0.2
6020B	MET-DIG (CLP)	Cobalt	Water	0.02
6020B	MET-DIG (CLP)	Copper	Water	0.1
6020B	MET-DIG (CLP)	Iron	Water	2
6020B	MET-DIG (CLP)	Lead	Water	0.02
6020B	MET-DIG (CLP)	Manganese	Water	0.2
6020B	MET-DIG (CLP)	Molybdenum	Water	0.1
6020B	MET-DIG (CLP)	Nickel	Water	0.2
6020B	MET-DIG (CLP)	Selenium	Water	1
6020B	MET-DIG (CLP)	Silver	Water	0.02
6020B	MET-DIG (CLP)	Thallium	Water	0.02
6020B	MET-DIG (CLP)	Tin	Water	0.1
6020B	MET-DIG (CLP)	Uranium	Water	0.02
6020B	MET-DIG (CLP)	Vanadium	Water	0.2
6020B	MET-DIG (CLP)	Zinc	Water	2



**TABLE 1C**  
Target Analyte MRLs - Tissue

<b>METHOD</b>	<b>PREP METHOD</b>	<b>ANALYTE</b>	<b>MATRIX</b>	<b>MRL mg/kg</b>
6020B	PSEP TISSUE	Aluminum	Tissue	2
6020B	PSEP TISSUE	Antimony	Tissue	0.05
6020B	PSEP TISSUE	Arsenic	Tissue	0.5
6020B	PSEP TISSUE	Barium	Tissue	0.05
6020B	PSEP TISSUE	Beryllium	Tissue	0.02
6020B	PSEP TISSUE	Bismuth	Tissue	0.05
6020B	PSEP TISSUE	Boron	Tissue	2
6020B	PSEP TISSUE	Cadmium	Tissue	0.02
6020B	PSEP TISSUE	Chromium	Tissue	0.2
6020B	PSEP TISSUE	Cobalt	Tissue	0.02
6020B	PSEP TISSUE	Copper	Tissue	0.1
6020B	PSEP TISSUE	Iron	Tissue	1
6020B	PSEP TISSUE	Lead	Tissue	0.02
6020B	PSEP TISSUE	Manganese	Tissue	0.05
6020B	PSEP TISSUE	Molybdenum	Tissue	0.05
6020B	PSEP TISSUE	Nickel	Tissue	0.2
6020B	PSEP TISSUE	Selenium	Tissue	1
6020B	PSEP TISSUE	Silver	Tissue	0.02
6020B	PSEP TISSUE	Thallium	Tissue	0.02
6020B	PSEP TISSUE	Tin	Tissue	0.05
6020B	PSEP TISSUE	Uranium	Tissue	0.02
6020B	PSEP TISSUE	Vanadium	Tissue	0.2
6020B	PSEP TISSUE	Zinc	Tissue	0.5



**TABLE 2**  
Target Element Masses

<b>ANALYTE</b>	<b>ISOTOPES ANALYZED</b>	<b>ISOTOPE REPORTED</b>
Aluminum	27	27
Antimony	121, 123	123
Arsenic	75	75
Barium	135, 137, 138	137
Beryllium	9	9
Cadmium	111, 112, 114	111
Chromium	52, 53	52
Cobalt	59	59
Copper	63, 65	65
Lead	206, 207, 208	208
Manganese	55	55
Molybdenum	95, 97, 98	98
Nickel	60, 61, 62	60
Selenium*	77, 78, 82	82
Silver	107, 109	107
Thallium	203, 205	205
Uranium	238	238
Vanadium	51	51
Zinc	66, 67, 68	66

\*Se 78 Is the default isotope on the NexION and The Agilent instruments.



**ATTACHMENT A**  
**Example Standard Sheets**

**Solution:** ICP-MS, 200.8 Intermediate Stock  
**Matrix:** 2% HNO<sub>3</sub>

<b>Element</b>	<b>Aliquot of 1000 ppm Std/1000 mL</b>	<b>Concentration (µg/L)</b>
HNO <sub>3</sub>	50.0 mL	5%
Al	1.0 mL	1000
Sb	1.0 mL	1000
As	1.0 mL	1000
Ba	1.0 mL	1000
Be	1.0 mL	1000
Cd	1.0 mL	1000
Cr	1.0 mL	1000
Co	1.0 mL	1000
Cu	1.0 mL	1000
Fe	1.0 mL	1000
Pb	1.0 mL	1000
Mn	1.0 mL	1000
Mo	1.0 mL	1000
Ni	1.0 mL	1000
Se	1.0 mL	1000
Tl	1.0 mL	1000
V	1.0 mL	1000
U	1.0 mL	1000
Zn	1.0 mL	1000



**Solution:** ICP-MS, 200.8 Silver Intermediate Stock  
**Matrix:** 5% HNO<sub>3</sub>

Element	Aliquot of 500 ppm Std/1000 mL	Concentration (µg/L)
HNO <sub>3</sub>	50.0 mL	5%
Ag	0.5 mL	500

**Solution:** ICP-MS 25 ppb Calibration Standard and CCV  
**Matrix:** As required

Source	Aliquot per 100 mL	Concentration (µg/L)
HNO <sub>3</sub> (Ultrex)	As Required	As Required
Intermediate Stock	2.5 mL	25.0
Silver Intermediate Stock	2.5 mL	12.5



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Mercury in Liquid Waste

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## MERCURY IN LIQUID WASTE

DOCUMENT ID: MET-7470A, REV 20.0

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Prepared By: Inorganics Manager, Jeff Coronado  
Signature on file.

Date: 1/29/2021

Prepared By: Quality Assurance Manager, Kurt Clarkson  
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Date: 1/29/2021

Approved By: Laboratory Director, Charles (Pat) Byrne  
Signature on file.

Date: 1/29/2021

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## 1) Scope & Applicability

- 1.1 This procedure is used to determine the concentrations of Mercury in aqueous samples, including mobility-procedure extractions, aqueous wastes, and ground water, using EPA Method 7470A. Method 7470A is a cold-vapor atomic absorption procedure.
- 1.2 The Method Reporting Limit (MRL) is 0.2 µg/L. Equivalent nomenclature for MRL includes Estimated Quantitation Limit (EQL) and Practical Quantitation Limit (PQL). Therefore, MRL=EQL=PQL. The reported MRL may be adjusted if required for specific project requirements; however, the capability of achieving other reported MRLs must be demonstrated. The current MDL for 7470A is 0.02 µg/L. The MDL may change slightly as annual studies are performed.
- 1.3 In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPP's supersede method specified requirements. An example of this are projects falling under DOD ELAP. QC requirements defined in the SOP *Department of Defense Projects – Laboratory Practices and Project Management* (ADM-DOD5) may supersede the requirements defined in this SOP.

## 2) Summary of Procedure

- 2.1 A representative aliquot of sample is prepared as described in this procedure. The mercury is reduced to its elemental state and aerated from solution and measured with an atomic absorption spectrometer. The mercury vapor passes through a cell positioned in the light path of the AA where absorbance is measured as a function of mercury concentration.

## 3) Definitions

- 3.1 For laboratory definitions applicable to most analyses, refer to the SOP for *Sample Batches*.

## 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.
- 4.2 It is the responsibility of the department supervisor/manager to document analyst training and method proficiency, as described in the SOP *Employee Training and Orientation* (ADM-TRAIN).

## 5) Interferences

- 5.1 Potassium permanganate is added to eliminate possible interference from sulfide. Samples high in chlorides require additional permanganate because, during the oxidation step, chlorides are converted to free chlorine, which absorbs radiation at 253 nm.

## 6) Safety

- 6.1 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.



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- 6.2 Sulfuric and Nitric Acid are used in this method. These acids are extremely corrosive and care must be taken while handling them. A face shield should be used while pouring acids. And safety glasses should be worn while working with the solutions. Lab coat and gloves should always be worn while working with these solutions.

### 7) Sample Collection, Containers, Preservation, and Storage

- 7.1 Aqueous samples are preserved with nitric acid (pH<2).  
7.2 The maximum holding time for mercury in aqueous samples is 28 days.

### 8) Standards, Reagents, and Consumable Materials

- 8.1 Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Refer to the SOP *Reagent and Standards Login and Tracking (ADM-RLT)* for the complete procedure and documentation requirements.
- 8.2 All stocks, working solutions and sample dilutions should be prepared using deionized water (DI) conforming to ASTM Type I or ASTM Type II reagent water. For more information on reagent water generation, refer to the related SOP, Operation and Maintenance of Laboratory Reagent Water Systems.
- 8.3 Mercury stock solution (1,000 mg/L). Commercially prepared certified solution stored at room temperature. The expiration date determined by manufacturer.
- 8.4 Mercury intermediate stock solution (10 mg/L). Prepared from the stock solution listed above. Store at room temperature and assign a one month expiration date.
- 8.5 Mercury working standard (100 µg/L). Prepared from the intermediate stock solution listed above. Store at room temperature and prepare a new standard daily.
- 8.6 See the Procedures section for details on preparation of calibration and ICV standards. See the Quality Assurance section for QC sample preparation.
- 8.7 Reagent water - ASTM Type II water (laboratory deionized water).
- 8.8 Concentrated nitric and sulfuric acids. Purity of acids must be established by the laboratory as being high enough to eliminate the introduction of contamination above the Method Reporting Limit.
- 8.9 Potassium permanganate solution, 5% w/v. To prepare, add 50 g of solid reagent to 1000 mL of DI water and place on magnetic stir plate for approximately 30 minutes until dissolved.
- 8.10 Potassium persulfate solution, 5% w/v. To prepare, add 50g of solid reagent to 1000 mL of DI water and warm in water bath for approximately 10 minutes. Place the warmed solution on a magnetic stir plate for approximately 10 minutes until dissolved.
- 8.11 Sodium chloride/hydroxylamine hydrochloride solution, 12% w/v each. To prepare, add 120 g sodium chloride and 120 g of hydroxylamine hydrochloride to 1000 mL of DI water and place on magnetic stir plate for approximately 15 minutes until dissolved.
- 8.12 Stannous chloride, 10% w/v in HCl (7% v/v). To prepare, add 100 g stannous chloride crystals and 70 mL of concentrated hydrochloric acid in 1000 mL of DI water. Seal lid on mixing bottle and shake until the stannous chloride is dissolved.

### 9) Apparatus and Equipment



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- 9.1 CETAC M-6100A Mercury Analyzer. (See Attachments for instrument parameters).
- 9.2 VWR Borosilicate glass tubes with disposable caps, 16 mL
- 9.3 Modified block digesters, 10 and 100 mL.
- 9.4 Pipettors, Eppendorf and Finnpiptette® fixed and adjustable volume.
- 9.5 Polypropylene graduated cylinders, 50 mL.
- 9.6 125 mL Centrifuge tubes.
- 9.7 Infrared Thermometer: Fluke: Model: 572-2.

## 10) Preventative Maintenance

- 10.1 All maintenance activities are recorded in a maintenance logbook kept for each instrument. Pertinent information (serial numbers, instrument I.D., etc.) must be in the logbook. This includes the routine maintenance described in section 9. The entry in the log must include: date of event, the initials of who performed the work, and a reference to analytical control.
- 10.2 ALS staff performs all routine maintenance and troubleshooting. Preventative maintenance activities listed below should be performed when needed as determined by instrument performance (i.e. stability, sensitivity, etc.) or by visual inspection. Repairs of an extraordinary nature may or may not require factory service, depending on the nature of the task.
- 10.3 Keep the instrument free of dust, deposits, and chemical spills.
- 10.4 Replace the peristaltic and autosampler rinse tubing.
- 10.5 Remove and clean the Gas-Liquid separator.
- 10.6 Remove, dismantle, and clean the optical cells (sample cell and reference cell) including the sapphire windows.
- 10.7 Replace the Hg lamp bulb when the Lamp Over-Range is triggered. (The new instrument does not display a value).
- 10.8 Each block digester is uniquely identified and the temperature is verified with each batch of samples. The temperature is turned to the 95°C setting and the block is allowed to come to temperature. The analyst will verify that the block gives a temperature of  $95 \pm 2^\circ\text{C}$  using a semi-annually-calibrated traceable handheld infrared thermometer. If not at the right temperature, the thermostat is adjusted until the IR thermometer reads  $95 \pm 2^\circ\text{C}$ .

## 11) Procedure

### 11.1 Sample Preparation

- 11.1.1 Shake the sample and measure 10 mL into a 16 mL glass tube. Add 0.5 mL of  $\text{H}_2\text{SO}_4$  and 0.25 mL of concentrated  $\text{HNO}_3$ , mixing after each addition. Add 1.5 mL of potassium permanganate solution to each tube and shake. If the purple color does not persist for 15 minutes add additional potassium permanganate until it does so. Any additional potassium permanganate solution must also be added to the blanks and standards in equal proportion. Note: Spiking solution is added prior to acidification.
- 11.1.2 Add 0.8 mL of potassium persulfate to each tube and heat for 2 hours in a block digester maintained at 95°C. Cool and add 0.6 mL of sodium chloride-hydroxylamine hydrochloride solution.



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11.1.3 The samples are now ready to be analyzed. The analyzer does the final step of adding the stannous chloride solution automatically.

11.2 Calibration

11.2.1 To prepare calibration standards a 10 ppm intermediate stock solution is first prepared by aliquoting 1.0 mL of commercially prepared 1000 ppm stock standard into an acid rinsed 100 mL Class A volumetric flask and diluting to volume with 1% HNO<sub>3</sub> (This solution must be prepared monthly). Next, a 100 ppb working solution is prepared by aliquoting 1.0 mL of the 10 ppm intermediate stock solution into an acid rinsed 100 mL Class A volumetric flask and diluting to volume with 1% HNO<sub>3</sub>. This solution must be prepared daily.

Note: All standard aliquots are measured using calibrated fixed or adjustable volume autopipettors.

11.2.2 Transfer 0, 0.1, 0.25, 0.5, 2.5, and 5.0 mL aliquots of the working solution to a series of labeled 125 mL centrifuge tubes. Add the appropriate amount of reagent water to bring each bottle to a final volume of 50 mL. The final concentrations of the prepared standards are 0, 0.2, 0.5, 1.0, 5.0, 10.0 ppb. Standards may be prepared at 100 mL final volume rather than 50 mL volume to ensure sufficient quantity is available for recalibrations as well as aliquoting for CCV, CCB and CRA samples in the analytical run. The proportions of reagents and their sources are identical to those of the samples.

11.2.3 The Initial Calibration Verification (ICV) is prepared by first making a 1000 ppb intermediate solution. 0.10 mL of commercially prepared 1000 ppm stock standard, from a different manufacturer and lot than the calibration standard, is aliquoted into an acid rinsed 100 mL Class A volumetric flask and diluting to volume with 1% HNO<sub>3</sub>. This solution must be prepared monthly. Prepare the ICV standard by aliquoting 0.25 mL to a labeled 125 mL centrifuge tube. Add 49.75 mL of reagent water to bring the final volume to 50 mL.

11.2.4 Mix thoroughly and add 2.5 mL of concentrated H<sub>2</sub>SO<sub>4</sub> and 1.25 mL of concentrated HNO<sub>3</sub> to each bottle. Add 7.5 mL of potassium permanganate to each bottle and let stand for 15 minutes. Add 4 mL of potassium persulfate to each bottle and heat in the modified block for 2 hours at 95°C. Cool and add 3 mL of sodium chloride-hydroxylamine hydrochloride solution.

11.3 CETAC Calibration and Sample Analysis

11.3.1 Turn on the CETAC instrument, including the Hg lamp, and autosampler. After this is done open the operating software (Mercury Analyzer 1.6.5).

11.3.2 The rinse station for the autosampler turns on automatically, but the peristaltic pump must be started manually. Make sure all sample uptake and drain tubes are placed correctly on the pump and are secured with the appropriate tension. Place the reagent uptake tube in the stannous chloride and start the pump.

11.3.3 From the software's main screen select "File", then: "New From". Under "Template Worksheet", click "Browse" and then select "Kelso Hg Template II". Enter the name of the worksheet and click: OK.

Note: The CETAC software will not allow "0" to be entered as a true value for a "Standard". The software template includes the "0" standard as the "calibration blank".

11.3.4 Go to the "Sequence Editor" tab to generate a sequence, then enter the QC and field samples to be analyzed in the appropriate order.

11.3.5 Transfer the solutions to be analyzed to labeled 12 mL polyethylene test tubes and place them in the appropriate spaces on the autosampler trays.



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11.3.6 Transfer the calibration blank and standards (0.2, 0.5, 1.0, 5.0, and 10 ppb) from their Centrifuge tubes to the standard tubes located behind the autosampler trays. The calibration blank is placed in the left most tube and the other standards are placed in ascending order to the right.

11.3.7 Click start and the analysis will begin.

11.3.8 After the calibration standards have run the software will use linear regression to create a calibration curve based on the concentration and measured absorbance of each standard. The form of regression line is  $y = mx + b$ . If the correlation coefficient of the curve is greater than 0.995 the analysis will continue, if not the analysis will be terminated and corrective action will be needed by the analyst.

11.4 As the analysis sequence proceeds, next analyze the following QC standards.

- ICV (5.0 ppb standard prepared from a second source)
- ICB
- CRA (0.2 ppb calibration standard)
- CCV (5.0 ppb calibration standard)
- CCB

11.5 If either the ICV or CCV are different from their true values by more than 10% the software will terminate the analysis. If either the ICB or CCB is greater than the MRL of 0.2 µg/L the software will terminate the analysis. CRA limits are ±30%.

**Note:** For projects falling under DoD QSM requirements, the QSM criteria for CRA standards is ±20% and for ICB and CCB standards no analytes detected > LOD.

11.6 Sample Analysis

11.6.1 The samples are analyzed with the CETAC analyzer in the same manner as the calibration standards. The analyzer does the step of adding the stannous chloride solution automatically. Check the baseline between samples to verify that the spectrometer reading has stabilized at the normal baseline level.

11.6.2 The analytical sequence should be set up to include all samples, QC samples, blanks, and calibration verification standards at necessary intervals. Refer to the SOP for Sample Batches.

11.7 Sample digestion batches are analyzed with a set of CCV and CCB standards which are run at the beginning and end of the analytical run and at a minimum every 10 samples during the run. The same criteria listed above are applied to the CCVs and CCBs. If outside these limits the analysis is terminated.

## 12) QA/QC Requirements

12.1 Initial Precision and Recovery Validation

12.1.1 The accuracy and precision of the procedure must be validated before analyses of samples begin, or whenever significant changes to the procedures have been made. To do this, four water samples are spiked with the LCS spike solution, then prepared and analyzed.

12.2 Method Detection Limits

12.2.1 A method detection limit (MDL) study must be undertaken before analysis of samples can begin. To establish detection limits that are precise and accurate, the analyst must perform the following procedure. Spike a minimum of seven blank replicates with a MDL spiking solution near the MRL and analyze. Refer to *Performing and Documenting Method*



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*Detection Limit Studies and Establishing Limits of Detection and Quantification (CE-QA011/ADM-MDL). The MDL study must be verified annually.*

12.2.2 Calculate the average concentration found ( $\bar{x}$ ) in  $\mu\text{g/L}$ , and the standard deviation of the concentrations ( $s$ ) in  $\mu\text{g/L}$  for each analyte. Calculate the MDL for each analyte. Refer to ADM-MDL). The MDL study must be verified annually with a limit of detection (LOD).

12.2.3 Note: Method Detection Limits are subject to change as new MDL studies are completed.

12.3 Limits of Quantification (LOQ)

12.3.1 The laboratory establishes a LOQ for each analyte as the lowest reliable laboratory reporting concentration or in most cases the lowest point in the calibration curve which is less than or equal to the desired regulatory action levels, based on the stated project requirements. Analysis of a standard or extract prepared at the lowest point calibration standard provides confirmation of the established sensitivity of the method. The LOQ recoveries should be within 50-150 % of the true values to verify the data reporting limit. Refer to the SOP: Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Quantification (CE-QA011)/ADM-MDL).

12.4 Ongoing QC Samples required are described in the ALS-Kelso Quality Assurance Manual, and in SOP *Sample Batches* (ADM-BATCH). For this analysis, these include:

12.4.1 Prepare one method blank (MB) per digestion batch, or per 20 samples, or per EPA SDG group, whichever is more frequent. Use D.I. water and follow the digestion procedures. The Method Blank should be  $< \text{MRL}$ . Re-digest the associated samples if sample levels are  $< 20\text{X}$  MB level.

12.4.2 DoD QSM Method Blank Requirements - The Method Blank will be considered contaminated if:

12.4.2.1 The concentration of any common laboratory contaminant in the blank exceeds the reporting limit and is greater than  $1/10$  the amount measured in any sample or  $1/10$  the regulatory limit (whichever is greater).

12.4.2.2 The blank result otherwise affects the samples results as per the test method requirements or the project-specific objectives.

12.4.3 Prepare one duplicate and matrix spike sample per each digestion batch, or per twenty samples, or per EPA SDG group, whichever is more frequent. At times, specific samples will be assigned as duplicates or spikes depending on client requirements. The matrix spike is prepared by aliquoting 0.05 mL of the 1000 ppb working standard to the 10 mL sample designated as the matrix spike, resulting in a spike concentration of 5ppb.

**Note:** Duplicate samples are routinely analyzed, however all DoD projects require a MSD with every preparation batch. The MSD sample is prepared as described above.

12.4.3.1 The RPD criterion for duplicates is 20% RPD. If not, flag the data or re-digest samples. Apply Matrix spike recovery criterion listed in the DQO Table, unless project-specific limits are required. For DoD QSM work, MS recoveries are assessed using the QSM LCS control limits. If the MS (and/or MSD where applicable) recovery is outside acceptance limits proceed with the additional interference tests. Based on results of these tests, the physical nature of the sample (e.g. homogeneity), and any specific project requirements, a determination can then be made as to appropriate corrective action (e.g. re-digestion, reporting with a qualifier, alternative methodologies, etc.). If the analyte concentration is  $>4\text{x}$  the spike level the spike control limit is no longer applicable and no action is required.



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12.4.4 Prepare one Laboratory Control Sample (LCS) per digestion batch, or per 20 samples. The LCSW is prepared by aliquoting 0.05 mL of the 1000 ppb ICV intermediate solution to 10 mL of reagent water, resulting in a concentration of 5ppb, and processing as per the procedure.

12.4.4.1 Apply LCS recovery criteria listed in the DQO Table, unless project-specific limits are required. If the LCS fails the acceptance criteria, re-digest the batch of samples. An LCS recovery criterion for **DoD** QSM projects is 80-120%.

12.4.4.2 Calculate the LCS recovery as follows:

$$\%R = X/TV \times 100$$

Where X = Concentration of the analyte recovered  
TV = True value of amount spiked

12.4.5 Interference Tests: Prepare one post spike for every batch of samples and if samples are sufficiently high (10x the MRL/LOQ) a serial dilution. The serial dilution must agree within 10% of the original sample result. Post spike recovery acceptance limits for method 7470A are 85-115% under SW846 Update 3, and 80-120% for project falling under SW846 Update 4. When both the post spike and dilution tests fail all of the samples in the associated preparation batch must be quantified via Method of Standard Additions (MSA).

### 13) Data Reduction and Reporting

13.1 Solution concentrations are calculated by the Mercury Analyzer software based on the linear regression calibration curve created when the calibration standards are analyzed. The absorbance measured for each sample is applied to the linear regression curve and the final solution concentration is determined and displayed as the instrument result.

13.2 Calculate sample results using the data system printouts and digestion information. The digestion and dilution information is entered into the data system. The data system then uses the calculations below to generate a sample result.

13.2.1 Aqueous samples are reported in µg/L:

$$\mu\text{g} / \text{L} (\text{Sample}) = C^* \times \text{Digestion Dilution Factor} \times \text{Post Digestion Dilution Factor}$$

C\* = Concentration of analyte as measured at the instrument in mg/L (in digestate).

13.3 A daily run log of all samples analyzed is maintained. All CLP data should be printed and stored after operator has checked for evenness of burns. A copy of this document will go with each package of Tier III or higher data run that day.

13.4 It is the analyst's responsibility to review analytical data to ensure that all quality control requirements have been met for each analytical run. Results for QC analyses are calculated and recorded.

13.5 Record all sample volumes and dilutions on an A.A. benchsheet.

13.6 Record all concentrations determined at the instrument and calculate the final results in µg/L. Record the final results on the A.A. benchsheet.

13.7 The data packet for the sequence is submitted for review by supervisor or designee. The results are transferred to the appropriate report form located in the ALS network directory R:\ICP\WIP. Once the results are transferred, the report is reviewed.



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- 13.8 Refer to the *SOP for Laboratory Data Review Process* (ADM-DREV) for general instructions for data review.
- 13.9 Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the *SOP for Laboratory Data Review Process* (ADM-DREV) for details. The person responsible for final review of the data report and/or data package should assess the overall validity and quality of the results and provide any appropriate comments and information to the Project Manager to inclusion in the report narrative.

#### 14) Contingencies for Handling Out-of-Control or Unacceptable Data

- 14.1 Refer to the *SOP for Nonconformance and Corrective Action Procedures* (ADM-NCAR) for procedures for corrective action.
- 14.2 Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

#### 15) Method Performance

- 15.1 This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional available method performance data.
- 15.2 The method detection limit (MDL), limit of detection (LOD), and limit of quantitation (LOQ) are established using the procedure described in *Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Quantitation*. Method Reporting Limits are established for this method based on MDL studies and as specified in the ALS Quality Assurance Manual.

#### 16) Pollution Prevention and Waste Management

- 16.1 The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Lab Waste Management Plan.
- 16.2 This method uses acid/bases. Waste acid/base is hazardous to the sewer system and to the environment. All waste must be neutralized prior to disposal down the drain. The neutralization step is considered hazardous waste treatment and must be documented on the treatment by generator record. Refer to the ALS Lab Waste Management Plan.

#### 17) Training

- 17.1 All analysts performing this analysis are required to read and understand this SOP.
- 17.2 Training is documented following the *Employee Training and New Employee Orientation* (ADM-TRAIN).

#### 18) Method Modifications

- 18.1 There are no known modifications in this laboratory standard operating procedure from the reference method.

#### 19) References

- 19.1 DoD Quality Systems Manual for Environmental Laboratories Current Version.
- 19.2 TNI Quality Standards, 2009; 2016.

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- 19.3 *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*. EPA SW-846, 3rd Edition, Final Update II, Method 7470A, September 1994.
- 19.4 ISO/IEC 17025:2005/2017 American National Standard, General requirements for the competence of testing and calibration laboratories.

## 20) Changes since Last Revision

Revision Number	Effective Date	SOP Review	Document Editor	Description of Changes
20.0	2/05/2021		T.Caron	ADMIN changes: SOP signatories, updates to standard paragraphs; References. Section 9: Infrared Thermometer: Fluke Model: 572 has been added to the equipment list. Section 10.8: Added Block digester temperature verification procedure. Section: 11.1.2: Procedural step has been updated to reflect current practice.
		Keith Linn		Procedural change form and revision request dated 1/27/2021.

## 21) Attachments, Tables, and Appendices

- 21.1 Attachment 1: Instrument Parameters.
- 21.2 Table 1: Summary of Corrective Actions.



## Attachment 1 Instrument Parameters

### Analysis Parameters

Instrument M-6100 Mercury Analyzer

#### Conditions

Gas flow (mL/min)	Sample Uptake (s)	Rinse (s)	Read delay (s)	Replicates (#)	Replicate time (s)	Pump speed (%)	Wavelength (nm)
40	30.00	60.00	50.00	4	2.00		253.65

#### Instrumental Zero

Zero before first sample: No

Zero periodically: Yes  
Before each calibration.

#### Baseline Correction

#1 Start time (s)	#1 End time (s)	#2 Start time (s)	#2 End time (s)
5.00	10.00		

#### Standby Mode

Enabled: Yes  
Standby Options: gas off, lamp off

#### Autodilution

Enabled: No  
Condition:  
Tube # range:  
If no autodilution tubes remaining

### Calibration

#### Settings

Algorithm	Through blank	Weighted fit	Cal. Type	Recalibration rate	Reslope rate	Reslope standard
Linear	Yes	No	Normal	0	0	N/A

#### Limits

Calibration slope		Reslope		Coeff. of Determination
Lower (%)	Upper (%)	Lower (%)	Upper (%)	
75	125	75	125	0.99500

Error action: Stop analysis

### QC

GLP Override: Yes

### QC Tests



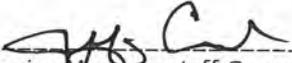
**Table 1**

<b>Summary of Corrective Actions</b>				
<b>Method Reference</b>	<b>Control</b>	<b>Specification and Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action</b>
EPA 7470A	ICAL	Prior to sample analysis	$R2 \geq 0.995$	Correct problem then repeat ICAL
EPA 7470A	ICV	After ICAL	$\pm 10\%$	Correct problem and verify second source standard; rerun second source verification. If fails, correct problem and repeat initial calibration.
EPA 7470A	CCV	Prior to sample analysis	$\pm 10\%$	Correct problem then repeat CCV or repeat ICAL
EPA 7470A	Method Blank	Include with each analysis batch (up to 20 samples)	<MRL	If target exceeds MRL, reanalyze to determine if instrument was cause. If still noncompliant then:  Re-extract or reanalyze samples containing contaminate, unless samples contain > 20x amount in blank.
EPA 7470A	Laboratory Control Sample	Include with each analysis batch (up to 20 samples)	See DQO Table	If exceeds limits, re-extract and re-analyze
EPA 7470A	Matrix Spike	Include with each analysis batch (up to 20 samples)	See DQO Table	Evaluate data to determine if there is a matrix effect or analytical error
EPA 7470A	Sample Duplicates	Include with each analysis batch (up to 20 samples)	$RPD \leq 20$	Re-homogenize and re-analyze if result is > 5 X the MRL



## Mercury in Solid or Semi-Solid Waste

DOCUMENT ID: MET-7471, REV 21.0

Approved By:   
Inorganics Manager, Jeff Coronado

Date: 12/1/20

Approved By:   
Quality Assurance Manager, Kurt Clarkson

Date: 12/1/2020

Approved By:   
Laboratory Director, Charles (Pat) Byrne

Date: 12-1-20



## 1) Scope & Applicability

- 1.1 This Standard Operating Procedure (SOP) describes the procedure used to determine the concentrations of Mercury in soils, sediments, freeze dried tissues, bottom deposits, and sludge-type materials using Method EPA 7471A or 7471B. If this dissolution procedure is not sufficient to dissolve a specific matrix type or sample, then this method is not applicable for that matrix. Method 7471 is a cold-vapor atomic absorption procedure.
- 1.2 The Method Reporting Limit (MRL) is 0.02 mg/kg. Equivalent nomenclature for MRL includes Estimated Quantitation Limit (EQL). Therefore, MRL=EQL. The reported MRL may be adjusted if required for specific project requirements; however, the capability of achieving other reported MRLs must be demonstrated. A Method Detection Limit (MDL) of 0.002 mg/kg has been achieved using this procedure. Refer to the ALS Kelso DQO Table for current data quality objectives.
- 1.3 In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPP's supersede method specified requirements. An example of this are projects falling under DOD ELAP. QC requirements defined in the SOP *Department of Defense Projects – Laboratory Practices and Project Management (ADM-DOD/ADM-DOD5)* may supersede the requirements defined in this SOP.

## 2) Summary of Procedure

- 2.1 A representative aliquot of sample is prepared as described in this procedure. The mercury is reduced to its elemental state and aerated from solution and measured with an atomic absorption spectrometer. The mercury vapor passes through a cell positioned in the light path of the AA where absorbance is measured as a function of mercury concentration.

## 3) Definitions

- 3.1 For general definitions applicable to most analyses refer to the SOP for *Sample Batches*, ADM-BATCH.

## 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. The department supervisor/manager or designee performs final review and sign-off of the data.
- 4.2 It is the responsibility of the department supervisor/manager to document analyst training and method proficiency, as described in the SOP *Employee Training and Orientation* (ADM-TRAIN).

## 5) Interferences

- 5.1 Potassium permanganate is added to eliminate possible interference from sulfide. Samples high in chlorides require additional permanganate because, during the oxidation step, chlorides are converted to free chlorine, which absorbs radiation at 253 nm.



## 6) Safety

- 6.1 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Kelso Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.
- 6.2 Hydrochloric and/or Nitric Acid are used in this method. These acids are extremely corrosive and care must be taken while handling them. A face shield should be used while pouring acids. And safety glasses should be worn while working with the solutions. Lab coat and gloves should always be worn while working with these solutions.

## 7) Sample Collection, Containers, Preservation, and Storage

- 7.1 Glass, plastic, and polytetrafluoroethylene (PTFE) containers are suitable in most cases.
- 7.2 Non-aqueous samples are stored at  $4 \pm 2$  °C from receipt until analysis, unless otherwise dictated by project specifications.
- 7.3 Samples must be analyzed within 28 days of sampling.
- 7.4 Non-aqueous samples are stored at  $4 \pm 2$  °C from receipt until analysis, unless otherwise dictated by project specifications.

## 8) Apparatus and Equipment

- 8.1 CETAC M-6100A Mercury Analyzer. See Attachments, Tables and Appendices for instrument parameters.
- 8.2 Environmental Express Block Digestion Unit.
- 8.3 Pipettors, Eppendorf and Finn pipette fixed and adjustable volume.
- 8.4 Polypropylene graduated cylinders, 50 mL.
- 8.5 125 mL Digestion Vessel tubes.
- 8.6 Laboratory balance, top-loader capable of readings .001g (3-place). Mettler, Ohaus, or equivalent Standards.
- 8.7 Infrared Thermometer.

## 9) Standards, Reagents, and Consumable Materials

- 9.1 Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Standards, reagents and consumable material documentation shall indicate traceability to purchased reagents or compounds. Refer to the SOP *Reagent/Standards Login and Tracking* (ADM-RTL) for the complete procedure and documentation requirements.
- 9.2 All stocks, working solutions and sample dilutions should be prepared using deionized water (DI) conforming to ASTM Type I or ASTM Type II reagent water. For more information on reagent water generation, refer to the related SOP, Operation and Maintenance of Laboratory Reagent Water Systems.
- 9.3 Mercury stock solution (1,000 mg/L). Commercially prepared certified solution stored at room temperature. The expiration date determined by manufacturer.



- 9.4 Mercury working standard (100µg/L). Prepared from the intermediate stock solution listed above. Store at room temperature and prepare a new standard daily.
- 9.5 Laboratory Control Sample - ERA Priority Pollutant/CLP Inorganic Soil reference material. Store at room temperature in the original container and use the vendor expiration date.
- 9.6 Matrix spike solution (1 mg/L) - Prepare by making a 1:1000 dilution of the mercury stock solution. Store at room temperature and prepare a new standard monthly.
- Note:** See the Procedure section for details on preparation of calibration and ICV standards. See the Quality Assurance section for QC sample preparation.
- 9.7 Reagent water - ASTM Type II water (laboratory deionized water).
- 9.8 Acids - Purity of acids must be established by the laboratory as being high enough to eliminate the introduction of contamination above the Method Reporting Limit.
- 9.8.1 Nitric Acid (HNO<sub>3</sub>) 69-70% - JT Baker-Baker Instra-Analyzed® or equivalent.
- 9.8.2 Sulfuric Acid concentrated (H<sub>2</sub>SO<sub>4</sub>) - EMD-OmniTrace® or equivalent.
- 9.8.3 Hydrochloric Acid concentrated (HCL) - VWR - BHD-Aristar® or equivalent.
- 9.9 Potassium permanganate solution, 5% w/v. To prepare, add 50 g of solid reagent to 1000 mL of DI water and place on magnetic stir plate for approximately 30 minutes until dissolved.
- 9.10 Sodium chloride/hydroxylamine hydrochloride solution, 12% w/v each. To prepare, add 120 g sodium chloride and 120 g of hydroxylamine hydrochloride to 1000 mL of DI water and place on magnetic stir plate for approximately 15 minutes until dissolved.
- 9.11 Stannous chloride, 10% w/v in HCl (7% v/v). To prepare, add 100 g stannous chloride crystals and 70 mL of concentrated hydrochloric acid in 1000 mL of D.I. water. Seal lid on mixing bottle and shake until the stannous chloride is dissolved.
- 9.12 Aqua Regia - Prepare immediately before use by carefully adding 3 parts of concentrated HCL to one part of HNO<sub>3</sub>.

## 10) Preventative Maintenance

- 10.1 All maintenance activities are recorded in a maintenance logbook kept for each instrument. Pertinent information (serial numbers, instrument I.D., etc.) must be in the logbook. This includes the routine maintenance described in section 9. The entry in the log must include: date of event, the initials of who performed the work, and a reference to analytical control.
- 10.2 ALS staff performs all routine maintenance and troubleshooting. Preventative maintenance activities listed below should be performed when needed as determined by instrument performance (i.e. stability, sensitivity, etc.) or by visual inspection. Repairs of an extraordinary nature may or may not require factory service, depending on the nature of the task.
- 10.3 Keep the instrument free of dust, deposits, and chemical spills.
- 10.4 Replace the peristaltic and autosampler rinse tubing.
- 10.5 Remove and clean the Gas-Liquid separator.
- 10.6 Remove, dismantle, and clean the optical cells (sample cell and reference cell) including the sapphire windows.



- 10.7 Replace the Hg lamp bulb when the Lamp Over-Range is triggered. (The new instrument does not display a value).
- 10.8 Each block digester is uniquely identified and the temperature is verified with each batch of samples. The temperature is turned to the 95°C setting and the block is allowed to come to temperature. The analyst will verify that the block gives a temperature of  $95 \pm 2^\circ\text{C}$  using a semi-annually-calibrated traceable handheld infrared thermometer. If not at the right temperature, the thermostat is adjusted until the IR thermometer reads  $95 \pm 2^\circ\text{C}$ .

## 11) Procedure

### 11.1 Sample Preparation

- 11.1.1 Mix the sample thoroughly to achieve homogeneity. For soil, sediment, solids, weigh approximately 0.5 g of well-homogenized sample and place in the bottom of a 125 mL digestion tube and record the weight to the nearest 0.01g. Add 5.0 mL of reagent water and 5.0 mL of aqua regia, then heat in the Block Digestion Unit for 2 minutes at 95°C.
- 11.1.2 Cool then add 10 mL of reagent water and 15 mL of potassium permanganate solution. If the purple color does not persist for 15 minutes, add additional potassium permanganate until it does so. Any additional potassium permanganate solution must also be added to the blanks and standards in equal proportion.  
**Note:** Spiking solution is added prior to acidification.
- 11.1.3 Mix thoroughly and place in the heating block for 30 minutes at 95°C. The temperature of the block is monitored with a thermometer that is calibrated annually.
- 11.1.4 Cool and add 6 mL of sodium chloride-hydroxylamine hydrochloride to reduce the excess permanganate. Perform this addition under a hood as  $\text{Cl}_2$  could be evolved.
- 11.1.5 Add 27 mL of reagent water and the sample is ready for analysis. (The vapor generator does the step of adding the stannous chloride solution automatically.)

### 11.2 Calibration

- 11.2.1 To prepare calibration standards a 10 ppm intermediate stock solution is first prepared by aliquoting 1.0 mL of commercially prepared 1000 ppm stock standard into an acid rinsed 100 mL Class A volumetric flask and diluting to volume with 1%  $\text{HNO}_3$ . This solution must be prepared monthly. Next, a 100 ppb working solution is prepared by aliquoting 1.0 mL of the 10 ppm intermediate stock solution into an acid rinsed 100 mL Class A volumetric flask and diluting to volume with 1%  $\text{HNO}_3$ . This solution must be prepared daily.  
**Note:** All standard aliquots are measured using calibrated fixed or adjustable volume autopipettors or calibrated disposable 5.0 or 10.0 mL pipettes.
- 11.2.2 Transfer 0, 0.1, 0.25, 0.5, 2.5 and 5.0 mL aliquots of the working solution to a series of labeled 125 mL digestion tubes. Add the appropriate amount of reagent water to bring each bottle to a volume of 5mL. Add 5.0 mL of aqua regia and heat in the heating block for 2 minutes at 95°C. The final concentrations of the prepared standards are 0, 0.2, 0.5, 1.0, 5.0, 10.0 ppb.



- 11.2.3 The Initial Calibration Verification (ICV) is prepared by first making a 1000 ppb intermediate solution. 0.10 mL of commercially prepared 1000 ppm stock standard, from a different manufacturer and lot than the calibration standard, is aliquoted into an acid rinsed 100 mL Class A volumetric flask and diluting to volume with 1% HNO<sub>3</sub>. This solution must be prepared monthly. Prepare the ICV standard by aliquoting 0.25 mL to a labeled 125 mL digestion tube. Add the 4.75 mL of reagent water and 5.0 mL of Aqua Regia.
- 11.2.4 Cool and then add 10 mL of reagent water and 15 mL of potassium permanganate solution and return the tubes to the Block Digestion Unit for 30 minutes.
- 11.2.5 Cool and add 6.0 mL of sodium chloride-hydroxylamine hydrochloride solution. Add 27 mL of reagent water and the standards are ready for analysis.
- 11.2.6 CETAC Calibration and Sample Analysis
- 11.2.6.1 Turn on the CETAC instrument, including the Hg lamp, and autosampler. After this is done turn open the operating software (Mercury Analyzer 1.6.5).
- 11.2.6.2 The rinse station for the autosampler turns on automatically, but the peristaltic pump must be started manually. Make sure all sample uptake and drain tubes are placed correctly on the pump and are secured with the appropriate tension. Place the reagent uptake tube in the stannous chloride and start the pump.
- 11.2.6.3 From the software's main screen select "File", then: "New From". Under "Template Worksheet", click "Browse" and then select "Kelso Hg Template II". Enter the name of the worksheet and click: OK.
- 11.2.6.4 Go to the "Sequence Editor" tab to generate a sequence, then enter the QC and field samples to be analyzed in the appropriate order.
- 11.2.6.5 Transfer the solutions to be analyzed to labeled 12mL polyethylene test tubes and place them in the appropriate spaces on the autosampler trays.
- 11.2.6.6 Transfer the calibration blank and standards (0.2, 0.5, 1.0, 5.0, and 10 ppb) from their digestion tubes to the standard tubes located behind the autosampler trays. The calibration blank is placed in the left most tube and the other standards are placed in ascending order to the right.
- 11.2.6.7 Click start and the analysis will begin.
- 11.2.6.8 After the calibration standards have run the software will use linear regression to create a calibration curve based on the concentration and measured absorbance of each standard. The form of regression line is  $y = mx + b$ . If the correlation coefficient of the curve is greater than 0.995 the analysis will continue, if not the analysis will be terminated and corrective action will be needed by the analyst.
- 11.3 As the analysis sequence proceeds, next analyze the following QC standards.
- ICV (5.0 ppb standard prepared from a second source)
  - ICB
  - CRA (0.2 ppb calibration standard)
  - CCV (5.0 ppb calibration standard)
  - CCB



11.3.1 If either the ICV or CCV are different from their true values by more than 10% the software will terminate the analysis. If either the ICB or CCB is greater than the MRL the software will terminate the analysis. Method 7471A does not contain criteria for the CRA, however, the result must be a positive measured concentration. For 7471B analyses the criteria are  $\pm 30\%$  of the true value. Also, specific project requirements may apply.

**Note:** For projects falling under DoD QSM requirements, the QSM criteria for CRA standards is  $\pm 20\%$  and for ICB and CCB standards no analytes detected > LOD. (The ICV limit is as listed above.)

#### 11.4 Sample Analysis

11.4.1 The samples are analyzed with the CETAC analyzer in the same manner as the calibration standards. The analyzer does the step of adding the stannous chloride solution automatically. Check the baseline between samples to verify that the spectrometer reading has stabilized at the normal baseline level.

11.4.2 The analytical sequence should be set up to include all samples, QC samples, blanks, and calibration verification standards at necessary intervals. Refer to the SOP for Sample Batches.

11.5 Sample digestion batches are analyzed with a set of CCV and CCB standards which are run at the beginning and end of the analytical run and at a minimum every 10 samples during the run. The same criteria listed above are applied to the CCVs and CCBs and if one is found to be outside these limits the analysis is terminated.

## 12) QA/QC Requirements

### 12.1 Initial Precision and Recovery Validation

12.1.1 This method shall operate under the formal Quality Assurance Program established at ALS and must maintain records that define the quality of data that is generated. Data shall be compared to established criteria in order to determine if the results of the analyses meet the performance characteristics of the method. It is required that an initial demonstration of capability and periodic analysis of laboratory reagent blanks, laboratory fortified blanks, and other QC solutions as a continuing check on performance. The accuracy and precision of the procedure must be validated *before* analyses of samples begin, or whenever significant changes to the procedures have been made.

12.1.2 Initial demonstration of capability must be performed by each analyst performing sample analysis and documented in the laboratory records.

### 12.2 Method Detection Limits

12.2.1 A method detection limit (MDL) study must be undertaken before analysis of samples can begin. To establish detection limits that are precise and accurate, the analyst must perform the following procedure. Spike a minimum of seven blank replicates with a MDL spiking solution near the MRL and analyze. Refer to *Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Quantification*.

12.2.2 Calculate the average concentration found ( $\bar{x}$ ) in  $\mu\text{g/L}$ , and the standard deviation of the concentrations ( $s$ ) in  $\mu\text{g/L}$  for each analyte. Calculate the MDL for each analyte. Refer to ADM-MDL.

**Note:** Method Detection Limits are subject to change as new MDL studies are completed.



12.3 Limits of Quantification

12.3.1 The laboratory establishes a Limit of Quantitation (LOQ) for each analyte as the lowest reliable laboratory reporting concentration or in most cases the lowest point in the calibration curve which is less than or equal to the desired regulatory action levels, based on the stated project requirements. Analysis of a standard or extract prepared at the lowest point calibration standard provides confirmation of the established sensitivity of the method. The LOQ recoveries should be within 70-130% of the true values to verify the data reporting limit. Refer to ADM-MDL.

12.4 For method 7471B, an LLQC sample (a CRA that is carried through the digestion) must be analyzed to verify accuracy at the MRL. The recovery must be  $\pm 30\%$ .

12.5 Ongoing QC Samples required are described in the ALS-Kelso Quality Assurance Manual, in *Sample Batches* (ADM-BATCH). For this analysis, these include:

12.5.1 Prepare one method blank (MB) per digestion batch, or per 20 samples, or per EPA SDG group, whichever is more frequent. Use D.I. water and follow the digestion procedures. The Method Blank should be  $< \text{MRL}$ . Re-digest the associated samples if sample levels are  $< 20\text{X}$  MB level.

**Note:** For projects falling under DoD QSM requirements, the QSM criteria for method blanks is no analytes detected  $> \frac{1}{2}$  MRL.

12.5.2 Prepare one Laboratory Control Sample (LCS) per digestion batch, or per 20 samples. Weigh 0.25 g of the current lot of "Environmental Resource Associates Priority Pollutant/CLP Inorganic Soil" prepared reference material in to a 125 mL Digestion vessel tube and prepare as per the procedure.

12.5.3 Calculate the LCS recovery as follows:

$$\%R = X/TV \times 100$$

Where

X = Concentration of the analyte recovered  
TV = True value of amount spiked

Apply LCS recovery criteria from the DQO Table, unless project-specific or in-house limits are established. For method 7471B, the LCS recovery limits are 80-120%. If statistical in-house limits are used, they must fall within the 80-120% range.

**Note:** For DoD QSM projects, the QSM LCS criterion is 80-120%. If the LCS fails the acceptance criteria, re-digest the batch of samples.

12.5.4 Prepare one sample duplicate and one matrix spike sample per each digestion batch, or per twenty samples, whichever is more frequent. For the matrix spike, add 0.25mL of the matrix spike solution to the designated spike sample, resulting in a spike concentration of 0.5 mg/kg. At times, specific samples will be assigned as duplicates or spikes depending on client requirements.

**Note:** Duplicate samples are routinely analyzed; however some projects may require a MSD. All DOD projects require a MSD. The MSD sample is prepared as described above.

12.5.5 The RPD criterion for duplicates is 20%. If not, flag the data or re-digest samples. Apply matrix spike recovery criterion listed in the DQO Table, unless



project-specific limits are required. For method 7471B, the recovery limits are 80-120%. If statistical in-house limits are used, they must fall within the 80-120% range. For DoD QSM work, MS recoveries are assessed using the QSM LCS control limits. If the MS (and/or MSD where applicable) recovery is outside acceptance limits proceed with the additional interference tests. Based on results of these tests, the physical nature of the sample (e.g. homogeneity), and any specific project requirements, a determination can then be made as to appropriate corrective action (e.g. re-digestion, reporting with a qualifier, alternative methodologies, etc.). If the analyte concentration is >4x the spike level the spike control limit is no longer applicable and no action is required.

**Note:** For DoD QSM projects, the duplicate RPD limit is 20% and MS recoveries are assessed using the QSM LCS control limits 80-120%.

12.5.5.1 Calculate percent recovery (%R) as:

$$\%R = \frac{X - X1}{TV} \times 100$$

Where X = Concentration of the analyte recovered  
X1 = Concentration of unspiked analyte  
TV = True value of amount spiked

12.5.5.2 Calculate Relative Percent Difference (RPD) as:

$$\%RPD = \frac{|R1 - R2|}{(R1 + R2) / 2} \times 100$$

Where R1 = Higher Result  
R2 = Lower Result

12.5.6 Interference Tests: Prepare one post spike for every batch of samples and if samples are sufficiently high (10x the MRL/LOQ) a serial dilution. The serial dilution must agree within 10% of the original sample result. Post spike recovery acceptance limits for method 7471A and 7471B are 80-120% for project falling under SW-846 Update IV. When both the post spike and dilution tests fail all of the samples in the associated preparation batch must be quantified via Method of Standard Additions (MSA).

### 13) Data Reduction and Reporting

- 13.1 It is the analyst's responsibility to review analytical data to ensure that all quality control requirements have been met for each analytical run. Results for QC analyses are calculated and recorded as specified in section 12.
- 13.2 Record all sample weight, volumes and dilutions on an A.A. benchsheet (see Attachments).
- 13.3 Solution concentrations are calculated by the Mercury Analyzer software based on the linear regression calibration curve created when the calibration standards are analyzed. The absorbance measured for each sample is applied to the linear regression curve and the final solution concentration is determined and displayed as the instrument result.
- 13.4 Calculate sample results using the data system printouts and digestion information. The digestion and dilution information is entered into the data system. The data



system then uses the calculations below to generate a sample result. Solid samples are reported in mg/Kg:

$$\text{mg/Kg(Sample)} = C^* \times \text{PostDigestionDilutionFactor} \times \frac{\text{DigestionVol.(ml)}}{\text{Samplewt.(g)}} \times \frac{1\text{mg}}{1000\text{ug}} \times \frac{1\text{L}}{1000\text{ml}} \times \frac{1000\text{g}}{1\text{Kg}}$$

C\*= Concentration of analyte as measured at the instrument in ug/L (in digestate).

**NOTE:** If results are to be reported on a dry weight basis as required by certain projects, the Sample Wt. (g) component of the equation should be the dry-weight derived from a determination of %moisture of a separate aliquot of the sample using the SOP for Total Solids.

- 13.5 Record all concentrations determined at the instrument and calculate the final results in mg/Kg. Record the final results on the A.A. Benchsheet.
- 13.6 The data packet for the sequence is submitted for review by supervisor or designee. The results are transferred to the appropriate report form located in the ALS network directory R:\ICP\WIP. Once the results are transferred, the report is reviewed.
- 13.7 A daily run log of all samples analyzed is maintained. All data should be printed and stored after operator has checked for evenness of burns. A copy of this document will go with each package of Tier III or higher data run that day.
- 13.8 Refer to the SOP *Laboratory Data Review Process* (ADM-DREV) for general instructions for data review.

#### 14) Method Performance

- 14.1 Available method performance data is given in the reference method. In addition, this procedure was validated through single laboratory studies of accuracy and precision as in the determinative procedure. The method detection limit(s) and method reporting limit(s) are established for the determinative procedure. See *Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Quantitation*.

#### 15) Pollution Prevention and Waste Management

- 15.1 The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Lab Waste Management Plan.

#### 16) Contingencies for Handling Out-of-Control or Unacceptable Data

- 16.1 Refer to the SOP for *Nonconformance and Corrective Action Procedure* (ADM-NCAR) for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

#### 17) Training

- 17.1 All analysts performing this analysis are required to read and understand this SOP.



17.2 Training is documented following the *Employee Training and New Employee Orientation* (ADM-TRAIN).

### 18) Method Modifications

18.1 There are no known modifications in this laboratory standard operating procedure from the reference method.

### 19) References

- 19.1 USEPA, Test Methods for Evaluating Solid Waste, SW-846, 3rd Edition, Update IV, Method 7471B, Revision 2, February 2007.
- 19.2 DoD Quality Systems Manual for Environmental Laboratories, current version.
- 19.3 TNI Standard, Volume 1, 2009 & 2016.
- 19.4 ISO/IEC 17025:2017 American National Standard, General requirements for the competence of testing and calibration laboratories.

### 20) Changes Since the Last Revision

Summary of Revision Changes			
Revision Number	Effective Date	Document Editor	Description of Changes
21.0	12/4/2020	T. Caron	Updated SOP signatories. Sections 8 & 10: Added the use of an infrared thermometer to verify hot block operating temperature.

### 21) Attachments, Tables, and Appendices

- 21.1 Table 1: Analysis Parameters - M 6100 Mercury Analyzer.
- 21.2 Table 2: Summary of Corrective Actions.



**Table 1**  
**Analysis Parameters M-6100 Mercury Analyzer**

*Analysis Parameters*

**Instrument** M-6100 Mercury Analyzer

**Conditions**

Gas flow (mL/min)	Sample Uptake (s)	Rinse (s)	Read delay (s)	Replicates (#)	Replicate time (s)	Pump speed (%)	Wavelength (nm)
40	30.00	60.00	50.00	4	2.00		253.65

**Instrumental Zero**

Zero before first sample: No  
Zero periodically: Yes  
Before each calibration:

**Baseline Correction**

#1 Start time (s)	#1 End time (s)	#2 Start time (s)	#2 End time (s)
5.00	10.00		

**Standby Mode**

Enabled: Yes  
Standby Options: gas off, lamp off

**Autodilution**

Enabled: No  
Condition:  
Tube # range:  
If no autodilution tubes remaining

**Calibration**

**Settings**

Algorithm	Through blank	Weighted fit	Cal. Type	Recalibration rate	Reslope rate	Reslope standard
Linear	Yes	No	Normal	0	0	N/A

**Limits**

Calibration slope		Reslope		Coeff. of Determination
Lower (%)	Upper (%)	Lower (%)	Upper (%)	
75	125	75	125	0.99500

Error action: Stop analysis

**QC**

GLP Override: Yes

**QC Tests**



Table 2

Summary of Corrective Actions

Method Reference	Control	Specification and Frequency	Acceptance Criteria	Corrective Action
EPA 7471A/B	ICAL	Prior to sample analysis	$R2 \geq 0.995$	Correct problem then repeat ICAL
EPA 7471A/B	ICV	After ICAL	$\pm 10\%$	Correct problem and verify second source standard; rerun second source verification. If fails, correct problem and repeat initial calibration.
EPA 7471A/B	CCV	Prior to sample analysis	$\pm 10\%$	Correct problem then repeat CCV or repeat ICAL
EPA 7471A/B	Method Blank	Include with each analysis batch (up to 20 samples)	<MRL	If target exceeds MRL, reanalyze to determine if instrument was cause. If still noncompliant then:  Re-extract or reanalyze samples containing contaminate, unless samples contain > 20x amount in blank.
EPA 7471A/B	Laboratory Control Sample	Include with each analysis batch (up to 20 samples)	See DQO	If exceeds limits, re-extract and re-analyze
EPA 7471A/B	Matrix Spike	Include with each analysis batch (up to 20 samples)	See DQO	Evaluate data to determine if there is a matrix effect or analytical error
EPA 7471A/B	Sample Duplicates	Include with each analysis batch (up to 20 samples)	$\leq 20\% \text{ RPD}$	Re-homogenize and re-analyze if result is > 5 X the MRL



## Metals Digestion of Aqueous Samples

DOCUMENT ID: MET-DIG REVISION 20.0

Prepared By:   
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Date: 12/1/20

Prepared By:   
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Date: 12/1/2020

Approved By:   
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Date: 12-1-20



## 1) Scope & Applicability

- 1.1 This procedure is used to prepare aqueous samples for determination of metals using ICP and ICP/MS methodologies. This procedure is the ALS default water digestion procedure and is based on methods described in EPA CLP ILM04.0, EPA 200.8, EPA 200.7, and EPA SW-846 3005A.
- 1.2 This procedure is applicable to all "CLP" scope of elements plus boron and molybdenum.
- 1.3 This procedure is used for the determination of dissolved as well as total recoverable metals.
- 1.4 This procedure is applicable to drinking water and non-potable water sample matrices.
- 1.5 In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPP's supersede method specified requirements. An example of this are projects falling under DOD ELAP. QC requirements defined in the SOP *Department of Defense Projects - Laboratory Practices and Project Management* (ADM-DOD) may supersede the requirements defined in this SOP.

## 2) Summary of Procedure

- 2.1 A representative aliquot of aqueous sample is digested in nitric, hydrochloric acid, or a mix of acids/reagents. After cooling, the sample is made up to volume prior to analysis.
- 2.2 This digestion procedure is carried out in a Class-10,000 clean room and "Clean" procedures are utilized throughout.

## 3) Definitions

- 3.1 For general definitions applicable to most analyses refer to the SOP for *Sample Batches*, ADM-BATCH.

## 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. The department supervisor/manager or designee performs final review and sign-off of the data.
- 4.2 It is the responsibility of the department supervisor/manager to document analyst training and method proficiency, as described in the ALS-Kelso SOP: *Employee Training and Orientation*, (ADM-TRAIN).

## 5) Interferences

- 5.1 Refer to the determinative method for a discussion of interferences.



## 6) Safety

- 6.1 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Kelso Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.
- 6.2 Hydrochloric and/or Nitric Acid are used in this method. These acids are extremely corrosive and care must be taken while handling them. A face shield should be used while pouring acids. And safety glasses should be worn while working with the solutions. Lab coat and gloves should always be worn while working with these solutions.
- 6.3 Hydrogen peroxide is an irritant of the eyes, mucous membranes, and skin. Inhalation of high concentrations of the vapor or mist may cause extreme irritation of the nose and throat. Lab coat, gloves and safety eyewear must be worn while working with this reagent.

## 7) Sample Collection, Containers, Preservation, and Storage

- 7.1 Aqueous samples are preserved with nitric acid ( $\text{pH} < 2$ ), then stored at room temperature from receipt until analysis. If properly acid preserved, the sample can be held up to 6 months before analysis.
- 7.2 Samples acidified at the laboratory must be held for 24 hours, then the pH verified as  $< 2$  prior to digestion.
- 7.3 Metals holding time is six months from sample collection until analysis.

## 8) Apparatus and Equipment

- 8.1 Class 10,000 clean room equipped with Class 100 High Efficiency Particulate Air (HEPA) filter equipped laminar flow hoods.
- 8.2 Hot Blocks
- 8.3 Powder free PVC gloves
- 8.4 16 mL plastic autosampler (digestion) tubes (Evergreen 214-2380-030).
- 8.5 Reflux caps for 14 mL digestion tubes (VWR 101093-898).
- 8.6 Evergreen disposable tubes and caps, 50 mL. Check tubes for accuracy on a per Lot basis at each of the volumes being used (i.e. 10 mL, 25 mL, and 50 mL) by filling a tube to the appropriate mL mark and measuring the water's mass in ten different tubes. The measured mass must be accurate to plus or minus 3%, if not obtain a new lot of tubes and re-test. Refer to the SOP for *Checking Volumetric Labware* (ADM-VOLWARE) for detailed instructions on performing the accuracy test.
- 8.7 Hot Plates.
- 8.8 Glass watch glasses, ribbed watch glasses.
- 8.9 Glass Beakers.
- 8.10 Infrared Thermometer.

## 9) Standards, Reagents, and Consumable Materials



- 9.1 Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Standards, reagents and consumable material documentation shall indicate traceability to purchased reagents or compounds. Refer to the SOP *Reagent/Standards Login and Tracking*, for the complete procedure and documentation requirements.
- 9.2 All stocks, working solutions and sample dilutions should be prepared using deionized water (DI) conforming to ASTM Type I or ASTM Type II reagent water. For more information on reagent water generation, refer to the related SOP, Operation and Maintenance of Laboratory Reagent Water Systems.
  - 9.2.1 Reagent water: ASTM Type I water (resistivity  $\geq 18$  M $\Omega$ -cm, conductivity  $\leq 0.056$  uS/cm).
  - 9.2.2 Concentrated Nitric Acid - demonstrated to be free of impurities
  - 9.2.3 Concentrated hydrochloric acid - demonstrated to be free of impurities
  - 9.2.4 Ultrex concentrated hydrochloric acid - demonstrated to be free of impurities
- 9.3 Standards
  - 9.3.1 Stock standard solutions may be purchased from a number of vendors. All reference standards, where possible, must be traceable to SI units or NIST certified reference materials. The vendor-assigned expiration date is used.
  - 9.3.2 Metals spiking solutions: 12 solutions are needed to prepare the matrix spiking standards: SS1, SS2, SS3, SS4, SS5, K-MET Hydride, QCP-CICV-1, QCP-CICV-3, 1/100 QCP-CCV-1, 5  $\mu$ g/mL Sb, 1/100 QCP-CICV-3 and Mo/U 5 ppm.
    - 9.3.2.1 QCP-CICV-1 and QCP-CICV-3 are purchased as prepared standards.
  - 9.3.3 Follow the formulations laid out on the "Metals Spiking Solutions Concentrations Form" and "ICPMS LCSW and spiking Solutions Form" (See Tables A and B). These solutions are prepared in acid rinsed Class A volumetric flasks using purchased custom mixed standards and 1000ppm and 10,000 ppm, single analyte standards. Aliquots are made using acid rinsed Class A volumetric pipettes of the appropriate size.
    - 9.3.3.1 SS1 (Al, Ag, Ba, Be, Cd, Co, Cr, Cu, Fe, Pb, Mn, Ni, Sb, V and Zn).  
Fill a 1000 mL Volumetric flask approximately half full with reagent water. Add 50 mL of nitric acid and mix. Next add 50 mL of 1000 ppm Sb. In addition add 100 mL of the custom mixed standard (CAS-CAL-14) purchased from Inorganic Ventures. Dilute to volume with reagent water and transfer to a 1000 mL Teflon bottle for storage. The solution expiration date is determined by the earliest expiration date of any single component in the solution.
    - 9.3.3.2 SS2 (As, Cd, Se, Pb, Tl and Cu): Fill a 500 mL volumetric flask approximately half full with reagent water, add 25 mL of nitric acid and mix. Next add 2.0 mL each of 1000 ppm Arsenic,



Cadmium, Lead, Selenium, Thallium and Copper. Dilute to volume with reagent water, mix thoroughly and transfer to a 500 mL Teflon bottle for storage. The solution expiration date is determined by the earliest expiration date of any single component in the solution.

- 9.3.3.3 SS3 (As, Se, Tl and Hg) Fill a 500 mL volumetric flask approximately half full with reagent water, add 25 mL of nitric acid and mix. Next add 50 mL of each of 1000 ppm Arsenic and Selenium. In addition add 10 mL of 1000 ppm Thallium and 6 mL of 1000 ppm Hg.
- 9.3.3.4 SS4 (B, Mo, U): Fill a 500 mL volumetric flask approximately half full with reagent water, add 25 mL of nitric acid and mix. Next add 25 mL of 1000 ppm Boron, 50 mL of 1000 ppm Molybdenum and 10 mL of 1000 ppm Uranium. Dilute to volume with reagent water, mix thoroughly and transfer to a 500 mL Teflon bottle for storage. The solution's expiration date is determined by the earliest expiration date of any single component in the solution.
- 9.3.3.5 SS5 (Fill a 200 mL volumetric flask approximately half full with reagent water. Next add 10.0 mL of nitric acid. Next add 20.0 mL of 10,000 ppm individual standards K, Na, Mg and Ca. Dilute to volume with reagent water, mix thoroughly and transfer to a 1000 mL Teflon bottle for storage. The solution expiration date is determined by the earliest expiration date of any single component in the solution.
- 9.3.3.6 K-met 1/100 QCP-CICV-1: Fill a 500 mL volumetric flask approximately half full with reagent water. Next add 5.0 mL of QCP-CICV-1 and 5 mL of Ultrex nitric acid. Dilute with reagent water mix thoroughly and transfer to a 500 mL Teflon bottle for storage. The solution expiration date is determined by the earliest expiration date of any single component in the solution.
- 9.3.3.7 K-met 1/100 QCP-CICV-3: Fill a 500 mL volumetric flask approximately half full with reagent water. Next add 5.0 mL of QCP-CICV-3 and 5 mL of Ultrex nitric acid. Dilute with reagent water mix thoroughly and transfer to a 500 mL Teflon bottle for storage. The solution expiration date is determined by the earliest expiration date of any single component in the solution.
- 9.3.3.8 K-met 1 µg/mL Sb: Fill a 500 mL volumetric flask approximately half full with reagent water. Next add 1% HNO<sub>3</sub> acid. Add 0.50 mL of 1000 ppm Sb, dilute with reagent water, mix thoroughly and transfer to a 500 mL HDPE bottle for storage.
- 9.3.3.9 K-met Mo/U 5ppm: Fill a 200 mL volumetric flask approximately half full with reagent water. Next add 1% HNO<sub>3</sub> acid. Add 1.00 mL of 1000 ppm Mo and 1000 ppm U, dilute with reagent water, mix thoroughly and transfer to a 500 mL HDPE bottle for storage.

## 10) Preventative Maintenance

### 10.1 Facility and Equipment Preparation



- 10.1.1 Laboratory equipment (i.e. centrifuge tubes, filtration apparatus, etc.) which comes in contact with the sample or digestate during the analysis must be thoroughly pre-cleaned with 1:5 HCl, and rinsed with DI water. All laboratory equipment used for trace metals analysis shall be stored in the clean room, and shall not be used for any other purpose.
- 10.1.2 All clean room work areas, including bench tops and laminar flow hoods, should be frequently washed and wiped dry with lint free; class-100 wipes to remove contamination.
- 10.2 Each block digester is uniquely identified and the temperature is verified with each batch of samples. The temperature is turned to the 95°C setting and the block is allowed to come to temperature. The analyst will verify that the block gives a temperature of  $95 \pm 2^\circ\text{C}$  using a semi-annually-calibrated traceable handheld infrared thermometer. If not at the right temperature, the thermostat is adjusted until the IR thermometer reads  $95 \pm 2^\circ\text{C}$ .

## 11) Procedure

- 11.1 Sample Digestion (25 mL Volume)
  - 11.1.1 Set up the sample batch in LIMs and print the *Preparation Information Sheet*. All digestion and sample information on this benchsheet.
  - 11.1.2 Shake the sample and measure a 25 mL aliquot into a 50 mL centrifuge tube. Use DI water for the MB and LCS.
  - 11.1.3 Add the appropriate spiking solutions directly into the designated MS and LCS samples prior to addition of reagents. The amount and mix of spiking solutions are determined during the initial batch set up in LIMs. Typically this is 0.1 mL - 0.5 mL appropriate spiking solution. Fill out a spiking data sheet and keep it with the digestion data sheets.
    - 11.1.3.1 Pipette tips used for ICP-MS analysis require pre-cleaning. This is done by rinsing once (1X) with diluted Ultrex HNO<sub>3</sub> and once (1X) with DI water. Dispose of the rinse into an acid waste container.
  - 11.1.4 The amount of type of reagents added for digestion will vary depending upon the method used for the final determination. The follow table list the amount and type of reagent to add:

Method	HNO <sub>3</sub>	HCL	Ultrex HCL
200.7 & 6010	0.25 mL	1.25 mL	
200.8	0.25 mL		0.05 mL
6020	0.25 mL		0.05 mL

- 11.1.4.1 If the sample is being prepared for analysis by ICP, add 0.25 mL of concentrated HNO<sub>3</sub>, and 1.25 mL of concentrated HCL. Cap centrifuge tube with open reflux caps.
- 11.1.4.2 If sample is being prepared for analysis by ICP-MS aliquot 25 mL into an acid rinsed centrifuge tube and add 0.25 mL of concentrated nitric acid and 0.05 mL of Ultrex hydrochloric acid. Cap centrifuge tube with centrifuge tube caps.



- 11.1.5 Place the centrifuge tube containing the sample in the “Block Digester”, located in the Clean Room laminar flow hood, and heat at 95°C for two hours, or until the volume has been reduced to between 15 and 25 mL.
- 11.1.6 Allow the sample to cool and dilute to the 25 mL mark with ASTM Type I - DI water.
- 11.1.7 Insoluble material is allowed to settle overnight, or the digestate may be centrifuged.
- 11.1.8 The digestates are ready for analysis.
- 11.2 Sample Digestion (10 mL Volume)
  - 11.2.1 Set up the sample batch in LIMs and print the *Preparation Information Sheet*. All digestion and sample information on this benchsheet.
  - 11.2.2 Reflux caps used during the digestion procedure require pre-cleaning. First soak the caps in a 5% HNO<sub>3</sub> solution for at least 30 minutes, preferably overnight. Then DI rinse the caps 6 times. 16 mL tubes are rinsed once with DI water.
  - 11.2.3 Shake the sample and measure a 10 mL ± 3% aliquot into a 16 mL digestion tube by pouring sample directly into the tube and using an adjacent pre-marked “template” tube to achieve the desired volume. The template tube has graduations at 9.7 and 10.3 mL.  
  
Note: The “template” tube must be from the same manufacturer’s lot as the tubes being used for samples
  - 11.2.4 Use DI water for the MB and LCS for all test codes except 'As Se SeaH20'. For test code 'As Se SeaH20' use 8 mL of DI and 2 mL of 10-11% NaCl.
  - 11.2.5 Add the appropriate spiking solutions directly into the designated MS and LCS samples prior to addition of reagents. The amount and mix of spiking solutions are determined during the initial batch set up in LIMs. Typically this is 0.02 mL - 0.1 mL appropriate spiking solution. Fill out a spiking data sheet and keep it with the digestion data sheets.
    - 11.2.5.1 Pipette tips used for ICP-MS analysis require pre-cleaning. This is done by rinsing once (1X) with diluted Ultrex HNO<sub>3</sub> and once (1X) with DI water. Dispose of the rinse into an acid waste container.
  - 11.2.6 The amount of type of reagents added for digestion will vary depending upon the method used for the final determination. The follow table list the amount and type of reagent to add:

Method	HNO <sub>3</sub>	HCL	Ultrex HCL
200.7 & 6010	0.1 mL	0.5 mL	
200.8	0.1 mL		0.02 mL
6020	0.1 mL		0.02 mL

- 11.2.6.1 If the sample is being prepared for analysis by ICP, add 0.1 mL of concentrated HNO<sub>3</sub>, and 0.5 mL of concentrated HCL. Cap digestion tube with reflux cap.



- 11.2.6.2 If the sample is being prepared for analysis by ICP-MS, add 0.1 mL of concentrated  $\text{HNO}_3$ , and 0.02 mL of Ultrex concentrated HCl. Cap digestion tube with reflux cap.
- 11.2.7 Place the digestion tube containing the sample in the "Block Digester", located in the Clean Room laminar flow hood, and heat at  $95^\circ\text{C}$  for two hours, or until the volume has been reduced to between 6 and 10 mL.
- 11.2.8 Remove the sample from the block digester and allow it to cool.
- 11.2.9 The final volume is determined multiplying the initial 10 mL volume by the experimentally derived factor below:
  - 11.2.9.1 ICP sample digest factor - 1.05
  - 11.2.9.2 ICP matrix spike factor - 1.09
  - 11.2.9.3 ICP LCSW factor - 1.07
  - 11.2.9.4 ICPMS sample digest factor - 1.00
  - 11.2.9.5 ICPMS matrix spike factor - 1.03
  - 11.2.9.6 ICPMS LCSW factor - 1.03
- 11.2.10 Insoluble material is allowed to settle overnight, or the digestate may be centrifuged.
- 11.2.11 The digestates are ready for analysis.
- 11.3 Procedure for Arizona Samples
  - 11.3.1 For the determination of total recoverable analytes in aqueous samples, transfer a 100 mL ( $\pm 1$  mL) aliquot from a well-mixed, acid preserved sample to an acid/DI rinsed 150 mL borosilicate beaker.
  - 11.3.2 Add 1 mL concentrated nitric acid and 0.5 mL concentrated hydrochloric acid to the beaker containing the measured volume of sample. Place the beaker on a 95 degree Hot Plate, located in a clean room laminar flow hood, for solution evaporation.
  - 11.3.3 Reduce the volume of the sample aliquot to about 20 mL by gentle heating. DO NOT BOIL. This step takes about two hours for a 100 mL aliquot with the rate of evaporation rapidly increasing as the sample volume approaches 20 mL.
  - 11.3.4 Cover the beaker with a glass watch glass to reduce additional evaporation and gently reflux the sample for 30 minutes. (Slight boiling may occur, but vigorous boiling must be avoided to prevent loss of the HCl-H<sub>2</sub>O azeotrope).
  - 11.3.5 Allow the sample to cool then dilute with reagent water to a final volume of 50 mL in a centrifuge tube. Seal the tube with an acid/DI rinsed cap and mix.
  - 11.3.6 Allow any undissolved material to settle overnight, or centrifuge a portion of the prepared sample until clear. (If after centrifuging or standing overnight the sample contains suspended solids that would clog the nebulizer, a portion of the sample may be filtered for their removal prior to analysis. However, care should be exercised to avoid potential contamination from filtration).



11.3.7 Prior to analysis, adjust the chloride concentration by diluting the sample 2.0 fold. (If the dissolved solids in this solution are >0.2%, additional dilution may be required to prevent clogging of the extraction and/or skimmer cones.) The sample is now ready for analysis. Because the effects of various matrices on the stability of diluted samples cannot be characterized, all analyses should be performed as soon as possible after the completed preparation.

## 12) QA/QC Requirements

12.1 This method shall operate under the formal Quality Assurance Program established at ALS and must maintain records that define the quality of data that is generated. Data shall be compared to established criteria in order to determine if the results of the analyses meet the performance characteristics of the method. It is required that an initial demonstration of capability and periodic analysis of laboratory reagent blanks, laboratory fortified blanks, and other QC solutions as a continuing check on performance. The accuracy and precision of the procedure must be validated *before* analyses of samples begin, or whenever significant changes to the procedures have been made.

### 12.2 Initial Precision and Recovery Validation

12.2.1 The accuracy and precision of the procedure must be validated before analyses of samples begin, or whenever significant changes to the procedures have been made. To do this, four water samples are spiked with the LCS spike solution, then prepared and analyzed using the applicable method.

12.3 Ongoing QC Samples required are described in the ALS-Kelso Quality Assurance Manual and in the SOP for Sample Batches. Additional QC Samples may be required in project specific quality assurance plans (QAPP). General QA requirements for DoD QSM are defined in the laboratory SOP, *Department of Defense Projects - Laboratory Practices and Project Management*. General QC Samples are:

#### 12.3.1 Method Blank

12.3.1.1 A method blank is extracted and analyzed with every batch of 20 (or fewer) samples to demonstrate that there are no method interferences. If the method blank shows any hits above the reporting limit, corrective action must be taken. Corrective action includes recalculation, reanalysis, system cleaning, or re-extraction and reanalysis. For some project specific needs, exceptions may be noted and method blank results above the MRL may be reported for common lab contaminants.

#### 12.3.2 Lab Control Sample (LCS)

12.3.2.1 Digest one laboratory control sample with each sample batch. Use the appropriate dilution of Inorganic Ventures ICV solutions for the liquid laboratory control sample (LCSW).

#### 12.3.3 Matrix Spike and Sample Duplicates

12.3.3.1 Digest one duplicate and one spiked sample with each sample matrix. For 6010 and 6020, prepare one duplicate and spiked



sample on a five percent frequency per twenty samples. For 200.7 and 200.8, prepare a duplicate and spiked sample on a ten percent frequency per twenty samples, or per SDG group, whichever is more frequent. Specific samples may be assigned as duplicates or spikes depending on client requirements.

### 13) Data Reduction and Reporting

13.1 Digestion data sheets including sample weights and volumes used are completed and a batch lot number is assigned and attached to the data sheet. The Manufacturer's lot numbers for the reagents used are added to the digestion data sheet as well as the spiking solutions and amount.

### 14) Method Performance

14.1 Available method performance data is given in the reference method. In addition, this procedure was validated through single laboratory studies of accuracy and precision as in the determinative procedure. The method detection limit(s) and method reporting limit(s) are established for the determinative procedure. See *Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Quantitation*.

### 15) Pollution Prevention and Waste Management

15.1 The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Lab Waste Management Plan.

### 16) Contingencies for Handling Out-of-Control or Unacceptable Data

16.1 Refer to the SOP for *Nonconformance and Corrective Action Procedure* (ADM-NCAR) for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

### 17) Training

17.1 All analysts performing this analysis are required to read and understand this SOP.

17.2 Training is documented following the *Employee Training and New Employee Orientation* (ADM-TRAIN).

### 18) Method Modifications

18.1 This SOP contains no known modifications to the reference method.

### 19) References

19.1 EPA Contract Laboratory Program, ILM04.0

19.2 DETERMINATION OF TRACE ELEMENTS IN WATERS AND WASTES BY INDUCTIVELY COUPLED PLASMA - MASS SPECTROMETRY, Method 200.8, Revision 5.4, 1994

19.3 DETERMINATION OF METALS AND TRACE ELEMENTS IN WATER AND WASTES BY INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROMETRY, Method



200.7, Rev 4.4, 1994

- 19.4 Acid Digestion of Waters for Total Recoverable or Dissolved Metals for Analysis by FLAA or ICP Spectroscopy, EPA SW-846, Method 3005A, July 1992.
- 19.5 DoD Quality Systems Manual for Environmental Laboratories, current version.
- 19.6 TNI Standard, Volume 1, 2009 & 2016.

## 20) Changes Since the Last Revision

Summary of Revision Changes			
Revision Number	Effective Date	Document Editor	Description of Changes
20.0	12/4/2020	T. Caron	Updated SOP signatories. Minor typographical changes to improve readability and consistency, not affecting technical content. Section 8: Updated Metals equipment list to reflect current procedure. Section 10: Added the use of an infrared thermometer to verify hot block operating temperature. Section 11: Removed former reference to pre-cleaning centrifuge tubes for ICP-OES/ICP-MS analyses. Added 16 mL tube rinse.

## 21) Attachments, Tables, and Appendices

- 21.1 Table A: METALS SPIKING SOLUTION CONCENTRATION FORM.
- 21.2 Table B: ICPMS LCSW AND SPIKING SOLUTIONS.



**Table A**  
**METALS SPIKING SOLUTIONS CONCENTRATIONS FORM**

Solution Name	Element	mL of 1000 ppm Solution	Final Volume	Conc. (mg/L)	Enter mL Added	
K-MET SS1	HNO3	50.0	1000 mL	-		
	Al	100*	1000 mL	200		
	Ag	100*	1000 mL	5		
	Ba	100*	1000 mL	100		
	Be	100*	1000 mL	5		
	Cd	100*	1000 mL	5		
	Co	100*	1000 mL	50		
	Cr	100*	1000 mL	20		
	Cu	100*	1000 mL	25		
	Fe	100*	1000 mL	100		
	Pb	100*	1000 mL	50		
	*** Add after HNO3 and before cal -14 when making the solution	Mn	100*	1000 mL	50	
	Ni	100*	1000 mL	50		
Sb***	50	1000 mL	50			
V	100*	1000 mL	50			
Zn	100*	1000 mL	50			
K-MET SS2	HNO3	25.0	500 mL	-		
	As	2.0	500 mL	4		
	Cd	2.0	500 mL	4		
	Pb	2.0	500 mL	4		
	Se	2.0	500 mL	4		
	Tl	2.0	500 mL	4		
	Cu	2.0	500 mL	4		
K-MET SS3	HNO3	25.0	500 mL	-		
	As	50.0	500 mL	100		
	Se	50.0	500 mL	100		
	Tl	10.0	500 mL	20		
	Hg	6	500 mL	12		
K-MET SS4	HNO3	25	500 mL	-		
	B	25	500 mL	50		
	Mo	50	500 mL	100		
	U	10	500 mL	20		
K-MET SS5	HNO3	10.0	200 mL	-		



Solution Name	Element	mL of 1000 ppm Solution	Final Volume	Conc. (mg/L)	Enter mL Added
	K**	20	200 mL	1000	
	Na**	20	200 mL	1000	
	Mg**	20	200 mL	1000	
	Ca**	20	200 mL	1000	
<b>K-MET Hydride</b>	HNO3	1.0	100 mL	-	
	As, Se,	0.25	100 mL	2.5	
<b>K-MET QCP-CICV-1</b>	Ca, Mg,	no dilution	-	2500	
	Na, K	no dilution	-	1000	
	Al, Ba	no dilution	-	500	
	Fe	no dilution	-	500	
	Co, Mn,	no dilution	-	250	
	Ni, V, Zn	no dilution	-	250	
	Cu, Ag	no dilution	-	125	
	Cr	no dilution	-	100	
	Be	no dilution	-	25	
<b>K-MET QCP-CICV-3</b>	As, Pb,	no dilution	-	500	
	Se, Tl	no dilution	-	250	
	Cd	no dilution	-	250	

\* Denotes volume of mixed stock standard.

\*\* Denotes 10,000 ppm individual stock standards.

Standard	mLs of standard	ppm	Logbook #	Exp. Date



**Table B**  
**ICPMS LCSW AND SPIKING SOLUTIONS**

5.00mL to 500mL Dilution of Inorganics Ventures QCP-CICV-1		
<b>k-met 1/100 QCP-CICV-1</b>		
Analyte	Concentration in solution (ppb)	Concentration in digest (ppb)
Al	10000	100
Ba	10000	100
Co	2500	25
Mn	2500	25
Ni	2500	25
V	2500	25
Zn	2500	25
Cu	1250	12.5
Ag	1250	12.5
Cr	1000	10
Be	250	2.5
0.50mL to 500mL Dilution of 1000 ppm Sb		
<b>k-met 1 µg/mL Sb</b>		
Analyte	Concentration in solution (ppb)	Concentration in digest (ppb)
Sb	1000	10
5.00mL to 500mL Dilution of Inorganics Ventures QCP-CICV-3		
<b>k-met 1/100 QCP-CICV-3</b>		
Analyte	Concentration in solution (ppb)	Concentration in digest (ppb)
As	5000	50
Pb	5000	50
Se	5000	50
Tl	5000	50
Cd	2500	25
1.00mL to 200mL Dilution of 1,000 ppm Mo and 1,000 ppm U		
<b>k-met Mo/U 5 ppm</b>		
Analyte	Concentration in solution (ppb)	Concentration in digest (ppb)
Mo	5000	20
U	5000	20



STANDARD OPERATING PROCEDURE

ALS | Environmental - Kelso

TCLP Extraction

MET-TCLP, Revision 11.0

Effective: 2/09/2021

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## Metals and Semi-volatiles TCLP Extraction

DOCUMENT ID: MET-TCLP, REVISION 11.0

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Date: 2/04/2021

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Date: 2/04/2021

	STANDARD OPERATING PROCEDURE	TCLP Extraction
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## 1) Scope & Applicability

- 1.1 This Standard Operating Procedure (SOP) describes procedures for performing the extraction (excluding zero headspace extraction) of samples requiring Toxicity Characteristic Leaching Procedure (TCLP) analysis. The TCLP-ZHE procedure is described in *Zero Headspace Extraction* (EXT-ZHE). The TCLP procedure is designed to determine the mobility of organic and inorganic analytes present in various waste matrices. The results of a “total” analysis of the waste may be used to evaluate if the TCLP needs to be performed.
- 1.2 The determinative procedures for TCLP analysis, with the exception of a few special considerations, will be referenced in the appropriate determinative method.

## 2) Summary of Procedure

- 2.1 The sample is characterized as to its moisture content, size, physical state and miscibility in water (in cases of liquid samples). The flowcharts found in Appendix B should be used to aid in determination of these sample characteristics.
- 2.2 Liquid waste (those containing less than 0.5% solid material) is defined as the TCLP extract after passing through a 0.6 to 0.8 µm filter. For wastes containing greater than or equal to 0.5% dry solids, the liquid, if any, is separated from the solid phase. The solid phase is extracted with a proportionate amount of extraction fluid and subsequently analyzed. If compatible, the initial liquid phase of the waste is added to the liquid extract and these are analyzed together. If incompatible, the liquids are analyzed separately.

## 3) .Definitions

- 3.1 For laboratory definitions applicable to most analyses, refer to the SOP for *Sample Batches*.

## 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. The department supervisor/manager or designee performs final review and sign-off of the data.
- 4.2 It is the responsibility of the department supervisor/manager to document analyst training as described in the *Employee Training and Orientation* (ADM-TRAIN). Documenting method proficiency, as described in SW-846, is also the responsibility of the department supervisor/manager.

## 5) Interferences

- 5.1 Some samples such as paints, thick oils or fine particulates may cause problems due to their physical characteristics. Potential interferences that may be encountered during analysis are discussed in the determinative methods.
- 5.2 Filters used in various stages of the procedure should be pre-washed to reduce interferences. This may include acid washing to reduce metals contaminants.

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## 6) Safety

- 6.1 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan
- 6.2 Sodium Hydroxide (NaOH) is a strong caustic and a severe health and contact hazard. Use nitrile or latex gloves while handling pellets or preparing solutions.
- 6.3 Hydrochloric and/or Nitric Acid are used in this method. These acids are extremely corrosive and care must be taken while handling them. A face shield must be used while pouring acids.

## 7) Sample Collection, Containers, Preservation, and Storage

- 7.1 Samples should be collected (received) in glass jars with a minimum of headspace. Samples may be refrigerated at  $4 \pm 2^{\circ}\text{C}$  until analysis, unless damage to the physical characteristics of the sample will result. Preservatives shall not be added to samples prior to extraction.
- 7.2 Refer to subsequent sections for procedures for handling TCLP samples and extracts, including specification of holding times.

## 8) Apparatus and Equipment

- 8.1 Balance: accurate to within 0.1 gram
- 8.2 Beaker or Erlenmeyer flask (various sizes ranging from 100 mL to 500 mL)
- 8.3 Extraction Bottles: Borosilicate glass, Teflon, or plastic. Plastic bottles should not be used when organics are being determined. For TCLP Extractions performed for inorganic analyses only, disposable one time use extraction bottles are used.
- 8.4 Graduated Cylinders: various sizes 250 mL to 2000 mL
- 8.5 Drying Oven: capable of maintaining a constant temperature of  $100 \pm 20^{\circ}\text{C}$
- 8.6 Magnetic Stirrer and Stir Bar
- 8.7 pH Meter: accurate to  $\pm 0.05$  units at  $25^{\circ}\text{C}$ , calibrated as described in Appendix A.
- 8.8 Filtration Apparatus and filters suitable for filtration (vendors may sell pre-cleaned filters designed specifically for the method). Filters are borosilicate glass fiber and have an effective pore size of 0.6 to 0.8  $\mu\text{m}$ . When samples are to be analyzed for metals, filters shall be acid-washed prior to use by rinsing with 1N nitric acid, followed by three consecutive rinses with DI water. Glass fiber filters are fragile and should be handled with care.
- 8.9 Tumbler: Must be capable of rotating the extraction vessel end-over-end at  $30 \pm 2$  rpm.
- 8.10 Stopwatch, preferably digital for tumbler rotation checks.
- 8.11 Checkpoint Temp Sys<sup>®</sup> probe for temperature measurement during tumbler rotation.
- 8.12 Hot plate, capable of maintaining  $50^{\circ}\text{C}$ .
- 8.13 Infrared thermometer, Fluke Model 572-2.

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## 9) Standards, Reagents, and Consumable Materials

- 9.1 Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Refer to *Reagent/Standards Login and Tracking* for the complete procedure and documentation requirements.
- 9.2 Reagent water: ASTM Type II, or equivalent, water which is free of target analytes at the levels determined in section 5.2 of the TCLP method (Appendix A).
- 9.3 Glacial Acetic Acid: ACS reagent grade.
- 9.4 Hydrochloric Acid: Reagent grade concentrated acid ( Fill 1000 mL volumetric flask with 50 mL of deionized water; add 83.3 mL of reagent grade concentrated HCL; using deionized water - bring the solution to a final volume of 1000 mL .
- 9.5 Nitric acid: 1N, made from reagent grade concentrated acid.
- 9.6 Sodium Hydroxide: 1N, prepared from ACS reagent grade.
- 9.7 Extraction Fluid (#1): Add 5.7 mL glacial acetic acid ( $\text{CH}_3\text{CH}_2\text{OOH}$ ) to 500 mL of reagent water; add 64.3 mL of 1N sodium hydroxide (NaOH); dilute to 1 liter. Larger amounts of reagents may be combined, in correct proportion, if larger amounts of the extraction fluid are needed. When correctly prepared the pH of this fluid will be  $4.93 \pm 0.05$ . Record date prepared and pH in the preparation log.
- 9.8 Extraction Fluid (#2): Dilute 5.7 mL glacial acetic acid ( $\text{CH}_3\text{CH}_2\text{OOH}$ ) with reagent water to a volume of 1 liter. Larger amounts of reagents may be combined, in correct proportion, if larger amounts of the extraction fluid are needed. When correctly prepared the pH of this fluid will be  $2.88 \pm 0.05$ . Record date prepared and pH in the preparation log.
- 9.9 pH buffers, 2.00, 4.00, and 7.00. Expiration dates for the buffers are listed on the container. Buffers are replaced and disposed of before the expiration date passes. Portions poured into secondary containers for daily use are discarded daily. After calibration, the calibration of the pH meter is verified using a second source pH buffer solution.

## 10) Preventative Maintenance

- 10.1 Maintenance activities are generally limited to routine metrological checks of balances, monitoring of extraction room temperature, and verification of tumbler rotation speed. Documentation of this monitoring is maintained in either metrological logbooks kept by the QA department, or in lab records.
- 10.2 pH Probe Cleaning and Maintenance - The glass bulb should be cleaned every other week, or more, by placing it in a centrifuge tube with approximately 30 mL of 0.1N HCL. (The 0.1N HCL is made by adding 250  $\mu\text{l}$  of concentrated acid to 20 mL of de ionized water in a graduated centrifuge tube. Dilute to 30 mL with deionized water in the graduated centrifuge tube) and allowed to sit while stirring for approximately 5 minutes. Then rinse the probe with DI water 3 times and blot with a kimwipe.

## 11) Procedure



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- 11.1 Preliminary Evaluations: These procedures should be performed in cases where the waste is not obviously solid (contains a liquid phase that cannot be completely mixed into the solid phase without a phase separation occurring) and/or when the waste cannot be extracted without size reduction.
- 11.1.1 Determine the percent solids.
- 11.1.1.1 If the sample contains moisture that may produce liquids when subjected to pressure filtration, the following steps are taken. If not, proceed to the particle size reduction section (11.1.4).
- 11.1.1.2 Pre weigh the filter and the container that will receive the filtrate. Record the filter lot number and masses.
- 11.1.1.3 Assemble the filter holder and filter as per manufacturer's instructions.
- 11.1.1.4 Weigh out a minimum of 100 g of the sample and record the mass.
- 11.1.1.5 Allow slurries to settle prior to filtration, centrifuge to aid in filtration if necessary.
- 11.1.1.6 Quantitatively transfer the waste to the filter (both the liquid and the solid). Apply gentle pressure (<10 psi) to the filter holder, if no solution has passed through the filter for two minutes, increase the pressure in increments of 10 psi until air passes through the filter or 50 psi is reached. Use only one filter. The portion remaining on the filter is considered the solid phase.
- 11.1.1.7 Determine the weight of the liquid phase by weighing the filtrate container and subtracting the initial mass of the container.
- 11.1.1.8 Subtract the mass of the liquid from the mass of sample filtered to get the mass of the solid phase.
- 11.1.1.9 Calculate the percent solids.
- 11.1.2 If the percent solids is <0.5, then the filtered sample is considered to be the TCLP extract and further manipulation of the sample is unnecessary. If the sample is >0.5 percent solids go to the next step.
- 11.1.2.1 In standard cases (i.e. liquids which will not pass through the filter are not present) remove the solid phase and the filter from the filtration apparatus, continue to the particle size reduction section (11.1.4).
- 11.1.2.2 Dry the solid phase with the filter at  $100 \pm 20^{\circ}\text{C}$  until two successive weighings yield the same value within  $\pm 1\%$ . Record the final mass.
- Note: If the amount of material remaining on the filter will obviously yield solids >0.5 percent note this on the extraction bench sheet, skip the drying step, and proceed to section 11.1.4 and subsequent extraction with this aliquot of waste.
- 11.1.2.3 Calculate the percent dry solids.
- 11.1.3 If the percent dry solids are < 0.5, the filtrate is considered the TCLP extract and further manipulation of the sample is unnecessary. If the percent dry solids is >0.5, then continue with a fresh portion of waste.



#### 11.1.4 Does the solid portion of the waste require particle size reduction?

11.1.4.1 Using the solid portion of the waste, see if all of the sample will pass through a 9.5mm sieve or if the surface area is  $> 3.1 \text{ cm}^2$  per gram. If these criteria are not met, the sample must be ground, cut, or crushed to fulfill the requirements. For samples that are pieces of wire, cloth, wire mesh, etc., the surface area criteria are not met if the pieces are too large (as estimated by the analyst) and so must be reduced in size to increase the surface area.

#### 11.1.5 Determine the extraction fluid to be used.

11.1.5.1 Weigh out 5.0 g sample of the solid waste to 500 mL beaker or Erlenmeyer flask. If not already accomplished with previous steps, reduce the solid to a particle size of approximately 1 mm in diameter or less.

11.1.5.2 Add 96.5 mL of reagent water to the beaker, cover with a watch glass, and stir vigorously for five minutes using a magnetic stirrer. Measure and record the pH. If the pH is  $< 5.0$ , use extraction fluid #1. If the pH is  $> 5.0$ , continue.

11.1.5.3 Add 3.5 mL 1N HCl, slurry briefly, cover with a watch glass, heat to  $50^\circ\text{C}$  for ten minutes. Let the solution cool to room temperature and record the pH. If the pH is  $< 5.0$ , use extraction fluid #1, if the pH is  $> 5.0$ , use extraction fluid #2.

#### 11.2 Extraction procedures

11.2.1 Due to the very detailed nature of the TCLP method, the following procedures represent an outline of the procedure for extraction. Refer to the TCLP method for specific instructions. Note the discussion of matrices such as oily wastes, paint wastes, etc. on page 1311-12.

11.2.2 Refer to section 7.1.5 of the TCLP method to determine if the aliquot from the preliminary evaluation may be used for extraction. If a fresh portion of the waste has been established from section 11.1.3 above then continue.

11.2.3 Extractions for 100 percent solids when only organics or metals are requested:

11.2.3.1 Determine if particle size reduction is required. If so, refer to section 11.1.4.

11.2.3.2 Weigh the sample into the extraction vessel and add the appropriate extraction fluid. Record the extraction fluid lot number.

11.2.3.3 Extract the sample by rotating the tumbler for  $18 \pm 2$  hours at  $30 \pm 2$  rpm. Check for pressure in the bottle after 15 minutes and release if necessary. If pressure is present, subsequently check for pressure at 15 minute intervals until pressure buildup is minimized. Measure and record on the bench sheet the tumbler rotation (RPM) and room temperature ( $^\circ\text{C}$ ) when the tumbling is in process. Room temperature must be maintained at  $23 \pm 2^\circ\text{C}$ .

11.2.3.4 Filter the sample, record filter lot number and the pH of the extract.



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11.2.3.5 For metals analysis, take a small portion of the extract (~5 mL) and add some nitric acid. If a precipitate forms, do nothing further with the extract and analyze as soon as possible.

Note: For metals analysis, the aliquot of TCLP extract that is to be used for the matrix spike analysis must be spiked prior to preservation.

11.2.3.6 If no precipitate forms, acidify the extract to a pH of < 2 and store until time of analysis. For organics, the extract is ready for preparation for analysis, do not acidify.

11.2.4 Extractions for 100 percent solids when both organics and metals are requested.

11.2.4.1 Determine if particle size reduction is required. If so, refer to section 11.1.4.

11.2.4.2 Weigh the sample into the Teflon extraction vessel and add the appropriate extraction fluid, and record extraction fluid lot number and vessel ID.

11.2.4.3 Extract the sample by rotating the tumbler for  $18 \pm 2$  hours at  $30 \pm 2$  rpm. Check for pressure in the bottle after 15 minutes, release if necessary. If pressure is present, subsequently check for pressure at 15 minute intervals until pressure buildup is minimized. Measure and record on the bench sheet the tumbler rotation (RPM) and room temperature ( $^{\circ}\text{C}$ ) when the tumbling is in process. Room temperature must be maintained at  $23 \pm 2^{\circ}\text{C}$ .

11.2.4.4 Filter the sample, record the filter lot number, and record the pH of the extract. Separate the samples, an aliquot for organics and an aliquot for metals. For metals fraction, take a small portion of the extract (~5 mL) and add some nitric acid. If a precipitate forms, do nothing further with the extract and analyze as soon as possible. If no precipitate forms, acidify the extract to a pH < 2 and store until analysis. For organics, the extract is ready for preparation for analysis.

Note: For metals analysis, the aliquot of TCLP extract that is to be used for the matrix spike analysis must be spiked prior to preservation.

11.2.5 Less than 0.5% solids (liquids only) when metals and/or organics are requested.

11.2.5.1 Measure out the required amount of sample.

11.2.5.2 Assemble the filtration apparatus, rinse, and filter the measured aliquot of waste into a borosilicate glass bottle.

11.2.5.3 Separate the fractions, if necessary. Take a small portion of the metals fraction (~5 mL) and add some nitric acid. If a precipitate forms, do nothing further with the extract and analyze as soon as possible. If no precipitation occurs, acidify the metals fraction to a pH < 2 and store of analysis.

Note: For metals analysis, the aliquot of TCLP extract that is to be used for the matrix spike analysis must be spiked prior to preservation.

11.2.5.4 The samples are ready for preparation for analysis.

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11.2.6 For 0.5 to less than 100 percent solids when either organics or metals, or both, are requested.

11.2.6.1 Pre weigh the container that will receive the filtrate. If a fresh portion of the waste is to be used (section 11.1.3) weigh out a subsample of the waste and record the mass and go to 11.2.6.2, else go to 11.2.6.3. Determine the sample size and amount of extraction fluid as specified in the method.

11.2.6.2 Assemble the filtration apparatus, rinse, and filter. Allow slurries to settle prior to filtration, centrifuge to aid in filtration if necessary. Quantitatively transfer the waste to the filter (both the liquid and the solid). Apply gentle pressure (<10 psi) to the filter holder, if no solution has passed through the filter for two minutes, increase the pressure in increments of ten psi until air passes through the filter or 50 psi is reached. Use only one filter.

11.2.6.3 The portion remaining on the filter is considered the solid phase. If a significant amount of waste remains in the transfer vessel, this should be taken into account by subtracting the amount left behind from the total amount of waste.

11.2.6.4 Collect the filtrate and determine if it will be miscible with the extraction fluid. If not, separate it into two fractions of ratio 1:5 (one part for metals and five parts for organics), preserve the metals fraction and analyze. If the filtrate will be miscible with the extractant, store the filtrate until the two portions can be mixed.

11.2.6.5 Reduce particle size of the solid portion if necessary.

11.2.6.6 Quantitatively transfer the solid portion of the waste to either a plastic (Metals Analysis) or a Teflon (Organics Analysis) extraction vessel.

11.2.6.7 Slowly add the determined amount of the appropriate extraction fluid and seal the extraction vessel.

11.2.6.8 Extract the sample by rotating the tumbler for  $18 \pm 2$  hours at  $30 \pm 2$  rpm. Check for pressure in the bottle after 15 minutes and release if necessary. If pressure is present, subsequently check for pressure at 15 minute intervals until pressure buildup is minimized. Measure and record on the bench sheet the tumbler rotation (RPM) and room temperature ( $^{\circ}\text{C}$ ) when the tumbling is in process. Room temperature must be maintained at  $23 \pm 2^{\circ}\text{C}$ .

11.2.6.9 Filter the sample and record the pH of the extract.

11.2.6.10 If applicable, mix the extract with the filtrate from section 11.2.5.3.

11.2.6.11 If both metals and organics are requested, separate the fractions for organics and for metals. For metals fraction, take a small portion of the extract (~ 5 mL) and add some nitric acid. If a precipitate forms, do nothing further with the extract and analyze as soon as possible. If no precipitate forms, acidify the extract to a pH of < 2 and analyze. For organics, the extract is ready for preparation for analysis.

Note: For metals analyses, the aliquot of TCLP extract that is to be used for the matrix spike analysis must be spiked prior to preservation.

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11.2.6.12 If only organics is requested, the extract is now ready for further preparation for analysis.

11.2.6.13 If only metals are requested, take a small portion of the extract (~ 5 mL) and add some nitric acid. If a precipitate forms, do nothing further with the extract and analyze as soon as possible. If no precipitate forms, acidify the extract to a pH of < 2 and analyze.

Note: For metals analyses, the aliquot of TCLP extract that is to be used for the matrix spike analysis must be spiked prior to preservation.

11.2.7 If the liquid portion of the waste and the extraction fluid are not miscible, the results from the analysis of the two fractions must be mathematically combined to give the final TCLP result for the waste.

## 12) QA/QC Requirements

12.1 Method Blank: A minimum of one extraction blank must be prepared with each batch of 20 samples or less. Do not designate specific extraction bottles to use for extraction blanks. Each Teflon bottle has a unique identifying number associated and must be used for the extraction blank at a minimum once per every 20 extractions conducted in that vessel. This is documented in a Laboratory Notebook 14-MET-TCLP-VESSEL-001. If a method blank contains a positively identified target analyte above the MRL, all samples that contain that analyte will be re-extracted, unless the sample results are greater than 20x the level detected in the method blank.

12.2 For TCLP Extractions performed for Inorganic analyses disposable one time use extraction bottles are used.

12.3 Matrix Spike: A matrix spike shall be performed for each waste type unless the result exceeds the regulatory level and the data is being used solely to demonstrate that the waste property exceeds the regulatory level. At a minimum, use the guidelines for addition of matrix spikes found in the determinative methods. Refer to section 8.2 of the TCLP method (Appendix A) for specific guidance on addition of matrix spikes.

**Note:** For metals analyses, the aliquot of TCLP extract that is to be used for the matrix spike analysis must be spiked prior to preservation.

12.4 All quality control measures described in the determinative methods shall be followed.

12.5 Refer to section 9.0 of the TCLP method for method performance information.

## 13) Data Reduction and Reporting

13.1 Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to SOP *Laboratory Data Review Process* (ADM-DREV) for details.

13.2 Reports are generated out of the applicable analytical departments. Refer to the analytical SOPs for the analyses used.

## 14) Method Performance

14.1 This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional available method performance data.

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14.2 The Method Detection Limits (MDLs) for the analytical procedures are established using the procedure described in the SOP for *Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Quantification*. Method Reporting Limits are established for this method based on MDL studies and as specified in the ALS Quality Assurance Manual.

## 15) Pollution Prevention and Waste Management

15.1 The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Lab Waste Management Plan.

## 16) Contingencies for Handling Out-of-Control or Unacceptable Data

16.1 Refer to the SOP for *Non Conformance and Corrective Action* ADM-NCAR for procedures for corrective action.

16.2 Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

## 17) Training

17.1 All analysts performing this analysis are required to read and understand this SOP.

Training is documented following the *Employee Training and New Employee Orientation* (ADM-TRAIN).

## 18) Method Modifications

18.1 There are no known modifications in this laboratory standard operating procedure from the reference method.

## 19) References

19.1 EPA Method 1311, Revision 0, SW-846 Update I. "Toxicity Characteristic Leaching Procedure", USEPA, July, 1992.

19.2 USEPA Region 10 Document Number ESAT-10A-210, February, 1991.

19.3 DoD Quality Systems Manual for Environmental Laboratories Current Version.

19.4 TNI Quality Standards, 2009; 2016.

19.5 ISO/IEC 17025:2005/2017 American National Standard, General requirements for the competence of testing and calibration laboratories.

## 20) Changes Since Last Revision

Revision Number	Effective Date	Document Editor	Description of Changes
11.0	2/09/2021	T. Caron	ADMIN changes: SOP signatories, updates to standard paragraphs; References. Section 8: Updated equipment list.



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			Procedural change form and revision request dated 1/27/2021 by Keith Linn
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21) **Appendices, Attachments, and Tables**

21.1 Appendix A - pH Meter Calibration Procedure.

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## APPENDIX A

### pH Meter Calibration Procedure

- 1) Reagents: pH buffer 2.00, 4.00 and 7.00.
- 2) Calibration:
  - 2.1 Buffers in 50 mL plastic centrifuge tubes need to be replaced with buffer from the primary container daily.
  - 2.2 Once a manufacturer's cubitainer is open it is viable for three months.
  - 2.3 Perform calibration daily. Record calibration, buffer checks and buffer temperatures in instrument logbook or bench sheet with date and analyst's initials.
  - 2.4 The slope percentage of the calibration points should be between 95 and 105%, the meter displays the slope of calibration.
    - 2.4.1 Pour the buffer calibration solutions into labeled calibration vessel. The label must have the date and pH buffer solution name, pH buffer solution lot #.
    - 2.4.2 Rinse the probe with deionized water and put the probe into the first calibration vessel. Make sure that there are no air bubbles under the probe tip.
    - 2.4.3 From the standby screen press CALIBRATE.
    - 2.4.4 Press READ to measure the first calibration solution. Record the measurement in the pH calibration logbook 2001-MET-pH. When the measurement is stable, the instrument will request the next calibration solution.
    - 2.4.5 Rinse the probe with deionized water and put the probe into the second calibration vessel. Make sure that there are no air bubbles under the probe tip.
    - 2.4.6 Press READ to measure the second calibration solution. Record the measurement in the pH calibration logbook 2001-MET-pH.
    - 2.4.7 If the calibration is correct the meter will display the message CALIBRATION OK and will save the calibration data.
    - 2.4.8 From the standby screen press CALIBRATE.
    - 2.4.9 Press CAL.DATA
    - 2.4.10 Select CURRENT CALIBRATION option. The data from the last calibration is shown.



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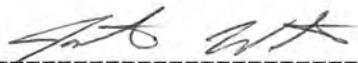
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- 2.4.11 Record the slope percentage of the calibration points in the pH calibration logbook 2001-MET-pH.
- 2.4.12 After calibration, a second source pH solution is used to verify calibration of the pH meter. The acceptance criteria are 70-105%. The result is recorded in the pH calibration logbook.
- 2.5 If the slope exceeds the above end points either the buffer(s) is contaminated or the probe is no longer functioning properly.
- 2.6 Replace buffers, and then re calibrate.
- 2.7 If after replacing the buffer solutions slope percentage of the calibration points is not between 95 and 105% follow the directions for cleaning the probe and re calibrate.
- 2.8 If cleaning the probe does not correct the calibration slope percentage error the probe needs to be replaced.



## Analysis of Water, Solids, and Soluble Waste Samples for Semi-volatile Fuel Hydrocarbons

DOCUMENT ID: PET-SVF, REV 17.0

Prepared By:   
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Date: 12/2/2020

Prepared By:   
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Date: 12/2/2020

Approved By:   
Laboratory Director, Charles (Pat) Byrne

Date: 12-2-20



## 1) Scope & Applicability

- 1.1 This Standard Operating Procedure (SOP) describes the method used for analysis of semi-volatile petroleum hydrocarbons using EPA Method 8015C and state-specific methods, as listed in Table 1.
- 1.2 The analysis is used for detection and quantification of semi-volatile fuel hydrocarbons ranging from gasoline through fuel oils and lubricating oils. The SOP is applicable for quantitative analysis of Total Petroleum Hydrocarbons as Diesel, Diesel Range Organics, Motor Oil and Residual Range Organics. The SOP is applicable for semi-quantitative analysis of more volatile petroleum products ranging chiefly from n-C8 through n-C11 (e.g., Gasoline). The SOP is also applicable for qualitative identification of petroleum products ranging from n-C8 through n-C44. Normally only the following analytes are reported under this SOP: Diesel Range Organics (various ranges), Residual Range Organics (various ranges) and C8-C12 Gasoline Range Organics. Other petroleum products are reported (quantitatively, semi-quantitatively or qualitatively) when and as requested by the client.
- 1.3 This SOP describes both the sample preparation and chromatographic procedures used to determine the target analytes in water, soil, sediment and unknown waste (product) matrices. The SOP may be applied to other miscellaneous sample matrices providing that the analyst demonstrates the ability of the SOP to give data of acceptable quality in that matrix. The Method Reporting Limits (MRLs) for target analytes in water and soil are presented in Table 2. Method Detection Limits which have been achieved are also given.

## 2) Summary of Procedure

- 2.1 Samples are solvent extracted using methylene chloride; the extracts are injected into the GC system using a micro-syringe. Target analytes are separated using a chromatographic column and quantitation is made by comparison of target analyte response to the response of calibration standards over a known concentration range. Integrations are performed over an extended hydrocarbon range. Chromatographic fingerprints are compared to known fuel and other hydrocarbon and petroleum product fingerprints for qualitative identification. Table 3 provides a list of fingerprints maintained on file in the lab. More fingerprints are generated as necessary, from purchased materials and from suspected contaminants often supplied by clients.
- 2.2 The SOP is applicable to the analysis of target analytes and meets method criteria for the methods listed in Table 1. The SOP may be applied to qualitative analysis and identification of a wide variety of hydrocarbon products.
- 2.3 The requested target analyte list is analyzed meeting established method criteria for the compounds of interest as set forth in sections 11 and 12 of this SOP. Calibration standards used to quantitate the various target analytes are listed in Table 1..

## 3) Definitions

- 3.1 For laboratory definitions applicable to most analyses, refer to the SOP for *Sample Batches*, ADM-BATCH.

## 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the



results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.

- 4.2 It is the responsibility of the department supervisor/manager to document analyst training and method proficiency, as described in the SOP *Employee Training and New Employee Orientation* (ADM-TRAIN).

## 5) Interferences

- 5.1 Solvents, reagents and labware may yield artifacts that will cause responses in various hydrocarbon ranges integrated in the SOP. These materials should be checked and cleaned to prevent positive biases to the data. For interpretive analyses, obvious artifacts resulting from contaminated solvents, reagents, and glassware will not be reported as petroleum products.
- 5.2 Direct exposure of samples and sample extracts to unregulated labware (such as polymeric tubing attached to a laboratory reagent water spigot), personal protective equipment (such as surfactant-coated nitrile gloves) and human contact (such as skin oils and personal hygiene products) generally yields artifacts that will cause responses in various hydrocarbon ranges integrated in the SOP. Such exposures are to be avoided.
- 5.3 Contamination by carryover can occur when high level samples immediately precede samples containing significantly lower levels of contamination. This can be minimized by running system blanks after samples that are suspected to contain high levels of target analyte. For purposes of evaluating sequencing criteria during an analytical batch, these system blanks are not defined as samples and therefore are not counted in the ten sample groupings.
- 5.4 An optional sulfuric acid/silica gel cleanup procedure is provided for removal of chiefly biogenic polar interferences. A state specific (AK 102 and AK 103 tests only), silica gel only cleanup procedure is also provided for, usually to be performed only upon client request.
- 5.5 This SOP provides for the qualitative identification and quantitative or semi-quantitative measurement of various petroleum products in samples. In practice, a great variety of different organic compounds, many of which are not part of petroleum products, are analyzed. In all cases, all chromatographic responses (exclusive of those due to surrogate compounds) that occur within a hydrocarbon range are reported; a qualitative evaluation of the result is then made and an appropriate Petroleum Hydrocarbon Specific Data Qualifier is added to the reported result.

## 6) Safety

- 6.1 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.
- 6.2 This method uses Methylene Chloride, a suspected human carcinogen. Viton gloves should be used while rinsing, pouring or transferring the solvent; if solvent is spilled on the glove surface, remove the glove immediately. Nitrile gloves are more practical for sample preparation but provide only momentary protection; if solvent (especially methylene chloride) is spilled on the glove surface, remove the glove immediately. Latex and vinyl gloves do not provide adequate protection from methylene chloride and



should not be worn during procedures involving large quantities of solvent. All procedures involving the transfer of organic solvents should be performed in a fume hood.

## 7) Sample Collection, Containers, Preservation, and Storage

### 7.1 Aqueous Samples:

- 7.1.1 For methods other than AK102/103 (i.e. 8015, NWTPH-Dx) the default sample size is 500 mL. Samples should be collected (received) in 500 mL glass amber bottles.
- 7.1.2 For AK102/103 the default sample size is 1L for aqueous samples and it is intended that samples are collected in 1L glass amber bottles, and these are the size provided by the laboratory.
- 7.1.3 This procedure also includes a “small volume” option for method AK102 only. When requested by the client, 250 mL is the intended sample size and 250 mL glass amber bottles will be used.
- 7.1.4 Samples should be preserved to pH <2 with hydrochloric acid. Samples will be refrigerated to  $4 \pm 2^{\circ}\text{C}$  upon sample login.

7.2 Solid samples should be collected (received) in glass jars with PTFE-lined septa. Alternatively, soil samples may be received in brass sleeves prepared in the field. Samples will be refrigerated to  $4 \pm 2^{\circ}\text{C}$  upon sample login.

7.3 Waste samples such as products can be collected (received) in a variety of sample containers. Typically, glass bottles with PTFE-lined septa are preferred.

7.4 Analytical and Sample Preparation Holding Times: See Table 4 for method specific maximum recommended holding times.

## 8) Standards, Reagents, and Consumable Materials

### 8.1 Reagents

8.1.1 Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Refer to the SOP *Reagent/Standards Login and Tracking* (ADM-RLT) for the complete procedure and documentation requirements.

#### 8.1.2 Acids and Bases

8.1.2.1 Hydrochloric Acid, concentrated

8.1.2.2 Sulfuric Acid, concentrated

8.1.3 Glass wool: baked overnight at  $280^{\circ}\text{C}$ .

8.1.4 Reagent Water: Laboratory reagent water that is free of contaminants of interest. The laboratory reagent water is produced by passing water through a series of deionizers followed by activated carbon filters in series.

8.1.5 Sodium Sulfate ( $\text{Na}_2\text{SO}_4$ ): Powdered and granular, baked overnight at  $400^{\circ}\text{C}$ .



- 8.1.6 Solvents: Reagent Grade acetone, hexane and methylene chloride (DCM). Histological grade acetone (for rinsing prior to DCM rinsing only).
- 8.1.7 Silica Gel: 100-200 Mesh, Baked for 4 hours at 130°C before use.
- 8.2 Standards: Standards should be labeled as follows: logbook ID number, compounds or compound mix, concentration, solvent, date prepared, expiration date, and analyst's initials.
  - 8.2.1 Neat Standard Material: non-fuel standards are purchased from a reliable source (e.g., Chem Service). Neat petroleum product is only routinely used to calibrate for Residual Range Organics (30 weight motor oil) but can be used when requested to calibrate for a suspected petroleum product contaminant (e.g., mineral spirits). Neat material used for quantitative analysis is given an expiration date equal to the manufacturer's recommendation, or if no expiration date is provided, the expiration date shall be five years.
  - 8.2.2 Stock Standards: Purchased as solutions from a reliable source (e.g., Supelco) or prepared in high concentration from neat material. Stock standards are generally prepared in methylene chloride. A stock standard is defined as any standard that requires additional dilution prior to being used in the analysis. To prepare stock standards from neat material, accurately weigh the neat material using a four-place analytical balance into a tared volumetric flask. Dilute to volume using methylene chloride. Stopper and invert several times to mix. Transfer the solution to an appropriate storage vial, label and refrigerate. When preparing stock standard mixes from neat material, it is recommended that each component of the mix be prepared individually at high concentration and then combined as a complete mix at a secondary dilution. Stock standards used for quantitative analysis are given an expiration date equal to the manufacturer's recommendation (purchased, sealed solutions) or one year for laboratory prepared stocks and purchased solutions that have been opened for use. The following stock standards are used in this SOP:
    - 8.2.2.1 Aliphatic Hydrocarbon Marker Mix: Multi-State hydrocarbon window defining standard from AccuStandard (or equivalent vendor) containing n-Alkanes from C8-C40, Pristane, and Phytane.
    - 8.2.2.2 Aromatic Hydrocarbon Marker Mix: Purchased or prepared solution containing discrete aromatic and non-aromatic hydrocarbons in methylene chloride. The solution must include Ethylbenzene, *o*-Xylene, *m*-Xylene, *p*-Xylene, 1,2,3-Trimethylbenzene, Fluoranthene, Pyrene,  $\alpha$ -Pinene,  $\beta$ -Pinene. It is useful, but not necessary, to include other compounds for characterization of products.
    - 8.2.2.3 Gasoline: Purchased solution containing a three-source composite of gasoline at 50,000 ppm (total) in methanol. Alternately, may be purchased at 5,000 ppm (total).
    - 8.2.2.4 Kerosene: Purchased solution containing kerosene at 50,000 ppm in methylene chloride. Alternately, may be purchased at 20,000 ppm.
    - 8.2.2.5 Diesel #2: Purchased solution containing a three-source composite of diesel #2 at 50,000 ppm (total) in methylene chloride. Alternately, may be purchased at 20,000 ppm (total).



- 8.2.2.6 SAE 30 Motor Oil: Prepared solution containing 30-weight motor oil at 10,000 ppm in methylene chloride.
- 8.2.2.7 SAE 30/SAE 40 Motor Oil Mixture: Purchased solution containing 30-weight motor oil and 40-weight motor oil at 50,000 ppm (total) in methylene chloride.
- 8.2.2.8 Other petroleum products (e.g., Mineral Spirits, Bunker C) may be purchased at a high concentration from a reliable vendor (usually in methylene chloride), or may be prepared from neat material.
- 8.2.2.9 Fuel Fingerprints: A wide variety of petroleum and other hydrocarbon products may be characterized by this SOP. Table 3 lists fuel fingerprints currently on file or available for qualitative analysis.
- 8.2.3 Working Standards: Purchased as solutions from a reliable source (e.g., Supelco) or prepared from stock standards. A working standard is defined as any standard that is used directly in sample analysis. Working standards are prepared from stock solutions by accurately transferring a volume of stock standard into a volumetric flask or graduated cylinder partially filled with the dilution solvent (usually methylene chloride). The volume is further adjusted using the dilution solvent to a known level. Working standards used for quantitative analysis are given an expiration date equal to the manufacturer's recommendation (purchased, sealed solutions), or 6 months for purchased solutions that have been opened and for laboratory prepared solutions.
  - 8.2.3.1 Calibration Standards: A series of standards prepared from a common stock ranging in concentration from a value representing the method reporting limit (or lower) to a value near the high end of the linear calibration range. Calibration standards (and continuing calibration standards) are prepared in methylene chloride. Calibrations will contain a minimum of five concentration levels. Recommended calibration standards are listed in Table 5.
  - 8.2.3.2 Surrogate Solution: Using neat products, prepare a solution containing 500 ppm each of *o*-Terphenyl, 4-Bromofluorobenzene, and n-Triacontane in methylene chloride. Since the solution is in a relatively volatile solvent, it is suggested that the working solution be stored in a bottle with a neck that is as narrow as practical, in order to minimize concentration.
  - 8.2.3.3 Working Analyte Spike Solution: Using neat products, prepare a solution in methylene chloride containing Diesel #2 at a concentration of 16,000 ppm and 30-weight Motor Oil at a concentration of 8,000 ppm. Since the solution is in a relatively volatile solvent, it is suggested that the working solution be stored in bottles with necks that are as narrow as practical, in order to minimize concentration.
  - 8.2.3.4 Working AK Analyte Spike Solution: Prepare a solution in methylene chloride containing Diesel #2 at 16,000 ppm, 30-weight motor oil and 40-weight motor oil at 8,000 ppm (total).
- 8.2.4 Independent Calibration Verification Standard (ICV), also known as Second Source Verification Standard (SSV): A stock standard should be prepared for



each analyte from a second source independent of that used in preparing the calibration curve; this is subsequently used to create a working standard to verify the curve accuracy. Recommended ICVs for the various calibration standards used in this SOP are listed in Table 1.

## 9) Apparatus and Equipment

### 9.1 Balance

- 9.1.1 Analytical Balance
- 9.1.2 Top Loading Balance

### 9.2 Centrifuge

### 9.3 Gas Chromatography System

- 9.3.1 Gas Chromatograph (GC): analytical system equipped with gas supplies, column inlet, programmable oven, heated detectors (FID), and a data system for determining peak areas. Hewlett-Packard 5890, Agilent 6890, or equivalent.
- 9.3.2 Chromatographic Column: Phenomenex ZB-1, 15 m x 0.25 mm ID, 1.0  $\mu$ m film thickness, or equivalent column of comparable chromatographic performance.
- 9.3.3 Autosampler Device: Designed for operation in conjunction with the gas chromatographic systems used in this SOP, Hewlett-Packard 7673 or Agilent 7683.
- 9.3.4 Compressed Gases or Gas Generators: Hydrogen (column flow and flame gas), Air (flame gas), and Nitrogen or Helium (make-up gas).

### 9.4 Labware and Syringes

- 9.4.1 Beakers: various sizes (125 mL, 250 mL, 400 mL, 600 mL)
- 9.4.2 Disposable Test Tubes: 15 mL (100 mm x 10 mm), 20 mL (150 mm x 10 mm)
- 9.4.3 Disposable Test Tubes Caps: Polypropylene, 10 mm
- 9.4.4 Disposable Pipettes: Pasteur and serological (1 mL, 2 mL, 5 mL, 10 mL)
- 9.4.5 Erlenmeyer Flasks: 500 mL
- 9.4.6 Brandtech Pipettors (or equivalent): 50 $\mu$ l, 100 $\mu$ l, 500  $\mu$ l, and 1000  $\mu$ l
- 9.4.7 Fleakers: 1000 mL and 500 mL
- 9.4.8 Graduated cylinders, 1 liter and 50 mL, Class A, TC
- 9.4.9 PTFE stoppers: of appropriate size for 50 mL graduated cylinder
- 9.4.10 Inject Vials: 1.8 mL glass autosampler vials with aluminum crimp tops with PTFE-lined silicone septa
- 9.4.11 Kuderna Danish (KD) Concentration Units:
  - 9.4.11.1 Flask: 500 mL
  - 9.4.11.2 Keck Clip (blue)
  - 9.4.11.3 Receiving Tube (collector): 15mL
  - 9.4.11.4 Snyder Column: 3 or 2 Ball



- 9.4.12 Microsyringes: various sizes (10  $\mu$ l, 25  $\mu$ l, 100  $\mu$ l, 250  $\mu$ l, 500  $\mu$ l, 1000  $\mu$ l)
- 9.4.13 Separatory Funnels: 1 liter, 2 liter
- 9.4.14 VOA vials (40 mL): capped, with PTFE-Lined Septa
- 9.4.15 Volumetric Flasks: various sizes (1 mL, 2 mL, 5 mL, 10 mL, 25 mL, 50 mL, 100 mL)
- 9.4.16 Large stainless steel tablespoon
- 9.5 N-EVAP Nitrogen Evaporation Unit
- 9.6 pH Paper: narrow range (0-4 pH units) for measuring aqueous sample pH
- 9.7 PTFE Filters: leur-locking, 0.45 micron
- 9.8 S-EVAP Concentration Unit
- 9.9 Sonication Device
  - 9.9.1 Lab Jack
  - 9.9.2 Sonic Controller
  - 9.9.3 Sonic Horn (4 x 1/4" microtip couple or 3/4" tip)
  - 9.9.4 Sonibox
- 9.10 Stainless Steel Scoopulas
- 9.11 Ultrasonic Bath
- 9.12 For AK 102 and AK 103 cleanup: Pre-packed Restek silica gel column: 0.5 g silica gel in a 3 mL total volume, PP barrel with PE frits.

## 10) Preventative Maintenance

- 10.1 A maintenance log will be kept documenting maintenance performed on each analytical system. Log entries will include the date maintenance was performed, symptoms of the problem, serial numbers of major equipment upgrades or replacements (defined as any non-consumable part essential to operation), phone logs from technical support contacts, a description of the maintenance performed, a description of the check performed to assure the system has returned to acceptable levels of operation, and the analyst's initials.
- 10.2 Autosampler: Maintenance is generally limited to cleaning or replacing dirty, clogged or otherwise malfunctioning syringes, and cleaning other moving components with methanol when necessary.
- 10.3 GC System: Maintenance of the GC system is generally limited to, in declining order of frequency:
  - 10.3.1 Replacement or cleaning of the injection port liner, or (more frequently) replacement of the glass wool plug therein. This is indicated by a significant drop in heavier range product (Motor Oil) and alkane (Triacontane) responses without a coincident drop in lighter range product and surrogate responses.
  - 10.3.2 Replacement of the injection port septum. Leaks may occur here.
  - 10.3.3 Replacement or cleaning of the injection port liner seal. This can be indicated by a change in surrogate responses without a coincident or proportionate change in hydrocarbon product responses. Note that the seal usually



functions satisfactorily even when obviously dirty in appearance because petroleum products are generally composed exclusively of 'non-polar' components and are thus not significantly affected by active sites; two notable exceptions are brake fluids, which are composed exclusively of glycol ethers, and Fuel Oil #6 (Bunker C), which contains significant quantities of sulfur-containing compounds.

- 10.3.4 Column trimming. This is indicated by surrogate peak broadening. Removal of less than two inches of the column at a time is usually sufficient.
- 10.3.5 Replacement of ferrules or o-rings (or tightening associated connections). Leaks may occur at these points.
- 10.3.6 Detector cleaning – scrubbing of the detector jet, collector and (less importantly) chimney. This is indicated by a steady increase or decrease (depending on the nature of the acquisition method) in all responses over time with no other discernable cause; or by the appearance of random spikes in chromatograms. This is also necessary if the flames fail to remain lit.
- 10.3.7 Column replacement. This generally becomes necessary if significant broadening and diminution of responses of early-eluting peaks (and responses of products), especially at lower concentrations (resulting in quadratic curves) is observed. Ready disintegration of the column upon handling is another indication.

## 11) Procedure

- 11.1 Cleaning of Labware: Non-disposable labware (except for syringes) used in sample analyses is washed with hot soapy water, rinsed three times with hot tap water, rinsed three times with reagent water, and either allowed to air dry or rinsed with histological grade acetone. Immediately prior to sample preparation, labware must be rinsed with methylene chloride. Syringes are rinsed with the appropriate solvent(s).
- 11.2 Sample Preparation: A preparation (or extraction) batch is defined as a group of field samples and QC samples processed together with the same reagents. Each preparation batch will consist of no more than 20 field samples. Every preparation batch will include one laboratory method blank (MB) and one laboratory control sample (LCS) at a frequency of not less than one each per 20 client samples. Additional QC sample requirements depend on the methodology (or matrix) employed:
  - EPA 8015C: matrix spike (MS) and duplicate matrix spike (DMS) samples are required at a frequency of not fewer than one each per 20 client samples. If insufficient sample is available for a DMS or both MS and DMS, a duplicate laboratory control sample (DLCS) must be prepared at the same frequency.
  - AK102/AK103: MS/DMS and DLCS are all required at a frequency of not fewer than one each per 20 client samples.
  - NWTPH-DX: a duplicate client sample (DUP) is required at a frequency of not fewer than one per 10 client samples (note higher frequency requirement). If insufficient sample is available for a DUP, a DLCS must be prepared at a frequency of not less than one per 20 client samples. Note that although a client may request MS/DMS as additional QC, the DUP (or DLCS) is still required.
  - WASTE or PRODUCT dilutions, all methods: a duplicate client sample (DUP) should be prepared with each batch. It is not necessary to prepare a MS or MS/DMS set (but do prepare a DLCS for EPA 8015C and AK102/AK103).



11.2.1 Aqueous Samples: EPA 3510 Liquid-Liquid Extraction

- 11.2.1.1 Prepare KD extract collection apparatuses: For each sample, tightly fit a 500 mL KD flask with a 15 mL collector, and secure these with a blue Keck clip. Place this assembly in a secure rack. Drop a clean PTFE boiling chip into the collector. Prepare a modified funnel thus: place a small glass wool plug at the bottom of the funnel (rinse the assembly 3 times at this point with methylene chloride, as the glass wool can be a significant source of contamination), and add about 3 or 4 heaping tablespoons of muffled, granular  $\text{Na}_2\text{SO}_4$  to the funnel. Place the funnel in the top of the KD flask. Arrange the KD apparatuses in a fume hood.
- 11.2.1.2 Allow the sample to warm to room temperature and shake to mix. Note that mixing of the sample may in some cases not be desirable. If a significant portion of the sample volume is solid material, consult with the supervisor or Project Manager for guidance.
- 11.2.1.2.1 Method 8015, NWTPH-Dx (500 mL or 1 L samples) and default AK102/103 (1L samples): Mark the meniscus on the side of the bottle and pour the entire contents of the bottle into a 1 L separatory funnel (2L funnel if more than approximately 600 mL of sample was received in one bottle). Save the bottle for solvent rinsing and sample volume determination (11.2.1.5). Laboratory QC (MB, LCS and DLCS) are each prepared from 500 mL (or 1 L, if any client samples are greater than approximately 600 mL in volume) laboratory reagent water.
- 11.2.1.2.2 Small volume option (AK102 only – 250 mL bottle): Mark the meniscus on the side of the bottle and pour the entire contents into a 1L separatory funnel. Save the bottle for solvent rinsing and sample volume determination (11.2.1.5). Laboratory QC (MB, LCS and DLCS) are each prepared from 250 mL laboratory reagent water.
- NOTE:** For AK102, if the client provides less than approximately 600 mL (e.g. limited volume at sampling site) in a 1 L or smaller bottle, the small volume option will be used. In this case, 250 mL of sample is measured in a graduated cylinder, transferred to the separatory funnel, and the graduated cylinder solvent rinsed and transferred to the funnel.
- 11.2.1.3 Check pH of sample. If sample pH is not  $< 2$ , acidify to pH  $< 2$  with concentrated HCl.
- 11.2.1.4 Add the working surrogate spike to all client and QC samples. Add the working analyte (matrix) spike to all MS, DMS, LCS and DLCS samples. Use the working AK analyte (matrix) spiking solution for the AK102 and 103 methods.
- 11.2.1.5 Add 60 mL of methylene chloride (DCM) to the empty sample bottle, swirl (in order to extract organics adhering to the bottle), and then pour the mixture into the funnel containing the sample; for laboratory QC, add 60 mL directly to the funnel.



- 11.2.1.6 Determine the sample volume (when the entire sample volume was used) by filling the sample bottle with water to the marked meniscus. Transfer the contents of the bottle to a graduated cylinder to measure the volume of the sample prepared. Record the volume prepared to at least 2 significant figures.
  - 11.2.1.7 Stopper and shake the funnel for 1-2 minutes with periodic venting. Allow the solvent layers to separate.
  - 11.2.1.8 Drain the Extract into an Erlenmeyer flask.
  - 11.2.1.9 If an unresolvable emulsion is encountered, first drain the emulsion into another vessel for mechanical resolution, preliminary drying employing granular  $\text{Na}_2\text{SO}_4$ , or centrifugation, followed by pipetting off of aqueous layer; then collect the DCM layer as in 11.2.1.8.
  - 11.2.1.10 Repeat the extraction twice more in sequence, starting each with a fresh 60 mL portion of DCM added directly to the sample in the separatory funnel. Pour the 3 extracts in the KD apparatus for concentration. Rinse the extract flask 3 times with DCM, adding to the appropriate KD apparatus each time. Finally, rinse the contents of the modified with DCM thoroughly and use a vacuum to pull remaining extract into the KD apparatus.
  - 11.2.1.11 Remove the modified funnel from the KD and fit the KD with a Snyder column. Concentrate the extract by means of a hot water bath (S-Evap) at 70°C-75°C. Remove the KD apparatus from the bath when the apparent solvent level in the collector is approximately 5 mL. Do not allow the extract in the collector to evaporate to dryness.
  - 11.2.1.12 Carefully remove the collector from the KD and further concentrate the extract, using a gentle  $\text{N}_2$  stream and < 40°C water bath (N-Evap) or TurboVap or micro-snyder, to 1 mL in DCM (if the sample volume was approximately 500 mL; 2 mL if sample volume was approximately 1L). Again, do not allow the extract to evaporate to dryness. If the extract is particularly dark, viscous and/or obnoxious smelling, it may be advisable to take the extract to a higher final volume. A graduated, disposable pipet or syringe may be used to measure the final volume.
  - 11.2.1.13 Place 1 mL of extract in a 1.8 mL autosampler vial and cap tightly with a PTFE-lined, silicone septum (natural rubber septa introduce irremovable, MDL/MRL level artifacts into the extract upon injection, and should not be used. Archive any remaining extract in a capped, disposable test tube.
  - 11.2.1.14 Mark the extract meniscuses. Complete paperwork, taking care to note all problems, difficulties or deviations from the standard operating procedure.
- 11.2.2 Solid Samples: Sonication
- 11.2.2.1 Prepare and arrange KD extract collection apparatuses as in 11.2.1.1.
  - 11.2.2.2 Sample aliquots are prepared by the appropriate group according to (SOILPREP-ALIQUOT) and (SOLPREP-SUBS). Determinations of sample % dry weight - In certain cases, sample results are desired based on dry



weight basis. Refer to the SOP for *Total Solids* (GEN-160.3) for water samples or *Total, Fixed, and Volatile Solids in Solid and Semisolid Samples* (SOILPREP-SOLIDS) for solid samples. If the determination is performed by the organics preparation personnel, a portion of the sample for this determination should be weighed out at the same time as the portion used for analytical determination..

- 11.2.2.3 Less sample may be prepared if the sample obviously contains high levels of petroleum product, and a homogeneous mixture can be attained. Muffled laboratory matrix sand is employed as the LCS/DLCS matrix; no matrix is employed for the MB (except a typically employed amount of muffled  $\text{Na}_2\text{SO}_4$ , which is added to all samples). Record weight prepared to at least 3 significant figures.
- 11.2.2.4 Add approximately 30 g muffled, granular  $\text{Na}_2\text{SO}_4$  to the sample in the beaker, stir the mixture thoroughly with a scoopula until the mixture is dry and free flowing, and no material adheres to the beaker or scoopula. After initial mixing, it will be necessary to allow the mixture to sit at room temperature for at least 15 minutes (often longer), followed by further mixing, in order to ensure that the  $\text{Na}_2\text{SO}_4$  has been allowed to dry the sample as effectively as possible.
- 11.2.2.5 Tune the sonic horn controller(s) in accordance with the manufacturer's instructions and record the action on the benchsheet.
- 11.2.2.6 Arrange the sample mixtures in a fume hood and keep them in the hood during the following steps (11.2.2.7 through 11.2.2.14) in order to minimize personal solvent exposure. Add working surrogate spike to all client and QC samples. Add working analyte (matrix) spike to all MS, DMS, LCS and DLCS samples.  

Note: The AK103 methods require the use of the working analyte matrix spiking solution described in sec 7.2.3.4.
- 11.2.2.7 As soon as practicable, add approximately 100 mL of DCM to the mixture. Add more or less solvent as necessary, such that the solid mixture is immersed under at least 2 cm of solvent. Since DCM is quite volatile, it will be necessary to cover those sample mixtures (with Al foil or watch glasses, e.g.) which are not immediately taken to the next step in order to minimize evaporation and consequent exposure.
- 11.2.2.8 Place the sonic horn tip in the solvent layer above the top of the solid mixture and sonicate for 3 minutes at a 2 second pulse interval.
- 11.2.2.9 Decant as much of the extract as possible off the solid mixture into a KD apparatus.
- 11.2.2.10 Rinse the top of the  $\text{Na}_2\text{SO}_4$  bed in the funnel (and whatever solid mixture was transferred with the extract) with approximately 20 mL of DCM.
- 11.2.2.11 Repeat the extraction (steps 11.2.2.8 through 11.2.2.10) twice more in sequence, starting each with a fresh portion of DCM sufficient to cover the solid mixture under at least 2 cm of solvent. Combine the 3 extracts in the same KD apparatus for concentration.



- 11.2.2.12 After the third decantation, and before rinsing the  $\text{Na}_2\text{SO}_4$  bed, transfer the entire solid matrix (or as much as will fit) to the modified funnel (a stream of DCM squirted into the beaker as it is held over the funnel is usually sufficient to accomplish the transfer); then thoroughly rinse the mixture in the funnel with approximately 30 mL of DCM. A vacuum pump may be employed to maximize extract collection in the KD apparatus.
  - 11.2.2.13 Remove the modified funnel from the KD and fit the KD with a Snyder column. Concentrate the extract by means of a hot water bath (S-Evap) at 70°C-75°C. Remove the KD apparatus from the bath when the apparent solvent level in the collector is approximately 5 mL. Do not allow the extract in the collector to evaporate to dryness.
  - 11.2.2.14 Carefully remove the collector from the KD and take the extract to 10 mL in DCM in a disposable test tube. If the extract is particularly dark, viscous and/or obnoxious smelling, it may be advisable to take the extract to a higher final volume. If further concentration of the extract is necessary, use a gentle  $\text{N}_2$  stream and < 40°C water bath (N-Evap) or TurboVap. Again, and more importantly at this point, do not allow the extract to evaporate to dryness. A graduated, disposable pipet is used to measure the final volume.
  - 11.2.2.15 Place 1 mL of extract in a 1.8 mL autosampler vial and cap tightly with a PTFE-lined, silicone septum (see note about natural rubber septa in 11.2.1.13). Cap and archive the test tube containing the balance of the extract.
  - 11.2.2.16 Mark the extract meniscuses. Complete paperwork, taking care to note all problems, difficulties or deviations from the standard operating procedure.
- 11.2.3 Extract Cleanups (for removal of mostly biological interferences)
- Note: If a sample cleanup is performed, a portion of each of all associated laboratory QC and common client QC must also undergo the same cleanup.
- 11.2.3.1 Sulfuric Acid/Silica Gel (for EPA 8015C and NWTPH methods):
  - 11.2.3.2 Measure a volume (usually 1 or 2 mL) of the extract at final volume into a disposable test tube. Note: if the extract is not in DCM, it will be necessary to exchange the portion to be cleaned up by this method into DCM before proceeding further.
  - 11.2.3.3 Add 2-3 mL of concentrated  $\text{H}_2\text{SO}_4$ . Tightly cap the test tube and vigorously but carefully vortex the mixture for approximately 15 seconds.
  - 11.2.3.4 Centrifuge the mixture (at least 200 G for 5 minutes is recommended) in order to maximize separation of the layers; the extract will be the top layer.
  - 11.2.3.5 Add 1-2 g activated silica gel to a separate test tube (cooling to room temperature, if directly from oven). Carefully (avoiding the  $\text{H}_2\text{SO}_4$ ) draw off as much of the extract layer as practicable from the acid layer in the  $\text{H}_2\text{SO}_4$ -cleanup tube and transfer it to the silica gel-cleanup tube.



- 11.2.3.6 Tightly cap the test tube and gently swirl the contents. Allow the mixture to sit for at least 30 minutes at room temperature.
- 11.2.3.7 Carefully (avoiding the silica gel) transfer an aliquot of the extract to a 1.8 mL autosampler vial. Cap the vial tightly with a PTFE-lined, silicone septum (see note about latex septa in 11.2.1.13).
- 11.2.3.8 Mark the extract meniscus. Complete paperwork, taking care to note all problems, difficulties or deviations from standard operation procedure.
- 11.2.4 Silica Gel (ADEC Technical Memorandum 06-001 for AK102/AK103):
  - 11.2.4.1 Place a pre-packed Restek silica gel column (0.5 g silica gel in a 3 mL total volume PP barrel with PE frits) in a disposable, 150 mm x 10 mm (length x diameter) test tube (the waste collection vessel). The lip at the top of the barrel will allow it to sit at the top of the test tube without falling in. Alternatively, a handmade column may be used.
  - 11.2.4.2 Precondition the column with at least 12 mL DCM, draining eluent to waste: DO NOT FORCE THE SOLVENT THROUGH THE COLUMN; allow the solvent to drip under the force of gravity ONLY. After the last of the DCM has eluted (the PE frit atop silica gel can go dry; it takes about a minute for the silica gel itself to start drying), remove the column from the waste collection vessel and place it in an extract collection vessel (another 150 mm x 10 mm test tube).

**Note:** The entire silica gel bed at this point should have a translucent appearance, and it should also appear darker than when new.
  - 11.2.4.3 Introduce exactly 0.50 mL extract to the column, collecting the eluent. Allow the PE frit to just go dry.
  - 11.2.4.4 Add approximately 1.5 mL DCM to column, collecting the eluent. Allow the PE frit to just go dry.
  - 11.2.4.5 Repeat step 11.2.4.1. Stop collecting eluent once it stops dripping from column: UNDER NO CIRCUMSTANCES SHOULD THE COLUMN BE FORCED TO DRYNESS by vacuum or pressure. Remove the column from the extract collection vessel: there will still be some solvent adhering to column exit. This is normal, and its presence does not imply the loss of any desired compounds of interest.
  - 11.2.4.6 Gently concentrate the now cleaned-up (approximately 3.5 mL) extract, using a gentle N<sub>2</sub> stream and < 40°C water bath (N-Evap), to 0.50 mL in DCM, and transfer to a 1.8 mL autosampler vial. Do not allow the extract to evaporate to dryness. Cap the vial tightly with a PTFE-lined, silicone septum (see note about natural rubber septa in 11.2.1.13).
  - 11.2.4.7 Mark the extract meniscus. Complete paperwork, taking care to note all problems, difficulties or deviations from standard operation procedure.
- 11.2.5 TCLP leachates are prepared as aqueous samples. Prepare a leachate blank in addition to the laboratory blank.



### 11.3 Gas Chromatography

- 11.3.1 See Table 6 for suggested GC operating conditions. Samples are analyzed as part of an analytical sequence. Sequencing guidelines are described in section 3.2. Sequences are programmed in the GC operating software and run on user command. Prior to initiating an analytical sequence, check that gas supplies and autosampler rinse cup reservoirs are adequate to last the entire sequence.
- 11.3.2 Establish retention time windows for hydrocarbon ranges. For hydrocarbon range analytes, start and end times are established by analyzing a marker solution containing individual compounds that define the quantitation range. See Table 7 for guidance on establishing windows for the various method specified ranges. The aliphatic hydrocarbon marker mix should be analyzed at least once every 24 hours to verify no significant retention time shift has occurred with respect to start and end times for the quantitation ranges. The aromatic hydrocarbon marker mix should be analyzed at least once every 24 hours.
- 11.3.3 Method 8015C also describes background subtraction that should be performed, as follows: "Because the chromatographic conditions employed for DRO analysis can result in significant column bleed and a resulting rise in the baseline, it is appropriate to perform a subtraction of the column bleed from the area of the DRO chromatogram. In order to accomplish this subtraction, analyze a methylene chlorine blank during each 12-hour analytical shift which samples are analyzed for DRO. Measure the area of this chromatogram in the same fashion as is used for samples by projecting a horizontal baseline across the retention time range for DRO. Then subtract this area from the area measured for the sample and use the difference in areas to calculate the DRO concentration". Automated software functions (e.g. the instrument's column compensation feature) are typically used to perform this column bleed subtraction from a blank run. Perform column compensation between analytical batches once baseline has stabilized or as needed (CCB concentration approaching MDL).
- 11.3.4 Calibration

**NOTE:** The calibration procedure(s) and options chosen must follow the ALS protocols. Any exceptions to the calibration procedures detailed in *SOP Calibration of Instruments for Organics Chromatographic Analyses (SOC-CAL)* are described as follows:

- 11.3.4.1 Average of Response Factor: Calibration factors are calculated as the total area of the peak or integration range divided by the amount injected. If the percent relative standard deviation (%RSD) of all points is less than 20% (25% for Alaska Methods AK 102 and AK 103), linearity through the origin may be assumed and the average calibration factor may be used in quantifying sample data.

Note: For fuel analytes the integrated area for the surrogate compound is subtracted from the total area for the fuel pattern. This is done to eliminate the contribution of the surrogate area within the fuel range. The EnviroQuant software automatically performs this operation.

- 11.3.4.2 Calibration Curve, Linear Regression: This option may be used if the correlation coefficient is greater than or equal to 0.995 ( $r > 0.995$ ,  $r^2 > 0.990$ ). This method of quantitation uses the equation of a line



( $y=mx+b$ ). It will generally provide an acceptable fit when %RSD is < 30% and is therefore a useful option in evaluating the acceptability of the calibration curve for generating quantitative values.

- 11.3.5 Evaluation of calibration curves for use in quantitative analysis should be performed in the following manner.
  - 11.3.5.1 If %RSD for the compound is less than 20% (25% for Alaska Methods AK 102 and AK 103) use average of response factor from the calibration. If %RSD exceeds this value but is less than 30%, plot a linear regression.
  - 11.3.5.2 For the NWTPH method: the measured result of every calibration standard employed in the initial calibration must be within 15% of its true value. For the 8015C method, the measured result of the lowest concentration calibration standards used must be within 30% of its true value; other calibration standards must be within 20% of the true value.

**Note:** For NWTPH-Dx analysis, when evaluating the initial calibration linearity the linear model is used, and when quantifying results the average response factor is used.
  - 11.3.5.3 If these guidelines are exceeded, obtain a secondary opinion from a senior analyst or supervisor. The calibration may need to be reanalyzed.
- 11.3.6 Verify the calibration by analyzing an independent calibration verification standard. Acceptance criteria for the ICV are  $\pm 20\%$  for 8015C,  $\pm 25\%$  for Alaska Methods AK 102 and AK 103; and  $\pm 15\%$  for NWTPH.
  - 11.3.6.1 Analyze a CCB to establish that the instrument is free of target analyte contamination.
  - 11.3.6.2 The first set of 10 samples in an analytical sequence may be analyzed immediately following an acceptable calibration and analysis of a CCB. This set of samples is bracketed with continuing calibration verification (CCV) standard. This pattern is continued until the sequence is complete, or a CCV fails to meet acceptance criteria described below.
  - 11.3.6.3 Verify the calibration each working day by the analysis of a CCV (mid-level concentration of the calibration curve). A mid-level standard (CCV) must be injected at the start of each sequence and after each set of sample extracts (every 10 samples or every 12 hours, whichever is first) in the analysis sequence. Table 8 lists method specific criteria for evaluating the acceptability of a CCV. See the SOP for *Calibration of Instruments for Organic Chromatographic Analyses* (SOC-CAL) for allowable exceptions.
- 11.3.7 Evaluation of the Analytical Sequence
  - 11.3.7.1 Check that CCVs and CCBs were interspersed throughout the sequence at the proper frequency. Nonconformances must be documented and obtain supervisory approval before data is accepted.



- 11.3.7.2 Check retention times in the aliphatic hydrocarbon marker mix and aromatic hydrocarbon marker mix. Update retention times as needed
- 11.3.7.3 Check that CCVs and CCBs are acceptable. CCV acceptance criteria are described in Table 8. CCBs should be free of all target analyte contamination at a level less than the MRL.
- 11.3.7.4 Check Method Blanks for potential extraction batch contamination. Extraction Method Blanks should be free of all target analyte contamination at a level less than the MRL. In the event that a Method Blank contains target analyte greater than or equal to the MRL, samples testing positive for that compound at levels less than 20 times the level detected in the Method Blank should be reanalyzed or the associated data must be flagged to indicate potential laboratory contribution.

**Note For DOD Projects:** If the Method Blank contains target analyte(s) greater than or equal to  $\frac{1}{2}$  the MRL, the associated samples, where the analyte(s) are detected at a concentration greater than or equal to the LOD and is less than 10 times the amount detected in the Method Blank, require re-analysis or the data must be flagged with appropriate qualifiers. This project-specific requirement may apply to other projects as well.

- 11.3.7.5 Check Method Blank and LCS surrogate recoveries. Surrogate recoveries for MBs and LCSs are used to make inferences about associated environmental samples. Low recoveries in the MB and/or LCS constitute an out-of-control event for the entire batch of samples and all samples in the batch testing positive for any target analyte should be re-analyzed or the data must be flagged to indicate potential laboratory contribution. High recoveries in the MB and/or LCS show a potential high bias. However, if all target analyte concentrations (in associated samples) are below the MRL, no corrective action is required other than flagging the high surrogate recoveries in the analytical report.
- 11.3.7.6 In order to report the associated sample results, all LCS recoveries must be within acceptance criteria. If the LCS recovery is outside the criteria due to chromatographic problems (injection problem, etc.) take the necessary corrective action and reanalyze. If reanalysis does not correct the problem or if the LCS recovery is outside the criteria due to extraction/preparation failure, re-extract and reanalyze the associated samples.
- 11.3.7.7 If matrix spike recoveries are outside acceptance criteria, examine corresponding sample results for potential matrix interferences such as high levels of target analyte (spike levels should be a minimum of 4 times the background concentration). If no obvious matrix interferences are observed, evaluate the recovery of the laboratory control sample (LCS). Reanalyze if deemed appropriate. Do not re-extract the matrix spike unless required by the project.
- 11.3.7.8 Check RPD values on duplicate sample analyses (sample/duplicate or MS/DMS). If values exceed the criteria, examine the chromatograms, bench sheet comments and the actual sample for potential matrix



interferences. Examples include product layers on aqueous samples that may result in non-homogenous sub-sampling, severe emulsions, non-homogenous solid samples, inefficient extraction in one sample compared to another as indicated by significantly different surrogate recoveries. Flag RPD values that are outside of acceptance criteria and explain the anomalies in the form of a case narrative. Reanalysis and/or re-extraction and reanalysis may be required, see supervisor.

- 11.3.7.9 Check RPD values on duplicate LCS/DLCS analyses (when applicable). If values exceed criteria, examine the data for obvious problems. Reanalyze one or the other LCS if deemed appropriate. If reanalysis does not correct the problem, re-extract and reanalyze the associated samples.
- 11.3.8 Evaluation of Sample Analysis - ALS acceptance criteria are established based on either the method criteria or on control charting of analytical results. Unless specific criteria are required by the method, or stated in project specific data quality objectives, ALS-generated criteria will be used in evaluating acceptability of the analysis.
  - 11.3.8.1 Calculate surrogate recovery as the amount detected in the sample (solution concentration) divided by the true value (solution concentration). If surrogate recovery is outside acceptance criteria examine the chromatogram for obvious matrix interferences such as high levels of target analyte or co-eluting peaks. If the problem is the result of obvious matrix interference, flag the recovery value as outside acceptance criteria due to matrix interference. If no obvious interference is observed, reanalyze (or re-extract and reanalyze if deemed more appropriate) the sample. If surrogate recovery is again outside criteria (or acceptable but within 5% of the primary analysis), report the original value and flag the recovery as being outside of acceptance criteria due to matrix interference. Otherwise, report the reanalysis.
  - 11.3.8.2 Examine solution concentrations of target analytes in the samples. If the concentration is greater than the high calibration standard, reanalyze the sample at a dilution. Preferably, dilutions should be performed to keep target analytes in the top half of the calibration range.
  - 11.3.8.3 Check for possible carryover. Pay particular attention to situations where samples containing low levels of target analyte were analyzed one or two runs after samples containing levels of target analyte near or above the high end of the calibration range. Reanalyze as needed.
  - 11.3.8.4 Check integrations. Where possible, all integrations should be performed consistent with integration of the corresponding calibration standards. Hydrocarbon ranges are integrated baseline to baseline, dropped to the lowest point in the chromatographic window. The integration software currently in use is usually capable of performing the integrations (and subtracting any responses contributed by added surrogates) satisfactorily.
  - 11.3.8.5 Perform qualitative evaluation of the chromatographic fingerprint. This is done by comparing the fingerprint of the sample to the two



marker mixes and the fingerprint library. The marker mixes are used to assess qualitatively the presence of common fuel components. The qualitative evaluation is used to report specific hydrocarbon products in the interpretive analyses (EPA Method 8015C) and to qualitatively flag the results for hydrocarbon range analyses. The following guidelines are provided:

- Gasoline is present if ethylbenzene, xylenes, and 1,2,3-trimethylbenzene, and a small hump of unresolved responses eluting about and after 1,2,3-trimethylbenzene are observed. Ethylbenzene and the xylenes should have the same pattern as the calibration standard (i.e. relative peak height to each other). Weathered gasoline is indicated by relative ethylbenzene and xylene responses that are different than in the calibration standard.
- Diesel is present if the fingerprint shows a recognizable n-alkane pattern that includes the isoprenes pristane and phytane, and a large hump of unresolved responses that elute from C10-C23 with its apex at about C15. 1,2,3-trimethylbenzene is usually distinguishable. Weathered diesel is indicated by (1) pristane/C17 and phytane/C18 response ratios greater than those in the calibration standard, (2) the later shifting of the unresolved response hump relative to that in the standard (yet pristane and phytane are observed) or (3) the presence of pristane and phytane with the lack of any recognizable n-alkanes. In the latter case, the unresolved hump is typically later eluting than in the standard, but should still be primarily within the diesel window; if most of the hump is outside the diesel window, the responses may be due to another fuel oil.
- Bunker C is present if the fingerprint shows a recognizable n-alkane pattern that includes pristane, phytane and contains fluoranthene and pyrene in approximately the correct ratio for Bunker C. Note that the aromatic compounds are more susceptible to weathering than the isoprenes, yet less susceptible to weathering than the n-alkanes.
- Lubricating range oil is present if the responses are chiefly a large hump of unresolved responses that resembles that of the 30-wt. Motor Oil calibration standard and usually elutes in approximately the same or heavier carbon range as that of the hump in the standard. The humps of lubricating oils of higher viscosity than the motor oil calibration standard elute later than that of the standard while those of lighter viscosity elute earlier, but still mostly within the motor oil range.
- Hydraulic fluids fingerprints resemble that of motor oil, and can indeed resemble 30-wt. motor oil in appearance and retention times, but often elute earlier, mostly in the latter half of the diesel range, and sometimes possess more than one, yet unresolved, hump (a large hump with a large shoulder).
- Transformer oil fingerprints also resemble that of motor oil, and are typically one simple hump, but elute earlier than hydraulic fluids, entirely within the early to middle regions of the diesel range.



- Turpentine is present if alpha pinene and beta pinene are observed in the chromatogram, in high concentrations (especially alpha pinene) relative to other extracted organics in the approximate elution range.
- Creosote is present if the chromatographic responses are due chiefly to PAHs, with many resolvable yet unidentifiable individual responses from C12-C36.
- Mineral spirits elute in a very short window approximately between C8-C14 with, in a relatively unweathered sample, the top of the hump centered between C10-C11, and the individual n-alkanes between C9-C12 especially prominent.
- Kerosene (and Jet A fuel; the two are chromatographically indistinguishable) is present if the fingerprint shows a recognizable n-alkane pattern that includes the isoprenes pristane and phytane (though all components eluting this late are at very low relative concentration and thus may not be observed if the concentration is relatively low), and a large hump of unresolved responses that elute from C8-C17 with its apex at about C12. 1,2,3-trimethylbenzene is more prominent than in diesel.
- Military jet fuels: Fingerprints can vary from site to site (and from supplier to supplier), and can have additives not present in kerosene, specifically ethylbenzene and xylenes. JP-5 tends to resemble kerosene, eluting at a slightly (extent can vary) earlier retention time; pristane/C17 and phytane/C18 are just distinguishable if the concentration is high enough. JP-4 resembles kerosene much less, and elutes at a much earlier retention time; pristane/C17 and phytane/C18 are not usually observed. JP-8 tends to resemble kerosene, eluting within the same window but with a flatter appearing hump; pristane/C17 can be observed but phytane/C18 usually cannot be observed.
- Weathered products: All fuels generally demonstrate weathering characteristics similar to those enumerated above for diesel. As a fuel is weathered, (1) its hump tends to shift later in the chromatogram, due to evaporation, (2) individual, semi-resolved, peaks in the hump become less resolved (the hump looks smoother) due to microbial weathering, (3) n-alkanes become much less prominent or disappear, also due to microbial action, and (4) individual marker compounds become more prominent relative to the total chromatographic responses due to their greater resistance to microbial weathering. For the purposes of this SOP (that is, among those marker compounds identifiable in this SOP), survivability of compounds increase in the following order:
  - 1 - n-alkanes < aromatics < branched alkanes
  - 2 - branched alkanes include the isoprenes pristane and phytane.
- Field samples often contain mixtures of many different petroleum products. Interpretation of petroleum product mixtures includes a



significant amount of analytical judgment and should be confirmed by an analyst experienced with interpretation or the supervisor.

**Note:** Alaska DEC requires both pre- and post-silica gel cleanup results be provided. The extract(s) must be analyzed per the standard AK102/AK103 methods, silica gel cleanup performed, re-analyzed and both results reported. Therefore, LIMS test codes AK\_DRO\_SGT or AK\_RRO\_SGT mean that both the non-SGT and SGT treated analyses will be reported.

## 12) QA/QC Requirements

### 12.1 Initial Precision and Recovery Validation

- 12.1.1 The accuracy and precision of the procedure must be validated before analysis of the samples begins, or whenever significant changes to the procedures have been made. IPR studies should be performed in order to be equivalent to NELAC's Initial Demonstration of Capability.
- 12.1.2 Perform IPR studies by preparing and analyzing four replicate laboratory control samples spiked at a level of 1 to 4 times the MRL. Calculate average percent recovery and relative standard deviation for the four replicate analyses. Unless specified by the method, acceptance criteria are the control limits used for LCS percent recovery and % RSD.
- 12.1.3 Calculate the average concentration found ( $\bar{x}$ ) in  $\mu\text{g/mL}$ , and the standard deviation of the concentrations ( $s$ ) in  $\mu\text{g/mL}$  for each analyte. Calculate the MDL for each analyte. Refer to CE-QA011, *Performing Method Detection Limit Studies and Establishing Limits of detection and Quantification*. The MDL study must be verified annually.

### 12.2 Limits of Quantification (LOQ)

- 12.2.1 The laboratory establishes a LOQ for each analyte as the lowest reliable laboratory reporting concentration or in most cases the lowest point in the calibration curve which is less than or equal to the desired regulatory action levels, based on the stated project requirements. Analysis of a standard or extract prepared at the lowest point calibration standard provides confirmation of the established sensitivity of the method. The LOQ recoveries must be within laboratory established acceptance range to verify the data reporting limit. Refer to CE-QA011, *Performing Method Detection Limit Studies and Establishing Limits of detection and Quantification*.
- 12.3 The Method Reporting Limits (MRLs) used at ALS are the routinely reported lower limits of quantitation which take into account day-to-day fluctuations in instrument sensitivity as well as other factors. These MRLs are the levels to which ALS routinely reports results in order to minimize false positive or false negative results. The MRL is normally two to ten times the method detection limit.
- 12.4 Ongoing QC Samples required are described in the ALS-Kelso Quality Assurance Manual and in the SOP for *Sample Batches* (ADM-BATCH). Additional QC Samples may be



required in project specific quality assurance plans (QAPP). For example projects managed under the DoD ELAP must follow requirements defined in the DoD *Quality Systems Manual for Environmental Laboratories*. General QA requirements for DoD QSM are defined in the laboratory SOP, *Department of Defense Projects - Laboratory Practices and Project Management* (ADM-DOD/ADM-DOD5). General QC Samples are:

- 12.4.1 QA/QC Sample Analysis: Each sample preparation batch will contain a maximum of 20 field samples, one Method Blank, and one Laboratory Control Sample. Additional QC analyses are performed at a rate of one set per 20 field samples. Unless stated in project specific data quality objectives, the standard QA/QC sample set for aqueous and solid matrices is Matrix Spike/Duplicate Matrix Spike. A Duplicate client sample is required for the NWT PH method at a rate of no less than one per 10 field samples. A Duplicate Laboratory Control Sample is required for Alaska Methods AK 102 and AK 103, and when the appropriate Matrix Spike/Duplicate Matrix Spike or Duplicate client sample requirements cannot be met (due to limited sample volume). The standard QC sample set for miscible waste samples is a Duplicate client sample.
- 12.4.2 QC Analyses: The acceptance criteria for QC analyses are listed in Table 9. The acceptance criteria are established based on method-required criteria or from control charting of analytical results. Surrogate recoveries for new compounds or analyses not charted are set at 70-130%. Unless criteria are required by the method or stated in project specific data quality objectives, ALS criteria determined from historical results will be used in evaluating acceptability of the analysis.
- 12.5 Section 11 provides guidelines for corrective action when QC sample recoveries are outside acceptance criteria.

### 13) Data Reduction and Reporting

- 13.1 External Standard Calibration: The concentration of each compound in the sample is determined by calculating the amount of analyte injected using the calibration curve or the calibration factor. Calculations for determining specific analyte concentrations in the sample are described below.

#### Calibration Factors

For external calibration, the calibration factor is calculated as:

$$Cf = \frac{Rx}{Ax}$$

Where:  $Cf$  = Calibration factor

$Rx$  = Response of the analyte (area)

$Ax$  = Concentration of analyte injected ( $\mu\text{g/mL}$ ).

- 13.2 Results based on average of response factor or a linear regression is calculated as:  
Solution Concentration of Analyte Detected



$$C_{sol} = \frac{R_{cmpd}}{C_f}$$

Where:  $C_{sol}$  = Solution concentration of the compound (mg/L)  
 $R_{cmpd}$  = Response of the compound (area)  
 $C_f$  = Calibration factor

#### Sample Concentration of Analyte Detected

Aqueous Samples:  $Result(ug / L) = C_{sol} \times \frac{(Fvol \times Df)}{V_{smp}}$

Solid and Waste Sample:  $Result(mg / Kg) = C_{sol} \times \frac{(Fvol \times Df)}{W_{smp}}$

Where:  $Result$  = Sample result (ppm)  
 $C_{sol}$  = Solution concentration of the compound (mg/L)  
 $Fvol$  = Final volume of the extraction (mL)  
 $Df$  = Dilution factor (if no dilution was performed  $Df = 1$ )  
 $C_f$  = Calibration factor  
 $V_{smp}$  = Volume of sample extracted (L)  
 $W_{smp}$  = Weight of sample extracted (g), in dry weight or wet weight, depending on the reporting basis of the data.

- 13.3 Results of extracted solid and waste samples are reported in mg/Kg (ppm). Solid sample results are usually reported on a dry-weight basis.
- 13.4 Data Review
- 13.4.1 Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to SOP *Laboratory Data Review Process* (ADM-DREV) for details.
- 13.5 Reporting
- 13.5.1 Reports are generated in the ALS LIMS reporting software by compiling the SMO login, sample prep database, instrument date, and client-specified report requirements (when specified). The forms generated may be ALS standard reports, DOD, or client-specific reports. The compiled data from LIMS are also used to create EDDs.
- 13.5.2 Sample concentrations are reported when all QC criteria for the analysis have been met or the results are qualified with an appropriate footnote. Refer to the SOP for *Data Reporting and Report Generation* (ADM-RG) for specific procedures and guidelines used for reporting analytical results and generating analytical reports.



### 13.5.3 Data Qualifiers

- 13.5.3.1 Data should be qualified when significant information regarding the analysis needs to be communicated to assist the user in determining the usability of the results. Acceptable qualifiers should comply with standard ALS (Kelso) data qualifiers.
- 13.5.3.2 When it is requested that results for Gasoline or lighter analytes be reported, these results are to be reported as estimated values and appropriately narrated.
- 13.5.3.3 Always use data qualifiers to describe hydrocarbon products. Refer to *Data Reporting and Report Generation* (ADM-RG), Appendix B for the specific hydrocarbon qualifiers:
- F-The chromatographic fingerprint of the range in question approximately matches that of the calibration standard used to quantify the result.
  - Y-The chromatographic fingerprint of the range in question resembles a petroleum product that elutes approximately within the range of integration of the calibration standard used to quantify the result but does not match the chromatographic fingerprint of the standard. A sufficiently weathered product that would otherwise match the appropriate calibration standard also falls into this category.
  - L,H-The chromatographic fingerprint of the range in question mostly matches that of a petroleum product, but is actually a partial contribution of a product which elutes mostly in a lighter or heavier range (e.g., motor oil partially eluting in the diesel range), respectively.
  - O-The chromatographic fingerprint in a range later than the Diesel range resembles that of oil, but does not match that of the calibration standard used to quantify the result.
  - Z-The hydrocarbon responses in the range in question are primarily not due to response from a petroleum product.

## 14) Contingencies for Handling Out-of-Control or Unacceptable Data

- 14.1 Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.
- 14.2 Refer to the SOP for *Non Conformance and Corrective Action* for documentation practices and proper action for *Out of Control* events.

## 15) Method Performance

- 15.1 This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional method performance data available.
- 15.2 The method detection limit (MDL) is established using the procedure described in the SOP *Performing and Documenting Method Detection Limit Studies and Establishing*



*Limits of Detection and Quantification* (CE-QA011/ADM-MDL). Method Reporting Limits are established for this method based on MDL studies and as specified in the ALS Quality Assurance Manual.

## 16) Pollution Prevention and Waste Management

16.1 The laboratory will comply with all Federal, State and local regulations governing waste restrictions as specified in the ALS Lab Waste Management Plan.

## 17) Training

17.1 Training is documented following the *Employee Training and New Employee Orientation* (ADM-TRAIN).

## 18) Method Modifications

18.1 There are no known modifications in this laboratory standard operating procedure from the reference methods.

## 19) References

- 19.1 EPA Method 3500C, SW-846 Update IV. *Organic Extraction and Sample Preparation*, USEPA, 02/2007.
- 19.2 EPA Method 3510C, SW-846 Update III. *Separatory Funnel Liquid-Liquid Extraction*, USEPA, December, 1996.
- 19.3 EPA Method 3540C, SW-846 Update III. *Soxhlet Extraction*, USEPA, December, 1996.
- 19.4 EPA Method 3550C, SW-846 Update IV. *Ultrasonic Extraction*, USEPA, December, 02/2007.
- 19.5 EPA Method 3580A, SW-846 Update I. *Waste Dilution*, USEPA, July 1992.
- 19.6 EPA Method 3600C, SW-846 Update III. *Cleanup*, USEPA, December, 1996.
- 19.7 EPA Method 3611B, SW-846 Update III. *Alumina Column Cleanup and Separation of Petroleum Wastes*, USEPA, December, 1996.
- 19.8 EPA Method 3630C, SW-846 Update III. *Silica Gel Cleanup*, USEPA, December, 1996.
- 19.9 EPA Method 3650B, SW-846 Update III. *Acid-Base Partition Cleanup*, USEPA, December, 1996.
- 19.10 EPA Method 8000C, SW-846 On-Line. *Gas Chromatography*, USEPA, 03/2003
- 19.11 EPA Method 8015C, SW-846 Update IV *Nonhalogenated Organics by Gas Chromatography*, USEPA, February, 2007.
- 19.12 Alaska DEC Method AK 102, Contaminated Sites Program, *Method AK102 for the Determination of Diesel Range Organics*, April 2002.
- 19.13 Alaska DEC Method AK 103, Underground Storage Tank/LUST Program, *Method for the Determination of Residual Range Organics*, April 2002.
- 19.14 Alaska DEC Technical Memorandum 06-001, Alaska Department of Environmental Conservation, Division of Spill Prevention and Response, Contaminated Sites Remediation Program, *Biogenic Interference and Silica Gel Cleanup*, May 2006.
- 19.15 NWTPH-Dx, Semi-Volatile Petroleum Products Method for Soil and



Water, Analytical Methods for Petroleum Hydrocarbons, Publication No. ECY 97-602, June 1997.

- 19.16 DOD Quality Systems Manual for Environmental Laboratories (QSM), Version 5.1.1, February 2018.
- 19.17 TNI Standard, Volume, 2009; 2016.
- 19.18 ISO/IEC 17025: 2017.

## 20) Changes Since the Last Revision

Summary of Revision Changes			
Revision Number	Effective Date	Document Editor	Description of Changes
17.0	12/2/2020	T Caron	Reformatted SOP to current ALS format. Updated signatories. Minor typographical changes to improve readability and consistency. Section 11: Numerous edits throughout the section including sample extraction, sample analysis. Updated References. Former Table 9 was removed (DQO, surrogate and MS recoveries, RPD for duplicate analysis).

## 21) Attachments, Tables, and Appendices

- 21.1 Table 1 - Applicable Method references, Target Analytes, Standard of Quantitation, Suggested Independent Calibration Verification Standards, and Calibration Techniques.
- 21.2 Table 2 - Method Reporting Limits.
- 21.3 Table 3 - Library of Fuel Fingerprints.
- 21.4 Table 4 - Maximum Recommended Analytical holding time and Preservatives.
- 21.5 Table 5 - Suggested Concentrations of Calibration Standards.
- 21.6 Table 6 - Suggested GC Operation Conditions.
- 21.7 Table 7 - Nominal Hydrocarbon Ranges for Petroleum Products.
- 21.8 Table 8 - Initial and Continuing Calibration Acceptance Criteria.
- 21.9 Table 9 - Summary of Calibration and QC Criteria with Corrective Actions.
- 21.10 Appendix A - Example Marker Chromatogram.



**TABLE 1**  
**Applicable Method References, Target Analytes, Standard of Quantitation, Suggested Independent Calibration Verification Standards, and Calibration Techniques**

<b>Method</b>	<b>Target Analytes</b>	<b>Standard of Quantitation</b>	<b>Suggested ICV</b>	<b>Calibration</b>
EPA Method 8015C	C10-C28 Diesel Range Organics	Diesel #2 composite	Diesel #2	External
EPA Method 8015C	Diesel Range Organics (various ranges) Residual Range Organics (various ranges)	Diesel #2 composite 30 wt. Motor Oil	Diesel #2 30 wt. Motor Oil	External
Alaska DEC AK102	C10-C25 DRO (Diesel Range Organics)	Diesel #2 composite	Diesel #2	External
Alaska DEC AK103	C25-C36 RRO (Residual Range Organics)	30/40wt. Motor Oil Mix	30/40 wt. Motor Oil Mix	External
Northwest TPH-Dx	C12-C25 Diesel Range Organics C25-C36 Residual Range Organics	Diesel #2 composite 30wt. Motor Oil Mix	Diesel #2 30 wt. Motor Oil	External



**TABLE 2**  
**Method Reporting Limits**

<b>Compound</b>	<b>Aqueous Sample MRL (µg/L)</b>	<b>Aqueous Sample MDL (µg/L)</b>	<b>Solid/Waste Sample MRL(mg/Kg)</b>	<b>Solid/Waste Sample MDL (mg/Kg)</b>
8015C TPH-Diesel Range Hydrocarbons	50	15	25	1.6
NW TPH-Diesel Range Hydrocarbons	250	11	25	1.2
NW TPH-Residual Range Hydrocarbons	500	19	100	2.9
AK102 Diesel Range Hydrocarbons	800*	11	20*	1.3
AK103 Residual Range Hydrocarbons	500*	38	100*	2.9

\* Required MRLs for Alaska fuels methods.



**TABLE 3**  
**Library of Fuel Fingerprints**

Class	Product	Class	Product	
Fuels and Oils	Unleaded Gasoline	Fuels and Oils	Hydraulic Oil (Standard Fluid)	
	Jet A		Hydraulic Oil (Tractor Fluid)	
	JP 4		Hydraulic Oil Composite	
	JP 5		90 wt Gear Oil	
	JP 8		Crude Oil	
	White Gas		Petroleum Solvents	Petroleum Naphtha
	Kerosene		Mineral Spirits	
	Diesel #1		Stoddard Solvent	
	Diesel #2	410 Thinner		
	#4 Fuel Oil	Commercial Paint Thinner		
	#5 Fuel Oil	Turpentine		
	#6 Fuel Oil (Bunker C)	Waxes, Greases, Residuals	Paraffin Wax	
	Stove Oil	Vacuum Grease		
	Transformer Oil	Petroleum Jelly		
	Mineral Oil (Light Grade)	Bearing Grease		
	Mineral Oil (Heavy Grade)	Pine Tar		
	Machine Oil	Asphalt		
	Cutting Oil	Creosote		
	Chain Bar Oil			
	30 wt Motor Oil			
40 wt Motor Oil				
Multi-viscosity Motor Oils				

**TABLE 4**  
**Maximum Recommended Analytical Holding Time and Preservatives**

Method	Matrix	Preservative	Extraction Holding Time	Analysis Holding Time
EPA Method 8015C	Aqueous	pH < 2 with HCL; 4°C	7 Days (collection)	40 Days (extraction)
	Solid	4°C	14 Days (collection)	40 Days (extraction)
	Waste	None	28 Days (collection)	40 Days (extraction)
Alaska DEC Method AK 102	Aqueous	pH < 2 with HCL; 4°C	14 Days (collection)	40 Days (extraction)
	Solid	4°C	14 Days (collection)	40 Days (extraction)
Alaska DEC Method AK 103	Solid	4°C	14 Days (collection)	40 Days (extraction)
Alaska DEC Method AK 103	Aqueous	pH < 2 with HCL, 4°C	14 Days (collection)	40 Days (extraction)
NWTPH-Dx	Aqueous	pH < 2 with HCL; 4°C	7 Days (collection)	40 Days (extraction)
			14 Days (collection) if preserved	
	Solid	4°C	14 Days (collection)	40 Days (extraction)



**TABLE 5**  
**Suggested Concentrations of Calibration Standards. Concentrations are in  $\mu\text{g/ml}$  (ppm)**

Compound	Type	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8	ICV
4-Bromofluorobenzene	Surrogate	1	2.5	10	25	100	250	NA	NA	NA
<i>o</i> -Terphenyl	Surrogate	1	2.5	10	25	100	250	NA	NA	NA
Triacontane	Surrogate	1	2.5	10	25	100	250	NA	NA	NA
Gasoline	Target Analyte	20	50	200	500	2000	5000	NA	NA	1000
Kerosene	Target Analyte	20	50	200	500	2000	5000	NA	NA	1000
Diesel #2	Target Analyte	20	50	200	500	2000	5000	2000 0	5000 0	1000
30 wt. Motor Oil	Target Analyte	20	50	200	500	2000	5000	NA	NA	1000
30wt./40wt. Motor Oil Mixture	Target Analyte	NA	50	200	500	2000	5000	NA	NA	1000



**TABLE 6**  
**Suggested GC Operating Conditions**

<b>Event</b>	<b>GC Setting</b>
<b>GC System</b>	
Carrier Gas	Hydrogen
Injection Mode	Splitless
Septum Purge On Time (min)	0.10
Septum Purge Flow (ml/min)	50
Initial Temperature (°C)	60
Initial Hold Time (min)	1.5
Ramp Rate 1 (°C/min)	45
Temp Break 1 (°C)	280
Ramp Rate 2 (°C/min)	25
Temp Break 2 (°C)	315
Ramp Rate 3 (°C/min)	10
Final Temperature (°C)	330
Final Hold Time (min)	7.00
Inlet Temperature (°C)	280
Detector Temperature (°C)	340
<b>Pressure Program</b>	
Constant Flow (✓)	NA
Constant Pressure (✓)	NA
Initial Pressure (psi)	10
Pulse Rate (psi/min):	150
Pulse Maximum (psi)	30
Pulse Maximum Hold Time (min)	0
Pulse Return Rate (psi/min)	150
Pulse Minimum (psi)	3.0
Pressure Hold Time (min)	0.5
Pressure Rate (psi/min)	4.7
Pressure Maximum (psi)	75
Pressure Hold Time (min)	0
Approximate Cycle Time (min)	22



**TABLE 7**  
**Nominal Hydrocarbon Ranges for Petroleum Products**

<b>Method</b>	<b>Target Analyte</b>	<b>Starting Marker</b>	<b>Closing Marker</b>
Nominal EPA Method 8015C	Diesel	Decane (inclusive)	Octacosane (inclusive)
8015C	Gasoline	Octane (inclusive)	Dodecane (exclusive)
8015C	Kerosene	Nonane (inclusive)	Octadecane (inclusive)
8015C when reported with separate heavy range	Diesel*	Dodecane (inclusive)	Pentacosane (exclusive)
8015C	Residual (or Heavy) Range Organics*	Pentacosane (inclusive)	Hexatriacontane (inclusive)
8015C	Motor Oil	Pentacosane (inclusive)	Hexatriacontane (inclusive)
8015C	#6 Fuel Oil (Bunker C)	Dodecane (inclusive)	Hexatriacontane (inclusive)
Alaska Method AK 102	Diesel Range Organics	Decane (inclusive)	Pentacosane (exclusive)
Alaska Method AK 103	Residual Range Organics	Pentacosane (inclusive)	Hexatriacontane (inclusive)
Washington NWTPH-Dx	Diesel Range Organics	Dodecane (inclusive)	Pentacosane (exclusive)
Washington NWTPH-Dx	Residual Range Organics	Pentacosane (inclusive)	Hexatriacontane (inclusive)

\* These ranges may be defined slightly differently based on client requests/requirements



**TABLE 8**  
**Acceptance Criteria for Performance Tests**

<b>Method</b>	<b>Initial Calibration Criteria</b>	<b>CCV Criteria</b>	<b>Notes</b>
EPA Method 8015C	<20 % RSD (or plot)	± 20 %	None
Alaska DEC Method AK 102	<25 % RSD (or plot)	± 25 %	Surrogate in CCV 60-120%
Alaska DEC Method AK 103	<25 % RSD (or plot)	± 25 %	Surrogate in CCV 60-120%
NWTPH-Dx	<20% RSD (or plot: r≥0.990)	± 15 %	Method sets criteria on linear regression. All points must be within 15% of true value.

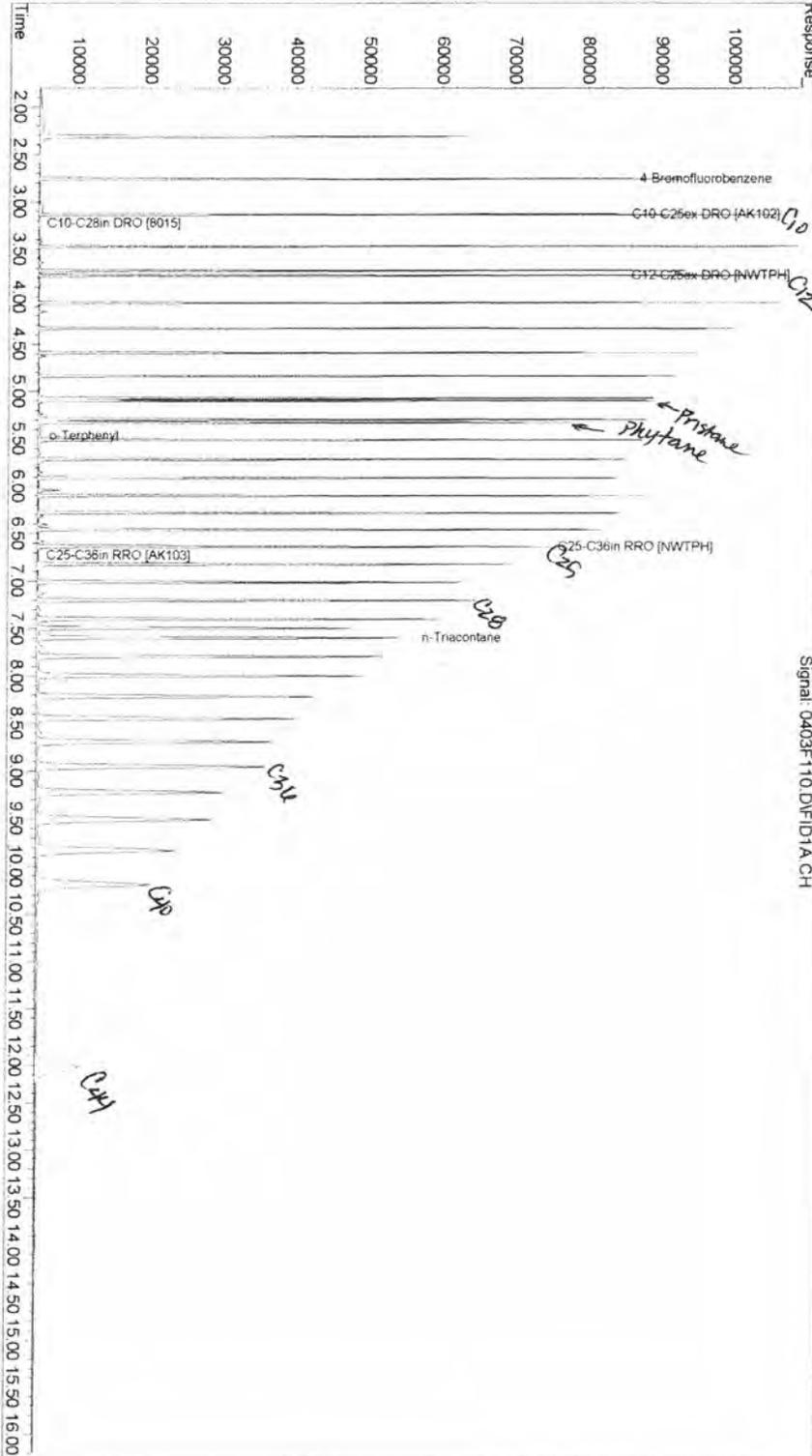


**TABLE 9**  
**Summary of Calibration and QC Criteria with Corrective Actions**

Method Reference	Control	Specification and Frequency	Acceptance Criteria	Corrective Action
EPA 8015C, NWTPH-Dx, AK102/103	ICAL	Prior to sample analysis	See Table 8	Correct problem then repeat ICAL
EPA 8015C, NWTPH-Dx, AK102/103	ICV	After ICAL	See Table 8	Correct problem and verify second source standard; rerun second source verification. If fails, correct problem and repeat initial calibration.
EPA 8015C, NWTPH-Dx, AK102/103	CCV	Prior to sample analysis	See Table 8	Correct problem then repeat CCV or repeat ICAL
EPA 8015C, NWTPH-Dx, AK102/103	Method Blank	Include with each analysis batch (up to 20 samples)	<MRL (unless project specified)	If target exceeds MRL, reanalyze to determine if instrument was cause. If still noncompliant then:  Re-extract or reanalyze samples containing contaminate, unless samples contain > 20x amount in blank.
EPA 8015C, NWTPH-Dx, AK102/103	Laboratory Control Sample	Include with each analysis batch (up to 20 samples)	See Table 9	If exceeds limits, re-extract and re-analyze
EPA 8015C, NWTPH-Dx, AK102/103	Matrix Spike	Include with each analysis batch (up to 20 samples)	See Table 9	Evaluate data to determine if there is a matrix effect or analytical error
EPA 8015C, NWTPH-Dx, AK102/103	MS/Sample Duplicates	Include with each analysis batch (up to 20 samples)	See Table 9	Re-homogenize and re-analyze if result is > 5 X the MRL



### Appendix A Acceptance Criteria for Performance Tests



File : J:\GC21\DATA\040319F\0403F110.D  
Operator : TAP  
Acquired : 03 Apr 2019 11:21 am using AcqMethod SVF\_FX32.M  
Instrument : GC21  
Sample Name: ALIPHATICS  
Misc Info :  
Vial Number: 91



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## Organochlorine Pesticides by Gas Chromatography

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DOCUMENT ID: SOC-8081, REV 22.0

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Prepared By: Organics Manager, Jonathon Walter  
Signature on File

Approved By: Quality Assurance Manager, Kurt Clarkson  
Signature on File

Approved By: Laboratory Director, Charles (Pat) Byrne  
Signature on File

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## 1) Scope & Applicability

- 1.1 This Standard Operating Procedure (SOP) describes the procedure used to determine the concentrations of Organochlorine Pesticides in liquid and solid matrices using EPA Method 8081B.
- 1.2 Table 1 indicates compounds that are routinely determined by this procedure and lists the method reporting limits (MRLs) in water and a low-level water option. Table 2A lists the MRLs in soil/sediment, and those for a low-level sediment option. Table 2B lists the MRLs in tissue. Additional analytes may also be determined as required by specific projects. The reported MRL may be adjusted if required for specific project requirements; however, the capability of achieving other reported MRLs must be demonstrated. Method Detection Limits (MDLs) that have been achieved are listed in the ALS-Kelso DQO tables. The MDL/LODs may change as repeat studies are conducted.
- 1.3 In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPPs supersede method specified requirements. An example of this are projects falling under DoD ELAP. QC requirements defined in the *SOP Department of Defense Projects – Laboratory Practices and Project Management (ADM-DOD)* may supersede the requirements defined in this SOP.

## 2) Summary of Procedure

- 2.1 This procedure provides gas chromatographic conditions for the detection of low concentration (typically parts-per-billion level organochlorine pesticides) pesticides. Target analytes are extracted from the sample and isolated via extract cleanup if needed. Liquid samples are extracted using shaker table microextraction (Method 3511, SOP EXT-3511). TCLP leachates are extracted using separatory funnel (Method 3510, SOP EXT-3510). In general, solid samples are extracted using automated microwave extraction (Method 3546, SOP EXT-3546).
- 2.2 A portion of the extract is analyzed using a gas chromatograph (GC) equipped with dual column fused silica capillary columns and dual electron capture detectors (ECD). Identification is based on comparison of sample retention times to the retention times of known target compounds. Quantitative analysis is performed by using certified standards to produce a calibration curve response factor. Analyte concentration can then be calculated using the response factor of the calibration curve. Sample concentration is calculated using the extract concentration and the extracted sample weights, volumes and dilution factors.

## 3) Definitions

- 3.1 For general definitions applicable to most analyses refer to the SOP for *Sample Batches*, ADM-BATCH.

## 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have

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demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.

- 4.2 It is the responsibility of the department supervisor/manager to document analyst training. Documenting method proficiency, as described in the *SOP Employee Training and Orientation*.

## 5) Interferences

- 5.1 Solvents, reagents, glassware, gases, and sample processing hardware may yield discrete artifacts and/or elevated baselines, causing misinterpretation of the chromatograms. All of these materials must be demonstrated to be free from interferences, under the conditions of the analysis, by running method blanks.
- 5.2 Interferences from phthalate esters introduced during sample handling can pose a problem with pesticide determinations. Analysts should take precautions not to introduce phthalates during the analysis and sample preparation process. Much interference can be removed using GPC (SOP SOC-3640A) and/or Florisil cleanup (SOP EXT-FLOR). Florisil cleanup is typically used to reduce matrix interferences caused by polar compounds. The presence of elemental sulfur will result in peaks interfering with early eluting pesticides. Cleanup via method 3660 (SOP SOC-3660) may be used for the removal of sulfur if GPC cleanup is inadequate. Other co-extractables such as lipids, waxes, etc., are removed via GPC cleanup. A cleanup procedure using carbon cartridges (SOP EXT-CARCU) that eliminates non-polar compounds that interfere with gas chromatographic analyses may also be utilized.

## 6) Safety

- 6.1 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Kelso Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.

## 7) Sample Collection, Containers, Preservation, and Storage

- 7.1 Containers used to collect samples should be purchased pre-cleaned containers. Alternatively, containers used to collect samples for the determination of semivolatile organic compounds may be soap and water washed followed by methanol (or isopropanol) rinsing. The sample containers should be of glass or Teflon and have screw-top covers with Teflon liners. In situations where Teflon is not available, solvent-rinsed aluminum foil may be used as a liner. Highly acidic or basic samples may react with the aluminum foil, causing eventual contamination of the sample. Plastic containers or lids may not be used for the storage of samples due to the possibility of sample contamination from the phthalate esters and other hydrocarbons within the plastic. Sampling should be performed according to SW-846 guidelines or project-specific procedures.
- 7.2 Water and soil samples must be iced or refrigerated at  $\leq 6^{\circ}\text{C}$  from time of collection until extraction. Water samples must be extracted within 7 days of collection and soil/sediment samples must be extracted within 14 days of collection.
- 7.3 Sample extracts are stored at  $4^{\circ}\text{C}$  in the dark and must be analyzed within 40 days

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## 8) Standards, Reagents, and Consumable Materials

### 8.1 Standards

8.1.1 The following commercially prepared stock standards and ICV stock standards are purchased from various vendors and must be certified by the manufacturer. The ICV stock standards are obtained from a different source from the initial calibration. The expiration date for unopened ampules is the manufacturer's assigned expiration date. If the manufacturer does not assign a date, an expiration date of 1 year from receipt is assigned. Stock standards are stored at the recommended temperature from the vendor. The intermediate stock standards prepared by the analysts are stored in freezer.

Standard	Concentration	Use
8081	1000 µg/mL	ICAL
8081 Surrogate <sup>a</sup>	200 µg/mL	ICAL
Isodrin	100 µg/mL	ICAL
Hexachlorobenzene	100 µg/mL	ICAL
8081 Misc. compounds*	250 µg/mL	ICAL
Chlordane	100 µg/mL	ICAL
Toxaphene	1000 µg/mL	ICAL

8081	1000 µg/mL	ICV
Isodrin	100 µg/mL	ICV
Hexachlorobenzene	100 µg/mL	ICV
8081 Misc. compounds	250 µg/mL	ICV
Chlordane	1000 µg/mL	ICV
Toxaphene	1000 µg/mL	ICV

8081 Internal Standard<sup>b</sup> 5000 µg/mL Internal standard  
 Surrogates are Decachlorobiphenyl (DCB) and 2,4,5,6-Tetrachlorometaxylene (TCMX).  
 Internal standard is 1-Bromo-2-nitrobenzene.

8.1.2 Intermediate standard solutions and ICV solutions are made in hexane by diluting stock standards to intermediate concentrations listed below. The ICV intermediates are prepared from the ICV stock standards obtained from a different source from the initial calibration stocks.

ICAL Intermediate	Concentration	Preparation
Combined 8081, isodrin, hexachlorobenzene, and surrogate.	1.0 µg/mL	1:1000 dilution of 8081 stock, 1:100 dilution of isodrin & hexachlorobenzene stocks, 1:100 dilution of surr. stock.
8081 Misc. compounds*	1.0 µg/mL	1:250 dilution of stock
Chlordane	1.0 µg/mL	1:1000 dilution of stock
Toxaphene	2.0 µg/mL	1:500 dilution of stock

Intermediate ICV Standard	Concentration	Preparation
Combined 8081, isodrin,	1.0 µg/mL	1:1000 dilution of 8081



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and hexachlorobenzene

stock, 1:100 dilution of isodrin & hexachlorobenzene stocks.

8081 Misc. compounds*	1.0 µg/mL
8081 Internal Standard	1.0 µg/mL
Chlordane	1.0 µg/mL
Toxaphene	2.0 µg/mL

1:1000 dilution of stock  
1:500 dilution of stock

8.1.3 Working Standard Solutions

8.1.3.1 Calibration standards are prepared containing surrogates and analytes in hexane. Calibration standards are stored at 4°C for up to six months. A series of standards are prepared from a common intermediate representing the MRL (or lower) to a value near the high end of the linear range. See Table 4 for preparation and concentrations, including standards designated as CCVs.

8.1.3.2 The independent calibration verification (ICV) standards are prepared from stock solutions from a different source from the initial calibration as listed below. Expiration periods are the same as for equivalent stock and calibration standards.

ICV Standard	Concentration	Preparation
Combined 8081, isodrin, and hexachlorobenzene	2.0 µg/L	1:500 dilution of combined 8081 ICV intermediate.
8081 Misc. compounds	2.0 µg/L	1:500 dilution of 8081 misc. compounds intermediate.
Chlordane	50 µg/L	1:20 dilution of Chlordane ICV stock.
Toxaphene	200 µg/L	1:10 dilution of Toxaphene ICV stock.

8.1.3.3 A surrogate spiking solution is prepared at 0.5µg/mL for water and 0.8 µg/mL for solids. The surrogate solution is stored at 4° C or up to six months.

8.1.3.4 An internal standard solution is prepared at 10 µg/ml (1 µg/ml for low-level) by diluting the internal stock standard in hexane. 10.0 µL of internal standard is added to each 1 mL of standard, blank and sample prior to analysis for a final concentration of 100 ng/mL.

8.1.3.5 All matrix spike solutions are prepared by diluting the stock solution in methanol. This solution is stored at 4°C. The 8081-Isodrin-HCB spike is good for 4 weeks, while the others are good for 6 months. The matrix spike solution is added to all matrix spikes and lab control samples as outlined in section 12.

Spiking Solution	Concentration	Preparation
8081, isodrin, and hexachlorobenzene.	0.5 µg/mL	1:2000 dilution of 8081, isodrin & hexachlorobenzene

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		stocks.
8081 Misc. compounds*	0.5 µg/mL	1:500 dilution of stock
Chlordane**	10 µg/mL	1:100 dilution of stock
Toxaphene	20 µg/mL	1:50 dilution of stock
*Prepare only as needed for projects requiring non-routine additional compounds.		
**Prepare only as needed for project requirements.		

8.1.4 Solvents: Hexane, acetone, methylene chloride, isooctane, and methanol. Pesticide grade or equivalent.

## 9) Apparatus and Equipment

### 9.1 GC Instrumentation - Dual Column

9.1.1 The dual column approach involves a single injection split between two columns mounted in a single gas chromatograph (Hewlett Packard 6890, 7890 or equivalent) equipped with split/splitless, temperature programmable, or multi-mode injection system; with dual ECDs. See Table 3 for typical chromatographic conditions. Hydrogen is used as the carrier gas. Nitrogen is used as the detector make-up gas. Current instrumental systems are identified as follows:

Instrument I.D.	Analytical System	Routine Matrix
GC23	Agilent 6890	Water/Solid
GC34	Agilent 7890A	Water/Solid
GC37	Agilent 7890A	Water/Solid

9.1.2 Columns, J&W columns typically are used;

Column 1: DB-XLB 30 m x 0.32 mm ID, 0.50 µm df or equivalent\*  
 Column 2: DB-35MS 30 m x 0.32 mm ID, 0.25 µm df or equivalent\*

**Note:** Column diameter and film thickness may vary depending on instrument. Refer to the instrument maintenance logbook for the columns used for a specific instrument configuration.

9.1.3 Autosampler, capable of reproducible injections, Hewlett Packard/Agilent 7673 or equivalent.

9.2 Data System - A computer data system must be interfaced to the GC/ECD. The system must allow the continuous acquisition and storage on machine-readable media of all chromatographic data obtained throughout the duration of the chromatographic program. The computer must have software that includes automated calibration, identification, and quantitation routines. The software must also be capable of integrating the chromatographic peaks abundances.

## 10) Preventative Maintenance

10.1 All maintenance activities are recorded in a maintenance logbook kept for each instrument. Pertinent information (serial numbers, instrument I.D., etc.) must be in the logbook. This includes the routine maintenance described herein. The entry in



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the log must include: date of event, the initials of who performed the work, and a reference to analytical control..

10.2 Carrier gas - Inline purifiers or scrubbers should be in place for all sources of carrier gas. These are selected to remove water, oxygen, and hydrocarbons. Purifiers should be changed as recommended by the supplier.

10.3 Gas Chromatograph

10.3.1 Whenever GC maintenance is performed, care should be taken to minimize the introduction of air or oxygen into the column. Injection port maintenance includes changing the injection port liner, seal, washer, o-ring, septum, column ferrule, and autosampler syringe as needed. Liners and seals should be changed when recent sample analyses predict a problem with chromatographic performance. In some cases liners and seals may be cleaned and re-used.

10.3.2 Clipping off a small portion of the head of the column often improves chromatographic performance. When cutting off any portion of the column, make sure the cut is straight and “clean” (uniform, without fragmentation) by using the proper column cutting tool.

10.3.3 Over time, the column will exhibit poorer overall performance, as contaminated sample matrices are analyzed. The length of time for this to occur will depend on the samples analyzed. When a noticeable decrease in column performance is evident and other maintenance options do not result in improvement, the column should be replaced. This is especially true when evident in conjunction with calibration difficulties.

## 11) Procedure

### 11.1 Sample Preparation

11.1.1 Water samples, (100 mL for LL, 200 mL for ULL) are extracted via shaker table microextraction (SOP EXT-3511) or solid phase extraction (SOP EXT-3535). TCLP leachates are extracted using separatory funnel (SOP EXT-3510). Refer to the applicable extraction SOP for the applicable procedure. For extraction by 3535, acidification of the sample prior to extraction may be allowable if project objectives and performance requirements of methods 3535 and 8081 are met.

**Note:** For projects originating from Alaska and South Carolina use the 3535 extraction method only.

11.1.2 Soil/sediment samples are extracted using EPA Method 3546 (SOP EXT-3546). Refer to the applicable extraction SOP.

11.1.3 Additional sample cleanup procedures may be used as appropriate for the samples. See Section 4.2 and refer to the applicable cleanup SOP.

### 11.2 Calibration



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- 11.2.1 Refer to the SOP *Sample Batches* (ADM-BATCH) for guidance on analytical calibration and sample batches. Refer to the SOP *Calibration of Instruments for Organics Chromatographic Analyses* (SOC-CAL), where calibration procedures and policies are described. The calibration procedure(s) and options chosen must follow the SOP SOC-CAL.
- 11.2.2 Check for degradation of 4,4'-DDT and Endrin by injecting a standard containing only 4,4'-DDT at 10ppb and Endrin at 5 ppb.

$$\% \text{ Breakdown} = \frac{\text{Total DDT degradation peak area (DDE + DDD)}}{\text{Total DDT peak area (DDT + DDE + DDD)}} \times 100$$

$$\% \text{ Breakdown} = \frac{\text{Total endrin degradation peak area} \\ \text{endrin aldehyde + endrin ketone}}{\text{Total endrin peak area} \\ \text{endrin + endrin aldehyde + endrin ketone}} \times 100$$

If degradation of either DDT or Endrin exceeds 15%, perform any necessary maintenance before proceeding with calibration. The breakdown of DDT and Endrin must be measured before samples are analyzed and at the beginning of each analytical sequence.

- 11.2.3 After determining that degradation is within acceptance, calibrate the system immediately prior to conducting any analyses. Analyze each calibration standard (containing internal standards) and tabulate the area against concentration for each compound. For multi-component analytes, only those specified in the project plan or work specification are used for calibration. Calculate response factors (RFs) for each compound relative to the internal standard as follows:

$$RF = (Ax/Cis)/(Ais/Cx)$$

where:

Ax = Area of the compound being measured.

Ais = Area of the specific internal standard.

Cis = Concentration of the specific internal standard (ng/μL).

Cx = Concentration of the compound being measured (ng/μL).

Note: For Chlordane, a minimum of 3 peaks must be chosen and for Toxaphene a minimum of 4 peaks must be chosen. The peaks must be characteristic of the compound of interest.

- 11.2.3.1 Calculate the mean response factor ( $\overline{RF_x}$ ) for each analyte and surrogate from the calibration levels. Calculate standard deviation (SD) and the percent relative standard deviations (%RSD) for each analyte from the mean with:

- 11.2.3.2 The % RSD should be less than 20% for each compound.



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- 11.2.3.3 If the % RSD for a given compound is 20% or less, linearity can be assumed over the calibration range, and the relative response factor for each analyte and surrogate is used to quantitate sample analytes.
- 11.2.3.4 If the % RSD exceeds 20%, then a linear curve or a quadratic calibration with a coefficient of determination (COD,  $R^2$ ) of 0.990 or greater may be used.
- 11.2.4 Following initial calibration, analyze an ICV standard. The ICV solution must contain all analytes in the calibration standards. Calculate the concentration using the typical procedure used for quantitation. Calculate the percent difference (%D) from the ICV true value. Evaluate the ICV as described in the SOC-CAL SOP. The acceptance criterion is  $\pm 20\%$  from the analytes assigned value.
- 11.2.5 Continuing Calibration Verification
- 11.2.5.1 The working calibration curve or calibration response factors must be verified on each analytical sequence by the analysis of one or more mid-range calibration standards (CCV). A CCV must be injected at the start of each 12 hour shift or every 20 samples, whichever is first. The 12 hour window starts with the injection time of the first CCV. The use of internal standard calibration technique does not require that all sample results be bracketed with calibration verification standards.
- Note:** DoD projects require a CCV analysis every 10 field samples. Work under QSM versions 5.x of the QSM require a closing CCV for single-component analytes.
- 11.2.5.2 The acceptance criteria for all analytes in the CCV analysis are a response (RF or concentration) within  $\pm 20\%$  D of the expected value, as compared to the initial calibration. Refer to the SOP SOC-CAL.
- Note:** For samples originating in Arizona and results reported for compliance purposes, the CCV criteria is  $\pm 15\%$  D, per Method 8081A. However, response factor averaging is not allowed for analysis of Arizona samples.
- 11.2.5.3 The measured area of the internal standard must be no more than -50% to + 100% difference from the average area calculated during initial calibration.
- 11.2.5.4 The retention time of the internal standard must also be evaluated. A retention time shift of >30 seconds necessitates system maintenance and reanalysis of CCV.
- 11.2.6 Retention Time Windows

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11.2.6.1 Establish retention time windows with the GC system in acceptable operating conditions. Make three injections of all analytes throughout the course of a 72-hour period. Serial injections over less than a 72-hour period may result in retention time windows that are too tight. Using retention times from these analyses, calculate retention time windows. Refer to EPA Method 8000 for detailed instructions.

11.2.6.2 The retention time window is defined as  $\pm 3x$  the standard deviation of the absolute retention times for each standard; however, the experience of the analyst should weigh heavily in the interpretation of chromatograms. In those cases where the standard deviation for a particular standard is zero, the laboratory may use a default window of  $\pm 0.03$  minutes. If the peak width is  $> 0.06$  minutes, use a default window of 0.1 minutes.

11.2.6.3 Calculate retention time windows for each standard on each GC column and whenever a new GC column is installed. Retain this data in the method file.

### 11.3 Sample Analysis

11.3.1 Table 3 indicates the typical operating conditions for the GC. Setup the analysis sequence of sample and QC samples. Also, refer to the SOP *Sample Batches* (ADM-BATCH) for guidance.

11.3.2 Calibrate the system as described in Section 11.2. Evaluate the CCVs as discussed in Section 11.2.5. If any standard falls outside of their daily retention time window, evaluate the chromatogram for possible causes such as carryover from a highly contaminated sample. If a problem related to GC system has been determined to be the cause of retention time shift, perform whatever maintenance is necessary before re-injecting a CCV or recalibrating and proceeding with sample analysis.

11.3.3 Spike 10 $\mu$ l of the internal standard 1-Bromo-2-nitrobenzene at 10 ppm into each 1ml of sample extract to give a final concentration of 100 ng/ml. The measured area of the internal standard must be -50% to +100% as measured from the average of the most recent calibration. Any samples falling outside of this criterion require reanalysis.

11.3.4 The retention time of the internal standard must also be evaluated. A retention time shift of  $>30$  seconds requires reanalysis of all affected samples.

### 11.4 Identification of Analytes

11.4.1 Tentative identification of an analyte occurs when a peak from a sample extract falls within the daily retention time window and the s/n ratio of the peak is  $>3$ . A tentatively identified compound is confirmed when the retention time for the compound on the confirmatory detector is within the retention time window on that system.

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11.4.2 Confirmation of all tentative hits should be made. Confirmation is made by injecting the sample extract on two columns with dissimilar phases simultaneously. If the retention time matches on both columns, then the hit for the analyte is considered a confirmed hit. Refer to the SOP *Confirmation of Organic Analytes* (SOC-CONF).

11.4.3 For Chlordane, a minimum of 3 peaks must be chosen and, for Toxaphene, a minimum of 4 peaks must be chosen for identification purposes. Refer to Section 13.2 for quantitation procedures for multi-response analytes.

11.5 Perform all necessary calculations as described in Sections 12 and 13.

## 12) QA/QC Requirements

### 12.1 Initial Precision and Recovery Validation

12.1.1 The precision of the extraction procedure and the GC procedure must be validated before analysis of samples begins, or whenever significant changes to the procedures have been made. To do this, four reagent water samples are spiked at a level near the midpoint of the calibration range (typically the LCS level), then extracting and proceeding with Section 11. The spiking solution may be prepared from pure standard materials, or purchased as certified solutions. If prepared by the laboratory, stock standards prepared independently from those used for calibration should be used. The concentration of the analytes to be spiked is 20x the MRL.

### 12.2 Method Detection Limits and Method Reporting Limits

12.2.1 A method detection limit (MDL) study must be undertaken before analysis of samples can begin. To establish detection limits that are precise and accurate, the analyst must perform the following procedure. Spike seven blank matrix (water or soil) samples with MDL spiking solution at a level below the MRL. Follow the analysis procedures in Section 11 to analyze the samples.

12.2.2 Calculate the average concentration found ( $\bar{x}$ ) in  $\mu\text{g/mL}$ , and the standard deviation of the concentrations ( $s$ ) in  $\mu\text{g/mL}$  for each analyte. Calculate the MDL for each analyte. Refer to the SOP *Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Limits of Quantitation*. The MDL/LOD must be verified annually.

#### 12.2.3 Limits of Quantification (LOQ)

12.2.3.1 The laboratory establishes a MRL/LOQ for each analyte as the lowest reliable laboratory reporting concentration or in most cases the lowest point in the calibration curve which is less than or equal to the desired regulatory action levels, based on the stated project requirements. Analysis of a standard or extract prepared at the lowest point calibration standard provides confirmation of the established sensitivity of the method. The LOQ recoveries should be within 50-150% of the true values to verify the data reporting limit. Refer to the SOP *Performing and*

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*Documenting Method Detection Limit Studies and Establishing Limits of Detection and Limits of Quantitation.*

- 12.2.4 The Method Reporting Limits (MRLs) used at ALS Kelso are the routinely reported lower limits of quantitation which take into account day-to-day fluctuations in instrument sensitivity as well as other factors. These MRLs are the levels to which ALS Kelso routinely reports results in order to minimize false positive or false negative results. The MRL is normally two to ten times the method detection limit.
- 12.3 Ongoing QC Samples required are described in the ALS-Kelso Quality Assurance Manual and in the SOP for Sample Batches. Additional QC Samples may be required in project specific quality assurance plans (QAPP). General QA requirements for DoD QSM are defined in the laboratory SOP *Department of Defense Projects – Laboratory Practices and Project Management (ADM-DOD)* or *Department of Defense Projects – Laboratory Practices and Project Management*. General QC Samples are:

12.3.1 Method Blank

- 12.3.1.1 A method blank is extracted and analyzed with every batch of 20 (or fewer) samples to demonstrate that there are no method interferences. If the method blank shows any hits above the reporting limit, corrective action must be taken. Corrective action includes recalculation, reanalysis, system cleaning, or re-extraction and reanalysis. For some project specific needs, exceptions may be noted and method blank results above the MRL may be reported for common lab contaminants (phthalate esters, etc.).

**Note:** DoD projects require that no analyte be detected > ½ the RL or 1/10 the regulatory limit, whichever is greater.

- 12.3.2 Lab Control Sample (LCS) must be extracted and analyzed with every batch of 20 samples. The LCS is spiked as follows:

3511 LL: 50 µL of 8081 Pest, 8081 Misc., 24-DDX, Toxaphene and Chlordane to 100 mL of reagent water.

3511 ULL: 10 µL of 8081 Pest, 8081 Misc., 24-DDX, Toxaphene and Chlordane to 200 mL of reagent water.

3535A: 20 µL 8081 Pest, 8081 Misc., 24-DDX, Toxaphene and Chlordane to 1 L of reagent water.

3546: 100 µL of 8081 Pest, 8081 Misc., 24-DDX, Toxaphene and 50 µL Chlordane to 2 g.

For project-specific low-level extractions, spiking amounts can be adjusted accordingly.

- 12.3.2.1 Calculate the LCS recovery as follows:

$$\%R = X/TV \times 100$$

Where X = Concentration of the analyte recovered  
TV = True value of amount spiked



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12.3.2.2 Current ALS QC acceptance criteria for lab control samples are listed in the current ALS-Kelso DQO tables. Project-specific or program-specific acceptance criteria may supersede ALS criteria. For example, for samples requiring South Carolina DHEC certification the acceptance criteria are 70-130 % recovery. If the lab control sample (LCS) fails acceptance limits for any of the compounds, corrective action must be taken. Corrective action includes recalculation, reanalysis, or re-extraction and reanalysis. Refer to the ALS-Kelso Quality Assurance Manual for guidance in evaluating recoveries that exceed LCS limits.

12.3.3 Matrix Spike

12.3.3.1 A matrix spike (MS) and duplicate matrix spike (DMS) must be prepared and analyzed with every batch of 20 (or fewer) samples. The MS/DMS is prepared by adding the same volume of the matrix spike solution to the sample as listed for the LCS, then proceeding with Section 11. Calculate percent recovery (%R) as:

$$\%R = \frac{X - X1}{TV} \times 100$$

Where X = Concentration of the analyte recovered

X1 = Concentration of unspiked analyte

TV = True value of amount spiked

12.3.3.2 Calculate Relative Percent Difference (RPD) as:

$$RPD = \frac{|R1 - R2|}{(R1 + R2) / 2} \times 100$$

Where R1= Higher Result

R2= Lower Result

12.3.3.3 Current QC acceptance criteria for MS/DMS are listed in the current ALS-Kelso DQO tables. Project-specific acceptance criteria may supersede lab criteria. If the MS/DMS recovery is out of acceptance limits for reasons other than matrix effects, corrective action must be taken. Corrective action includes recalculation, reanalysis, or re-extraction and reanalysis.

12.3.3.4 Following analysis of the MS the percent recovery is calculated and compared to acceptance limits. If the recovery is within control limits the results may be reported. If not, and the LCS is within control limits, this indicates that the matrix potentially biases analyte recovery. It is verified that the spike level is at least five times the background level. If not, the results are reported with a qualifier that the background level is too high for accurate recovery determination. If matrix interferences are present or results indicate a potential problem with sample preparation, steps may be taken to improve results; such as

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performing any additional cleanups, dilution and reanalysis, or re-preparation and reanalysis. Results that do not meet acceptance limits are reported with an appropriate qualifier.

#### 12.3.4 Surrogate

12.3.4.1 Surrogate spike is added to every sample, blank and spike prior to extraction. Two surrogate standards (Tetrachloro-m-xylene and Decachlorobiphenyl) are added to each sample. The surrogate spike amounts are:

3511 LL:	50 µL of 0.5 ppm to 100 mL
3511 ULL:	10 µL of 0.5 ppm to 200 mL
3535A:	20 µL of 0.5 ppm to 1 L
3546:	50 µL of 0.8 ppm to 2 g

12.3.4.2 Calculate surrogate percent recovery (%R) as:

$$\%R = S/V \times 100$$

Where S = Amount of surrogate recovered  
V = Amount spiked

12.3.4.3 Current QC acceptance criteria for surrogates are listed in the current ALS-Kelso DQO tables. Project-specific acceptance criteria may supersede lab criteria. Both surrogate recoveries must be within the acceptance limits. If either (or both) surrogate is outside of acceptance limits for reasons other than matrix interferences, corrective action must be taken. Corrective actions include recalculation, reanalysis, or re-extraction and reanalysis. The acceptance criteria listed are current criteria, but are subject to change as control limits are updated.

12.3.5 Control charts for QC results should be reviewed periodically for trends in results. Control limits for QC analyses may be determined using the control charts or similar mechanism on an annual basis.

### 13) Data Reduction and Reporting

13.1 Both detectors are used as primary and/or confirmatory systems when not interfered with by the sample matrix.

#### 13.2 Calculations

13.2.1 Quantitation of analytes in sample extracts is performed by comparing total area of residue peaks to total area or peaks from the appropriate reference materials.

13.2.2 Quantitation of multi-response analytes:

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13.2.2.1 The quantitation of Chlordane, Toxaphene, and other multi-response analytes is accomplished by comparison of the sample chromatogram to that of the authentic standard. All calibration acceptance criteria as described in section 11 must be met before reporting any results. Sample results should then be reported according to the SOP *Confirmation of Organic Analytes* (SOC-CONF). Results may be reported from either of the columns as long as all calibration acceptance criteria are met.

13.2.2.2 Once the analyte pattern has been identified, compare the responses of the major peaks in the calibration standard with the peaks observed in the sample extract. The amount of analyte is calculated using the individual calibration factor for each peak and the calibration model selected in section 11. The concentration is determined using the characteristic peaks and then the concentrations are averaged to determine the concentration. If there are interfering peaks that cause the average to be falsely overstated, then that interference peak is Q-Q-deleted using the data system, provided 3 peaks remain for Chlordane and 4 peaks for Toxaphene. The average is then recalculated so that the average more truly represents the concentration in the sample.

13.2.3 The concentration of each analyte in the sample extract ( $C_{ex}$ ) is computed. When  $\overline{RF}_x$  is used, calculate the extract concentration as follows:

$$C_{ex} = \frac{(Resp_x)(Amt_{ISTD})}{(Resp_{ISTD})(\overline{RF}_x)}$$

Where:

- $C_{ex}$  = the concentration in the sample extract (ppb);
- $Resp_x$  = the peak area of the analytes of interest;
- $Resp_{ISTD}$  = the peak area of the associated internal standard;
- $Amt_{ISTD}$  = the amount, in ppb, of internal standard added
- $\overline{RF}_x$  = the average response from the initial calibration.

13.2.4 The concentration of analytes in the original sample is computed using the following equations:

**Aqueous Samples:**  $Concentration (\mu g / L) = \frac{(C_{ex})(V_f)(D)}{(V_s)}$

Where

- $C_{ex}$  = Concentration in extract in  $\mu g/mL$
- $V_f$  = Final volume of extract in mL
- $D$  = Dilution factor
- $V_s$  = Volume of sample extracted, liters

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**Non aqueous Samples:**  $Concentration (mg / Kg) = \frac{(C_{ex}) (V_f) (D)}{(W)}$

Where	$C_{ex}$	=	Concentration in extract in $\mu\text{g/mL}$
	$V_f$	=	Final volume of extract in mL
	$D$	=	Dilution factor
	$W$	=	Weight of sample extracted in grams.

### 13.3 Data Review

13.3.1 Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the SOP *Laboratory Data Review Process* (ADM-DREV) for details. The person responsible for final review of the data report and/or data package should assess the overall validity and quality of the results and provide any appropriate comments and information to the Project Chemist to inclusion in the report narrative.

### 13.4 Reporting

13.4.1 Reports are generated using the STEALTH Data Reporting System which compiles the SMO login information. This compilation is then transferred to a file, which STEALTH uses to generate a report. The forms generated may be ALS standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.

13.4.2 Sample concentrations are reported when all QC criteria for the analysis have been met or the results are qualified with an appropriate footnote. For Arizona projects the appropriate Arizona qualifier must be used.

## 14) Contingencies for Handling Out-of-Control or Unacceptable Data

14.1 Refer to the SOP for *Non Conformance and Corrective Action* for corrective action.

14.2 Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

## 15) Method Performance

15.1 This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional method performance data available. In addition, this procedure was validated through single laboratory studies of accuracy and precision as specified in Section 12.1.

15.2 The method detection limit (MDL) is established using the procedure described in the SOP *Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Quantification*. Method Reporting Limits are established for this method based on the low calibration point and the MDL study results.

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## 16) Pollution Prevention and Waste Management

16.1 The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Lab Waste Management Plan.

## 17) Training

17.1 All analysts performing this analysis are required to read and understand this SOP.

17.2 Training is documented following the SOP for *Employee Training and New Employee Orientation*.

## 18) Method Modifications

18.1 There are no known modifications in this laboratory standard operating procedure from the reference method.

## 19) References

19.1 EPA SW-846, Test Methods for Evaluating Solid Waste, Third Edition, Update IV, February 2007, Method 8081B, Revision 2.

19.2 EPA SW-846, Test Methods for Evaluating Solid Waste, Third Edition, Update III, December 1996, Method 8081A, Revision 1.

19.3 EPA SW-846, Determinative Chromatographic Separations, Update III, December 1996, Method 8000B, Revision 2.

19.4 EPA SW-846, Determinative Chromatographic Separations, On-Line, March 2003, Method 8000C, Revision 3.

19.5 DoD Quality Systems Manual for Environmental Laboratories, current version.

19.6 8000C Method criteria, Arizona DHS, 2/13/2007. Available online at <https://www.azdhs.gov/documents/preparedness/state-laboratory/lab-licensure-certification/technical-resources/additional-resources/method-criteria-8000.pdf>

19.7 TNI Standard, Volume 1, -2009.

19.8 ISO/IEC 17005:2017 American National Standard, General requirements for the competence of testing and calibration laboratories.

## 20) Changes Since the Last Revision

Revision Number	Effective Date	Document Editor	Description of Changes
22.0	2/15/2021	T. Caron	Updated SOP signatories. Standard paragraph edits. Reference Section has been edited to include ISO 17025. Section 8.1.3.4: 10 ul of internal standard is added to each 1ml of standard, blank and sample prior to analysis for a final concentration of 100 ng/ml has been added. Section 9.1.1: Added GC37. Sections 11 and 12: Edited to reference 3511 LL. Section 11/1/1: Water samples (100 mL for LL, 200 mL for ULL). Procedural change form submitted by UA 2.27.20.



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			Procedural Change form submitted 2/15/2021 by R. Enzor.
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21) **Attachments, Tables, and Appendices**

- 21.1 Table 1 - Target Analytes and Method Reporting Limits\* - Water.
- 21.2 Table 2 - Target Analytes and Method Reporting Limits\* - Soil/Sediment/Tissue.
- 21.3 Table 3 - Gas Chromatograph Operating Conditions\*.
- 21.4 Table 4 - Calibration Standard Preparation.
- 21.5 Table 5 - Summary of Corrective Actions.

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**TABLE 1  
TARGET ANALYTES and METHOD REPORTING LIMITS\* - WATER**

<b>Analyte</b>	<b>Standard MRL (µg/L)</b>	<b>Low-Level MRL (ng/L)</b>
2,4'-DDD	0.01	1.0
2,4'-DDE	0.01	1.0
2,4'-DDT	0.01	1.0
4,4'-DDD	0.01	1.0
4,4'-DDE	0.01	1.0
4,4'-DDT	0.01	1.0
Aldrin	0.01	1.0
alpha-BHC	0.01	1.0
alpha-Chlordane	0.01	1.0
beta-BHC	0.01	1.0
Chlordane	0.2	20
Chlorpyrifos	0.01	1
cis-Nonachlor	0.01	1.0
delta-BHC	0.01	1.0
Dieldrin	0.01	1.0
Endosulfan I	0.01	1.0
Endosulfan II	0.01	1.0
Endosulfan Sulfate	0.01	1.0
Endrin	0.01	1.0
Endrin Aldehyde	0.01	1.0
Endrin Ketone	0.01	1.0
gamma-BHC (Lindane)	0.01	1.0
gamma-Chlordane	0.01	1.0
Heptachlor	0.01	1.0
Heptachlor Epoxide	0.01	1.0
Hexachlorobenzene	0.01	1.0
Hexachlorobutadiene	0.01	1.0
Hexachloroethane	0.01	1.0
Isodrin	0.01	1.0
Methoxychlor	0.01	1.0
Mirex	0.01	1.0
Oxychlordane	0.01	1.0
Toxaphene	1.0	50
trans-Nonachlor	0.01	1.0

\*For some analytes, LOQs may vary slightly from MRLs due to program/project requirements.

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**TABLE 2**  
**TARGET ANALYTES and METHOD REPORTING LIMITS\* - SOIL/SEDIMENT/TISSUE**

<b>Analyte</b>	<b>MRL (µg/kg)</b>
2,4'-DDD	1.0
2,4'-DDE	1.0
2,4'-DDT	1.0
4,4'-DDD	1.0
4,4'-DDE	1.0
4,4'-DDT	1.0
Aldrin	1.0
alpha-BHC	1.0
alpha-Chlordane	1.0
beta-BHC	1.0
Chlordane	10
Chlorpyrifos	1.0
cis-Nonachlor	1.0
delta-BHC	1.0
Dieldrin	1.0
Endosulfan I	1.0
Endosulfan II	1.0
Endosulfan Sulfate	1.0
Endrin	1.0
Endrin Aldehyde	1.0
Endrin Ketone	1.0
gamma-BHC (Lindane)	1.0
gamma-Chlordane	1.0
Heptachlor	1.0
Heptachlor Epoxide	1.0
Hexachlorobenzene	1.0
Hexachlorobutadiene	1.0
Hexachloroethane	1.0
Isodrin	1.0
Methoxychlor	1.0
Mirex	1.0
Oxychlordane	1.0
Toxaphene	100
trans-Nonachlor	1.0

\*For some analytes, LOQs may vary slightly from MRLs due to program/project requirements.



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**TABLE 3  
GAS CHROMATOGRAPH OPERATING CONDITIONS\***

Gas Chromatograph:	Agilent 6890
Injection Port Temperature:	250-325°C at 250°C/min., hold for 5 min.
Oven Temperature Program:	50°C hold for 0.5min., 50-150°C at 40°C/min.; Ramp 13°C/min. to 320°C, hold for 3.92 min.
Detector Temperature:	325°C
Injection Volume:	1 µL (2 µL for ultra-low level analysis)
Column 1:	30 m, 0.32 mm ID, DB-XLB, 0.50 µm film thickness or equivalent
Column 2:	30 m, 0.32 mm ID, DB-35MS, 0.25 µm film thickness or equivalent.
Carrier Gas:	Hydrogen
Auxiliary Gas:	Nitrogen
Data System:	HP EnviroQuant

\*The above instrument temperatures may be modified when determining additional single response or multi-response pesticides.



**TABLE 4  
CALIBRATION STANDARD PREPARATION**

8081 <u>Intermediate Std.</u>	<u>Initial Calibration Standards*</u>			Final Concentration	
	<u>Initial Concentration</u>	<u>Final Volume</u>	<u>Solvent</u>		
1.0 µL	2.0 µg/mL ↓	10 mL ↓	Hexane ↓	0.2 µg/L	CCV Standard
2.5 µL				0.5 µg/L	
5.0 µL				1.0 µg/L	
10 µL				2.0 µg/L	
25 µL				5.0 µg/L	
50 µL				10 µg/L	
<b>Chlordane</b>					
<u>Intermediate Std.</u>	<u>Initial Concentration</u>	<u>Final Volume</u>	<u>Solvent</u>	<u>Final Concentration</u>	
10 µL	2.0 mg/L ↓	10 mL ↓	Hexane ↓	2.0 µg/L	CCV Standard
25 µL				5.0 µg/L	
50 µL				10 µg/L	
100 µL				20 µg/L	
250 µL				50 µg/L	
500 µL				100 µg/L	
1.0 mL				200 µg/L	
<b>Toxaphene</b>					
<u>Intermediate Std.</u>	<u>Initial Concentration</u>	<u>Final Volume</u>	<u>Solvent</u>	<u>Final Concentration</u>	
10 µL	10 mg/L ↓	10 mL ↓	Hexane ↓	10 µg/L	CCV Standard
20 µL				20 µg/L	
50 µL				50 µg/L	
100 µL				100 µg/L	
200 µL				200 µg/L	
500 µL				500 µg/L	

\*As needed for projects requiring non-routine additional compounds, similar dilutions are prepared to obtain calibration standards for these compounds.



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**TABLE 5**

**SUMMARY OF CORRECTIVE ACTIONS**

<b>Method Reference</b>	<b>Control</b>	<b>Specification and Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action</b>
EPA 8000C EPA 8081B	ICAL	Prior to sample analysis	% RSD $\leq$ 20 COD $\geq$ 0.990	Correct problem then repeat ICAL
EPA 8000C EPA 8081B	ICV	After ICAL	$\pm$ 20% Diff	Correct problem and verify second source standard; rerun second source verification. If fails, correct problem and repeat initial calibration.
EPA 8000C EPA 8081B	CCV	Prior to sample analysis	$\pm$ 20% Diff	Correct problem then repeat CCV or repeat ICAL
EPA 8000C EPA 8081B	Method Blank	Include with each analysis batch (up to 20 samples)	<MRL	If target exceeds MRL, reanalyze to determine if instrument was cause. If still noncompliant then:  Re-extract or reanalyze samples containing contaminate, unless samples contain > 20x amount in blank.
EPA 8000C EPA 8081B	Laboratory Control Sample	Include with each analysis batch (up to 20 samples)	See DQO	If exceeds limits, re-extract and re-analyze
EPA 8000C EPA 8081B	Matrix Spike	Include with each analysis batch (up to 20 samples)	See DQO	Evaluate data to determine if the there is a matrix effect or analytical error
EPA 8000C EPA 8081B	Matrix Spike Duplicates	Include with each analysis batch (up to 20 samples)	See DQO	Evaluate data to determine if the there is a matrix effect or analytical error



## PCBs as Aroclors

DOCUMENT ID: SOC-8082AR, REV 20.0

Prepared By:   
Organics Manager, Jonathon Walter

Date: 12/2/2020

Prepared By:   
Quality Assurance Manager, Kurt Clarkson

Date: 12/2/2020

Approved By:   
Laboratory Director, Charles (Pat) Byrne

Date: 12-2-20



## 1) Scope & Applicability

- 1.1 This procedure is used to determine the concentrations of PCBs as Aroclors using EPA Method 8082A. This procedure is typically applied to water, sediment, and soil matrices but may also be applicable to tissue or various miscellaneous waste samples. Tables 1 and 2 lists the analytes that are determined by this procedure and lists the method reporting limits (MRLs) for each compound in water and soil. Equivalent nomenclature for MRL includes Estimated Quantitation Limit (EQL). Therefore, MRL=EQL. The reported MRL may be adjusted if required for specific project requirements; however, the capability of achieving other reported MRLs must be demonstrated. MDLs may change as repeat studies are conducted.
- 1.2 In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPPs supersede method specified requirements. An example of this are projects falling under DoD ELAP. QC requirements defined in the SOP *Department of Defense Projects – Laboratory Practices and Project Management* may supersede the requirements defined in this SOP.

## 2) Summary of Procedure

- 2.1 This procedure provides gas chromatographic conditions for the detection of parts-per-billion (ppb) levels of PCBs. The target PCBs are extracted from samples using the appropriate procedure for the sample matrix (see applicable SOP), analyzed, and reported as Aroclors.
- 2.2 An aliquot of the extract is injected into the gas chromatograph (GC). The compounds are separated on a fused silica capillary column. Compounds of interest are detected by an electron capture detector. Identification of the analytes of interest is performed by comparing the retention times of the analytes with the respective retention times of an authentic standard and by comparison of elution patterns to those of Aroclor standards. Quantitative analysis is performed by using the authentic standard to produce a calibration factor or calibration curve, and using the calibration data to determine the concentration of an analyte in the extract. The concentration in the sample is calculated using the sample weight or volume and the extract volume.
- 2.3 The sensitivity of this method usually depends on the level of interferences rather than on instrument limitations. If interferences prevent detection of the analytes, GPC, Florisil cleanup, sulfur cleanup, or concentrated sulfuric acid cleanups are used to eliminate interferences in the analysis. Refer to section 4.2 for cleanup procedure references.

## 3) Definitions

- 3.1 For laboratory definitions applicable to most analyses, refer to the SOP for *Sample Batches*.

## 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.



- 4.2 It is the responsibility of the department supervisor/manager to document analyst training and method proficiency, as described in Method 8082A and the SOP *Employee Training and New Employee Orientation* (ADM-TRAIN).

## 5) Interferences

- 5.1 Interferences by phthalate esters can pose a major problem in PCB determinations when using the electron capture detector. These compounds generally appear in the chromatogram as large, late-eluting peaks, especially in the 15% and 50% fractions from the Florisil cleanup. Common flexible plastics contain varying amounts of phthalates. These phthalates are easily extracted or leached from such materials during laboratory operations. Phthalate contamination is not usually a problem in our laboratory operation.
- 5.2 Co-extractables such as lipids, waxes, etc., can be removed via GPC cleanup (SOC-3640A). Certain fractionation cleanups can be used to selectively remove organochlorine pesticides, aiding in Aroclor determination (SOC-3665). The presence of elemental sulfur will result in interferences for most Aroclors. If GPC cleanup is insufficient, cleanup via Method 3660 (SOC-3660) may be used for the removal of sulfur. If interferences from polar compounds is evident, cleanup using Florisil (EXT-FLOR) can be utilized.
- 5.3 A standard of the DDT analogs must be injected with each initial calibration to determine which of the PCB or Aroclor peaks may be subject to interferences on the analytical columns used. There may be substantial DDT interference with the last major Aroclor 1254 peak in some soil and sediment samples.

## 6) Safety

- 6.1 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.

## 7) Sample Collection, Containers, Preservation, and Storage

- 7.1 Containers used to collect samples should be purchased pre-cleaned containers.
- 7.2 Samples should be tested for residual chlorine at the time of sampling. For aqueous samples with residual chlorine present, add 3-mL 10% sodium thiosulfate solution per gallon (0.008%).
- 7.3 Water and soil samples must be iced or refrigerated at  $<6^{\circ}\text{C}$  from time of collection until extraction. Tissue samples should be stored in accordance with project requirements, typically refrigerated or frozen.
- 7.4 There are no holding time requirements for this method.

## 8) Standards, Reagents, and Consumable Materials

- 8.1 Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Refer to the SOP *Reagent/Standards Login and Tracking* (ADM-RTL) for the complete procedure and documentation requirements.



- 8.2 Solvents: Hexane, acetone, methylene chloride, isooctane, and methanol. Pesticide grade or equivalent. Solvents must be of sufficient purity to permit usage without lessening the accuracy of the determination or introducing interferences.
- 8.3 Stock Standard Solutions
- 8.3.1 Stock standard solutions may be purchased from a number of vendors. All reference standards, where possible, must be traceable to SI units or NIST certified reference materials.
- 8.3.2 Stock standard solutions for each target Aroclor are purchased from AccuStandard at 1000 µg/mL. Other vendors may be used providing they meet the requirements in sec 8.3.1. Unopened stock standard solutions are stored as directed by manufacturer's recommendation. If no storage instructions are provided, the standards are stored at ambient and protected from light. Opened ampoules are stored in crimp-sealed vials at  $4 \pm 2^\circ\text{C}$ . The expiration date for unopened ampoules is the manufacturer's assigned expiration date. If the manufacturer does not assign a date, an expiration date of 1 year from receipt is assigned. Check opened stock standards frequently for signs of degradation or evaporation, especially just prior to preparing calibration standards from them.
- 8.3.2.1 Intermediate calibration standard solutions are made for the following Aroclor mixtures by diluting 1000 µg/mL stock standards 1:20 in hexane:
- Aroclor 1016/Aroclor 1260
  - Aroclor 1221/Aroclor 1254
  - Aroclor 1232/Aroclor 1262
  - Aroclor 1242/Aroclor 1268
  - Aroclor 1248
- 8.3.2.2 Prepare calibration standards at a minimum of five concentration levels for each Aroclor by dilution of the intermediate standards with hexane. One of the concentration levels should be at or below a concentration representing the method reporting limit (MRL). The remaining concentration levels should correspond to the expected range of concentrations found in real samples or should define the working range of the GC. See Table 4 for preparation and concentrations. A calibration standard of Aroclor 1016/Aroclor 1260 and the surrogates at mid-range concentration is used for the CCV.
- 8.3.2.3 Calibration standard solutions are stored at  $4 \pm 2^\circ\text{C}$  and must be replaced after six months, or sooner, if comparison with check standards indicate a problem.
- 8.3.3 The independent calibration verification (ICV) standards for each target Aroclor are purchased from Ultra Scientific at 100 µg/mL. Other vendors may be used providing they meet the requirements in sec 7.3.1. Unopened stock standard solutions are stored as directed by manufacturer's recommendation. If no storage instructions are provided, the standards are stored at ambient and protected from light. Opened ampoules are stored in crimp-sealed vials at  $4^\circ\text{C} \pm 2^\circ\text{C}$ . The expiration date for unopened ampoules is the manufacturer's assigned expiration date. If the manufacturer does not assign a date, an expiration date of 1 year from receipt is assigned. Check opened stock standards frequently for signs of degradation or evaporation, especially just prior to preparing calibration standards from them.



- 8.3.3.1 Working ICV standards at 1000 µg/L are prepared as described in Table 4. ICV Standards are stored at 4°C ± 2°C for up to six months.
- 8.3.4 Surrogate solutions are prepared from stock solutions of Tetrachloro-m-xylene (TCMX) and Decachlorobiphenyl (DCB) purchased from Ultra Scientific at 200 µg/mL. Other vendors may be used providing they meet the requirements in sec 7.3.1.
  - 8.3.4.1 An intermediate surrogate standard is prepared with the Aroclor 1016/Aroclor 1260 intermediate standard by diluting the 200 µg/mL surrogate stock 1:40 with hexane.
  - 8.3.4.2 A surrogate spiking solution is prepared at 2 µg/mL by making a 1:100 dilution of the surrogate stock standard in acetone. The surrogate solution is stored in the refrigerator for up to six months.
- 8.3.5 Matrix spike solution: Prepare a spiking solution at 40 µg/mL containing both Aroclors 1016 and 1260 by diluting the 1000 µg/mL stock standards 1:25 with acetone.

## 9) Apparatus and Equipment

### 9.1 Gas Chromatograph (GC)

- 9.1.1 Analytical system complete with gas chromatograph suitable for splitless or split automated injection into a wide bore capillary column with an electron capture detector (ECD). Use of Large Volume Injection (LVI) is optional. Helium is used as the carrier gas; argon/methane mixture is used for the detector makeup gas (auxiliary gas).
- 9.1.2 GC Autosampler: The GC system should be configured with a compatible autosampler for automated injection of standards, samples, and QC samples.
- 9.1.3 GC Columns - fused silica capillary columns

Column 1: DB-35MS 30 m x 0.32 mm ID, 0.25 µm df or equivalent\*  
Column 2: DB-XLB 30 m x 0.32 mm ID, 0.50 µm df or equivalent\*

**Note:** Column diameter and film thickness may vary depending on instrument. Refer to the instrument maintenance logbook for the columns used for a specific instrument configuration.

- 9.2 Data System - A computer data system must be interfaced to the GC/ECD. The system must allow the continuous acquisition and storage on machine-readable media of all chromatographic data obtained throughout the duration of the chromatographic program. The computer must have software that includes automated calibration, identification, and quantitation routines. The software must also be capable of integrating the chromatographic peaks abundances.

## 10) Preventative Maintenance

- 10.1 All maintenance activities are recorded in a maintenance logbook kept for each instrument. Pertinent information (serial numbers, instrument I.D., etc.) must be in the logbook. The entry in the log must include: date of event, the initials of who performed the work, and a reference to analytical control.



- 10.2 Carrier gas - Inline purifiers or scrubbers should be in place for all sources of carrier gas. These are selected to remove water, oxygen, and hydrocarbons. Purifiers should be changed as recommended by the supplier.
- 10.3 Gas Chromatograph
  - 10.3.1 Whenever GC maintenance is performed, care should be taken to minimize the introduction of air or oxygen into the column. Injection port maintenance includes changing the injection port liner, seal, washer, o-ring, septum, column ferrule, and autosampler syringe as needed. Liners and seals should be changed when recent sample analyses predict a problem with chromatographic performance. In some cases liners and seals may be cleaned and re-used. Additionally, disassembly and sonication of the septum-less head may be performed if indicated.
  - 10.3.2 Clipping off a small portion of the head of the column often improves chromatographic performance. When cutting off any portion of the column, make sure the cut is straight and "clean" (uniform, without fragmentation) by using the proper column cutting tool.
  - 10.3.3 Over time, the column will exhibit poorer overall performance, as contaminated sample matrices are analyzed. The length of time for this to occur will depend on the samples analyzed. When a noticeable decrease in column performance is evident and other maintenance options do not result in improvement, the column should be replaced. This is especially true when evident in conjunction with calibration difficulties.

## 11) Procedure

### 11.1 Sample Preparation

11.1.1 Water samples (1L or less) are extracted at a pH of 5-9 with methylene chloride, using either continuous Liquid-Liquid extraction (EPA Method 3510C or 3520C); with hexane by microextraction (SW-846 Method 3511). Refer to the applicable extraction SOP.

**Note:** Project-specific or regulation-specific extraction methods may apply. For projects originating from South Carolina and under the SC DHEC lab certification, use the EPA Method 3520C extraction method only.

11.1.2 Soil/sediment samples are extracted using either a automated Soxhlet extraction, (EPA Method 3541, EXT-3541) or by microwave extraction (SW-846 Method 3546, EXT-3546). Refer to the applicable extraction SOP.

11.1.3 Waste samples (organic liquids) may be prepared using the waste dilution method (EPA Method 3580A, EXT-3580). Refer to the extraction SOP for specific parameters.

11.1.4 Additional sample cleanup procedures may be employed as appropriate for the samples. Refer to the section on interferences and the appropriate ALS SOP.

### 11.2 Calibration

**Note:** The calibration procedure(s) and options chosen must follow the ALS protocols. Any exceptions to the calibration procedures detailed in *Calibration of Instruments for Organics Chromatographic Analyses* (SOC-CAL) are described as follows:



**Note:** Certain state or program protocols have specific procedures for calibration. The analyst must ensure that the correct procedures are used. Known exceptions are as follows:

- The use of quadratic regression calibration is not allowed for projects (samples) originating from South Carolina and under the SC DHEC lab certification.

**Note:** DOD QSM requires the quantitation for Aroclors must be performed using a 5-point calibration. Results may not be quantitated using a single point.

11.2.1 For each target Aroclor, select three to six characteristic peaks to use for quantitation. Choose peaks that are at least 25% of the height of the largest Aroclor peak and do not coelute with any of the DDT analogs. For each Aroclor, select at least one quantitation peak that is unique to that Aroclor. Use at least five peaks for the Aroclor 1016 and Aroclor 1260 mixture, none of which should be found in both of these Aroclors. Establish the retention time window position using the mid-point of the ICAL range before processing the calibration curve.

11.2.2 Calibrate the system immediately prior to conducting any analyses. Refer to Table 3 for instrument conditions. Starting with the standard of lowest concentration, analyze each calibration standard and tabulate response (peak area) versus the concentration in the standard. Calculate the ratio of the response to the amount injected the (calibration factor) for each analyte at each standard concentration. The Relative Standard Deviation (RSD) must be less than 20% when average response factor is used.

11.2.3 The calibration of each Aroclor is verified by an independent source. Prepare an independent calibration verification standard (ICV) by dilution of a stock solution purchased from a different vendor and analyze immediately after each initial calibration. Calculate the concentration using the typical procedure used for quantitation. Calculate the percent difference (%D) from the ICV true value. Evaluate the ICV as described in *Calibration of Instruments for Organics Chromatographic Analyses* (SOC-CAL).

### 11.3 Calibration Verification

11.3.1 The working calibration curve or calibration factor must be verified on each analytical sequence by the analysis of one or more mid-range calibration standards (CCV) containing Aroclors 1016/1260 and the surrogates. A standard (CCV) must be injected at the start of each sequence and after each set of sample extracts (every 10 samples or every 12 hours, whichever is first) in the analysis sequence. Evaluate the CCV as described in SOC-CAL. The %D for Aroclor 1016 is a control for Aroclors 1016, 1221, 1232, 1242, and 1248. The %D for Aroclor 1260 controls for Aroclors 1254, 1260, 1262, and 1268.

**Note:** DOD projects require a CCV analysis every 10 field samples.

### 11.4 Retention Time Windows

11.4.1 Pattern recognition/matching and retention times are used for the identification of PCBs as Aroclors.

11.4.2 Establish retention time windows for the peaks used for quantitation with the GC system in acceptable operating condition. Make three injections of all analytes throughout the course of a 72 hour period. Serial injections over less than a 72 hour period may result in retention time windows that are too tight. Using retention times from these analyses, calculate retention time windows. Refer to



EPA Method 8000C for detailed instructions.

11.4.3 Plus or minus three times the standard deviation of the absolute retention times for each standard will be used to define the retention time window; however, the experience of the analyst should weigh heavily in the interpretation of chromatograms. In those cases where the standard deviation for a particular standard is zero, the laboratory may use a default window of  $\pm 0.03$  minutes. If the peak width is  $> 0.06$  minutes, use a default window of 0.1 minutes.

11.4.4 Calculate retention time windows for each standard on each GC column and whenever a new GC column is installed. Retain this data in the method file.

11.5 Gas Chromatography

11.5.1 Set up an analytical sequence for the standards and samples to be analyzed. Calibrate the system as described in Section 11.2. Refer to Table 3 for typical instrument operating conditions. The same conditions must be used for samples as for calibration and QC analyses. Ensure that the instrument configuration is correct and that any necessary maintenance has been performed. Figure 1 shows a typical analysis sequence.

11.5.2 Evaluate the CCVs as indicated in Section 11.3. Use the standards interspersed throughout the sample analysis sequence to evaluate the qualitative performance of the GC system including positioning of the retention time window. If any retention time shift which would impede analyte identification is evident (as shown by Aroclor pattern irregularities or the surrogate falling outside of the retention time window), evaluate the chromatogram for possible causes such as carryover from a highly contaminated sample. If a problem related to GC system has been determined to be the cause of retention time shift, perform whatever maintenance is necessary before reanalyzing the CCV or recalibrating and proceeding with sample analysis. All samples that were injected after the sample exceeded the criteria must be re injected if initial analysis indicated the presence of any analytes of interest.

**FIGURE 1**  
**Analysis Sequence**

2,4'/4,4'-DDx Retention Time Marker	
Initial Calibration Blank	ICB
Standards 1-6	1016/1260/TCMX/DCB ICAL Standards
Standards 7-12	1221/1254 ICAL Standards
Standards 13-18	1232/1262 ICAL Standards
Standards 19-24	1242/1268 ICAL Standards
Standards 25-30	1248 ICAL Standards
Standards 31-39	ICVs for 1016, 1221, 1232, 1242, 1248, 1254, 1260, 1262, 1268
Continuing Calibration Verification CCB	CCV
Method Blank	
Laboratory Control Sample	LCS
Sample 1 - 8	
Matrix Spike	
Duplicate Matrix Spike	
Continuing Calibration Verification	CCV



Continuing Calibration Blank Sample 9 - 18	CCB
Continuing Calibration Verification	CCV
Continuing Calibration Blank	CCB

**Note:** For DOD projects, the CCB must be analyzed following the CCV. Instrument blanks and CCBs may not be analyzed prior to QC samples or standards.

#### 11.6. Troubleshooting

11.6.1. Initial calibration – If the initial calibration fails to meet the criteria, or the ICV fails (indicating a calibration problem), the following steps may be taken, depending on nature of the problem.

- Recheck the information entered into the software used for calibration and quantitation. Verify the standard values are correct and data files are correct. If incorrect, repeat the calibration with the correct information.
- Recheck standards preparation to ensure that standards are correct. Re-prepare and reanalyze if needed.
- Ensure that proper preventive maintenance was performed. Repeat the preventive maintenance if necessary and reanalyze the calibration.
- If calibration problems persist or more substantial calibration problems exist, corrective maintenance or repair may be needed. This includes such measures as column changes, detector maintenance, or GC repair. This will depend on the nature of the problem. Following any such maintenance, repeat the calibration.

11.6.2. Continuing calibration – If the CCV analysis fails to meet the criteria, the following steps may be taken, depending on nature of the problem.

- Recheck the information entered into the software used for calibration and quantitation. Verify the standard values are correct and data files are correct. If incorrect, repeat the calibration with the correct information.
- Recheck standards preparation to ensure that standards are correct and that the correct standard is used as the CCV. Re-prepare and reanalyze if needed. Note that NELAC and DOD requirements apply when multiple CCVs are analyzed.
- Ensure that proper preventive maintenance was performed. Repeat the preventive maintenance if necessary and reanalyze the CCV.
- If calibration problems persist or more substantial calibration problems exist, corrective maintenance or repair may be needed. This includes such measures as column changes, detector maintenance, or GC repair. This will depend on the nature of the problem. Following any such maintenance, repeat analysis of the CCV and necessary samples. Major maintenance will require recalibration. Note that some samples may quickly deteriorate the system to the point that closing CCVs will not pass. This should be verified through a second run of the samples and documented.

## 12) QA/QC Requirements

### 12.1 Initial Precision and Recovery Validation

12.1.1 The precision of the extraction procedure and the GC procedure must be validated before analysis of samples begins, or whenever significant changes to



the procedures have been made. To do this, four reagent water samples are spiked at a level near the midpoint of the calibration range (typically the LCS level), then extracting and proceeding with Section 11. The spiking solution may be prepared from pure standard materials, or purchased as certified solutions. If prepared by the laboratory, stock standards prepared independently from those used for calibration should be used. The concentration of the analytes to be spiked is 20x the MRL.

## 12.2 Method Detection Limits and Method Reporting Limits

12.2.1 A method detection limit (MDL) study must be undertaken before analysis of samples can begin. To establish detection limits that are precise and accurate, the analyst must perform the following procedure. Spike seven blank matrix (water or soil) samples with MDL spiking solution at a level below the MRL. Follow the analysis procedures in Section 11 to analyze the samples.

12.2.2 Calculate the average concentration found ( $\bar{x}$ ) in  $\mu\text{g/mL}$ , and the standard deviation of the concentrations ( $s$ ) in  $\mu\text{g/mL}$  for each analyte. Calculate the MDL for each analyte. Refer to the SOP *Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Limits of Quantitation* (CE-QA011/ADM-MDL).

### 12.2.3 Limits of Quantification (LOQ)

12.2.3.1 The laboratory establishes a MRL/LOQ for each analyte as the lowest reliable laboratory reporting concentration or in most cases the lowest point in the calibration curve which is less than or equal to the desired regulatory action levels, based on the stated project requirements. Analysis of a standard or extract prepared at the lowest point calibration standard provides confirmation of the established sensitivity of the method. The LOQ recoveries should be within 50-150% of the true values to verify the data reporting limit. Refer to the SOP *Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Limits of Quantitation* (CE-QA011/ADM-MDL).

12.2.4 The Method Reporting Limits (MRLs) used at ALS Kelso are the routinely reported lower limits of quantitation which take into account day-to-day fluctuations in instrument sensitivity as well as other factors. These MRLs are the levels to which ALS Kelso routinely reports results in order to minimize false positive or false negative results. The MRL is normally two to ten times the method detection limit.

12.3 Ongoing QC Samples required are described in the ALS-Kelso Quality Assurance Manual and in the SOP for Sample Batches. Additional QC Samples may be required in project specific quality assurance plans (QAPP). General QA requirements for DoD QSM are defined in the laboratory SOP *Department of Defense Projects – Laboratory Practices and Project Management* (ADM-DOD) or *Department of Defense Projects – Laboratory Practices and Project Management – QSM 5.0* (ADM-DOD5). General QC Samples are:

### 12.3.1 Method Blank

12.3.1.1 A method blank is extracted and analyzed with every batch of 20 (or fewer) samples to demonstrate that there are no method interferences. If the method blank shows any hits above the reporting limit, corrective action must be taken. Corrective action includes recalculation, reanalysis, system cleaning, or re-extraction and reanalysis. For some project



specific needs, exceptions may be noted and method blank results above the MRL may be reported for common lab contaminants (phthalate esters, etc.).

**Note:** DoD projects require that no analyte be detected > ½ the RL or 1/10 the regulatory limit, whichever is greater.

### 12.3.2 Laboratory control Sample

12.3.2.1 A lab control sample (LCS) must be extracted and analyzed with every batch of 20 samples. The water LCS is prepared by adding 50 µL of the matrix spike solution to 1L of reagent water, resulting in a concentration of 2.0 µg/L. The soil LCS is prepared by adding 100 µL of spike solution to 20 g of sand, resulting in a concentration of 200 µg/kg. For project-specific low-level extractions, spiking amounts can be adjusted accordingly. Calculate percent recovery (%R) as follows:

$$\%R = X/TV \times 100$$

Where X = Concentration of the analyte recovered  
TV = True value of amount spiked

12.3.2.2 Current ALS QC acceptance criteria for lab control samples are listed in the current laboratory DQO tables. Project-specific or program-specific acceptance criteria may supersede ALS criteria. For example, for samples requiring South Carolina DHEC certification the acceptance criteria are 70-130 % recovery. If the lab control sample (LCS) fails acceptance limits for any of the compounds, corrective action must be taken. Corrective action includes recalculation, reanalysis, or re-extraction and reanalysis. Refer to the ALS-Kelso Quality Assurance Manual for guidance in evaluating recoveries that exceed LCS limits.

### 12.3.3 Matrix Spike

12.3.3.1 A matrix spike (MS) and duplicate matrix spike (DMS) must be prepared and analyzed with every batch of 20 (or fewer) samples. The MS/DMS is prepared by adding the same volume of the matrix spike solution to the sample as listed for the LCS, then proceeding the entire extraction and analysis as specified in Section 11. Calculate percent recovery (%R) as:

$$\%R = \frac{X - X1}{TV} \times 100$$

Where X = Concentration of the analyte recovered  
X1 = Concentration of unspiked analyte  
TV = True value of amount spiked

12.3.3.2 Calculate Relative Percent Difference (RPD) as:

$$RPD = \frac{|R1 - R2|}{(R1 + R2) / 2} \times 100$$

Where R1 = % recovery of the MS  
R2 = % recovery of the DMS



12.3.3.3 Current QC acceptance criteria for MS/DMS are the same as the LCS as listed in the lab DQO tables. Project-specific acceptance criteria may supersede lab criteria. If the MS/DMS recovery is out of acceptance limits for reasons other than matrix effects, corrective action must be taken. Corrective action includes recalculation, reanalysis, or re-extraction and reanalysis.

12.3.3.4 Following analysis of the MS the percent recovery is calculated and compared to acceptance limits. If the recovery is within control limits the results may be reported. If not, and the LCS is within control limits, this indicates that the matrix potentially biases analyte recovery. It is verified that the spike level is at least five times the background level. If not, the results are reported with a qualifier that the background level is too high for accurate recovery determination. If matrix interferences are present or results indicate a potential problem with sample preparation, steps may be taken to improve results; such as performing any additional cleanups, dilution and reanalysis, or re-preparation and reanalysis. Results that do not meet acceptance limits are reported with an appropriate qualifier.

#### 12.3.4 Surrogate

12.3.4.1 Surrogate spike is added to every sample, blank and spike prior to extraction. Two surrogate standards (Tetrachloro-m-xylene and Decachlorobiphenyl) are added to each sample. For water, 100 µL of the surrogate spike is added to 1 L, resulting in 0.2 µg/L. For soil, 200 µL of the surrogate spike is added to 20 g, resulting in 20 µg/Kg. Calculate surrogate percent recovery (%R) as:

12.3.4.2 Calculate surrogate percent recovery (%R) as:

$$\%R = S/V \times 100$$

Where S = Amount of surrogate recovered  
V = Amount spiked

12.3.4.3 Current QC acceptance criteria for surrogates are listed in the current laboratory DQO tables. Project specific acceptance criteria may supersede lab criteria. Both surrogate recoveries must be within the acceptance limits. If either (or both) surrogate is outside of acceptance limits for reasons other than matrix interferences, corrective action must be taken. Corrective actions include recalculation, reanalysis, or re-extraction and reanalysis. The acceptance criteria listed are current criteria, but are subject to change as control limits are updated.

12.3.5 QC results should be reviewed periodically for trends in results. Refer to the SOP *Trending, Control Limits, and Uncertainty* (ADM-TREND) for guidance. Control limits for QC analyses may be determined using the control charts or similar mechanism on an annual basis.

### 13) Data Reduction and Reporting

#### 13.1 Identification of PCBs as Aroclors

13.1.1 To identify Aroclors, compare the chromatographic pattern of the sample to known Aroclor standards. Tentative identification of PCBs as Aroclors is made when the pattern of peaks in the sample chromatogram matches the pattern of



peaks in the Aroclor standard itself. There also needs to be agreement between the retention times and response ratios of the 3-6 selected quantitation peaks in the sample chromatogram and the Aroclor standard.

- 13.1.2 Tentative identification of analytes must be confirmed using a second GC column of dissimilar phase. Identify the Aroclor by comparing the chromatographic pattern of the sample to known Aroclor standards analyzed on the same column. Confirmation of the Aroclor is made when the sample chromatogram matches the pattern of peaks in the Aroclor being confirmed. Quantitation results for the 2 columns must agree ( $\leq 40\%$  RPD) to confirm the identification. If interferences or other sample anomalies make the RPD value  $>40\%$  but the analyst makes a positive identification, the basis of the identification must be documented and the data user notified of the discrepancy (see section 13.2).
- 13.2 Sample matrix difficulties
  - 13.2.1 Weathering of PCBs in the environment and changes resulting from waste treatment processes may alter the pattern of a specific Aroclor so it does not closely match an Aroclor standard. The earlier eluting peaks will often diminish in comparison to the later eluting peaks. If this is observed, alternate peaks may be selected to aid identification to reduce quantitation bias.
  - 13.2.2 Metabolism by organisms may also alter the pattern since individual PCB congeners are metabolized at different rates. When working with tissue samples, the 40% RPD criteria for confirmation may not be met.
  - 13.2.3 Samples may also include mixtures of two or more Aroclors. To the extent possible, identify and quantify each Aroclor.
  - 13.2.4 High amounts of organochlorine pesticides in the sample may interfere with identification. If this is observed, alternate peaks may be selected to aid identification and to reduce quantitation bias.
  - 13.2.5 For all of these reasons a high level of analyst expertise is required to interpret complex chromatograms.
- 13.3 Quantitation of PCBs as Aroclors:
  - 13.3.1 The quantitation of PCBs as Aroclors is accomplished by comparison of the sample chromatogram to that of the most similar Aroclor standard or standards. All calibration acceptance criteria as described in section 11 must be met before reporting any results. Sample results should then be reported according to *Confirmation Procedures for GC and HPLC Analyses* (SOC-CONF). Results may be reported from either column if all calibration acceptance criteria as described in section 11 are met.
  - 13.3.2 Once the Aroclor pattern has been identified, compare the responses of 3 to 6 major peaks in the calibration standard of that Aroclor with the peaks observed in the sample extract. The amount of Aroclor is calculated using the individual calibration factor for each of the 3 to 6 peaks and the calibration model selected in section 11. The concentration is determined using the 3 to 6 characteristic peaks and then the concentrations are averaged to determine the concentration of the Aroclor. If there are interfering peaks with the 3 to 6 quantitation peaks that cause Aroclor average to be falsely overstated, then that interference peak is Q-deleted using the data system and the average is recalculated so that the average more truly represents the concentration in the sample. This often occurs when there are more than one Aroclor in a sample extract or if pesticides are



present. Quantitation of mixed Aroclors will require the selection of peaks that are not shared in common by both Aroclors.

- 13.3.3 For samples with severe matrix interferences, the quantitation may be performed by measuring the total area of the PCB pattern and quantifying on the basis of the Aroclor standard that is most similar to the sample. Any peaks that are not identifiable as PCBs should be subtracted from the total area. When the quantitation option is used, the sample problems should be described for the data user and quantification procedure documented.
- 13.3.4 Using the data system, calculate the concentration in the extract using the calibration model chosen for calibration from *Calibration of Instruments for Organics Chromatographic Analyses* (SOC-CAL).
- 13.3.4.1 Using the data system, calculate the concentration of each analyte in the sample extract ( $C_{ex}$ ) in  $\mu\text{g/ml}$  units using the calibration factor or calibration curve (Section 11). The sample concentration computed using the following equations:

$$\text{Aqueous Samples: Concentration } (\mu\text{g} / \text{L}) = \frac{(C_{ex}) (V_f) (D)}{(V_s)}$$

Where

$C_{ex}$	=	Concentration in extract in $\mu\text{g/ml}$
$V_f$	=	Final volume of extract in mL
$D$	=	Dilution factor
$V_s$	=	Volume of sample extracted, liters

$$\text{Non-aqueous Samples: Concentration } (\text{mg} / \text{Kg}) = \frac{(C_{ex}) (V_f) (D) \times 1,000}{(W) \times 1,000}$$

Where

$C_{ex}$	=	Concentration in extract in $\mu\text{g/ml}$
$V_f$	=	Final volume of extract in mL
$D$	=	Dilution factor
$W$	=	Weight of sample extracted in grams.

- 13.4 Sample concentrations are reported when all QC criteria for the analysis have been met or the results are qualified with a footnote.
- 13.5 Data Review
- 13.5.1 Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the SOP *Laboratory Data Review Process* (ADM-DREV) for details. The person responsible for final review of the data report and/or data package should assess the overall validity and quality of the results and provide any appropriate comments and information to the Project Manager to inclusion in the report narrative.
- 13.6 Reporting
- 13.6.1 Reports are generated using the STEALTH Data Reporting System which compiles the SMO login information. This compilation is then transferred to a file, which STEALTH uses to generate a report. The forms generated may be ALS standard



reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.

13.6.2 Sample concentrations are reported when all QC criteria for the analysis have been met or the results are qualified with an appropriate footnote. For Arizona projects the appropriate Arizona qualifier must be used.

#### 14) Contingencies for Handling Out-of-Control or Unacceptable Data

14.1 Refer to the SOP for *Non Conformance and Corrective Action* (CE-QA008/ADM-NCAR) for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

#### 15) Method Performance

15.1 This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional method performance data available. The method detection limit (MDL) is established using the procedure described in the SOP *Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Quantification*. Method Reporting Limits are established for this method based on the low calibration point and the MDL study results.

#### 16) Pollution Prevention and Waste Management

16.1 The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Lab Waste Management Plan.

#### 17) Training

17.1 All analysts performing this analysis are required to read and understand this SOP.  
17.2 Training is documented following the *Employee Training and New Employee Orientation* (ADM-TRAIN).

#### 18) Method Modifications

18.1 There are no known modifications in this laboratory standard operating procedure from the reference method.

#### 19) References

- 19.1 Polychlorinated Biphenyls (PCBs) as Aroclors, Method 8082A, Revision 1, February 2007, EPA Test Methods for Evaluating Solid Waste, SW-846, Update IV
- 19.2 Determinative Chromatographic Separations, EPA SW846, Test Methods For Evaluating Solid Waste, On-Line, Method 8000C, Revision 3, March 2003.
- 19.3 DoD Quality Systems Manual for Environmental Laboratories, current version .
- 19.4 8000C Method criteria, Arizona DHS, 2/13/2007. Available online at <https://www.azdhs.gov/documents/preparedness/state-laboratory/lab-licensure-certification/technical-resources/additional-resources/method-criteria-8000.pdf>.
- 19.5 TNI Quality Standards, 2009; 2016.



19.6 ISO/IEC 17025:2005/2017 American National Standard, General requirements for the competence of testing and calibration laboratories.

## 20) Changes Since the Last Revision

Summary of Revision Changes			
Revision Number	Effective Date	Document Editor	Description of Changes
19.0	12/2/20	T Caron	Updated Signatories Minor grammatical, typographical, and formatting corrections.

## 21) Attachments, Tables, and Appendices

- 21.1 Table 1 - Target Analytes and Method Reporting Limits\* - Water.
- 21.2 Table 2 - Target Analytes and Method Reporting Limits\* - Soil/Sediment.
- 21.3 Table 3 - Gas Chromatograph Operating Conditions\*.
- 21.4 Table 4 - Calibration Standard Preparation.
- 21.5 Table 5 - Summary of Corrective Actions.



**TABLE 1**  
**Target Analytes and Method Reporting Limits\* - Water**

Analyte	Standard Level (µg/L)	Low-Level (µg/L)	Ultra Low- Level (µg/L)
Aroclor 1016	0.20	0.020	0.0050
Aroclor 1221	0.40	0.040	0.010
Aroclor 1232	0.20	0.020	0.0050
Aroclor 1242	0.20	0.020	0.0050
Aroclor 1248	0.20	0.020	0.0050
Aroclor 1254	0.20	0.020	0.0050
Aroclor 1260	0.20	0.020	0.0050
Aroclor 1262	0.20	0.020	0.0050
Aroclor 1268	0.20	0.020	0.0050

**TABLE 2**  
**Target Analytes and Method Reporting Limits\* - Soil/Sediment**

Analyte	Standard Level (mg/Kg)	Low-Level (µg/Kg)
Aroclor 1016	0.10	10
Aroclor 1221	0.20	20
Aroclor 1232	0.10	10
Aroclor 1242	0.10	10
Aroclor 1248	0.10	10
Aroclor 1254	0.10	10
Aroclor 1260	0.10	10
Aroclor 1262	0.10	10
Aroclor 1268	0.10	10

\*For some analytes, LOQs may vary slightly from MRLs due to program/project requirements.



**TABLE 3**  
**Gas Chromatograph Operating Conditions\***

Gas Chromatograph:	Agilent 6890 or equivalent with ECD
Injection Port Temperature:	Initial Temp 90°C for 0.5 min., 250°C/min ramp to 325°C for 5.0 min., 20°C/min ramp to 250°C for 5.0 min.
Oven Temperature Program:	90°C hold for 0.5min., 5°C/min ramp to 230°C for 0.5 min., 7°C/min ramp to 315°C, hold for 0.06 min.
Detector Temperature:	325°C
Injection Volume:	1 µL
Column 1:	DB-35MS, 30 m x 0.32 mm ID x 0.25 µm film thickness or equivalent.
Column 2:	DB-XLB, 30 m x 0.32 mm ID x 0.50 µm film thickness or equivalent
Carrier Gas:	Hydrogen
Auxiliary Gas:	Nitrogen
Data System:	HP EnviroQuant (acquisition), Target (data processing)

\* The above instrument temperatures may be modified depending on the instrument used. The GC column diameter and phase thickness depend on the instrument used. All conditions must be the same for initial calibration, continuing calibration, sample, and QC analysis.



**TABLE 4**  
**Calibration Standard Preparation**

<u>Aroclor 1260</u> <u>50 µg/mL</u> <u>Intermediate</u>	<u>1016/1260 Initial Calibration Standards (prepared in hexane)</u>			
	<u>Surrogate</u> <u>5 µg/mL</u> <u>Intermediate</u>	<u>Final Volume</u>	<u>Final</u> <u>Concentration</u> <u>Aroclors</u>	<u>Final</u> <u>Concentration</u> <u>Surrogates</u>
40 µL	40 µL	10 mL	200 µg/L	20 µg/L
20 µL	20 µL	10 mL	100 µg/L	10 µg/L
10 µL	10 µL	10 mL	50 µg/L	5 µg/L
	<u>Aroclor1016-</u> <u>1260/Surg</u> <u>(20/200 ppb)</u>			
1000 µL	1000 µL	10 mL	20 µg/L*	2 µg/L*
500 µL	500 µL	10 mL	10 µg/L	1 µg/L
250 µL	250 µL	10 mL	5 µg/L	0.5 µg/L
100 µL	100 µL	10 mL	2 µg/L	0.2 µg/L
50 µL	50 µL	10 mL	1 µg/L	0.1 µg/L

\* CCV Standard

**Single-Point Calibration Standards (1,000 µl/mL)**

<u>Aliquot</u>	<u>Final Volume</u>	<u>Solvent</u>	<u>Final</u> <u>Concentration</u>
10 µL	10 mL	Hexane	1000 µg/L
10 µL	10 mL	↓	1000 µg/L
10 µL	10 mL	↓	1000 µg/L
10 µL	10 mL	↓	1000 µg/L
10 µL	10 mL	↓	1000 µg/L
10 µL	10 mL	↓	1000 µg/L
10 µL	10 mL	↓	1000 µg/L

**ICV Standards (100 µl/mL)**

<u>Aliquot</u>	<u>Final Volume</u>	<u>Solvent</u>	<u>Final</u> <u>Concentration</u>
100 µL	10 mL	Hexane	1000 µg/L
100 µL	10 mL	↓	1000 µg/L
100 µL	10 mL	↓	1000 µg/L
100 µL	10 mL	↓	1000 µg/L
100 µL	10 mL	↓	1000 µg/L
100 µL	10 mL	↓	1000 µg/L
100 µL	10 mL	↓	1000 µg/L
100 µL	10 mL	↓	1000 µg/L
100 µL	10 mL	↓	1000 µg/L

\*As needed for projects requiring non-routine additional compounds, similar dilutions are prepared to obtain calibration standards for these compounds.



TABLE 5

Summary of Corrective Actions				
Method Reference	Control	Specification and Frequency	Acceptance Criteria	Corrective Action
EPA 8000C EPA 8082A	ICAL	Prior to sample analysis	% RSD $\leq$ 20 $R^2$ COD $\geq$ 0.990	Correct problem then repeat ICAL
EPA 8000C EPA 8082A	ICV	After ICAL	$\pm$ 20% Diff	Correct problem and verify second source standard; rerun second source verification. If fails, correct problem and repeat initial calibration.
EPA 8000C EPA 8082A	CCV	Prior to sample analysis, every 10 samples or 12 hours	$\pm$ 20% Diff	Correct problem then repeat CCV or repeat ICAL
EPA 8000C EPA 8082A	Method Blank	Include with each analysis batch (up to 20 samples)	<MRL	If target exceeds MRL, reanalyze to determine if instrument was cause. If still noncompliant then:  Re-extract or reanalyze samples containing contaminate, unless samples contain > 20x amount in blank.
EPA 8000C EPA 8082A	Laboratory Control Sample	Include with each analysis batch (up to 20 samples)	See DQO	If exceeds limits, re-extract and re-analyze
EPA 8000C EPA 8082A	Matrix Spike	Include with each analysis batch (up to 20 samples)	See DQO	Evaluate data to determine if there is a matrix effect or analytical error
EPA 8000C EPA 8082A	Matrix Spike Duplicates	Include with each analysis batch (up to 20 samples)	See DQO	Evaluate data to determine if there is a matrix effect or analytical error



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Approved By: Laboratory Director, Charles (Pat) Byrne  
Signature on File



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### 1. Scope and Applicability

- 1.1. This procedure is used to determine the concentrations of chlorinated herbicides in water and soil samples using EPA Method 8151A. Compounds that may be determined by this method and the associated method reporting limit (MRL) or Lower Limit of Quantitation (LLOQ) for each compound in water and soil are listed in Table 1. The reported MRL may be adjusted if required for specific project requirements; however, the capability of achieving other reported MRLs must be demonstrated. Method detection are listed in the laboratory DQO tables.
- 1.2. The form of each acid herbicide (salts and esters) occurring in the sample is not distinguished by this method. The results are calculated and reported for each analyte as the total free acid herbicide.
- 1.3. In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPP's supersede method specified requirements. An example of this are projects falling under DoD ELAP. QC requirements defined in the SOP *Department of Defense Projects – Laboratory Practices and Project Management* (ADM-DOD/ADM-DOD5) may supersede the requirements defined in this SOP.

### 2. Summary of Procedure

- 2.1. This procedure provides gas chromatographic (GC) conditions for the detection of chlorinated herbicides. Prior to GC analysis, an appropriate sample extraction technique must be used to recover the analytes. Water and soil samples are adjusted to a pH <2, and the herbicides in both acid and derivatized forms are extracted with ethyl ether. Derivatives of the phenoxy acid herbicides in the extract are hydrolyzed to the acid form by the addition of sodium hydroxide and, for soils, heat. The sample is acidified, and the acid herbicides are extracted. The acids are then converted to their methyl esters using diazomethane. For extraction of soil/solid samples, modifications to method 8151A are made to minimize chromatographic interferences from aldol condensation products. Also, the Dichloromethane extraction (wash) is not used for water samples since it has been shown that certain target analytes are lost during this step.
- 2.2. A 2  $\mu$ L aliquot of the derivatized extract is injected into the gas chromatograph (GC). The compounds are separated on a fused silica capillary column and detected by an electron capture detector. Identification of the analytes is performed by comparing the retention times of the analytes with the respective retention times of an authentic standard, which has been derivatized to the methyl ester. Quantitative analysis is performed by using the authentic standard to produce a calibration factor or calibration curve, and using the calibration data to determine the concentration of an analyte in the extract. The concentration in the sample is calculated using the sample weight or volume and the extract volume.
- 2.3. The sensitivity of this method usually depends on the level of interferences rather than on instrument limitations.

### 3. Definitions

- 3.1. For laboratory definitions applicable to most analyses, refer to the SOP for *Sample Batches*.



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### 4. Responsibilities

- 4.1. It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.
- 4.2. It is the responsibility of the department supervisor/manager to document analyst training and method proficiency as described in *Employee Training and New Employee Orientation* (ADM-TRAN).

### 5. Interferences

- 5.1. Organic acids, especially chlorinated acids, cause the most direct interference with the determination. Phenols, including chlorophenols may also interfere with this procedure.
- 5.2. The herbicides, being strong organic acids, react readily with alkaline substances and may be lost during analysis. Therefore, glassware may need to be acid-rinsed and then rinsed to constant pH with organic-free reagent water. Sodium sulfate must be acidified.
- 5.3. Sample extracts should be dry prior to methylation or else poor recoveries

### 6. Safety

- 6.1. Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.
- 6.2. The toxicity or carcinogenicity of each compound or reagent used in this method has not been precisely determined; however, each chemical compound should be treated as a potential health hazard. Exposure to these compounds should be reduced to the lowest possible level. A reference file of Safety Data Sheets (SDS) is available to all personnel involved in these analyses. ALS also maintains a file of OSHA regulations regarding the safe handling of the chemicals specified in this method.
- 6.3. Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Kelso Chemical Hygiene Plan and the appropriate SDS prior to beginning this method.
- 6.4. Sodium Hydroxide (NaOH) is a strong caustic and a severe health and contact hazard. Use nitrile or latex gloves while handling pellets or preparing solutions.
- 6.5. The use of Diazomethane requires special consideration. It is a toxic carcinogen, which can explode under certain conditions. The following precautions must be followed:
  - 6.5.1. Use only a well-ventilated hood - do not breathe vapors.
  - 6.5.2. Use a safety screen.
  - 6.5.3. Use mechanical pipetting aides.



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- 6.5.4. Do not heat above 9°C - Explosion may result.
- 6.5.5. Avoid grinding surfaces, ground glass joints, sleeve bearings, glass stirrers; Explosion may result.
- 6.5.6. Store away from alkali metals - Explosion may result.
- 6.5.7. Solutions of diazomethane decompose rapidly in the presence of solid materials such as copper powder, calcium chloride, and boiling chips.
- 6.5.8. Store in a freezer at -10°C.
- 6.6. Refer to diazomethane SOP (EXT-DIAZ) for preparation and holding times.

## 7. Sample Collection, Containers, Preservations and Storage

- 7.1. Containers used to collect samples should be purchased pre-cleaned containers.
- 7.2. Water and soil samples must be iced or refrigerated at  $4 \pm 2^\circ\text{C}$  and protected from light from time of collection until extraction.
- 7.3. Water and soil samples must be iced or refrigerated at  $<6^\circ\text{C}$  and protected from light from time of collection until extraction.

## 8. Standards, Reagents, and Consumable Materials

- 8.1. Sodium hydroxide (NaOH), 10N.
- 8.2. Sulfuric Acid ( $\text{H}_2\text{SO}_4$ ), 1:1.
- 8.3. Concentrated Hydrochloric Acid (HCl).
- 8.4. Silicic Acid.
- 8.5. Solvents: ethyl ether, methanol, isooctane (pesticide quality or equivalent).
- 8.6. Acidified sodium sulfate (anhydrous),  $\text{Na}_2\text{SO}_4$ . Pre-clean by heating at  $400^\circ\text{C}$  for 4 hours. Acidify as directed in Method 8151A. Once prepared, place the sodium sulfate in an oven at  $\geq 130^\circ\text{C}$ . Store at this temperature when not in use. If the oven is also used for other purposes, verify the oven temperature while stored.
- 8.7. Acidified glass wool. Pre-clean by solvent rinsing. Acid wash prior to use.
- 8.8. Stock Solutions
  - 8.8.1. Stock solutions are purchased from Accustandard (M-8151), Ultra Scientific (HBM-8150A) or other vendors. The concentration of analytes varies from 100 - 10,000 ppm in methanol. The stock standards used to make the calibration standards are the herbicide methyl esters. The analyte concentration for calibration standards is converted to acid equivalent based on molecular weight. This allows for accurate quantitation of target analytes on an acid equivalent basis. Stock solutions are stored in the freezer until the manufacturer's expiration date.



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8.8.2. 2,4-Dichlorophenyl acetic acid is the surrogate and is purchased as the acetate for preparing the calibration standards at 1000 ppm. The acid form is purchased for spiking.

### 8.9. Working Solutions

8.9.1. A working solution is prepared by diluting the stock solutions (targets and surrogate) of the methyl esters 1:100 in isooctane. The working solution is stored in a refrigerator and has a 6 month expiration date.

8.9.2. A minimum of 5 calibration standards are made for initial calibration by diluting the working solution. The suggested calibration range is 10 ppb to 200 ppb, except for MCPP and MCPA which are at 1000 ppb to 20000ppb.

### 8.10. QC Standards

8.10.1. The surrogate spiking solution is prepared at 5 µg/mL in isooctane. For water and soil samples, 500 µl of surrogate solution is added to each sample and blank. For soils, 1000 µl of surrogate solution is added to each sample and blank. The surrogate is used to evaluate the effectiveness of the extraction procedure. The standard is stored at  $4 \pm 2^\circ\text{C}$  for up to 6 months.

8.10.2. A matrix spike solution containing all analytes (at various concentrations) is prepared in acetone (Absolute Standard or equivalent). This solution contains the free acid forms of the analytes. For water, 500 µl of matrix spike solution is added to all matrix spikes and lab control samples, and 1000 µl for and soil MS/LCS samples. The standard is stored at  $4 \pm 2^\circ\text{C}$  for up to 6 months.

8.10.3. Independent Calibration Verification (ICV) standard. A stock standard from a second source, independent of that used for preparation of calibration standards, is prepared. Using this stock standard, dilute to give a working standard, which is a mid-calibration concentration. The standard is used to verify accuracy of the calibration.

## 9. Apparatus and Equipment

9.1. Gas Chromatograph - Analytical system complete with gas chromatograph (GC) suitable for splitless or on-column automated injection into guard and analytical columns with an electron capture detector (ECD). The gas chromatograph can be configured with two analytical columns and two ECDs connected to the same guard column. Helium is used as the carrier gas; argon/methane mixture is used for the detector makeup gas (auxiliary gas).

### 9.2. GC Columns

9.2.1. Column 1: 30m x 0.32mm x 0.30u RTX-C1 Pesticides.

9.2.2. Column 2: 30m x 0.32mm x 0.25u RTX-CLPesticides.

9.3. Data system - A computer system must be interfaced to the GC. The system must allow the continuous acquisition and storage on machine-readable media of all chromatographic data obtained throughout the duration of the chromatographic program. The computer must have software that can search any GC data file and plot such response versus time. Must be



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capable of performing calibrations and quantitation calculations. HP Enviroquant is the current software in use.

- 9.4. Analytical balance (0.0001 g).
- 9.5. Volumetric flasks, syringes, vials, and bottles for standards preparation.

## 10. Preventative Maintenance

- 10.1. All maintenance activities are recorded in a maintenance logbook kept for each instrument. Pertinent information (serial numbers, etc.) must be in the logbook. Maintenance entries should include date, symptom of problem, corrective actions, a description of maintenance, date, and name. The log should contain a reference to return to analytical control.
- 10.2. Carrier gas - Inline purifiers or scrubbers should be in place for all sources of carrier gas. These are selected to remove water, oxygen, and hydrocarbons. Purifiers should be changed as recommended by the supplier.
- 10.3. Gas Chromatograph
  - 10.3.1. Whenever GC maintenance is performed, care should be taken to minimize the introduction of air or oxygen into the column. Injection port maintenance includes changing the injection port liner, seal, washer, O-ring, septum, column ferrule, and autosampler syringe as needed. Liners and seals should be changed when recent sample analyses predict a problem with chromatographic performance. In some cases liners and seals may be cleaned and re-used.
  - 10.3.2. Clipping off a small portion of the head of the column often improves chromatographic performance. When cutting off any portion of the column, make sure the cut is straight and "clean" (uniform, without fragmentation) by using the proper column-cutting tool.
  - 10.3.3. Over time, the column will exhibit poorer overall performance, as contaminated sample matrices are analyzed. The length of time for this to occur will depend on the samples analyzed. When a noticeable decrease in column performance is evident and other maintenance options do not result in improvement, the column should be replaced.
- 10.4. The autosampler should be cleaned periodically. This includes turret cleaning and cleaning or replacing the syringe. Refer to manufacturer's instructions for autosampler restarting.
- 10.5. The detector should be leak-checked and serviced as specified by the manufacturer.

## 11. Procedure

- 11.1. Sample Preparation - Water samples
  - 11.1.1. Extract 1 L aqueous sample. Mark the water meniscus on the side of the sample bottle for later determination of sample volume. Pour the entire sample into a 2 L separatory funnel. Add surrogate and matrix spike as needed.
  - 11.1.2. Add 250 g NaCl to the sample, seal, and shake to dissolve salt.



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- 11.1.3. Add 7 mL of 10N NaOH to the sample, seal, and shake. Check the pH of the sample with pH paper; if the sample does not have a pH  $\geq 12$ , adjust the pH by adding more 10N NaOH. Let the sample sit at room temperature for a minimum of 1 hour, shaking the separatory funnel and contents periodically.
- 11.1.4. Add 7 mL of 1:1 H<sub>2</sub>SO<sub>4</sub> to the sample, seal, and shake to mix. Check the pH of the sample with pH paper; if the sample does not have a pH  $\leq 2$ , adjust the pH by adding more H<sub>2</sub>SO<sub>4</sub>.
- 11.1.5. Add 100mL ethyl ether to the sample, seal, and extract by shaking or tumbling the funnel for 2 minutes with periodic venting to release excess pressure. Allow the organic layer to separate from the water phase. If the emulsion interface between layers is more than one-third the volume of the solvent layer, the analyst should employ mechanical techniques to complete the phase separation. The optimum technique depends upon the sample, but may include stirring, filtration through glass wool, centrifugation, or other physical methods. Remove the aqueous phase to a 1 L beaker and collect the ether phase in a beaker containing approximately 10 g of acidified anhydrous sodium sulfate. Periodically, shake the sample and drying agent.
- 11.1.6. Return the aqueous phase to the separatory funnel, add a 50 mL volume of ethyl ether to the sample, and repeat the extraction procedure a second time, combining the extracts in a beaker. Perform a third extraction with 50 mL of ethyl ether in the same manner. Allow the extract to remain in contact with the sodium sulfate overnight.
- 11.1.7. Determine the original sample volume by refilling the sample bottle to the mark and transferring the water to a 1000 mL graduated cylinder. Record the sample volume to the nearest 10 mL.
- 11.1.8. Quantitatively transfer the extract into a pre-rinsed K-D apparatus via funnel with small amount of acidified muffled anhydrous sodium sulfate (add more sodium sulfate, if necessary).
- 11.1.9. Evaporate the extract down to approx. 5mL on the S-Evap. keeping the temperature 55-70°C.
- 11.1.10. Esterification
  - 11.1.10.1. Bring to a 10 mL volume in ethyl ether.
  - 11.1.10.2. Remove 1 mL of extract to a second 15ml test tube for derivatization. Store the remaining 9 mL in a sealed and labeled test tube.
  - 11.1.10.3. Derivatize with 1 mL of diazomethane, let stand for 30 minutes, repeat if yellow color is not present.
  - 11.1.10.4. Solvent exchange to iso-octane by adding 1-2 mL of iso-octane then concentrating down to exactly 2 mL on the N-Evap. This gives a true final volume of 20 mL.

11.2. Sample Preparation - Soil samples



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- 11.2.1. Add 30 g dry weight of the well mixed soil sample into a 250 mL Teflon shaker bottle, utilize acidified sulfate to dry (approx. 10g). Weigh out the method blank using acidified sulfate and the laboratory control sample using matrix sand and acidified sulfate.
- 11.2.2. Adjust to pH 2 using up to 5 mL of concentrated HCl. Add HCl and mix thoroughly. Check with pH strips and record the pH. Add surrogates and matrix spikes as needed.
- 11.2.3. Add 100 mL of ethyl ether and shake sample using wrist action shaker for 30 min.
- 11.2.4. Transfer 20 mL of extract to a large culture tube. Evaporate extract down to ~3ml using N-evap. It is now ready for saponification.
- 11.2.5. Hydrolysis
  - 11.2.5.1. Add 5 mL of Deionized H<sub>2</sub>O to the sample extract in the culture tube.
  - 11.2.5.2. Add 1 mL of 37% (w/v) KOH, and vortex for one minute.
  - 11.2.5.3. Check pH of all samples; if not  $\geq 12$ , repeat 11.2.5.2.
  - 11.2.5.4. Heat on N-Evap., under a gentle stream of nitrogen, for one hour at 60°C, vortex every 20 minutes. When done, cool by letting stand for 10 minutes.
  - 11.2.5.5. The phenoxy acid herbicides remain soluble in the water as potassium salts.
- 11.2.6. Acid Extraction
  - 11.2.6.1. Adjust the pH to 2 by adding 1 mL cold (4°C) sulfuric acid (1:3) to the culture tube. Check pH and add more acid if necessary.
  - 11.2.6.2. Extract the herbicides three times with 5,3,3 mL of ethyl ether, by vortexing for 30 seconds, allowing phases to separate, and collecting the ether layer in another culture tube. Bring to 10 mL volume using iso-octane.
- 11.2.7. Esterification
  - 11.2.7.1. Remove 1 mL of extract for derivatization. Store remaining 9 mL in extract refrigerator.
  - 11.2.7.2. Derivatize with 1 mL of diazomethane, let stand for 30 minutes, repeat if yellow color is not present.
  - 11.2.7.3. Solvent exchange to iso-octane by adding 1-2 mL of iso-octane then concentrating down to exactly 1 mL on the N-Evap (this gives a calculated final volume of 50 mL). Vial exactly 1 mL of extract and mark the meniscus. Archive remaining 9 mL of extract in ether fridge with the meniscus marked.

### 11.3. Initial Calibration



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**NOTE:** The calibration procedure(s) and options chosen must follow the ALS protocols. Any exceptions to the calibration procedures detailed in the ALS SOP for *Calibration of Instruments for Organics Chromatographic Analyses* (SOC-CAL) are described as follows:

- 11.3.1. Using the GC conditions given in Table 2, calibrate the system prior to conducting any analyses. Starting with the standard of lowest concentration, analyze each calibration standard and tabulate response (peak area or height) versus the concentration in the standard. The results can be used to determine a response factor (RF) for each compound. The average response factor ( $RF_a$ ) is then calculated. The Relative Standard Deviation (RSD) must be less than 20% when average response factor is used.
- 11.3.2. Following initial calibration, analyze an ICV standard. The ICV solution must contain all analytes in the calibration standards. Calculate the concentration using the typical procedure used for quantitation. Calculate the percent difference (%D) from the ICV true value. Evaluate the ICV as described in the SOP for *Calibration of Instruments for Organics Chromatographic Analyses* (SOC-CAL).

### 11.4. Calibration Verification

- 11.4.1.1. The working calibration curve or calibration factor must be verified on each analytical sequence by the analysis of one or more mid-range calibration standards (CCV). A mid-level standard (CCV) must be injected at the start of each sequence and after each set of sample extracts (every 10 samples or every 12 hours, whichever is first) in the analysis sequence.
- 11.4.1.2. The acceptance criterion for all analytes in the CCV analysis is a response (RF or concentration) within  $\pm 20\%$  D of the expected value, as compared to the initial calibration. Refer to the ALS SOP for Calibration of Instruments for Organics Chromatographic Analyses for allowable exceptions.
- 11.4.1.3. Use the mid-level standards interspersed throughout the analysis sequence to evaluate the qualitative performance of the GC system. If any standard falls outside of their daily retention time window, evaluate the chromatogram for possible causes such as carryover from a highly contaminated sample. If a problem related to GC system has been determined to be the cause of retention time shift, the analysis sequence is ended. Perform whatever maintenance is necessary and inject another CCV. If the standard still falls outside of the daily retention time window, recalibrate and proceed with sample analysis. All samples that were injected after the sample exceeded the criteria must be re injected.

### 11.5. Retention Time Windows

- 11.5.1. Establish retention time windows with the GC system in acceptable operating conditions. Make three injections of all analytes throughout the course of a 72-hour period. Serial injections over less than a 72-hour period may result in retention time windows that are too tight. Using retention times from these analyses, calculate retention time windows. Refer to EPA Method 8000D for detailed instructions.
- 11.5.2. Plus or minus three times the standard deviation of the absolute retention times for each standard will be used to define the retention time window; however, the



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experience of the analyst should weigh heavily in the interpretation of chromatograms. In those cases where the standard deviation for a particular standard is zero, substitute the standard deviation of a close eluting, similar compound to develop a valid retention time window.

11.5.3. Calculate retention time windows for each standard on each GC column and whenever a new GC column is installed. Retain this data in the method file.

### 11.6. Gas Chromatography

11.6.1. Table 2 indicates the operating conditions for the gas chromatograph. Samples and standards are analyzed in an analysis sequence in which continuing calibration (CCV) standards are analyzed every 10 analyses or 12 hours.

11.6.2. Calibrate the system as described in Section 11.3. Evaluate the CCVs as indicated in Section 11.4.

11.6.3. Use the mid-level standards interspersed throughout the analysis sequence to evaluate the qualitative performance of the GC system. If any standard falls outside of their daily retention time window, evaluate the chromatogram for possible causes such as carryover from a highly contaminated sample. If a problem related to GC system has been determined to be the cause of retention time shift, the analysis sequence is ended. Perform whatever maintenance is necessary before reevaluating the CCV or recalibrating and proceeding with sample analysis.

#### 11.6.4. Identification of Analytes

11.6.4.1. Identify a sample component by comparison of its retention time to the retention time of the daily standard chromatogram.

11.6.4.2. Tentative identification of an analyte occurs when a peak from a sample extract falls within the daily retention time window. Confirmation is done on a second GC column or by GC/MS if concentration permits.

11.6.4.3. A tentatively identified compound is confirmed when the retention time for the compound on the confirmatory column/detector system is within the retention time window on that system.

11.6.5. Perform all necessary calculations as described in Section 13.

## 12. QA/QC Requirements

**Note:** The analyst should refer to *Sample Batches (ADM-BATCH)* and *Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Quantitation*.

12.1. Refer to Section 8.0 of Method 8151A for general QC protocol. In addition to instrument criteria for calibration, the ability of each analyst/instrument to generate acceptable accuracy and precision must be documented prior to sample analysis (IPR study). This must be validated before analysis of samples, or whenever significant changes to the procedures have been made. To do this, four reagent water samples are spiked with each target analyte, extracted, and analyzed. Refer to Method 8151A for these requirement and acceptance criteria.



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12.2. Method Detection Limits

12.2.1. A method detection limit (MDL) study must be undertaken before analysis of samples can begin. To establish detection limits that are precise and accurate, the analyst must perform the following procedure. Spike a minimum of seven blank replicates with a MDL spiking solution (at a level below the MRL) for each target analyte, extract, and analyze. The MDL studies should be done for each matrix, prep method, and instrument. Refer to the SOP *Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Quantitation*. Calculate the average concentration found (x) in the sample concentration, and the standard deviation of the concentrations for each analyte. Calculate the MDL for each analyte using the correct T value for the number of replicates. The MDL study must be verified annually.

12.3. Limits of Quantification (LOQ)

12.3.1. The laboratory establishes a LOQ for each analyte as the lowest reliable laboratory reporting concentration or in most cases the lowest point in the calibration curve which is less than or equal to the desired regulatory action levels, based on the stated project requirements. Analysis of a standard or extract prepared at the lowest point calibration standard provides confirmation of the established sensitivity of the method. The LOQ recoveries must be within 50% of the true values to verify the data reporting limit. Refer to the SOP *Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Quantitation*.

12.4. Ongoing QC Samples required are described in the ALS-Kelso Quality Assurance Manual and in the SOP for *Sample Batches* (ADM-BATCH). In general, these include:

12.4.1. Method blank - A method blank is extracted and analyzed with every batch of 20 or fewer samples to demonstrate that there are no method interferences. The method blank must demonstrate that interferences from the analytical and preparation steps minimized. No target analytes should be detected above the MRL in the method blank. For some project specific needs, exceptions may be noted and method blank results above the MRL may be reported for common lab contaminants (phthalate esters, etc.).

12.4.2. A lab control sample (LCS) must be extracted and analyzed with every batch of 20 or fewer samples. The LCS is prepared by spiking a blank with the matrix spike solution, and going through the entire extraction and analysis. Calculate percent recovery (%R) as follows:

$$\%R = X/TV \times 100$$

Where X = Concentration of the analyte recovered  
TV = True value of amount spiked

Evaluate the recovery using the acceptance criteria in the criteria in the current ALS-Kelso DQO spreadsheets. If the lab control sample (LCS) fails acceptance limits for any of the compounds, the analyst must evaluate the system and calibration. If no problems are found, corrective action must be taken.

12.4.3. A matrix spike/duplicate matrix spike (MS/DMS) must be extracted and analyzed with every batch of 20 or fewer samples. The MS is prepared by spiking a sample



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aliquot with the matrix spike solution, and going through the entire extraction and analysis. Calculate percent recovery (%R) as follows:

$$\%R = \frac{X - X1}{TV} \times 100$$

Where X = Concentration of the analyte recovered  
X1 = Concentration of unspiked analyte  
TV = True value of amount spiked

Calculate Relative Percent Difference (RPD) as:

$$\%RPD = \frac{R1 - R2}{(R1 + R2)/2} \times 100$$

Where R1 = Recovery of the high result  
R2 = Recovery of the lower result

Evaluate the recovery and RPD using the acceptance criteria in the current ALS-Kelso DQO spreadsheets. If the MS/DMS recovery is out of acceptance limits for reasons other than matrix effects, corrective action must be taken.

12.4.4. Calculate and evaluate the surrogate recovery using the acceptance criteria in the current ALS-Kelso DQO spreadsheets. If surrogate recovery is outside acceptance criteria, the sample data must be closely evaluated for possible matrix interferences. If none are present, then corrective action must be identified.

12.5. Additional QA/QC measures include control charting of QC sample results.

## 13. Data Reduction and Reporting

### 13.1. Calculations

13.1.1. Quantitation of herbicides in sample extracts is performed by comparing total area of residue peaks to total area of peaks from the appropriate reference materials.

13.1.2. The concentration of each analyte in the sample extract (Cex) is computed in µg/mL using the calibration factor or calibration curve. The concentration of analytes in the original samples is computed using the following equations:

#### Aqueous Samples:

$$\text{Concentration } (\mu\text{g} / \text{L}) = \frac{(Cex) (Vf) (D)}{(Vs)}$$

Where Cex = Concentration in extract in µg/mL  
Vf = Final volume of extract in mL  
D = Dilution factor  
Vs = Volume of sample extracted, liters



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### Non-aqueous Samples:

$$\text{Concentration (mg)/ Kg} = \frac{(C_{ex}) (V_f) (D) \times 1,000}{(W) \times 1,000}$$

Where C<sub>ex</sub> = Concentration in extract in µg/mL  
V<sub>f</sub> = Final volume of extract in mL  
D = Dilution factor  
W = Weight of sample extracted. The wet or dry weight may be used, depending upon the specific client requirements.

#### 13.2. Data Review

13.2.1. Following primary data interpretation and calculations, a secondary analyst reviews all data. Following generation of the report, the report is also reviewed. Refer to the SOP for Laboratory Data Review Process for details.

#### 13.3. Reporting

13.3.1. Reports are generated using the STEALTH Data Reporting System which compiles the SMO login information. This compilation is then transferred to a file, which STEALTH uses to generate a report. The forms generated may be ALS standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.

13.3.2. Sample concentrations are reported when all QC criteria for the analysis has been met or the results are qualified with an appropriate footnote.

### 14. Contingencies for Handling Out-of-Control or Unacceptable Data

14.1. Refer to the SOP for *Nonconformity and Corrective Action* for corrective action procedures.

14.2. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

### 15. Method Performance

15.1. This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional method performance data available.

15.2. The method detection limit (MDL) is established using the procedure described in the SOP *Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Quantification*. Method Reporting Limits are established for this method based on MDL studies and as specified in the ALS Quality Assurance Manual.

### 16. Pollution Prevention and Waste Management

16.1. The laboratory will comply with all Federal, State, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal



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restrictions as specified in the ALS-Kelso Lab Waste Management Plan.

**17. Training**

- 17.1. All analysts performing this analysis are required to read and understand this SOP.
- 17.2. Training is documented following the Employee Training and New Employee Orientation (ADM-TRAIN).

**18. Method Modifications**

- 18.1. There are no known modifications in this laboratory standard operating procedure from the reference method.

**19. References**

- 19.1. *EPA Test Methods for Evaluating Solid Waste, SW-846, Update III, December 1996, Method 8151A, Revision 1.*
- 19.2. *Determinative Chromatographic Separations, Method 8000D, EPA Test Methods for Evaluating Solid Waste, SW-846, On-Line March 2018.*
- 19.3. TNI Standard, Volume 1-2009, 2016.
- 19.4. DoD/DOE Quality Systems Manual, current version.
- 19.5. ISO/IEC 17025: 2017 American National Standard, General requirements for the competence of testing and calibration laboratories.

**20. Changes Since Last Revision**

Summary of Revision Changes			
Revision Number	SOP REVIEW	Document Editor	Description of Changes
19.0		T. CARON	Section 8.9: Updated calibration ranges. Calibration range 10-200ppb MCP and MCPA is 1000-20000ppb.  Section 9.2: Updated Column details: Column1 = 30m x 0.32mm x 0.30u RTX-C1 Pesticides. Column2 = 30m x 0.32mm x 0.25u RTX-CLPesticides.  Updated: Table 2: Column1 = 30m x 0.32mm x 0.30u RTX-C1 Pesticides Column2 = 30m x 0.32mm x 0.25u RTX-CLPesticides.
19.0	2/12/2021		Procedural Change form submitted by R.E. dated 2/12/2021.

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## 21. Attachments and Appendices

- 21.1. Table 1 - Target Compounds and MRL/LLOQs.
- 21.2. Table 2 - GC Operating Conditions.
- 21.3. Appendix 1 - Analytical Worksheets.



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**TABLE 1**  
**TARGET COMPOUNDS and MRL/LLOQs**

<u>Analyte</u>	<u>Matrix</u>	<u>MRL/LOQ</u>	<u>Units</u>
2,4,5-T	Soil	50	µg/kg
2,4,5-TP (Silvex)	Soil	50	µg/kg
2,4-D	Soil	50	µg/kg
2,4-DB	Soil	50	µg/kg
Dalapon	Soil	50	µg/kg
Dicamba	Soil	50	µg/kg
Dichlorprop	Soil	50	µg/kg
Dinoseb	Soil	50	µg/kg
MCPA	Soil	5000	µg/kg
MCPP	Soil	5000	µg/kg
2,4,5-T	Water	0.20	µg/L
2,4,5-TP (Silvex)	Water	0.20	µg/L
2,4-D	Water	0.40	µg/L
2,4-DB	Water	0.40	µg/L
Dalapon	Water	0.40	µg/L
Dicamba	Water	0.20	µg/L
Dichlorprop	Water	0.40	µg/L
Dinoseb	Water	0.20	µg/L
MCPA	Water	100	µg/L
MCPP	Water	100	µg/L



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**TABLE 2**  
**GC OPERATING CONDITIONS**

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Gas Chromatograph:	Hewlett-Packard Model 5890 or equivalent
Injection Port Temperature:	250°C
Oven Temperature Program:	60°C for 2 min.; 30°/min ramp to 200°C, hold for 2.83 minutes; 10°/min ramp to 275°C, hold for 2 minutes
Detector Temperature:	350°C
Injection Volume:	2 µL
Column 1	30m x 0.32mm x 0.30u RTX-C1 Pesticides.
Column 2:	30m x 0.32mm x 0.25u RTX-CLPesticides.
Carrier Gas:	Helium
Auxiliary Gas:	Nitrogen
Data System:	HP Enviroquant

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Appendix 1

ANALYTICAL WORKSHEETS

[R:\Extractions\Active Benchsheets\8151\8151\\_Soil\\_Herbicides.doc](R:\Extractions\Active Benchsheets\8151\8151_Soil_Herbicides.doc)

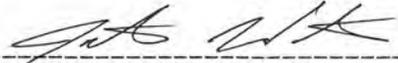
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## Butyltins

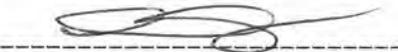
DOCUMENT ID: SOC-BUTYL, REV 16.0

Approved By:   
Organics Manager, Jonathon Walter

Date: 12/2/2020

Approved By:   
Quality Assurance Manager, Kurt Clarkson

Date: 12/2/2020

Approved By:   
Laboratory Director, Charles (Pat) Byrne

Date: 12/2/20



## 1. Scope and Application

- 1.1. This Standard Operating Procedure (SOP) describes the procedure used for the analysis of butyltins by GC-FPD. Concentrations of Tributyltin chloride ( $\text{Bu}_3\text{SnCl}$ ) as well as butyltin trichloride ( $\text{BuSnCl}_3$ ), dibutyltin dichloride ( $\text{Bu}_2\text{SnCl}_2$ ), and tetrabutyltin ( $\text{Bu}_4\text{Sn}$ ) in water, sediment and tissue can be determined by this method. The butyltin chloride salts of tributyltin, dibutyltin and monobutyltin are reported as butyltin cations.
- 1.2. The current Method Reporting Limit (MRL) and MDLs for each of these analytes are listed in the laboratory DQO tables. The Method Detection Limit (MDL) that has been obtained is subject to change as studies are repeated.
- 1.3. In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPP's supersede method specified requirements. An example of this are projects falling under DoD ELAP. QC requirements defined in the SOP *Department of Defense Projects - Laboratory Practices and Project Management* (ADM-DOD5) may supersede the requirements defined in this SOP.

## 2. Summary of Procedure

- 2.1. This procedure is based on techniques described in various papers (Unger, et. al; Krone, et.al.) for performing the extraction, derivitization, and analysis of mono-, di-, tri-, and tetrabutyltin chloride, with use of certain modifications. This procedure involves a 0.1% tropolone in methylene chloride extraction of the analytes of interest from an acidified sample, followed by a Grignard reaction of the hexane extract with Hexylmagnesium bromide ( $\text{HxMgBr}$ ). The extract is then eluted through silica and alumina cartridge columns for cleanup of soil extracts, or Florisil columns for cleanup of tissue and water extracts.
- 2.2. Extracts are then analyzed by GC/FPD with a 610nm bandwidth filter. The extraction procedure used is outlined in the ALS SOP EXT-OSWT.

## 3. Definitions

- 3.1. For laboratory definitions applicable to most analyses, refer to the SOP for *Sample Batches*.

## 4. Responsibilities

- 4.1. It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.
- 4.2. It is the responsibility of the department supervisor/manager to document method proficiency and analyst training.

## 5. Interferences

- 5.1. Solvents, reagents, glassware, and other sample processing hardware may yield discrete artifacts and/or elevated baselines, causing misinterpretation of the chromatograms. All of these materials must be demonstrated to be free from interferences, under the conditions of the analysis, by running method blanks.
- 5.2. Since this procedure is often applied to trace level analyses, particular attention should be paid to ensuring that standards are of acceptable quality and purity.

## 6. Safety



- 6.1. Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS-Kelso Chemical Hygiene Plan and the appropriate SDS prior to beginning this method.

## 7. Sample Collection, Containers, Preservation, and Storage

- 7.1. Containers used to collect samples should be purchased pre-cleaned containers. The sample containers should be of glass or polycarbonate and have screw-top covers with Teflon liners. Where Teflon is not available, solvent-rinsed aluminum foil may be used as a liner. Highly acidic or basic samples may react with the aluminum foil, causing eventual contamination of the sample. Plastic containers or lids may not be used for the storage of samples due to the possibility of sample contamination from the phthalate esters and other hydrocarbons within the plastic.
- 7.2. Water and soil samples must be iced or refrigerated at  $<6^{\circ}\text{C}$  and protected from light from time of collection until extraction. Water samples should be extracted within 7 days and soil/sediment samples should be extracted within 14 days of collection. Tissue samples should be extracted within 1 year when stored frozen ( $<-10^{\circ}\text{C}$ ) until extraction. Studies have not been done to determine sample or extract stability, however extracts should be analyzed within 40 days after extraction.

## 8. Standards, Reagents, and Consumable Materials

- 8.1. Stock standard solutions may be purchased from a number of vendors. All reference standards, where possible, must be traceable to SI units or NIST certified reference materials. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Refer to the SOP *Reagent/Standards Login and Tracking* (ADM-RTL) for the complete procedure and documentation requirements.

### 8.2. Stock Solutions - 2000 $\mu\text{g}/\text{mL}$

- 8.2.1. A certified butyltins stock solution containing Tetrabutyltin, Tributyltin, Dibutyltin, and Monobutyltin chloride salts is purchased from Restek or equivalent at 2000 ppm in methylene chloride.
- 8.2.2. Alternatively, a stock solution may be prepared from neat materials. Neat standards may be purchased from an approved vendor such as Aldrich, Alfa, or Acros. Prepare by weighing out the following amounts of the neat standards and diluting to 10 mL in DCM. Replace stock solutions yearly, or sooner if there are signs of degradation.

Tetrabutyltin	20.0 mg
Tributyltin chloride	22.4 mg
Dibutyltin dichloride	26.1 mg
Butyltin trichloride	32.1 mg

- 8.2.3. The surrogate stock solution, tripropyltin chloride, is purchased as certified stock solution at 2000 ppm (Restek or equivalent). Alternatively, the solution may be prepared by weighing 20 mg of the neat standard and diluting to 10 mL in DCM. The solution is good for 1 year, or as specified by the manufacturer. Tripropyltin chloride and tricyclohexyltin chloride may be used as alternate surrogates.
  - 8.2.4. An ICV stock standard is purchased from a source different from the calibration standards (Accustandard or equivalent), and prepared at 2000 ppm in DCM.
- ### 8.3. Spiking Standards
- 8.3.1. Butyltin Spike Standard - Prepare a 5  $\mu\text{g}/\text{mL}$  solution by diluting the stock butyltin standard in acetone ( $2000 \mu\text{g}/\text{mL} \times 125 \mu\text{L}/50 \text{ mL}$ ). Replace every 2 months.
  - 8.3.2. Butyltin Surrogate Spike - Prepare a 5  $\mu\text{g}/\text{mL}$  solution by diluting the stock butyltin standard in acetone ( $2000 \mu\text{g}/\text{mL} \times 125 \mu\text{L}/50 \text{ mL}$ ). Replace every 2 months.



#### 8.4. Calibration Standards

- 8.4.1. A 5 ppm intermediate calibration standard mix is prepared by diluting 125 µL of the 2000 ppm butyltins stock solution and 125 µL of 2000 ppm surrogate stock solution into 1 mL hexane and derivitizing with Grignard reagent. The standard is brought to 50 mL final volume following alumina and silica gel cleanups. This standard can be prepared at the same time that a sample set is derivitized. Replace every 12 months.
- 8.4.2. Calibration standards are prepared by diluting the calibration intermediate mix into hexane at appropriate levels. A minimum of five concentrations are used to calibrate the instrument. Recommended concentrations are: 2, 5, 20, 50, 200, 500, and 1000 µg/L as cations. Replace every 6 months. To convert the butyltin chloride salt concentration to the corresponding cation concentration, multiply the chloride salt conc. by the following correction factors:

Tributyltin	=	0.8910
Dibutyltin	=	0.7665
Monobutyltin	=	0.6230

- 8.5. ICV Standard Solution - Using the ICV stock standard, prepare the same as for the calibration intermediate standard (8.3.1). Replace every 12 months. From that solution, make an appropriate dilution to give an ICV concentration that is mid-range in the calibration.
- 8.6. Store all standards in a refrigerator or freezer (<4°C).

### 9. Apparatus and Equipment

- 9.1. Gas Chromatograph (GC) equipped with a flame photometric detector (FPD) and autosampler, HP 6890 with Enviroquant. A 610nm center wavelength, 10nm bandwidth filter for the FPD is required (purchased from Oriel, Stratford, Conn., Part No. 53295). The recommended GC columns and operating conditions are as follows:

#### 9.1.1. Columns:

- Restek RTX-1, 30 m x 0.32 mm I.D., 1.0 µm film thickness, or equivalent.  
Restek RTX-35, 30 m x 0.32 mm I.D., 1.0 µm film thickness, or equivalent.

#### 9.1.2. GC conditions:

Carrier flow (column)	2-5 mL/min.
Carrier + Makeup flow	25 ml/min.
Hydrogen flow (detector)	175 ml/min.
Air flow (detector)	100 ml/min.
Temperature program (both columns):	
Injector Temp	30°C, hold for .6 min., 250°C/min. to 325°C
Detector Temp	250°C
Oven Temp	120°C, hold for 1 minute, 20°C/minute to 280°C, hold for 3 minutes

- 9.2. Data system - A computer system must be interfaced to the GC. The system must allow the continuous acquisition and storage on machine-readable media of all chromatographic data obtained throughout the duration of the chromatographic program. The computer must have software that can search any GC data file and plot such response versus time. The data system must be capable of performing calibrations and quantitation calculations. HP Enviroquant is the current software in use.
- 9.3. Analytical balance (0.0001 g).
- 9.4. Volumetric flasks, syringes, vials, and bottles for standards preparation.

### 10. Preventative Maintenance



- 10.1. All maintenance activities are recorded in a maintenance logbook kept for each instrument. Pertinent information (serial numbers, instrument I.D., etc.) must be in the logbook. This includes the routine maintenance. The entry in the log must include: date of event, the initials of who performed the work, and a reference to analytical control.
- 10.2. Carrier gas - Inline purifiers or scrubbers should be in place for all sources of carrier gas. These are selected to remove water, oxygen, and hydrocarbons. Purifiers should be changed as recommended by the supplier.
- 10.3. Gas Chromatograph
  - 10.3.1. Whenever GC maintenance is performed, care should be taken to minimize the introduction of air or oxygen into the column. Injection port maintenance includes changing the injection port liner, seal, washer, o-ring, septum, column ferrule, and autosampler syringe as needed. Liners and seals should be changed when recent sample analyses predict a problem with chromatographic performance. In some cases liners and seals may be cleaned and re-used.
  - 10.3.2. Clipping off a small portion of the head of the column often improves chromatographic performance. When cutting off any portion of the column, make sure the cut is straight and clean (uniform, without fragmentation) by using the proper column cutting tool.
  - 10.3.3. Over time, the column will exhibit poorer overall performance, as contaminated sample matrices are analyzed. The length of time for this to occur will depend on the samples analyzed. When a noticeable decrease in column performance is evident and other maintenance options do not result in improvement, the column should be replaced. This is especially true when evident in conjunction with calibration difficulties.
- 10.4. The autosampler should be cleaned periodically. This includes turret cleaning and cleaning or replacing the syringe. Refer to manufacturer's instructions for autosampler restarting.
- 10.5. The detector should be cleaned and serviced as specified by the manufacturer.

## 11. Procedure

- 11.1. Refer to the SOP *Sample Batches* (ADM-BATCH) for guidance on analytical calibration and sample batches.

**Note:** Refer to the SOP for *Calibration of Instruments for Organics Chromatographic Analyses* (SOC-CAL), where calibration procedures and policies are described. The calibration procedure(s) and options chosen must follow the SOP SOC-CAL. Any criteria described in the following sections takes precedence over the SOP SOC-CAL.
- 11.2. Initial Calibration
  - 11.2.1. Calibrate the GC immediately prior to conducting any analyses, using the external standard technique. Starting with the standard of lowest concentration, analyze each calibration standard and tabulate response (peak area) versus the concentration in the standard. The ratio of the response to the amount injected, defined as the calibration factor (CF), is calculated for each analyte at each standard concentration.
  - 11.2.2. If the percent relative standard deviation (%RSD) of the calibration factor is less than or equal to 25% over the working range, linearity through the origin can be assumed, and the average calibration factor may be used in place of a calibration curve. Other options for establishing the calibration are given in the SOP for *Calibration of Instruments for Organics Chromatographic Analyses* (SOC-CAL).
- 11.3. Prior to sample analysis; verify the calibration by analyzing the ICV standard immediately after the initial calibration. The acceptance criteria for the ICV are 75-125% of the true value. Values exceeding  $\pm 20\%D$  should be scrutinized for possible error.



#### 11.4. Calibration Verification

11.4.1. The start of any sequence must include a CCV checked against the Initial Calibration (curve or average calibration factors). For any analyte to pass, the response (calculated concentration or calibration factor) must be within  $\pm 25\%D$  of the expected response. For this specific passing analyte, this CCV is valid for 12 hours and is considered an opening CCV. An opening CCV must be run prior to (within 8 hours of the commencement of) any analytical sequence.

11.4.2. CCV standards must be analyzed at the start of each analytical sequence (except when the sequence is initiated with an ICAL and ICV).

11.4.3. CCV standards are analyzed at the following frequency:

11.4.3.1. CCVs must be analyzed at the start of each sequence and after each set of 10 field samples (including MS/DMS) or every 12 hours, whichever is more frequent.

11.4.3.2. Samples with confirmed detections must be bracketed by acceptable CCV standards.

11.4.3.3. When a closing CCV standard is not acceptable, corrective action must be taken. A new CCV standard may be prepared and analyzed to demonstrate degradation of the standard as the cause of a CCV outlier. In this case, instrument stability will be verified and samples analyzed prior to this CCV can be reported. CCV standards that are reinjected after minor instrument maintenance (e.g., injection port maintenance, column bake-out, installation of a new trap, etc.) do not verify instrument stability. Samples analyzed prior to this CCV must be reanalyzed.

11.4.4. Any samples following a failing CCV must be rerun.

#### 11.5. Retention Time Windows

11.5.1. The width of the retention time window used to make identifications should be based upon measurements of actual retention time variations of standards over the course of 72 hours. Three times the standard deviation of a retention time is used to calculate a suggested window size for a compound. However, the experience of the analyst should weigh heavily in the interpretation of chromatograms.

11.5.2. Use the mid-level standards (CCVs) interspersed throughout the analysis sequence to evaluate the qualitative performance of the GC system. If any standard falls outside of their daily retention time window, evaluate the chromatogram for possible causes such as carryover from a highly contaminated sample. If a problem related to GC system has been determined to be the cause of retention time shift, perform whatever maintenance is necessary before reinjecting a CCV or recalibrating and proceeding with sample analysis.

#### 11.6. Sample Analysis

11.6.1. Following calibration analyses, analyze samples in a set referred to as an analytical sequence. The sequence includes field samples and QC samples bracketed by CCVs. Using the data system, setup the data acquisition to acquire data for each analysis into a distinct folder. Refer to the SOP *Sample Batches* (ADM-BATCH) for guidance on setting up an analytical sequence.

##### 11.6.2. Identification of Analytes

11.6.2.1. Identify a sample component by comparison of its retention time to the retention time of the daily standard chromatogram.

11.6.2.2. Tentative identification of an analyte occurs when a peak from a sample extract falls within the daily retention time window. A tentatively identified



compound is confirmed when the retention time for the compound on the confirmatory detector is within the retention time window on that system. Confirmation is routinely done using secondary column and/or GCMS techniques.

## 12. QA/QC Requirements

12.1. The ability of each analyst/instrument to generate acceptable accuracy and precision must be documented prior to sample analysis (IPR study). This must be validated before analysis of samples, or whenever significant changes to the procedures have been made. To do this, four reagent water samples are spiked with each target analyte, extracted, and analyzed. Calculate the average percent recovery and standard deviation. Since no specific criteria are defined for this analysis, the section supervisor/manager should review this data for reasonableness.

### 12.2. Method Detection Limits

12.2.1. A method detection limit (MDL) study must be undertaken before analysis of samples can begin. To establish detection limits that are precise and accurate, the analyst must perform the following procedure. Spike a minimum of seven blank replicates with a MDL spiking solution (at a level below the MRL) for each target analyte, extract, and analyze. The MDL studies should be done for each matrix, prep method, and instrument. Refer to *Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Quantification* (CE-QA011/ADM-MDL).

12.2.2. Calculate the average concentration found (x) in the sample concentration, and the standard deviation of the concentrations for each analyte. Calculate the MDL for each analyte using the correct T value for the number of replicates. The MDL must be verified annually (LOD) for each sample matrix or the MDL study repeated.

### 12.3. Limit of Quantitation (LOQ)

12.3.1. The LOQ must be verified annually for each quality system matrix. Any established LOQ must be above the LOD. Alternatively, the annual LOQ verification is not required if the LOD successfully meets the laboratory established acceptance limits.

12.4. Ongoing QC Samples required are described in the ALS-Kelso Quality Assurance Manual and in the SOP for *Sample Batches* (ADM-BATCH). Routinely, these include:

12.4.1. Method blank - A method blank is extracted and analyzed with every batch of 20 or fewer samples to demonstrate that there are no method interferences. The method blank must demonstrate that interferences from the analytical and preparation steps minimized. No target analytes should be detected above the MRL in the method blank.

**Note:** For DoD projects, no target analytes should be detected in the Method Blank above ½ the MRL. If this criterion is exceeded, the source of the contamination is investigated and steps are taken to correct, minimize, or eliminate the problem. The laboratory shall evaluate whether reprocessing of the samples is necessary.

12.4.2. A lab control sample (LCS) must be extracted and analyzed with every batch of 20 or fewer samples. The LCS is prepared by spiking a blank with the matrix spike solution, and going through the entire extraction and analysis. Calculate percent recovery (%R) as follows:

$$\%R = X/TV \times 100$$

Where X = Concentration of the analyte recovered  
TV = True value of amount spiked



Compare recovery to the current acceptance limits. If the lab control sample (LCS) fails acceptance limits for any of the compounds, the analyst must evaluate the system and calibration. If no problems are found, corrective action must be taken.

- 12.4.3. A matrix spike/duplicate matrix spike (MS/DMS) must be extracted and analyzed with every batch of 20 or fewer samples. The MS is prepared by spiking a sample aliquot with the matrix spike solution, and going through the entire extraction and analysis. Calculate percent recovery (%R) as follows:

$$\%R = \frac{X - X1}{TV} \times 100$$

Where X = Concentration of the analyte recovered  
X1 = Concentration of unspiked analyte  
TV = True value of amount spiked

Calculate Relative Percent Difference (RPD) as:

$$RPD = \frac{R1 - R2}{(R1 + R2) / 2} \times 100$$

Where R1 = % recovery of the MS  
R2 = % recovery of the DMS

Compare recovery and RPD to the current acceptance limits. If the MS/DMS recovery is out of acceptance limits for reasons other than matrix effects, corrective action must be taken.

- 12.4.4. Compare recovery for surrogates to the current acceptance limits. If surrogate recovery is outside acceptance criteria, the sample data must be closely evaluated for possible matrix interferences. If none are present, then corrective action must be identified.
- 12.5. Current acceptance criteria for matrix spikes, LCSs and surrogates are listed in the ALS-Kelso DQO spreadsheets. The acceptance criteria listed are current criteria, but are subject to change as control limits are updated.
- 12.6. Additional QA/QC measures include control charting of QC sample results.

### 13. Data Reduction and Reporting

#### 13.1. Calculations

Sample results are calculated by the external standard method. If there are no interferences, results may also be calculated by the internal standard method, using  $Pe_3SnCl$  as the internal standard, if the associated internal calibration is established. For external standard, use the following equations, for internal standard, use techniques described in EPA Method 8000B for quantification.

Aqueous Samples:

$$Concentration (\mu g / L) = \frac{(C_{ex}) (vf) (D)}{V_s} \times C$$

Where C<sub>ex</sub> = Concentration in extract in  $\mu g/ml$   
VF = Final volume of extract in ml  
D = Dilution factor



- Vs = Volume of sample extracted, liters  
C = Appropriate chloride-to-cation correction factor (Table 2)

Non aqueous Samples:

$$\text{Concentration (mg / Kg)} = \frac{(C_{ex}) (V_f) (D) \times 1000}{(W) \times 1000} \times C$$

- C<sub>ex</sub> = Concentration in extract in µg/ml  
V<sub>F</sub> = Final volume of extract in ml  
D = Dilution factor  
W = Weight of sample extracted. The wet or dry weight may be used, depending upon the specific client requirements.  
C = Appropriate chloride-to-cation correction factor (Table 2)

### 13.2. Data Review

Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the SOP for *Laboratory Data Review Process* (ADM-DREV) for details.

### 13.3. Reporting

13.3.1. Reports are generated in the ALS LIMS by compiling the SMO login, sample prep database, instrument, date, and client-specified report requirements (when specified). The forms generated may be ALS standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs..

13.3.2. Sample concentrations are reported when all QC criteria for the analysis has been met or the results are qualified with an appropriate footnote.

## 14. Contingencies for Handling Out-of-Control or Unacceptable Data

14.1. Refer to the SOP for *Non Conformance and Corrective Action* (CE-QA008/ADM-NCAR) for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

## 15. Method Performance

15.1. Available method performance data is given in the reference method. In addition, this procedure was validated through single laboratory studies of accuracy and precision as specified in Section 12.1. The method detection limit(s) and method reporting limit(s) were established for this method as specified in Section 12.2.

## 16. Pollution Prevention and Waste Management

16.1. The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS-Kelso Lab Waste Management Plan.

16.2. This method uses non-halogenated solvents and any waste generated from this solvent must be placed in the collection cans in the lab. The solvent will then be added to the hazardous waste storage area and disposed of in accordance with Federal and State regulations.

## 17. Training

17.1. Training is documented following the SOP ALS-Kelso Training Procedure (ADM-TRAIN).



## 18. Method Modifications

- 18.1. This procedure is based upon procedures published in literature referenced in section 19.
- 18.2. Krone uses GC/MS for analysis, this procedure uses GC/FPD as described in the Unger reference.
- 18.3. The procedure in Krone addressed tissue and sediment matrices. This procedure applies to all matrices.

## 19. References

- 19.1. Unger, M.A.; MacIntyre, W.G. Greaves, J.; Huggett, R.J., *GC Determination of Butyltins in Natural Waters by Flame Photometric Detection of Hexane Derivatives with Mass Spectrometric Confirmation*, *Chemosphere*, 1986, 16 (4): 461-470.
- 19.2. Krone, C.A.; Brown, D.W.; Burrows, D.G.; Bogar, R.G.; Chan, S.; Varanasi, U., *A Method for Analysis of Butyltin Species and Measurement of Butyltins in Sediment and English Sole Livers from Puget Sound*, Environmental Conservation Division, Northwest and Alaska Fisheries Center, National Marine Fisheries Service, NOAA, November, 1988.
- 19.3. DoD Quality Systems Manual for Environmental Laboratories, current version.
- 19.4. TNI Quality Standards, 2009; 2016.
- 19.5. ISO/IEC 17025:2005/2017 American National Standard, General requirements for the competence of testing and calibration laboratories

## 20. Changes Since the Last Revision

Revision Number	Effective Date	Document Editor	Description of Changes
16.0	12/2/2020	T. Caron K. Clarkson	Updated Signatories Grammatical, typographical, and formatting corrections. Section 7.1 & 7.2 Updated sample collection and preservation requirements. Section 13.3.1 updated report generation procedures Section 17.1 updated training documentation guidance

## 21. Attachments, Tables, and Appendices

- 21.1. Table 1 - Conversion Factors.
- 21.2. Table 2 - Summary of Corrective Actions.



**Table 1**  
**Conversion Factors**

Compound	Salt - Cation	Cation - Sn
Tetrabutyltin	1	0.3419
Tributyltin	0.8911	0.4092
Dibutyltin	0.7666	0.5095
Monobutyltin	0.6230	0.6751

**Table 2**

**Summary of Corrective Actions**

Method Reference	Control	Specification and Frequency	Acceptance Criteria	Corrective Action
SOC-Butyl	ICAL	Prior to sample analysis	% RSD $\leq$ 25% or see SOC-CAL	Correct problem then repeat ICAL
SOC-Butyl	ICV	After ICAL	$\pm$ 25%	Correct problem and verify second source standard; rerun second source verification. If fails, correct problem and repeat initial calibration.
SOC-Butyl	Method Blank	Include with each analysis batch (up to 20 samples)	<MRL	If target < 20x MB re-extract and re-analyze.
SOC-Butyl	Matrix Spike	Include with each analysis batch (up to 20 samples)	See DQO Table	Evaluate data to determine if there is a matrix effect or analytical error
SOC-Butyl	Lab Control Sample	Include with each analysis batch (up to 20 samples)	See DQO Table	Re-extract and re-analyze.



## ALS-Kelso SOP Annual Review Statement

**SOP Code: PET-SVF**

Revision: 16

An annual review of the SOP listed was completed on (date): 12/2/2020

The SOP reflects current practices and requires no procedural changes.

Supervisor:            Date:

Revision of the SOP is needed to reflect current practices. Draft revisions are listed below.

SOP Section Number	Description of Revision Needed	Date Procedure Change Implemented	Supervisor Initials Indicating Approval of Revision
11.2.1.7	Stopper and shake or tumble the funnel for 1-2 minutes with periodic venting. Allow the solvent layers to separate.	12/11/2020	JW
11.2.1.12	Carefully remove the collector from the KD and further concentrate the extract, using a gentle N <sub>2</sub> stream and < 40°C water bath (N-Evap) or TurboVap or micro-snyder, to 1 mL in DCM (if the sample volume was approximately 500 mL; 2 mL if sample volume was approximately 1L). Again, do not allow the extract to evaporate to dryness. If the extract is particularly dark, viscous and/or obnoxious smelling, it may be advisable to take the extract to a higher final volume. A graduated, disposable pipet or syringe may be used to measure the final volume	12/11/2020	JW
11.2.2.4	Add approximately 30 g muffled, granular Na <sub>2</sub> SO <sub>4</sub> to the sample in the beaker, stir the mixture thoroughly with a scoopula until the mixture is dry and free flowing, and no material adheres to the beaker or scoopula. After initial mixing, it will be necessary to allow the mixture to sit at room temperature for at least 15 minutes (often longer), followed by further mixing, in order to ensure that the Na <sub>2</sub> SO <sub>4</sub> has been allowed to dry the sample as effectively as possible.	12/11/2020	JW
11.3.7.6	In order to report the associated sample results, all LCS recoveries must be within acceptance criteria. If the LCS recovery is outside the criteria due to chromatographic problems (injection problem, etc.) take the necessary corrective action and reanalyze. If reanalysis does not correct the problem or if the LCS recovery is outside the	12/11/2020	JW



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	criteria due to extraction/preparation failure, re-extract and reanalyze the associated samples.		
11.3.7.6.1	This replaced 11.3.7.6	12/11/2020	JW
11.1.2.3	Evaluation of Sample Analysis - ALS acceptance criteria are established based on either the method criteria or on control charting of analytical results. Unless specific criteria are required by the method, or stated in project specific data quality objectives, ALS-generated criteria will be used in evaluating acceptability of the analysis.	12/11/2020	JW
Table 9	Remove, SOPs should not have limits	12/11/2020	JW
13.5.1	Reports are generated in the ALS LIMS reporting software by compiling the SMO login, sample prep database, instrument date, and client-specified report requirements (when specified). The forms generated may be ALS standard reports, DOD, or client-specific reports. The compiled data from LIMS are also used to create EDDs.	12/11/2020	JW
13.5.2	Remove	12/11/2020	JW
17.1	Training is documented following Employee Training and New Employee Orientation (ADM-TRAIN).  That is all that is needed	12/11/2020	JW



## ALS-Kelso SOP Annual Review Statement

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Attach additional pages or information if necessary



STANDARD OPERATING PROCEDURE ALS   Environmental - Kelso	Total, Fixed, and Volatile Solids in Solid Samples
	SOIL-SOLIDS, Rev 2.0
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## Total, Fixed, and Volatile Solids in Solid and Semisolid Samples

DOCUMENT ID: SOIL-SOLIDS, REV 2.0

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Prepared By: Soil Prep Manager, Jonathon Walter  
Signature on file.

Date: 1/29/2021

Prepared By: Quality Assurance Manager, Kurt Clarkson  
Signature on file.

Date: 1/29/2021

Approved By: Laboratory Director, Charles (Pat) Byrne  
Signature on file.

Date: 1/29/2021

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## 1) Scope & Applicability

- 1.1 This procedure determines percent dry solids in soil, sediment, and solid samples using Standard Methods 2540G, modified EPA Method 160.3 (160.3M) and modified PSEP. These methods are suitable for the determination of solid and semisolid materials produced during water and wastewater treatment.
- 1.2 This procedure is used to determine volatile solids in soil, sediment and sludge using SM 2540G and modified EPA Method 160.4 (160.4M). This determination is useful because it offers a rough approximation of the amount of organic matter present in the solid fraction of wastewater, activated sludge and industrial wastes.
- 1.3 In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPP's supersede method specified requirements. An example of this are projects falling under DOD ELAP. QC requirements defined in the SOP *Department of Defense Projects - Laboratory Practices and Project Management* (ADM-DOD5), may supersede the requirements defined in this SOP.

## 2) Summary of Procedure

- 2.1 EPA 160.3M, PSEP, and 2540G - A well-mixed sample is quantitatively transferred to a pre-weighed, metal pan or porcelain crucible and evaporated to dryness at 103-105°C. The pan is weighed and the weight of the residue calculated.
- 2.2 EPA 160.4M and SM 2540G - The residue from EPA 160.3M, PSEP, or 2540G is ignited to a constant weight at 550°C. The weight loss upon ignition is the volatile solids.

## 3) Definitions

- 3.1 Total solids - the residue left in the pan or vessel after evaporation of a sample and its subsequent drying in an oven at a defined temperature.
- 3.2 Total volatile solids, also known as volatile residue, is defined as the total residue obtained from the residue ignited at 550°C in a muffle furnace
- 3.3 Fixed solids/Volatile Solids - is the term applied to the residue of total, suspended, or dissolved solids after ignition for a specified time at a specified temperature. The weight loss on ignition is called volatile solids.
- 3.4 Batch - A batch of samples is a group of environmental samples that are prepared and/or analyzed together as a unit with the same process and personnel using the same lot(s) of reagents. It is the basic unit for analytical quality control.
  - 3.4.1 Preparation Batch - A preparation batch is composed of one to twenty field samples, all of the same matrix, all of the same matrix, processed on the same date.
- 3.5 Sample
  - 3.5.1 Field Sample - An environmental sample collected and delivered to the laboratory for analysis; a.k.a., client's sample.
  - 3.5.2 Laboratory Sample - A representative portion, aliquot, or subsample of a field sample upon which laboratory analyses are made and results generated.

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- 3.6 Quality System Matrix - The matrix of an environmental sample is distinguished by its physical and/or chemical state and by the program for which the results are intended. The following sections describe the matrix distinctions. These matrices shall be used for purpose of batch and quality control requirements.
- 3.7 Solids - Any solid sample such as soil, sediment, sludge, and other materials with >15% settleable solids.
- 3.8 Laboratory Duplicates (DUP) - Duplicates are additional replicates of samples that are subjected to the same preparation and analytical scheme as the original sample. The relative percent difference (RPD) between the sample and its duplicate is calculated and used to assess analytical precision.

#### 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. The department supervisor/manager or designee performs final review and sign-off of the data.
- 4.2 It is the responsibility of the department supervisor/manager to document analyst training and method proficiency, as described in the *ALS-Kelso Training Procedure* (ADM-TRAIN).

#### 5) Interferences

- 5.1 Sampling and subsampling may introduce serious errors. Homogenize samples thoroughly prior to, and during transfer. Use special handling to insure sample integrity when subsampling.
- 5.2 The temperature at which the residue is dried has an important bearing on sample results, because weight losses due to the volatilization of organic matter and gases from heat-induced chemical decomposition depend on temperature and time of heating.
- 5.3 Each sample requires close attention to desiccation after drying. Minimize opening the desiccator to reduce the entry of moist air.

#### 6) Safety

- 6.1 Samples must be handled as described in the ALS safety policies and approved methods. Refer to the ALS Chemical Hygiene Plan prior to beginning this method.

#### 7) Sample Collection, Containers, Preservation, and Storage

- 7.1 Soil samples may be collected in glass jars, sleeves, or other suitable container.
- 7.2 For soil samples, a minimum of 10 g is required. Collecting 8 oz jars of soil improves subsampling homogeneity.
- 7.3 Samples should be stored at 4°C.
- 7.4 Samples must be analyzed within 7 days of collection.

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## 8) Standards, Reagents, and Consumable Materials

- 8.1 All equipment cleaning, working solutions and dilutions should be prepared using deionized water (DI) conforming to ASTM Type I or ASTM Type II reagent water. For more information on reagent water generation, refer to the related SOP, Operation and Maintenance of Laboratory Reagent Water Systems.

## 9) Apparatus and Equipment

- 9.1 Evaporating dishes: dishes of 100 mL capacity made of porcelain.
- 9.2 Evaporating pans, aluminum
- 9.3 Desiccators, containing desiccant.
- 9.4 Drying oven, for operation at 103-105°C.
- 9.4.1 Ovens housing an internal temperature recorder/display as part of its operational system are calibrated twice per year by an external, accredited calibration service.
- 9.4.2 Oven temperature may be monitored by using a thermometer immersed in sand, or other suitable solid material, in a vessel in the oven. The liquid in glass thermometer is verified annually using a reference traceable to NIST.
- 9.5 Analytical balance capable of weighing to 0.1 mg.
- 9.6 Balance calibration verification weights, ASTM Class 1.
- 9.7 Muffle furnace for operation at 550°C.
- 9.8 Porcelain Dishes (for 2540G only).

## 10) Preventative Maintenance

- 10.1 All maintenance activities are recorded in a maintenance logbook kept for each instrument. Pertinent information (serial numbers, instrument I.D., etc.) must be in the logbook. This includes the routine maintenance described herein. The entry in the log must include: date of event, the initials of who performed the work, and a reference to return to analytical control.
- 10.2 The laboratory utilizes an external calibration service that is accredited to perform calibration or re-certification of ovens housing an internal temperature recorder/display as part of its operational system.
- 10.3 A bound logbook is used to record all balance measurements. Format the logbook such that the date, initials, balance I.D., weight set ID, measurements, and specifications for the check weights are listed for each balance. Record each calibration verification measurement in the logbook. Entries into logbooks are to be performed in accordance with the SOP for *Making Entries Onto Analytical Records* (CE-QA007). Desiccant should be changed as needed.

## 11) Procedure

- 11.1 Total Solids - EPA Method 160.3M and PSEP.
- 11.1.1 Pre-dry the aluminum pans prior to use by heating at 103-105°C for one hour. Allow to cool. Label the pans with corresponding sample I.D.s.



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- 11.1.2 Determine and record the tare (dry pan) weight.
- 11.1.3 Measure 10 g of homogenized sample into the tared weigh pan. Record the pan plus sample weight. If the sample consists of discrete pieces of solid material (dewatered sludge, for example), take cores from each piece with a No. 7 cork borer (or equivalent); as an alternative, pulverize the entire sample coarsely on a clean surface by hand, using rubber gloves.
- 11.1.4 Place in a drying oven overnight at 103-105°C.
  - 11.1.4.1 If solids must be done same day, samples are placed in the oven for four hours. After sample is cooled and weighed, the sample is placed back in oven for an additional 30 minutes, cooled at reweighed for a confirmation weight. Data reported this way must be qualified as estimated.
- 11.1.5 Remove from the oven and cool to room temperature and weigh.
- 11.2 Total Solids -SM 2540G.
  - 11.2.1 Pre-dry the porcelain crucible prior to use by heating at 103-105°C for one hour. Allow to cool. Label the crucibles with corresponding sample I.D.s.
  - 11.2.2 Determine and record the tare (dry crucible) weight.
  - 11.2.3 Measure 25-50 g of homogenized sample into the tared crucible. Record the crucible plus sample weight. If the sample consists of discrete pieces of solid material (dewatered sludge, for example), take cores from each piece with a No. 7 cork borer (or equivalent); as an alternative, pulverize the entire sample coarsely on a clean surface by hand, using rubber gloves.
  - 11.2.4 Place in a drying oven overnight at 103-105°C.
    - 11.2.4.1 If solids must be done same day, samples are placed in the oven for four hours. After sample is cooled and weighed, the sample is placed back in oven for an additional 30 minutes, cooled at reweighed for a confirmation weight. Data reported this way must be qualified as estimated.
  - 11.2.5 Remove from the oven and cool to room temperature and weigh.
- 11.3 Volatile Solids - EPA Method 160.4M and SM 2540G.
  - 11.3.1 Prepare an evaporating dish by igniting a clean evaporating dish at 550°C for 60 minutes in a muffle furnace.
  - 11.3.2 Cool in a desiccator, weigh and store in desiccator until ready for use.
  - 11.3.3 If the sample consists of discrete pieces of solid material (dewatered sludge, for example), take cores from each piece with a No.7 cork borer (or equivalent); as an alternative, pulverize the entire sample coarsely on a clean surface by hand, using rubber gloves.
  - 11.3.4 Measure 25-50 g of homogenized sample into the pre-weighed, evaporating dish/crucible. Record the weight.
  - 11.3.5 Place in a drying oven overnight at 103-105°C.
  - 11.3.6 Remove from the oven and cool to balance temperature in a desiccator and weigh. Place samples back in the 105°C oven for 1 hour to repeat drying,



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cooling, weighing and desiccating steps until weight change is less than 4% or 50 mg, whichever is less.

11.3.7 Weigh samples and record on the bench sheet. Transfer the dried residue to a cool muffle furnace, heat furnace to 550°C and ignite for one hour.

Note: if the residue contains high amounts of organic matter, refer to SM 2540G for procedure to lessen losses due to reducing conditions.

11.4 Remove from the muffle furnace and cool in a desiccator to balance temperature and weigh. Repeat igniting, cooling, weighing and desiccating steps until weight change is less than 4% or 50 mg, whichever is less.

## 12) QA/QC Requirements

- 12.1 This method shall operate under the formal Quality Assurance Program established at ALS and must maintain records that define the quality of data that is generated. Data shall be compared to established criteria in order to determine if the results of the analyses meet the performance characteristics of the method.
- 12.2 Multi-point balance calibration verifications are required for each day the balance is used and must be performed prior to use. The calibration verification weights must bracket the range of use. For additional information, refer to the SOP *Documenting Laboratory Balance and Temperature Checks* (ADM-BAL).
- 12.3 For gravimetric determination, prior to, and after each analytical batch, balance calibration verification (CCV) is performed using weights bracketing the sample weights and must be  $\pm 0.5\%$  of the true value.
- 12.4 A system of documentation (logbook, benchsheet, etc.) must be established for recording the serial number of the Weight Set used for CCV verification.
- 12.5 Prior to, and after each analytical batch, drying oven temperature check(s) and time(s) shall be recorded.
- 12.6 Ongoing QC Samples required are described in the ALS-Kelso Quality Assurance Manual and in the SOP for *Sample Batches* (ADM-BATCH). Additional QC Samples may be required in project specific quality assurance plans (QAPP). For example projects managed under the DOD ELAP must follow requirements defined in the DoD Quality Systems Manual for Environmental Laboratories. General QA requirements for DoD QSM are defined in the SOP *Department of Defense Projects - Laboratory Practices and Project Management*. General QC requirements are:

$$RPD = \frac{|R1 - R2|}{(R1 + R2) / 2} \times 100$$

Where: R1 = Higher Result

R2 = Lower Result

- 12.7 Sample Duplicates (DUP) - Run one duplicate per batch of ten samples. Calculate Relative Percent Difference (RPD) for duplicates as:
- 12.7.1 Duplicate determinations should agree within 5% of their average weight for SM 2540G and 10% for 160.3M, 160.4M, and PSEP..



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NOTE: For samples analyzed under PSEP protocol, samples must be analyzed in triplicate.

12.7.2 Duplicate are required for 10% of all samples (one for every ten samples).

12.8 One method blank (MB) per batch of 20 samples for TVS is required.

### 13) Data Reduction and Reporting

13.1 For soils, sediments, and solids, calculate % solids as follows:

$$(\text{tare} + \text{dry weight}) - \text{tare} = \text{dry weight}$$

$$\text{dry weight} \div \text{wet weight} \times 100 = \% \text{ solids}$$

13.2 For Volatile Solids:

$$\% \text{ Total Solids} = \frac{(A - B) \times 100}{C - B}$$

$$\% \text{ Volatile Solids} = \frac{(A - D) \times 100}{A - B}$$

$$\% \text{ Fixed Solids} = \frac{(D - B) \times 100}{A - B}$$

A = weight of dry residue + dish (mg)

B = weight of dish (mg).

C = weight of wet sample + dish (mg)

D = weight of residue = dish after ignition (mg).

13.3 Reporting

13.3.1 Refer to *Data Reporting and Report Generation* (ADM-RG) for reporting guidelines.

13.3.2 Reports are generated in the ALS LIMS by compiling the SMO login, sample prep database, instrument date, and client-specified report requirements (when specified). The forms generated may be ALS standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.

13.4 Data review and Assessment

13.4.1 Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the SOP for *Laboratory Data Review Process* (ADM-DREV) for details. The person responsible for final review of the data report and/or data package should assess the overall validity and quality of the results and provide any appropriate comments and information to the Project Manager to inclusion in the report narrative).

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#### 14) Method Performance

14.1 Refer to the reference method for additional method performance data available.

#### 15) Pollution Prevention and Waste Management

15.1 The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Lab Waste Management Plan.

#### 16) Contingencies for Handling Our-of-Control or Unacceptable Data

16.1 Refer to the SOP for *Non Conformance and Corrective Action Procedure* (ADM-NCAR) for procedures for corrective action.

16.2 Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

#### 17) Training

17.1 All analysts performing this analysis are required to read and understand this SOP.

17.2 Training is documented following the *Employee Training and New Employee Orientation* (ADM-TRAIN).

#### 18) Method Modifications

18.1 The EPA 160.3 procedure is modified to determine percent dry solids in soil, sediment, and solids (160.3M). 10 g of samples used instead of 25-50 g for total solids only analysis.

18.2 The EPA 160.4 procedure is modified to determine percent dry solids in soil, sediment, and solids (160.4M). 25-50 g of samples is used for Total Volatile Solids.

18.3 PSEP procedure is modified to determine percent dry solids in soil, sediment, and solids using 10 g of samples used instead of 25 g for total solids only analysis. Pre-dry the aluminum pans are used in place of porcelain crucible.

#### 19) References

19.1 *Total solids dried at 103-105°C*, SM 2540B-2011.

19.2 *Residue, Total*, Method 160.3 EPA 600/4-79-020.

19.3 *Total, Fixed and Volatile Solids in Solids and Semisolid Samples*, SM 2540G-2011.

19.4 *Residue, Volatile*, Method 160.4 EPA 600/4-79-020, Revised March, 1983.

19.5 TNI Standard, Volume 1, 2009 and 2016.

19.6 DoD Quality Systems Manual for Environmental Laboratories. Current version.

19.7 ISO/IEC 17025:2017 American National Standard, General requirements for the competence of testing and calibration laboratories.

19.8 Conventional Sediment Variables – Particle Size, March 1986, Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound, January, 1996.

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## 20) Changes Since Last Revision

Revision Number	Effective Date	SOP Review Date	Document Editor	Description of Changes
2.0	1/17/2020		T. Caron	ADMIN changes only not affecting technical content: Updated SOP signatories standard paragraph edits, and references.
		1/22/2021		Scott Chappelle.

## 21) Attachments, Tables, and Appendices

21.1 TS Bench sheet: <R:\Soil Prep\Templates\TS Fixed SOIL Rev5.xltx>.

21.2 TVS Bench Sheet: <R:\Soil Prep\Templates\TVS SOIL Rev4.xltx>.

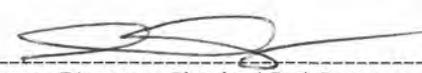


## Semi-Volatile Organic Compounds by GC/MS Low Level Procedure

DOCUMENT ID: SVM-8270L, REV. 11.0

Approved By:  Date: 12/2/2020  
Inorganics Manager, Jonathon Walter

Approved By:  Date: 12/2/2020  
Quality Assurance Manager, Kurt Clarkson

Approved By:  Date: 12/2/20  
Laboratory Director, Charles (Pat) Byrne



## 1) Scope & Applicability

- 1.1. This procedure is used to determine low level concentrations of Semi-Volatile Organic Compounds in water and soil using EPA Method 8270D. This procedure may also be applicable to various miscellaneous waste samples. Table 1 indicates compounds that may be determined by this method and lists their method reporting limits (MRLs) in water and soil. Equivalent nomenclature for MRL includes Estimated Quantitation Limit (EQL) or Low Level of Quantitation (LLOQ). The reported MRL may be adjusted if required for specific project requirements; however, the capability of achieving other reported MRLs must be demonstrated. The laboratory DQO Table lists Method Detection Limits (MDLs) that have been achieved. MDLs may change as studies are updated or new studies performed, and will vary depending on the preparation method.
- 1.2. This procedure can be used to quantitate most neutral, acidic, and basic organic compounds that are soluble in methylene chloride and capable of being eluted without derivatization as sharp peaks from a gas chromatographic fused-silica capillary column coated with a slightly polar silicone phase. Such compounds include polynuclear aromatic hydrocarbons, chlorinated hydrocarbons and pesticides, phthalate esters, organophosphate esters, nitrosamines, haloethers, aldehydes, ethers, ketones, anilines, pyridines, quinolines, aromatic nitro compounds, and phenols, including nitrophenols. Other compounds than those listed in Tables 4 and 6 may be analyzed. Refer to Section 1 of method 8270D.
- 1.3. In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPP's supersede method specified requirements. An example of this are projects falling under DoD ELAP. QC requirements defined in the *SOP Department of Defense Projects – Laboratory Practices and Project Management – QSM 5.X (ADM-DOD5)* may supersede the requirements defined in this SOP.

## 2) Summary of Procedure

- 2.1 This method provides Gas Chromatography/Mass Spectrometry (GC/MS) conditions for the detection of Semi-volatile Organic Compounds. Prior to the use of this method, an appropriate sample preparation method must be used to recover the analytes of interest. A 1  $\mu$ L aliquot of the extract is injected into the gas chromatograph (GC) using a Agilent Multi-Mode Injector (MMI). The compounds are separated on a fused silica capillary column. Compounds of interest are detected by a mass selective detector. Identification of the analytes of interest is performed by comparing the retention times of the analytes with the respective retention times of an authentic standard, and by comparing mass spectra of analytes with mass spectra of reference materials. Quantitative analysis is performed by using the authentic standard to produce a response factor and calibration curve, and using the calibration data to determine the concentration of an analyte in the extract. The concentration in the sample is calculated using the sample weight or volume and the extract volume.
- 2.2 The following compounds may require special treatment when being determined by this method. Hexachlorocyclopentadiene is subject to decomposition in the injection port of the gas chromatograph, to a chemical reaction in acetone, and can undergo photochemical decomposition. N-Nitroso-dimethylamine is difficult to separate from the solvent under the chromatographic conditions described. N-Nitroso-diphenylamine decomposes in the gas chromatographic inlet and cannot be separated from diphenylamine. Benzoic acid, pentachlorophenol, 2,4-dinitrophenol, 2-nitroaniline, 3-



nitroaniline, 4-chloroaniline, and benzyl alcohol are subject to erratic chromatographic behavior, especially if the GC system is contaminated with high boiling material.

### 3) Definitions

- 3.1 For laboratory definitions applicable to most analyses, refer to the SOP for *Sample Batches*.

### 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.
- 4.2 It is the responsibility of the department supervisor/manager to document analyst training and method proficiency, as described in: *Employee Training and Orientation* (ADM-TRAIN).

### 5) Interferences

- 5.1 Raw GC/MS data from all blanks, samples, and spikes must be evaluated for interferences. Determine if the source of interference is in the preparation of the samples. Corrective action should be taken to eliminate the interferences.
- 5.2 Accurate determination of phthalate esters can pose difficulties when using this methodology. Common flexible plastics contain varying amounts of phthalates. These phthalates are easily extracted or leached from such materials during laboratory operations. Cross contamination of clean glassware may occur when plastics are handled during extraction steps, especially when solvent-wetted surfaces are handled. Interferences from phthalates can best be minimized by avoiding contact with any plastic materials. Exhaustive cleanup of reagents and glassware may be required to eliminate background phthalate contamination.
- 5.3 Contamination by carryover can occur whenever high-concentration and low-concentration samples are sequentially analyzed. To reduce carryover, the sample syringe must be rinsed out between samples with solvent. Whenever an unusually concentrated sample is encountered, it should be followed by the analysis of a solvent blank to check for cross contamination.

### 6) Safety

- 6.1 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Environmental, Health and Safety Manual and the appropriate SDS prior to beginning this method.
- 6.2 This method uses Dichloromethane, a known human carcinogen. Refer to the methylene chloride policy document, ENV-HSE-NA-EX-006-EN for proper handling.

<G:\SAFETY\TRAINING\Methylene Chloride\Methylene Chloride - NA 031419.pdf>



## 7) Sample Collection, Containers, Preservation, and Storage

- 7.1 Certified clean containers should be purchased for sample collection. The sample containers should be of glass or Teflon and have screw-top covers with Teflon liners. Plastic containers or lids may not be used for the storage of samples due to the possibility of sample contamination from the phthalate esters and other hydrocarbons within the plastic.
- 7.2 Water and soil samples should be iced or refrigerated at  $<6^{\circ}\text{C}$  from time of collection until extraction.
- 7.3 Water samples must be extracted within 7 days and the extracts analyzed within 40 days following extraction. Soil samples must be extracted within 14 days and the extract analyzed within 40 days following extraction. Extracts are stored at  $\leq 10^{\circ}\text{C}$ .

## 8) Standards, Reagents, and Consumable Materials

- 8.1 Solvents: Acetone, methylene chloride, methanol, and other appropriate solvents.
- 8.2 Stock Standard Solutions (See Table 2)
  - 8.2.1 Commercially prepared stock standards are typically used when available at a concentration of  $1000\ \mu\text{g}/\text{mL}$  or more. They must be obtained from an A2LA or ISO9000 certified vendor. Standard concentrations can be verified by comparison versus an independently prepared standard. Alternatively, prepare stock standard solutions at a concentration of  $1000\ \mu\text{g}/\text{mL}$  by dissolving  $0.0100\ \text{g}$  of reference material in methylene chloride or other suitable solvent and diluting to volume in a  $10\ \text{mL}$  volumetric flask. Larger volumes can be used at the convenience of the analyst. When compound purity is assayed to be 96% or greater, the weight can be used without correction to calculate the concentration of the stock standard. Store according to vendors recommendations.
  - 8.2.2 Transfer the stock standard solutions into Teflon-sealed screw-cap bottles. Store at  $\leq 10^{\circ}\text{C}$  and protect from light. Stock standards should be checked frequently for signs of degradation or evaporation, especially just prior to preparing calibration standards from them.
  - 8.2.3 Stock standard solutions must be replaced after one year, or sooner, if comparison with check standards or samples indicates a problem.
- 8.3 Internal Standard Solutions (See Table 4) - The internal standards are 1,4-dichlorobenzene- $\text{d}_4$ , naphthalene- $\text{d}_8$ , acenaphthene- $\text{d}_{10}$ , phenanthrene- $\text{d}_{10}$ , chrysene- $\text{d}_{12}$ , and perylene- $\text{d}_{12}$  (See Table 4 for corresponding compounds). The nominal concentration of the standard is  $100\ \text{ng}/\mu\text{L}$ . Each  $1\ \text{mL}$  of sample extract undergoing analysis should be spiked with  $10\ \mu\text{L}$  of the internal standard solution, resulting in a concentration of  $1.0\ \text{ng}/\mu\text{L}$  of each internal standard. Store at  $-10^{\circ}\text{C}$  or less when not being used. When using premixed certified solutions, store according to the vendors recommendations.
- 8.4 GC/MS Tuning Standard - For a  $20\ \mu\text{L}$  injection, use a methylene chloride solution containing  $2.5\ \text{ng}/\mu\text{L}$  of decafluorotriphenylphosphine (DFTPP). This will result in  $50\ \text{ng}$  on column injection of DFTPP. The standard should also contain  $2.5\ \text{ng}/\mu\text{L}$  of benzidine, DDT, and pentachlorophenol, to verify injection port inertness and GC column performance. Store at  $-10^{\circ}\text{C}$  or less when not being used, or store according to the manufacturer's recommendations. For smaller injection volumes, use a DFTPP standard with a concentration that will result in a  $10\text{-}50\ \text{ng}$  on column injection.



## 8.5 Calibration Standards (See Table 2)

- 8.5.1 A minimum of five initial calibration standards should be prepared from stock solutions. One of the calibration standards should be at a concentration at or below the method reporting limit; the others should correspond to the range of concentrations found in real samples, but should not exceed the working range of the GC/MS system. At least one calibration standard must be at a concentration corresponding to a sample concentration meeting project-specific data quality objectives. Each standard should contain each analyte for detection by this method. Each 1 ml aliquot of calibration standards should be spiked with 10  $\mu\text{L}$  of the internal standard solution prior to analysis. All calibration standards should be stored at  $-10^{\circ}\text{C}$  or less and should be freshly prepared once a year, or sooner if check standards indicate a problem.
- 8.5.2 The daily calibration standard (CCV) is prepared from stock solutions at a concentration at the midpoint of the calibration curve (typically 2-4  $\text{ng}/\mu\text{L}$ ). The CCV is prepared weekly and can be stored at  $4 \pm 2^{\circ}\text{C}$ , or as recommended by the manufacturer. The DFTPP standard may be combined with this standard (maintaining a 1-50 ng on column injection) providing tuning verification and calibration verification can be done without interferences.

## 8.6 QC Standards (See Table 3)

- 8.6.1 Surrogates: Prepare a working solution in methanol containing 2-fluorophenol, phenol- $\text{d}_6$ , and 2,4,6-tribromophenol at 150  $\text{ng}/\mu\text{L}$  and nitrobenzene- $\text{d}_5$ , 2-fluorobiphenyl, and terphenyl- $\text{d}_{14}$  at 100  $\text{ng}/\mu\text{L}$ . Aliquots of the solution are spiked into all extracted samples, blanks, and QC samples according to the extraction SOP used.
- 8.6.2 Matrix Spike Standards: Prepare a working solution in methanol containing all analytes of interest (full list spike) at 100  $\text{ng}/\mu\text{L}$  (Pyridine is at 200  $\text{ng}/\mu\text{L}$ ). Aliquots of the solution are spiked into the selected QC aliquots according to the extraction SOP used.

**Note:** The spiking level of surrogate and spike may need to be adjusted according to project requirements, if dilutions are expected due to high levels of extracted components, or if a lower calibration range is used

## 9) Apparatus and Equipment

### 9.1 Gas Chromatograph/Mass Spectrometer System

- 9.1.1 Gas Chromatograph – HP 5890, Agilent 6890, or Agilent 7890 -An analytical system complete with a temperature-programmable gas chromatograph suitable for large volume injection with cryogenic cooling, or for small volume injection without cryogenic cooling.
- 9.1.1.1 Atas Optic 2 or 3 large volume injector units – This allows for injection of up to 100  $\mu\text{L}$  of solvent for each analysis. After injection into the cold injector, the solvent is vented while the analytes are retained within a specially packed liner. The injector is then flash heated and the analytes are transferred into the GC. The unit also controls gas flow rates.
- 9.1.1.2 Agilent Split/Splitless Injector – The injector is held at a constant temperature allowing for the direct transfer of analytes onto the analytical column. The unit also controls the gas flow rates.



- 9.1.1.3 Agilent MMI injector - This allows for injection of up to 1000  $\mu\text{L}$  of extract. The injector can be temperature programmed and is equipped with cryogenic cooling. The unit also controls gas flow rates.
- 9.1.1.4 Autosampler - HP 7673, Agilent 7683, Agilent 7693, or equivalent with programmable operation.
- 9.1.1.5 All other required accessories, syringes, analytical columns, and gases. The capillary column should be directly coupled to the source.
- 9.1.2 Column: ZB-5MS, 30 m x 0.25 mm ID x 0.25  $\mu\text{m}$  film thickness silicone-coated fused-silica capillary column with 5 m guard column (or equivalent). Recommended part number 7HG-6010-11-GGA.
- 9.1.3 Mass Spectrometer - HP 5972, Agilent 5973, or Agilent 5975 - Capable of scanning from 35 to 500 amu every 1 second or less, using 70 volts (nominal) electron energy in the electron impact ionization mode. The mass spectrometer must be capable of producing a mass spectrum for decafluorotriphenylphosphine (DFTPP) which meets all of the criteria in Table 1A or 1B when a 10-50 ng tune standard is injected onto the GC
- 9.1.4 GC/MS Interface - Any GC-to-MS interface that gives acceptable calibration points for each compound of interest and achieves acceptable tuning performance criteria may be used.
- 9.1.5 Data System - A computer system must be interfaced to the mass spectrometer. The system must allow the continuous acquisition and storage on machine-readable media of all mass spectra obtained throughout the duration of the chromatographic program. The computer must have software that can search any GC/MS data file for ions of a specific mass and that can plot such ion abundances versus time or scan number. This type of plot is defined as an Extracted Ion Current Profile (EICP). Software must also be available that allows integrating the abundances in any EICP between specified time or scan-number limits. NIST98 Mass Spectral Library is used for spectral comparisons.
- 9.2 Appropriate analytical balance (0.0001 g), volumetric flasks, syringes, vials, and bottles for standards preparation.

## 10) Preventative Maintenance

- 10.1 All maintenance activities are recorded in a maintenance logbook kept for each instrument. Pertinent information (serial numbers, instrument I.D., etc.) must be in the logbook. Maintenance entries should include date, symptom of problem, corrective actions, and description of maintenance, date, and name. The log should contain a reference to return to analytical control.
- 10.2 Carrier gas - Inline purifiers or scrubbers should be in place for all sources of carrier gas. These are selected to remove water, oxygen, and hydrocarbons. Purifiers should be changed as recommended by the supplier.
- 10.3 Gas Chromatograph
  - 10.3.1 Whenever GC maintenance is performed, care should be taken to minimize the introduction of air or oxygen into the column. Injection port maintenance includes changing the injection port liner, seal, washer, O-ring, septum, column ferrule, and autosampler syringe as needed. Liners and seals should be changed when recent sample analyses predict a problem with chromatographic performance. In some cases liners and seals may be cleaned and re-used.



10.3.2 Clipping off a small portion of the head of the column often improves chromatographic performance. When cutting off any portion of the column, make sure the cut is straight and "clean" (uniform, without fragmentation) by using the proper column cutting tool. The column head pressure must be adjusted to maintain proper flow rates.

10.3.3 Over time, the column will exhibit poorer overall performance, as indicated by poor peak shape and reduced responses. The length of time for this to occur will depend on the samples analyzed. When a noticeable decrease in performance is evident, more thorough maintenance is necessary. Some steps are to solvent rinse the split vent and septum lines with a mix of 20% methanol in DCM. When these and other maintenance options do not result in improvement, the column should be replaced. This is especially true when evident in conjunction with calibration difficulties.

#### 10.4 Mass Spectrometer

10.4.1 For units under service contract, certain maintenance is performed by instrument service staff, including pump oil changed, vacuuming boards, etc., as recommended by the manufacturer.

10.4.2 MS source cleaning should be performed as needed, depending on the performance of the unit. This may be done by the analyst or by instrument service staff.

10.4.3 Tune the MS as needed to result in consistent and acceptable performance while meeting the required ion abundance criteria.

### 11) Procedure

#### 11.1 Sample Preparation

##### 11.1.1 Water samples

11.1.1.1 Water samples are prepared using continuous liquid-liquid extraction and EPA method 3520C. Refer to EXT-3520 or samples may be prepared using separatory funnel procedures (EPA 3510C). Refer to EXT-3510.

11.1.1.2 Perform the extraction on a 1000mL or less aliquot of sample.

11.1.2 Soil, sediment, and solid samples are prepared using automated soxhlet extraction EXT-3541. The nominal sample size is 20g. Sample amounts may be decreased in the case of high-concentration waste samples. GPC cleanup may be used (SOP SOC-3640A).

11.1.3 Extracts should be screened by GC/FID (SOC-SCR).

11.1.4 Following sample preparation, sample extracts are then transferred to the extract cold storage unit. Extracts must be analyzed within 40 days of extraction.

11.2 The recommended GC/MS operating conditions are listed below. The GC conditions may be modified to accommodate specific instrument models and configurations.

Mass range:	35-500 amu
Scan Time:	1 sec/scan
Initial temperature:	45°C, hold for 3.5 minutes
Temperature program:	45-100°C at 15°C/min, 100-270°C at 10°C/min, 270-320°C at 6°C/min, hold until 3 minutes after benzo[g,h,i]perylene has eluted.
Detector interface temp:	300°C



Injector: Atas Optic 2, or Optic 3 or equivalent  
Final time: 32.7 min.  
Initialization time: 0.00 min.

Temperature profile: Initial temperature - 5°C

RAMP	RATE	FINAL TEMP	ISOTHERMAL TEMP
1		5°C	2.20 MIN
2	6°C/sec	305°C	30.5 min

Pressure ramps:

RAMP	START PRESS	FINAL TEMP	TARGET PRESS
1	5.00 PSI	0.7 min	5.00 psi
2	10.00 PSI	3.30 min	10.00 psi
3*	*psi	19 min	*psi
4*	*psi	8.0 min	*psi

\* Will vary to give 1.0 ml/min. @ 45°C and the target pressure is set to give 1.5 ml/min @ 320°C.

Split state:

Time	Split State
Initial	Vent
0.75 min	Closed/splitless*
1.90 min	Open/split

\* Splitless time may be adjusted to optimize GC performance.

Vent Flow	85 ml/min. @ 5 psi, 50°C
Split Flow	2-5 ml/min. @ 10 psi, 45°C
Sample Volume	20 µL (5972/5973)
	µL (5975)
Carrier Gas	Helium as 30-45 cm/sec

### 11.3 Initial Calibration

**NOTE** The calibration procedure(s) and options chosen must follow the ALS protocols. Any exceptions to the calibration procedures detailed in SOC-CAL, *Calibration of Instruments for Organics Chromatographic Analyses* are described as follows:



- 11.3.1 Prior to calibration, analyze the GC/MS tuning standard using instrument conditions used for calibration. Obtain the spectrum for evaluation using one of the following options:
- Three scans (the peak apex scan and the scans immediately preceding and following the apex) are acquired and averaged. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of DFTPP. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the DFTPP peak or part of any other closely eluting peak.
  - Use one scan at the apex of the peak. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of DFTPP. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the DFTPP peak or part of any other closely eluting peak.
  - Use one scan either directly preceding or following the apex of the peak. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of DFTPP. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the DFTPP peak or part of any other closely eluting peak.
  - Use the average across the entire peak up to a total of 5 scans. If the peak is wider than 5 scans, the tune will consist of the peak apex scan and the two scans immediately preceding and following the apex. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of DFTPP. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the DFTPP peak or part of any other closely eluting peak.
- 11.3.2 Evaluate the spectrum obtained for DFTPP against the tuning criteria. Criteria are given in Tables 1 and 1A. The GC/MS must meet the DFTPP ion abundance criteria prior to further analyses. To assess column performance and injection port inertness, pentachlorophenol and benzidine should be present at an acceptable level and peak tailing should not exceed a tailing factor of 2. DDT degradation should not exceed 20%. If excessive tailing, poor chromatography, or degradation of >20% is noted, the injection port may require cleaning. It may also be necessary to remove the first 15-30 cm of the GC column. If hardware tuning criteria cannot be met, the source may need cleaning, filaments replaced or other maintenance.
- 11.3.3 The internal standards should permit most of the components of interest in the chromatogram to have retention times of 0.80-1.20 relative to one of the internal standards. Refer to Table 4 for internal standards and corresponding analytes assigned for quantitation. Use the base peak ion from the specific internal standard as the primary ion for quantitation (see Table 1 in EPA method 8270D). If interferences are noted, use the next most intense ion as the quantitation ion (i.e. for 1,4-dichlorobenzene- $d_4$ , use 152 m/z for quantitation).
- 11.3.4 Analyze 20  $\mu$ L of each calibration standard (containing internal standards) and tabulate the area of the primary characteristic ion against concentration for each compound (see Table 1 in EPA method 8270D). Calculate response factors (RFs) for each compound relative to one of the internal standards as follows:



$$RF = (A_x C_{is}) / (A_{is} C_x)$$

Where:

- A<sub>x</sub> = Area of the characteristic ion for compound being measured.
- A<sub>is</sub> = Area of the characteristic ion for specific internal standard.
- C<sub>is</sub> = Concentration of the specific internal standard (ng/μL).
- C<sub>x</sub> = Concentration of the compound being measured (ng/μL).

11.3.5 The percent relative standard deviation (%RSD) should be less than or equal to 20% for each compound. It is also recommended that a minimum response factor for the most common target analytes, as noted in Table 5, be demonstrated as a means to ensure that these compounds are performing as expected.

$$\%RSD = \frac{SD}{\overline{RF}} \times 100$$

where:

- RSD = relative standard deviation.
- $\overline{RF}$  = mean of initial RFs for a compound.
- SD = standard deviation of average RFs for a compound.

$$SD = \sqrt{\frac{\sum_{i=1}^N (RF_i - \overline{RF})^2}{N - 1}}$$

where:

- RF<sub>i</sub> = RF for each of the calibration levels
- N = Number of RF values (e.g., 6)

11.3.6 The relative retention times (RRT) of each compound in each calibration run should agree within 0.06 relative retention time units.

$$RRT = \frac{\text{Retention time of the analyte}}{\text{Retention time of the internal standard}}$$

11.3.7 Linearity - If the % RSD of any compound is 20% or less, then the relative response factor is assumed to be constant over the calibration range, and the average relative response factor may be used for quantitation.

11.3.8 If the %RSD for a compound is >20%, then alternative calibration models should be used. Refer to SOC-CAL, Calibration of Instruments for Organics Chromatographic Analysis for alternative fit guidance.

11.3.9 If more than 10% of the compounds included with the initial calibration exceed the 20% RSD limit and do not meet the minimum correlation coefficient (0.99) for alternate curve fits, then the chromatographic system is considered too reactive



for analysis to begin. Clean or replace the injector liner and/or capillary column, then repeat the calibration procedure.

11.3.10 When calculating the calibration curves using the alternative curve fits, a minimum quantitation check on the viability of the lowest calibration point should be performed by re-fitting the response from the low concentration calibration standard back into the curve (see Method 8000C for additional details). It is not necessary to re-analyze a low concentration standard; rather the data system can recalculate the concentrations as if it were an unknown sample. The recalculated concentration of the low calibration point should be within  $\pm 30\%$  of the standard's true concentration.

11.3.11 Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is less than 50% of the average of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs. The resolution should be verified on the mid-point concentration of the initial calibration as well as the laboratory designated continuing calibration verification level if closely eluting isomers are to be reported

#### 11.4 Independent Calibration Verification

11.4.1 Following initial calibration, analyze an ICV standard. The ICV solution must contain all analytes in the calibration standards at a concentration in the middle of the range of the initial calibration. Calculate the concentration using the typical procedure used for quantitation. Calculate the percent difference (%D) from the ICV true value. The maximum allowed % Difference or % Drift is  $\pm 30\%$ .

11.4.2 If a second source standard is not available or is cost prohibitive (such as certain non-routine analytes), then a second lot number may be used as the ICV and must meet the criteria above.

11.4.3 After the multi-point calibration has passed all of the above criteria, and the Independent Calibration Verification has been performed, samples can be analyzed. The calibration curve mid-point standard may serve as the CCV for the opening set of samples within the same 12-hour window as the initial calibration.

#### 11.5 Continuing Calibration

11.5.1 A calibration standard, or standards, at mid-concentration (See Table 2) containing all semivolatiles, DFTPP, and all required surrogates, must be analyzed every 12 hours during analysis. The DFTPP must result in a mass spectrum which meets the criteria given in Tables 1A or 1B. These criteria must be demonstrated during each 12 hour shift. Obtain the DFTPP spectrum as described.

11.5.2 The internal standard responses and retention times in the calibration check standard must be evaluated immediately after or during data acquisition. If the retention time for any internal standard changes by more than 30 seconds from that in the midpoint standard of the most recent initial calibration sequence, the chromatographic system must be inspected for malfunctions and corrective action identified, as required. If the EICP area for any of the internal standards changes by a factor of two (50% to 200%) from that in the midpoint standard of the most recent initial calibration sequence, the chromatographic system must be inspected for malfunctions and corrective action identified, as appropriate. When corrective action is taken, reanalysis of samples analyzed while the system



was malfunctioning is required. Update the reference spectra and retention times in the quantitation database for the instrument method or ID file. The initial calibration average RF or calibration curve is then used in the quantitation of subsequent analyses.

- 11.5.3 If the percent difference or percent drift for each compound is less than or equal to 20%, the initial calibration is assumed to be valid and the analysis of samples may begin. Calculate the percent drift using:

$$\% \text{ Drift} = \frac{C_i - C_c}{C_i} \times 100$$

where:  $C_i$  = Compound standard concentration.

$C_c$  = Measured concentration using selected quantitation method.

- 11.5.4 Due to the large number of compounds that may be analyzed by this method, some compounds may fail to meet the  $\leq 20\%$  criteria. If no more than 20% of the compounds, included in the initial calibration, differ from their true concentration by 40%, the initial calibration is valid and no corrective action is necessary.
- 11.5.5 In cases where compounds fail, they may still be reported as non-detects if it can be demonstrated that there was adequate sensitivity to detect the compound at the applicable quantitation limit. This is done by analyzing a MRL check standard for the failing compounds, where the resulting peaks for the failing compounds must pass 3:1 signal to noise.
- 11.5.6 Non-detected analytes can be reported from analyses when a CCV exhibit a positive bias (i.e., outside the upper control limit), no further documentation is required.
- 11.5.7 For situations when the CCV fails to meet the criterion in section 11.5.4, and a confirmed detection exceeds the MRL, the sample must be reanalyzed to ensure accurate quantification. If it is not possible to reanalyze the sample, the result must be reported as an estimated value.
- 11.5.8 A blank (method blank, GPC blank, or solvent blank) should be analyzed after the CCV, or at any other time during the analytical shift, to prove the system is free of contaminants. If contaminants are found in a method blank or GPC blank, then a solvent blank should be analyzed to help isolate the source of contamination.
- 11.5.9 Each of the most common target analytes in the calibration verification standard should meet the minimum response factors noted in Table 5.
- 11.5.10 If the minimum response factors are not met, the system should be evaluated, and corrective action should be taken before sample analysis begins. Possible problems include standard mixture degradation, injection port inlet contamination, contamination of the front end of the analytical column, and active sites in the column or chromatographic system.
- 11.6 GCMS Analysis
- 11.6.1 Evaluate FID screen and make proper dilution (See FID screening SOP).



- 11.6.2 Spike the 1 mL extract obtained from sample preparation with 10  $\mu\text{L}$  of the internal standard solution just prior to analysis. Use the same operating conditions as were used for initial calibration.
- 11.6.3 If the response for any quantitation ion exceeds the initial calibration curve range of the GC/MS system, extract dilution must take place. Additional internal standard must be added to the diluted extract to maintain the required 1.0 ng/ $\mu\text{L}$  of each internal standard in the extracted volume. The diluted extract must be reanalyzed.
- 11.6.4 Store the extracts at  $-10^{\circ}\text{C}$  or less, protected from light in vials equipped with unpierced Teflon lined septa. Archive the extract in freezer for 3 months after analysis in the instrument/date specific storage boxes.

## 12) QA/QC Requirements

- 12.1 In addition to instrument criteria for calibration, the ability of each analyst/instrument to generate acceptable accuracy and precision must be documented prior to sample analysis (IPR study). This must be validated before analysis of samples begins, or whenever significant changes to the procedures have been made. To do this, four tap water samples are spiked with each target analyte, extracted, and analyzed.
- 12.2 Method Detection Limits
  - 12.2.1 A method detection limit (MDL) study, or verification of an existing LOD from an equivalent instrument must be completed prior to analysis of samples. To establish detection limits that are precise and accurate, the analyst must perform the following procedure. Spike a minimum of seven blank replicates with a MDL spiking solution (at a level below the MRL) for each target analyte, extract, and analyze. The MDL studies should be done for each matrix, prep method, and instrument. Refer to the SOP Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification..
  - 12.2.2 Calculate the average concentration found (x) in the sample concentration, and the standard deviation of the concentrations for each analyte. Calculate the MDL for each analyte using the correct T value for the number of replicates. The MDL study must be verified annually.
- 12.3 Limits of Quantification (LOQ)
  - 12.3.1 The laboratory establishes a LOQ for each analyte as the lowest reliable laboratory reporting concentration or in most cases the lowest point in the calibration curve which is less than or equal to the desired regulatory action levels, based on the stated project requirements. Analysis of a standard or extract prepared at the lowest point calibration standard provides confirmation of the established sensitivity of the method. The LOQ recoveries should be within the laboratories LCS acceptance limits to verify the data reporting limit. Refer to the SOP Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Quantification (CE-QA011/ADM-MDL).
- 12.4 The Method Reporting Limits (MRLs) used at ALS are the routinely reported lower limits of quantitation which take into account day-to-day fluctuations in instrument sensitivity as well as other factors. These MRLs are the levels to which ALS routinely reports results in order to minimize false positive or false negative results. The MRL is normally two to ten times the method detection limit.



- 12.5 Ongoing QC Samples required are described in the ALS-Kelso Quality Assurance Manual and in the SOP for Sample Batches. Additional QC Samples may be required in project specific quality assurance plans (QAPP). General QA requirements for DoD QSM are defined in the laboratory SOP, *Department of Defense Projects – Laboratory Practices and Project Management (ADM-DOD5)*. General QC Samples are:

12.5.1 Method blank - A method blank is extracted and analyzed with every batch of 20 or fewer samples to demonstrate that there are no method interferences. The method blank must demonstrate that interferences from the analytical and preparation steps are minimized. No target analytes should be detected above the MRL in the method blank. For some project specific needs, exceptions may be noted and method blank results above the MRL may be reported for common lab contaminants (phthalate esters, etc.).

12.5.2 A lab control sample (LCS) must be extracted and analyzed with every batch of 20 or fewer samples. The LCS is prepared by spiking a blank with the matrix spike solution, and going through the entire extraction and analysis. Calculate percent recovery (%R) as follows:

$$\%R = X/TV \times 100$$

Where X = Concentration of the analyte recovered  
TV = True value of amount spiked

12.5.2.1 Acceptance criteria for lab control samples can be found in the laboratory Data Quality Objectives (DQO) tables. The accuracy of the analysis is controlled on a subset of target analytes. If the project analyte list is fewer than 20 analytes, all are considered control analytes. Analytes which are used for control analytes are listed in Table 6. For DoD projects all project target analytes are considered control analytes. If the LCS recovery for any control analyte fails acceptance limits, the cause is evaluated and corrective action taken as necessary. If instrument corrective action is not applicable or ineffective, re-extraction of the associated samples may be required. If any other analyte fails the advisory acceptance limits, the analyst must evaluate the impact on data quality and take any necessary corrective action, which may include re-extraction of the associated samples. Project-specific requirements may require all compounds to be treated as control analytes, or dictate use of project acceptance criteria.

12.5.3 A matrix spike/duplicate matrix spike (MS/DMS) must be extracted and analyzed with every batch of 20 or fewer samples. The MS is prepared by spiking a sample aliquot with the matrix spike solution, and going through the entire extraction and analysis. Calculate percent recovery (%R) as follows:

$$\%R = \frac{X - X1}{TV} \times 100$$

Where X = Concentration of the analyte recovered  
X1 = Concentration of unspiked analyte  
TV = True value of amount spiked

Calculate Relative Percent Difference (RPD) as:



$$\%RPD = \frac{R1 - R2}{(R1 + R2)/2} \times 100$$

Where R1 = %recovery of the MS  
R2 = %recovery of the DMS

12.5.3.1 The acceptance limits for the MS/DMS recovery can be found in the laboratory Data Quality Objectives (DQO) tables. If the MS/DMS recovery is out of acceptance limits for reasons other than matrix effects, corrective action must be taken. (See Quality Assurance Manual section 11) The RPD acceptance limits are 30% for water and 40% for soils, sediments, and solids. Project-specific requirements may dictate the use of project acceptance criteria.

12.5.4 The acceptance limits for the surrogates can be found in the laboratory Data Quality Objectives (DQO) tables. If any surrogate recovery is outside acceptance criteria, the sample data must be closely evaluated for possible matrix interferences. If none are present, then corrective action must be taken. The sample should be re-analyzed if instrument factors (calibration, injection port) are suspected. If not, re-extraction and re-analysis is required, except in cases of high recovery and no positive hits in the sample for the analyte class represented by the particular surrogate.

12.5.5 The acceptance criteria listed in the laboratory Data Quality Objective (DQO) Tables are current criteria, but are subject to change as control limits are updated.

12.6 Additional QA/QC measures include control charting of QC sample results

### 13) Data Reduction and Reporting

13.1 Qualitative Analysis - The qualitative identification of compounds determined by this procedure is based on retention time, and comparison of the sample mass spectrum, after background correction, with characteristic ions in a reference mass spectrum. The reference mass spectrum must be generated by the laboratory using the instrument and conditions used for the sample analysis. The characteristic ions from the reference mass spectrum are defined to be the three ions of greatest relative intensity, or any ions over 30% relative intensity, if less than three such ions occur in the reference spectrum. Compounds should be identified as present when the criteria below are met.

13.1.1 The intensities of the characteristic ions of a compound maximize in the same scan or within one scan of each other. Selection of a peak by a data system target compound search routine where the search is based on the presence of a target chromatographic peak containing ions specific for the target compound at a compound-specific retention time will be accepted as meeting this criterion.

13.1.2 The RRT of the sample component is within  $\pm 0.06$  RRT units of the RRT of the standard component.

13.1.3 The relative intensities of the characteristic ions agree within 30% of the relative intensities of these ions in the reference spectrum.

13.1.4 Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two



isomer peaks is <25% of the sum of the 2 peak heights. Otherwise, structural isomers are identified as isomeric pairs.

13.1.5 Identification is hampered when sample components are not resolved chromatographically and produce mass spectra containing ions contributed by more than one analyte. When gas chromatographic peaks appear to represent more than one sample component (i.e., a broadened peak with shoulder(s) or a valley between two or more maxima), appropriate selection of analyte spectra and background spectra is important. Examination of extracted ion current profiles of appropriate ions can aid in the selection of spectra, and in qualitative identification. When analytes coelute, the identification criteria can be met, but each analyte spectrum will contain extraneous ions contributed by the coeluting compound.

13.2 For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. Refer to method 8270D for guidance on tentatively identified compound (TIC) identification and quantification.

13.3 Quantitation and Calculations

13.3.1 The GC/MS data stations, in current use, all use the H-P RTE Integrator to generate the raw data used to calculate the standards  $\overline{RF}_x$  values, the sample amounts, and the spike values. The software does three passes through each data file. The first two identify and integrate each internal standard and surrogate. The third pass uses the time-drift information from the first two passes to search for all method analytes in the proper retention times and with the proper characteristic quantitation ions

When  $\overline{RF}_x$  is used, calculate the extract concentration as follows:

$$C_{ex} = \frac{(Resp_x)(Amt_{ISTD})}{(Resp_{ISTD})(\overline{RF}_x)}$$

Where:

- $C_{ex}$  = the concentration in the sample extract (ppb);
- $Resp_x$  = the peak area of the analytes of interest;
- $Resp_{ISTD}$  = the peak area of the associated internal standard;
- $Amt_{ISTD}$  = the amount, in ppb, of internal standard added
- $\overline{RF}_x$  = the average response from the initial calibration.

13.3.2 The concentration of analytes in the original sample is computed using the following equations:

$$\text{Aqueous Samples: } \text{Concentration } (\mu\text{g} / \text{L}) = \frac{(C_{ex})(V_f)(D)}{(V_s)}$$

- Where  $C_{ex}$  = Concentration in extract in ng/mL
- $V_f$  = Final volume of extract in mL



D = Dilution factor  
Vs = Volume of sample extracted, liters

$$\text{Non-aqueous Samples: Concentration (ug/Kg)} = \frac{(C_{ex}) (V_f) (D)}{(W)}$$

Where C<sub>ex</sub> = Concentration in extract in ng/mL  
V<sub>f</sub> = Final volume of extract in mL  
D = Dilution factor  
W = Weight of sample extracted in grams.

#### 13.4 Data Review and Assessment

13.4.1 Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the SOP *Laboratory Data Review Process (ADM-DREV)* for details. The person responsible for final review of the data report and/or data package should assess the overall validity and quality of the results and provide any appropriate comments and information to the Project Chemist to inclusion in the report narrative

#### 13.5 Reporting

13.5.1 Refer to the SOP for Data Reporting and Report Generation for reporting guidelines.

13.5.2 Reports are generated in the ALS LIMS by compiling the SMO login, sample prep database, instrument, date, and client-specified report requirements (when specified). This compilation is then transferred to a file which the Stealth reporting system uses to generate a report. The forms generated may be ALS standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.

### 14) Contingencies for Handling Our-of-Control or Unacceptable Data

14.1 Refer to the SOP for *Nonconformance and Corrective Action Procedures (ADM-NCAR)* for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

### 15) Method Performance

15.1 This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional method performance data available.

15.2 The method detection limit (MDL) is and related method reporting limit(s) were established using the procedure described in SOP *Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Quantification (Ce-QA011/ADM-MDL)*. Method Reporting Limits are established for this method based on MDL studies and as specified in the ALS Quality Assurance Manual.

### 16) Pollution Prevention and Waste Management



- 16.1 The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Lab Waste Management Plan.
- 16.2 This method uses Methylene Chloride and any waste generated from this solvent must be placed in the collection cans in the lab. The solvent will then be added to the hazardous waste storage area and recycled off site.
- 16.3 This method uses non-halogenated solvents and any waste generated from this solvent must be placed in the collection cans in the lab. The solvent will then be added to the hazardous waste storage area and disposed of in accordance with Federal and State regulations.

**17) Training**

- 17.1 Training is documented following ADM-TRAIN, ALS-Kelso Training Procedure.

**18) Method Modifications**

- 18.1 Section 11.5.4 - No limit defined in reference method, so lab assigned a limit of 40% based on CLP protocols.
- 18.2 Lower reporting levels are achieved in this procedure through injection of larger volumes and a lower calibration range. Lower limits of quantitation for soils are > 10 µg/Kg for soils and > 0.2 µg/L for waters.
- 18.3 Minimum Response factors listed in Table 5 were determined from representative initial calibrations performed after system maintenance. Recommended minimum response factors listed in Table 4 of EPA 8270D are not applicable due the differences in quantitation levels from the reference method.

**19) References**

- 19.1 *Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry*, Method 8270D, EPA Test Methods for Evaluating Solid Waste, SW-846, Final Update IV, February 2007.
- 19.2 *Determinative Chromatographic Separations*, Method 8000C, EPA Test Methods for Evaluating Solid Waste, SW-846, On-Line March 2003.
- 19.3 DoD Quality Systems Manual for Environmental Laboratories current version.
- 19.4 TNI Standard, Volume 1- 2009, 2016.
- 19.5 ISO/IEC 17025: 2017

**20) Changes Since the Last Revision**

Summary of Revision Changes			
Rev. #	Effective Date	Document Editor	Description of Changes
11.0	12/2/2020	K Clarkson	Section 6.1: updated chemical handling and storage references. Sections 7.1 & 7.2: updated container and sample storage requirements. Section 11.1.1.1 & 11.1.1.2: Updated applicable water extraction methods and volume requirements



			Section 11.1.2: updated applicable soil extraction methods and mass requirements. Section 17.1: updated training documentation
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## 21) Attachments, Tables, and Appendices

- 21.1 Table 1A - DFTPP Key Ions and Ion Abundance Criteria.
- 21.2 Table 1B - DFTPP Key Ions and Ion Abundance Criteria for 5973 and newer GC/MS Systems.
- 21.3 Table 2 - 8270 LL Standards.
- 21.4 Table 3 - QC Standards.
- 21.5 Table 4 - Semivolatile Internal Standards With Corresponding Analytes Assigned for Quantitation.
- 21.6 Table 5 - Recommended Minimum Response Factors.
- 21.7 Table 6 - Control Analyties for Non- DoD Projects.
- 21.8 Table 7 - Summary of Corrective Actions.



**Table 1A**  
**DFTPP Key Ions and Ion Abundance Criteria**

Method 8270D Ion Abundance Criteria		CLP OLM04.2 Ion Abundance Criteria	
Mass	Ion Abundance Criteria	Mass	Ion Abundance Criteria
51	30-60% of mass 198	51	30-80% of mass 198
68	< 2% of mass 69	68	<2% of mass 69
70	< 2% of mass 69	69	Present
127	40-60% of mass 198	70	<2% of mass 69
197	< 1% of mass 198	127	25-75% of mass 198
198	Base peak, 100% relative abundance	197	<1% of mass 198
199	5-9% of mass 198	198	Base peak, 100% relative abundance
275	10-30% of mass 198	199	5-9% of mass 198
365	> 1% of mass 198	275	10-30% of mass 198
441	Present but less than mass 443	365	>0.75% of mass 198
442	> 40% of mass 198	441	Present, but less than mass 443
443	17-23% of mass 442	442	40-110% of mass 198
		443	15-24% of mass 442

**Table 1B**  
**DFTPP Key Ions and Ion Abundance Criteria**  
**FOR 5973 and newer GC/MS SYSTEMS**

Mass	Ion Abundance Criteria
51	10-80% of mass 198
68	0-2% of mass 69
70	0-2% of mass 69
127	10-80% of 198
197	0-2% of 198
198	30-100% of 442 (alternate base)
199	5-9% of 198
275	10-60% of 198
365	1-50% of 442
441	0.01-100% of 443
442	30-100% of 198 (alternate base)
443	15-24% of 442

Alternate tuning criteria (from Method 525.2 or CLP OLM04.2) may be used provided that method performance is not adversely affected and that method performance criterion is met. The criteria used must be the same for all ion abundance criteria checks associated with a given analysis. For example, initial calibration, continuing calibration(s), QC, and sample analyses for a given sample must all use the same criteria.



**Table 2**  
**8270-LL Standards**

**CALIBRATION**

The calibration curve is prepared from the following Supelco stock standards (or equivalent from other vendors\*): 8270 CLP Mix, Equity 8270 Mix 4, Equity Benzidines Mix, Equity N-Nitrosodiphenylamine, 1-Methylnaphthalene, Acetophenone and 8270 Surrogates Mix.

The mix of standards to prepare the ICAL intermediate may be changed to meet project requirements.

Calibration curve is prepared from a 100 ppm intermediate solution and ranges from 50 – 10000ppb depending upon project requirements. Add internal standard when curve is prepared.

Place in amber autosampler vial, cap.

Store at -10°C. Expiration is 1 year from date prepared or expiration of parent standard(s), whichever is earlier.

**ICV**

Recommended: AccuStandard catalog # (or equivalent from other vendors\*):

CLP-HC-BN-R	2000 ppm BN mix
CLP-HC-A-PAK 2000 ppm	Acid composite mix
Z-014E-R3	2000 ppm Composite 3 mix
M-8270-SS-PAK	4000 ppm Surrogates mix
Z-014J	4000 ppm Internal standards mix
M-625C	25000 ppm DFTPP
Z-014F	2000 ppm Benzidines mix

Add 10 µl internal standard for each 1 ml of ICV prepared.

Place in autosampler vial, analyze, recap, and refrigerate.

Expiration is one year after ICV was prepared or the expiration date from the manufacturer, which ever is earlier.

**CCV & TUNE**

Prepare 1 ml 8270\_LL CCV standard that falls near the mid point of the calibration curve. DFTPP is added to the CCV to give a final concentration of 2.5 µg/ml. The CCV is stored in an amber autosampler vial and is good for one week.

**RECAP AND STORE IMMEDIATELY AFTER INJECTING**

\* Vendor must be A2LA and/or ISO9000 certified.



**Table 3  
QC Standards**

<b>Surrogate Spiking Solution</b>					
Parent	Initial Concentration	Aliquot	Final Volume	Final Concentration	Solvent
8-61377*	5000 µg/mL	20 mL	1000 mL **	100 µg/mL	Methanol
8-61376*	10000 µg/mL	15 mL		150 µg/mL	
S-8522*	5000 µg/mL	20 mL		100 µg/mL	
Expiration - Unopened = 6 months from prep date					
* 8-61377 - Supelco BN Surrogate Standard (custom mix) - reorder 4 at a time					
* 8-61376 - Supelco Acids Surrogate Standard (custom mix) - reorder 3 at a time					
* S-8522 - Accustandard custom - reorder 4 at a time.					
** Split into 4 - 250 mL bottles.					
<b>LCS/MS Spiking Solution</b>					
Parent	Initial Concentration (ppm)	Aliquot (mL)	Final Volume	Final Concentration	Solvent
50608	1000	10	100 mL	100 ppm	MeOH
4-8467	2000	5			
46702-u	5000	2			
86-1148	2000	5			
79131	1000	10			
48462	2000	5			
App9186-20x	2000	5			
Expiration -6 months from prep date.					



**TABLE 4**  
**Semivolatile Internal Standards with corresponding Analytes Assigned for Quantitation**

<b>1,4-Dichlorobenzene-d4 Internal Standard</b>		
N-Nitrosodimethylamine	2-Chlorophenol	N-Nitrosodi-n-propylamine
Aniline	Benzyl Alcohol	Hexachloroethane
2-Fluorophenol (surrogate)	Pyridine	2-Methylphenol
Bis(2-chloroethyl) Ether	1,2-Dichlorobenzene	3- and 4-Methylphenol (coeluting cpds)
Phenol-d <sub>6</sub> (surrogate)	1,3-Dichlorobenzene	Bis(2-chloroisopropyl) Ether
Phenol	1,4-Dichlorobenzene	Nitrobenzene
Nitrobenzene-d5 (surrogate)		
<b>Naphthalene-d8 Internal Standard</b>		
Naphthalene	2,4-Dimethylphenol	4-Chloroaniline
Benzoic Acid	Isophorone	Hexachlorobutadiene
2,4-Dichlorophenol	Bis(2-chloroethoxy)methane	2-Methylnaphthalene
1-Methylnaphthalene	4-Chloro-3- methylphenol	1,2,4-Trichlorobenzene
2-Nitrophenol		
<b>Acenaphthene-d10 Internal Standard</b>		
2-Fluorobiphenyl (surrogate)	Acenaphthylene	Fluorene
Hexachlorocyclopentadiene	Acenaphthene	4-Nitrophenol
2-Chloronaphthalene	Dibenzofuran	2,4,6-Trichlorophenol
2-Nitroaniline	2,4-Dinitrotoluene	2,4,5-Trichlorophenol
3-Nitroaniline	2,6-Dinitrotoluene	2,4-Dinitrophenol
4-Nitroaniline	Diethyl Phthalate	Azobenzene
Dimethyl Phthalate	4-Chlorophenyl Phenyl Ether	2,2,4,6-Tetrachlorophenol
2-Methyl-4,6-dinitrophenol		



**Table 4 (continued)**

<b>Phenanthrene-d10 Internal Standard</b>		
Phenanthrene	Anthracene	Pentachlorophenol
4-Bromophenyl Phenyl Ether	Di-n-butyl Phthalate	Carbazole
Hexachlorobenzene	Fluoranthene	
<b>Chrysene-d12 Internal Standard</b>		
Pyrene	Benz(a)anthracene	Terphenyl-d14 (surrogate)
Butylbenzyl Phthalate	Bis(2-ethylhexyl) Phthalate	
3,3'-Dichlorobenzidine	Chrysene	
<b>Perylene-d12 Internal Standard</b>		
Di-n-octyl Phthalate	Benzo(a)pyrene	Benzo(g,h,i)perylene
Benzo(b)fluoranthene	Indeno(1,2,3-c,d)pyrene	
Benzo(k)fluoranthene	Dibenz(a,h)anthracene	



**Table 5**  
**Recommended Minimum Response Factors**

<b>Compound</b>	<b>Minimum Response Factor (RF)</b>
Benzaldehyde	0.010
Phenol	0.800
Bis(2-chloroethyl) Ether	0.700
2-Chlorophenol	0.800
2-Methylphenol	0.500
2,2'-Oxybis-(1-chloropropane)	0.010
Acetophenone	0.010
4-Methylphenol	0.600
N-Nitrosodi-n-propylamine	0.500
Hexachloroethane	0.300
Isophorone	0.300
Nitrobenzene	0.200
2-Nitrophenol	0.100
2,4-Dimethylphenol	0.100
Bis(2-chloroethoxy)methane	0.200
2,4-Dichlorophenol	0.100
Naphthalene	0.700
4-Chloroaniline	0.010
Hexachlorobutadiene	0.010
Caprolactam	0.010
2-Methylnaphthalene	0.300
Hexachlorocyclopentadiene	0.050
2,4,6-Trichlorophenol	0.200
2,4,5-Trichlorophenol	0.200
1,1'-Biphenyl	0.010
2-Chloronaphthalene	0.700
2-Nitroaniline	0.010
Dimethyl Phthalate	0.010



Table 5 (continued)

Compound	Minimum Response Factor (RF)
2,6-Dinitrotoluene	0.100
Acenaphthylene	0.900
3-Nitroaniline	0.010
Acenaphthene	0.700
2,4-Dinitrophenol	0.010
4-Nitrophenol	0.010
Dibenzofuran	0.800
2,4-Dinitrotoluene	0.200
Diethyl phthalate	0.010
1,2,4,5-Tetrachlorobenzene	0.010
4-Chlorophenyl-phenyl ether	0.400
Fluorene	0.800
4-Nitroaniline	0.010
4,6-Dinitro-2-methylphenol	0.010
4-Bromophenyl-phenyl ether	0.100
N-Nitrosodiphenylamine	0.010
Hexachlorobenzene	0.100
Atrazine	0.010
Pentachlorophenol	0.050
Phenanthrene	0.600
Anthracene	0.600
Carbazole	0.010
Di-n-butyl phthalate	0.010
Fluoranthene	0.600
Pyrene	0.600
Butyl benzyl phthalate	0.010
3,3'-Dichlorobenzidine	0.010
Benzo(a)anthracene	0.600



**Table 5 (continued)**

<b>Compound</b>	<b>Minimum Response Factor (RF)</b>
Chrysene	0.600
Bis-(2-ethylhexyl)phthalate	0.010
Di-n-octyl phthalate	0.010
Benzo(b)fluoranthene	0.600
Benzo(k)fluoranthene	0.600
Benzo(a)pyrene	0.600
Indeno(1,2,3-cd)pyrene	0.500
Dibenz(a,h)anthracene	0.400
Benzo(g,h,i)perylene	0.500
2,3,4,6-Tetrachlorophenol	0.010



**Table 6**  
**Control Analytes for Non-DoD Projects**

1,2,4-Trichlorobenzene
1,4-Dichlorobenzene
2,4-Dinitrotoluene
2-Chloronaphthalene
2-Chlorophenol
4-Bromophenyl Phenyl Ether
4-Chloro-3-methylphenol
4-Nitrophenol
Acenaphthene
Benzo(a)pyrene
Diethyl Phthalate
Hexachloroethane
N-Nitrosodi-n-propylamine
Pentachlorophenol
Phenol
Pyrene



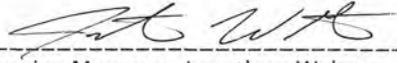
**Table 7**

<b>Summary of Corrective Actions</b>				
<b>Method Reference</b>	<b>Control</b>	<b>Specification and Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action</b>
EPA 8000C, EPA 8270D	ICAL	Prior to sample analysis	% RSD $\leq$ 20 COD $\geq$ 0.990	Correct problem then repeat ICAL
EPA 8000C,	ICV	After ICAL	$\pm$ 30% Diff	Correct problem and verify second source standard; rerun second source verification. If fails, correct problem and repeat initial calibration.
EPA 8270D	CCV	Prior to sample analysis	$\pm$ 20% Diff	Correct problem then repeat CCV or repeat ICAL
EPA 8000C,	Method Blank	Include with each analysis batch (up to 20 samples)	<MRL	If target exceeds MRL, reanalyze to determine if instrument was cause. If still noncompliant then:  Re-extract or reanalyze samples containing contaminate, unless samples contain > 20x amount in blank.
EPA 8270D	Laboratory Control Sample	Include with each analysis batch (up to 20 samples)	See DQO Tables	If exceeds limits, re-extract and re-analyze
EPA 8000C,	Matrix Spike	Include with each analysis batch (up to 20 samples)	See DQO Tables	Evaluate data to determine if there is a matrix effect or analytical error
EPA 8270D	Sample Duplicates	Include with each analysis batch (up to 20 samples)	W: RPD $\leq$ 30 S: RPD $\leq$ 40	Re-homogenize and re-analyze if result is > 5 X the MRL

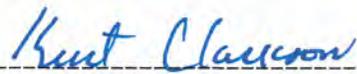


## Semi-Volatile Organic Compounds by GC/MS Selective Ion Monitoring

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## 1) Scope & Applicability

- 1.1. This procedure is used to determine the concentrations of Semi-Volatile Organic Compounds in water, soil, and tissue matrices using EPA Method 8270D and Selected Ion Monitoring (SIM). This procedure may also be applicable to various miscellaneous waste samples. Table 1 lists compounds that may be determined by this method and lists nominal method reporting limits (MRLs) in water, soil, and tissue. Other compounds may be analyzed to meet project requirements. Due to the nature of this analysis and its applications, MRLs may vary due to project specifications. Table 1 lists Method Detection Limits (MDLs) that have been achieved, however, MDLs may change as MDL studies are performed, and may vary depending on the instrument used and preparation method.
- 1.2. The procedure is intended for samples containing trace-level amounts of target compounds. Samples containing high concentrations of target analyte will not be analyzed undiluted. Extracts may be screened using GC/FID to estimate the hydrocarbon content and concentrations of individual polynuclear aromatic hydrocarbons (PAHs). Samples containing PAHs are diluted prior to analysis. All MRLs will be adjusted in accordance with this dilution. Therefore, samples containing high levels of PAHs will not be analyzed to achieve the optimum MRLs for the analysis.
- 1.3. This procedure can be used to quantitate most neutral, acidic, and basic organic compounds that are soluble in methylene chloride and capable of being eluted as sharp peaks from a gas chromatographic fused-silica capillary column coated with a slightly polar silicone phase. Such compounds include polynuclear aromatic hydrocarbons, chlorinated hydrocarbons, phthalate esters, nitrosamines, haloethers, ketones, anilines, aromatic nitro compounds, and phenols, including nitrophenols. Most acidic compounds are derivatized in tissue samples prior to analysis to aid sensitivity and chromatographic resolution.
- 1.4. Other compounds than those listed in Table 1 may be analyzed. However, analytes not summarized in Table 1 may not be validated with a method detection limit study. Therefore, the lab will not use this procedure to analyze for non-routine analytes unless a similar analyte has been validated with a MDL study. As a general rule, the MRL for these compounds will equal the MRL of a similar compound in the routine analyte list. Results will not be reported below this estimated MRL.
- 1.5. In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPP's supersede method specified requirements. An example of this are projects falling under DoD ELAP. QC requirements defined in the SOP *Department of Defense Projects – Laboratory Practices and Project Management* (ADM-DOD) may supersede the requirements defined in this SOP.

## 2) Summary of Procedure

- 2.1 This method provides Gas Chromatography/Mass Spectrometry (GC/MS) conditions for the detection of Semi-volatile Organic Compounds. Prior to the use of this method, an appropriate sample preparation method must be used to recover the analytes of interest. Soil, tissue, and colored water extracts may be cleaned using EPA Method 3640 (gel permeation chromatography) prior to analysis.
- 2.2 A 0.5-20  $\mu\text{L}$  aliquot of the extract is injected into the gas chromatograph (GC). The compounds are separated on a fused silica capillary column. Compounds of interest are detected by a mass selective detector in the selective ion mode. Identification of the



analytes of interest is performed by comparing the retention times of the analytes with the respective retention times of an authentic standard, and by comparing mass spectra of analytes with mass spectra of reference materials. Quantitative analysis is performed by using the authentic standard to produce a response factor and calibration curve, and using the calibration data to determine the concentration of an analyte in the extract. The concentration in the sample is calculated using the sample weight or volume and the extract volume. To achieve MRLs listed in Table 1 the initial sample amount, final extract volume, and injection aliquot are specified for each product.

- 2.3 The following compounds may require special treatment when being determined by this method. Benzidine, 3, 3'-Dichlorobenzidine, nitrophenols, Hexachlorocyclopentadiene, Pentachlorophenol, Benzoic Acid and Benzyl Alcohol are subject to poor extraction efficiency or erratic chromatographic behavior, especially if the GC system is contaminated with high boiling material.

### 3) Definitions

- 3.1 For laboratory definitions applicable to most analyses, refer to the SOP for Sample Batches.

### 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.
- 4.2 It is the responsibility of the department supervisor/manager to document analyst training and method proficiency, as described in: *Employee Training and Orientation* (ADM-TRAIN).

### 5) Interferences

- 5.1 Raw GC/MS data from all blanks, samples, and spikes must be evaluated for interferences. Determine if the source of interference is in the preparation of the samples. Corrective action should be taken to eliminate the interferences.
- 5.2 Accurate determination of phthalate esters can pose difficulties when using this methodology. Common flexible plastics contain varying amounts of phthalates. These phthalates are easily extracted or leached from such materials during laboratory operations. Cross contamination of clean glassware may occur when plastics are handled during extraction steps, especially when solvent-wetted surfaces are handled. Interferences from phthalates can best be minimized by avoiding contact with any plastic materials. Exhaustive cleanup of reagents and glassware may be required to eliminate background phthalate contamination.
- 5.3 Contamination by carryover can occur whenever high-concentration and low-concentration samples are sequentially analyzed. To reduce carryover, the sample syringe must be rinsed out between samples with solvent. Whenever an unusually concentrated sample is encountered, it should be followed by the analysis of an instrument blank to check for cross contamination.



## 6) Safety

- 6.1 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.
- 6.2 This method uses Dichloromethane, a known human carcinogen. Refer to the methylene chloride policy document, ENV-HSE-NA-EX-006-EN for proper handling.  
<G:\SAFETY\TRAINING\Methylene Chloride\Methylene Chloride - NA 031419.pdf>.

## 7) Sample Collection, Containers, Preservation, and Storage

- 7.1 Certified clean containers should be purchased for sample collection. The sample containers should be of glass or Teflon and have screw-top covers with Teflon liners. Plastic containers or lids may not be used for the storage of samples due to the possibility of sample contamination from the phthalate esters and other hydrocarbons within the plastic.
- 7.2 Water and soil samples should be iced or refrigerated at  $4 \pm 2^{\circ}\text{C}$  from time of collection until extraction. Tissue samples are stored frozen until extraction.
- 7.3 Water and soil samples should be iced or refrigerated at  $<6^{\circ}\text{C}$  from time of collection until extraction. Tissue samples are stored frozen until extraction.

## 8) Standards, Reagents, and Consumable Materials

- 8.1 Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Refer to the SOP *Reagent/Standards Login and Tracking* (ADM-RTL) for the complete procedure and documentation requirements.
- 8.2 BSTFA + TMCS 99:1, Supelco 33154-U: This is used to derivatize the phenols in extracts.
- 8.3 Standards
  - 8.3.1 Stock standard solutions may be purchased from a number of vendors. All reference standards, where possible, must be traceable to SI units or NIST certified reference materials. Commercially prepared stock standards are typically used when available at a concentration of 100  $\mu\text{g}/\text{mL}$  or more. Standard concentrations can be verified by comparison versus an independently prepared standard. Alternatively, prepare stock standard solutions at a concentration of 1000  $\mu\text{g}/\text{mL}$  by dissolving 0.0100 g of reference material in methylene chloride or other suitable solvent and diluting to volume in a 10 mL volumetric flask. Larger volumes can be used at the convenience of the analyst. When compound purity is assayed to be 96% or greater, the weight can be used without correction to calculate the concentration of the stock standard.
  - 8.3.2 Transfer the stock standard solutions into amber Teflon-sealed crimp top autosampler vials at  $-10^{\circ}\text{C}$  and protect from light, or store as



recommended by the manufacturer. Stock standards should be checked frequently for signs of degradation or evaporation, especially just prior to preparing calibration standards from them. The expiration date is 1 year.

- 8.3.3 Unopened stock standards and neat materials have an expiration date equal to the manufacturer's recommendation. Neat material that does not have a manufacturer's recommended expiration date should be replaced after five years. Stock standard solutions received in sealed ampules with manufacture expiration dates in excess of 1 year have an expiration date of 1 year from the date of opening the sealed ampoule.
- 8.4 Internal Standard Solutions - The internal standards are 1,4-dichlorobenzene-d<sub>4</sub>, naphthalene-d<sub>8</sub>, acenaphthene-d<sub>10</sub>, phenanthrene-d<sub>10</sub>, chrysene-d<sub>12</sub>, and perylene-d<sub>12</sub> (See Table 3 for corresponding compounds). The nominal concentration of the standard is 100 ppb. For ultralow-level analyses, use 10 ppb. Each 100 µL of sample extract undergoing analysis should be spiked with 1 µL of the internal standard solution. Store at -10°C or less when not being used. When using premixed certified solutions, store according to the manufacturer's recommendations. The expiration date is 1 year
- 8.5 GC/MS Tuning/Standard, A methylene chloride solution containing decafluorotriphenylphosphine (DFTPP) and pentachlorophenol is prepared. The concentration used (ng injected) will vary depending on the instrument model and/or sensitivity, but generally is 10-50ng. Store at -10°C or less when not being used, or store according to the manufacturer's recommendations. The expiration date is 1 year.
- 8.6 Calibration Standards
  - 8.6.1 A minimum of five initial calibration standards must be prepared from stock solutions (note that a seven point calibration is recommended). One of the calibration standards must be at a concentration at or below the method reporting limit. The others should correspond to the range of concentrations found in samples, but should not exceed the working range of the GC/MS system. Each 1 mL aliquot of calibration standards should be spiked with 10 µL of the internal standard solution prior to analysis. All calibration standards should be stored at -10°C or less and should be freshly prepared from stocks every 1 year, or sooner if check standards indicate a problem.
  - 8.6.2 A calibration range of 10-5000 ng/mL is recommended. Higher concentrations may be prepared for poorer performing analytes. Calibration levels and injection amount may be adjusted to meet project-specific requirements.
  - 8.6.3 The daily calibration standard (CCV) is prepared at a mid-level concentration from stock solutions. The CCV is prepared weekly and can be stored at 4 ± 2°C, or as recommended by the manufacturer.
- 8.7 QC Standards
  - 8.7.1 Surrogates: Prepare a working solution in methanol containing 2-



fluorophenol, phenol-d<sub>6</sub>, and 2,4,6-tribromophenol at 150 ng/μL and nitrobenzene-d<sub>5</sub>, 2-fluorobiphenyl, and terphenyl-d<sub>14</sub> at 100 ng/μL. This solution may be combined with the surrogate solution used to monitor analyses for PAHs only (Fluorene-d<sub>10</sub>, and Fluoranthene-d<sub>10</sub>). Custom project-specific surrogate solutions may also be used. Aliquots of the solution are spiked into all extracted samples, blanks, and QC samples according to the extraction SOP used.

- 8.7.2 Matrix Spike Standards: Prepare a working solution in methanol containing all analytes of interest ("full list spike"). Base-Neutral analytes and acid analytes are prepared at a concentration of 100 ng/μL. Aliquots of the solution are spiked into the selected QC aliquots according to the extraction SOP used

## 9) Apparatus and Equipment

### 9.1 Gas Chromatograph/Mass Spectrometer System

- 9.1.1 Gas Chromatograph - An analytical system complete with a temperature-programmable gas chromatograph suitable for splitless, split, or large-volume injection and all required accessories, including syringes, analytical columns, and gases. The capillary column should be directly coupled to the source.
- 9.1.2 Column: 5% Diphenyl, 95% Dimethyl Polysiloxane - 30 m x 0.25 mm ID x 0.25 μm film thickness silicone-coated fused-silica capillary column or equivalent (recommended: Phenomenex Zebron ZB-5MS, catalog # 7HG-G010-11-GGA.) Some projects may require a similar column, but with a different phase, to achieve improved separation.
- 9.1.3 Mass Spectrometer - Capable of scanning from 35 to 500 amu every 1 second or less, using 70 volts (nominal) electron energy in the electron impact ionization mode, and capable of operating in the SIM mode.
- 9.1.4 GC/MS Interface - Any GC-to-MS interface that gives acceptable calibration points for each compound of interest and achieves acceptable tuning performance criteria may be used.
- 9.1.5 Data System - A computer system must be interfaced to the mass spectrometer. The system must allow the continuous acquisition and storage on machine-readable media of all mass spectra obtained throughout the duration of the chromatographic program. The computer must have software that can search any GC/MS data file for ions of a specific mass and that can plot such ion abundances versus time or scan number. This type of plot is defined as an Extracted Ion Current Profile (EICP). Software must also be available that allows integrating the abundances in any EICP between specified time or scan-number limits.
- 9.1.6 Appropriate analytical balance (0.0001 g), volumetric flasks, syringes, vials, and bottles for standards preparation

## 10) Preventative Maintenance

- 10.1 All maintenance activities are recorded in a maintenance logbook kept for each



instrument. Pertinent information (serial numbers, instrument I.D., etc.) must be in the logbook. Maintenance entries should include date, symptom of problem, corrective actions, and description of maintenance, date, and name. The log should contain a reference to return to analytical control.

- 10.2 Carrier gas - Inline purifiers or scrubbers should be in place for all sources of carrier gas. These are selected to remove water, oxygen, and hydrocarbons. Purifiers should be changed as recommended by the supplier

### 10.3 Gas Chromatograph

10.3.1 Whenever GC maintenance is performed, care should be taken to minimize the introduction of air or oxygen into the column. Injection port maintenance may include swabbing out the port, changing the injection port liner, seal, washer, O-ring, septum, column ferrule, and autosampler syringe as needed. Liners and seals should be changed when recent sample analyses predict a problem with chromatographic performance. In some cases liners and seals may be cleaned and re-used.

10.3.2 Clipping off a small portion of the head of the column often improves chromatographic performance. When cutting off any portion of the column, make sure the cut is straight and "clean" (uniform, without fragmentation) by using the proper column cutting tool.

10.3.3 Over time, the column will exhibit poorer overall performance, as indicated by poor peak shape and reduced responses. The length of time for this to occur will depend on the samples analyzed. When a noticeable decrease in performance is evident, more thorough maintenance is necessary. Some steps are to solvent rinse the split vent and septum lines with a mix of 20% methanol in DCM. When these and other maintenance options do not result in improvement, the column should be replaced. This is especially true when evident in conjunction with calibration difficulties

### 10.4 Mass Spectrometer

10.4.1 For units under service contract, certain maintenance is performed by instrument service staff, including pump oil changed, vacuuming boards, etc., as recommended by the manufacturer.

10.4.2 MS source cleaning should be performed as needed, depending on the performance of the unit. This may be done by the analyst or by instrument service staff.

10.4.3 Tune the MS as needed to result in consistent and acceptable performance while meeting the required ion abundance criteria given in section 11.



## 11) Procedure

### 11.1 Sample Preparation

11.1.1 Water, soil, tissue and waste samples are prepared using the appropriate extraction and cleanup methods (refer to SOPs) and may be screened by GC/FID (see screening SOP). Soil, tissue, waste, and colored water extracts may be cleaned using EPA Method 3640 (GPC).

11.1.2 Tissue extracts and standards that are to be analyzed for phenols are derivatized by the following procedure: 100 µL of BSTFA+TMCS is added to 1.0 mL of the extract or standard in 2 mL autosampler vial. The vial is then sealed with a cap and heated to 60 C for 1.0 hour.

11.1.3 Following sample preparation, sample extracts are then transferred to the extract cold storage unit. Extracts must be analyzed within 40 days of extraction.

11.2 Typical GC/MS operating conditions are listed below, but should be optimized for specific instruments and projects to achieve optimal performance for the application.

Ion dwell time:	10 - 50 msec per ion
Initial temperature:	40°C, hold for 1 minutes
Temperature program:	40-150°C at 10°C/min hold for 2 minutes
Temperature program:	150-270°C at 15°C/min hold for 2 minutes
Final temperature:	270-300°C at 30°/min, hold for 4.33 minutes
Injector temperature:	275°C
Detector interface temp:	300°C
Injector:	Atas Optic, Agilent PTV or equivalent (parameters are method-specific)
Sample volume:	0.5-20 µL
Carrier gas:	helium at 1.3mL/min (constant flow)

### 11.3 Selected Ion Acquisition

11.3.1 Determine the ions to be monitored for the compounds of interest. Refer to Table 2 for characteristic ions. At a minimum, 2 ions (preferably 3 or more) are monitored for each compound, and a minimum of 3 monitored for halogenated compounds and compounds with more complex fragmentation patterns. Set the SIM windows in order to monitor the correct ions at the correct time, based on chromatographic elution of the compounds. This can be setup by analyzing a standard using a full scan analysis and using the GC conditions of the SIM analysis. This analysis will give retention time and spectral information for determining the location of start times for the SIM groups or windows. This is often referred to as a "locator" analysis.

11.3.2 Select the dwell times to be used for each group of ions to be monitored. Dwell times should be selected in order to provide a sufficient number of measurements across the chromatographic peak to accurately define the peak shape. Too few measurements across the peak will result in poor definition of the peak and subsequently result in poor accuracy and precision of results. Too



many measurements across the peak may result in inconsistent detector behavior over the calibration range. Significant differences in dwell times may also affect sensitivity.

#### 11.4 Initial Calibration

**NOTE:** The calibration procedure(s) and options chosen must follow the ALS protocols. Any exceptions to the calibration procedures detailed in the ALS SOP for *Calibration of Instruments for Organics Chromatographic Analyses* (SOC-CAL) are described as follows:

- 11.4.1 Prior to calibration, analyze the GC/MS tuning standard using instrument conditions used for calibration. The DFTPP solution is analyzed to verify GC/MS tuning, injection port inertness, and GC column performance. This injection is acquired in full scan mode and evaluated in accordance with the method specified criteria.
- 11.4.2 Evaluate the spectrum obtained for DFTPP against the tuning criteria in Table 4 and 4A. The GC/MS must meet the DFTPP ion abundance criteria prior to further analyses. Once the instrument is tuned, all subsequent analyses of standards, samples, and QA/QC samples must be analyzed using the identical mass spectrometer operating conditions. If hardware tuning criteria cannot be met, the source may need cleaning, filaments replaced or other maintenance. The following tune verification options can be used.
  - Three scans (the peak apex scan and the scans immediately preceding and following the apex) are acquired and averaged. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to elution of DFTPP. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the tune peak or part of any other peak eluting close to the tune peak.
  - Use one scan at the apex of the peak. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of DFTPP. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the tune peak or part of any other peak eluting close to the tune peak.
  - Use one scan either directly preceding or following the apex of the peak. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of DFTPP. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the tune peak or part of any other peak eluting close to the tune peak.
  - Use the average across the entire peak up to a total of 5 scans. Peak integration must be consistent with standard operating procedure. If the peak is wider than 5 scans, the tune will consist of the peak apex scan and the two scans immediately preceding and following the apex.



Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of DFTPP. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the tune peak or part of any other peak eluting close to the tune peak.

- 11.4.3 To assess column performance and injection port inertness, pentachlorophenol should be present at an acceptable level and peak tailing should not be excessive. Tailing is evaluated using a tailing factor. The tailing factor is calculated by the processing software as follows (also refer to EPA 8270D, Figure1):

$$\text{Tailing Factor} = \text{PeakBack}/\text{PeakFront}$$

Where:

*PeakBack* is the time from Peak Apex to Peak End measured at 10% of the peak height

*PeakFront* is the time from Peak Start to Peak APEX measured at 10% of the peak height.

The tailing factor should not exceed 2. If excessive tailing or poor chromatography is noted, the injection port may require cleaning. It may also be necessary to remove the first 15-30 cm of the GC column.

- 11.4.4 The internal standards should permit most of the components of interest in the chromatogram to have retention times of 0.80-1.20 relative to one of the internal standards. Refer to Table 3 for internal standards and corresponding analytes assigned for quantitation. Use the base peak ion from the specific internal standard as the primary ion for quantitation (See Table 2). If interferences are noted, use the next most intense ion as the quantitation ion (i.e. for 1,4-dichlorobenzene-d<sub>4</sub>, use 152 m/z for quantitation).
- 11.4.5 Analyze each calibration standard (containing internal standards) and tabulate the area of the primary characteristic ion against concentration for each compound (as indicated in Table 2). Calculate response factors (RFs) for each compound relative to one of the internal standards as follows:

$$\text{RF} = (A_x C_{is}) / (A_{is} C_x)$$

where:

A<sub>x</sub> = Area of the characteristic ion for compound being measured.

A<sub>is</sub> = Area of the characteristic ion for specific internal standard.

C<sub>is</sub> = Concentration of the specific internal standard (ng/μL).

C<sub>x</sub> = Concentration of the compound being measured (ng/μL).

- 11.4.6 The recommended minimum acceptable average RF for target analytes is given in Table 5. If the RF does not meet these recommendations the GC system may require maintenance (see section 9) and recalibration.



11.4.7 The percent relative standard deviation (%RSD) should be less than 20% for each compound. The relative retention times of each compound in each calibration run should agree within 0.06 relative retention time units.

$$\%RSD = \frac{SD}{\overline{RF}} \times 100$$

Where:

RSD = relative standard deviation.

$\overline{RF}$  = mean of 5 initial RFs for a compound.

SD = standard deviation of average RFs for a compound.

$$SD = \sqrt{\frac{\sum_{i=1}^N (RF_i - \overline{RF})^2}{N - 1}}$$

where:

RF<sub>i</sub> = RF for each of the 5 calibration levels

N = Number of RF values (i.e., 5)

11.4.8 Linearity - If the % RSD of any compound is 20% or less, then the relative response factor is assumed to be constant over the calibration range, and the average relative response factor may be used for quantitation.

11.4.9 If the %RSD for a compound is >20%, then alternative calibration models should be used. See the SOP (SOC-CAL) *Calibration of Instruments for Organics Chromatographic Analysis* for further guidance.

#### 11.5 Review of calibration curve

11.5.1 The calibration curve must be reviewed to ensure it represents the calibration data. This is done by re-fitting each calibration level against the true concentration of each calibration standard. See the SOP (SOC-CAL) *Calibration of Instruments for Organics Chromatographic Analysis* for further guidance.

11.5.2 Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is less than 50% of the average of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs. The resolution should be verified on the mid-point concentration of the initial calibration as well as the laboratory designated continuing calibration verification level if closely eluting isomers are to be reported

#### 11.6 Independent Calibration Verification



11.6.1 Following initial calibration, analyze an ICV standard. The ICV solution must contain all analytes in the calibration standards. Calculate the concentration using the typical procedure used for quantitation. Calculate the percent difference (%D) from the ICV true value. For each compound of interest, the calculated value must be  $\pm 30\%$  of the true value for the initial calibration to be valid.

## 11.7 Continuing Calibration

11.7.1 Following an acceptable tune, a calibration standard, or standards, at mid-concentration containing all semivolatile analytes, and all required surrogates, must be analyzed every 12 hours during analysis.

11.7.2 For each compound in the continuing calibration standard, a minimum response factor given in Table 5 should be met. If the minimum response factors are not met, the system should be evaluated, and corrective action taken before sample analysis begins. Some possible problems are standard mixture degradation, injection port inlet contamination, contamination at the front end of the analytical column, and active sites in the column or chromatographic system.

11.7.3 If the percent difference or percent drift for each compound is less than or equal to 20%, the initial calibration is assumed to be valid and the analysis of samples may begin.

Calculate the percent drift using:

$$\% \text{ Drift} = \frac{C_i - C_e}{C_i} \times 100$$

Where:

$C_i$  = Compound standard concentration.

$C_e$  = Measured concentration using selected quantitation method.

11.7.4 If the percent difference or percent drift for a compound is less than or equal to 20%, then the initial calibration for that compound is assumed to be valid. Due to the large number of compounds that may be analyzed by this method, some compounds may fail to meet the  $\leq 20\%$  criteria. If no more than 20% of the compounds, included in the initial calibration, differ from their true concentration by 40%, the initial calibration is valid and no corrective action is necessary.

11.7.5 In cases where compounds fail, they may still be reported as non-detects if it can be demonstrated that there was adequate sensitivity to detect the compound at the applicable quantitation limit.



- 11.7.6 Non-detected analytes can be reported from analyses when a CCV exhibit a positive bias (i.e., outside the upper control limit), no further documentation is required.
- 11.7.7 For situations when the CCV fails to meet the criterion in section 11.7.3, and a confirmed detection exceeds the MRL, the sample must be reanalyzed to ensure accurate quantification. If it is not possible to reanalyze the sample, the result must be reported as an estimated value.
- 11.7.8 The internal standard responses and retention times in the calibration check standard must be evaluated immediately after or during data acquisition. If the retention time for any internal standard changes by more than 30 seconds from that in the midpoint standard of the most recent initial calibration sequence, the chromatographic system must be inspected for malfunctions and corrective action identified, as required. If the EICP area for any of the internal standards changes by a factor of two (50% to 200%) from that in the midpoint standard of the most recent initial calibration sequence, the chromatographic system must be inspected for malfunctions and corrective action identified, as appropriate. When corrective action is taken, reanalysis of samples analyzed while the system was malfunctioning is required. Update the reference spectra and retention times in the quantitation database for the instrument method or ID file. The initial calibration average RF or calibration curve is then used in the quantitation of subsequent analyses.
- 11.7.9 A blank (method blank, GPC blank, or solvent blank) should be analyzed after the CCV, or at any other time during the analytical shift, to prove the system is free of contaminants. If contaminants are found in a method blank or GPC blank, then a solvent blank should be analyzed to help isolate the source of contamination.

## 11.8 GC/MS Analysis

- 11.8.1 Evaluate FID screen, if performed, and make proper dilution (See FID screening SOP).
- 11.8.2 Spike the 1 mL extract obtained from sample preparation with 10  $\mu$ L of the internal standard solution just prior to analysis. Use the same operating conditions as were used for initial calibration.
- 11.8.3 If the response for any quantitation ion exceeds the initial calibration curve range of the GC/MS system, extract dilution must take place. Additional internal standard must be added to the diluted extract to maintain the required concentration of each internal standard in the extracted volume. The diluted extract must be reanalyzed.
- 11.8.4 Store the extracts at  $-10^{\circ}\text{C}$  or less, protected from light in vials equipped with unpierced Teflon lined septa. Extracts are archived in a freezer for 3 months after analysis in the instrument/date specific storage boxes.



## 12) Data Reduction and Reporting

- 12.1 Qualitative Analysis - The qualitative identification of compounds determined by this procedure is based on retention time, and comparison of the sample mass spectrum with characteristic ions in a reference mass spectrum. The reference mass spectrum must be generated by the laboratory using the instrument and conditions used for the sample analysis. The characteristic ions from the reference mass spectrum are defined to be the ions monitored in the SIM mode and typically are the two or three ions of greatest relative intensity. Compounds are identified as present when the criteria below are met.
- 12.2 Qualitative Analysis - The qualitative identification of compounds determined by this procedure is based on retention time, and comparison of the sample mass spectrum with characteristic ions in a reference mass spectrum. The reference mass spectrum must be generated by the laboratory using the instrument and conditions used for the sample analysis. The characteristic ions from the reference mass spectrum are defined to be the ions monitored in the SIM mode and typically are the two or three ions of greatest relative intensity. Compounds are identified as present when the criteria below are met.
- 12.2.1 The intensities of the characteristic ions of a compound maximize in the same scan or within one scan of each other. Selection of a peak by a data system target compound search routine where the search is based on the presence of a target chromatographic peak containing ions specific for the target compound at a compound-specific retention time will be accepted as meeting this criterion.
  - 12.2.2 The RRT of the sample component is within  $\pm 0.06$  RRT units of the RRT of the standard component.
  - 12.2.3 The relative intensities of the characteristic ions agree within 30% of the relative intensities of these ions in the reference spectrum.
  - 12.2.4 Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is  $<25\%$  of the sum of the 2 peak heights. Otherwise, structural isomers are identified as isomeric pairs.
  - 12.2.5 Identification is hampered when sample components are not resolved chromatographically and produce mass spectra containing ions contributed by more than one analyte. When the ion relative intensities do not agree within 30% due to these types of matrix interferences, the analyst uses professional judgement in determining whether the analyte is or is not present. The analyst will take into account other knowledge of the sample, presence of other compounds, and other presumptive evidence available for review. Difficulties will be noted in the case narrative.
  - 12.2.6 Evaluate internal standard areas in each sample. If the area in the sample is less than 50% or greater than 200% the area of in the CCV,



corrective action must be taken. Depending on the analysis, this corrective action may include reinjection or dilution of the extract followed by reinjection.

12.3 Tentatively identified compound (TIC) cannot be reported using this method.

12.4 Quantitation and Calculations

12.4.1 The GC/MS data stations, in current use, all use the H-P RTE Integrator to generate the raw data used to calculate the standards  $\overline{RF}_x$  values, the sample amounts, and the spike values. The software does three passes through each data file. The first two identify and integrate each internal standard and surrogate. The third pass uses the time-drift information from the first two passes to search for all method analytes in the proper retention times and with the proper characteristic quantitation ions. When  $\overline{RF}_x$  is used, calculate the extract concentration as follows:

$$C_{ex} = \frac{(Resp_x)(Amt_{ISTD})}{(Resp_{ISTD})(\overline{RF}_x)}$$

Where:  $C_{ex}$  = the concentration in the sample extract (ppm);  
 $Resp_x$  = the peak area of the analytes of interest;  
 $Resp_{ISTD}$  = the peak area of the associated internal standard;  
 $Amt_{ISTD}$  = the amount, in ppm, of internal standard added  
 $\overline{RF}_x$  = the average response from the initial calibration.

12.4.2 The concentration of analytes in the original sample is computed using the following equations:

Aqueous Samples:  $Concentration (\mu g / L) = \frac{(C_{ex})(V_f)(D)}{(V_s)}$

Where  $C_{ex}$  = Concentration in extract in  $\mu g/mL$   
 $V_f$  = Final volume of extract in mL  
 $D$  = Dilution factor  
 $V_s$  = Volume of sample extracted, liters

Non-aqueous Samples:  $Concentration (mg / Kg) = \frac{(C_{ex})(V_f)(D)}{(W)}$

Where  $C_{ex}$  = Concentration in extract in  $\mu g/mL$   
 $V_f$  = Final volume of extract in mL  
 $D$  = Dilution factor  
 $W$  = Weight of sample extracted in grams.



## 12.5 Data Review

- 12.5.1 Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the SOP for *Laboratory Data Review Process* (ADM-DREV) for details.

## 12.6 Reporting

- 12.6.1 Reports are generated in the ALS LIMS by compiling the SMO login, sample prep database, instrument, date, and client-specified report requirements (when specified). This compilation is then transferred to a file which the Stealth reporting system uses to generate a report. The forms generated may be ALS standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.

## 13) Contingencies for Handling Out-of-Control or Unacceptable Data

- 13.1 Refer to the SOP for *Non Conformance and Corrective Action Procedure* (ADM-NCAR) for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

## 14) Method Performance

- 14.1 This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional method performance data available.
- 14.2 The method detection limit (MDL) is and related method reporting limit(s) were established using the procedure described in SOP *Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Quantification*. Method Reporting Limits are established for this method based on MDL studies and as specified in the ALS Quality Assurance Manual.

## 15) Pollution Prevention and Waste Management

- 15.1 The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Lab Waste Management Plan.

## 16) Training

- 16.1 All analysts performing this analysis are required to read and understand this SOP.
- 16.2 Training is documented following the *Employee Training and New Employee Orientation* (ADM-TRAIN).

## 17) Method Modifications

- 17.1 There are no known modifications from the reference method.

## 18) References

- 18.1 *Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry*, Method



8270D Revision 4, EPA Test Methods for Evaluating Solid Waste, SW-846, Update IV, February 2007..

- 18.2 DoD Quality Systems Manual for Environmental Laboratories current version.
- 18.3 TNI Standard, Volume 1- 2009, 2016.
- 18.4 ANSI/ISO/IEC 17005:2005/2017 American National Standard, General requirements for the competence of testing and calibration laboratories.
- 18.5 ALS-Kelso SOPS
  - 18.5.1 Continuous Liquid-Liquid Extraction, EXT-3520
  - 18.5.2 Solid Phase Extraction, EXT-3535
  - 18.5.3 Automated Soxhlet Extraction, EXT-3541
  - 18.5.4 Silica Gel Cleanup, EXT-3630
  - 18.5.5 Gel Permeation Chromatography, EXT-3640

## 19) Changes Since the Last Revision

Summary of Revision Changes			
Rev. #	Effective Date	Document Editor	Description of Changes
9.0	12/2/2020	T CARON	Reformatted SOP to current ALS brand. Minor typographical, grammatical and format changes to improve readability not affecting content. Section 1: Removed obsolete reference to the MDL found in Table 1. Section 6: Added Methylene Chloride exposure control plan. Updated safety references, where applicable throughout the document. Section 11.1: Subsampling and compositing performed by the Soil Prep Department, replacing General Chemistry. Section: 11.2.1.9 Removed obsolete Stealth reference Section 21: Added updated extraction benchsheet associated with SVM-AQ Revision 1.0. Section 7.1 & 7.2 updated collection and storage requirements

## 20) Attachments, Tables, and Appendices

- 20.1 Table 1A –Water and Soil Target Analytes.
- 20.2 Table 1B –Tissue Target Analytes.
- 20.3 Table 2 – Target Compounds and Corresponding Primary and secondary Quantitation Ions.
- 20.4 Table 3- Semi-Volatile Internal Standards with Corresponding Analytes assigned for Quantitation.
- 20.5 Table 4 – DFTPP Key Ions and Ion Abundance Criteria.
- 20.6 Table 4A – DFTPP Key Ions and Ion Abundance Criteria for 5973 and newer GC/MS.



20.7 Table 5 – Target Compounds and Recommended Minimum RT.

**Table 1A**  
**Water and Soil Target Analytes**

<b>ANALYTE</b>	<b>CAS No.</b>	<b>MATRIX</b>	<b>MRL</b>	<b>UNITS</b>
Pentachlorophenol	87-86-5	Soil	200	µg/kg
1,4-Dioxane	123-91-1	Soil	5.0	µg/Kg
PBDE 100	189084-64-8	Soil	0.1	µg/Kg
PBDE 128	CASID30336	Soil	0.1	µg/Kg
PBDE 138	182677-30-1	Soil	0.1	µg/Kg
PBDE 153	68631-49-2	Soil	0.1	µg/Kg
PBDE 154	207122-15-4	Soil	0.1	µg/Kg
PBDE 17	147217-75-2	Soil	0.1	µg/Kg
PBDE 183	207122-16-5	Soil	0.1	µg/Kg
PBDE 190	CASID30338	Soil	0.1	µg/Kg
PBDE 203	CASID30339	Soil	0.1	µg/Kg
PBDE 206	63936-56-1	Soil	1.0	µg/Kg
PBDE 209	1163-19-5	Soil	1.0	µg/Kg
PBDE 28	41318-75-6	Soil	0.1	µg/Kg
PBDE 47	5436-43-1	Soil	0.1	µg/Kg
PBDE 66	189084-61-5	Soil	0.1	µg/Kg
PBDE 71	189084-62-6	Soil	0.1	µg/Kg
PBDE 85	182346-21-0	Soil	0.1	µg/Kg
PBDE 99	60348-60-9	Soil	0.1	µg/Kg
PBDE 47C13 (surr.)	CASID30341	Soil	NA	%
PBDE 99C13 (surr.)	CASID30342	Soil	NA	%
1,4-Dioxane-d <sub>8</sub> (surr.)	17647-74-4	Soil	NA	%
Pentachlorophenol	87-86-5	Water	1.0	µg/L
1,4-Dioxane	123-91-1	Water	1.0	µg/L
Di(propylene glycol) butyl ether	29911-28-2	Water	0.25	µg/L
PBDE 100	189084-64-8	Water	1.0	ng/L
PBDE 128	CASID30336	Water	1.0	ng/L
PBDE 138	182677-30-1	Water	1.0	ng/L
PBDE 153	68631-49-2	Water	1.0	ng/L
PBDE 154	207122-15-4	Water	1.0	ng/L
PBDE 17	147217-75-2	Water	1.0	ng/L
PBDE 183	207122-16-5	Water	1.0	ng/L
PBDE 190	CASID30338	Water	1.0	ng/L
PBDE 203	CASID30339	Water	1.0	ng/L
PBDE 206	63936-56-1	Water	10	ng/L
PBDE 209	1163-19-5	Water	10	ng/L
PBDE 28	41318-75-6	Water	1.0	ng/L
PBDE 47	5436-43-1	Water	1.0	ng/L
PBDE 66	189084-61-5	Water	1.0	ng/L
PBDE 71	189084-62-6	Water	1.0	ng/L



**Table 1A Continued**

<b>ANALYTE</b>	<b>CAS No.</b>	<b>MATRIX</b>	<b>MRL</b>	<b>UNITS</b>
PBDE 85	182346-21-0	Water	1.0	ng/L
PBDE 99	60348-60-9	Water	1.0	ng/L
PBDE 99C13 (Surr.)	CASID30342	Water	NA	%
PBDE 47C13 (Surr.)	CASID30341	Water	NA	%
1,4-Dioxane-d <sub>8</sub> (Surr.)	17647-74-4	Water	NA	%



**TABLE 1B**  
**Tissue Target Analytes**

<b>ANALYTE</b>	<b>CAS No.</b>	<b>MATRIX</b>	<b>MRL</b>	<b>UNITS</b>
1,2,4,5-Tetrachlorobenzene	95-94-3	Tissue	40	µg/Kg
1,2,4-Trichlorobenzene	120-82-1	Tissue	40	µg/Kg
1,2-Dichlorobenzene	95-50-1	Tissue	40	µg/Kg
1,3-Dichlorobenzene	541-73-1	Tissue	40	µg/Kg
1,4-Dichlorobenzene	106-46-7	Tissue	40	µg/Kg
2,3,4,6-Tetrachlorophenol	58-90-2	Tissue	40	µg/Kg
2,4,5-Trichlorophenol	95-95-4	Tissue	40	µg/Kg
2,4,6-Trichlorophenol	88-06-2	Tissue	40	µg/Kg
2,4-Dichlorophenol	120-83-2	Tissue	40	µg/Kg
2,4-Dimethylphenol	105-67-9	Tissue	40	µg/Kg
2,4-Dinitrophenol	51-28-5	Tissue	500	µg/Kg
2,4-Dinitrotoluene	121-14-2	Tissue	80	µg/Kg
2,6-Dinitrotoluene	606-20-2	Tissue	40	µg/Kg
2-Chloronaphthalene	91-58-7	Tissue	40	µg/Kg
2-Chlorophenol	95-57-8	Tissue	40	µg/Kg
2-Methyl-4,6-dinitrophenol	534-52-1	Tissue	500	µg/Kg
2-Methylnaphthalene	91-57-6	Tissue	40	µg/Kg
2-Methylphenol	95-48-7	Tissue	40	µg/Kg
2-Nitroaniline	88-74-4	Tissue	200	µg/Kg
2-Nitrophenol	88-75-5	Tissue	40	µg/Kg
3-Nitroaniline	99-09-2	Tissue	400	µg/Kg
4-Bromophenyl Phenyl Ether	101-55-3	Tissue	40	µg/Kg
4-Chloro-3-methylphenol	59-50-7	Tissue	40	µg/Kg
4-Chlorophenyl Phenyl Ether	7005-72-3	Tissue	40	µg/Kg
4-Methylphenol	106-44-5	Tissue	40	µg/Kg
4-Nitroaniline	100-01-6	Tissue	400	µg/Kg
4-Nitrophenol	100-02-7	Tissue	40	µg/Kg
Acenaphthene	83-32-9	Tissue	40	µg/Kg
Acenaphthylene	208-96-8	Tissue	40	µg/Kg
Acetophenone	98-86-2	Tissue	80	µg/Kg
Anthracene	120-12-7	Tissue	40	µg/Kg
Azobenzene	103-33-3	Tissue	40	µg/Kg
Benz(a)anthracene	56-55-3	Tissue	40	µg/Kg
Benzo(a)pyrene	50-32-8	Tissue	40	µg/Kg
Benzo(b)fluoranthene	205-99-2	Tissue	40	µg/Kg
Benzo(g,h,i)perylene	191-24-2	Tissue	40	µg/Kg
Benzo(k)fluoranthene	207-08-9	Tissue	40	µg/Kg
Benzyl Alcohol	100-51-6	Tissue	40	µg/Kg
Biphenyl	92-52-4	Tissue	40	µg/Kg
Bis(2-chloroethoxy)methane	111-91-1	Tissue	40	µg/Kg
Bis(2-chloroethyl) Ether	111-44-4	Tissue	40	µg/Kg
Bis(2-chloroisopropyl) Ether	39638-32-9	Tissue	40	µg/Kg
Bis(2-ethylhexyl) Phthalate	117-81-7	Tissue	200	µg/Kg
Butyl Benzyl Phthalate	85-68-7	Tissue	40	µg/Kg



**TABLE 1B**  
**Tissue Target Analytes (continued)**

Caprolactam	105-60-2	Tissue	200	µg/Kg
Carbazole	86-74-8	Tissue	40	µg/Kg
Chrysene	218-01-9	Tissue	40	µg/Kg
Dibenz(a,h)anthracene	53-70-3	Tissue	40	µg/Kg
Dibenzofuran	132-64-9	Tissue	40	µg/Kg
Diethyl Phthalate	84-66-2	Tissue	40	µg/Kg
Dimethyl Phthalate	131-11-3	Tissue	40	µg/Kg
Di-n-butyl Phthalate	84-74-2	Tissue	100	µg/Kg
Di-n-octyl Phthalate	117-84-0	Tissue	40	µg/Kg
Fluoranthene	206-44-0	Tissue	40	µg/Kg
Fluorene	86-73-7	Tissue	40	µg/Kg
Hexachlorobenzene	118-74-1	Tissue	40	µg/Kg
Hexachlorobutadiene	87-68-3	Tissue	40	µg/Kg
Hexachloroethane	67-72-1	Tissue	40	µg/Kg
Indeno(1,2,3-cd)pyrene	193-39-5	Tissue	40	µg/Kg
Isophorone	78-59-1	Tissue	40	µg/Kg
Naphthalene	91-20-3	Tissue	40	µg/Kg
Nitrobenzene	98-95-3	Tissue	40	µg/Kg
N-Nitrosodimethylamine	62-75-9	Tissue	200	µg/Kg
N-Nitrosodi-n-propylamine	621-64-7	Tissue	40	µg/Kg
N-Nitrosodiphenylamine	86-30-6	Tissue	40	µg/Kg
Pentachlorophenol	87-86-5	Tissue	100	µg/Kg
Phenanthrene	85-01-8	Tissue	40	µg/Kg
Phenol	108-95-2	Tissue	100	µg/Kg
Pyrene	129-00-0	Tissue	40	µg/Kg
2,4,6-Tribromophenol (Surr.)	118-79-6	Tissue	NA	%
2-Fluorobiphenyl (Surr.)	321-60-8	Tissue	NA	%
2-Fluorophenol (Surr.)	367-12-4	Tissue	NA	%
Nitrobenzene-d <sub>5</sub> (Surr.)	4165-60-0	Tissue	NA	%
Phenol-d <sub>5</sub> (Surr.)	13127-88-3	Tissue	NA	%
Terphenyl-d <sub>14</sub> (Surr.)	1718-51-0	Tissue	NA	%



**TABLE 2**  
**TARGET COMPOUNDS AND CORRESPONDING PRIMARY AND SECONDARY QUANTITATION IONS**

<b>Compound</b>	<b>Primary Ion</b>	<b>Secondary Ion</b>
Phenol	94	66
1,3-Dichlorobenzene	146	148,111
1,4-Dichlorobenzene-d <sub>4</sub> (I.S.)	152	150
1,4-Dichlorobenzene	146	148,111
1,2-Dichlorobenzene	146	79148,111
Benzyl alcohol	79	108,77
2-Methylphenol	108	77
Hexachloroethane	117	119,121
3-and 4-Methylphenol (coelute)	108	77
2,4-Dimethylphenol	122	107
1,2,4-Trichlorobenzene	180	182,145
Naphthalene-d <sub>8</sub> (I.S.)	136	68
Naphthalene	128	127
Benzoic acid	122	105
Hexachlorobutadiene	225	227,223
2-Methylnaphthalene	141	142
Acenaphthylene	152	153
Dimethyl phthalate	163	164,194
Acenaphthlene-d <sub>10</sub> (I.S.)	164	162
Acenaphthene	154	153
Dibenzofuran	168	139
Fluorene	166	165
Diethyl phthalate	149	177
N-Nitrosodiphenylamine	169	168,167
Hexachlorobenzene	284	249,142
Pentachlorophenol	266	268
Phenanthrene-d <sub>10</sub> (I.S.)	188	94
Phenanthrene	178	179
Anthracene	178	176
Di-n-butyl phthalate	149	150
Fluoranthene	202	203
Pyrene	202	203
Butyl Benzyl Phthalate	149	91,206
Benz (a) anthracene	228	226
Chrysene-d <sub>12</sub> (I.S.)	240	236
Chrysene	228	226



**TABLE 2**  
**TARGET COMPOUNDS AND CORRESPONDING PRIMARY AND SECONDARY QUANTITATION IONS**  
**(continued)**

Bis (2-ethylhexyl) phthalate	149	167,279
Di-n-octyl phthalate	149	150,279
Benzo(b)fluoranthene	252	126
Benzo(k)fluoranthene	252	126
Benzo(a)pyrene	252	126
Perylene-d <sub>12</sub> (I.S.)	264	260
Indeno (1,2,3-cd) pyrene	276	277
Dibenz (a, h) anthracene	278	279
Benzo(g,h,i)perylene	276	277
2-Fluorophenol (surr.)	112	64
Phenol-d <sub>6</sub> (surr.)	99	71
Nitrobenzene-d <sub>5</sub> (surr.)	82	128
2-Fluorobiphenyl (surr.)	172	171
2,4,6-Tribromophenol (surr.)	330	332
Terphenyl-d <sub>14</sub> (surr.)	244	122
1,4-Dioxane	88	58,43
1,4-Dioxane-d <sub>8</sub>	96	64,48
2-Methylphenol	151	166,152
4-Methylphenol	165	180,90
2-Chlorophenol	185	200,93
2,4-Dimethylphenol	194	179,105
Benzoic Acid	179	105,135,194
4-Chloro-3-methylphenol	199	214,201
2,4-Dichlorophenol	219	234,183
2-Nitrophenol	196	151,197
2,4,6-Trichlorophenol	253	255,270
2,4,5-Trichlorophenol	253	255,270
4-Nitrophenol	196	211,150
2,3,4,6-Tetrachlorophenol	289	287,304
Pentachlorophenol	323	325,338
2-Fluorophenol (surr.)	91	184
Phenol-d <sub>6</sub> (surr.)	156	171
2,4,6-Tribromophenol (surr.)	389	404,227



TABLE 3

SEMIVOLATILE INTERNAL STANDARDS WITH CORRESPONDING ANALYTES ASSIGNED FOR  
QUANITATION\*

**1,4-Dichlorobenzene-d<sub>4</sub>**

Phenol  
Benzyl Alcohol  
1,3-Dichlorobenzene  
1,4-Dichlorobenzene  
1,2-Dichlorobenzene  
2-Fluorophenol (surr.)  
Hexachloroethane  
Phenol-d<sub>6</sub> (surr.)  
Nitrobenzene-d<sub>5</sub> (surr.)

**Naphthalene-d<sub>8</sub>**

Benzoic Acid  
2,4-Dimethylphenol  
Hexachlorobutadiene  
Naphthalene  
1,2,4-Trichlorobenzene  
2-Methylnaphthalene  
2-Methylphenol  
4-Methylphenol

**Acenaphthene-d<sub>10</sub>**

Acenaphthene  
Acenaphthylene  
Dibenzofuran  
Diethyl phthalate  
Dimethyl phthalate  
Fluorene  
2-Fluorobiphenyl (surr.)  
Hexachlorocyclopentadiene  
N-Nitrosodiphenylamine

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**Phenanthrene-d<sub>10</sub>**

Anthracene  
Di-n-butyl phthalate  
Hexachlorobenzene  
Pentachlorophenol  
Phenanthrene  
2,4,6-Tribromophenol (surr.)  
Fluoranthene

**Chrysene-d<sub>12</sub>**

Benzo(a) anthracene  
Bis (2-ethylhexyl)phthalate  
Butyl benzyl phthalate  
Chrysene  
Pyrene  
Terphenyl-d<sub>14</sub> (surr.)

**Perylene-d<sub>12</sub>**

Benzo(b)fluoranthene  
Benzo(k)fluoranthene  
Benzo(g,h,i)perylene  
Dibenz(a,h)anthracene  
Benzo(a)pyrene  
Indeno (1,2,3-cdd)pyrene  
Di-n-octyl-phthalate

\* Example list only



**TABLE 4**  
**DFTPP KEY IONS AND ION ABUNDANCE CRITERIA**

<u>Mass</u>	<u>Ion Abundance Criteria</u>
51	30-60% of mass 198
68	< 2% of mass 69
70	< 2% of mass 69
127	40-60% of mass 198
197	< 1% of mass 198
198	Base peak, 100% relative abundance
199	5-9% of mass 198
275	10-30% of mass 198
365	> 1% of mass 198
441	Present but less than mass 443
442	> 40% of mass 198
443	17-23% of mass 442

**TABLE 4A**  
**DFTPP KEY IONS AND ION ABUNDANCE CRITERIA**  
**FOR 5973 and newer GC/MS Systems**

<u>Mass</u>	<u>Ion Abundance Criteria</u>
51	10-80% of mass 198
68	0-2% of mass 69
70	0-2% of mass 69
127	10-80% of 198
197	0-2% of 198
198	30-100% of 442 (alternate base)
199	5-9% of 198
275	10-60% of 198
365	1-50% of 442
441	0.01-100% of 443
442	30-100% of 198 (alternate base)
443	15-24% of 442

Alternate tuning criteria (from Method 525.2 or CLP OLM04.2) may be used provided that method performance is not adversely affected and that method performance criteria is met. The criteria used must be the same for all ion abundance criteria checks associated with a given analysis. For example, initial calibration, continuing calibration(s), QC, and sample analyses for a given sample must all use the same criteria.



**TABLE 5**  
**TARGET COMPOUNDS AND RECOMMENDED MINIMUM RF**

<b>Compound</b>	<b>Min RF</b>
Phenol	0.800
1,3-Dichlorobenzene	0.050
1,4-Dichlorobenzene-d <sub>4</sub> (I.S.)	-
1,4-Dichlorobenzene	0.050
1,2-Dichlorobenzene	0.050
Benzyl alcohol	0.050
2-Methylphenol	0.700
Hexachloroethane	0.050
3-and 4-Methylphenol (coelute)	0.600
2,4-Dimethylphenol	0.200
1,2,4-Trichlorobenzene	0.050
Naphthalene-d <sub>8</sub> (I.S.)	-
Naphthalene	0.700
Benzoic acid	0.050
Hexachlorobutadiene	0.010
2-Methylnaphthalene	0.400
Acenaphthylene	0.900
Dimethyl phthalate	0.01
Acenaphthylene-d <sub>10</sub> (I.S.)	-
Acenaphthene	0.900
Dibenzofuran	0.800
Fluorene	0.900
Diethyl phthalate	0.010
N-Nitrosodiphenylamine	0.010
Hexachlorobenzene	0.100
Pentachlorophenol	0.050
Phenanthrene-d <sub>10</sub> (I.S.)	-
Phenanthrene	0.700
Anthracene	0.700
Di-n-butyl phthalate	0.010
Fluoranthene	0.600
Pyrene	0.600
Butyl Benzyl Phthalate	0.010
Benz (a) anthracene	0.800
Chrysene-d <sub>12</sub> (I.S.)	-
Chrysene	0.700



**TABLE 5**  
**TARGET COMPOUNDS AND RECOMMENDED MINIMUM RF**  
**(continued)**

<b>Compound</b>	<b>Min RF</b>
Bis (2-ethylhexyl) phthalate	0.010
Di-n-octyl phthalate	0.010
Benzo(b)fluoranthene	0.700
Benzo(k)fluoranthene	0.700
Benzo(a)pyrene	0.700
Perylene-d <sub>12</sub> (I.S.)	-
Indeno (1,2,3-cd) pyrene	0.500
Dibenz (a, h) anthracene	0.400
Benzo(g,h,i)perylene	0.500
2-Fluorophenol (surr.)	-
Phenol-d <sub>6</sub> (surr.)	-
Nitrobenzene-d <sub>5</sub> (surr.)	-
2-Fluorobiphenyl (surr.)	-
2,4,6-Tribromophenol (surr.)	-
Terphenyl-d <sub>14</sub> (surr.)	-
1,4-Dioxane	0.010
1,4-Dioxane-d <sub>8</sub> (surr.)	0.010
<b>Derivatized Phenols</b>	
2-Methylphenol	0.05
4-Methylphenol	0.05
2-Chlorophenol	0.05
2,4-Dimethylphenol	0.05
Benzoic Acid	0.05
4-Chloro-3-methylphenol	0.05
2,4-Dichlorophenol	0.05
2-Nitrophenol	0.05
2,4,6-Trichlorophenol	0.05
2,4,5-Trichlorophenol	0.05
4-Nitrophenol	0.05
2,3,4,6-Tetrachlorophenol	0.05
Pentachlorophenol	0.05
2-Fluorophenol (surr.)	0.05
Phenol-d <sub>6</sub> (surr.)	0.05
2,4,6-Tribromophenol (surr.)	0.05



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## Chlorinated Pesticides by GC/MS/MS

DOCUMENT ID: SVM-PESTMS2, REV 7.0

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Approved By: Organics Manager, Jonathon Walter  
Signature on File

Approved By: Quality Assurance Manager, Kurt Clarkson  
Signature on File

Approved By: Laboratory Director, Charles (Pat) Byrne  
Signature on File

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## 1) Scope & Applicability

- 1.1. This Standard Operating Procedure (SOP) describes the method used for trace analysis of various chlorinated pesticides by high performance gas chromatography/tandem mass spectrometry (HPGC/MS/MS). This SOP describes both the extraction and chromatographic procedures used to determine the target analytes. Table 1 indicates compounds that may be determined by this method and lists their method reporting limits (MRLs) in water and soil. The reported MRL may be adjusted to meet specific project requirements; however, the capability of achieving other reported MRLs must be demonstrated. Method Detection Limits (MDLs) which have been achieved are also given. The Method Detection Limits (MDLs) will vary depending on the instrument used and preparation method.
- 1.2. This procedure is used to determine the concentrations of chlorinated pesticides in water, soil, and tissue using HPGC/MS/MS. The procedure may be applied to other miscellaneous sample matrices providing that the analyst demonstrates the ability of the procedure to give data of acceptable quality in that matrix.

## 2) Summary of Procedure

- 2.1 This SOP describes HPGC/MS/MS conditions for the detection chlorinated pesticides. Prior to the use of this method, an appropriate sample preparation method must be used to recover the analytes of interest. Stable, isotopically labeled analogs of the analytes of interest are spiked into the samples before they are extracted. They are used to both assess the efficiency of the extraction and to quantitate the analytes of interest.
- 2.2 A 5.0 µL aliquot of the extract is injected into the gas chromatograph (GC). The compounds are separated on a fused silica capillary column. Compounds of interest are detected by a mass selective detector. Identification of the analytes of interest is performed by comparing the retention times of the analytes with the respective retention times of an authentic standard, and by comparing the ratio of the two parent/daughter transitions acquired for each compound with the same ratio in the CCV Standard. Quantitative analysis is performed by using the authentic standard to produce a response factor and calibration curve, and using the calibration data to determine the concentration of an analyte in the extract. The concentration in the sample is calculated using the sample weight or volume and the extract volume.
- 2.3 The following compounds may require special treatment when being determined by this method. DDT and Endrin are subject to thermal decomposition in the inlet of the gas chromatograph. Endosulfan I, Endosulfan II, Dieldrin, Endrin, Endrin aldehyde, and Endrin ketone produce relatively low response areas due to their fragmentation patterns.

## 3) Definitions

- 3.1 For environmental laboratory quality definitions, guidance on analytical calibration and sample batches, refer to the SOP for Sample Batches, ADM-BATCH.

## 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in

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accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.

- 4.2 It is the responsibility of the department supervisor/manager to document analyst training and method proficiency, as described in: *Employee Training and Orientation* (ADM-TRAIN).

## 5) Interferences

- 5.1 The GC/MS data from all blanks, samples, and spikes must be evaluated for interferences. Determine if the source of interference is in the preparation of the samples. Corrective action should be taken to eliminate the interferences.
- 5.2 Contamination by carryover can occur whenever high-concentration and low-concentration samples are sequentially analyzed. To reduce carryover, the sample syringe must be rinsed out between samples with solvent. Whenever an unusually concentrated sample is encountered, it should be followed by the analysis of solvent to check for cross contamination.
- 5.3 The reporting limits for these analytes are in the low ppb to ppt level. Therefore, low level background contamination is a concern when conducting this method. Solvents, reagents, glassware and other sample processing hardware may yield discrete artifacts and/or elevated baselines, causing misinterpretation of the chromatograms. All of these materials must be demonstrated to be free from interferences.

## 6) Safety

- 6.1 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.
- 6.2 This method uses Methylene Chloride, a known human carcinogen. Viton brand gloves should be used while rinsing, pouring or transferring the solvent.

## 7) Sample Collection, Containers, Preservation, and Storage

- 7.1 Containers used to collect samples should be purchased pre-cleaned containers. Alternatively, containers used to collect samples for the determination of pesticides may be soap and water washed followed by methanol (or isopropanol) rinsing. The sample containers should be of glass or Teflon and have screw-top covers with Teflon liners. In situations where Teflon is not available, solvent-rinsed aluminum foil may be used as a liner. Highly acidic or basic samples may react with the aluminum foil, causing eventual contamination of the sample. Plastic containers or lids may not be used for the storage of samples due to the possibility of sample contamination from the phthalate esters and other hydrocarbons within the plastic.
- 7.2 Sample containers should be filled with care so as to prevent any portion of the collected sample coming in contact with the sampler's gloves, thus causing contamination. Samples should not be collected or stored in the presence of exhaust fumes. If the



sample comes in contact with the sampler (e.g., if an automatic sampler is used), run reagent water through the sampler and use the rinsate as a field blank.

- 7.3 Water and soil samples must be iced or refrigerated at 0-6°C from time of collection until extraction.
- 7.4 Tissue samples should be kept frozen until they are extracted to minimize decomposition.
- 7.5 Water samples must be extracted within 7 days and the extracts analyzed within 40 days following extraction. Solid, mixed-phase, semi-solid, tissue, and oily samples - Extract and analyze within 1 year of collection. If a sample is to be stored for more than 14 days, and results are to be reported in solids units, either hermetically seal the sample container or determine the moisture content upon receipt and immediately prior to analysis. Adjust the final concentration based on the original moisture content. Extracts are stored at <-10°C and analyzed within 40 days of extraction.

## 8) Standards, Reagents, and Consumable Materials

- 8.1 Solvents: Acetone, methylene chloride, methanol, hexane, and other appropriate solvents. Solvents must be of sufficient purity to permit usage without lessening the accuracy of the determination or introducing interferences.
- 8.2 Stock Standard Solutions
  - 8.2.1 Commercially prepared stock standards are typically used, and are available from several vendors. They must be A2LA or ISO9000 certified by the manufacturer. Standard concentrations can be verified by comparison versus an independently prepared standard. Alternatively, prepare stock standard solutions at a concentration of 1000 µg/ml by dissolving 0.0100 g of reference material in hexane, methylene chloride or other suitable solvent and diluting to volume in a 10mL volumetric flask. Larger volumes can be used at the convenience of the analyst. When compound purity is assayed to be 96% or greater, the weight can be used without correction to calculate the concentration of the stock standard.
  - 8.2.2 Transfer the stock standard solutions into Teflon-sealed screw-cap bottles. Store at -10°C and protect from light, or store as recommended by the manufacturer. Stock standards should be checked frequently for signs of degradation or evaporation, especially just prior to preparing calibration standards from them.
  - 8.2.3 Stock standard solutions must be replaced after one year, or sooner, if comparison with check standards or samples indicates a problem.
- 8.3 Instrument Internal Standard - 10 ul of a 10ug/ml Pyrene-d10 solution is added to each 1 ml sample extract undergoing analysis. The resulting concentration of the standard is 100ng/mL. Store at 0-6°C when not being used. When using premixed certified solutions, store according to the manufacturer's recommendations. Other internal standards can be used as long as they do not interfere with the target analytes, and have similar retention times.



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- 8.4 DDT/Endrin calibration standard. A hexane solution containing 20ng/mL of 4,4'-DDT, 4,4'-DDE, 4,4'-DDD, Endrin, Endrin Ketone, Endrin aldehyde, and 100ng/mL of the instrument internal standard.
- 8.5 DDT/ Endrin Standard - A hexane solution containing 20ng/ml of 4,4'-DDT, and Endrin, and 100ng/ml of the instrument internal standard. This is used to verify injection port inertness and GC column performance. Store at 0-6°C when not being used, or store according to the manufacturer's recommendations.
- 8.6 Calibration Standards
- 8.6.1 A minimum of eight initial calibration standards should be prepared from stock solutions. One of the calibration standards should be at a concentration at or below the method reporting limit; the others should correspond to the range of concentrations found in real samples, but should not exceed the working range of the GC/MS system. At least one calibration standard must be at a concentration corresponding to a sample concentration meeting project-specific data quality objectives. Each standard should contain each analyte for detection by this method. Each 1 ml aliquot of calibration standards should be spiked with 10 µL of the internal standard solution prior to analysis. All calibration standards should be stored at 0-6°C or less and should be freshly prepared once a year, or sooner if check standards indicate a problem.
- 8.6.2 The daily calibration standard (CCV) is prepared at a nominal 20 ng/ml concentration from stock solutions. The CCV is prepared weekly and can be stored at 0-6°C, or as recommended by the manufacturer.
- 8.7 QC Standards
- 8.7.1 Labeled internal standards: These are isotopically labeled of the pesticides being analyzed. Prepare a working solution in acetone containing the following: Hexachlorobenzene<sup>13</sup>C<sub>6</sub>, Chlorpyrifos-d<sup>10</sup>, gamma.BHC-d<sub>6</sub>, Aldrin<sup>13</sup>C<sub>12</sub>, Heptachlor<sup>13</sup>C<sub>10</sub>, Endrin<sup>13</sup>C<sub>12</sub>, cis-Heptachlorepoxyde<sup>13</sup>C<sub>10</sub>, Oxychlordane<sup>13</sup>C<sub>10</sub>, Octachlorostyrene<sup>13</sup>C<sub>8</sub>, Isodrin<sup>13</sup>C<sub>12</sub>, Methoxychlor-d<sub>6</sub>, Endrin ketone<sup>13</sup>C<sub>12</sub>, 4,4'-DDD-d<sub>4</sub>, 4,4'-DDT-d<sub>4</sub>, and Mirex<sup>13</sup>C<sub>10</sub> at the concentrations listed in Table 4. Aliquots of the solution are spiked into all extracted samples, blanks, and QC samples according to the extraction SOP used. All labeled internal standards should be stored at 4 ±2°C or less. General expiration guidelines do not apply to labeled isotopes, but standard should be freshly prepared once a year, or sooner if problems are identified. To certify that the labeled internal standards are not degraded or concentrated from storage, and still suitable for use: prepare and analyze a standard containing the labeled standards and the unlabeled target analytes at 100 ng/ml. The ratio of: Labeled Compound Area/ Unlabeled Compound Area should be between 0.5-1.5.
- 8.7.2 Matrix Spike Standards: Prepare a working solution in methanol containing all analytes of interest ("full list spike") from the standard

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analyte list (Table1) at 200ng/mL. Aliquots of the solution are spiked into the selected QC aliquots according to the extraction SOP used.

**Note:** The spiking level of Labeled internal standards and spike may need to be adjusted according to project requirements, if dilutions are expected due to high levels of extracted components, or if a lower calibration range is used.

## 9) Apparatus and Equipment

### 9.1 Gas Chromatograph/Mass Spectrometer System

- 9.1.1 Gas Chromatograph - An analytical system complete with a temperature-programmable gas chromatograph suitable for large volume cool splitless injection and all required accessories, including syringes, analytical columns, and gases. The capillary column should be directly coupled to the source. Agilent 6890N equipped with the Agilent PTV injector recommended.
- 9.1.2 Column: ZB-Multiresidue-1 30 m x 0.25 mm ID x 0.25 µm film thickness silicone-coated fused-silica capillary column or equivalent. Recommended: Phenomenex #7HG-G016-11.
- 9.1.3 MS/MS System – Waters Micromass Quattro Micro GC, tandem mass spectrometer or equivalent.
- 9.1.4 Data System - A computer system must be interfaced to the mass spectrometer. The system must allow the continuous acquisition and storage on machine-readable media of all mass spectra obtained throughout the duration of the chromatographic program. The computer must have software that can search any GC/MS data file for ions of a specific mass and that can plot such ion abundances versus time or scan number. ( Waters MassLynx or equivalent ) This type of plot is defined as an Extracted Ion Current Profile (EICP). Software must also be available that allows integrating the abundances in any EICP between specified time or scan-number limits. The most recent version of the EPA/NIST Mass Spectral Library should also be available.
- 9.1.5 Appropriate analytical balance (0.0001 g), volumetric flasks, syringes, vials, and bottles for standards preparation.

## 10) Preventative Maintenance

- 10.1 All maintenance activities are recorded in a maintenance logbook kept for each instrument.
- 10.2 Carrier gas - Inline purifiers or scrubbers should be in place for all sources of carrier gas. These are selected to remove water, oxygen, and hydrocarbons. Purifiers should be changed as recommended by the supplier.
- 10.3 Gas Chromatograph



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- 10.3.1 Whenever GC maintenance is performed, care should be taken to minimize the introduction of air or oxygen into the column. Injection port maintenance includes changing the injection port liner, seal, washer, O-ring, septum, column ferrule, and autosampler syringe as needed. Liners and seals should be changed when recent sample analyses predict a problem with chromatographic performance. In some cases liners and seals may be cleaned and re-used.
- 10.3.2 Clipping off a small portion of the head of the column often improves chromatographic performance. When cutting off any portion of the column, make sure the cut is straight and "clean" (uniform, without fragmentation) by using the proper column cutting tool.
- 10.3.3 Over time, the column will exhibit poorer overall performance, as contaminated sample matrices are analyzed. The length of time for this to occur will depend on the samples analyzed. When a noticeable decrease in column performance is evident and other maintenance options do not result in improvement, the column should be replaced. This is especially true when evident in conjunction with calibration difficulties.

#### 10.4 Mass Spectrometer

- 10.4.1 For units under service contract, certain maintenance is performed by instrument service staff, including pump oil changed, vacuuming boards, etc., as recommended by the manufacturer.
- 10.4.2 MS source cleaning should be performed as needed, depending on the performance of the unit. This may be done by the analyst or by instrument service staff.

## 11) Procedure

### 11.1 Sample Preparation

#### 11.1.1 Water samples

- 11.1.1.1 Water samples are prepared using solid phase extraction (SPE) and EPA method 3510. Refer to the ALS SOP EXT-3510. Alternative extraction procedures such as EPA 3520 may be used for aqueous samples not suitable for 3510.
- 11.1.1.2 Perform the extraction on a 1000mL aliquot of sample. For heavily contaminated samples use a smaller volume or dilute the sample before extraction.

- 11.1.2 Soil, sediment, and solid samples are prepared using automated soxhlet extraction (SOP EXT-3541). The nominal sample size is 10g. Sample amounts may be decreased in the case of high-concentration waste samples.



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- 11.1.3 Tissue samples are prepared using automated soxhlet extraction (SOP EXT-3541). The nominal sample size is 2.0g.
- 11.1.4 Product samples may not be analyzed by this method.
- 11.1.5 Extracts should be screened by GC/FID (SOP SOC-SCR). Cleanup by GPC, and carbon columns is mandatory for soil and tissue samples, and may be needed for contaminated water samples. All colored extracts must be cleaned with carbon columns. GPC is used to remove lipids from tissue extracts.
- 11.1.6 Extracts are solvent exchanged to hexane before they are taken to final volume. The final volume for all extracts is 1.0ml.
- 11.1.7 Following sample preparation, sample extracts are then transferred to the extract cold storage unit. Extracts must be analyzed within 40 days of extraction.

## 11.2 Analysis

- 11.2.1 The recommended GC/MS operating conditions are listed below. The GC conditions may be modified to accommodate specific instrument models and configurations.

### GC Conditions

Injector	Agilent PTV
Mode	Solvent Vent, Ramped pressure
Injector liner:	Baffled, Restek Siltek Deactivated #21704-214.10
Injection volume:	5uL
Injection speed:	Slow
Post injection dwell:	1.0min
Carrier gas:	Helium @ 0.7 ml/min
Injector temperature:	20 - 320°C, temperature programmed

### GC Temperature program:

Initial temperature	65°C for 2 min
Initial ramp	65 - 240°C @ 20°C per min
Second ramp	240 - 280°C @ 6.1°C per min
Third ramp	280 - 310°C @ 15°C per min
Final Hold	0.7 min or until Mirex or the last analyte elutes

### Mass Spectrometer Conditions

Source temperature	225°C
Detector interface temp:	290°C
Trap Current	200
Collision Gas	Argon @ 2-3 × 10 <sup>-3</sup> torr
Tune file	dtrscan
Photomultiplier	650

- 11.2.2 Analysis sequence - Samples are analyzed in a set referred to as an



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analysis sequence. The sequence begins with injection of a DFTPP Standard, followed by a DDT/Endrin standard and then the initial calibration standards. Once calibrated, a CCV is evaluated and extracts can be run. The sequence ends after 12 hours based on the DFTPP injection time

- 11.2.3 Tune the MS as needed to maximize sensitivity for MS/MS analysis. For the Micromass Quattro micro GC in EI mode the parameters will be similar to these:

Electron Energy	70
Trap	200
Repeller	0.5
Extraction Lens	5.0
Focus lens 1	40
Focus Lens 3	45
LM1 Resolution	10
HM1 Resolution	10
Ion Energy 1	0.9
Entrance	-1
Collision	2
Exit	+1
LM 2 Resolution	12
HM 2 Resolution	12
Ion Energy 2	1.0
Multiplier	650

#### 11.2.4 Daily DFTPP Tune Verification

- 11.2.4.1 5ul of a 1.0ug/ml DFTPP standard is injected and analyzed in MRM mode to verify the MS/MS functioning of the instrument. The 442>198, 443>198, 198>110, 255>186, and the 127>77 transitions are monitored. Acceptance criteria are listed in table 8.

- 11.2.4.2 The analysis time for DFTPP is used to define the start of the 12-hour window in which all analyses must be performed. Once the instrument is tuned, all subsequent analyses of standards, samples, and QA/QC samples within the same 12-hour window must be analyzed using the identical mass spectrometer operating conditions.

#### 11.2.5 Initial Calibration

**NOTE:** The calibration procedure(s) and options chosen must follow the ALS protocols. Any exceptions to the calibration procedures detailed in the ALS SOP for Calibration of Instruments for Organics Chromatographic Analyses are described as follows:

- 11.2.5.1 To assess column performance and injection port inertness; first analyze 5uL of the DDT/Endrin calibration standard by MRM and update



the calibration file. Then analyze the DDT/Endrin standard and quantitate it against the DDT/Endrin calibration.

11.2.5.2 Calculate the DDT/Endrin breakdown as follows:

$$\%DDT = (4,4'\text{-DDE} + 4,4'\text{-DDD}) * 100 / (4,4'\text{-DDE} + 4,4'\text{-DDD} + 4,4'\text{-DDT})$$

$$\%\text{Endrin} = (\text{endrin aldehyde} + \text{endrin ketone}) * 100 / (\text{endrin aldehyde} + \text{endrin ketone} + \text{endrin})$$

11.2.5.3 DDT and Endrin degradation should not exceed 20%. If degradation of >20% is noted, the injection port may require cleaning. It may also be necessary to remove the first 15-30 cm of the GC column

11.2.5.4 The internal standards should permit most of the components of interest in the chromatogram to have retention times of 0.80-1.20 relative to one of the internal standards. Refer to Table 6 for internal standards and corresponding analytes assigned for quantitation.

11.2.5.5 Analyze 5.0  $\mu\text{L}$  of each calibration standard (containing internal standards) and tabulate the area of the primary characteristic ion against concentration for each compound (as indicated in Table 1). Calculate response factors (RFs) for each compound relative to one of the internal standards as follows:

$$RF = (A_x C_{is}) / (A_{is} C_x)$$

where:

$A_x$  = Area of the characteristic ion for compound being measured.

$A_{is}$  = Area of the characteristic ion for specific internal standard.

$C_{is}$  = Concentration of the specific internal standard ( $\text{ng}/\mu\text{L}$ ).

$C_x$  = Concentration of the compound being measured ( $\text{ng}/\mu\text{L}$ ).

11.2.5.6 The minimum RF for analytes and surrogates is 0.01

11.2.5.7 Calculate the %RSD for each analyte and internal standard.

$$\%RSD = \frac{SD}{\overline{RF}} \times 100$$

where:

RSD = relative standard deviation.

$\overline{RF}$  = mean of initial RFs for a compound.

SD = standard deviation of average RFs for a compound.



$$SD = \sqrt{\frac{\sum_{i=1}^N (RF_i - RF)^2}{N - 1}}$$

where:

RF<sub>i</sub> = RF for each of the calibration levels

N = Number of RF values (i.e., 8)

11.2.5.8 The % RSD should be less than 20% for each compound.

11.2.5.9 If the % RSD for any compound is  $\leq 20\%$ , linearity can be assumed over the calibration range, and the relative response factor for each analyte and surrogate is used.

11.2.5.10 If the %RSD for a compound is  $>20\%$ , then alternative calibration models should be used. See the SOP (SOC-CAL) Calibration of Instruments for Organics Chromatographic Analysis for further guidance.

#### 11.2.6 Independent Calibration Verification

11.2.6.1 Following initial calibration, analyze an ICV standard. The ICV solution must contain all analytes in the calibration standards. Calculate the concentration using the typical procedure used for quantitation. Calculate the percent difference (%D) from the ICV true value. The ICV should quantitate within 75–125 % of the target concentration.

### 11.3 Continuing Calibration

11.3.1 First analyze the DDT/Endrin breakdown standard as detailed in 11.3.1 to 11.3.3.

11.3.2 A mid-level calibration verification standard, containing all pesticides, labeled, and recovery internal standards must be analyzed every 12 hours during analysis. Calculate the percent drift using:

$$\% \text{ Drift} = \frac{C_t - C_m}{C_t} \times 100$$

where:

C<sub>t</sub> = Analyte standard concentration.

C<sub>m</sub> = Measured concentration using selected quantitation method.

11.3.3 If the percent drift for each analyte is less than or equal to 25%, the initial calibration is assumed to be valid. If no source of the problem can be determined after corrective action has been taken, a new multipoint calibration must be generated. This criterion must be met

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before sample analysis begins. If the % RSD for any analyte exceeds 25%, the analyst must determine if the response is sufficient to attain MRL for that analyte and any hits for that analyte must be rerun for quantitation.

- 11.3.4 The internal standard responses and retention times in the calibration verification standard must be evaluated immediately after or during data acquisition. If the retention time for the instrument internal standard changes by more than 30 seconds from that in the midpoint standard of the most recent initial calibration sequence, the chromatographic system must be inspected for malfunctions and corrective action identified, as required. If the EICP area for the PCB-52 13C12 internal standard changes by a factor of two (50% to 200%) from that in the midpoint standard of the most recent initial calibration sequence, the chromatographic system must be inspected for malfunctions and corrective action identified, as appropriate. When corrective action is taken, reanalysis of samples analyzed while the system was malfunctioning is required. Update retention times and transition ratios in the quantitation database for the instrument method or ID file. The initial calibration average RF or calibration curve is then used in the quantitation of subsequent analyses.
- 11.3.5 A blank (method blank, GPC blank, or solvent blank) should be analyzed after the CCV to prove the system is free of contaminants. If contaminants are found in a method blank or GPC blank, then a solvent blank should be ran to help isolate the source of contamination.

#### 11.4 GC/MS Analysis

- 11.4.1 Evaluate FID screen and make proper dilution (See FID screening SOP).
- 11.4.2 Spike the 1 mL extract obtained from sample preparation with 10 µL of the instrument internal standard solution just prior to analysis. Use the same operating conditions as were used for initial calibration.
- 11.4.3 If the response for any quantitation ion exceeds the initial calibration curve range of the GC/MS system, extract dilution must take place. Additional internal standard must be added to the diluted extract to maintain the required 100ng/ml of the instrument internal standard in the extract volume. The diluted extract must be reanalyzed.
- 11.4.4 If a dilution of more than 10X is required; re-extract the sample using a smaller aliquot or re-fortify the sample for further dilution with internal standard/labeled compounds.
- 11.4.5 Store the extracts at -10°C or less, protected from light in vials equipped with un-pierced Teflon lined septa. Archive the extract in freezer for 3 months after analysis in the instrument/date specific storage boxes.

## 12) QA/QC Requirements

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## 12.1 Initial Precision and Recovery Validation

12.1.1 The accuracy and precision of the procedure must be validated before analyses of samples begin, or whenever significant changes to the procedures have been made. To do this, four laboratory generated samples are spiked with the LCS spike solution, then prepared and analyzed. The acceptance criterion is the same as LCS criteria.

## 12.2 Method Detection Limits, Limits of Detection and Limits of Quantitation

12.2.1 Method detection limit (MDL), Limits of Detection (LOD) and Limits of Quantitation (LOQ) must be determined before analysis of samples can begin. Refer to, Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification.

12.2.2 Calculate the average concentration found (x) in ng/L, and the standard deviation of the concentrations (s) in ng/L for each analyte. Calculate the MDL for each analyte.

## 12.3 Ongoing QC Samples required are described in the ALS-Kelso Quality Assurance Manual and in the SOP for Sample Batches. In general, these include:

12.3.1 Method blank - A method blank is extracted and analyzed with every batch of 20 or fewer samples to demonstrate that there are no method interferences. The method blank must demonstrate that interferences from the analytical and preparation steps minimized. No target analytes should be detected above the MRL in the method blank. For some project specific needs, exceptions may be noted and method blank results above the MRL may be reported.

12.3.2 An LCS or Laboratory Control Sample must be extracted and analyzed with every batch of 20 or fewer samples. The LCS is prepared by spiking a blank with the matrix spike solution, and going through the entire extraction and analysis.

12.3.2.1 Calculate percent recovery (%R) as follows:

$$\%R = X/TV \times 100$$

Where:

X = Concentration of the analyte recovered

TV = True value of amount spiked

12.3.2.2 If the LCS recovery for any control analyte fails acceptance limits, corrective action is required. If instrument corrective action is not applicable or ineffective, re-extraction of the associated samples is required. If any other analyte fails the advisory acceptance limits, the analyst must evaluate the impact on data quality and take any necessary corrective action, which may include re-extraction of the associated



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samples. Project-specific requirements may require all compounds to be treated as control analytes, or dictate use of project acceptance criteria.

12.3.3 A matrix spike/duplicate matrix spike (MS/DMS) must be extracted and analyzed with every batch of 20 or fewer samples. The MS is prepared by spiking a sample aliquot with the matrix spike solution, and going through the entire extraction and analysis.

12.3.3.1 Calculate percent recovery (%R) as follows:

$$\%R = \frac{X - X1}{TV} \times 100$$

Where:

X = Concentration of the analyte recovered  
X1 = Concentration of unspiked analyte  
TV = True value of amount spiked

12.3.3.2 Calculate Relative Percent Difference (RPD) as:

$$\%RPD = \frac{|R1 - R2|}{(R1 + R2)/2} \times 100$$

Where:

R1 = recovered concentration in the MS  
R2 = recovered concentration in the DMS

12.3.4 If any internal standard recovery is outside acceptance criteria, the sample data must be closely evaluated for possible matrix interferences. If none are present, then corrective action must be taken. The sample should be re-analyzed if instrument factors (calibration, injection port) are suspected. If not, re-extraction and re-analysis is required, except in cases of high recovery and no positive hits in the sample for the analyte class represented by the particular surrogate.

12.4 Additional QA/QC measures include control charting of QC sample results.

### 13) Data Reduction and Reporting

13.1 Qualitative Analysis - The qualitative identification of compounds determined by this procedure is based on retention time, and the ratio of the quantitation transition and the qualifier transition. Compounds should be identified as present when the criteria below are met.

13.1.1 The intensities of the characteristic transitions of a compound maximize in the same scan or within one scan of each other. Selection of a peak

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by a data system target compound search routine where the search is based on the presence of a target chromatographic peak containing transitions specific for the target compound at a compound-specific retention time will be accepted as meeting this criterion.

- 13.1.2 The RRT of the sample component is within  $\pm 0.06$  RRT units of the RRT of the standard component.
- 13.1.3 The ratio of the quantitation transition/qualifier transition agrees within 30% of the ratio of these transitions in the reference spectrum.
- 13.1.4 Structural isomers that produce very similar transitions should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is  $<25\%$  of the sum of the 2 peak heights. Otherwise, structural isomers are identified as isomeric pairs.
- 13.1.5 Identification is hampered when sample components are not resolved chromatographically and produce mass spectra containing transitions contributed by more than one analyte. When gas chromatographic peaks appear to represent more than one sample component (i.e., a broadened peak with shoulder(s) or a valley between two or more maxima), appropriate selection of analyte spectra and background spectra is important. Examination of extracted transition current profiles of appropriate transitions can aid in the selection of spectra, and in qualitative identification. When analytes coelute, the identification criteria can be met, but each analyte spectrum will contain extraneous transitions contributed by the coeluting compound.

## 13.2 Quantitation and Calculations

- 13.2.1 The GC/MS/MS data stations, in current use, use the Waters MassLynx Integrator to generate the raw data used to calculate the standards  $\overline{RF}_x$  values, the sample amounts, and the spike values. The software does three passes through each data file. The first two identify and integrate each internal standard and surrogate. The third pass uses the time-drift information from the first two passes to search for all method analytes in the proper retention times and with the proper characteristic quantitation transitions.

When  $\overline{RF}_x$  is used, calculate the extract concentration as follows:

$$C_{ex} = \frac{(Resp_x)(Amt_{ISTD})}{(Resp_{ISTD})(\overline{RF}_x)}$$

Where:

C<sub>ex</sub> = the concentration in the sample extract (ppm);  
 Respx = the peak area of the analytes of interest;



Resp<sub>ISTD</sub> = the peak area of the associated internal standard;  
Amt<sub>ISTD</sub> = the amount, in ppm, of internal standard added  
= the average response from the initial calibration.

13.2.2 The concentration of analytes in the original sample is computed using the following equations:

Aqueous Samples:

When  $\overline{RF}_x$  is used, calculate the extract concentration as follows:

$$C_{ex} = \frac{(Resp_x)(Amt_{ISTD})}{(Resp_{ISTD})(\overline{RF}_x)}$$

Where:

C<sub>ex</sub> = Concentration in extract in µg/mL

V<sub>f</sub> = Final volume of extract in mL

D = Dilution factor

V<sub>s</sub> = Volume of sample extracted, liters

Non-aqueous Samples:

$$\text{Concentration (mg / Kg)} = \frac{(C_{ex})(V_f)(D)}{(W)}$$

Where C<sub>ex</sub> = Concentration in extract in µg/mL

V<sub>f</sub> = Final volume of extract in mL

D = Dilution factor

W = Weight of sample extracted in grams.

13.2.2.1 If the area of the quantitation transition for any of the pesticides exceeds the calibration range, dilute and reanalyze the extract. Add additional recovery internal standard to maintain its concentration at 100ng/ml.

13.2.2.2 If a dilution greater than 10X is required; re-extract the sample using a smaller aliquot.

13.2.2.3 If the recovery of any of the labeled internal standards is outside of the limits, extract and analyze a smaller aliquot of the sample or refortify if due to dilution. Adjust the MRL/MDL to account for this dilution.

### 13.3 Data Review

13.3.1 Following primary data interpretation and calculations, all data is

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reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the SOP for Laboratory Data Review Process for details.

#### 13.4 Reporting

13.4.1 Reports are generated using the STEALTH Data Reporting System which compiles the SMO login information and Enviroquant data. This compilation is then transferred to a file, which STEALTH uses to generate a report. The forms generated may be ALS standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.

13.4.2 As an alternative, reports are generated using [REDACTED] templates located in R:\SVM\forms. The analyst should choose the appropriate form and QC pages to correspond to required tier level and deliverables requirements. The detected analytes, surrogate and matrix spikes are then transferred, by hand or electronically, to the templates.

#### 14) Contingencies for Handling Our-of-Control or Unacceptable Data

14.1 Refer to the SOP for *Nonconformance and Corrective Action Procedures* (ADM-NCAR) for procedures for corrective action.

14.2 Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

#### 15) Method Performance

15.1 This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional method performance data available.

15.2 The method detection limit (MDL) is and related method reporting limit(s) were established using the procedure described in *SOP Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Quantification*. Method Reporting Limits are established for this method based on MDL studies and as specified in the ALS Quality Assurance Manual.

#### 16) Pollution Prevention and Waste Management

16.1 The laboratory will comply with all Federal, State and local regulations governing waste restrictions as specified in the ALS Lab Waste Management Plan.

#### 17) Training

17.1 All analysts performing this analysis are required to read and understand this SOP.

17.2 Training is documented following the Employee Training and New Employee Orientation (ADM-TRAIN).

#### 18) Method Modifications

18.1 N/A.

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## 19) References

- 19.1 *Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry, Method 8270C*, EPA Test Methods for Evaluating Solid Waste, SW-846, Final Update III, December 1996.
- 19.2 *Method 1699*, USEPA: *Pesticides in Water, Soil, Biosolids, and Tissue by HRGC/HRMS*, Office of Water, Office of Science and Technology, Engineering and Analysis Division. December 2007.
- 19.3 DoD Quality Systems Manual for Environmental Laboratories, current version.
- 19.4 TNI Standard, Volume 1, 2009 & 2016.
- 19.5 ISO/IEC 17025: 2017 American National Standard, General requirements for the competence of testing and calibration laboratories.

## 20) Changes Since the Last Revision

Rev. #	Effective Date	Document Editor	Description of Changes
7.0	4/22/2021	T.Caron	<p>Admin Changes not affecting technical content. Documented date of annual SOP Review, updated SOP signatories; boiler plate standard paragraphs and references.</p> <p>Section 7.5: New content added regarding solid, mixed-phase, semi-solid, tissue and oily samples.</p> <p>Section 12.3.2.2: LCS Recovery/acceptance has been updated.</p> <p>Section 12.3.3.3: MS/DMS acceptance/recovery has been removed.</p> <p>Sections 13.2.2.3&amp;12.3.4: Internal Standard Recovery/acceptance has been updated.</p> <p>Table 5: QC Acceptance Criteria has been removed.</p> <ul style="list-style-type: none"> <li>• Procedural Change Request submitted by J. Walter, on 4/16/2021.</li> <li>• Procedural Change Request submitted by J. Walter, on 4/21/2021.</li> </ul>

## 21) Attachments, Tables, and Appendices

- 21.1 Table 1: ORGANOCHLORINE PESTICIDES- STANDARD ANALYTE LIST.
- 21.2 Table 2 - Labeled Compound Spiking Solution.

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- 21.3 Table 3; Recovery Internal Standard Spiking Solution.
- 21.4 Table 4: Concentration of Calibration Solutions (ng/ml).
- 21.5 Table 5: Quantitation References.
- 21.6 Table 6: Target Compound Transitions and Collision Energy.
- 21.7 Table 7: DFTPP Transitions, Collision Energy, Acceptance Criteria.



**Table 1**

**ORGANOCHLORINE PESTICIDES- STANDARD ANALYTE LIST**

Compound	Water		Soil		Tissue	
	MDL (ng/L)	MRL (ng/L)	MDL(µg/Kg)	MRL (µg/Kg)	MDL(µg/Kg)	MRL (µg/Kg)
alpha-BHC	0.27	0.50	0.0069	0.050	0.26	1.0
gamma-BHC	0.15	0.50	0.011	0.050	17	0.50
beta-BHC	0.31	0.50	0.012	0.050	0.40	1.0
delta-BHC	0.19	0.50	0.011	0.050	0.28	1.0
Hexachlorobenzene	0.13	0.50	0.015	0.050	0.70	2.5
Heptachlor	0.17	1.0	0.0091	0.10	0.090	0.50
Chlorpyrifos	0.17	0.50	0.0072	0.050	0.13	0.5
Aldrin	0.47	1.0	0.012	0.10	0.22	1.0
Octachlorostyrene	0.28	1.0	0.017	0.10	0.16	0.50
Isodrin	1.1	2.0	0.029	0.20	0.23	1.0
Oxychlordane	0.72	2.0	0.092	0.20	0.77	2.50
Heptachlor epoxide	0.47	1.0	0.030	0.10	0.061	0.50
2,4'-DDE	0.19	0.50	0.0069	0.050	0.42	1.0
gamma-Chlordane	0.20	0.5	0.0081	0.050	0.13	0.50
alpha-Chlordane	0.15	0.50	0.0066	0.050	0.12	0.50
trans-Nonachlor	0.24	0.50	0.014	0.050	0.094	0.50
Endosulfan I	1.2	2.0	0.050	0.20	0.42	1.0
4,4'-DDE	0.13	0.50	0.0055	0.050	0.70	2.5
2,4'-DDD	0.11	0.50	0.0094	0.050	0.31	1.0
Dieldrin	2.3	5.0	0.098	0.50	0.22	1.0
Endrin	0.84	2.0	0.045	0.20	0.45	1.0
2,4'-DDT	0.13	0.50	0.0060	0.050	0.46	1.0
cis-Nonachlor	0.31	0.5	0.015	0.20	0.13	0.50
4,4'-DDD	0.20	0.50	0.015	0.050	013	1.0
Endosulfan II	0.51	1.0	0.043	0.10	0.35	1.0
Endrin aldehyde	0.67	1.0	0.051	0.10	56	1.0
4,4'-DDT	0.23	0.50	0.014	0.050	0.35	1.0



Compound	Water		Soil		Tissue	
	MDL (ng/L)	MRL (ng/L)	MDL(µg/K g)	MRL (µg/Kg)	MDL(µg/K g)	MRL (µg/Kg)
Endosulfan sulfate	0.12	0.50	0.017	0.050	0.22	1.0
Methoxychlor	0.16	0.50	0.018	0.050	0.15	0.50
Endrin Ketone	0.70	1.0	0.036	0.10	0.16	0.50
Mirex	0.12	1.0	0.029	0.10	0.11	0.50

**Table 2:**  
**Labeled Compound Spiking Solution**

Compound Name	Spiking solution conc. (ng/ml)	Spike amount (ng) 100ul spike volume
g-BHC-d6	200	20
Hexachlorobenzene-13C6	200	20
Heptachlor-13C10	200	20
Chlorpyrifos-d10	200	20
Aldrin-13C12	200	20
Octachlorostyrene-13C8	200	20
Isodrin-13C12	200	20
Oxychlorane-13C10	200	20
Heptachlorepox-13C10	200	20
Endrin-13C12	200	20
4,4'-DDD-d4	50	5
4,4'-DDT-d4	50	5
Methoxychlor-d6	200	20
Endrin ketone-13C12	200	20
Mirex-13C10	50	5

**Table 3**  
**: Recovery Internal Standard Spiking Solution**

Compound Name	Spiking solution conc. (ug/ml)	Spike amount (ng) 100ul spike volume
Pyrene-d10	10	100



**Table 4**  
**Concentration of Calibration Solutions (ng/ml)**

Compound	CS-1	CS-2	CS-3	CS-4	CS-5	CS-6 CCV	CS-7	CS-8	CS-9
Pyrene-d10	100	100	100	100	100	100	100	100	100
g-BHC-d6	20	20	20	20	20	20	20	20	20
Hexachlorobenzene-13C6	20	20	20	20	20	20	20	20	20
Heptachlor-13C10	20	20	20	20	20	20	20	20	20
Chlorpyrifos-d10	20	20	20	20	20	20	20	20	20
Aldrin-13C12	20	20	20	20	20	20	20	20	20
Octachlorostyrene-13C8	20	20	20	20	20	20	20	20	20
Isodrin-13C12	20	20	20	20	20	20	20	20	20
Oxychlordane-13C10	20	20	20	20	20	20	20	20	20
Heptachlorepoxy-13C10	20	20	20	20	20	20	20	20	20
Endrin-13C12	20	20	20	20	20	20	20	20	20
4,4'-DDD-d4	5	5	5	5	5	5	5	5	5
4,4'-DDT-d4	5	5	5	5	5	5	5	5	5
Methoxychlor-d6	20	20	20	20	20	20	20	20	20
Endrin ketone-13C12	20	20	20	20	20	20	20	20	20
Mirex-13C10	5	5	5	5	5	5	5	5	5
alpha-BHC	0.5	1	2	5	10	20	50	70	100
Gamma-BHC	0.5	1	2	5	10	20	50	70	100
Beta-BHC	0.5	1	2	5	10	20	50	70	100
Delta-BHC	0.5	1	2	5	10	20	50	70	100
Hexachlorobenzene	0.5	1	2	5	10	20	50	70	100
Heptachlor	0.5	1	2	5	10	20	50	70	100
Chlorpyrifos	0.5	1	2	5	10	20	50	70	100
Aldrin	0.5	1	2	5	10	20	50	70	100
Octachlorostyrene	0.5	1	2	5	10	20	50	70	100
Isodrin	0.5	1	2	5	10	20	50	70	100
Oxychlordane	0.5	1	2	5	10	20	50	70	100
Heptachlor epoxide	0.5	1	2	5	10	20	50	70	100
2,4'-DDE	0.5	1	2	5	10	20	50	70	100
Gamma-Chlordane	0.5	1	2	5	10	20	50	70	100
Alpha-Chlordane	0.5	1	2	5	10	20	50	70	100
Trans-Nonachlor	0.5	1	2	5	10	20	50	70	100
EndosulfanI	0.5	1	2	5	10	20	50	70	100



**Table 4**  
**Concentration of Calibration Solutions (ng/ml) continued**

Compound	CS-1	CS-2	CS-3	CS-4	CS-5	CS-6 CCV	CS-7	CS-8	CS-9
4,4'-DDE	0.5	1	2	5	10	20	50	70	100
2,4'-DDD	0.5	1	2	5	10	20	50	70	100
Dieldrin	0.5	1	2	5	10	20	50	70	100
Endrin	0.5	1	2	5	10	20	50	70	100
2,4'-DDT	0.5	1	2	5	10	20	50	70	100
Cis-Nonachlor	0.5	1	2	5	10	20	50	70	100
4,4'-DDD	0.5	1	2	5	10	20	50	70	100
EndosulfanII	0.5	1	2	5	10	20	50	70	100
Endrin aldehyde	0.5	1	2	5	10	20	50	70	100
4,4'-DDT	0.5	1	2	5	10	20	50	70	100
Endosulfan sulfate	0.5	1	2	5	10	20	50	70	100
Methoxychlor	0.5	1	2	5	10	20	50	70	100
Endrin ketone	0.5	1	2	5	10	20	50	70	100
Mirex	0.5	1	2	5	10	20	50	70	100

**LABELED PESTICIDE STANDARDS**

Isotopically labeled pesticide and PCB standards are obtained from Cambridge Isotope Laboratories, C/D/N Isotopes, and Dr Erhenstorfer Laboratories.

**CALIBRATION**

The multipoint calibration is prepared from: AccuStandard catalog # M-8081-SC, M-8080-OP, P-297S, P-184S, P-331S-H, P-066S, P-094S, P-471S, APP-9-112 (or equivalent from other vendors\*)

**ICV**

The ICV standard is prepared from the following: Ultra Scientific catalog # PPM-808C-1, PPM-828-1, PST-480C100A01, PST-590C100A01, PST-120C100A01, PST-3185C100A01, PP-430-1, PST-2705M100A01, PST-1200C100A01, PST-720C100A01

**CCV**

Use the same solutions that were used for the calibration curve  
Prepare 1 ml of 20 ng/ml CCV standard, place in autosampler vial and cap. Expiration date is 1 week after CCV was prepared.

**RECAP AND STORE IMMEDIATELY AFTER INJECTING**

Store remaining stock solutions in 1 ml amber vial. Expiration date is one year after ampule is opened or the manufacturers expiration date which ever is first Order when down to one unopened ampule.

\* Vendor must be A2LA and/or ISO9000 certified.



**Table 5**  
**Quantitation References**

Compound	Quantitation Reference
Pyrene-d10	None
g-BHC-d6	Pyrene-d10
Hexachlorobenzene-13C6	Pyrene-d10
Heptachlor-13C10	Pyrene-d10
Chlorpyrifos-d10	Pyrene-d10
Aldrin-13C12	Pyrene-d10
Octachlorostyrene-13C8	Pyrene-d10
Isodrin-13C12	Pyrene-d10
Oxychlorthane-13C10	Pyrene-d10
Heptachlorepoxy-13C10	Pyrene-d10
Endrin-13C12	Pyrene-d10
4,4'-DDD-d4	Pyrene-d10
4,4'-DDT-d4	Pyrene-d10
Methoxychlor-d6	Pyrene-d10
Endrin ketone-13C12	Pyrene-d10
Mirex-13C10	Pyrene-d10
alpha-BHC	g-BHC-d6
Gamma-BHC	g-BHC-d6
Beta-BHC	g-BHC-d6
Delta-BHC	g-BHC-d6
Hexachlorobenzene	Hexachlorobenzene-13C6
Heptachlor	Heptachlor-13C10
Chlorpyrifos	Chlorpyrifos-d10
Aldrin	Aldrin-13C12
Octachlorostyrene	Octachlorostyrene-13C8
Isodrin	Isodrin-13C12
Oxychlorthane	Oxychlorthane-13C10
Heptachlor epoxide	Heptachlorepoxy-13C10
2,4'-DDE	4,4'-DDD-d4
Gamma-Chlordane	Oxychlorthane-13C10
Alpha-Chlordane	Oxychlorthane-13C10
Trans-Nonachlor	Oxychlorthane-13C10
EndosulfanI	Endrin-13C12
4,4'-DDE	4,4'-DDD-d4
2,4'-DDD	4,4'-DDD-d4
Dieldrin	Endrin-13C12
Endrin	Endrin-13C12
2,4'-DDT	4,4'-DDT-d4
Cis-Nonachlor	Oxychlorthane-13C10
4,4'-DDD	4,4'-DDD-d4
EndosulfanII	Endrin-13C12



STANDARD OPERATING PROCEDURE

ALS | Environmental - Kelso

Chlorinated Pest by GC/MS/MS

SVM-PESTMS2, Rev. 7.0

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Endrin aldehyde		Endrin-13C12
4,4'-DDT		4,4'-DDT-d4
Endosulfan sulfate		Endrin-13C12
Methoxychlor		Methoxychlor-d14
Endrin ketone		Endrin ketone-13C12
Mirex		Mirex-13C10



**Table 6**  
**Target Compound Transitions and Collision Energy**

Compound	Ionization Mode	Quan Transition Trace	Qual Transition Trace	Collision energy (v) Quan Qual
Pyrene-d10	El+	212>208	212>184	20 20
g-BHC-d6	El+	223.9>187	184.9>150	10 20
Hexachlorobenzene13C6	El+	289.8>254.8	254.8>219.8	20 20
Heptachlor-13C10	El+	276.8>241.8	279>244	15 15
Chlorpyrifos-d10	El+	324>259.8	199.9>171.9	15 20
Aldrin-13C12	El+	269.8>200	304.8>269.9	30 20
Octachlorostyrene-13C8	El+	385.7>315.8	315.8>245.8	25 30
Isodrin-13C12	El+	199.9>130.1	269.8>200.2	30 30
Oxychlordane-13C10	El+	154>125	190>154	5 5
Heptachlorepo13C10	El+	362.8>270	362.8>291.8	15 15
Endrin-13C12	El+	269.8>200	289.9>254	35 10
4,4'-DDD-d4	El+	243>173.1	243>208	25 10
4,4'-DDT-d4	El+	243>173.1	243>208	25 10
Methoxychlor-d6	El+	233>141	233>169	30 20
Endrin ketone-13C12	El+	327.9>291.8	327.9>255	10 20
Mirex-13C10	El+	276.8>241.8	279>244	15 20
alpha-BHC	El+	218.9>182.9	183>147	10 20
Gamma-BHC	El+	218.9>182.9	183>147	10 20
Beta-BHC	El+	218.9>182.9	183>147	10 20
Delta-BHC	El+	218.9>182.9	183>147	10 20
Hexachlorobenzene	El+	283.8>248.8	248.8>213.9	20 20
Heptachlor	El+	271.8>236.8	269.8>234.8	15 15
Chlorpyrifos	El+	314>257.8	196.9>168.9	15 20
Aldrin	El+	262.9>192.9	293>222	30 20
Octachlorostyrene	El+	379.7>309.4	307.8>237.8	25 30
Isodrin	El+	192.9>123	262.9>192.8	30 30
Oxychlordane	El+	149>121	185>149	5 5
Heptachlor epoxide	El+	352.8>262.8	352.8>281.8	15 15
2,4'-DDE	El+	246>176	317.9>248	30 18
Gamma-Chlordane	El+	373>265.8	373>300.8	20 10
Alpha-Chlordane	El+	373>265.8	373>300.8	20 10
Trans-Nonachlor	El+	408.8>299.8	410.9>301.9	20 20
Endosulfanl	El+	195>159	241>170	6 20
4,4'-DDE	El+	246>176	317.9>248	30 18
2,4'-DDD	El+	235>165	235>199	25 10
Dieldrin	El+	262.8>192.9	279>243	35 10
Endrin	El+	262.8>192.9	279>243	35 10



**Target Compound Transitions and Collision Energy (continued)**

Compounds	Ionization Mode	Quan Transition Trace	Qual Transition Trace	Collision energy (v)
2,4'-DDT	EI+	235>165	235>199	25 10
Cis-Nonachlor	EI+	408.8>299.8	410.9>301.9	20 20
4,4'-DDD	EI+	235>165	235>199	25 10
EndosulfanII	EI+	195>159	241>206	6 10
Endrin aldehyde	EI+	344.8>280.7	344.8>244.9	10 20
4,4'-DDT	EI+	235>165	235>199	25 10
Endosulfan sulfate	EI+	271.8>236.7	386.8>288.8	15 8
Methoxychlor	EI+	227>141	227>169.1	30 20
Endrin ketone	EI+	316.9>280.8	316.9>244.9	10 20
Mirex	EI+	271.8>236.8	269.8>234.8	15 15

**Table 7**  
**DFTPP Transitions, Collision Energy, Acceptance Criteria**

Transitions	Range	Ionization Mode	Transition	Collision energy (v)
DFTPP1	1.000 (base)	EI+	442>198	14
DFTPP2	4.557-11.374	EI+	443>198	14
DFTPP3	1.380-3.834	EI+	198>110	14
DFTPP4	1.545-5.505	EI+	255>186	14
DFTPP5	10.211-34.819	EI+	127>77	20

Note: Relative abundance defined as: abundance (DFTPP1)/abundance (DFTPPX). Criteria



## Volatile Organic Compounds by GC/MS

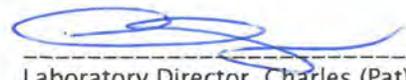
DOCUMENT ID: VOC-8260, REVISION 21.0

Prepared By:   
Organics Manager, Jonathon Walter

Date: 9/24/2020

Prepared By:   
Quality Assurance Manager, Kurt Clarkson

Date: 10/2/2020

Approved By:   
Laboratory Director, Charles (Pat) Byrne

Date: 10-2-2020



## 1) Scope & Applicability

- 1.1 This procedure is used to determine the concentration of volatile organic compounds in water and soil using USEPA Method 8260C. This method is also applicable to TCLP ZHE leachates and may also be applicable to various types of aqueous and non-aqueous waste samples.
- 1.2 The analyte reporting list and current Method Reporting Limits (MRL), Method Detection Limits (MDL)/Lower Limits of Quantitation (LLOQ), Limits of Quantitation (LOQ), and Limits of Detection (LOD) can be found in the ALS-Kelso Data Quality Objective (DQO) Tables.
- 1.3 The nominal quantitation range for water samples is 0.5 - 80 µg/L. The nominal quantitation range for low concentration soils is 5-200 µg/kg. The nominal quantitation range for high concentration soils is 50-8000 µg/kg.

## 2) Summary of Procedure

- 2.1 This procedure gives gas chromatographic/mass spectrometric (GC/MS) conditions for the detection of parts per billion (ppb) levels of volatile organic compounds. A sample aliquot is injected into the gas chromatograph (GC) by either the purge and trap method or by direct injection. The compounds are separated on a fused silica capillary GC column. The compounds are detected by a mass selective detector (MSD), which gives both qualitative as well as quantitative information.
- 2.2 In the purge and trap process an inert gas, helium, is bubbled through the sample aliquot, at room temperature. This gas stream sweeps the volatile organic compounds out of the aqueous phase and into the gas stream - it purges the compounds out of the sample. The gas stream then passes through a sorbent column which selectively adsorbs, (traps) these compounds out of the helium. The preparation and analysis of soil samples uses procedures described in USEPA Method 5030B or 5035/5035A. After the purging sequence is done, the sorbent column (the trap) is heated and desorbed onto the GC column. The GC column separates the compounds and passes then onto the MSD for identification and quantification.
- 2.3 The sensitivity of this method depends on the level of background contamination (i.e. interferences) rather than on instrumental limitations. Highly contaminated waste samples will require a methanol extraction prior to analysis. This will elevate the reporting levels and may mask low levels of compounds of interest.

## 3) Definitions

- 3.1 For laboratory definitions applicable to most analyses, refer to the SOP for [Sample Batches](#).

## 4) Responsibilities

- 4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.



- 4.2 It is the responsibility of the department supervisor/manager to document analyst training and method proficiency, as described in the *Employee Training and New Employee Orientation*. (ADM-TRAIN).

## 5) Interferences

- 5.1 Interferences by common laboratory extraction solvents, such as Methylene Chloride, Acetone, and Freon 113 can cause problems. The area where volatile organic analyses are performed is isolated from areas of the laboratory that perform extraction activities. Laboratory experience has shown that when Methylene Chloride is a problem it is due to maintenance activities or air handling equipment failures. In the rare event this happens, ultra-pure water can be used for all samples and calibration standards for that analytical batch.
- 5.2 Other interferences include but are not limited to impurities in the inert purge gas, dirty plumbing/purge vessels, cross contamination by highly contaminated samples to clean ones in transport and storage, and carry over from one analysis to subsequent ones.

## 6) Safety

- 6.1 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.

## 7) Sample Collection, Containers, Preservation, and Storage

- 7.1 Refer to procedures for methods 5030 and 5035 for sample container and collection procedures. Pre-cleaned sample containers are purchased from a lab equipment supplier. All containers should be of glass or amber glass and equipped with a screw top cap and PTFE (Teflon) lined septa.
- 7.2 Samples collected using EPA Method 5035 should be shipped in Encore sample tubes or collected in VOA vials containing sodium bisulfate (low concentration) and/or methanol (high concentration).
- 7.3 Collect all samples in duplicate, triplicate when possible. Prepare the proper number of sample bottles/containers prior to the sampling event with preservatives to adjust the samples pH to <2 with 1:1 HCl (water samples).
- 7.4 Slowly fill sample bottles to just overflowing taking care not to flush out the preservative or to entrain air bubbles in the samples. Seal the bottles with PTFE lined septa toward the sample and invert to check for entrained air bubbles.
- 7.5 Experimental evidence has shown refrigeration at 4°C alone will not stop biological degradation of some aromatic volatile organics. Adjusting the pH of the replicate samples to less than two (pH <2) with 1:1 HCl (@ 2-3 drops per 40 mL) preserves samples for 14 days after collection. Residual chlorine can also degrade some organic compounds, generating trihalomethanes (THMs).
- 7.6 All samples must be stored at 0-6°C and must be analyzed within 14 days of collection. See SOP VOC-5035 for additional holding time information. Any free product samples to be tested do not have any set holding times but should be analyzed as soon as possible.
- 7.7 The analysis of 2-CEVE in water by method 8260 requires the collection of an unpreserved sample. 2-Chloroethyl Vinyl Ether is highly reactive and preservation



may accelerate loss by polymerization or other rapid chemical reaction. Therefore, the accuracy of results from a preserved sample cannot be guaranteed. If a client requests 2-CEVE they must collect three preserved and three unpreserved vials and the sample must be logged in for a separate 2-CEVE analysis.

## 8) Apparatus and Equipment

### 8.1 Gas Chromatograph/Mass Spectrometer System

8.1.1 Each GC/MS system is set up with a GC capable of cooling the GC oven/column, injection onto a capillary column, and a transfer line interfaced with the MSD. Each MSD is a 5973, 5975, or 5977 that is controlled by the HP-MSDOS ChemStation software.

<u>Instrument ID</u>	<u>Configuration</u>	<u>Column</u>
MS13, MS18, MS19, MS23, MS24, MS27, MS46, MS30	Split/splitless capillary direct	- RTX-624, 20m, 0.18mm, 1um

8.1.2 Instrument systems and associated test methods are listed below.

<u>Instrument ID</u>	<u>Description</u>	<u>Tests Performed</u>
MS13	6890/5973	8260W, 8260S
MS18	6890/5973	8260W, 8260S, 8260 SIM
MS19	6890/5973	Screening
MS23	6890/5973	624
MS24/MS27	7890/5975	8260W, 8260S
MS46	7890/5977	8260W, 8260S
MS30	7890/5977	8260SIM

8.2 Purge and Trap with Autosampler - Each volatile GC/MS analytical system uses a purge and trap to introduce the sample onto the GC column. Each purge and trap has an autosampler (A/S) attached to run multiple samples, one at a time, and run unattended for extended periods of time. Teledyne Tekmar or EST Analytical autosamplers and Purge and Traps are preferred for extended unattended automated analyses.

### 8.3 GC Columns

8.3.1 Restek RTX-624 (or equivalent) 20 M x 0.18 mm id fused silica column 1.0 µm film thickness

8.4 Each volatile GC/MS data processing station uses the most recent version of the EPA/NIST Mass Spectral Library. The current version is the NIST98k library.

8.5 Analytical balance - Capable of accurately weighing to 0.001 g, Mettler PE160 or equivalent.

8.6 Syringes, Hamilton Gas-Tight in 10 µL, 25 µL, 100 µL, 500 µL, and 1000 µL sizes.



8.7 Standard storage vials, screw thread with Mini-inert caps.

## 9) Standards, Reagents, and Consumable Materials

9.1 Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Refer to the SOP *Reagent/Standards Login and Tracking* (ADM-RLT) for the complete procedure and documentation requirements.

9.2 Methanol, purge and trap grade or equivalent.

9.3 Reagent water, prepared from deionized water, by charcoal filtration and then purging with high purity helium or nitrogen that is set at 4-5 psi for approximately 2 hours prior to use.

9.4 Blank soil matrix - Ottawa sand, AccuStandard specialty sands.

9.5 Helium, compressed high purity grade.

9.6 BFB Tuning Verification Stock Standard - A 25,000 ppm stock standard is purchased (AccuStandard). This stock solution is diluted in methanol to give a working standard of 50 ppm.

9.7 Stock Standard Solutions

9.7.1 Commercially prepared and certified stock standards are used routinely for all the method specified analytes. All such mixtures are also routinely checked against an independent source for both analyte identification and analyte concentration. All such stock standard mixtures have expiration dates given by the manufacturer and must be replaced if the comparison with the independent check standards indicates a problem. Alternatively, stock standards may be prepared from neat chemicals. Store according to manufacturer's instructions. If no storage instructions are provided, store with minimal headspace, at -10° to -20°C and protect from light.

9.7.2 When preparing stock standards from neat chemicals accurately weigh approximately 0.1 g of material and dilute with methanol to 10 mL in a volumetric flask. If the purity of the neat chemical is <96%, adjust the calculated concentration accordingly.

9.8 Working Standards - Prepare these standards from stock solutions. Prepare at concentrations which facilitate ease of preparation of instrument-level standards (calibration standards, etc.). Refer to Table 1 for Standard Expiration Date Guidelines. Store standards with minimal headspace in appropriately sized standard storage vials with mini-inert caps. Solutions should be checked for degradation or evaporation prior to use.

9.9 Calibration Standards

9.9.1 A minimum of five different concentration levels for all the analytes are prepared by diluting working standards into reagent water. The lowest concentration level must be at the method reporting level, or a level corresponding to a sample concentration meeting project-specific data quality objectives, with the remaining four levels defining the working linear range of the analytical system. **The permanent gas stock**



**standards used to prepare calibration standards must not be more than one week old.**

- 9.9.2 The suggested levels are 0.5, 2, 10, 20 and 40 ppb for waters; and 5, 20, 50, 100, and 200 ppb for soils. All calibration solutions are made up daily.
- 9.9.3 The continuing calibration verification (CCV) solution is prepared by adding 10  $\mu$ L of a 50 ppm working standard to 50 mL of prepared reagent water, resulting in a 10 ppb (nominal concentration) standard. The CCV solution is prepared daily.
- 9.10 ICV Standard
- 9.10.1 The independent calibration verification (ICV) solution is prepared by adding 10  $\mu$ L of a 50 ppm intermediate to 50 mL of prepared reagent water, resulting in a 10 ppb (nominal concentration) standard. Acrolein is added at 50  $\mu$ L directly from a 100 ppm stock into the 50 mL of prepared reagent water yield a final concentration of 100 ppb in. The ICV solution is prepared with each initial calibration.
- 9.11 Internal Standards and Surrogates
- 9.11.1 The surrogates recommended are Dibromofluoromethane, Toluene- $d_8$  and 4-Bromofluorobenzene. The internal standards recommended are: Fluorobenzene, 1,4-Dichlorobenzene- $d_4$  and Chlorobenzene- $d_5$ . Other internal standards and surrogates may be used, depending on the analysis requirements. All internal standards are added to every calibration standard. The spike level for samples, blanks, and matrix spikes is 10  $\mu$ g/L for waters and 50  $\mu$ g/L for soils.
- 9.12 Spiking Solutions
- 9.12.1 Waters are typically spiked at 10 ppb and soils are typically spiked at 50 ppb.
- 9.12.2 Matrix spike and laboratory control spike solutions should contain the full list of analytes of interest. However, a subset may be reported.
- Note:** Refer to Table 1 for Standard Expiration Date Guidelines.

## 10) Preventative Maintenance

- 10.1 All maintenance activities are recorded in a maintenance logbook kept for each instrument. Pertinent information (serial numbers, instrument I.D., etc.) must be in the logbook. This includes the routine maintenance described in section 9. The entry in the log must include: date of event, the initials of who performed the work, and a reference to analytical control.
- 10.2 Carrier gas - Inline purifiers or scrubbers should be in place for all sources of carrier gas. These are selected to remove water, oxygen, and hydrocarbons. Purifiers should be changed as recommended by the supplier.
- 10.3 Purge and Trap /Autosamplers
- 10.3.1 The purge/trap system should be baked out and back-flushed daily as needed, generally prior to use on a daily basis. An instrument primer is run that serves to bake out the system and at the same time will prime the



column. This is especially useful if the instrument has been idle for an extended period of time.

10.3.2 Replace the trap monthly or sooner if performance deteriorates.

#### 10.4 Gas Chromatograph

10.4.1 Clipping off a small portion of the head of the column may improve chromatographic performance. This is typically done at the same time the MS source is cleaned or if unusually dirty samples are analyzed. When cutting off any portion of the column, make sure the cut is straight and “clean” (uniform, without fragmentation) by using the proper column cutting tool.

10.4.2 Over time, the column will exhibit poorer overall performance, as contaminated sample matrices are analyzed. Analytes at the front end of the run will show an increase in tailing and will start to behave in a non-linear manner. The length of time for this to occur will depend on the samples analyzed. When a noticeable decrease in column performance is evident and other maintenance options do not result in improvement, the column should be replaced. This is especially true when evident in conjunction with calibration difficulties.

#### 10.5 Mass Spectrometer

10.5.1 Tune the MS as needed to result in consistent and acceptable performance (see section 11).

10.5.2 For units under service contract, certain maintenance is performed by instrument service staff, including pump oil changed, vacuuming boards, etc., as recommended by the manufacturer.

10.5.3 MS source cleaning should be performed as needed, depending on the performance of the unit. This may be done by the analyst or by instrument service staff.

## 11) Procedure

### 11.1 Sample Preparation

#### 11.1.1 Water Samples

11.1.1.1 No preparation is generally required, other than dilution with reagent water to bring analytes into the upper half of the calibration range. Thus, a 10 mL sample volume is run straight from the sample vial. See the SOP for *Purge and Trap for Aqueous Samples* (VOC-5030) for details.

11.1.1.2 All water samples must be checked to have a  $\text{pH} \leq 2$  after sample analysis has taken place. Narrow range pH paper is used and the results are recorded on the injection log.

11.1.1.3 TCLP ZHE leachates are diluted 1:400 in reagent water prior to analysis. The TCLP samples and method blanks are diluted from the acidified ZHE extract; and the TCLP MS and LCS are diluted from a non-acidified extract, spiked, and poured into an HCL preserved VOA vial.

11.1.2 Soil samples are analyzed as either low concentration (direct purge) or high concentration (methanol preservation/extraction). Refer to the SOP for



*Purge and Trap/Extraction for Volatile Organics in Soil and Waste Samples, Close System (VOC-5035) for details.*

11.1.2.1 For low concentration analyses, one of the sampling options given in method 5035 is to be used. Depending on the option used, follow the instructions given in the method. Typically, 1-5 g is weighed out into the sample vial and 5 mL of reagent water is added. QC spikes and internal standards are then added, and the sample is purged at a temperature of 40°C ± 1°. Calibration standards, LCS, and method blanks require 5 g Ottawa sand as the matrix.

11.1.2.2 In the event that low concentration analyses are specified but samples were not taken using a EPA Method 5035 procedure, a portion of the sample is analyzed via direct heated purge of soil and EPA Method 5030A is cited. The analytical report should also be narrated with a statement indicating that 5030A has been deleted from SW-846. The low concentration analyses require a calibration specific to direct soil analysis.

11.1.2.3 The mid-level type is a methanol extraction method. In general, a 5 g wet weight of soil is extracted with 5 mL of purge-and-trap methanol in a scintillation vial. Place 5 mL of purge-and-trap methanol into vial, tare, and add 5 g of sample, and record the weight. Quickly cap and vortex until the sample is thoroughly mixed. A 1:100 dilution (500 µL to 50 mL) of this extract is then prepared in reagent water and analyzed using the water calibration. The extract weight, volume used, and methanol lot number are recorded on the injection log (or a bench sheet).

**NOTE:** For soil/solid samples requiring VOA and non-VOA analyses and only one container was submitted to the lab, sample receiving will label the sample container as "VOA Analysis First" and/or attach a "VOA FIRST" tag. The VOA department will remove a sample aliquot first for their analyses. The sample should be handled as if it were a Rush analysis, so that the other non-VOA analyses will not be unduly delayed. The VOA analyst who opens the container will either break the custody seal and will initial and date it when the container was opened or sign and date the "VOA FIRST" tag. A VOA Analysis First note will also be included on the SR.

11.2 The recommended typical operating conditions are listed below. Minor modification may be necessary based off the various instrument combinations which may be used.

Purge & Trap	Purge flow rate: 40 mL/min, "K" (Vocarb 3000) or "9" Trap; Purge 11 min, desorb 2 min at 240°C, bake 20 min at 260°C (Tekmar 3000)
Injection Port Temperature	200°C
Initial Temperature	35°C for 1.0 min
Temperature Program	15°C/min to 140°C; hold 0 min
Final Temperature	20°C/min to 200°C; hold 2.5 min
Detector Temperature	200°C
MS Scanning	~3.0 scans/second



Scan Range 35 - 270  
Carrier Gas He, 22.7 psig head pressure

### 11.3 Initial Calibration

**NOTE:** The calibration procedure(s) and options chosen must follow the ALS protocols. Any exceptions to the calibration procedures detailed in the SOP for *Calibration of Instruments for Organics Chromatographic Analyses (SOC-CAL)* are described as follows:

#### 11.3.1 BFB Tuning

11.3.1.1 Prior to calibration and sample analyses, analyze a 25 ng or 50 ng injection of Bromofluorobenzene (BFB). Each volatile GC/MS analytical system set up to run 8260C must meet the criteria listed in Table 2 for the injection of BFB. The analysis time for BFB is used to define the start of the 12-hour window in which all analyses must be performed. Once the instrument is tuned, all subsequent analyses of standards, samples, and QA/QC samples within the same 12-hour window must be analyzed using the identical mass spectrometer operating conditions.

11.3.1.2 Obtain the spectrum for evaluation using one of the following options:

- Three scans (the peak apex scan and the scans immediately preceding and following the apex) are acquired and averaged. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of BFB. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the BFB peak or part of any other closely eluting peak.
- Use one scan at the apex of the peak. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of BFB. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the BFB peak or part of any other closely eluting peak.
- Use the average across the entire peak up to a total of 5 scans. Peak integration must be consistent with standard operating procedure. If the peak is wider than 5 scans, the tune will consist of the peak apex scan and the two scans immediately preceding and following the apex. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of BFB. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the BFB peak or part of any other closely eluting peak.
- Use the average across the entire peak. Peak integration must be consistent with standard operating procedure. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of BFB. The background subtraction should be designed only to eliminate column



bleed or instrument background ions. Do not subtract part of the BFB peak or part of any other closely eluting peak.

- 11.3.1.3 Evaluate the spectrum against the criteria specified in Table 2. The criteria used must be the same for all ion abundance criteria checks associated with a given analysis. For example, initial calibration, continuing calibration(s), QC, and sample analyses for a given sample must all use the same criteria.

### 11.3.2 GC/MS Analytical System Initial Calibrations

- 11.3.2.1 Prior to conducting any sample analyses, a multi-point (5 point minimum) calibration must be run. Recommended calibration levels are 0.5 - 70 ppb for waters, and 5 - 300 ppb for soils. Analyze each calibration standard and tabulate the area response of the characteristic quantitation ions (Table 3) versus concentration for each compound, internal standard and surrogate. Calculate the response factors (RF) for each compound relative to the specified internal standard by:

$$RF_x = \frac{(A_x)(C_{ISTD})}{(A_{ISTD})(C_x)}$$

Where:

$A_x$  = Area of the characteristic ion for compound being measured.

$A_{ISTD}$  = Area of the characteristic ion for specific internal standard.

$C_{ISTD}$  = Concentration of the specific internal standard (ng/ $\mu$ L).

$C_x$  = Concentration of the compound being measured (ng/ $\mu$ L).

**Note:** For DoD projects, a multi-point calibration is performed for the surrogates.

- 11.3.2.2 Calculate the mean response factor ( $\overline{RF_x}$ ) for each analyte from the five calibration levels. Calculate standard deviation (SD) and the percent relative standard deviations (%RSD) for each analyte from the mean with:

$$\%RSD = \frac{SD}{RF} \times 100$$

Where:

RSD = relative standard deviation.

$\overline{RF}$  = mean of 5 initial RFs for a compound.

SD = standard deviation of average RFs for a compound.

$$SD = \sqrt{\frac{\sum_{i=1}^N (RF_i - \overline{RF})^2}{N - 1}}$$

Where:



$RF_i$  = RF for each of the 5 calibration levels

$N$  = Number of RF values (i.e., 5)

- 11.3.2.3 The %RSD should be less than 20% for each compound.
- 11.3.2.4 If the % RSD for any compound is  $\leq 20\%$ , linearity can be assumed over the calibration range, and the relative response factor for each analyte and surrogate is used.
- 11.3.2.5 If the %RSD for a compound is  $>20\%$ , then alternative calibration models should be used. See the SOP *Calibration of Instruments for Organics Chromatographic (SOC-CAL) Analysis* for further guidance.
- 11.3.2.6 The mean response factor for each target analyte should meet the minimum response factors listed in Table 5. Meeting the minimum response factor criteria for the lowest calibration standard is critical in establishing and demonstrating the desired sensitivity. Due to the large number of compounds that may be analyzed by this method, some compounds will fail to meet this criterion. For these occasions, the analyte is qualified as not meeting the method recommended response factor criterion.
- 11.3.2.7 When instrument response does not follow a linear model, a non-linear calibration model may be used. Refer to the SOP for *Calibration of Instruments for Organics Chromatographic Analysis (SOC-CAL)* for alternative curve fit guidance.
- 11.3.2.8 If more than 10% of the compounds included with the initial calibration exceed the 20% RSD limit and do not meet the minimum correlation coefficient (0.99) for alternate curve fits, then the chromatographic system is considered too imprecise for analysis to begin and corrective action is necessary. Further preventative maintenance may be required or the system may not be adequately *primed* for initial calibration.
- 11.3.3 Review of calibration curve
- 11.3.3.1 The calibration curve must be reviewed to ensure it represents the calibration data. This is done by re-fitting each calibration level against the true concentration of each calibration standard. The % difference between the calculated concentration versus the true concentration should be  $\leq 30\%$  for each calibration level and may not exceed 50% for any level.
- 11.3.3.2 Due to the large number of compounds that may be analyzed, one or more analytes may exceed 20% RSD or 0.99 COD. The initial calibration may still be acceptable if the following conditions are met:
- The % difference between the calculated concentrations versus the true concentration for each level of the initial calibration curve meets the criteria specified in section 11.2.3.1.
  - In order to report non-detects, it must be demonstrated that there is adequate sensitivity to detect the failed compounds



at the applicable lower quantitation limit. This is done by re-evaluating the concentrations of the calibrations standards against the calculated concentrations.

**NOTE:** Certain project plans that fall under the (DoD QSM) contain additional initial calibration acceptance criteria. In these cases, the analyst must refer to the project plan to know if the criteria listed in the DoD QSM or QAPP-specified criteria or EPA method calibration criteria are to be used.

**NOTE:** The “80/20” criteria allowed under section 11.3.3.2 only applies when the full target compound list is being reported. Individual compounds that are a subset of the entire target analyte list and have  $\leq 20\%D$  may still be reported, e.g. dilutions, reruns, abbreviated reporting lists.

#### 11.3.4 Independent Calibration Verification

11.3.4.1 Following initial calibration, analyze an ICV standard. The ICV solution must be obtained for all analytes that are analyzed and reported. Calculate the percent difference (%D) or % Drift from the ICV true value. The acceptance limits for the ICV are  $\pm 30\%$  of true value.

11.3.4.2 If a second source standard is not available from a second vendor, a second lot number from the same vendor may be used. It is recommended that the lab obtain a written warranty that the lot numbers are prepared from different source materials.

11.3.4.3 After the multi-point calibration has passed all of the above criteria, and the Independent Calibration Verification has been performed, samples can be analyzed. The calibration curve mid-point standard may serve as the CCV for the opening set of samples within the same 12-hour window as the initial calibration.

#### 11.4 Continuing Calibration

11.4.1 The start of a 12-hour analysis window requires a check of the instrument tune via an injection of 25ng or 50 ng of BFB. Refer to section 11.2.1.2 for the procedure. If the criteria found in Table 2 are met, then a check of the initial calibration curve is done. If the first analysis of the BFB fails, inspect the instrument for malfunction and perform maintenance as necessary. A second BFB tune verification may then be performed. If the second run fails, it may be necessary to retune the system.

11.4.2 After the tuning criteria have been verified, the initial calibration must be checked and verified by analyzing a midrange calibration standard. The 10 ppb level for waters and 50 ppb level for soils is recommended. For water, CCVs are prepared by adding 10 $\mu$ l of the 50 ppm 8260 working standard and 5 $\mu$ l of the 2000 ppm ketone mix into 50 mL reagent water and a 10 mL aliquot is purged. For soil, CCVs are prepared by adding 25 $\mu$ l of the 100ppm (nominal) working standard into 50 mL reagent water, and a 5 mL aliquot is purged.

11.4.3 The CCV result is evaluated for each target compound using the following



criteria:

11.4.3.1 If the percent difference or percent drift for a compound is less than or equal to 20%, then the initial calibration for that compound is assumed to be valid.

11.4.3.2 Due to the large number of compounds that may be analyzed by this method, some compounds may fail to meet the  $\leq 20\%$  criteria. If no more than 20% of the compounds, included in the initial calibration, differ from their true concentration by 40%, the initial calibration is valid and no corrective action is necessary.

**NOTE:** The "80/20" criteria allowed under section 11.3.3.2 only applies when the full target compound list is being reported. Individual compounds that are a subset of the entire target analyte list and have  $\leq 20\%$  may still be reported (e.g. dilutions, reruns, abbreviated reporting list).

11.4.4 In cases where compounds fail, they may still be reported as non-detects if it can be demonstrated that there was adequate sensitivity to detect the compound at the applicable quantitation limit.

11.4.5 Non-detected analytes can be reported from analyses when a CCV exhibit a positive bias (i.e., outside the upper control limit), no further documentation is required.

11.4.6 For situations when the CCV fails to meet the criterion in section 11.3.3, and a confirmed detection exceed the MRL, the sample must be reanalyzed to ensure accurate quantification. If it is not possible to reanalyze the sample, the result must be reported as an estimated value.

11.4.7 If the tune criteria and the continuing calibration criteria are met, then the retention times of all compounds, surrogates, and internal standards are checked against the initial calibration. If the retention time for any internal standard changes by more than 10 seconds from the retention time from the mid-point standard of the most recent initial calibration, the system must be inspected for malfunctions and corrections must be made, as required.

11.4.8 If the area for any of the internal standards changes by a factor of 2 (-50% to +100%) from the area from the mid-point standard of the most recent initial calibration, corrections must be made to the system.

11.4.9 Quantitation of all compounds will be based on the initial calibration.

## 11.5 GC/MS Analysis

11.5.1 Perform GC/MS screening analysis.

11.5.1.1 Samples are typically diluted 50X for liquid matrices and 500X for solid matrices.

11.5.1.2 Quantify chromatographs from the screening analysis and evaluate based on peaks of interest and the high point of the associated analytical instrument calibration.

11.5.1.3 If required, dilutions are typically performed with the intent to bring the high range analytes of interest into the mid-range of



the instrument calibration as well as a base run that dilutes the highest peak to approximately three times the highest point of the instrument calibration.

- 11.5.1.4 Note the requirement of a dilution in the comment section of the analytical instrument injection log.
- 11.5.2 Prepare samples as described in section 11. Use the same operating conditions as were used for initial calibration.
- 11.5.3 If the response for any quantitation ion exceeds the initial calibration curve range of the GC/MS system, extract dilution must take place.
- 11.6 Identification of Analytes
  - 11.6.1 The MSD data system software identifies a sample component by first finding and identifying the surrogate and internal standards. After they have been integrated, the extracted ion chromatogram is searched for all calibrated analytes.
  - 11.6.2 The qualitative identification of each compound determined by this method is based on retention time, and on comparison of the sample mass spectrum, after background correction, with characteristic ions in a reference mass spectrum. The reference mass spectrum is generated from analysis of a calibration standard and is updated with each initial calibration.
  - 11.6.3 The characteristic ions from the reference mass spectrum are defined to be the three ions of greatest relative intensity, or any ions over 30% relative intensity if less than three such ions occur in the reference spectrum. Compounds are identified as present when the following criteria are met.
    - 11.6.3.1 The intensities of the characteristic ions of a compound maximize in the same scan or within one scan of each other. Selection of a peak by a data system target compound search routine where the search is based on the presence of a target chromatographic peak containing ions specific for the target compound at a compound-specific retention time will be accepted as meeting this criterion.
    - 11.6.3.2 The relative retention time (RRT) of the sample component is within  $\pm 0.06$  RRT units of the RRT of the standard component.
    - 11.6.3.3 The relative intensities of the characteristic ions agree within 30% of the relative intensities of these ions in the reference spectrum.
  - 11.6.4 Table 3 lists characteristic ions as given in Method 8260C. If there is no peak found for an analyte in the expected retention time window and the mass spectrum does not match according to the method criteria, then the analyte is "not found". Print out spectra for all confirmed hits.
- 11.7 The analyst reviews all analyses to confirm (or correct) all data system qualitative interpretations.
- 11.8 If results are to be reported on a dry weight basis, determine the dry weight of a separate aliquot of the sample, using the SOP for Total Solids.



## 12) QA/QC Requirements

### 12.1 Initial Precision and Recovery Validation

12.1.1 The accuracy and precision of the procedure must be validated before analysis of samples begins, or whenever significant changes to the procedures have been made or when an analyst is new to the procedure. To do this, analyze four water sample spikes, calculate the average recovery and standard deviation, and evaluate as described in EPA SW-846. The concentration of the analytes to be spiked should be in the working calibration range. Initial Demonstration of Capability studies must be performed as part of analyst training. Copies of the studies are maintained in the lab and in the analyst's training file.

### 12.2 Method Detection Limits/Lower Limit of Quantitation/LOD/LOQ

12.2.1 For projects that require reporting to the method detection limit (MDL), a method detection limit (MDL) study must be undertaken before analysis of samples can begin. To establish detection limits that are precise and accurate, the analyst must perform the procedure specified in the corporate QA SOP *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification*. The MDL studies should be done for each matrix and include data from all instruments on which the test is analyzed.

12.2.2 Calculate the average concentration found ( $\bar{x}$ ) in the sample concentration, and the standard deviation of the concentrations for each analyte. Calculate the MDL for each analyte using the correct T value for the number of replicates. The MDL study must be verified as specified in CE-QA011.

12.2.3 The Limits of Detection (LOD) and Limits of Quantitation (LOQ) must be established and verified following the procedure in the SOP *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification*.

12.2.4 The Method Reporting Limits (MRLs) used at ALS are the routinely reported Lower Limits of Quantitation (LLOQ) which take into account day-to-day fluctuations in instrument sensitivity as well as other factors. These MRLs are the levels to which ALS routinely reports results in order to minimize false positive or false negative results. The MRL is normally two to ten times the method detection limit.

12.3 Ongoing QC Samples required are described in the ALS-Kelso Quality Assurance Manual and in the SOP for *Sample Batches* (ADM-BATCH). In general, these include:

12.3.1 Method blank - A method blank is extracted and analyzed with every batch of 20 or fewer samples to demonstrate that there are no method interferences. The method blank must demonstrate that interferences from the analytical and preparation steps minimized. No target analytes should be detected above the MRL in the method blank. For some project specific needs, additional requirements or exceptions may be given.

Note: For DoD projects - The Method Blank will be considered contaminated if:



- The concentration of any target analyte in the blank exceeds  $\frac{1}{2}$  the reporting limit and is greater than  $\frac{1}{10}$  the amount measured in any sample or  $\frac{1}{10}$  the regulatory limit (whichever is greater).
- The concentration of any common laboratory contaminant in the blank exceeds the reporting limit and is greater than  $\frac{1}{10}$  the amount measured in any sample or  $\frac{1}{10}$  the regulatory limit (whichever is greater).
- The blank result otherwise affects the samples results as per the test method requirements or the project-specific objectives.

12.3.2 A lab control sample (LCS) must be prepared and analyzed with every batch, not to exceed 20 samples. The LCS is prepared by spiking a blank with the matrix spike solution, and going through the entire preparation and analysis. Calculate percent recovery (%R) as follows:

$$\%R = X/TV \times 100$$

Where:

X = Concentration of the analyte recovered

TV = True value of amount spiked

Compare the %R to LCS acceptance criteria, located in the current ALS-Kelso LIMS tables. The accuracy of the analysis is controlled on a subset of target analytes. If the project analyte list is fewer than 20 analytes, all are considered control analytes. For DoD projects all project target analytes are considered control analytes. Analytes which are used for control analytes are listed in Table 4. Project-specific acceptance limits may supersede those listed in this SOP. If the lab control sample (LCS) fails acceptance limits for any of the control compounds, any associated sample data is rejected and corrective action must be taken. This may include evaluation of the sample preparation, analytical system, and calibration; and may require re-extraction, re-analysis, and/or recalibration and re-analysis.

12.3.3 A matrix spike/duplicate matrix spike (MS/DMS) must be prepared and analyzed with every batch of 20 or fewer samples if adequate sample volume is received (4 or more vials are needed). If insufficient sample is received, an LCS/DLCS pair will be analyzed to establish batch precision. In the event a dilution analysis is necessary on a sample chosen for MS/DMS, the sample will be spiked at the base level. The MS is prepared by spiking a sample aliquot with the matrix spike solution, and going through the entire preparation and analysis. Calculate percent recovery (%R) as follows:

The MS is prepared by spiking a sample aliquot with the matrix spike solution, and going through the entire preparation and analysis. Calculate percent recovery (%R) as follows:

$$\%R = \frac{X - X1}{TV} \times 100$$

Where:

X = Measured concentration of the spiked sample aliquot

X1 = Measured concentration of unspiked sample aliquot

TV = True value (theoretical concentration) of amount spiked



Calculate Relative Percent Difference (RPD) as:

$$RPD = \frac{|R1 - R2|}{(R1 + R2)/2} \times 100$$

Where:

R1 = measured concentration of the higher concentration

R2 = measured concentration of the lower concentration

Compare the %R and RPD to MS/DMS acceptance criteria located in the ALS-Kelso LIMS tables. If the MS/DMS recovery is out of acceptance limits for reasons other than matrix effects, corrective action must be taken.

**Note:** For DoD projects, recovery limits for the MS are the same as the LCS limits specified in the QSM.

12.3.4 The acceptance limits for the surrogates are given in the ALS-Kelso DQO tables. If any surrogate recovery is outside acceptance criteria, the sample data must be closely evaluated for possible matrix interferences. If none are present, then corrective action must be taken. The sample should be re-analyzed if instrument factors (calibration, poor purge, etc.) are suspected.

12.4 Acceptance criteria and corrective action requirements have been outlined above in the Procedure section and in Table 6.

12.5 Additional QA/QC measures include trend analysis by means of control charts or other means.

### 13) Data Reduction and Reporting

13.1 Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is less than 50% of the average of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs. The resolution should be verified on the midpoint concentration of the initial calibration as well as the laboratory designated continuing calibration verification level if closely eluting isomers are to be reported.

#### 13.2 Calculations

13.2.1 The GC/MS data stations, in current use, all use the H-P RTE Integrator to generate the raw data used to calculate the standards  $\overline{RF}_x$  values, the sample amounts, and the spike values. The software does three passes through each data file. The first two identify and integrate each internal standard and surrogate. The third pass uses the time-drift information from the first two passes to search for all method analytes in the proper retention times and with the proper characteristic quantitation ions. The results for a water sample are calculated as follows when  $\overline{RF}_x$  is used:

$$A_x = \frac{(Resp_x)(Amt_{ISTD})}{(Resp_{ISTD})(\overline{RF}_x)}$$



Where:  $A_x$  = the amount, in ppb, of the analytes in the sample;  
 $Resp_x$  = the peak area of the analytes of interest;  
 $Resp_{ISTD}$  = the peak area of the associated internal standard;  
 $Amt_{ISTD}$  = the amount, in ppb, of internal standard added  
 $RF_x$  = the average response from the five-point for the analytes of interest.

- 13.2.2 The results for low concentration soil work are calculated by taking the normal print out, in ppb, (see the water results outlined above) and correcting for the total, dry soil sample actually purged:

$$(A_x) = \frac{(5 \text{ grams})}{(ASW_t \text{ gr})(\% \text{ Solids})} = A_x \text{ Low - Level Soil}$$

Where:  $A_x$  = the amount, in ppb, from the data system  
 5 g = Nominal amount of soil that is heated and purged  
 $ASW_t$  = the actual soil wet weight, in grams, that is purged; and  
 % Solids the correction factor for dry weight.

- 13.2.3 Results for a high concentration soil samples (methanol extracts) are calculated as follows:

$$(A_x) = \frac{(Dilution)(V_{EXTR})}{(ASW_t)(\% \text{ Solids})} = A_x \text{ High - Level Soil Amt.}$$

Where:  $AX$  = Amount reported from the data station, in ppb  
 Dilution = Dilution factor of the extract  
 % Solids = Correction factor for dry weight  
 $V_{EXTR}$  = Methanol extract volume (mL)\*

\* The water contained in the native sample is accounted for when determining the final extract volume. The final volume of the methanol extract is the total volume of the methanol/water mixture. Calculate the final volume as follows:

$$FinalVolume \text{ Methanol/Water} = mL \text{ of solvent} + \left( \frac{\% \text{ Moisture} \times Sample \text{ Wt.}(g)}{100} \right)$$

### 13.3 Data Review

- 13.3.1 Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the SOP *Laboratory Data Review Process* (ADM-DREV) for details.

### 13.4 Reporting

- 13.4.1 Reports are generated in the ALS LIMS which compiles the SMO login, sample prep database, instrument, date, and client-specified report requirements (when specified). This compilation is then transferred to a file which the reporting system uses to generate a report. The forms generated may be ALS standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.



#### 14) Method Performance

- 14.1 This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional method performance data available.
- 14.2 The method detection limit (MDL) is established using the procedure described in the SOP *Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Limits of Quantitation*. Method Reporting Limits are established for this method based on MDL studies

#### 15) Pollution Prevention and Waste Management

- 15.1 It is the laboratory's practice to minimize the amount of solvents, acids and reagent used to perform this method wherever feasible. Standards are prepared in volumes consistent with methodology and only the amount needed for routine laboratory use is kept on site. The threat to the environment from solvent and reagents used in this method can be minimized when recycled or disposed of properly.
- 15.2 The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Lab Waste Management Plan.
- 15.3 This method uses non-halogenated solvents and any waste generated from this solvent must be placed in the collection cans in the lab. The solvent will then be added to the hazardous waste storage area and disposed of in accordance with Federal and State regulations.

#### 16) Contingencies for Handling Out-of-Control or Unacceptable Data

- 16.1 Refer to the SOP for *Non Conformance and Corrective Action Procedure* (ADM-NCAR) for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

#### 17) Training

- 17.1 All analysts performing this analysis are required to read and understand this SOP.
- 17.2 Training is documented following the *Employee Training and New Employee Orientation* (ADM-TRAIN).

#### 18) Method Modifications

- 18.1 For water samples, a purge volume of 10mL is used, whereas the method (section 7.5.5) states 5mL or 25mL. The use of a 10mL volume ensures sensitivity for "5mL" type analyses *and*, on the analytical systems in use, meets the sensitivity goals of a 25mL purge volume analysis. Also, the use of 10mL rather than 25mL decreases the negative effects of water being introduced into the P/T-GC-MS system.
- 18.2 Reference method recommends recalculation of low point only and that should be  $\pm 30\%$ . This SOP states each point is refit and each point should be with  $\pm 30\%$  but may not exceed  $\pm 50\%$ .
- 18.3 No limit defined in reference method, so lab assigned a limit of 40% based on CLP protocols.



**19) References and Related Documents**

- 19.1 VOC-5030, Purge and Trap for Aqueous Samples.
- 19.2 VOC-5035, Purge and Trap Extraction for Volatile Organics in Soil and Waste Samples, Closed System.
- 19.3 Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS): Capillary Column Technique, U.S. EPA, SW-846, Method 8260C, Revision 3, August 2006.
- 19.4 Purge and Trap, U.S. EPA, SW-846, Final Updates I and III, Methods 5030A Rev. 1, July 1992, 5030B Rev. 2, December 1996, and 5030C Rev. 3, May 2003.
- 19.5 Closed System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste, U.S. EPA, SW-846, Final Update III, Method 5035, Rev. 0, December 1996; and Method 5035A Rev. 1, July 2002.
- 19.6 DoD/DOE Quality Systems Manual, current version.
- 19.7 TNI Quality Standards, 2009; 2016.
- 19.8 ANSI/ISO/IEC 17005:2005/2017 American National Standard, General requirements for the competence of testing and calibration laboratories.

**20) Changes Since the Last Revision**

Revision Number	Effective Date	Document Editor	Description of Changes
21.0	10/05/2020	T.Caron	Updated SOP format to ALS branding template. Change in SOP signatories. Minor grammatical and typographical changes not affecting content. Section 12: Numerous edits - references to the ALS LIMS Tables. Updated standard paragraphs to current practices.

**21) Tables, Appendices, and Attachments, Standard Expiration Date Guidelines**

- 21.1 Table 2 - 4-Bromofluorobenzene Characteristic Ion Abundance Criteria
- 21.2 Table 3 - Characteristic Masses (m/z) for Purgeable Organic Compounds
- 21.3 Table 4 - Control Analytes for Non-DoD Projects
- 21.4 Table 5 - Recommended Minimum Relative Response Factor Criteria for Initial and Continuing Calibration Verification
- 21.5 Table 6 - Summary of Corrective Actions.



**TABLE 1**  
**Standard Expiration Date Guidelines**

<b>Standard</b>	<b>Expiration time</b>
<b>Neat Chemicals</b> from supplier's	Expiration date 5 years date opened, or assigned date.
<b>Stock Standards (unopened ampules, commercially prepared or lab prepared)</b> or 1 preparation if no expiration date provided.	Supplier's assigned date, year from
<b>Opened ampules and working standards</b> <ul style="list-style-type: none"><li>• concentration <math>\geq</math> 5000 ppm</li><li>• concentration 1000 - &lt;5000 ppm</li><li>• concentration 200 - &lt;1000 ppm</li><li>• concentration &lt; 200 ppm</li></ul>	6 month expiration date. 2 month expiration date. 1 month expiration date. 7 day expiration date.
<b>Internal Standard Solutions</b> date.	One month expiration

**Note:** The analyst performing specific analytical procedures should use judgment and take into consideration the solution reactivity, volatility, and concentration when using standards to prepare calibration curves. Certain standards, depending on use and storage, may have shorter usable life than described in these guidelines.



**TABLE 2**  
**4-Bromofluorobenzene Characteristic Ion Abundance Criteria**

Mass	Ion Abundance Criteria *
50	15-40% of mass 95
75	30-60% of mass 95
95	Base peak, 100% relative abundance
96	5-9% of mass 95
173	< 2% of mass 174
174	> 50% of mass 95
175	5-9% of mass 174
176	95 -101% of mass 174
177	5-9% of mass 176

Reference: EPA 8260C

\* Manufacturer specified ion abundance criteria may be used



**TABLE 3**  
**Characteristic Masses (m/z) for Purgeable Organic Compounds**

<b>Analyte</b>	<b>1° Ion</b>	<b>2°, 3°, etc. Ion</b>
Acetone	58	43
Acetonitrile	41	40, 39
Acrolein	56	55, 58
Acrylonitrile	53	52, 51
Allyl alcohol	57	58, 39
Allyl chloride	76	41, 39, 78
Benzene	78	-
Benzyl chloride	91	126, 65, 128
Bromoacetone	136	43, 138, 93, 95
Bromobenzene	156	77, 158
Bromochloromethane	128	49, 130
Bromodichloromethane	83	85, 127
Bromoform	173	175, 254
Bromomethane	94	96
iso-Butanol	74	43
n-Butanol	56	41
2-Butanone	72	43
n-Butylbenzene	91	92, 134
sec-Butylbenzene	105	134
tert-Butylbenzene	119	91, 134
Carbon disulfide	76	78
Carbon tetrachloride	117	119
Chloral hydrate	82	44, 84, 86, 111
Chloroacetonitrile	48	75
Chlorobenzene	112	77, 114
1-Chlorobutane	56	49
Chlorodibromomethane	129	208, 206
Chloroethane	64	66
2-Chloroethanol	49	44, 43, 51, 80
Bis(2-chloroethyl) sulfide	109	111, 158, 160
2-Chloroethyl vinyl ether	63	65, 106
Chloroform	83	85
Chloromethane	50	52
Chloroprene	53	88, 90, 51
3-Chloropropionitrile	54	49, 89, 91
2-Chlorotoluene	91	126
4-Chlorotoluene	91	126
1,2-Dibromo-3-chloropropane	75	155, 157
Dibromochloromethane	129	127
1,2-Dibromoethane	107	109, 188
Dibromomethane	93	95, 174
1,2-Dichlorobenzene	146	111, 148
1,3-Dichlorobenzene	146	111, 148
1,4-Dichlorobenzene	146	111, 148



**TABLE 3 (cont.)**  
**Characteristic Masses (m/z) for Purgeable Organic Compounds**

<b>Analyte</b>	<b>1° Ion</b>	<b>2°, 3°, etc. Ion</b>
cis-1,4-Dichloro-2-butene	75	53, 77, 124, 89
trans-1,4-Dichloro-2-butene	53	88, 75
Dichlorodifluoromethane	85	87
1,1-Dichloroethane	63	65, 83
1,2-Dichloroethane	62	98
1,1-Dichloroethene	96	61, 63
cis-1,2-Dichloroethene	96	61, 98
trans-1,2-Dichloroethene	96	61, 98
1,2-Dichloropropane	63	112
1,3-Dichloropropane	76	78
2,2-Dichloropropane	77	97
1,3-Dichloro-2-propanol	79	43, 81, 49
1,1-Dichloropropene	75	110, 77
cis-1,3-Dichloropropene	75	77, 39
trans-1,3-Dichloropropene	75	77, 39
1,2,3,4-Diepoxybutane	55	57, 56
Diethyl ether	74	45, 59
1,4-Dioxane	88	58, 43, 57
Epichlorohydrin	57	49, 62, 51
Ethanol	31	45, 27, 46
Ethyl acetate	88	43, 45, 61
Ethylbenzene	91	106
Ethylene oxide	44	43, 42
Ethyl methacrylate	69	41, 99, 86, 114
Hexachlorobutadiene	225	223, 227
Hexachloroethane	201	166, 199, 203
2-Hexanone	43	58, 57, 100
2-Hydroxypropionitrile	44	43, 42, 53
Iodomethane	142	127, 141
Isobutyl alcohol	43	41, 42, 74
Isopropylbenzene	105	120
p-Isopropyltoluene	119	134, 91
Malononitrile	66	39, 65, 38
Methacrylonitrile	41	67, 39, 52, 66
Methyl acrylate	55	85
Methyl-t-butyl ether	73	57
Methylene chloride	84	86, 49
Methyl ethyl ketone	72	43
Methyl iodide	142	127, 141
Methyl methacrylate	69	41, 100, 39
4-Methyl-2-pentanone	100	43, 58, 85
Naphthalene	128	-



**TABLE 3 (cont.)**  
**Characteristic Masses (m/z) for Purgeable Organic Compounds**

<b>Analyte</b>	<b>1° Ion</b>	<b>2°, 3°, etc. Ion</b>
Nitrobenzene	123	51, 77
2-Nitropropane	46	-
2-Picoline	93	66, 92, 78
Pentachloroethane	167	130, 132, 165, 169
Propargyl alcohol	55	39, 38, 53
b-Propiolactone	42	43, 44
Propionitrile (ethyl cyanide)	54	52, 55, 40
n-Propylamine	59	41, 39
n-Propylbenzene	91	120
Pyridine	79	52
Styrene	104	78
1,2,3-Trichlorobenzene	180	182, 145
1,2,4-Trichlorobenzene	180	182, 145
1,1,1,2-Tetrachloroethane	131	133, 119
1,1,2,2-Tetrachloroethane	83	131, 85
Tetrachloroethene	164	129, 131, 166
Toluene	92	91
1,1,1-Trichloroethane	97	99, 61
1,1,2-Trichloroethane	83	97, 85
Trichloroethene	95	97, 130, 132
Trichlorofluoromethane	151	101, 153
1,2,3-Trichloropropane	75	77
1,2,4-Trimethylbenzene	105	120
1,3,5-Trimethylbenzene	105	120
Vinyl acetate	43	86
Vinyl chloride	62	64
o-Xylene	106	91
m-Xylene	106	91
p-Xylene	106	91
<b>Surrogates:</b>		
1,2-Dichloroethane-d4	65	67, 51
4-Bromofluorobenzene	95	174, 176
Dibromofluoromethane	113	111, 192
Toluene-d8	98	99, 70
<b>Internal Standards:</b>		
1,4-Difluorobenzene	114	63, 88
Fluorobenzene	96	77, 70, 50
1,4-Dichlorobenzene-d4	152	115, 150
Chlorobenzene-d5	117	119, 82



**TABLE 4**  
**Control Analytes for Non-DoD Projects**

1,1-Dichloroethene
Benzene
Trichloroethene
Toluene
Chlorobenzene
1,2-Dichlorobenzene
Naphthalene
1,1,2-Trichloroethane
2-Chlorotoluene
2-Hexanone
Carbon Tetrachloride
Vinyl Chloride
Ethylbenzene
Chloroform
Bromodichloromethane
1,2,3-Trichloropropane



**TABLE 5**  
**Recommended Minimum Relative Response Factor Criteria for Initial and Continuing Calibration Verification**

<b>Analyte</b>	<b>Response Factor (RF)</b>
Dichlorodifluoromethane	0.100
Chloromethane	0.100
Vinyl chloride	0.100
Bromomethane	0.100
Chloroethane	0.100
Trichlorofluoromethane	0.100
1,1-Dichloroethene	0.100
1,1,2-Trichloro-1,2,2-trifluoroethane	0.100
Acetone	0.010*
Carbon disulfide	0.100
Methyl Acetate	0.100
Methylene chloride	0.100
trans-1,2-Dichloroethene	0.100
cis-1,2-Dichloroethene	0.100
Methyl tert-Butyl Ether	0.100
1,1-Dichloroethane	0.200
2-Butanone	0.010*
Chloroform	0.200
1,1,1-Trichloroethane	0.100
Cyclohexane	0.100
Carbon tetrachloride	0.100
Benzene	0.500
1,2-Dichloroethane	0.100
Trichloroethene	0.200
Methylcyclohexane	0.100
1,2-Dichloropropane	0.100
Bromodichloromethane	0.200
cis-1,3-Dichloropropene	0.200
trans-1,3-Dichloropropene	0.100
4-Methyl-2-pentanone	0.010*
Toluene	0.400
1,1,2-Trichloroethane	0.100
Tetrachloroethene	0.200
2-Hexanone	0.015*



**TABLE 5 (cont.)  
Recommended Minimum Relative Response Factor Criteria for Initial and  
Continuing Calibration Verification**

<b>Analyte</b>	<b>Response Factor (RF)</b>
Dibromochloromethane	0.100
1,2-Dibromoethane	0.100
Chlorobenzene	0.500
Ethylbenzene	0.100
m-/p-Xylene	0.100
o-Xylene	0.300
Styrene	0.300
Bromoform	0.100
Isopropylbenzene	0.100
1,1,2,2-Tetrachloroethane	0.300
1,3-Dichlorobenzene	0.600
1,4-Dichlorobenzene	0.500
1,2-Dichlorobenzene	0.400
1,2-Dibromo-3-chloropropane	0.025*
1,2,4-Trichlorobenzene	0.200
Any other analyte not included in this table	0.010

\* These analytes have poor purging efficiencies. Response factors based upon USEPA CLP guidance and laboratory performance after system maintenance.



**TABLE 6**

**Summary of Corrective Actions**

<b>Method Reference</b>	<b>Control</b>	<b>Specification and Frequency</b>	<b>Acceptance Criteria</b>	<b>Corrective Action</b>
EPA 8000C EPA 8260C	ICAL	Prior to sample analysis	% RSD ≤ 20 R2 ≥ 0.995 COD ≥ 0.990	Correct problem then repeat ICAL
EPA 8260C	ICV	After ICAL	± 30% Diff	Correct problem and verify second source standard; rerun second source verification. If fails, correct problem and repeat initial calibration.
EPA 8260C	CCV	Prior to sample analysis	See Sec. 11.3.3	Correct problem then repeat CCV or repeat ICAL
EPA 8260C	Method Blank	Include with each analysis batch (up to 20 samples)	< MRL DOD < 1/2 MRL	If target exceeds MRL, reanalyze to determine if instrument was cause. If still noncompliant then: Re-extract or reanalyze samples containing contaminant, unless samples contain > 20x amount in blank.
EPA 8260C	Laboratory Control Sample	Include with each analysis batch (up to 20 samples)	See DQO Tables	If exceeds limits on control compounds, perform corrective actions, re-extract and re-analyze
EPA 8260C	Matrix Spike	Include with each analysis batch (up to 20 samples)	See DQO Tables	Evaluate data to determine if there is a matrix effect or analytical error
EPA 8260C	Matrix Spike Duplicates	Include with each analysis batch (up to 20 samples)	Water: RPD ≤ 30 Soil, L: RPD ≤ 40 Soil, M: RPD ≤ 40	Re-analyze if result is > 5 X the MRL



STATE OF LOUISIANA  
DEPARTMENT OF ENVIRONMENTAL QUALITY

ALS Environmental Burlington - CANADA  
AI Number: 199920  
Activity No. ACC20210001  
Expiration Date: June 30, 2022

Effective Date: July 1, 2021

1435 Norjohn Ct Unit 1, Burlington, Canada L7L 0E6  
Certificate Number: 05064

**Air Emissions**

Analyte	Method Name	Method Code	Type	AB
1005 - Antimony	EPA 0060	10003404	NELAP	LA
1010 - Arsenic	EPA 0060	10003404	NELAP	LA
1015 - Barium	EPA 0060	10003404	NELAP	LA
1020 - Beryllium	EPA 0060	10003404	NELAP	LA
1030 - Cadmium	EPA 0060	10003404	NELAP	LA
1050 - Cobalt	EPA 0060	10003404	NELAP	LA
1055 - Copper	EPA 0060	10003404	NELAP	LA
1075 - Lead	EPA 0060	10003404	NELAP	LA
1090 - Manganese	EPA 0060	10003404	NELAP	LA
1095 - Mercury	EPA 0060	10003404	NELAP	LA
1105 - Nickel	EPA 0060	10003404	NELAP	LA
1140 - Selenium	EPA 0060	10003404	NELAP	LA
1150 - Silver	EPA 0060	10003404	NELAP	LA
1165 - Thallium	EPA 0060	10003404	NELAP	LA
1910 - Total Phosphorus	EPA 0060	10003404	NELAP	LA
1600 - Total chromium	EPA 0060	10003404	NELAP	LA
1190 - Zinc	EPA 0060	10003404	NELAP	LA
1415 - Extraction of Semivolatile Analytes Collected Using Method 0010 (Modified Method 5 Sampling Train)	EPA 3542	10140600	NELAP	LA
3847 - Modified Method 5 Sampling Train	EPA 3542	10140600	NELAP	LA
5160 - 1,1,1-Trichloroethane	EPA 5041A	10154800	NELAP	LA
5110 - 1,1,2,2-Tetrachloroethane	EPA 5041A	10154800	NELAP	LA
5165 - 1,1,2-Trichloroethane	EPA 5041A	10154800	NELAP	LA
4630 - 1,1-Dichloroethane	EPA 5041A	10154800	NELAP	LA
5180 - 1,2,3-Trichloropropane	EPA 5041A	10154800	NELAP	LA
4635 - 1,2-Dichloroethane (Ethylene dichloride)	EPA 5041A	10154800	NELAP	LA
4655 - 1,2-Dichloropropane	EPA 5041A	10154800	NELAP	LA
4410 - 2-Butanone (Methyl ethyl ketone, MEK)	EPA 5041A	10154800	NELAP	LA
4860 - 2-Hexanone	EPA 5041A	10154800	NELAP	LA
4315 - Acetone	EPA 5041A	10154800	NELAP	LA
4375 - Benzene	EPA 5041A	10154800	NELAP	LA
4395 - Bromodichloromethane	EPA 5041A	10154800	NELAP	LA
4400 - Bromoform	EPA 5041A	10154800	NELAP	LA
4450 - Carbon disulfide	EPA 5041A	10154800	NELAP	LA
<del>4455 - Carbon tetrachloride</del>	<del>EPA 5041A</del>	<del>10154800</del>	<del>NELAP</del>	<del>LA</del>
4475 - Chlorobenzene	EPA 5041A	10154800	NELAP	LA
4575 - Chlorodibromomethane (dibromochloromethane)	EPA 5041A	10154800	NELAP	LA
4485 - Chloroethane (Ethyl chloride)	EPA 5041A	10154800	NELAP	LA
4505 - Chloroform	EPA 5041A	10154800	NELAP	LA
4595 - Dibromomethane (Methylene bromide)	EPA 5041A	10154800	NELAP	LA
4765 - Ethylbenzene	EPA 5041A	10154800	NELAP	LA
4950 - Methyl bromide (Bromomethane)	EPA 5041A	10154800	NELAP	LA
4960 - Methyl chloride (Chloromethane)	EPA 5041A	10154800	NELAP	LA
4975 - Methylene chloride	EPA 5041A	10154800	NELAP	LA

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# Air Emissions

Analyte	Method Name	Method Code	Type	AB
(Dichloromethane)				
5100 - Styrene	EPA 5041A	10154800	NELAP	LA
5115 - Tetrachloroethylene	EPA 5041A	10154800	NELAP	LA
(Perchloroethylene)				
5140 - Toluene	EPA 5041A	10154800	NELAP	LA
5170 - Trichloroethene (Trichloroethylene)	EPA 5041A	10154800	NELAP	LA
5175 - Trichlorofluoromethane	EPA 5041A	10154800	NELAP	LA
(Fluorotrchloromethane, Freon 11)				
5235 - Vinyl chloride	EPA 5041A	10154800	NELAP	LA
100719 - Volatile Principle Organic Hazardous Constituents	EPA 5041A	10154800	NELAP	LA
4705 - cis & trans-1,2-Dichloroethene	EPA 5041A	10154800	NELAP	LA
4645 - cis-1,2-Dichloroethylene	EPA 5041A	10154800	NELAP	LA
4680 - cis-1,3-Dichloropropene	EPA 5041A	10154800	NELAP	LA
5240 - m+p-xylene	EPA 5041A	10154800	NELAP	LA
5245 - m-Xylene	EPA 5041A	10154800	NELAP	LA
5250 - o-Xylene	EPA 5041A	10154800	NELAP	LA
5255 - p-Xylene	EPA 5041A	10154800	NELAP	LA
4700 - trans-1,2-Dichloroethylene	EPA 5041A	10154800	NELAP	LA
4685 - trans-1,3-Dichloropropylene	EPA 5041A	10154800	NELAP	LA
1095 - Mercury	EPA 7470	10165603	NELAP	LA
1095 - Mercury	EPA 7470A	10165807	NELAP	LA
5160 - 1,1,1-Trichloroethane	EPA 8260B	10184802	NELAP	LA
5110 - 1,1,2,2-Tetrachloroethane	EPA 8260B	10184802	NELAP	LA
5165 - 1,1,2-Trichloroethane	EPA 8260B	10184802	NELAP	LA
4630 - 1,1-Dichloroethane	EPA 8260B	10184802	NELAP	LA
5180 - 1,2,3-Trichloropropane	EPA 8260B	10184802	NELAP	LA
4635 - 1,2-Dichloroethane (Ethylene dichloride)	EPA 8260B	10184802	NELAP	LA
4655 - 1,2-Dichloropropane	EPA 8260B	10184802	NELAP	LA
4410 - 2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260B	10184802	NELAP	LA
4860 - 2-Hexanone	EPA 8260B	10184802	NELAP	LA
4315 - Acetone	EPA 8260B	10184802	NELAP	LA
4375 - Benzene	EPA 8260B	10184802	NELAP	LA
4395 - Bromodichloromethane	EPA 8260B	10184802	NELAP	LA
4400 - Bromoform	EPA 8260B	10184802	NELAP	LA
4450 - Carbon disulfide	EPA 8260B	10184802	NELAP	LA
4455 - Carbon tetrachloride	EPA 8260B	10184802	NELAP	LA
4475 - Chlorobenzene	EPA 8260B	10184802	NELAP	LA
4575 - Chlorodibromomethane (dibromochloromethane)	EPA 8260B	10184802	NELAP	LA
4485 - Chloroethane (Ethyl chloride)	EPA 8260B	10184802	NELAP	LA
4505 - Chloroform	EPA 8260B	10184802	NELAP	LA
4595 - Dibromomethane (Methylene bromide)	EPA 8260B	10184802	NELAP	LA
4765 - Ethylbenzene	EPA 8260B	10184802	NELAP	LA
4950 - Methyl bromide (Bromomethane)	EPA 8260B	10184802	NELAP	LA
4960 - Methyl chloride (Chloromethane)	EPA 8260B	10184802	NELAP	LA
4975 - Methylene chloride	EPA 8260B	10184802	NELAP	LA
(Dichloromethane)				
5100 - Styrene	EPA 8260B	10184802	NELAP	LA
5115 - Tetrachloroethylene	EPA 8260B	10184802	NELAP	LA
(Perchloroethylene)				
5140 - Toluene	EPA 8260B	10184802	NELAP	LA

ALS Environmental Burlington - CANADA

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# Air Emissions

Analyte	Method Name	Method Code	Type	AB
5170 - Trichloroethene (Trichloroethylene)	EPA 8260B	10184802	NELAP	LA
5175 - Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	EPA 8260B	10184802	NELAP	LA
5235 - Vinyl chloride	EPA 8260B	10184802	NELAP	LA
4705 - cis & trans-1,2-Dichloroethene	EPA 8260B	10184802	NELAP	LA
4645 - cis-1,2-Dichloroethylene	EPA 8260B	10184802	NELAP	LA
4680 - cis-1,3-Dichloropropene	EPA 8260B	10184802	NELAP	LA
5240 - m+p-xylene	EPA 8260B	10184802	NELAP	LA
5245 - m-Xylene	EPA 8260B	10184802	NELAP	LA
5250 - o-Xylene	EPA 8260B	10184802	NELAP	LA
5255 - p-Xylene	EPA 8260B	10184802	NELAP	LA
4700 - trans-1,2-Dichloroethylene	EPA 8260B	10184802	NELAP	LA
4685 - trans-1,3-Dichloropropylene	EPA 8260B	10184802	NELAP	LA
6715 - 1,2,4,5-Tetrachlorobenzene	EPA 8270	10185203	NELAP	LA
5155 - 1,2,4-Trichlorobenzene	EPA 8270	10185203	NELAP	LA
4610 - 1,2-Dichlorobenzene	EPA 8270	10185203	NELAP	LA
6885 - 1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8270	10185203	NELAP	LA
4615 - 1,3-Dichlorobenzene	EPA 8270	10185203	NELAP	LA
6160 - 1,3-Dinitrobenzene (1,3-DNB)	EPA 8270	10185203	NELAP	LA
4835 - 1,3-Hexachlorobutadiene	EPA 8270	10185203	NELAP	LA
4620 - 1,4-Dichlorobenzene	EPA 8270	10185203	NELAP	LA
5790 - 1-Chloronaphthalene	EPA 8270	10185203	NELAP	LA
6425 - 1-Naphthylamine	EPA 8270	10185203	NELAP	LA
6735 - 2,3,4,6-Tetrachlorophenol	EPA 8270	10185203	NELAP	LA
6835 - 2,4,5-Trichlorophenol	EPA 8270	10185203	NELAP	LA
6840 - 2,4,6-Trichlorophenol	EPA 8270	10185203	NELAP	LA
6000 - 2,4-Dichlorophenol	EPA 8270	10185203	NELAP	LA
6130 - 2,4-Dimethylphenol	EPA 8270	10185203	NELAP	LA
6175 - 2,4-Dinitrophenol	EPA 8270	10185203	NELAP	LA
6185 - 2,4-Dinitrotoluene (2,4-DNT)	EPA 8270	10185203	NELAP	LA
6005 - 2,6-Dichlorophenol	EPA 8270	10185203	NELAP	LA
6190 - 2,6-Dinitrotoluene (2,6-DNT)	EPA 8270	10185203	NELAP	LA
5515 - 2-Acetylaminofluorene	EPA 8270	10185203	NELAP	LA
5795 - 2-Chloronaphthalene	EPA 8270	10185203	NELAP	LA
5800 - 2-Chlorophenol	EPA 8270	10185203	NELAP	LA
6360 - 2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	EPA 8270	10185203	NELAP	LA
5145 - 2-Methylaniline (o-Toluidine)	EPA 8270	10185203	NELAP	LA
6385 - 2-Methylnaphthalene	EPA 8270	10185203	NELAP	LA
6400 - 2-Methylphenol (o-Cresol)	EPA 8270	10185203	NELAP	LA
6430 - 2-Naphthylamine	EPA 8270	10185203	NELAP	LA
6460 - 2-Nitroaniline	EPA 8270	10185203	NELAP	LA
6490 - 2-Nitrophenol	EPA 8270	10185203	NELAP	LA
6355 - 3-Methylcholanthrene	EPA 8270	10185203	NELAP	LA
6405 - 3-Methylphenol (m-Cresol)	EPA 8270	10185203	NELAP	LA
6465 - 3-Nitroaniline	EPA 8270	10185203	NELAP	LA
5540 - 4-Aminobiphenyl	EPA 8270	10185203	NELAP	LA
5660 - 4-Bromophenyl phenyl ether	EPA 8270	10185203	NELAP	LA
5700 - 4-Chloro-3-methylphenol	EPA 8270	10185203	NELAP	LA
5745 - 4-Chloroaniline	EPA 8270	10185203	NELAP	LA
5825 - 4-Chlorophenyl phenylether	EPA 8270	10185203	NELAP	LA
6410 - 4-Methylphenol (p-Cresol)	EPA 8270	10185203	NELAP	LA
6470 - 4-Nitroaniline	EPA 8270	10185203	NELAP	LA
6500 - 4-Nitrophenol	EPA 8270	10185203	NELAP	LA
6115 - 7,12-Dimethylbenz(a) anthracene	EPA 8270	10185203	NELAP	LA

ALS Environmental Burlington - CANADA

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## Air Emissions

Analyte	Method Name	Method Code	Type	AB
9417 - 7h-Dibenzo(c,g) carbazole	EPA 8270	10185203	NELAP	LA
5500 - Acenaphthene	EPA 8270	10185203	NELAP	LA
5505 - Acenaphthylene	EPA 8270	10185203	NELAP	LA
5510 - Acetophenone	EPA 8270	10185203	NELAP	LA
5545 - Aniline	EPA 8270	10185203	NELAP	LA
5555 - Anthracene	EPA 8270	10185203	NELAP	LA
5575 - Benz(a)anthracene	EPA 8270	10185203	NELAP	LA
5580 - Benzo(a)pyrene	EPA 8270	10185203	NELAP	LA
5585 - Benzo(b)fluoranthene	EPA 8270	10185203	NELAP	LA
5590 - Benzo(g,h,i)perylene	EPA 8270	10185203	NELAP	LA
5600 - Benzo(k)fluoranthene	EPA 8270	10185203	NELAP	LA
5630 - Benzyl alcohol	EPA 8270	10185203	NELAP	LA
5780 - Bis(2-Chloroisopropyl) ether (2,2-oxybis(1-chloropropane))	EPA 8270	10185203	NELAP	LA
5670 - Butyl benzyl phthalate	EPA 8270	10185203	NELAP	LA
5855 - Chrysene	EPA 8270	10185203	NELAP	LA
6065 - Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)	EPA 8270	10185203	NELAP	LA
5925 - Di-n-butyl phthalate	EPA 8270	10185203	NELAP	LA
6200 - Di-n-octyl phthalate	EPA 8270	10185203	NELAP	LA
9354 - Dibenz(a, h) acridine	EPA 8270	10185203	NELAP	LA
5900 - Dibenz(a, j)acridine	EPA 8270	10185203	NELAP	LA
5895 - Dibenz(a,h)anthracene	EPA 8270	10185203	NELAP	LA
5890 - Dibenzo(a,e)pyrene	EPA 8270	10185203	NELAP	LA
9348 - Dibenzo(a,h) pyrene	EPA 8270	10185203	NELAP	LA
9351 - Dibenzo(a,i) pyrene	EPA 8270	10185203	NELAP	LA
5905 - Dibenzofuran	EPA 8270	10185203	NELAP	LA
6070 - Diethyl phthalate	EPA 8270	10185203	NELAP	LA
6135 - Dimethyl phthalate	EPA 8270	10185203	NELAP	LA
8620 - Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8270	10185203	NELAP	LA
6205 - Diphenylamine	EPA 8270	10185203	NELAP	LA
6260 - Ethyl methanesulfonate	EPA 8270	10185203	NELAP	LA
6265 - Fluoranthene	EPA 8270	10185203	NELAP	LA
6270 - Fluorene	EPA 8270	10185203	NELAP	LA
6275 - Hexachlorobenzene	EPA 8270	10185203	NELAP	LA
6285 - Hexachlorocyclopentadiene	EPA 8270	10185203	NELAP	LA
4840 - Hexachloroethane	EPA 8270	10185203	NELAP	LA
6295 - Hexachloropropene	EPA 8270	10185203	NELAP	LA
6315 - Indeno(1,2,3-cd)pyrene	EPA 8270	10185203	NELAP	LA
6320 - Isophorone	EPA 8270	10185203	NELAP	LA
6325 - Isosafrole	EPA 8270	10185203	NELAP	LA
6375 - Methyl methanesulfonate	EPA 8270	10185203	NELAP	LA
5005 - Naphthalene	EPA 8270	10185203	NELAP	LA
6590 - Pentachlorobenzene	EPA 8270	10185203	NELAP	LA
5035 - Pentachloroethane	EPA 8270	10185203	NELAP	LA
6600 - Pentachloronitrobenzene	EPA 8270	10185203	NELAP	LA
<del>6605 - Pentachlorophenol</del>	<del>EPA 8270</del>	<del>10185203</del>	<del>NELAP</del>	<del>LA</del>
6610 - Phenacetin	EPA 8270	10185203	NELAP	LA
6615 - Phenanthrene	EPA 8270	10185203	NELAP	LA
6625 - Phenol	EPA 8270	10185203	NELAP	LA
6665 - Pyrene	EPA 8270	10185203	NELAP	LA
6685 - Safrole	EPA 8270	10185203	NELAP	LA
5760 - bis(2-Chloroethoxy)methane	EPA 8270	10185203	NELAP	LA
5765 - bis(2-Chloroethyl) ether	EPA 8270	10185203	NELAP	LA

ALS Environmental Burlington - CANADA

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## Air Emissions

Analyte	Method Name	Method Code	Type	AB
5025 - n-Nitroso-di-n-butylamine	EPA 8270	10185203	NELAP	LA
6545 - n-Nitrosodi-n-propylamine	EPA 8270	10185203	NELAP	LA
6525 - n-Nitrosodiethylamine	EPA 8270	10185203	NELAP	LA
6530 - n-Nitrosodimethylamine	EPA 8270	10185203	NELAP	LA
6535 - n-Nitrosodiphenylamine	EPA 8270	10185203	NELAP	LA
6550 - n-Nitrosomethylethylamine	EPA 8270	10185203	NELAP	LA
6555 - n-Nitrosomorpholine	EPA 8270	10185203	NELAP	LA
6560 - n-Nitrosopiperidine	EPA 8270	10185203	NELAP	LA
6565 - n-Nitrosopyrrolidine	EPA 8270	10185203	NELAP	LA
6105 - p-Dimethylaminoazobenzene	EPA 8270	10185203	NELAP	LA
9519 - 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 8290	10187209	NELAP	LA
9516 - 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 8290	10187209	NELAP	LA
9426 - 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	EPA 8290	10187209	NELAP	LA
9420 - 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA 8290	10187209	NELAP	LA
9423 - 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA 8290	10187209	NELAP	LA
9453 - 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)	EPA 8290	10187209	NELAP	LA
9471 - 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)	EPA 8290	10187209	NELAP	LA
9456 - 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)	EPA 8290	10187209	NELAP	LA
9474 - 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)	EPA 8290	10187209	NELAP	LA
9459 - 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)	EPA 8290	10187209	NELAP	LA
9477 - 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)	EPA 8290	10187209	NELAP	LA
9540 - 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)	EPA 8290	10187209	NELAP	LA
9543 - 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)	EPA 8290	10187209	NELAP	LA
9480 - 2,3,4,6,7,8-Hexachlorodibenzofuran	EPA 8290	10187209	NELAP	LA
9549 - 2,3,4,7,8-Pentachlorodibenzofuran	EPA 8290	10187209	NELAP	LA
9618 - 2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)	EPA 8290	10187209	NELAP	LA
9612 - 2,3,7,8-Tetrachlorodibenzofuran	EPA 8290	10187209	NELAP	LA
100489 - Dibenzo-p-dioxins & dibenzofurans	EPA 8290	10187209	NELAP	LA
9438 - Total Hpcdd	EPA 8290	10187209	NELAP	LA
9444 - Total Hpcdf	EPA 8290	10187209	NELAP	LA
<del>9468 - Total Hxcdd</del>	<del>EPA 8290</del>	<del>10187209</del>	<del>NELAP</del>	<del>LA</del>
9483 - Total Hxcdf	EPA 8290	10187209	NELAP	LA
9555 - Total Pecdd	EPA 8290	10187209	NELAP	LA
9552 - Total Pecdf	EPA 8290	10187209	NELAP	LA
9609 - Total TCDD	EPA 8290	10187209	NELAP	LA
9615 - Total TCDF	EPA 8290	10187209	NELAP	LA
9519 - 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 8290A, Rev.2007	10187403	NELAP	LA

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## Air Emissions

Analyte	Method Name	Method Code	Type	AB
9516 - 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9426 - 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9420 - Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9423 - Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9453 - 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9471 - 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9456 - 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9474 - 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9459 - 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9477 - 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9540 - 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9543 - 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9480 - 2,3,4,6,7,8-Hexachlorodibenzofuran	EPA 8290A, Rev.2007	10187403	NELAP	LA
9549 - 2,3,4,7,8-Pentachlorodibenzofuran	EPA 8290A, Rev.2007	10187403	NELAP	LA
9618 - 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9612 - 2,3,7,8-Tetrachlorodibenzofuran	EPA 8290A, Rev.2007	10187403	NELAP	LA
100489 - Dibenzo-p-dioxins & dibenzofurans	EPA 8290A, Rev.2007	10187403	NELAP	LA
9438 - Total Hpcdd	EPA 8290A, Rev.2007	10187403	NELAP	LA
9444 - Total Hpcdf	EPA 8290A, Rev.2007	10187403	NELAP	LA
9468 - Total Hxcdd	EPA 8290A, Rev.2007	10187403	NELAP	LA
9483 - Total Hxcdf	EPA 8290A, Rev.2007	10187403	NELAP	LA
9555 - Total Pecdd	EPA 8290A, Rev.2007	10187403	NELAP	LA
9552 - Total Pecdf	EPA 8290A, Rev.2007	10187403	NELAP	LA
9609 - Total TCDD	EPA 8290A, Rev.2007	10187403	NELAP	LA
9615 - Total TCDF	EPA 8290A, Rev.2007	10187403	NELAP	LA
1575 - Chloride	EPA 9057	10199801	NELAP	LA
1515 - Ammonia as N	EPA CTM-027	10214707	NELAP	LA
9519 - 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA Method 23	10246705	NELAP	LA
9516 - 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA Method 23	10246705	NELAP	LA
9426 - 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	EPA Method 23	10246705	NELAP	LA
9420 - Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA Method 23	10246705	NELAP	LA
9423 - Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA Method 23	10246705	NELAP	LA

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Analyte	Method Name	Method Code	Type	AB
9453 - 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)	EPA Method 23	10246705	NELAP	LA
9471 - 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)	EPA Method 23	10246705	NELAP	LA
9456 - 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)	EPA Method 23	10246705	NELAP	LA
9474 - 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)	EPA Method 23	10246705	NELAP	LA
9459 - 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)	EPA Method 23	10246705	NELAP	LA
9477 - 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)	EPA Method 23	10246705	NELAP	LA
9540 - 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)	EPA Method 23	10246705	NELAP	LA
9543 - 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)	EPA Method 23	10246705	NELAP	LA
9480 - 2,3,4,6,7,8-Hexachlorodibenzofuran	EPA Method 23	10246705	NELAP	LA
9549 - 2,3,4,7,8-Pentachlorodibenzofuran	EPA Method 23	10246705	NELAP	LA
9618 - 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD)	EPA Method 23	10246705	NELAP	LA
9612 - 2,3,7,8-Tetrachlorodibenzofuran	EPA Method 23	10246705	NELAP	LA
9438 - Total Hpcdd	EPA Method 23	10246705	NELAP	LA
9444 - Total Hpcdf	EPA Method 23	10246705	NELAP	LA
9468 - Total Hxcdd	EPA Method 23	10246705	NELAP	LA
9483 - Total Hxcdf	EPA Method 23	10246705	NELAP	LA
9555 - Total Pecdd	EPA Method 23	10246705	NELAP	LA
9552 - Total Pecdf	EPA Method 23	10246705	NELAP	LA
9609 - Total TCDD	EPA Method 23	10246705	NELAP	LA
9615 - Total TCDF	EPA Method 23	10246705	NELAP	LA
5500 - Acenaphthene	EPA TO-13A	10248405	NELAP	LA
5505 - Acenaphthylene	EPA TO-13A	10248405	NELAP	LA
5555 - Anthracene	EPA TO-13A	10248405	NELAP	LA
5575 - Benz(a)anthracene	EPA TO-13A	10248405	NELAP	LA
5580 - Benzo(a)pyrene	EPA TO-13A	10248405	NELAP	LA
5585 - Benzo(b)fluoranthene	EPA TO-13A	10248405	NELAP	LA
5605 - Benzo(e)pyrene	EPA TO-13A	10248405	NELAP	LA
5590 - Benzo(g,h,i)perylene	EPA TO-13A	10248405	NELAP	LA
5600 - Benzo(k)fluoranthene	EPA TO-13A	10248405	NELAP	LA
5855 - Chrysene	EPA TO-13A	10248405	NELAP	LA
5856 - Coronene	EPA TO-13A	10248405	NELAP	LA
5895 - Dibenz(a,h)anthracene	EPA TO-13A	10248405	NELAP	LA
6265 - Fluoranthene	EPA TO-13A	10248405	NELAP	LA
6270 - Fluorene	EPA TO-13A	10248405	NELAP	LA
6315 - Indeno(1,2,3-cd)pyrene	EPA TO-13A	10248405	NELAP	LA
5005 - Naphthalene	EPA TO-13A	10248405	NELAP	LA
6608 - Perylene	EPA TO-13A	10248405	NELAP	LA
6615 - Phenanthrene	EPA TO-13A	10248405	NELAP	LA
6665 - Pyrene	EPA TO-13A	10248405	NELAP	LA
7355 - 4,4'-DDD	EPA TO-4A	10249204	NELAP	LA
7360 - 4,4'-DDE	EPA TO-4A	10249204	NELAP	LA
7365 - 4,4'-DDT	EPA TO-4A	10249204	NELAP	LA
8880 - Aroclor-1016 (PCB-1016)	EPA TO-4A	10249204	NELAP	LA
8885 - Aroclor-1221 (PCB-1221)	EPA TO-4A	10249204	NELAP	LA
8890 - Aroclor-1232 (PCB-1232)	EPA TO-4A	10249204	NELAP	LA
8895 - Aroclor-1242 (PCB-1242)	EPA TO-4A	10249204	NELAP	LA

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Analyte	Method Name	Method Code	Type	AB
8900 - Aroclor-1248 (PCB-1248)	EPA TO-4A	10249204	NELAP	LA
8905 - Aroclor-1254 (PCB-1254)	EPA TO-4A	10249204	NELAP	LA
8910 - Aroclor-1260 (PCB-1260)	EPA TO-4A	10249204	NELAP	LA
8913 - Aroclor-1268 (PCB-1268)	EPA TO-4A	10249204	NELAP	LA
9519 - 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA TO-9A	10249408	NELAP	LA
9516 - 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA TO-9A	10249408	NELAP	LA
9426 - 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	EPA TO-9A	10249408	NELAP	LA
9420 - 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA TO-9A	10249408	NELAP	LA
9423 - 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA TO-9A	10249408	NELAP	LA
9453 - 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)	EPA TO-9A	10249408	NELAP	LA
9471 - 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)	EPA TO-9A	10249408	NELAP	LA
9456 - 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)	EPA TO-9A	10249408	NELAP	LA
9474 - 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)	EPA TO-9A	10249408	NELAP	LA
9459 - 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)	EPA TO-9A	10249408	NELAP	LA
9477 - 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)	EPA TO-9A	10249408	NELAP	LA
9540 - 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)	EPA TO-9A	10249408	NELAP	LA
9543 - 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)	EPA TO-9A	10249408	NELAP	LA
9480 - 2,3,4,6,7,8-Hexachlorodibenzofuran	EPA TO-9A	10249408	NELAP	LA
9549 - 2,3,4,7,8-Pentachlorodibenzofuran	EPA TO-9A	10249408	NELAP	LA
9618 - 2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)	EPA TO-9A	10249408	NELAP	LA
9612 - 2,3,7,8-Tetrachlorodibenzofuran	EPA TO-9A	10249408	NELAP	LA
9438 - Total Hpcdd	EPA TO-9A	10249408	NELAP	LA
9444 - Total Hpcdf	EPA TO-9A	10249408	NELAP	LA
9468 - Total Hxcdd	EPA TO-9A	10249408	NELAP	LA
9483 - Total Hxcdf	EPA TO-9A	10249408	NELAP	LA
9555 - Total Pecdd	EPA TO-9A	10249408	NELAP	LA
9552 - Total Pecdf	EPA TO-9A	10249408	NELAP	LA
9609 - Total TCDD	EPA TO-9A	10249408	NELAP	LA
9615 - Total TCDF	EPA TO-9A	10249408	NELAP	LA
1095 - Mercury	EPA 101A	10401204	NELAP	LA
4467 - Condensible Particulate Matter	EPA 202	10403006	NELAP	LA
<del>100798 - Extractable Condensable</del>	<del>EPA 202</del>	<del>10403006</del>	<del>NELAP</del>	<del>LA</del>
Particulate Matter				
100799 - Non-extractable Condensable Particulate Matter	EPA 202	10403006	NELAP	LA
1541 - Bromine	EPA 26	10403108	NELAP	LA
1575 - Chloride	EPA 26	10403108	NELAP	LA
1580 - Chlorine	EPA 26	10403108	NELAP	LA
1770 - Hydrochloric acid (Hydrogen	EPA 26	10403108	NELAP	LA

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Analyte	Method Name	Method Code	Type	AB
chloride (gas only))				
1768 - Hydrogen Bromide (HBr)	EPA 26	10403108	NELAP	LA
1775 - Hydrogen fluoride (Hydrofluoric acid)	EPA 26	10403108	NELAP	LA
1541 - Bromine	EPA Method 26A	10403200	NELAP	LA
1575 - Chloride	EPA Method 26A	10403200	NELAP	LA
1580 - Chlorine	EPA Method 26A	10403200	NELAP	LA
1770 - Hydrochloric acid (Hydrogen chloride (gas only))	EPA Method 26A	10403200	NELAP	LA
1768 - Hydrogen Bromide (HBr)	EPA Method 26A	10403200	NELAP	LA
1775 - Hydrogen fluoride (Hydrofluoric acid)	EPA Method 26A	10403200	NELAP	LA
1095 - Mercury	EPA Method 29 (CVAA)	10403302	NELAP	LA
1000 - Aluminum	EPA Method 29 (ICP-MS)	10403700	NELAP	LA
1005 - Antimony	EPA Method 29 (ICP-MS)	10403700	NELAP	LA
1010 - Arsenic	EPA Method 29 (ICP-MS)	10403700	NELAP	LA
1015 - Barium	EPA Method 29 (ICP-MS)	10403700	NELAP	LA
1020 - Beryllium	EPA Method 29 (ICP-MS)	10403700	NELAP	LA
1030 - Cadmium	EPA Method 29 (ICP-MS)	10403700	NELAP	LA
1040 - Chromium	EPA Method 29 (ICP-MS)	10403700	NELAP	LA
1050 - Cobalt	EPA Method 29 (ICP-MS)	10403700	NELAP	LA
1055 - Copper	EPA Method 29 (ICP-MS)	10403700	NELAP	LA
1070 - Iron	EPA Method 29 (ICP-MS)	10403700	NELAP	LA
1075 - Lead	EPA Method 29 (ICP-MS)	10403700	NELAP	LA
1090 - Manganese	EPA Method 29 (ICP-MS)	10403700	NELAP	LA
1100 - Molybdenum	EPA Method 29 (ICP-MS)	10403700	NELAP	LA
1105 - Nickel	EPA Method 29 (ICP-MS)	10403700	NELAP	LA
1140 - Selenium	EPA Method 29 (ICP-MS)	10403700	NELAP	LA
1150 - Silver	EPA Method 29 (ICP-MS)	10403700	NELAP	LA
1165 - Thallium	EPA Method 29 (ICP-MS)	10403700	NELAP	LA
1175 - Tin	EPA Method 29 (ICP-MS)	10403700	NELAP	LA
1910 - Total Phosphorus	EPA Method 29 (ICP-MS)	10403700	NELAP	LA
1185 - Vanadium	EPA Method 29 (ICP-MS)	10403700	NELAP	LA
1190 - Zinc	EPA Method 29 (ICP-MS)	10403700	NELAP	LA
3915 - Particulates	EPA 5	10404305	NELAP	LA
3915 - Particulates	EPA Method 5D	10404601	NELAP	LA
1095 - Mercury	ASTM D6784	30033104	NELAP	LA

## Non Potable Water

Analyte	Method Name	Method Code	Type	AB
9519 - 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 1613B	10120602	NELAP	LA
9516 - 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 1613B	10120602	NELAP	LA
<del>9426 - 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)</del>	<del>EPA 1613B</del>	<del>10120602</del>	<del>NELAP</del>	<del>LA</del>
9420 - 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA 1613B	10120602	NELAP	LA
9423 - 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA 1613B	10120602	NELAP	LA
9453 - 1,2,3,4,7,8-Hexachlorodibenzo-p-	EPA 1613B	10120602	NELAP	LA

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## Non Potable Water

Analyte	Method Name	Method Code	Type	AB
dioxin (1,2,3,4,7,8-Hxcdd)				
9471 - 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)	EPA 1613B	10120602	NELAP	LA
9456 - 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)	EPA 1613B	10120602	NELAP	LA
9474 - 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)	EPA 1613B	10120602	NELAP	LA
9459 - 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)	EPA 1613B	10120602	NELAP	LA
9477 - 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)	EPA 1613B	10120602	NELAP	LA
9540 - 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)	EPA 1613B	10120602	NELAP	LA
9543 - 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)	EPA 1613B	10120602	NELAP	LA
9480 - 2,3,4,6,7,8-Hexachlorodibenzofuran	EPA 1613B	10120602	NELAP	LA
9549 - 2,3,4,7,8-Pentachlorodibenzofuran	EPA 1613B	10120602	NELAP	LA
9618 - 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD)	EPA 1613B	10120602	NELAP	LA
9612 - 2,3,7,8-Tetrachlorodibenzofuran	EPA 1613B	10120602	NELAP	LA
9438 - Total Hpcdd	EPA 1613B	10120602	NELAP	LA
9444 - Total Hpcdf	EPA 1613B	10120602	NELAP	LA
9468 - Total Hxcdd	EPA 1613B	10120602	NELAP	LA
9483 - Total Hxcdf	EPA 1613B	10120602	NELAP	LA
9555 - Total Pecdd	EPA 1613B	10120602	NELAP	LA
9552 - Total Pecdf	EPA 1613B	10120602	NELAP	LA
9609 - Total TCDD	EPA 1613B	10120602	NELAP	LA
9615 - Total TCDF	EPA 1613B	10120602	NELAP	LA
9873 - 2,2',3,3',4',5,6-Heptabromodiphenylether (BDE-177)	EPA 1614A	10120704	NELAP	LA
9902 - 2,2',3,3',4,4',5,5',6-Nonabromodiphenylether (BDE-206)	EPA 1614A	10120704	NELAP	LA
9892 - 2,2',3,3',4,4',5,6'-Octabromodiphenylether (BDE-196)	EPA 1614A	10120704	NELAP	LA
9903 - 2,2',3,3',4,4',5,6,6'-Nonabromodiphenylether (BDE-207)	EPA 1614A	10120704	NELAP	LA
9893 - 2,2',3,3',4,4',6,6'-Octabromodiphenylether (BDE-197)	EPA 1614A	10120704	NELAP	LA
9867 - 2,2',3,3',4,4',6-Heptabromodiphenylether (BDE-171)	EPA 1614A	10120704	NELAP	LA
9897 - 2,2',3,3',4,5',6,6'-Octabromodiphenylether (BDE-201)	EPA 1614A	10120704	NELAP	LA
9904 - 2,2',3,3',4,5',6,6'-Nonabromodiphenylether (BDE-208)	EPA 1614A	10120704	NELAP	LA
9896 - 2,2',3,3',4,5,6,6'-Octabromodiphenylether (BDE-200)	EPA 1614A	10120704	NELAP	LA
9872 - 2,2',3,3',4,6,6'-Heptabromodiphenylether (BDE-176)	EPA 1614A	10120704	NELAP	LA
9789 - 2,2',3,4',5-Pentabromodiphenylether (BDE-90)	EPA 1614A	10120704	NELAP	LA
9879 - 2,2',3,4,4',5',6-Heptabromodiphenylether (BDE-183)	EPA 1614A	10120704	NELAP	LA
9835 - 2,2',3,4,4',5'-Hexabromodiphenylether (BDE-138)	EPA 1614A	10120704	NELAP	LA
9899 - 2,2',3,4,4',5,5',6-	EPA 1614A	10120704	NELAP	LA

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Analyte	Method Name	Method Code	Type	AB
Octabromodiphenylether (BDE-203) 9876 - 2,2',3,4,4',5,5'-	EPA 1614A	10120704	NELAP	LA
Heptabromodiphenylether (BDE-180) 9878 - 2,2',3,4,4',5,6'-	EPA 1614A	10120704	NELAP	LA
Heptabromodiphenylether (BDE-182) 9900 - 2,2',3,4,4',5,6,6'-	EPA 1614A	10120704	NELAP	LA
Octabromodiphenylether (BDE-204) 9877 - 2,2',3,4,4',5,6-	EPA 1614A	10120704	NELAP	LA
Heptabromodiphenylether (BDE-181) 9837 - 2,2',3,4,4',6'-	EPA 1614A	10120704	NELAP	LA
Hexabromodiphenylether (BDE-140) 9880 - 2,2',3,4,4',6,6'-	EPA 1614A	10120704	NELAP	LA
Heptabromodiphenylether (BDE-184) 9836 - 2,2',3,4,4',6-	EPA 1614A	10120704	NELAP	LA
Hexabromodiphenylether (BDE-139) 9784 - 2,2',3,4,4'-Pentabromodiphenylether (BDE-85)	EPA 1614A	10120704	NELAP	LA
9850 - 2,2',4,4',5',6-	EPA 1614A	10120704	NELAP	LA
Hexabromodiphenylether (BDE-154) 9569 - 2,2',4,4',5,5'-Hexabromodiphenyl ether (BDE-153)	EPA 1614A	10120704	NELAP	LA
9571 - 2,2',4,4',5-Pentabromodiphenyl ether (BDE-99)	EPA 1614A	10120704	NELAP	LA
9851 - 2,2',4,4',6,6'-	EPA 1614A	10120704	NELAP	LA
Hexabromodiphenylether (BDE-155) 9572 - 2,2',4,4',6-Pentabromodiphenyl ether (BDE-100)	EPA 1614A	10120704	NELAP	LA
9773 - 2,2',4,4'-Tetrabromodiphenyl ether (BDE-47)	EPA 1614A	10120704	NELAP	LA
9747 - 2,2',4,5'-Tetrabromodiphenylether (BDE-49)	EPA 1614A	10120704	NELAP	LA
9716 - 2,2',4-Tribromodiphenylether (BDE- 17)	EPA 1614A	10120704	NELAP	LA
9749 - 2,2',4,6'-Tetrabromodiphenylether (BDE-51)	EPA 1614A	10120704	NELAP	LA
9769 - 2,3',4',6-Tetrabromodiphenylether (BDE-71)	EPA 1614A	10120704	NELAP	LA
9815 - 2,3',4,4',5-Pentabromodiphenylether (BDE-118)	EPA 1614A	10120704	NELAP	LA
9764 - 2,3',4,4'-Tetrabromodiphenylether (BDE-66)	EPA 1614A	10120704	NELAP	LA
9724 - 2,3',4-Tribromodiphenylether (BDE- 25)	EPA 1614A	10120704	NELAP	LA
9887 - 2,3,3',4,4',5',6-	EPA 1614A	10120704	NELAP	LA
Heptabromodiphenylether (BDE-191) 9901 - 2,3,3',4,4',5,5',6-	EPA 1614A	10120704	NELAP	LA
Octabromodiphenylether (BDE-205) 9886 - 2,3,3',4,4',5,6-	EPA 1614A	10120704	NELAP	LA
Heptabromodiphenylether (BDE-190) 9852 - 2,3,3',4,4',5-	EPA 1614A	10120704	NELAP	LA
Hexabromodiphenylether (BDE-156) 9862 - 2,3,4,4',5,6-Hexabromodiphenylether (BDE-166)	EPA 1614A	10120704	NELAP	LA
9813 - 2,3,4,5,6-Pentabromodiphenylether (BDE-116)	EPA 1614A	10120704	NELAP	LA

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9720 - 2,3,4-Tribromodiphenylether (BDE-21)	EPA 1614A	10120704	NELAP	LA
9731 - 2,4',6-Tribromodiphenylether (BDE-32)	EPA 1614A	10120704	NELAP	LA
9774 - 2,4,4',6-Tetrabromodiphenylether (BDE-75)	EPA 1614A	10120704	NELAP	LA
9729 - 2,4,6-Tribromodiphenylether (BDE-30)	EPA 1614A	10120704	NELAP	LA
9706 - 2,4-Dibromodiphenylether (BDE-7)	EPA 1614A	10120704	NELAP	LA
9709 - 2,6-Dibromodiphenylether (BDE-10)	EPA 1614A	10120704	NELAP	LA
9700 - 2-Bromodiphenylether (BDE-1)	EPA 1614A	10120704	NELAP	LA
9865 - 3,3',4,4',5,5'-Hexabromodiphenylether (BDE-169)	EPA 1614A	10120704	NELAP	LA
9823 - 3,3',4,4',5-Pentabromodiphenylether (BDE-126)	EPA 1614A	10120704	NELAP	LA
9776 - 3,3',4,4'-Tetrabromodiphenylether (BDE-77)	EPA 1614A	10120704	NELAP	LA
9734 - 3,3',4-Tribromodiphenylether (BDE-35)	EPA 1614A	10120704	NELAP	LA
9712 - 3,4'-Dibromodiphenylether (BDE-13)	EPA 1614A	10120704	NELAP	LA
9736 - 3,4,4'-Tribromodiphenylether (BDE-37)	EPA 1614A	10120704	NELAP	LA
9711 - 3,4-Dibromodiphenylether (BDE-12)	EPA 1614A	10120704	NELAP	LA
9701 - 3-Bromodiphenylether (BDE-2)	EPA 1614A	10120704	NELAP	LA
9714 - 4,4'-Dibromodiphenylether (BDE-15)	EPA 1614A	10120704	NELAP	LA
5660 - 4-Bromophenyl phenyl ether	EPA 1614A	10120704	NELAP	LA
8902 - Coelution - Dibromodiphenyl ethers (BDE-8 + BDE-11)	EPA 1614A	10120704	NELAP	LA
9908 - Coelution - Pentabromodiphenyl ethers (BDE-119 + BDE-120)	EPA 1614A	10120704	NELAP	LA
9909 - Coelution - Tribromodiphenyl ethers (BDE-28 + BDE-33)	EPA 1614A	10120704	NELAP	LA
9905 - Decabromodiphenylether (BDE-209)	EPA 1614A	10120704	NELAP	LA
9105 - 2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl (BZ-209)	EPA 1668A	10129405	NELAP	LA
9095 - 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ-206)	EPA 1668A	10129405	NELAP	LA
9090 - 2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194)	EPA 1668A	10129405	NELAP	LA
9102 - 2,2',3,3',4,4',5,6'-Octachlorobiphenyl (BZ-196)	EPA 1668A	10129405	NELAP	LA
9101 - 2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (BZ-207)	EPA 1668A	10129405	NELAP	LA
9103 - 2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195)	EPA 1668A	10129405	NELAP	LA
9065 - 2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170)	EPA 1668A	10129405	NELAP	LA
9104 - 2,2',3,3',4,4',6,6'-Octachlorobiphenyl (BZ-197)	EPA 1668A	10129405	NELAP	LA
9106 - 2,2',3,3',4,4',6-Heptachlorobiphenyl (BZ-171)	EPA 1668A	10129405	NELAP	LA
9020 - 2,2',3,3',4,4'-Hexachlorobiphenyl (BZ-128)	EPA 1668A	10129405	NELAP	LA

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9114 - 2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ-177)	EPA 1668A	10129405	NELAP	LA
9112 - 2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ-201)	EPA 1668A	10129405	NELAP	LA
9115 - 2,2',3,3',4,5',6-Heptachlorobiphenyl (BZ-175)	EPA 1668A	10129405	NELAP	LA
9117 - 2,2',3,3',4,5'-Hexachlorobiphenyl (BZ-130)	EPA 1668A	10129405	NELAP	LA
9108 - 2,2',3,3',4,5,5',6'-Octachlorobiphenyl (BZ-199)	EPA 1668A	10129405	NELAP	LA
9107 - 2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl (BZ-208)	EPA 1668A	10129405	NELAP	LA
9109 - 2,2',3,3',4,5,5',6-Octachlorobiphenyl (BZ-198)	EPA 1668A	10129405	NELAP	LA
9110 - 2,2',3,3',4,5,5'-Heptachlorobiphenyl (BZ-172)	EPA 1668A	10129405	NELAP	LA
9116 - 2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-174)	EPA 1668A	10129405	NELAP	LA
9111 - 2,2',3,3',4,5,6,6'-Octachlorobiphenyl (BZ-200)	EPA 1668A	10129405	NELAP	LA
9113 - 2,2',3,3',4,5,6-Heptachlorobiphenyl (BZ-173)	EPA 1668A	10129405	NELAP	LA
9118 - 2,2',3,3',4,5-Hexachlorobiphenyl (BZ-129)	EPA 1668A	10129405	NELAP	LA
9120 - 2,2',3,3',4,6'-Hexachlorobiphenyl (BZ-132)	EPA 1668A	10129405	NELAP	LA
9119 - 2,2',3,3',4,6,6'-Heptachlorobiphenyl (BZ-176)	EPA 1668A	10129405	NELAP	LA
9121 - 2,2',3,3',4,6-Hexachlorobiphenyl (BZ-131)	EPA 1668A	10129405	NELAP	LA
9122 - 2,2',3,3',4-Pentachlorobiphenyl (BZ-82)	EPA 1668A	10129405	NELAP	LA
9123 - 2,2',3,3',5,5',6,6'-Octachlorobiphenyl (BZ-202)	EPA 1668A	10129405	NELAP	LA
9124 - 2,2',3,3',5,5',6-Heptachlorobiphenyl (BZ-178)	EPA 1668A	10129405	NELAP	LA
9125 - 2,2',3,3',5,5'-Hexachlorobiphenyl (BZ-133)	EPA 1668A	10129405	NELAP	LA
9127 - 2,2',3,3',5,6'-Hexachlorobiphenyl (BZ-135)	EPA 1668A	10129405	NELAP	LA
9126 - 2,2',3,3',5,6,6'-Heptachlorobiphenyl (BZ-179)	EPA 1668A	10129405	NELAP	LA
9128 - 2,2',3,3',5,6-Hexachlorobiphenyl (BZ-134)	EPA 1668A	10129405	NELAP	LA
9129 - 2,2',3,3',5-Pentachlorobiphenyl (BZ-83)	EPA 1668A	10129405	NELAP	LA
9130 - 2,2',3,3',6,6'-Hexachlorobiphenyl (BZ-136)	EPA 1668A	10129405	NELAP	LA
9131 - 2,2',3,3',6-Pentachlorobiphenyl (BZ-84)	EPA 1668A	10129405	NELAP	LA
9132 - 2,2',3,3'-Tetrachlorobiphenyl (BZ-40)	EPA 1668A	10129405	NELAP	LA
9151 - 2,2',3,4',5',6-Hexachlorobiphenyl (BZ-149)	EPA 1668A	10129405	NELAP	LA
9154 - 2,2',3,4',5'-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	LA

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(BZ-97)				
9080 - 2,2',3,4',5,5',6-Heptachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-187)				
9144 - 2,2',3,4',5,5'-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-146)				
9147 - 2,2',3,4',5,6'-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-148)				
9146 - 2,2',3,4',5,6,6'-Heptachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-188)				
9149 - 2,2',3,4',5,6-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-147)				
9155 - 2,2',3,4',5-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-90)				
9159 - 2,2',3,4',6'-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-98)				
9157 - 2,2',3,4',6,6'-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-150)				
9160 - 2,2',3,4',6-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-91)				
9162 - 2,2',3,4'-Tetrachlorobiphenyl (BZ-42)	EPA 1668A	10129405	NELAP	LA
9075 - 2,2',3,4,4',5',6-Heptachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-183)				
9025 - 2,2',3,4,4',5'-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-138)				
9133 - 2,2',3,4,4',5,5',6-Octachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-203)				
9134 - 2,2',3,4,4',5,5'-Heptachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-180)				
9136 - 2,2',3,4,4',5,6'-Heptachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-182)				
9135 - 2,2',3,4,4',5,6,6'-Octachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-204)				
9137 - 2,2',3,4,4',5,6-Heptachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-181)				
9138 - 2,2',3,4,4',5-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-137)				
9140 - 2,2',3,4,4',6'-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-140)				
9139 - 2,2',3,4,4',6,6'-Heptachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-184)				
9141 - 2,2',3,4,4',6-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-139)				
9142 - 2,2',3,4,4'-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-85)				
9150 - 2,2',3,4,5',6-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-144)				
8975 - 2,2',3,4,5'-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-87)				
9143 - 2,2',3,4,5,5',6-Heptachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-185)				
9030 - 2,2',3,4,5,5'-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-141)				
9152 - 2,2',3,4,5,6'-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-143)				

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9145 - 2,2',3,4,5,6,6'-Heptachlorobiphenyl (BZ-186)	EPA 1668A	10129405	NELAP	LA
9148 - 2,2',3,4,5,6-Hexachlorobiphenyl (BZ-142)	EPA 1668A	10129405	NELAP	LA
9153 - 2,2',3,4,5-Pentachlorobiphenyl (BZ-86)	EPA 1668A	10129405	NELAP	LA
9161 - 2,2',3,4,6'-Pentachlorobiphenyl (BZ-89)	EPA 1668A	10129405	NELAP	LA
9156 - 2,2',3,4,6,6'-Hexachlorobiphenyl (BZ-145)	EPA 1668A	10129405	NELAP	LA
9158 - 2,2',3,4,6-Pentachlorobiphenyl (BZ-88)	EPA 1668A	10129405	NELAP	LA
9163 - 2,2',3,4-Tetrachlorobiphenyl (BZ-41)	EPA 1668A	10129405	NELAP	LA
9166 - 2,2',3,5',6-Pentachlorobiphenyl (BZ-95)	EPA 1668A	10129405	NELAP	LA
8945 - 2,2',3,5'-Tetrachlorobiphenyl (BZ-44)	EPA 1668A	10129405	NELAP	LA
9035 - 2,2',3,5,5',6-Hexachlorobiphenyl (BZ-151)	EPA 1668A	10129405	NELAP	LA
9164 - 2,2',3,5,5'-Pentachlorobiphenyl (BZ-92)	EPA 1668A	10129405	NELAP	LA
9167 - 2,2',3,5,6'-Pentachlorobiphenyl (BZ-94)	EPA 1668A	10129405	NELAP	LA
9165 - 2,2',3,5,6,6'-Hexachlorobiphenyl (BZ-152)	EPA 1668A	10129405	NELAP	LA
9168 - 2,2',3,5,6-Pentachlorobiphenyl (BZ-93)	EPA 1668A	10129405	NELAP	LA
9169 - 2,2',3,5-Tetrachlorobiphenyl (BZ-43)	EPA 1668A	10129405	NELAP	LA
9171 - 2,2',3,6'-Tetrachlorobiphenyl (BZ-46)	EPA 1668A	10129405	NELAP	LA
9170 - 2,2',3,6,6'-Pentachlorobiphenyl (BZ-96)	EPA 1668A	10129405	NELAP	LA
9172 - 2,2',3,6-Tetrachlorobiphenyl (BZ-45)	EPA 1668A	10129405	NELAP	LA
9173 - 2,2',3-Trichlorobiphenyl (BZ-16)	EPA 1668A	10129405	NELAP	LA
9040 - 2,2',4,4',5,5'-Hexachlorobiphenyl (BZ-153)	EPA 1668A	10129405	NELAP	LA
9174 - 2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-154)	EPA 1668A	10129405	NELAP	LA
9175 - 2,2',4,4',5-Pentachlorobiphenyl (BZ-99)	EPA 1668A	10129405	NELAP	LA
9176 - 2,2',4,4',6,6'-Hexachlorobiphenyl (BZ-155)	EPA 1668A	10129405	NELAP	LA
9177 - 2,2',4,4',6-Pentachlorobiphenyl (BZ-100)	EPA 1668A	10129405	NELAP	LA
9178 - 2,2',4,4'-Tetrachlorobiphenyl (BZ-47)	EPA 1668A	10129405	NELAP	LA
9179 - 2,2',4,5',6-Pentachlorobiphenyl (BZ-103)	EPA 1668A	10129405	NELAP	LA
8950 - 2,2',4,5'-Tetrachlorobiphenyl (BZ-49)	EPA 1668A	10129405	NELAP	LA
8980 - 2,2',4,5,5'-Pentachlorobiphenyl (BZ-101)	EPA 1668A	10129405	NELAP	LA

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9180 - 2,2',4,5,6'-Pentachlorobiphenyl (BZ-102)	EPA 1668A	10129405	NELAP	LA
9181 - 2,2',4,5-Tetrachlorobiphenyl (BZ-48)	EPA 1668A	10129405	NELAP	LA
9183 - 2,2',4,6'-Tetrachlorobiphenyl (BZ-51)	EPA 1668A	10129405	NELAP	LA
9182 - 2,2',4,6,6'-Pentachlorobiphenyl (BZ-104)	EPA 1668A	10129405	NELAP	LA
9184 - 2,2',4,6-Tetrachlorobiphenyl (BZ-50)	EPA 1668A	10129405	NELAP	LA
9185 - 2,2',4-Trichlorobiphenyl (BZ-17)	EPA 1668A	10129405	NELAP	LA
8955 - 2,2',5,5'-Tetrachlorobiphenyl (BZ-52)	EPA 1668A	10129405	NELAP	LA
9186 - 2,2',5,6'-Tetrachlorobiphenyl (BZ-53)	EPA 1668A	10129405	NELAP	LA
8930 - 2,2',5-Trichlorobiphenyl (BZ-18)	EPA 1668A	10129405	NELAP	LA
9187 - 2,2',6,6'-Tetrachlorobiphenyl (BZ-54)	EPA 1668A	10129405	NELAP	LA
9188 - 2,2',6-Trichlorobiphenyl (BZ-19)	EPA 1668A	10129405	NELAP	LA
9189 - 2,2'-Dichlorobiphenyl (BZ-4)	EPA 1668A	10129405	NELAP	LA
9224 - 2,3',4',5',6-Pentachlorobiphenyl (BZ-125)	EPA 1668A	10129405	NELAP	LA
9229 - 2,3',4',5'-Tetrachlorobiphenyl (BZ-76)	EPA 1668A	10129405	NELAP	LA
9222 - 2,3',4',5,5'-Pentachlorobiphenyl (BZ-124)	EPA 1668A	10129405	NELAP	LA
9230 - 2,3',4',5-Tetrachlorobiphenyl (BZ-70)	EPA 1668A	10129405	NELAP	LA
9237 - 2,3',4',6-Tetrachlorobiphenyl (BZ-71)	EPA 1668A	10129405	NELAP	LA
9239 - 2,3',4'-Trichlorobiphenyl (BZ-33)	EPA 1668A	10129405	NELAP	LA
9218 - 2,3',4,4',5',6-Hexachlorobiphenyl (BZ-168)	EPA 1668A	10129405	NELAP	LA
9000 - 2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)	EPA 1668A	10129405	NELAP	LA
9011 - 2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)	EPA 1668A	10129405	NELAP	LA
9055 - 2,3',4,4',5,5'-Hexachlorobiphenyl (BZ-167)	EPA 1668A	10129405	NELAP	LA
8995 - 2,3',4,4',5-Pentachlorobiphenyl (BZ-118)	EPA 1668A	10129405	NELAP	LA
9220 - 2,3',4,4',6-Pentachlorobiphenyl (BZ-119)	EPA 1668A	10129405	NELAP	LA
8960 - 2,3',4,4'-Tetrachlorobiphenyl (BZ-66)	EPA 1668A	10129405	NELAP	LA
9226 - 2,3',4,5',6-Pentachlorobiphenyl (BZ-121)	EPA 1668A	10129405	NELAP	LA
9231 - 2,3',4,5'-Tetrachlorobiphenyl (BZ-68)	EPA 1668A	10129405	NELAP	LA
9223 - 2,3',4,5,5'-Pentachlorobiphenyl (BZ-120)	EPA 1668A	10129405	NELAP	LA
9232 - 2,3',4,5-Tetrachlorobiphenyl (BZ-67)	EPA 1668A	10129405	NELAP	LA
9235 - 2,3',4,6-Tetrachlorobiphenyl (BZ-69)	EPA 1668A	10129405	NELAP	LA

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9240 - 2,3',4-Trichlorobiphenyl (BZ-25)	EPA 1668A	10129405	NELAP	LA
9244 - 2,3',5',6-Tetrachlorobiphenyl (BZ-73)	EPA 1668A	10129405	NELAP	LA
9246 - 2,3',5'-Trichlorobiphenyl (BZ-34)	EPA 1668A	10129405	NELAP	LA
9242 - 2,3',5,5'-Tetrachlorobiphenyl (BZ-72)	EPA 1668A	10129405	NELAP	LA
8935 - 2,3',5-Trichlorobiphenyl (BZ-26)	EPA 1668A	10129405	NELAP	LA
9248 - 2,3',6-Trichlorobiphenyl (BZ-27)	EPA 1668A	10129405	NELAP	LA
9249 - 2,3'-Dichlorobiphenyl (BZ-6)	EPA 1668A	10129405	NELAP	LA
9201 - 2,3,3',4',5',6-Hexachlorobiphenyl (BZ-164)	EPA 1668A	10129405	NELAP	LA
9202 - 2,3,3',4',5'-Pentachlorobiphenyl (BZ-122)	EPA 1668A	10129405	NELAP	LA
9195 - 2,3,3',4',5,5',6-Heptachlorobiphenyl (BZ-193)	EPA 1668A	10129405	NELAP	LA
9197 - 2,3,3',4',5,5'-Hexachlorobiphenyl (BZ-162)	EPA 1668A	10129405	NELAP	LA
9199 - 2,3,3',4',5,6-Hexachlorobiphenyl (BZ-163)	EPA 1668A	10129405	NELAP	LA
9205 - 2,3,3',4',5-Pentachlorobiphenyl (BZ-107)	EPA 1668A	10129405	NELAP	LA
8990 - 2,3,3',4',6-Pentachlorobiphenyl (BZ-110)	EPA 1668A	10129405	NELAP	LA
9207 - 2,3,3',4'-Tetrachlorobiphenyl (BZ-56)	EPA 1668A	10129405	NELAP	LA
9192 - 2,3,3',4,4',5',6-Heptachlorobiphenyl (BZ-191)	EPA 1668A	10129405	NELAP	LA
9045 - 2,3,3',4,4',5'-Hexachlorobiphenyl (BZ-157)	EPA 1668A	10129405	NELAP	LA
9190 - 2,3,3',4,4',5,5',6-Octachlorobiphenyl (BZ-205)	EPA 1668A	10129405	NELAP	LA
9085 - 2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ-189)	EPA 1668A	10129405	NELAP	LA
9191 - 2,3,3',4,4',5,6-Heptachlorobiphenyl (BZ-190)	EPA 1668A	10129405	NELAP	LA
9050 - 2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)	EPA 1668A	10129405	NELAP	LA
9193 - 2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158)	EPA 1668A	10129405	NELAP	LA
8985 - 2,3,3',4,4'-Pentachlorobiphenyl (BZ-105)	EPA 1668A	10129405	NELAP	LA
9200 - 2,3,3',4,5',6-Hexachlorobiphenyl (BZ-161)	EPA 1668A	10129405	NELAP	LA
9203 - 2,3,3',4,5'-Pentachlorobiphenyl (BZ-108)	EPA 1668A	10129405	NELAP	LA
9194 - 2,3,3',4,5,5',6-Heptachlorobiphenyl (BZ-192)	EPA 1668A	10129405	NELAP	LA
9196 - 2,3,3',4,5,5'-Hexachlorobiphenyl (BZ-159)	EPA 1668A	10129405	NELAP	LA
9198 - 2,3,3',4,5,6-Hexachlorobiphenyl (BZ-160)	EPA 1668A	10129405	NELAP	LA
9204 - 2,3,3',4,5-Pentachlorobiphenyl (BZ-106)	EPA 1668A	10129405	NELAP	LA
9206 - 2,3,3',4,6-Pentachlorobiphenyl (BZ-109)	EPA 1668A	10129405	NELAP	LA

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9208 - 2,3,3',4-Tetrachlorobiphenyl (BZ-55)	EPA 1668A	10129405	NELAP	LA
9212 - 2,3,3',5',6-Pentachlorobiphenyl (BZ-113)	EPA 1668A	10129405	NELAP	LA
9213 - 2,3,3',5'-Tetrachlorobiphenyl (BZ-58)	EPA 1668A	10129405	NELAP	LA
9209 - 2,3,3',5,5',6-Hexachlorobiphenyl (BZ-165)	EPA 1668A	10129405	NELAP	LA
9210 - 2,3,3',5,5'-Pentachlorobiphenyl (BZ-111)	EPA 1668A	10129405	NELAP	LA
9211 - 2,3,3',5,6-Pentachlorobiphenyl (BZ-112)	EPA 1668A	10129405	NELAP	LA
9214 - 2,3,3',5-Tetrachlorobiphenyl (BZ-57)	EPA 1668A	10129405	NELAP	LA
9215 - 2,3,3',6-Tetrachlorobiphenyl (BZ-59)	EPA 1668A	10129405	NELAP	LA
9216 - 2,3,3'-Trichlorobiphenyl (BZ-20)	EPA 1668A	10129405	NELAP	LA
9227 - 2,3,4',5,6-Pentachlorobiphenyl (BZ-117)	EPA 1668A	10129405	NELAP	LA
9233 - 2,3,4',5-Tetrachlorobiphenyl (BZ-63)	EPA 1668A	10129405	NELAP	LA
9236 - 2,3,4',6-Tetrachlorobiphenyl (BZ-64)	EPA 1668A	10129405	NELAP	LA
9241 - 2,3,4'-Trichlorobiphenyl (BZ-22)	EPA 1668A	10129405	NELAP	LA
9217 - 2,3,4,4',5,6-Hexachlorobiphenyl (BZ-166)	EPA 1668A	10129405	NELAP	LA
9005 - 2,3,4,4',5-Pentachlorobiphenyl (BZ-114)	EPA 1668A	10129405	NELAP	LA
9219 - 2,3,4,4',6-Pentachlorobiphenyl (BZ-115)	EPA 1668A	10129405	NELAP	LA
9221 - 2,3,4,4'-Tetrachlorobiphenyl (BZ-60)	EPA 1668A	10129405	NELAP	LA
9225 - 2,3,4,5,6-Pentachlorobiphenyl (BZ-116)	EPA 1668A	10129405	NELAP	LA
9228 - 2,3,4,5-Tetrachlorobiphenyl (BZ-61)	EPA 1668A	10129405	NELAP	LA
9234 - 2,3,4,6-Tetrachlorobiphenyl (BZ-62)	EPA 1668A	10129405	NELAP	LA
9238 - 2,3,4-Trichlorobiphenyl (BZ-21)	EPA 1668A	10129405	NELAP	LA
9243 - 2,3,5,6-Tetrachlorobiphenyl (BZ-65)	EPA 1668A	10129405	NELAP	LA
9245 - 2,3,5-Trichlorobiphenyl (BZ-23)	EPA 1668A	10129405	NELAP	LA
9247 - 2,3,6-Trichlorobiphenyl (BZ-24)	EPA 1668A	10129405	NELAP	LA
8920 - 2,3-Dichlorobiphenyl (BZ-5)	EPA 1668A	10129405	NELAP	LA
8940 - 2,4',5-Trichlorobiphenyl (BZ-31)	EPA 1668A	10129405	NELAP	LA
9255 - 2,4',6-Trichlorobiphenyl (BZ-32)	EPA 1668A	10129405	NELAP	LA
9256 - 2,4'-Dichlorobiphenyl (BZ-8)	EPA 1668A	10129405	NELAP	LA
9250 - 2,4,4',5-Tetrachlorobiphenyl (BZ-74)	EPA 1668A	10129405	NELAP	LA
9251 - 2,4,4',6-Tetrachlorobiphenyl (BZ-75)	EPA 1668A	10129405	NELAP	LA
9252 - 2,4,4'-Trichlorobiphenyl (BZ-28)	EPA 1668A	10129405	NELAP	LA
9253 - 2,4,5-Trichlorobiphenyl (BZ-29)	EPA 1668A	10129405	NELAP	LA
9254 - 2,4,6-Trichlorobiphenyl (BZ-30)	EPA 1668A	10129405	NELAP	LA
9257 - 2,4-Dichlorobiphenyl (BZ-7)	EPA 1668A	10129405	NELAP	LA

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9258 - 2,5-Dichlorobiphenyl (BZ-9)	EPA 1668A	10129405	NELAP	LA
9259 - 2,6-Dichlorobiphenyl (BZ-10)	EPA 1668A	10129405	NELAP	LA
8915 - 2-Chlorobiphenyl (BZ-1)	EPA 1668A	10129405	NELAP	LA
9060 - 3,3',4,4',5,5'-Hexachlorobiphenyl (BZ-169)	EPA 1668A	10129405	NELAP	LA
9015 - 3,3',4,4',5-Pentachlorobiphenyl (BZ-126)	EPA 1668A	10129405	NELAP	LA
8965 - 3,3',4,4'-Tetrachlorobiphenyl (BZ-77)	EPA 1668A	10129405	NELAP	LA
9261 - 3,3',4,5'-Tetrachlorobiphenyl (BZ-79)	EPA 1668A	10129405	NELAP	LA
9260 - 3,3',4,5,5'-Pentachlorobiphenyl (BZ-127)	EPA 1668A	10129405	NELAP	LA
9262 - 3,3',4,5-Tetrachlorobiphenyl (BZ-78)	EPA 1668A	10129405	NELAP	LA
9263 - 3,3',4-Trichlorobiphenyl (BZ-35)	EPA 1668A	10129405	NELAP	LA
9264 - 3,3',5,5'-Tetrachlorobiphenyl (BZ-80)	EPA 1668A	10129405	NELAP	LA
9265 - 3,3',5-Trichlorobiphenyl (BZ-36)	EPA 1668A	10129405	NELAP	LA
8925 - 3,3'-Dichlorobiphenyl (BZ-11)	EPA 1668A	10129405	NELAP	LA
9268 - 3,4',5-Trichlorobiphenyl (BZ-39)	EPA 1668A	10129405	NELAP	LA
9269 - 3,4'-Dichlorobiphenyl (BZ-13)	EPA 1668A	10129405	NELAP	LA
8970 - 3,4,4',5-Tetrachlorobiphenyl (BZ-81)	EPA 1668A	10129405	NELAP	LA
9266 - 3,4,4'-Trichlorobiphenyl (BZ-37)	EPA 1668A	10129405	NELAP	LA
9267 - 3,4,5-Trichlorobiphenyl (BZ-38)	EPA 1668A	10129405	NELAP	LA
9270 - 3,4-Dichlorobiphenyl (BZ-12)	EPA 1668A	10129405	NELAP	LA
9271 - 3,5-Dichlorobiphenyl (BZ-14)	EPA 1668A	10129405	NELAP	LA
9272 - 3-Chlorobiphenyl (BZ-2)	EPA 1668A	10129405	NELAP	LA
9273 - 4,4'-Dichlorobiphenyl (BZ-15)	EPA 1668A	10129405	NELAP	LA
9274 - 4-Chlorobiphenyl (BZ-3)	EPA 1668A	10129405	NELAP	LA
1444 - Separatory Funnel Liquid-liquid extraction	EPA 3510C	10138202	NELAP	LA
9519 - 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 8290	10187209	NELAP	LA
9516 - 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 8290	10187209	NELAP	LA
9426 - 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	EPA 8290	10187209	NELAP	LA
9420 - 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA 8290	10187209	NELAP	LA
9423 - 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA 8290	10187209	NELAP	LA
9453 - 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)	EPA 8290	10187209	NELAP	LA
9471 - 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)	EPA 8290	10187209	NELAP	LA
9456 - 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)	EPA 8290	10187209	NELAP	LA
9474 - 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)	EPA 8290	10187209	NELAP	LA
9459 - 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)	EPA 8290	10187209	NELAP	LA

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9477 - 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)	EPA 8290	10187209	NELAP	LA
9540 - 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)	EPA 8290	10187209	NELAP	LA
9543 - 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)	EPA 8290	10187209	NELAP	LA
9480 - 2,3,4,6,7,8-Hexachlorodibenzofuran	EPA 8290	10187209	NELAP	LA
9549 - 2,3,4,7,8-Pentachlorodibenzofuran	EPA 8290	10187209	NELAP	LA
9618 - 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD)	EPA 8290	10187209	NELAP	LA
9612 - 2,3,7,8-Tetrachlorodibenzofuran	EPA 8290	10187209	NELAP	LA
9438 - Total Hpcdd	EPA 8290	10187209	NELAP	LA
9444 - Total Hpcdf	EPA 8290	10187209	NELAP	LA
9468 - Total Hxcdd	EPA 8290	10187209	NELAP	LA
9483 - Total Hxcdf	EPA 8290	10187209	NELAP	LA
9555 - Total Pecdd	EPA 8290	10187209	NELAP	LA
9552 - Total Pecdf	EPA 8290	10187209	NELAP	LA
9609 - Total TCDD	EPA 8290	10187209	NELAP	LA
9615 - Total TCDF	EPA 8290	10187209	NELAP	LA
9519 - 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9516 - 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9426 - 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9420 - 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9423 - 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9453 - 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9471 - 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9456 - 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9474 - 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9459 - 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9477 - 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9540 - 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9543 - 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9480 - 2,3,4,6,7,8-Hexachlorodibenzofuran	EPA 8290A, Rev.2007	10187403	NELAP	LA
9549 - 2,3,4,7,8-Pentachlorodibenzofuran	EPA 8290A, Rev.2007	10187403	NELAP	LA
9618 - 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9612 - 2,3,7,8-Tetrachlorodibenzofuran	EPA 8290A, Rev.2007	10187403	NELAP	LA
9438 - Total Hpcdd	EPA 8290A, Rev.2007	10187403	NELAP	LA
9444 - Total Hpcdf	EPA 8290A, Rev.2007	10187403	NELAP	LA
9468 - Total Hxcdd	EPA 8290A, Rev.2007	10187403	NELAP	LA

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9483 - Total Hxcdf	EPA 8290A, Rev.2007	10187403	NELAP	LA
9555 - Total Pecdd	EPA 8290A, Rev.2007	10187403	NELAP	LA
9552 - Total Pecdf	EPA 8290A, Rev.2007	10187403	NELAP	LA
9609 - Total TCDD	EPA 8290A, Rev.2007	10187403	NELAP	LA
9615 - Total TCDF	EPA 8290A, Rev.2007	10187403	NELAP	LA
9105 - 2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl (BZ-209)	EPA 1668C	10262109	NELAP	LA
9095 - 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ-206)	EPA 1668C	10262109	NELAP	LA
9090 - 2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194)	EPA 1668C	10262109	NELAP	LA
9102 - 2,2',3,3',4,4',5,6'-Octachlorobiphenyl (BZ-196)	EPA 1668C	10262109	NELAP	LA
9101 - 2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (BZ-207)	EPA 1668C	10262109	NELAP	LA
9103 - 2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195)	EPA 1668C	10262109	NELAP	LA
9065 - 2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170)	EPA 1668C	10262109	NELAP	LA
9104 - 2,2',3,3',4,4',6'-Octachlorobiphenyl (BZ-197)	EPA 1668C	10262109	NELAP	LA
9106 - 2,2',3,3',4,4',6-Heptachlorobiphenyl (BZ-171)	EPA 1668C	10262109	NELAP	LA
9020 - 2,2',3,3',4,4'-Hexachlorobiphenyl (BZ-128)	EPA 1668C	10262109	NELAP	LA
9114 - 2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ-177)	EPA 1668C	10262109	NELAP	LA
9112 - 2,2',3,3',4,5',6'-Octachlorobiphenyl (BZ-201)	EPA 1668C	10262109	NELAP	LA
9115 - 2,2',3,3',4,5',6-Heptachlorobiphenyl (BZ-175)	EPA 1668C	10262109	NELAP	LA
9117 - 2,2',3,3',4,5'-Hexachlorobiphenyl (BZ-130)	EPA 1668C	10262109	NELAP	LA
9108 - 2,2',3,3',4,5,5',6'-Octachlorobiphenyl (BZ-199)	EPA 1668C	10262109	NELAP	LA
9107 - 2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl (BZ-208)	EPA 1668C	10262109	NELAP	LA
9109 - 2,2',3,3',4,5,5',6-Octachlorobiphenyl (BZ-198)	EPA 1668C	10262109	NELAP	LA
9110 - 2,2',3,3',4,5,5'-Heptachlorobiphenyl (BZ-172)	EPA 1668C	10262109	NELAP	LA
9116 - 2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-174)	EPA 1668C	10262109	NELAP	LA
9111 - 2,2',3,3',4,5,6,6'-Octachlorobiphenyl (BZ-200)	EPA 1668C	10262109	NELAP	LA
9113 - 2,2',3,3',4,5,6-Heptachlorobiphenyl (BZ-173)	EPA 1668C	10262109	NELAP	LA
9118 - 2,2',3,3',4,5-Hexachlorobiphenyl (BZ-129)	EPA 1668C	10262109	NELAP	LA
9120 - 2,2',3,3',4,6'-Hexachlorobiphenyl (BZ-132)	EPA 1668C	10262109	NELAP	LA
9119 - 2,2',3,3',4,6,6'-Heptachlorobiphenyl (BZ-176)	EPA 1668C	10262109	NELAP	LA
9121 - 2,2',3,3',4,6-Hexachlorobiphenyl (BZ-131)	EPA 1668C	10262109	NELAP	LA

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9122 - 2,2',3,3',4-Pentachlorobiphenyl (BZ-82)	EPA 1668C	10262109	NELAP	LA
9123 - 2,2',3,3',5,5',6,6'-Octachlorobiphenyl (BZ-202)	EPA 1668C	10262109	NELAP	LA
9124 - 2,2',3,3',5,5',6-Heptachlorobiphenyl (BZ-178)	EPA 1668C	10262109	NELAP	LA
9125 - 2,2',3,3',5,5'-Hexachlorobiphenyl (BZ-133)	EPA 1668C	10262109	NELAP	LA
9127 - 2,2',3,3',5,6'-Hexachlorobiphenyl (BZ-135)	EPA 1668C	10262109	NELAP	LA
9126 - 2,2',3,3',5,6,6'-Heptachlorobiphenyl (BZ-179)	EPA 1668C	10262109	NELAP	LA
9128 - 2,2',3,3',5,6-Hexachlorobiphenyl (BZ-134)	EPA 1668C	10262109	NELAP	LA
9129 - 2,2',3,3',5-Pentachlorobiphenyl (BZ-83)	EPA 1668C	10262109	NELAP	LA
9130 - 2,2',3,3',6,6'-Hexachlorobiphenyl (BZ-136)	EPA 1668C	10262109	NELAP	LA
9131 - 2,2',3,3',6-Pentachlorobiphenyl (BZ-84)	EPA 1668C	10262109	NELAP	LA
9132 - 2,2',3,3'-Tetrachlorobiphenyl (BZ-40)	EPA 1668C	10262109	NELAP	LA
9151 - 2,2',3,4',5',6-Hexachlorobiphenyl (BZ-149)	EPA 1668C	10262109	NELAP	LA
9154 - 2,2',3,4',5'-Pentachlorobiphenyl (BZ-97)	EPA 1668C	10262109	NELAP	LA
9080 - 2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ-187)	EPA 1668C	10262109	NELAP	LA
9144 - 2,2',3,4',5,5'-Hexachlorobiphenyl (BZ-146)	EPA 1668C	10262109	NELAP	LA
9147 - 2,2',3,4',5,6'-Hexachlorobiphenyl (BZ-148)	EPA 1668C	10262109	NELAP	LA
9146 - 2,2',3,4',5,6,6'-Heptachlorobiphenyl (BZ-188)	EPA 1668C	10262109	NELAP	LA
9149 - 2,2',3,4',5,6-Hexachlorobiphenyl (BZ-147)	EPA 1668C	10262109	NELAP	LA
9155 - 2,2',3,4',5-Pentachlorobiphenyl (BZ-90)	EPA 1668C	10262109	NELAP	LA
9159 - 2,2',3,4',6'-Pentachlorobiphenyl (BZ-98)	EPA 1668C	10262109	NELAP	LA
9157 - 2,2',3,4',6,6'-Hexachlorobiphenyl (BZ-150)	EPA 1668C	10262109	NELAP	LA
9160 - 2,2',3,4',6-Pentachlorobiphenyl (BZ-91)	EPA 1668C	10262109	NELAP	LA
9162 - 2,2',3,4'-Tetrachlorobiphenyl (BZ-42)	EPA 1668C	10262109	NELAP	LA
9075 - 2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ-183)	EPA 1668C	10262109	NELAP	LA
9025 - 2,2',3,4,4',5'-Hexachlorobiphenyl (BZ-138)	EPA 1668C	10262109	NELAP	LA
9133 - 2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ-203)	EPA 1668C	10262109	NELAP	LA
9134 - 2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ-180)	EPA 1668C	10262109	NELAP	LA
9136 - 2,2',3,4,4',5,6'-Heptachlorobiphenyl	EPA 1668C	10262109	NELAP	LA

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(BZ-182) 9135 - 2,2',3,4,4',5,6,6'-Octachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-204) 9137 - 2,2',3,4,4',5,6-Heptachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-181) 9138 - 2,2',3,4,4',5-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-137) 9140 - 2,2',3,4,4',6'-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-140) 9139 - 2,2',3,4,4',6,6'-Heptachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-184) 9141 - 2,2',3,4,4',6-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-139) 9142 - 2,2',3,4,4'-Pentachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-85) 9150 - 2,2',3,4,5',6-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-144) 8975 - 2,2',3,4,5'-Pentachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-87) 9143 - 2,2',3,4,5,5',6-Heptachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-185) 9030 - 2,2',3,4,5,5'-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-141) 9152 - 2,2',3,4,5,6'-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-143) 9145 - 2,2',3,4,5,6,6'-Heptachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-186) 9148 - 2,2',3,4,5,6-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-142) 9153 - 2,2',3,4,5-Pentachlorobiphenyl (BZ-	EPA 1668C	10262109	NELAP	LA
86) 9161 - 2,2',3,4,6'-Pentachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-89) 9156 - 2,2',3,4,6,6'-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-145) 9158 - 2,2',3,4,6-Pentachlorobiphenyl (BZ-	EPA 1668C	10262109	NELAP	LA
88) 9163 - 2,2',3,4-Tetrachlorobiphenyl (BZ-	EPA 1668C	10262109	NELAP	LA
41) 9166 - 2,2',3,5',6-Pentachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-95) 8945 - 2,2',3,5'-Tetrachlorobiphenyl (BZ-	EPA 1668C	10262109	NELAP	LA
44) 9035 - 2,2',3,5,5',6-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-151) 9164 - 2,2',3,5,5'-Pentachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-92) 9167 - 2,2',3,5,6'-Pentachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-94) 9165 - 2,2',3,5,6,6'-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-152) 9168 - 2,2',3,5,6-Pentachlorobiphenyl (BZ-	EPA 1668C	10262109	NELAP	LA
93) 9169 - 2,2',3,5-Tetrachlorobiphenyl (BZ-	EPA 1668C	10262109	NELAP	LA
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9171 - 2,2',3,6'-Tetrachlorobiphenyl (BZ-46)	EPA 1668C	10262109	NELAP	LA
9170 - 2,2',3,6,6'-Pentachlorobiphenyl (BZ-96)	EPA 1668C	10262109	NELAP	LA
9172 - 2,2',3,6-Tetrachlorobiphenyl (BZ-45)	EPA 1668C	10262109	NELAP	LA
9173 - 2,2',3-Trichlorobiphenyl (BZ-16)	EPA 1668C	10262109	NELAP	LA
9040 - 2,2',4,4',5,5'-Hexachlorobiphenyl (BZ-153)	EPA 1668C	10262109	NELAP	LA
9174 - 2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-154)	EPA 1668C	10262109	NELAP	LA
9175 - 2,2',4,4',5-Pentachlorobiphenyl (BZ-99)	EPA 1668C	10262109	NELAP	LA
9176 - 2,2',4,4',6,6'-Hexachlorobiphenyl (BZ-155)	EPA 1668C	10262109	NELAP	LA
9177 - 2,2',4,4',6-Pentachlorobiphenyl (BZ-100)	EPA 1668C	10262109	NELAP	LA
9178 - 2,2',4,4'-Tetrachlorobiphenyl (BZ-47)	EPA 1668C	10262109	NELAP	LA
9179 - 2,2',4,5',6-Pentachlorobiphenyl (BZ-103)	EPA 1668C	10262109	NELAP	LA
8950 - 2,2',4,5'-Tetrachlorobiphenyl (BZ-49)	EPA 1668C	10262109	NELAP	LA
8980 - 2,2',4,5,5'-Pentachlorobiphenyl (BZ-101)	EPA 1668C	10262109	NELAP	LA
9180 - 2,2',4,5,6'-Pentachlorobiphenyl (BZ-102)	EPA 1668C	10262109	NELAP	LA
9181 - 2,2',4,5-Tetrachlorobiphenyl (BZ-48)	EPA 1668C	10262109	NELAP	LA
9183 - 2,2',4,6'-Tetrachlorobiphenyl (BZ-51)	EPA 1668C	10262109	NELAP	LA
9182 - 2,2',4,6,6'-Pentachlorobiphenyl (BZ-104)	EPA 1668C	10262109	NELAP	LA
9184 - 2,2',4,6-Tetrachlorobiphenyl (BZ-50)	EPA 1668C	10262109	NELAP	LA
9185 - 2,2',4-Trichlorobiphenyl (BZ-17)	EPA 1668C	10262109	NELAP	LA
8955 - 2,2',5,5'-Tetrachlorobiphenyl (BZ-52)	EPA 1668C	10262109	NELAP	LA
9186 - 2,2',5,6'-Tetrachlorobiphenyl (BZ-53)	EPA 1668C	10262109	NELAP	LA
8930 - 2,2',5-Trichlorobiphenyl (BZ-18)	EPA 1668C	10262109	NELAP	LA
9187 - 2,2',6,6'-Tetrachlorobiphenyl (BZ-54)	EPA 1668C	10262109	NELAP	LA
9188 - 2,2',6-Trichlorobiphenyl (BZ-19)	EPA 1668C	10262109	NELAP	LA
9189 - 2,2'-Dichlorobiphenyl (BZ-4)	EPA 1668C	10262109	NELAP	LA
9224 - 2,3',4',5',6-Pentachlorobiphenyl (BZ-125)	EPA 1668C	10262109	NELAP	LA
9229 - 2,3',4',5'-Tetrachlorobiphenyl (BZ-76)	EPA 1668C	10262109	NELAP	LA
9222 - 2,3',4',5,5'-Pentachlorobiphenyl (BZ-124)	EPA 1668C	10262109	NELAP	LA
9230 - 2,3',4',5-Tetrachlorobiphenyl (BZ-70)	EPA 1668C	10262109	NELAP	LA
9237 - 2,3',4',6-Tetrachlorobiphenyl (BZ-71)	EPA 1668C	10262109	NELAP	LA

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9239 - 2,3',4'-Trichlorobiphenyl (BZ-33)	EPA 1668C	10262109	NELAP	LA
9218 - 2,3',4,4',5',6-Hexachlorobiphenyl (BZ-168)	EPA 1668C	10262109	NELAP	LA
9011 - 2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)	EPA 1668C	10262109	NELAP	LA
9000 - 2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)	EPA 1668C	10262109	NELAP	LA
9055 - 2,3',4,4',5,5'-Hexachlorobiphenyl (BZ-167)	EPA 1668C	10262109	NELAP	LA
8995 - 2,3',4,4',5-Pentachlorobiphenyl (BZ-118)	EPA 1668C	10262109	NELAP	LA
9220 - 2,3',4,4',6-Pentachlorobiphenyl (BZ-119)	EPA 1668C	10262109	NELAP	LA
8960 - 2,3',4,4'-Tetrachlorobiphenyl (BZ-66)	EPA 1668C	10262109	NELAP	LA
9226 - 2,3',4,5',6-Pentachlorobiphenyl (BZ-121)	EPA 1668C	10262109	NELAP	LA
9231 - 2,3',4,5'-Tetrachlorobiphenyl (BZ-68)	EPA 1668C	10262109	NELAP	LA
9223 - 2,3',4,5,5'-Pentachlorobiphenyl (BZ-120)	EPA 1668C	10262109	NELAP	LA
9232 - 2,3',4,5-Tetrachlorobiphenyl (BZ-67)	EPA 1668C	10262109	NELAP	LA
9235 - 2,3',4,6-Tetrachlorobiphenyl (BZ-69)	EPA 1668C	10262109	NELAP	LA
9240 - 2,3',4-Trichlorobiphenyl (BZ-25)	EPA 1668C	10262109	NELAP	LA
9244 - 2,3',5',6-Tetrachlorobiphenyl (BZ-73)	EPA 1668C	10262109	NELAP	LA
9246 - 2,3',5'-Trichlorobiphenyl (BZ-34)	EPA 1668C	10262109	NELAP	LA
9242 - 2,3',5,5'-Tetrachlorobiphenyl (BZ-72)	EPA 1668C	10262109	NELAP	LA
8935 - 2,3',5-Trichlorobiphenyl (BZ-26)	EPA 1668C	10262109	NELAP	LA
9248 - 2,3',6-Trichlorobiphenyl (BZ-27)	EPA 1668C	10262109	NELAP	LA
9249 - 2,3'-Dichlorobiphenyl (BZ-6)	EPA 1668C	10262109	NELAP	LA
9201 - 2,3,3',4',5',6-Hexachlorobiphenyl (BZ-164)	EPA 1668C	10262109	NELAP	LA
9202 - 2,3,3',4',5'-Pentachlorobiphenyl (BZ-122)	EPA 1668C	10262109	NELAP	LA
9195 - 2,3,3',4',5,5',6-Heptachlorobiphenyl (BZ-193)	EPA 1668C	10262109	NELAP	LA
9197 - 2,3,3',4',5,5'-Hexachlorobiphenyl (BZ-162)	EPA 1668C	10262109	NELAP	LA
9199 - 2,3,3',4',5,6-Hexachlorobiphenyl (BZ-163)	EPA 1668C	10262109	NELAP	LA
9205 - 2,3,3',4',5-Pentachlorobiphenyl (BZ-107)	EPA 1668C	10262109	NELAP	LA
8990 - 2,3,3',4',6-Pentachlorobiphenyl (BZ-110)	EPA 1668C	10262109	NELAP	LA
9207 - 2,3,3',4'-Tetrachlorobiphenyl (BZ-56)	EPA 1668C	10262109	NELAP	LA
9192 - 2,3,3',4,4',5',6-Heptachlorobiphenyl (BZ-191)	EPA 1668C	10262109	NELAP	LA
9045 - 2,3,3',4,4',5'-Hexachlorobiphenyl (BZ-157)	EPA 1668C	10262109	NELAP	LA
9190 - 2,3,3',4,4',5,5',6-Octachlorobiphenyl	EPA 1668C	10262109	NELAP	LA

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(BZ-205) 9085 - 2,3,3',4,4',5,5'-Heptachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-189) 9191 - 2,3,3',4,4',5,6-Heptachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-190) 9050 - 2,3,3',4,4',5-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-156) 9193 - 2,3,3',4,4',6-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-158) 8985 - 2,3,3',4,4'-Pentachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-105) 9200 - 2,3,3',4,5',6-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-161) 9203 - 2,3,3',4,5'-Pentachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-108) 9194 - 2,3,3',4,5',6-Heptachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-192) 9196 - 2,3,3',4,5,5'-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-159) 9198 - 2,3,3',4,5,6-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-160) 9204 - 2,3,3',4,5-Pentachlorobiphenyl (BZ-106)	EPA 1668C	10262109	NELAP	LA
9206 - 2,3,3',4,6-Pentachlorobiphenyl (BZ-109)	EPA 1668C	10262109	NELAP	LA
9208 - 2,3,3',4-Tetrachlorobiphenyl (BZ-55)	EPA 1668C	10262109	NELAP	LA
9212 - 2,3,3',5',6-Pentachlorobiphenyl (BZ-113)	EPA 1668C	10262109	NELAP	LA
9213 - 2,3,3',5'-Tetrachlorobiphenyl (BZ-58)	EPA 1668C	10262109	NELAP	LA
9209 - 2,3,3',5,5',6-Hexachlorobiphenyl (BZ-165)	EPA 1668C	10262109	NELAP	LA
9210 - 2,3,3',5,5'-Pentachlorobiphenyl (BZ-111)	EPA 1668C	10262109	NELAP	LA
9211 - 2,3,3',5,6-Pentachlorobiphenyl (BZ-112)	EPA 1668C	10262109	NELAP	LA
9214 - 2,3,3',5-Tetrachlorobiphenyl (BZ-57)	EPA 1668C	10262109	NELAP	LA
9215 - 2,3,3',6-Tetrachlorobiphenyl (BZ-59)	EPA 1668C	10262109	NELAP	LA
9216 - 2,3,3'-Trichlorobiphenyl (BZ-20)	EPA 1668C	10262109	NELAP	LA
9227 - 2,3,4',5,6-Pentachlorobiphenyl (BZ-117)	EPA 1668C	10262109	NELAP	LA
9233 - 2,3,4',5-Tetrachlorobiphenyl (BZ-63)	EPA 1668C	10262109	NELAP	LA
9236 - 2,3,4',6-Tetrachlorobiphenyl (BZ-64)	EPA 1668C	10262109	NELAP	LA
9241 - 2,3,4'-Trichlorobiphenyl (BZ-22)	EPA 1668C	10262109	NELAP	LA
9217 - 2,3,4,4',5,6-Hexachlorobiphenyl (BZ-166)	EPA 1668C	10262109	NELAP	LA
9005 - 2,3,4,4',5-Pentachlorobiphenyl (BZ-114)	EPA 1668C	10262109	NELAP	LA
9219 - 2,3,4,4',6-Pentachlorobiphenyl (BZ-115)	EPA 1668C	10262109	NELAP	LA

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Analyte	Method Name	Method Code	Type	AB
9221 - 2,3,4,4'-Tetrachlorobiphenyl (BZ-60)	EPA 1668C	10262109	NELAP	LA
9225 - 2,3,4,5,6-Pentachlorobiphenyl (BZ-116)	EPA 1668C	10262109	NELAP	LA
9228 - 2,3,4,5-Tetrachlorobiphenyl (BZ-61)	EPA 1668C	10262109	NELAP	LA
9234 - 2,3,4,6-Tetrachlorobiphenyl (BZ-62)	EPA 1668C	10262109	NELAP	LA
9238 - 2,3,4-Trichlorobiphenyl (BZ-21)	EPA 1668C	10262109	NELAP	LA
9243 - 2,3,5,6-Tetrachlorobiphenyl (BZ-65)	EPA 1668C	10262109	NELAP	LA
9245 - 2,3,5-Trichlorobiphenyl (BZ-23)	EPA 1668C	10262109	NELAP	LA
9247 - 2,3,6-Trichlorobiphenyl (BZ-24)	EPA 1668C	10262109	NELAP	LA
8920 - 2,3-Dichlorobiphenyl (BZ-5)	EPA 1668C	10262109	NELAP	LA
8940 - 2,4',5-Trichlorobiphenyl (BZ-31)	EPA 1668C	10262109	NELAP	LA
9255 - 2,4',6-Trichlorobiphenyl (BZ-32)	EPA 1668C	10262109	NELAP	LA
9256 - 2,4'-Dichlorobiphenyl (BZ-8)	EPA 1668C	10262109	NELAP	LA
9250 - 2,4,4',5-Tetrachlorobiphenyl (BZ-74)	EPA 1668C	10262109	NELAP	LA
9251 - 2,4,4',6-Tetrachlorobiphenyl (BZ-75)	EPA 1668C	10262109	NELAP	LA
9252 - 2,4,4'-Trichlorobiphenyl (BZ-28)	EPA 1668C	10262109	NELAP	LA
9253 - 2,4,5-Trichlorobiphenyl (BZ-29)	EPA 1668C	10262109	NELAP	LA
9254 - 2,4,6-Trichlorobiphenyl (BZ-30)	EPA 1668C	10262109	NELAP	LA
9257 - 2,4-Dichlorobiphenyl (BZ-7)	EPA 1668C	10262109	NELAP	LA
9258 - 2,5-Dichlorobiphenyl (BZ-9)	EPA 1668C	10262109	NELAP	LA
9259 - 2,6-Dichlorobiphenyl (BZ-10)	EPA 1668C	10262109	NELAP	LA
8915 - 2-Chlorobiphenyl (BZ-1)	EPA 1668C	10262109	NELAP	LA
9060 - 3,3',4,4',5,5'-Hexachlorobiphenyl (BZ-169)	EPA 1668C	10262109	NELAP	LA
9015 - 3,3',4,4',5-Pentachlorobiphenyl (BZ-126)	EPA 1668C	10262109	NELAP	LA
8965 - 3,3',4,4'-Tetrachlorobiphenyl (BZ-77)	EPA 1668C	10262109	NELAP	LA
9261 - 3,3',4,5'-Tetrachlorobiphenyl (BZ-79)	EPA 1668C	10262109	NELAP	LA
9260 - 3,3',4,5,5'-Pentachlorobiphenyl (BZ-127)	EPA 1668C	10262109	NELAP	LA
9262 - 3,3',4,5-Tetrachlorobiphenyl (BZ-78)	EPA 1668C	10262109	NELAP	LA
9263 - 3,3',4-Trichlorobiphenyl (BZ-35)	EPA 1668C	10262109	NELAP	LA
9264 - 3,3',5,5'-Tetrachlorobiphenyl (BZ-80)	EPA 1668C	10262109	NELAP	LA
9265 - 3,3',5-Trichlorobiphenyl (BZ-36)	EPA 1668C	10262109	NELAP	LA
8925 - 3,3'-Dichlorobiphenyl (BZ-11)	EPA 1668C	10262109	NELAP	LA
9268 - 3,4',5-Trichlorobiphenyl (BZ-39)	EPA 1668C	10262109	NELAP	LA
9269 - 3,4'-Dichlorobiphenyl (BZ-13)	EPA 1668C	10262109	NELAP	LA
8970 - 3,4,4',5-Tetrachlorobiphenyl (BZ-81)	EPA 1668C	10262109	NELAP	LA
9266 - 3,4,4'-Trichlorobiphenyl (BZ-37)	EPA 1668C	10262109	NELAP	LA
9267 - 3,4,5-Trichlorobiphenyl (BZ-38)	EPA 1668C	10262109	NELAP	LA
9270 - 3,4-Dichlorobiphenyl (BZ-12)	EPA 1668C	10262109	NELAP	LA
9271 - 3,5-Dichlorobiphenyl (BZ-14)	EPA 1668C	10262109	NELAP	LA
9272 - 3-Chlorobiphenyl (BZ-2)	EPA 1668C	10262109	NELAP	LA
9273 - 4,4'-Dichlorobiphenyl (BZ-15)	EPA 1668C	10262109	NELAP	LA

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Analyte	Method Name	Method Code	Type	AB
9274 - 4-Chlorobiphenyl (BZ-3)	EPA 1668C	10262109	NELAP	LA

## Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
9519 - 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 1613B	10120602	NELAP	LA
9516 - 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 1613B	10120602	NELAP	LA
9426 - 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	EPA 1613B	10120602	NELAP	LA
9420 - 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA 1613B	10120602	NELAP	LA
9423 - 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA 1613B	10120602	NELAP	LA
9453 - 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)	EPA 1613B	10120602	NELAP	LA
9471 - 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)	EPA 1613B	10120602	NELAP	LA
9456 - 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,6,7,8-Hxcdd)	EPA 1613B	10120602	NELAP	LA
9474 - 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)	EPA 1613B	10120602	NELAP	LA
9459 - 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)	EPA 1613B	10120602	NELAP	LA
9477 - 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)	EPA 1613B	10120602	NELAP	LA
9540 - 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)	EPA 1613B	10120602	NELAP	LA
9543 - 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)	EPA 1613B	10120602	NELAP	LA
9480 - 2,3,4,6,7,8-Hexachlorodibenzofuran	EPA 1613B	10120602	NELAP	LA
9549 - 2,3,4,7,8-Pentachlorodibenzofuran	EPA 1613B	10120602	NELAP	LA
9618 - 2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)	EPA 1613B	10120602	NELAP	LA
9612 - 2,3,7,8-Tetrachlorodibenzofuran	EPA 1613B	10120602	NELAP	LA
9438 - Total Hpcdd	EPA 1613B	10120602	NELAP	LA
9444 - Total Hpcdf	EPA 1613B	10120602	NELAP	LA
9468 - Total Hxcdd	EPA 1613B	10120602	NELAP	LA
9483 - Total Hxcdf	EPA 1613B	10120602	NELAP	LA
9555 - Total Pecdd	EPA 1613B	10120602	NELAP	LA
9552 - Total Pecdf	EPA 1613B	10120602	NELAP	LA
9609 - Total TCDD	EPA 1613B	10120602	NELAP	LA
9615 - Total TCDF	EPA 1613B	10120602	NELAP	LA
9873 - 2,2',3,3',4',5,6-Heptabromodiphenylether (BDE-177)	EPA 1614A	10120704	NELAP	LA
9902 - 2,2',3,3',4,4',5,5',6-Nonabromodiphenylether (BDE-206)	EPA 1614A	10120704	NELAP	LA
9892 - 2,2',3,3',4,4',5,6'-Octabromodiphenylether (BDE-196)	EPA 1614A	10120704	NELAP	LA
9903 - 2,2',3,3',4,4',5,6,6'-Nonabromodiphenylether (BDE-207)	EPA 1614A	10120704	NELAP	LA

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## Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
9893 - 2,2',3,3',4,4',6,6'-Octabromodiphenylether (BDE-197)	EPA 1614A	10120704	NELAP	LA
9867 - 2,2',3,3',4,4',6-Heptabromodiphenylether (BDE-171)	EPA 1614A	10120704	NELAP	LA
9897 - 2,2',3,3',4,5',6,6'-Octabromodiphenylether (BDE-201)	EPA 1614A	10120704	NELAP	LA
9904 - 2,2',3,3',4,5,5',6,6'-Nonabromodiphenylether (BDE-208)	EPA 1614A	10120704	NELAP	LA
9896 - 2,2',3,3',4,5,6,6'-Octabromodiphenylether (BDE-200)	EPA 1614A	10120704	NELAP	LA
9872 - 2,2',3,3',4,6,6'-Heptabromodiphenylether (BDE-176)	EPA 1614A	10120704	NELAP	LA
9789 - 2,2',3,4',5-Pentabromodiphenylether (BDE-90)	EPA 1614A	10120704	NELAP	LA
9879 - 2,2',3,4,4',5',6-Heptabromodiphenylether (BDE-183)	EPA 1614A	10120704	NELAP	LA
9835 - 2,2',3,4,4',5'-Hexabromodiphenylether (BDE-138)	EPA 1614A	10120704	NELAP	LA
9899 - 2,2',3,4,4',5,5',6-Octabromodiphenylether (BDE-203)	EPA 1614A	10120704	NELAP	LA
9876 - 2,2',3,4,4',5,5'-Heptabromodiphenylether (BDE-180)	EPA 1614A	10120704	NELAP	LA
9878 - 2,2',3,4,4',5,6'-Heptabromodiphenylether (BDE-182)	EPA 1614A	10120704	NELAP	LA
9900 - 2,2',3,4,4',5,6,6'-Octabromodiphenylether (BDE-204)	EPA 1614A	10120704	NELAP	LA
9877 - 2,2',3,4,4',5,6-Heptabromodiphenylether (BDE-181)	EPA 1614A	10120704	NELAP	LA
9837 - 2,2',3,4,4',6'-Hexabromodiphenylether (BDE-140)	EPA 1614A	10120704	NELAP	LA
9880 - 2,2',3,4,4',6,6'-Heptabromodiphenylether (BDE-184)	EPA 1614A	10120704	NELAP	LA
9836 - 2,2',3,4,4',6-Hexabromodiphenylether (BDE-139)	EPA 1614A	10120704	NELAP	LA
9784 - 2,2',3,4,4'-Pentabromodiphenylether (BDE-85)	EPA 1614A	10120704	NELAP	LA
9850 - 2,2',4,4',5',6-Hexabromodiphenylether (BDE-154)	EPA 1614A	10120704	NELAP	LA
9569 - 2,2',4,4',5,5'-Hexabromodiphenyl ether (BDE-153)	EPA 1614A	10120704	NELAP	LA
9571 - 2,2',4,4',5-Pentabromodiphenyl ether (BDE-99)	EPA 1614A	10120704	NELAP	LA
9851 - 2,2',4,4',6,6'-Hexabromodiphenylether (BDE-155)	EPA 1614A	10120704	NELAP	LA
9572 - 2,2',4,4',6-Pentabromodiphenyl ether (BDE-100)	EPA 1614A	10120704	NELAP	LA
9773 - 2,2',4,4'-Tetrabromodiphenyl ether (BDE-47)	EPA 1614A	10120704	NELAP	LA
9747 - 2,2',4,5'-Tetrabromodiphenylether (BDE-49)	EPA 1614A	10120704	NELAP	LA
9716 - 2,2',4-Tribromodiphenylether (BDE-17)	EPA 1614A	10120704	NELAP	LA
9749 - 2,2',4,6'-Tetrabromodiphenylether (BDE-51)	EPA 1614A	10120704	NELAP	LA
9769 - 2,3',4',6-Tetrabromodiphenylether	EPA 1614A	10120704	NELAP	LA

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## Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
(BDE-71) 9815 - 2,3',4,4',5-Pentabromodiphenylether	EPA 1614A	10120704	NELAP	LA
(BDE-118) 9764 - 2,3',4,4'-Tetrabromodiphenylether	EPA 1614A	10120704	NELAP	LA
(BDE-66) 9724 - 2,3',4-Tribromodiphenylether (BDE-25)	EPA 1614A	10120704	NELAP	LA
9887 - 2,3,3',4,4',5',6-Heptabromodiphenylether (BDE-191)	EPA 1614A	10120704	NELAP	LA
9901 - 2,3,3',4,4',5,5',6-Octabromodiphenylether (BDE-205)	EPA 1614A	10120704	NELAP	LA
9886 - 2,3,3',4,4',5,6-Heptabromodiphenylether (BDE-190)	EPA 1614A	10120704	NELAP	LA
9852 - 2,3,3',4,4',5-Hexabromodiphenylether (BDE-156)	EPA 1614A	10120704	NELAP	LA
9862 - 2,3,4,4',5,6-Hexabromodiphenylether (BDE-166)	EPA 1614A	10120704	NELAP	LA
9813 - 2,3,4,5,6-Pentabromodiphenylether (BDE-116)	EPA 1614A	10120704	NELAP	LA
9720 - 2,3,4-Tribromodiphenylether (BDE-21)	EPA 1614A	10120704	NELAP	LA
9731 - 2,4',6-Tribromodiphenylether (BDE-32)	EPA 1614A	10120704	NELAP	LA
9774 - 2,4,4',6-Tetrabromodiphenylether (BDE-75)	EPA 1614A	10120704	NELAP	LA
9729 - 2,4,6-Tribromodiphenylether (BDE-30)	EPA 1614A	10120704	NELAP	LA
9706 - 2,4-Dibromodiphenylether (BDE-7)	EPA 1614A	10120704	NELAP	LA
9709 - 2,6-Dibromodiphenylether (BDE-10)	EPA 1614A	10120704	NELAP	LA
9700 - 2-Bromodiphenylether (BDE-1)	EPA 1614A	10120704	NELAP	LA
9865 - 3,3',4,4',5,5'-Hexabromodiphenylether (BDE-169)	EPA 1614A	10120704	NELAP	LA
9823 - 3,3',4,4',5-Pentabromodiphenylether (BDE-126)	EPA 1614A	10120704	NELAP	LA
9776 - 3,3',4,4'-Tetrabromodiphenylether (BDE-77)	EPA 1614A	10120704	NELAP	LA
9734 - 3,3',4-Tribromodiphenylether (BDE-35)	EPA 1614A	10120704	NELAP	LA
9712 - 3,4'-Dibromodiphenylether (BDE-13)	EPA 1614A	10120704	NELAP	LA
9736 - 3,4,4'-Tribromodiphenylether (BDE-37)	EPA 1614A	10120704	NELAP	LA
9711 - 3,4-Dibromodiphenylether (BDE-12)	EPA 1614A	10120704	NELAP	LA
9701 - 3-Bromodiphenylether (BDE-2)	EPA 1614A	10120704	NELAP	LA
9714 - 4,4'-Dibromodiphenylether (BDE-15)	EPA 1614A	10120704	NELAP	LA
5660 - 4-Bromophenyl phenyl ether	EPA 1614A	10120704	NELAP	LA
8902 - Coelution - Dibromodiphenyl ethers (BDE-8 + BDE-11)	EPA 1614A	10120704	NELAP	LA
9908 - Coelution - Pentabromodiphenyl ethers (BDE-119 + BDE-120)	EPA 1614A	10120704	NELAP	LA
9909 - Coelution - Tribromodiphenyl ethers (BDE-28 + BDE-33)	EPA 1614A	10120704	NELAP	LA
9905 - Decabromodiphenylether (BDE-209)	EPA 1614A	10120704	NELAP	LA
9105 - 2,2',3,3',4,4',5,5',6,6'-	EPA 1668A	10129405	NELAP	LA

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## Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
Decachlorobiphenyl (BZ-209) 9095 - 2,2',3,3',4,4',5,5',6-	EPA 1668A	10129405	NELAP	LA
Nonachlorobiphenyl (BZ-206) 9090 - 2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194)	EPA 1668A	10129405	NELAP	LA
9102 - 2,2',3,3',4,4',5,6'-Octachlorobiphenyl (BZ-196)	EPA 1668A	10129405	NELAP	LA
9101 - 2,2',3,3',4,4',5,6,6'-	EPA 1668A	10129405	NELAP	LA
Nonachlorobiphenyl (BZ-207) 9103 - 2,2',3,3',4,4',5,6'-Octachlorobiphenyl (BZ-195)	EPA 1668A	10129405	NELAP	LA
9065 - 2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170)	EPA 1668A	10129405	NELAP	LA
9104 - 2,2',3,3',4,4',6,6'-Octachlorobiphenyl (BZ-197)	EPA 1668A	10129405	NELAP	LA
9106 - 2,2',3,3',4,4',6-Heptachlorobiphenyl (BZ-171)	EPA 1668A	10129405	NELAP	LA
9020 - 2,2',3,3',4,4'-Hexachlorobiphenyl (BZ-128)	EPA 1668A	10129405	NELAP	LA
9114 - 2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ-177)	EPA 1668A	10129405	NELAP	LA
9112 - 2,2',3,3',4,5',6'-Octachlorobiphenyl (BZ-201)	EPA 1668A	10129405	NELAP	LA
9115 - 2,2',3,3',4,5',6-Heptachlorobiphenyl (BZ-175)	EPA 1668A	10129405	NELAP	LA
9117 - 2,2',3,3',4,5'-Hexachlorobiphenyl (BZ-130)	EPA 1668A	10129405	NELAP	LA
9108 - 2,2',3,3',4,5,5',6'-Octachlorobiphenyl (BZ-199)	EPA 1668A	10129405	NELAP	LA
9107 - 2,2',3,3',4,5,5',6,6'-	EPA 1668A	10129405	NELAP	LA
Nonachlorobiphenyl (BZ-208) 9109 - 2,2',3,3',4,5,5',6-Octachlorobiphenyl (BZ-198)	EPA 1668A	10129405	NELAP	LA
9110 - 2,2',3,3',4,5,5'-Heptachlorobiphenyl (BZ-172)	EPA 1668A	10129405	NELAP	LA
9116 - 2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-174)	EPA 1668A	10129405	NELAP	LA
9111 - 2,2',3,3',4,5,6,6'-Octachlorobiphenyl (BZ-200)	EPA 1668A	10129405	NELAP	LA
9113 - 2,2',3,3',4,5,6-Heptachlorobiphenyl (BZ-173)	EPA 1668A	10129405	NELAP	LA
9118 - 2,2',3,3',4,5-Hexachlorobiphenyl (BZ-129)	EPA 1668A	10129405	NELAP	LA
9120 - 2,2',3,3',4,6'-Hexachlorobiphenyl (BZ-132)	EPA 1668A	10129405	NELAP	LA
9119 - 2,2',3,3',4,6,6'-Heptachlorobiphenyl (BZ-176)	EPA 1668A	10129405	NELAP	LA
9121 - 2,2',3,3',4,6-Hexachlorobiphenyl (BZ-131)	EPA 1668A	10129405	NELAP	LA
9122 - 2,2',3,3',4-Pentachlorobiphenyl (BZ-82)	EPA 1668A	10129405	NELAP	LA
9123 - 2,2',3,3',5,5',6,6'-Octachlorobiphenyl (BZ-202)	EPA 1668A	10129405	NELAP	LA
9124 - 2,2',3,3',5,5',6-Heptachlorobiphenyl (BZ-178)	EPA 1668A	10129405	NELAP	LA

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## Solid Chemical Materials

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9125 - 2,2',3,3',5,5'-Hexachlorobiphenyl (BZ-133)	EPA 1668A	10129405	NELAP	LA
9127 - 2,2',3,3',5,6'-Hexachlorobiphenyl (BZ-135)	EPA 1668A	10129405	NELAP	LA
9126 - 2,2',3,3',5,6,6'-Heptachlorobiphenyl (BZ-179)	EPA 1668A	10129405	NELAP	LA
9128 - 2,2',3,3',5,6-Hexachlorobiphenyl (BZ-134)	EPA 1668A	10129405	NELAP	LA
9129 - 2,2',3,3',5-Pentachlorobiphenyl (BZ-83)	EPA 1668A	10129405	NELAP	LA
9130 - 2,2',3,3',6,6'-Hexachlorobiphenyl (BZ-136)	EPA 1668A	10129405	NELAP	LA
9131 - 2,2',3,3',6-Pentachlorobiphenyl (BZ-84)	EPA 1668A	10129405	NELAP	LA
9132 - 2,2',3,3'-Tetrachlorobiphenyl (BZ-40)	EPA 1668A	10129405	NELAP	LA
9151 - 2,2',3,4',5',6-Hexachlorobiphenyl (BZ-149)	EPA 1668A	10129405	NELAP	LA
9154 - 2,2',3,4',5'-Pentachlorobiphenyl (BZ-97)	EPA 1668A	10129405	NELAP	LA
9080 - 2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ-187)	EPA 1668A	10129405	NELAP	LA
9144 - 2,2',3,4',5,5'-Hexachlorobiphenyl (BZ-146)	EPA 1668A	10129405	NELAP	LA
9147 - 2,2',3,4',5,6'-Hexachlorobiphenyl (BZ-148)	EPA 1668A	10129405	NELAP	LA
9146 - 2,2',3,4',5,6,6'-Heptachlorobiphenyl (BZ-188)	EPA 1668A	10129405	NELAP	LA
9149 - 2,2',3,4',5,6-Hexachlorobiphenyl (BZ-147)	EPA 1668A	10129405	NELAP	LA
9155 - 2,2',3,4',5-Pentachlorobiphenyl (BZ-90)	EPA 1668A	10129405	NELAP	LA
9159 - 2,2',3,4',6-Pentachlorobiphenyl (BZ-98)	EPA 1668A	10129405	NELAP	LA
9157 - 2,2',3,4',6,6'-Hexachlorobiphenyl (BZ-150)	EPA 1668A	10129405	NELAP	LA
9160 - 2,2',3,4',6-Pentachlorobiphenyl (BZ-91)	EPA 1668A	10129405	NELAP	LA
9162 - 2,2',3,4'-Tetrachlorobiphenyl (BZ-42)	EPA 1668A	10129405	NELAP	LA
9075 - 2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ-183)	EPA 1668A	10129405	NELAP	LA
9025 - 2,2',3,4,4',5'-Hexachlorobiphenyl (BZ-138)	EPA 1668A	10129405	NELAP	LA
9133 - 2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ-203)	EPA 1668A	10129405	NELAP	LA
9134 - 2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ-180)	EPA 1668A	10129405	NELAP	LA
9136 - 2,2',3,4,4',5,6'-Heptachlorobiphenyl (BZ-182)	EPA 1668A	10129405	NELAP	LA
9135 - 2,2',3,4,4',5,6,6'-Octachlorobiphenyl (BZ-204)	EPA 1668A	10129405	NELAP	LA
9137 - 2,2',3,4,4',5,6-Heptachlorobiphenyl (BZ-181)	EPA 1668A	10129405	NELAP	LA
9138 - 2,2',3,4,4',5-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA

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Analyte	Method Name	Method Code	Type	AB
(BZ-137) 9140 - 2,2',3,4,4',6'-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-140) 9139 - 2,2',3,4,4',6,6'-Heptachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-184) 9141 - 2,2',3,4,4',6-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-139) 9142 - 2,2',3,4,4'-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-85) 9150 - 2,2',3,4,5',6-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-144) 8975 - 2,2',3,4,5'-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-87) 9143 - 2,2',3,4,5,5',6-Heptachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-185) 9030 - 2,2',3,4,5,5'-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-141) 9152 - 2,2',3,4,5,6'-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-143) 9145 - 2,2',3,4,5,6,6'-Heptachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-186) 9148 - 2,2',3,4,5,6-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-142) 9153 - 2,2',3,4,5-Pentachlorobiphenyl (BZ-86)	EPA 1668A	10129405	NELAP	LA
9161 - 2,2',3,4,6'-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-89) 9156 - 2,2',3,4,6,6'-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-145) 9158 - 2,2',3,4,6-Pentachlorobiphenyl (BZ-88)	EPA 1668A	10129405	NELAP	LA
9163 - 2,2',3,4-Tetrachlorobiphenyl (BZ-41)	EPA 1668A	10129405	NELAP	LA
9166 - 2,2',3,5',6-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-95) 8945 - 2,2',3,5'-Tetrachlorobiphenyl (BZ-44)	EPA 1668A	10129405	NELAP	LA
9035 - 2,2',3,5,5',6-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-151) 9164 - 2,2',3,5,5'-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-92) 9167 - 2,2',3,5,6'-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-94) 9165 - 2,2',3,5,6,6'-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-152) 9168 - 2,2',3,5,6-Pentachlorobiphenyl (BZ-93)	EPA 1668A	10129405	NELAP	LA
9169 - 2,2',3,5-Tetrachlorobiphenyl (BZ-43)	EPA 1668A	10129405	NELAP	LA
9171 - 2,2',3,6'-Tetrachlorobiphenyl (BZ-46)	EPA 1668A	10129405	NELAP	LA
9170 - 2,2',3,6,6'-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-96) 9172 - 2,2',3,6-Tetrachlorobiphenyl (BZ-45)	EPA 1668A	10129405	NELAP	LA

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9173 - 2,2',3-Trichlorobiphenyl (BZ-16)	EPA 1668A	10129405	NELAP	LA
9040 - 2,2',4,4',5,5'-Hexachlorobiphenyl (BZ-153)	EPA 1668A	10129405	NELAP	LA
9174 - 2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-154)	EPA 1668A	10129405	NELAP	LA
9175 - 2,2',4,4',5-Pentachlorobiphenyl (BZ-99)	EPA 1668A	10129405	NELAP	LA
9176 - 2,2',4,4',6,6'-Hexachlorobiphenyl (BZ-155)	EPA 1668A	10129405	NELAP	LA
9177 - 2,2',4,4',6-Pentachlorobiphenyl (BZ-100)	EPA 1668A	10129405	NELAP	LA
9178 - 2,2',4,4'-Tetrachlorobiphenyl (BZ-47)	EPA 1668A	10129405	NELAP	LA
9179 - 2,2',4,5',6-Pentachlorobiphenyl (BZ-103)	EPA 1668A	10129405	NELAP	LA
8950 - 2,2',4,5'-Tetrachlorobiphenyl (BZ-49)	EPA 1668A	10129405	NELAP	LA
8980 - 2,2',4,5,5'-Pentachlorobiphenyl (BZ-101)	EPA 1668A	10129405	NELAP	LA
9180 - 2,2',4,5,6'-Pentachlorobiphenyl (BZ-102)	EPA 1668A	10129405	NELAP	LA
9181 - 2,2',4,5-Tetrachlorobiphenyl (BZ-48)	EPA 1668A	10129405	NELAP	LA
9183 - 2,2',4,6'-Tetrachlorobiphenyl (BZ-51)	EPA 1668A	10129405	NELAP	LA
9182 - 2,2',4,6,6'-Pentachlorobiphenyl (BZ-104)	EPA 1668A	10129405	NELAP	LA
9184 - 2,2',4,6-Tetrachlorobiphenyl (BZ-50)	EPA 1668A	10129405	NELAP	LA
9185 - 2,2',4-Trichlorobiphenyl (BZ-17)	EPA 1668A	10129405	NELAP	LA
8955 - 2,2',5,5'-Tetrachlorobiphenyl (BZ-52)	EPA 1668A	10129405	NELAP	LA
9186 - 2,2',5,6'-Tetrachlorobiphenyl (BZ-53)	EPA 1668A	10129405	NELAP	LA
8930 - 2,2',5-Trichlorobiphenyl (BZ-18)	EPA 1668A	10129405	NELAP	LA
9187 - 2,2',6,6'-Tetrachlorobiphenyl (BZ-54)	EPA 1668A	10129405	NELAP	LA
9188 - 2,2',6-Trichlorobiphenyl (BZ-19)	EPA 1668A	10129405	NELAP	LA
9189 - 2,2'-Dichlorobiphenyl (BZ-4)	EPA 1668A	10129405	NELAP	LA
9224 - 2,3',4',5',6-Pentachlorobiphenyl (BZ-125)	EPA 1668A	10129405	NELAP	LA
9229 - 2,3',4',5'-Tetrachlorobiphenyl (BZ-76)	EPA 1668A	10129405	NELAP	LA
9222 - 2,3',4',5,5'-Pentachlorobiphenyl (BZ-124)	EPA 1668A	10129405	NELAP	LA
9230 - 2,3',4',5-Tetrachlorobiphenyl (BZ-70)	EPA 1668A	10129405	NELAP	LA
9237 - 2,3',4',6-Tetrachlorobiphenyl (BZ-71)	EPA 1668A	10129405	NELAP	LA
9239 - 2,3',4'-Trichlorobiphenyl (BZ-33)	EPA 1668A	10129405	NELAP	LA
9218 - 2,3',4,4',5',6-Hexachlorobiphenyl (BZ-168)	EPA 1668A	10129405	NELAP	LA
9011 - 2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)	EPA 1668A	10129405	NELAP	LA
9000 - 2,3',4,4',5'-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	LA

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Analyte	Method Name	Method Code	Type	AB
(BZ-123) 9055 - 2,3',4,4',5,5'-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-167) 8995 - 2,3',4,4',5-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-118) 9220 - 2,3',4,4',6-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-119) 8960 - 2,3',4,4'-Tetrachlorobiphenyl (BZ-66)	EPA 1668A	10129405	NELAP	LA
9226 - 2,3',4,5',6-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-121) 9231 - 2,3',4,5'-Tetrachlorobiphenyl (BZ-68)	EPA 1668A	10129405	NELAP	LA
9223 - 2,3',4,5,5'-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-120) 9232 - 2,3',4,5-Tetrachlorobiphenyl (BZ-67)	EPA 1668A	10129405	NELAP	LA
9235 - 2,3',4,6-Tetrachlorobiphenyl (BZ-69)	EPA 1668A	10129405	NELAP	LA
9240 - 2,3',4-Trichlorobiphenyl (BZ-25)	EPA 1668A	10129405	NELAP	LA
9244 - 2,3',5',6-Tetrachlorobiphenyl (BZ-73)	EPA 1668A	10129405	NELAP	LA
9246 - 2,3',5'-Trichlorobiphenyl (BZ-34)	EPA 1668A	10129405	NELAP	LA
9242 - 2,3',5,5'-Tetrachlorobiphenyl (BZ-72)	EPA 1668A	10129405	NELAP	LA
8935 - 2,3',5-Trichlorobiphenyl (BZ-26)	EPA 1668A	10129405	NELAP	LA
9248 - 2,3',6-Trichlorobiphenyl (BZ-27)	EPA 1668A	10129405	NELAP	LA
9249 - 2,3'-Dichlorobiphenyl (BZ-6)	EPA 1668A	10129405	NELAP	LA
9201 - 2,3,3',4',5',6-Hexachlorobiphenyl (BZ-164)	EPA 1668A	10129405	NELAP	LA
9202 - 2,3,3',4',5'-Pentachlorobiphenyl (BZ-122)	EPA 1668A	10129405	NELAP	LA
9195 - 2,3,3',4',5,5',6-Heptachlorobiphenyl (BZ-193)	EPA 1668A	10129405	NELAP	LA
9197 - 2,3,3',4',5,5'-Hexachlorobiphenyl (BZ-162)	EPA 1668A	10129405	NELAP	LA
9199 - 2,3,3',4',5,6-Hexachlorobiphenyl (BZ-163)	EPA 1668A	10129405	NELAP	LA
9205 - 2,3,3',4',5-Pentachlorobiphenyl (BZ-107)	EPA 1668A	10129405	NELAP	LA
8990 - 2,3,3',4',6-Pentachlorobiphenyl (BZ-110)	EPA 1668A	10129405	NELAP	LA
9207 - 2,3,3',4'-Tetrachlorobiphenyl (BZ-56)	EPA 1668A	10129405	NELAP	LA
9192 - 2,3,3',4,4',5',6-Heptachlorobiphenyl (BZ-191)	EPA 1668A	10129405	NELAP	LA
9045 - 2,3,3',4,4',5'-Hexachlorobiphenyl (BZ-157)	EPA 1668A	10129405	NELAP	LA
9190 - 2,3,3',4,4',5,5',6-Octachlorobiphenyl (BZ-205)	EPA 1668A	10129405	NELAP	LA
9085 - 2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ-189)	EPA 1668A	10129405	NELAP	LA
9191 - 2,3,3',4,4',5,6-Heptachlorobiphenyl (BZ-190)	EPA 1668A	10129405	NELAP	LA
9050 - 2,3,3',4,4',5-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA

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(BZ-156) 9193 - 2,3,3',4,4',6-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-158) 8985 - 2,3,3',4,4'-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-105) 9200 - 2,3,3',4,5',6-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-161) 9203 - 2,3,3',4,5'-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-108) 9194 - 2,3,3',4,5,5',6-Heptachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-192) 9196 - 2,3,3',4,5,5'-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-159) 9198 - 2,3,3',4,5,6-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-160) 9204 - 2,3,3',4,5-Pentachlorobiphenyl (BZ-106)	EPA 1668A	10129405	NELAP	LA
9206 - 2,3,3',4,6-Pentachlorobiphenyl (BZ-109)	EPA 1668A	10129405	NELAP	LA
9208 - 2,3,3',4-Tetrachlorobiphenyl (BZ-55)	EPA 1668A	10129405	NELAP	LA
9212 - 2,3,3',5',6-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-113) 9213 - 2,3,3',5'-Tetrachlorobiphenyl (BZ-58)	EPA 1668A	10129405	NELAP	LA
9209 - 2,3,3',5,5',6-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-165) 9210 - 2,3,3',5,5'-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-111) 9211 - 2,3,3',5,6-Pentachlorobiphenyl (BZ-112)	EPA 1668A	10129405	NELAP	LA
9214 - 2,3,3',5-Tetrachlorobiphenyl (BZ-57)	EPA 1668A	10129405	NELAP	LA
9215 - 2,3,3',6-Tetrachlorobiphenyl (BZ-59)	EPA 1668A	10129405	NELAP	LA
9216 - 2,3,3'-Trichlorobiphenyl (BZ-20)	EPA 1668A	10129405	NELAP	LA
9227 - 2,3,4',5,6-Pentachlorobiphenyl (BZ-117)	EPA 1668A	10129405	NELAP	LA
9233 - 2,3,4',5-Tetrachlorobiphenyl (BZ-63)	EPA 1668A	10129405	NELAP	LA
9236 - 2,3,4',6-Tetrachlorobiphenyl (BZ-64)	EPA 1668A	10129405	NELAP	LA
9241 - 2,3,4'-Trichlorobiphenyl (BZ-22)	EPA 1668A	10129405	NELAP	LA
9217 - 2,3,4,4',5,6-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-166) 9005 - 2,3,4,4',5-Pentachlorobiphenyl (BZ-114)	EPA 1668A	10129405	NELAP	LA
<del>9219 - 2,3,4,4',6-Pentachlorobiphenyl (BZ-115)</del>	<del>EPA 1668A</del>	<del>10129405</del>	<del>NELAP</del>	<del>LA</del>
9221 - 2,3,4,4'-Tetrachlorobiphenyl (BZ-60)	EPA 1668A	10129405	NELAP	LA
9225 - 2,3,4,5,6-Pentachlorobiphenyl (BZ-116)	EPA 1668A	10129405	NELAP	LA
9228 - 2,3,4,5-Tetrachlorobiphenyl (BZ-61)	EPA 1668A	10129405	NELAP	LA

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9234 - 2,3,4,6-Tetrachlorobiphenyl (BZ-62)	EPA 1668A	10129405	NELAP	LA
9238 - 2,3,4-Trichlorobiphenyl (BZ-21)	EPA 1668A	10129405	NELAP	LA
9243 - 2,3,5,6-Tetrachlorobiphenyl (BZ-65)	EPA 1668A	10129405	NELAP	LA
9245 - 2,3,5-Trichlorobiphenyl (BZ-23)	EPA 1668A	10129405	NELAP	LA
9247 - 2,3,6-Trichlorobiphenyl (BZ-24)	EPA 1668A	10129405	NELAP	LA
8920 - 2,3-Dichlorobiphenyl (BZ-5)	EPA 1668A	10129405	NELAP	LA
8940 - 2,4',5-Trichlorobiphenyl (BZ-31)	EPA 1668A	10129405	NELAP	LA
9255 - 2,4',6-Trichlorobiphenyl (BZ-32)	EPA 1668A	10129405	NELAP	LA
9256 - 2,4'-Dichlorobiphenyl (BZ-8)	EPA 1668A	10129405	NELAP	LA
9250 - 2,4,4',5-Tetrachlorobiphenyl (BZ-74)	EPA 1668A	10129405	NELAP	LA
9251 - 2,4,4',6-Tetrachlorobiphenyl (BZ-75)	EPA 1668A	10129405	NELAP	LA
9252 - 2,4,4'-Trichlorobiphenyl (BZ-28)	EPA 1668A	10129405	NELAP	LA
9253 - 2,4,5-Trichlorobiphenyl (BZ-29)	EPA 1668A	10129405	NELAP	LA
9254 - 2,4,6-Trichlorobiphenyl (BZ-30)	EPA 1668A	10129405	NELAP	LA
9257 - 2,4-Dichlorobiphenyl (BZ-7)	EPA 1668A	10129405	NELAP	LA
9258 - 2,5-Dichlorobiphenyl (BZ-9)	EPA 1668A	10129405	NELAP	LA
9259 - 2,6-Dichlorobiphenyl (BZ-10)	EPA 1668A	10129405	NELAP	LA
8915 - 2-Chlorobiphenyl (BZ-1)	EPA 1668A	10129405	NELAP	LA
9060 - 3,3',4,4',5,5'-Hexachlorobiphenyl (BZ-169)	EPA 1668A	10129405	NELAP	LA
9015 - 3,3',4,4',5-Pentachlorobiphenyl (BZ-126)	EPA 1668A	10129405	NELAP	LA
8965 - 3,3',4,4'-Tetrachlorobiphenyl (BZ-77)	EPA 1668A	10129405	NELAP	LA
9261 - 3,3',4,5'-Tetrachlorobiphenyl (BZ-79)	EPA 1668A	10129405	NELAP	LA
9260 - 3,3',4,5,5'-Pentachlorobiphenyl (BZ-127)	EPA 1668A	10129405	NELAP	LA
9262 - 3,3',4,5-Tetrachlorobiphenyl (BZ-78)	EPA 1668A	10129405	NELAP	LA
9263 - 3,3',4-Trichlorobiphenyl (BZ-35)	EPA 1668A	10129405	NELAP	LA
9264 - 3,3',5,5'-Tetrachlorobiphenyl (BZ-80)	EPA 1668A	10129405	NELAP	LA
9265 - 3,3',5-Trichlorobiphenyl (BZ-36)	EPA 1668A	10129405	NELAP	LA
8925 - 3,3'-Dichlorobiphenyl (BZ-11)	EPA 1668A	10129405	NELAP	LA
9268 - 3,4',5-Trichlorobiphenyl (BZ-39)	EPA 1668A	10129405	NELAP	LA
9269 - 3,4'-Dichlorobiphenyl (BZ-13)	EPA 1668A	10129405	NELAP	LA
8970 - 3,4,4',5-Tetrachlorobiphenyl (BZ-81)	EPA 1668A	10129405	NELAP	LA
9266 - 3,4,4'-Trichlorobiphenyl (BZ-37)	EPA 1668A	10129405	NELAP	LA
9267 - 3,4,5-Trichlorobiphenyl (BZ-38)	EPA 1668A	10129405	NELAP	LA
9270 - 3,4-Dichlorobiphenyl (BZ-12)	EPA 1668A	10129405	NELAP	LA
9271 - 3,5-Dichlorobiphenyl (BZ-14)	EPA 1668A	10129405	NELAP	LA
9272 - 3-Chlorobiphenyl (BZ-2)	EPA 1668A	10129405	NELAP	LA
9273 - 4,4'-Dichlorobiphenyl (BZ-15)	EPA 1668A	10129405	NELAP	LA
9274 - 4-Chlorobiphenyl (BZ-3)	EPA 1668A	10129405	NELAP	LA
8580 - 2,4'-DDD	EPA 1699	10133105	NELAP	LA
8585 - 2,4'-DDE	EPA 1699	10133105	NELAP	LA
8590 - 2,4'-DDT	EPA 1699	10133105	NELAP	LA
7355 - 4,4'-DDD	EPA 1699	10133105	NELAP	LA
7360 - 4,4'-DDE	EPA 1699	10133105	NELAP	LA

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7361 - 4,4'-DDMU	EPA 1699	10133105	NELAP	LA
7365 - 4,4'-DDT	EPA 1699	10133105	NELAP	LA
7025 - Aldrin	EPA 1699	10133105	NELAP	LA
7470 - Dieldrin	EPA 1699	10133105	NELAP	LA
7510 - Endosulfan I	EPA 1699	10133105	NELAP	LA
7515 - Endosulfan II	EPA 1699	10133105	NELAP	LA
7520 - Endosulfan sulfate	EPA 1699	10133105	NELAP	LA
7540 - Endrin	EPA 1699	10133105	NELAP	LA
7530 - Endrin aldehyde	EPA 1699	10133105	NELAP	LA
7535 - Endrin ketone	EPA 1699	10133105	NELAP	LA
7685 - Heptachlor	EPA 1699	10133105	NELAP	LA
7690 - Heptachlor epoxide	EPA 1699	10133105	NELAP	LA
7810 - Methoxychlor	EPA 1699	10133105	NELAP	LA
7870 - Mirex	EPA 1699	10133105	NELAP	LA
7110 - alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 1699	10133105	NELAP	LA
7240 - alpha-Chlordane	EPA 1699	10133105	NELAP	LA
7115 - beta-BHC (beta-Hexachlorocyclohexane)	EPA 1699	10133105	NELAP	LA
7925 - cis-Nonachlor	EPA 1699	10133105	NELAP	LA
7105 - delta-BHC	EPA 1699	10133105	NELAP	LA
7120 - gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 1699	10133105	NELAP	LA
7245 - gamma-Chlordane	EPA 1699	10133105	NELAP	LA
7910 - trans-Nonachlor	EPA 1699	10133105	NELAP	LA
1444 - Separatory Funnel Liquid-liquid extraction	EPA 3510C	10138202	NELAP	LA
1452 - Soxhlet Extraction	EPA 3540C	10140202	NELAP	LA
1030 - Cadmium	EPA 6020	10156000	NELAP	LA
1040 - Chromium	EPA 6020	10156000	NELAP	LA
1050 - Cobalt	EPA 6020	10156000	NELAP	LA
1055 - Copper	EPA 6020	10156000	NELAP	LA
1070 - Iron	EPA 6020	10156000	NELAP	LA
1075 - Lead	EPA 6020	10156000	NELAP	LA
1090 - Manganese	EPA 6020	10156000	NELAP	LA
1095 - Mercury	EPA 6020	10156000	NELAP	LA
1100 - Molybdenum	EPA 6020	10156000	NELAP	LA
1105 - Nickel	EPA 6020	10156000	NELAP	LA
1140 - Selenium	EPA 6020	10156000	NELAP	LA
1150 - Silver	EPA 6020	10156000	NELAP	LA
1165 - Thallium	EPA 6020	10156000	NELAP	LA
1175 - Tin	EPA 6020	10156000	NELAP	LA
1910 - Total Phosphorus	EPA 6020	10156000	NELAP	LA
1185 - Vanadium	EPA 6020	10156000	NELAP	LA
1190 - Zinc	EPA 6020	10156000	NELAP	LA
1030 - Cadmium	EPA 6020	10156204	NELAP	LA
1040 - Chromium	EPA 6020	10156204	NELAP	LA
<del>1050 - Cobalt</del>	<del>EPA 6020</del>	<del>10156204</del>	<del>NELAP</del>	<del>LA</del>
1055 - Copper	EPA 6020	10156204	NELAP	LA
1070 - Iron	EPA 6020	10156204	NELAP	LA
1075 - Lead	EPA 6020	10156204	NELAP	LA
1090 - Manganese	EPA 6020	10156204	NELAP	LA
1095 - Mercury	EPA 6020	10156204	NELAP	LA
1100 - Molybdenum	EPA 6020	10156204	NELAP	LA
1105 - Nickel	EPA 6020	10156204	NELAP	LA

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## Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
1140 - Selenium	EPA 6020	10156204	NELAP	LA
1150 - Silver	EPA 6020	10156204	NELAP	LA
1165 - Thallium	EPA 6020	10156204	NELAP	LA
1175 - Tin	EPA 6020	10156204	NELAP	LA
1910 - Total Phosphorus	EPA 6020	10156204	NELAP	LA
1185 - Vanadium	EPA 6020	10156204	NELAP	LA
1190 - Zinc	EPA 6020	10156204	NELAP	LA
1000 - Aluminum	EPA 6020A	10156408	NELAP	LA
1005 - Antimony	EPA 6020A	10156408	NELAP	LA
1010 - Arsenic	EPA 6020A	10156408	NELAP	LA
1015 - Barium	EPA 6020A	10156408	NELAP	LA
1020 - Beryllium	EPA 6020A	10156408	NELAP	LA
1030 - Cadmium	EPA 6020A	10156408	NELAP	LA
1040 - Chromium	EPA 6020A	10156408	NELAP	LA
1050 - Cobalt	EPA 6020A	10156408	NELAP	LA
1055 - Copper	EPA 6020A	10156408	NELAP	LA
1070 - Iron	EPA 6020A	10156408	NELAP	LA
1075 - Lead	EPA 6020A	10156408	NELAP	LA
1090 - Manganese	EPA 6020A	10156408	NELAP	LA
1100 - Molybdenum	EPA 6020A	10156408	NELAP	LA
1105 - Nickel	EPA 6020A	10156408	NELAP	LA
1909 - Phosphorus	EPA 6020A	10156408	NELAP	LA
1140 - Selenium	EPA 6020A	10156408	NELAP	LA
1150 - Silver	EPA 6020A	10156408	NELAP	LA
1165 - Thallium	EPA 6020A	10156408	NELAP	LA
1175 - Tin	EPA 6020A	10156408	NELAP	LA
1910 - Total Phosphorus	EPA 6020A	10156408	NELAP	LA
1185 - Vanadium	EPA 6020A	10156408	NELAP	LA
1190 - Zinc	EPA 6020A	10156408	NELAP	LA
1000 - Aluminum	EPA 6020A, Rev.1	10156419	NELAP	LA
1005 - Antimony	EPA 6020A, Rev.1	10156419	NELAP	LA
1010 - Arsenic	EPA 6020A, Rev.1	10156419	NELAP	LA
1015 - Barium	EPA 6020A, Rev.1	10156419	NELAP	LA
1020 - Beryllium	EPA 6020A, Rev.1	10156419	NELAP	LA
1030 - Cadmium	EPA 6020A, Rev.1	10156419	NELAP	LA
1040 - Chromium	EPA 6020A, Rev.1	10156419	NELAP	LA
1050 - Cobalt	EPA 6020A, Rev.1	10156419	NELAP	LA
1055 - Copper	EPA 6020A, Rev.1	10156419	NELAP	LA
1070 - Iron	EPA 6020A, Rev.1	10156419	NELAP	LA
1075 - Lead	EPA 6020A, Rev.1	10156419	NELAP	LA
1090 - Manganese	EPA 6020A, Rev.1	10156419	NELAP	LA
1100 - Molybdenum	EPA 6020A, Rev.1	10156419	NELAP	LA
1105 - Nickel	EPA 6020A, Rev.1	10156419	NELAP	LA
1140 - Selenium	EPA 6020A, Rev.1	10156419	NELAP	LA
1150 - Silver	EPA 6020A, Rev.1	10156419	NELAP	LA
1165 - Thallium	EPA 6020A, Rev.1	10156419	NELAP	LA
1175 - Tin	EPA 6020A, Rev.1	10156419	NELAP	LA
1185 - Vanadium	EPA 6020A, Rev.1	10156419	NELAP	LA
1190 - Zinc	EPA 6020A, Rev.1	10156419	NELAP	LA
5160 - 1,1,1-Trichloroethane	EPA 8260B	10184802	NELAP	LA
5110 - 1,1,2,2-Tetrachloroethane	EPA 8260B	10184802	NELAP	LA
5165 - 1,1,2-Trichloroethane	EPA 8260B	10184802	NELAP	LA
4630 - 1,1-Dichloroethane	EPA 8260B	10184802	NELAP	LA
5180 - 1,2,3-Trichloropropane	EPA 8260B	10184802	NELAP	LA
4635 - 1,2-Dichloroethane (Ethylene	EPA 8260B	10184802	NELAP	LA

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## Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
dichloride)				
4655 - 1,2-Dichloropropane	EPA 8260B	10184802	NELAP	LA
4410 - 2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260B	10184802	NELAP	LA
4860 - 2-Hexanone	EPA 8260B	10184802	NELAP	LA
4315 - Acetone	EPA 8260B	10184802	NELAP	LA
4375 - Benzene	EPA 8260B	10184802	NELAP	LA
4395 - Bromodichloromethane	EPA 8260B	10184802	NELAP	LA
4400 - Bromoform	EPA 8260B	10184802	NELAP	LA
4450 - Carbon disulfide	EPA 8260B	10184802	NELAP	LA
4455 - Carbon tetrachloride	EPA 8260B	10184802	NELAP	LA
4475 - Chlorobenzene	EPA 8260B	10184802	NELAP	LA
4575 - Chlorodibromomethane (dibromochloromethane)	EPA 8260B	10184802	NELAP	LA
4485 - Chloroethane (Ethyl chloride)	EPA 8260B	10184802	NELAP	LA
4505 - Chloroform	EPA 8260B	10184802	NELAP	LA
4595 - Dibromomethane (Methylene bromide)	EPA 8260B	10184802	NELAP	LA
4765 - Ethylbenzene	EPA 8260B	10184802	NELAP	LA
4950 - Methyl bromide (Bromomethane)	EPA 8260B	10184802	NELAP	LA
4960 - Methyl chloride (Chloromethane)	EPA 8260B	10184802	NELAP	LA
4975 - Methylene chloride (Dichloromethane)	EPA 8260B	10184802	NELAP	LA
5100 - Styrene	EPA 8260B	10184802	NELAP	LA
5115 - Tetrachloroethylene (Perchloroethylene)	EPA 8260B	10184802	NELAP	LA
5140 - Toluene	EPA 8260B	10184802	NELAP	LA
5170 - Trichloroethene (Trichloroethylene)	EPA 8260B	10184802	NELAP	LA
5175 - Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	EPA 8260B	10184802	NELAP	LA
5235 - Vinyl chloride	EPA 8260B	10184802	NELAP	LA
4705 - cis & trans-1,2-Dichloroethene	EPA 8260B	10184802	NELAP	LA
4645 - cis-1,2-Dichloroethylene	EPA 8260B	10184802	NELAP	LA
4680 - cis-1,3-Dichloropropene	EPA 8260B	10184802	NELAP	LA
5240 - m+p-xylene	EPA 8260B	10184802	NELAP	LA
5245 - m-Xylene	EPA 8260B	10184802	NELAP	LA
5250 - o-Xylene	EPA 8260B	10184802	NELAP	LA
5255 - p-Xylene	EPA 8260B	10184802	NELAP	LA
4700 - trans-1,2-Dichloroethylene	EPA 8260B	10184802	NELAP	LA
4685 - trans-1,3-Dichloropropylene	EPA 8260B	10184802	NELAP	LA
6703 - 1,1'-Biphenyl (BZ-0) (Biphenyl)	EPA 8270D	10186002	NELAP	LA
6715 - 1,2,4,5-Tetrachlorobenzene	EPA 8270D	10186002	NELAP	LA
5155 - 1,2,4-Trichlorobenzene	EPA 8270D	10186002	NELAP	LA
4610 - 1,2-Dichlorobenzene	EPA 8270D	10186002	NELAP	LA
6885 - 1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8270D	10186002	NELAP	LA
4615 - 1,3-Dichlorobenzene	EPA 8270D	10186002	NELAP	LA
6160 - 1,3-Dinitrobenzene (1,3-DNB)	EPA 8270D	10186002	NELAP	LA
<del>4835 - 1,3-Hexachlorobutadiene</del>	<del>EPA 8270D</del>	<del>10186002</del>	<del>NELAP</del>	<del>LA</del>
4620 - 1,4-Dichlorobenzene	EPA 8270D	10186002	NELAP	LA
5790 - 1-Chloronaphthalene	EPA 8270D	10186002	NELAP	LA
6425 - 1-Naphthylamine	EPA 8270D	10186002	NELAP	LA
6735 - 2,3,4,6-Tetrachlorophenol	EPA 8270D	10186002	NELAP	LA
6835 - 2,4,5-Trichlorophenol	EPA 8270D	10186002	NELAP	LA
6840 - 2,4,6-Trichlorophenol	EPA 8270D	10186002	NELAP	LA
6000 - 2,4-Dichlorophenol	EPA 8270D	10186002	NELAP	LA

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## Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
6130 - 2,4-Dimethylphenol	EPA 8270D	10186002	NELAP	LA
6175 - 2,4-Dinitrophenol	EPA 8270D	10186002	NELAP	LA
6185 - 2,4-Dinitrotoluene (2,4-DNT)	EPA 8270D	10186002	NELAP	LA
6005 - 2,6-Dichlorophenol	EPA 8270D	10186002	NELAP	LA
6190 - 2,6-Dinitrotoluene (2,6-DNT)	EPA 8270D	10186002	NELAP	LA
5515 - 2-Acetylaminofluorene	EPA 8270D	10186002	NELAP	LA
5795 - 2-Chloronaphthalene	EPA 8270D	10186002	NELAP	LA
5800 - 2-Chlorophenol	EPA 8270D	10186002	NELAP	LA
6360 - 2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	EPA 8270D	10186002	NELAP	LA
5145 - 2-Methylaniline (o-Toluidine)	EPA 8270D	10186002	NELAP	LA
6385 - 2-Methylnaphthalene	EPA 8270D	10186002	NELAP	LA
6400 - 2-Methylphenol (o-Cresol)	EPA 8270D	10186002	NELAP	LA
6430 - 2-Naphthylamine	EPA 8270D	10186002	NELAP	LA
6460 - 2-Nitroaniline	EPA 8270D	10186002	NELAP	LA
6490 - 2-Nitrophenol	EPA 8270D	10186002	NELAP	LA
6355 - 3-Methylcholanthrene	EPA 8270D	10186002	NELAP	LA
6405 - 3-Methylphenol (m-Cresol)	EPA 8270D	10186002	NELAP	LA
6465 - 3-Nitroaniline	EPA 8270D	10186002	NELAP	LA
5540 - 4-Aminobiphenyl	EPA 8270D	10186002	NELAP	LA
5660 - 4-Bromophenyl phenyl ether	EPA 8270D	10186002	NELAP	LA
5700 - 4-Chloro-3-methylphenol	EPA 8270D	10186002	NELAP	LA
5745 - 4-Chloroaniline	EPA 8270D	10186002	NELAP	LA
5825 - 4-Chlorophenyl phenylether	EPA 8270D	10186002	NELAP	LA
6410 - 4-Methylphenol (p-Cresol)	EPA 8270D	10186002	NELAP	LA
6470 - 4-Nitroaniline	EPA 8270D	10186002	NELAP	LA
6500 - 4-Nitrophenol	EPA 8270D	10186002	NELAP	LA
6115 - 7,12-Dimethylbenz(a) anthracene	EPA 8270D	10186002	NELAP	LA
9417 - 7h-Dibenzo(c,g) carbazole	EPA 8270D	10186002	NELAP	LA
5500 - Acenaphthene	EPA 8270D	10186002	NELAP	LA
5505 - Acenaphthylene	EPA 8270D	10186002	NELAP	LA
5510 - Acetophenone	EPA 8270D	10186002	NELAP	LA
5545 - Aniline	EPA 8270D	10186002	NELAP	LA
5555 - Anthracene	EPA 8270D	10186002	NELAP	LA
5575 - Benz(a)anthracene	EPA 8270D	10186002	NELAP	LA
5580 - Benzo(a)pyrene	EPA 8270D	10186002	NELAP	LA
5585 - Benzo(b)fluoranthene	EPA 8270D	10186002	NELAP	LA
5590 - Benzo(g,h,i)perylene	EPA 8270D	10186002	NELAP	LA
5600 - Benzo(k)fluoranthene	EPA 8270D	10186002	NELAP	LA
5630 - Benzyl alcohol	EPA 8270D	10186002	NELAP	LA
5780 - Bis(2-Chloroisopropyl) ether (2,2-oxybis(1-chloropropane))	EPA 8270D	10186002	NELAP	LA
5670 - Butyl benzyl phthalate	EPA 8270D	10186002	NELAP	LA
5855 - Chrysene	EPA 8270D	10186002	NELAP	LA
6065 - Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)	EPA 8270D	10186002	NELAP	LA
5925 - Di-n-butyl phthalate	EPA 8270D	10186002	NELAP	LA
6200 - Di-n-octyl phthalate	EPA 8270D	10186002	NELAP	LA
9354 - Dibenz(a, h) acridine	EPA 8270D	10186002	NELAP	LA
5900 - Dibenz(a, j)acridine	EPA 8270D	10186002	NELAP	LA
5895 - Dibenz(a,h)anthracene	EPA 8270D	10186002	NELAP	LA
5890 - Dibenzo(a,e)pyrene	EPA 8270D	10186002	NELAP	LA
9348 - Dibenzo(a,h) pyrene	EPA 8270D	10186002	NELAP	LA
9351 - Dibenzo(a,i) pyrene	EPA 8270D	10186002	NELAP	LA
5905 - Dibenzofuran	EPA 8270D	10186002	NELAP	LA

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## Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
6070 - Diethyl phthalate	EPA 8270D	10186002	NELAP	LA
6135 - Dimethyl phthalate	EPA 8270D	10186002	NELAP	LA
8620 - Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8270D	10186002	NELAP	LA
6205 - Diphenylamine	EPA 8270D	10186002	NELAP	LA
6260 - Ethyl methanesulfonate	EPA 8270D	10186002	NELAP	LA
6265 - Fluoranthene	EPA 8270D	10186002	NELAP	LA
6270 - Fluorene	EPA 8270D	10186002	NELAP	LA
6275 - Hexachlorobenzene	EPA 8270D	10186002	NELAP	LA
6285 - Hexachlorocyclopentadiene	EPA 8270D	10186002	NELAP	LA
4840 - Hexachloroethane	EPA 8270D	10186002	NELAP	LA
6295 - Hexachloropropene	EPA 8270D	10186002	NELAP	LA
6315 - Indeno(1,2,3-cd)pyrene	EPA 8270D	10186002	NELAP	LA
6320 - Isophorone	EPA 8270D	10186002	NELAP	LA
6325 - Isosafrole	EPA 8270D	10186002	NELAP	LA
6375 - Methyl methanesulfonate	EPA 8270D	10186002	NELAP	LA
5005 - Naphthalene	EPA 8270D	10186002	NELAP	LA
6590 - Pentachlorobenzene	EPA 8270D	10186002	NELAP	LA
5035 - Pentachloroethane	EPA 8270D	10186002	NELAP	LA
6600 - Pentachloronitrobenzene	EPA 8270D	10186002	NELAP	LA
6605 - Pentachlorophenol	EPA 8270D	10186002	NELAP	LA
6610 - Phenacetin	EPA 8270D	10186002	NELAP	LA
6615 - Phenanthrene	EPA 8270D	10186002	NELAP	LA
6625 - Phenol	EPA 8270D	10186002	NELAP	LA
6665 - Pyrene	EPA 8270D	10186002	NELAP	LA
6685 - Safrole	EPA 8270D	10186002	NELAP	LA
5760 - bis(2-Chloroethoxy)methane	EPA 8270D	10186002	NELAP	LA
5765 - bis(2-Chloroethyl) ether	EPA 8270D	10186002	NELAP	LA
5025 - n-Nitroso-di-n-butylamine	EPA 8270D	10186002	NELAP	LA
6545 - n-Nitrosodi-n-propylamine	EPA 8270D	10186002	NELAP	LA
6525 - n-Nitrosodiethylamine	EPA 8270D	10186002	NELAP	LA
6530 - n-Nitrosodimethylamine	EPA 8270D	10186002	NELAP	LA
6535 - n-Nitrosodiphenylamine	EPA 8270D	10186002	NELAP	LA
6550 - n-Nitrosomethylethylamine	EPA 8270D	10186002	NELAP	LA
6555 - n-Nitrosomorpholine	EPA 8270D	10186002	NELAP	LA
6560 - n-Nitrosopiperidine	EPA 8270D	10186002	NELAP	LA
6565 - n-Nitrosopyrrolidine	EPA 8270D	10186002	NELAP	LA
6105 - p-Dimethylaminoazobenzene	EPA 8270D	10186002	NELAP	LA
9519 - 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 8290	10187209	NELAP	LA
9516 - 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 8290	10187209	NELAP	LA
9426 - 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	EPA 8290	10187209	NELAP	LA
9420 - 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA 8290	10187209	NELAP	LA
9423 - 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA 8290	10187209	NELAP	LA
9453 - 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)	EPA 8290	10187209	NELAP	LA
9471 - 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)	EPA 8290	10187209	NELAP	LA
9456 - 1,2,3,6,7,8-Hexachlorodibenzo-p-	EPA 8290	10187209	NELAP	LA

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## Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
dioxin(1,2,3,6,7,8-Hxcdd)				
9474 - 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)	EPA 8290	10187209	NELAP	LA
9459 - 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)	EPA 8290	10187209	NELAP	LA
9477 - 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)	EPA 8290	10187209	NELAP	LA
9540 - 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)	EPA 8290	10187209	NELAP	LA
9543 - 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)	EPA 8290	10187209	NELAP	LA
9480 - 2,3,4,6,7,8-Hexachlorodibenzofuran	EPA 8290	10187209	NELAP	LA
9549 - 2,3,4,7,8-Pentachlorodibenzofuran	EPA 8290	10187209	NELAP	LA
9618 - 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD)	EPA 8290	10187209	NELAP	LA
9612 - 2,3,7,8-Tetrachlorodibenzofuran	EPA 8290	10187209	NELAP	LA
9438 - Total Hpcdd	EPA 8290	10187209	NELAP	LA
9444 - Total Hpcdf	EPA 8290	10187209	NELAP	LA
9468 - Total Hxcdd	EPA 8290	10187209	NELAP	LA
9483 - Total Hxcdf	EPA 8290	10187209	NELAP	LA
9555 - Total Pecdd	EPA 8290	10187209	NELAP	LA
9552 - Total Pecdf	EPA 8290	10187209	NELAP	LA
9609 - Total TCDD	EPA 8290	10187209	NELAP	LA
9615 - Total TCDF	EPA 8290	10187209	NELAP	LA
9618 - 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD)	EPA 1613B	10257600	NELAP	LA
9105 - 2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl (BZ-209)	EPA 1668C	10262109	NELAP	LA
9095 - 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ-206)	EPA 1668C	10262109	NELAP	LA
9090 - 2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194)	EPA 1668C	10262109	NELAP	LA
9102 - 2,2',3,3',4,4',5,6'-Octachlorobiphenyl (BZ-196)	EPA 1668C	10262109	NELAP	LA
9101 - 2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (BZ-207)	EPA 1668C	10262109	NELAP	LA
9103 - 2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195)	EPA 1668C	10262109	NELAP	LA
9065 - 2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170)	EPA 1668C	10262109	NELAP	LA
9104 - 2,2',3,3',4,4',6'-Octachlorobiphenyl (BZ-197)	EPA 1668C	10262109	NELAP	LA
9106 - 2,2',3,3',4,4',6-Heptachlorobiphenyl (BZ-171)	EPA 1668C	10262109	NELAP	LA
9020 - 2,2',3,3',4,4'-Hexachlorobiphenyl (BZ-128)	EPA 1668C	10262109	NELAP	LA
9114 - 2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ-177)	EPA 1668C	10262109	NELAP	LA
9112 - 2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ-201)	EPA 1668C	10262109	NELAP	LA
9115 - 2,2',3,3',4,5',6-Heptachlorobiphenyl (BZ-175)	EPA 1668C	10262109	NELAP	LA
9117 - 2,2',3,3',4,5'-Hexachlorobiphenyl (BZ-130)	EPA 1668C	10262109	NELAP	LA
9108 - 2,2',3,3',4,5,5',6'-Octachlorobiphenyl	EPA 1668C	10262109	NELAP	LA

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Analyte	Method Name	Method Code	Type	AB
(BZ-199) 9107 - 2,2',3,3',4,5,5',6,6'- Nonachlorobiphenyl (BZ-208)	EPA 1668C	10262109	NELAP	LA
9109 - 2,2',3,3',4,5,5',6-Octachlorobiphenyl (BZ-198)	EPA 1668C	10262109	NELAP	LA
9110 - 2,2',3,3',4,5,5'-Heptachlorobiphenyl (BZ-172)	EPA 1668C	10262109	NELAP	LA
9116 - 2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-174)	EPA 1668C	10262109	NELAP	LA
9111 - 2,2',3,3',4,5,6,6'-Octachlorobiphenyl (BZ-200)	EPA 1668C	10262109	NELAP	LA
9113 - 2,2',3,3',4,5,6-Heptachlorobiphenyl (BZ-173)	EPA 1668C	10262109	NELAP	LA
9118 - 2,2',3,3',4,5-Hexachlorobiphenyl (BZ-129)	EPA 1668C	10262109	NELAP	LA
9120 - 2,2',3,3',4,6'-Hexachlorobiphenyl (BZ-132)	EPA 1668C	10262109	NELAP	LA
9119 - 2,2',3,3',4,6,6'-Heptachlorobiphenyl (BZ-176)	EPA 1668C	10262109	NELAP	LA
9121 - 2,2',3,3',4,6-Hexachlorobiphenyl (BZ-131)	EPA 1668C	10262109	NELAP	LA
9122 - 2,2',3,3',4-Pentachlorobiphenyl (BZ-82)	EPA 1668C	10262109	NELAP	LA
9123 - 2,2',3,3',5,5',6,6'-Octachlorobiphenyl (BZ-202)	EPA 1668C	10262109	NELAP	LA
9124 - 2,2',3,3',5,5',6-Heptachlorobiphenyl (BZ-178)	EPA 1668C	10262109	NELAP	LA
9125 - 2,2',3,3',5,5'-Hexachlorobiphenyl (BZ-133)	EPA 1668C	10262109	NELAP	LA
9127 - 2,2',3,3',5,6'-Hexachlorobiphenyl (BZ-135)	EPA 1668C	10262109	NELAP	LA
9126 - 2,2',3,3',5,6,6'-Heptachlorobiphenyl (BZ-179)	EPA 1668C	10262109	NELAP	LA
9128 - 2,2',3,3',5,6-Hexachlorobiphenyl (BZ-134)	EPA 1668C	10262109	NELAP	LA
9129 - 2,2',3,3',5-Pentachlorobiphenyl (BZ-83)	EPA 1668C	10262109	NELAP	LA
9130 - 2,2',3,3',6,6'-Hexachlorobiphenyl (BZ-136)	EPA 1668C	10262109	NELAP	LA
9131 - 2,2',3,3',6-Pentachlorobiphenyl (BZ-84)	EPA 1668C	10262109	NELAP	LA
9132 - 2,2',3,3'-Tetrachlorobiphenyl (BZ- 40)	EPA 1668C	10262109	NELAP	LA
9151 - 2,2',3,4',5',6-Hexachlorobiphenyl (BZ-149)	EPA 1668C	10262109	NELAP	LA
9154 - 2,2',3,4',5'-Pentachlorobiphenyl (BZ-97)	EPA 1668C	10262109	NELAP	LA
<del>9080 - 2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ-187)</del>	<del>EPA 1668C</del>	<del>10262109</del>	<del>NELAP</del>	<del>LA</del>
9144 - 2,2',3,4',5,5'-Hexachlorobiphenyl (BZ-146)	EPA 1668C	10262109	NELAP	LA
9147 - 2,2',3,4',5,6'-Hexachlorobiphenyl (BZ-148)	EPA 1668C	10262109	NELAP	LA
9146 - 2,2',3,4',5,6,6'-Heptachlorobiphenyl (BZ-188)	EPA 1668C	10262109	NELAP	LA

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Analyte	Method Name	Method Code	Type	AB
9149 - 2,2',3,4',5,6-Hexachlorobiphenyl (BZ-147)	EPA 1668C	10262109	NELAP	LA
9155 - 2,2',3,4',5-Pentachlorobiphenyl (BZ-90)	EPA 1668C	10262109	NELAP	LA
9159 - 2,2',3,4',6'-Pentachlorobiphenyl (BZ-98)	EPA 1668C	10262109	NELAP	LA
9157 - 2,2',3,4',6,6'-Hexachlorobiphenyl (BZ-150)	EPA 1668C	10262109	NELAP	LA
9160 - 2,2',3,4',6-Pentachlorobiphenyl (BZ-91)	EPA 1668C	10262109	NELAP	LA
9162 - 2,2',3,4'-Tetrachlorobiphenyl (BZ-42)	EPA 1668C	10262109	NELAP	LA
9075 - 2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ-183)	EPA 1668C	10262109	NELAP	LA
9025 - 2,2',3,4,4',5'-Hexachlorobiphenyl (BZ-138)	EPA 1668C	10262109	NELAP	LA
9133 - 2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ-203)	EPA 1668C	10262109	NELAP	LA
9134 - 2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ-180)	EPA 1668C	10262109	NELAP	LA
9136 - 2,2',3,4,4',5,6'-Heptachlorobiphenyl (BZ-182)	EPA 1668C	10262109	NELAP	LA
9135 - 2,2',3,4,4',5,6,6'-Octachlorobiphenyl (BZ-204)	EPA 1668C	10262109	NELAP	LA
9137 - 2,2',3,4,4',5,6-Heptachlorobiphenyl (BZ-181)	EPA 1668C	10262109	NELAP	LA
9138 - 2,2',3,4,4',5-Hexachlorobiphenyl (BZ-137)	EPA 1668C	10262109	NELAP	LA
9140 - 2,2',3,4,4',6'-Hexachlorobiphenyl (BZ-140)	EPA 1668C	10262109	NELAP	LA
9139 - 2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ-184)	EPA 1668C	10262109	NELAP	LA
9141 - 2,2',3,4,4',6-Hexachlorobiphenyl (BZ-139)	EPA 1668C	10262109	NELAP	LA
9142 - 2,2',3,4,4'-Pentachlorobiphenyl (BZ-85)	EPA 1668C	10262109	NELAP	LA
9150 - 2,2',3,4,5',6-Hexachlorobiphenyl (BZ-144)	EPA 1668C	10262109	NELAP	LA
8975 - 2,2',3,4,5'-Pentachlorobiphenyl (BZ-87)	EPA 1668C	10262109	NELAP	LA
9143 - 2,2',3,4,5,5',6-Heptachlorobiphenyl (BZ-185)	EPA 1668C	10262109	NELAP	LA
9030 - 2,2',3,4,5,5'-Hexachlorobiphenyl (BZ-141)	EPA 1668C	10262109	NELAP	LA
9152 - 2,2',3,4,5,6'-Hexachlorobiphenyl (BZ-143)	EPA 1668C	10262109	NELAP	LA
9145 - 2,2',3,4,5,6,6'-Heptachlorobiphenyl (BZ-186)	EPA 1668C	10262109	NELAP	LA
9148 - 2,2',3,4,5,6-Hexachlorobiphenyl (BZ-142)	EPA 1668C	10262109	NELAP	LA
9153 - 2,2',3,4,5-Pentachlorobiphenyl (BZ-86)	EPA 1668C	10262109	NELAP	LA
9161 - 2,2',3,4,6'-Pentachlorobiphenyl (BZ-89)	EPA 1668C	10262109	NELAP	LA
9156 - 2,2',3,4,6,6'-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA

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Analyte	Method Name	Method Code	Type	AB
(BZ-145) 9158 - 2,2',3,4,6-Pentachlorobiphenyl (BZ-88)	EPA 1668C	10262109	NELAP	LA
9163 - 2,2',3,4-Tetrachlorobiphenyl (BZ-41)	EPA 1668C	10262109	NELAP	LA
9166 - 2,2',3,5',6-Pentachlorobiphenyl (BZ-95)	EPA 1668C	10262109	NELAP	LA
8945 - 2,2',3,5'-Tetrachlorobiphenyl (BZ-44)	EPA 1668C	10262109	NELAP	LA
9035 - 2,2',3,5,5',6-Hexachlorobiphenyl (BZ-151)	EPA 1668C	10262109	NELAP	LA
9164 - 2,2',3,5,5'-Pentachlorobiphenyl (BZ-92)	EPA 1668C	10262109	NELAP	LA
9167 - 2,2',3,5,6'-Pentachlorobiphenyl (BZ-94)	EPA 1668C	10262109	NELAP	LA
9165 - 2,2',3,5,6,6'-Hexachlorobiphenyl (BZ-152)	EPA 1668C	10262109	NELAP	LA
9168 - 2,2',3,5,6-Pentachlorobiphenyl (BZ-93)	EPA 1668C	10262109	NELAP	LA
9169 - 2,2',3,5-Tetrachlorobiphenyl (BZ-43)	EPA 1668C	10262109	NELAP	LA
9171 - 2,2',3,6'-Tetrachlorobiphenyl (BZ-46)	EPA 1668C	10262109	NELAP	LA
9170 - 2,2',3,6,6'-Pentachlorobiphenyl (BZ-96)	EPA 1668C	10262109	NELAP	LA
9172 - 2,2',3,6-Tetrachlorobiphenyl (BZ-45)	EPA 1668C	10262109	NELAP	LA
9173 - 2,2',3-Trichlorobiphenyl (BZ-16)	EPA 1668C	10262109	NELAP	LA
9040 - 2,2',4,4',5,5'-Hexachlorobiphenyl (BZ-153)	EPA 1668C	10262109	NELAP	LA
9174 - 2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-154)	EPA 1668C	10262109	NELAP	LA
9175 - 2,2',4,4',5-Pentachlorobiphenyl (BZ-99)	EPA 1668C	10262109	NELAP	LA
9176 - 2,2',4,4',6,6'-Hexachlorobiphenyl (BZ-155)	EPA 1668C	10262109	NELAP	LA
9177 - 2,2',4,4',6-Pentachlorobiphenyl (BZ-100)	EPA 1668C	10262109	NELAP	LA
9178 - 2,2',4,4'-Tetrachlorobiphenyl (BZ-47)	EPA 1668C	10262109	NELAP	LA
9179 - 2,2',4,5',6-Pentachlorobiphenyl (BZ-103)	EPA 1668C	10262109	NELAP	LA
8950 - 2,2',4,5'-Tetrachlorobiphenyl (BZ-49)	EPA 1668C	10262109	NELAP	LA
8980 - 2,2',4,5,5'-Pentachlorobiphenyl (BZ-101)	EPA 1668C	10262109	NELAP	LA
9180 - 2,2',4,5,6'-Pentachlorobiphenyl (BZ-102)	EPA 1668C	10262109	NELAP	LA
9181 - 2,2',4,5-Tetrachlorobiphenyl (BZ-48)	EPA 1668C	10262109	NELAP	LA
9183 - 2,2',4,6'-Tetrachlorobiphenyl (BZ-51)	EPA 1668C	10262109	NELAP	LA
9182 - 2,2',4,6,6'-Pentachlorobiphenyl (BZ-104)	EPA 1668C	10262109	NELAP	LA
9184 - 2,2',4,6-Tetrachlorobiphenyl (BZ-48)	EPA 1668C	10262109	NELAP	LA

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Analyte	Method Name	Method Code	Type	AB
50)				
9185 - 2,2',4-Trichlorobiphenyl (BZ-17)	EPA 1668C	10262109	NELAP	LA
8955 - 2,2',5,5'-Tetrachlorobiphenyl (BZ-52)	EPA 1668C	10262109	NELAP	LA
9186 - 2,2',5,6'-Tetrachlorobiphenyl (BZ-53)	EPA 1668C	10262109	NELAP	LA
8930 - 2,2',5-Trichlorobiphenyl (BZ-18)	EPA 1668C	10262109	NELAP	LA
9187 - 2,2',6,6'-Tetrachlorobiphenyl (BZ-54)	EPA 1668C	10262109	NELAP	LA
9188 - 2,2',6-Trichlorobiphenyl (BZ-19)	EPA 1668C	10262109	NELAP	LA
9189 - 2,2'-Dichlorobiphenyl (BZ-4)	EPA 1668C	10262109	NELAP	LA
9224 - 2,3',4',5',6-Pentachlorobiphenyl (BZ-125)	EPA 1668C	10262109	NELAP	LA
9229 - 2,3',4',5'-Tetrachlorobiphenyl (BZ-76)	EPA 1668C	10262109	NELAP	LA
9222 - 2,3',4',5,5'-Pentachlorobiphenyl (BZ-124)	EPA 1668C	10262109	NELAP	LA
9230 - 2,3',4',5-Tetrachlorobiphenyl (BZ-70)	EPA 1668C	10262109	NELAP	LA
9237 - 2,3',4',6-Tetrachlorobiphenyl (BZ-71)	EPA 1668C	10262109	NELAP	LA
9239 - 2,3',4'-Trichlorobiphenyl (BZ-33)	EPA 1668C	10262109	NELAP	LA
9218 - 2,3',4,4',5',6-Hexachlorobiphenyl (BZ-168)	EPA 1668C	10262109	NELAP	LA
9000 - 2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)	EPA 1668C	10262109	NELAP	LA
9011 - 2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)	EPA 1668C	10262109	NELAP	LA
9055 - 2,3',4,4',5,5'-Hexachlorobiphenyl (BZ-167)	EPA 1668C	10262109	NELAP	LA
8995 - 2,3',4,4',5-Pentachlorobiphenyl (BZ-118)	EPA 1668C	10262109	NELAP	LA
9220 - 2,3',4,4',6-Pentachlorobiphenyl (BZ-119)	EPA 1668C	10262109	NELAP	LA
8960 - 2,3',4,4'-Tetrachlorobiphenyl (BZ-66)	EPA 1668C	10262109	NELAP	LA
9226 - 2,3',4,5',6-Pentachlorobiphenyl (BZ-121)	EPA 1668C	10262109	NELAP	LA
9231 - 2,3',4,5'-Tetrachlorobiphenyl (BZ-68)	EPA 1668C	10262109	NELAP	LA
9223 - 2,3',4,5,5'-Pentachlorobiphenyl (BZ-120)	EPA 1668C	10262109	NELAP	LA
9232 - 2,3',4,5-Tetrachlorobiphenyl (BZ-67)	EPA 1668C	10262109	NELAP	LA
9235 - 2,3',4,6-Tetrachlorobiphenyl (BZ-69)	EPA 1668C	10262109	NELAP	LA
9240 - 2,3',4-Trichlorobiphenyl (BZ-25)	EPA 1668C	10262109	NELAP	LA
9244 - 2,3',5',6-Tetrachlorobiphenyl (BZ-73)	EPA 1668C	10262109	NELAP	LA
9246 - 2,3',5'-Trichlorobiphenyl (BZ-34)	EPA 1668C	10262109	NELAP	LA
9242 - 2,3',5,5'-Tetrachlorobiphenyl (BZ-72)	EPA 1668C	10262109	NELAP	LA
8935 - 2,3',5-Trichlorobiphenyl (BZ-26)	EPA 1668C	10262109	NELAP	LA
9248 - 2,3',6-Trichlorobiphenyl (BZ-27)	EPA 1668C	10262109	NELAP	LA
9249 - 2,3'-Dichlorobiphenyl (BZ-6)	EPA 1668C	10262109	NELAP	LA

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## Solid Chemical Materials

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9201 - 2,3,3',4',5',6-Hexachlorobiphenyl (BZ-164)	EPA 1668C	10262109	NELAP	LA
9202 - 2,3,3',4',5'-Pentachlorobiphenyl (BZ-122)	EPA 1668C	10262109	NELAP	LA
9195 - 2,3,3',4',5,5',6-Heptachlorobiphenyl (BZ-193)	EPA 1668C	10262109	NELAP	LA
9197 - 2,3,3',4',5,5'-Hexachlorobiphenyl (BZ-162)	EPA 1668C	10262109	NELAP	LA
9199 - 2,3,3',4',5,6-Hexachlorobiphenyl (BZ-163)	EPA 1668C	10262109	NELAP	LA
9205 - 2,3,3',4',5-Pentachlorobiphenyl (BZ-107)	EPA 1668C	10262109	NELAP	LA
8990 - 2,3,3',4',6-Pentachlorobiphenyl (BZ-110)	EPA 1668C	10262109	NELAP	LA
9207 - 2,3,3',4'-Tetrachlorobiphenyl (BZ-56)	EPA 1668C	10262109	NELAP	LA
9192 - 2,3,3',4,4',5',6-Heptachlorobiphenyl (BZ-191)	EPA 1668C	10262109	NELAP	LA
9045 - 2,3,3',4,4',5'-Hexachlorobiphenyl (BZ-157)	EPA 1668C	10262109	NELAP	LA
9190 - 2,3,3',4,4',5,5',6-Octachlorobiphenyl (BZ-205)	EPA 1668C	10262109	NELAP	LA
9085 - 2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ-189)	EPA 1668C	10262109	NELAP	LA
9191 - 2,3,3',4,4',5,6-Heptachlorobiphenyl (BZ-190)	EPA 1668C	10262109	NELAP	LA
9050 - 2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)	EPA 1668C	10262109	NELAP	LA
9193 - 2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158)	EPA 1668C	10262109	NELAP	LA
8985 - 2,3,3',4,4'-Pentachlorobiphenyl (BZ-105)	EPA 1668C	10262109	NELAP	LA
9200 - 2,3,3',4,5',6-Hexachlorobiphenyl (BZ-161)	EPA 1668C	10262109	NELAP	LA
9203 - 2,3,3',4,5'-Pentachlorobiphenyl (BZ-108)	EPA 1668C	10262109	NELAP	LA
9194 - 2,3,3',4,5,5',6-Heptachlorobiphenyl (BZ-192)	EPA 1668C	10262109	NELAP	LA
9196 - 2,3,3',4,5,5'-Hexachlorobiphenyl (BZ-159)	EPA 1668C	10262109	NELAP	LA
9198 - 2,3,3',4,5,6-Hexachlorobiphenyl (BZ-160)	EPA 1668C	10262109	NELAP	LA
9204 - 2,3,3',4,5-Pentachlorobiphenyl (BZ-106)	EPA 1668C	10262109	NELAP	LA
9206 - 2,3,3',4,6-Pentachlorobiphenyl (BZ-109)	EPA 1668C	10262109	NELAP	LA
9208 - 2,3,3',4-Tetrachlorobiphenyl (BZ-55)	EPA 1668C	10262109	NELAP	LA
9212 - 2,3,3',5',6-Pentachlorobiphenyl (BZ-113)	EPA 1668C	10262109	NELAP	LA
9213 - 2,3,3',5'-Tetrachlorobiphenyl (BZ-58)	EPA 1668C	10262109	NELAP	LA
9209 - 2,3,3',5,5',6-Hexachlorobiphenyl (BZ-165)	EPA 1668C	10262109	NELAP	LA
9210 - 2,3,3',5,5'-Pentachlorobiphenyl	EPA 1668C	10262109	NELAP	LA

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Analyte	Method Name	Method Code	Type	AB
(BZ-111)				
9211 - 2,3,3',5,6-Pentachlorobiphenyl (BZ-112)	EPA 1668C	10262109	NELAP	LA
9214 - 2,3,3',5-Tetrachlorobiphenyl (BZ-57)	EPA 1668C	10262109	NELAP	LA
9215 - 2,3,3',6-Tetrachlorobiphenyl (BZ-59)	EPA 1668C	10262109	NELAP	LA
9216 - 2,3,3'-Trichlorobiphenyl (BZ-20)	EPA 1668C	10262109	NELAP	LA
9227 - 2,3,4',5,6-Pentachlorobiphenyl (BZ-117)	EPA 1668C	10262109	NELAP	LA
9233 - 2,3,4',5-Tetrachlorobiphenyl (BZ-63)	EPA 1668C	10262109	NELAP	LA
9236 - 2,3,4',6-Tetrachlorobiphenyl (BZ-64)	EPA 1668C	10262109	NELAP	LA
9241 - 2,3,4'-Trichlorobiphenyl (BZ-22)	EPA 1668C	10262109	NELAP	LA
9217 - 2,3,4,4',5,6-Hexachlorobiphenyl (BZ-166)	EPA 1668C	10262109	NELAP	LA
9005 - 2,3,4,4',5-Pentachlorobiphenyl (BZ-114)	EPA 1668C	10262109	NELAP	LA
9219 - 2,3,4,4',6-Pentachlorobiphenyl (BZ-115)	EPA 1668C	10262109	NELAP	LA
9221 - 2,3,4,4'-Tetrachlorobiphenyl (BZ-60)	EPA 1668C	10262109	NELAP	LA
9225 - 2,3,4,5,6-Pentachlorobiphenyl (BZ-116)	EPA 1668C	10262109	NELAP	LA
9228 - 2,3,4,5-Tetrachlorobiphenyl (BZ-61)	EPA 1668C	10262109	NELAP	LA
9234 - 2,3,4,6-Tetrachlorobiphenyl (BZ-62)	EPA 1668C	10262109	NELAP	LA
9238 - 2,3,4-Trichlorobiphenyl (BZ-21)	EPA 1668C	10262109	NELAP	LA
9243 - 2,3,5,6-Tetrachlorobiphenyl (BZ-65)	EPA 1668C	10262109	NELAP	LA
9245 - 2,3,5-Trichlorobiphenyl (BZ-23)	EPA 1668C	10262109	NELAP	LA
9247 - 2,3,6-Trichlorobiphenyl (BZ-24)	EPA 1668C	10262109	NELAP	LA
8920 - 2,3-Dichlorobiphenyl (BZ-5)	EPA 1668C	10262109	NELAP	LA
8940 - 2,4',5-Trichlorobiphenyl (BZ-31)	EPA 1668C	10262109	NELAP	LA
9255 - 2,4',6-Trichlorobiphenyl (BZ-32)	EPA 1668C	10262109	NELAP	LA
9256 - 2,4'-Dichlorobiphenyl (BZ-8)	EPA 1668C	10262109	NELAP	LA
9250 - 2,4,4',5-Tetrachlorobiphenyl (BZ-74)	EPA 1668C	10262109	NELAP	LA
9251 - 2,4,4',6-Tetrachlorobiphenyl (BZ-75)	EPA 1668C	10262109	NELAP	LA
9252 - 2,4,4'-Trichlorobiphenyl (BZ-28)	EPA 1668C	10262109	NELAP	LA
9253 - 2,4,5-Trichlorobiphenyl (BZ-29)	EPA 1668C	10262109	NELAP	LA
9254 - 2,4,6-Trichlorobiphenyl (BZ-30)	EPA 1668C	10262109	NELAP	LA
9257 - 2,4-Dichlorobiphenyl (BZ-7)	EPA 1668C	10262109	NELAP	LA
9258 - 2,5-Dichlorobiphenyl (BZ-9)	EPA 1668C	10262109	NELAP	LA
<del>9259 - 2,6-Dichlorobiphenyl (BZ-10)</del>	<del>EPA 1668C</del>	<del>10262109</del>	<del>NELAP</del>	<del>LA</del>
8915 - 2-Chlorobiphenyl (BZ-1)	EPA 1668C	10262109	NELAP	LA
9060 - 3,3',4,4',5,5'-Hexachlorobiphenyl (BZ-169)	EPA 1668C	10262109	NELAP	LA
9015 - 3,3',4,4',5-Pentachlorobiphenyl (BZ-126)	EPA 1668C	10262109	NELAP	LA
8965 - 3,3',4,4'-Tetrachlorobiphenyl (BZ-77)	EPA 1668C	10262109	NELAP	LA

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## Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
9261 - 3,3',4,5'-Tetrachlorobiphenyl (BZ-79)	EPA 1668C	10262109	NELAP	LA
9260 - 3,3',4,5,5'-Pentachlorobiphenyl (BZ-127)	EPA 1668C	10262109	NELAP	LA
9262 - 3,3',4,5-Tetrachlorobiphenyl (BZ-78)	EPA 1668C	10262109	NELAP	LA
9263 - 3,3',4-Trichlorobiphenyl (BZ-35)	EPA 1668C	10262109	NELAP	LA
9264 - 3,3',5,5'-Tetrachlorobiphenyl (BZ-80)	EPA 1668C	10262109	NELAP	LA
9265 - 3,3',5-Trichlorobiphenyl (BZ-36)	EPA 1668C	10262109	NELAP	LA
8925 - 3,3'-Dichlorobiphenyl (BZ-11)	EPA 1668C	10262109	NELAP	LA
9268 - 3,4',5-Trichlorobiphenyl (BZ-39)	EPA 1668C	10262109	NELAP	LA
9269 - 3,4'-Dichlorobiphenyl (BZ-13)	EPA 1668C	10262109	NELAP	LA
8970 - 3,4,4',5-Tetrachlorobiphenyl (BZ-81)	EPA 1668C	10262109	NELAP	LA
9266 - 3,4,4'-Trichlorobiphenyl (BZ-37)	EPA 1668C	10262109	NELAP	LA
9267 - 3,4,5-Trichlorobiphenyl (BZ-38)	EPA 1668C	10262109	NELAP	LA
9270 - 3,4-Dichlorobiphenyl (BZ-12)	EPA 1668C	10262109	NELAP	LA
9271 - 3,5-Dichlorobiphenyl (BZ-14)	EPA 1668C	10262109	NELAP	LA
9272 - 3-Chlorobiphenyl (BZ-2)	EPA 1668C	10262109	NELAP	LA
9273 - 4,4'-Dichlorobiphenyl (BZ-15)	EPA 1668C	10262109	NELAP	LA
9274 - 4-Chlorobiphenyl (BZ-3)	EPA 1668C	10262109	NELAP	LA

## Biological Tissue

Analyte	Method Name	Method Code	Type	AB
9519 - 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 1613B	10120602	NELAP	LA
9516 - 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 1613B	10120602	NELAP	LA
9426 - 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	EPA 1613B	10120602	NELAP	LA
9420 - 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA 1613B	10120602	NELAP	LA
9423 - 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA 1613B	10120602	NELAP	LA
9453 - 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)	EPA 1613B	10120602	NELAP	LA
9471 - 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)	EPA 1613B	10120602	NELAP	LA
9456 - 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)	EPA 1613B	10120602	NELAP	LA
9474 - 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)	EPA 1613B	10120602	NELAP	LA
9459 - 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)	EPA 1613B	10120602	NELAP	LA
9477 - 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)	EPA 1613B	10120602	NELAP	LA
9540 - 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)	EPA 1613B	10120602	NELAP	LA
9543 - 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)	EPA 1613B	10120602	NELAP	LA

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Analyte	Method Name	Method Code	Type	AB
9480 - 2,3,4,6,7,8-Hexachlorodibenzofuran	EPA 1613B	10120602	NELAP	LA
9549 - 2,3,4,7,8-Pentachlorodibenzofuran	EPA 1613B	10120602	NELAP	LA
9618 - 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD)	EPA 1613B	10120602	NELAP	LA
9612 - 2,3,7,8-Tetrachlorodibenzofuran	EPA 1613B	10120602	NELAP	LA
9438 - Total Hpccd	EPA 1613B	10120602	NELAP	LA
9444 - Total Hpccdf	EPA 1613B	10120602	NELAP	LA
9468 - Total Hxcdd	EPA 1613B	10120602	NELAP	LA
9483 - Total Hxcdf	EPA 1613B	10120602	NELAP	LA
9555 - Total Pecdd	EPA 1613B	10120602	NELAP	LA
9552 - Total Pecdf	EPA 1613B	10120602	NELAP	LA
9609 - Total TCDD	EPA 1613B	10120602	NELAP	LA
9615 - Total TCDF	EPA 1613B	10120602	NELAP	LA
9105 - 2,2',3,3',4,4',5,5',6,6'- Decachlorobiphenyl (BZ-209)	EPA 1668A	10129405	NELAP	LA
9095 - 2,2',3,3',4,4',5,5',6- Nonachlorobiphenyl (BZ-206)	EPA 1668A	10129405	NELAP	LA
9090 - 2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194)	EPA 1668A	10129405	NELAP	LA
9102 - 2,2',3,3',4,4',5,6'-Octachlorobiphenyl (BZ-196)	EPA 1668A	10129405	NELAP	LA
9101 - 2,2',3,3',4,4',5,6,6'- Nonachlorobiphenyl (BZ-207)	EPA 1668A	10129405	NELAP	LA
9103 - 2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195)	EPA 1668A	10129405	NELAP	LA
9065 - 2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170)	EPA 1668A	10129405	NELAP	LA
9104 - 2,2',3,3',4,4',6'-Octachlorobiphenyl (BZ-197)	EPA 1668A	10129405	NELAP	LA
9106 - 2,2',3,3',4,4',6-Heptachlorobiphenyl (BZ-171)	EPA 1668A	10129405	NELAP	LA
9020 - 2,2',3,3',4,4'-Hexachlorobiphenyl (BZ-128)	EPA 1668A	10129405	NELAP	LA
9114 - 2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-177)	EPA 1668A	10129405	NELAP	LA
9112 - 2,2',3,3',4,5,6'-Octachlorobiphenyl (BZ-201)	EPA 1668A	10129405	NELAP	LA
9115 - 2,2',3,3',4,5,6-Heptachlorobiphenyl (BZ-175)	EPA 1668A	10129405	NELAP	LA
9117 - 2,2',3,3',4,5'-Hexachlorobiphenyl (BZ-130)	EPA 1668A	10129405	NELAP	LA
9108 - 2,2',3,3',4,5,5',6'-Octachlorobiphenyl (BZ-199)	EPA 1668A	10129405	NELAP	LA
9107 - 2,2',3,3',4,5,5',6,6'- Nonachlorobiphenyl (BZ-208)	EPA 1668A	10129405	NELAP	LA
9109 - 2,2',3,3',4,5,5',6-Octachlorobiphenyl (BZ-198)	EPA 1668A	10129405	NELAP	LA
9110 - 2,2',3,3',4,5,5'-Heptachlorobiphenyl (BZ-172)	EPA 1668A	10129405	NELAP	LA
9116 - 2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-174)	EPA 1668A	10129405	NELAP	LA
9111 - 2,2',3,3',4,5,6'-Octachlorobiphenyl (BZ-200)	EPA 1668A	10129405	NELAP	LA
9113 - 2,2',3,3',4,5,6-Heptachlorobiphenyl (BZ-173)	EPA 1668A	10129405	NELAP	LA

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Analyte	Method Name	Method Code	Type	AB
9118 - 2,2',3,3',4,5-Hexachlorobiphenyl (BZ-129)	EPA 1668A	10129405	NELAP	LA
9120 - 2,2',3,3',4,6'-Hexachlorobiphenyl (BZ-132)	EPA 1668A	10129405	NELAP	LA
9119 - 2,2',3,3',4,6,6'-Heptachlorobiphenyl (BZ-176)	EPA 1668A	10129405	NELAP	LA
9121 - 2,2',3,3',4,6-Hexachlorobiphenyl (BZ-131)	EPA 1668A	10129405	NELAP	LA
9122 - 2,2',3,3',4-Pentachlorobiphenyl (BZ-82)	EPA 1668A	10129405	NELAP	LA
9123 - 2,2',3,3',5,5',6,6'-Octachlorobiphenyl (BZ-202)	EPA 1668A	10129405	NELAP	LA
9124 - 2,2',3,3',5,5',6-Heptachlorobiphenyl (BZ-178)	EPA 1668A	10129405	NELAP	LA
9125 - 2,2',3,3',5,5'-Hexachlorobiphenyl (BZ-133)	EPA 1668A	10129405	NELAP	LA
9127 - 2,2',3,3',5,6'-Hexachlorobiphenyl (BZ-135)	EPA 1668A	10129405	NELAP	LA
9126 - 2,2',3,3',5,6,6'-Heptachlorobiphenyl (BZ-179)	EPA 1668A	10129405	NELAP	LA
9128 - 2,2',3,3',5,6-Hexachlorobiphenyl (BZ-134)	EPA 1668A	10129405	NELAP	LA
9129 - 2,2',3,3',5-Pentachlorobiphenyl (BZ-83)	EPA 1668A	10129405	NELAP	LA
9130 - 2,2',3,3',6,6'-Hexachlorobiphenyl (BZ-136)	EPA 1668A	10129405	NELAP	LA
9131 - 2,2',3,3',6-Pentachlorobiphenyl (BZ-84)	EPA 1668A	10129405	NELAP	LA
9132 - 2,2',3,3'-Tetrachlorobiphenyl (BZ-40)	EPA 1668A	10129405	NELAP	LA
9151 - 2,2',3,4',5,6-Hexachlorobiphenyl (BZ-149)	EPA 1668A	10129405	NELAP	LA
9154 - 2,2',3,4',5'-Pentachlorobiphenyl (BZ-97)	EPA 1668A	10129405	NELAP	LA
9080 - 2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ-187)	EPA 1668A	10129405	NELAP	LA
9144 - 2,2',3,4',5,5'-Hexachlorobiphenyl (BZ-146)	EPA 1668A	10129405	NELAP	LA
9147 - 2,2',3,4',5,6'-Hexachlorobiphenyl (BZ-148)	EPA 1668A	10129405	NELAP	LA
9146 - 2,2',3,4',5,6,6'-Heptachlorobiphenyl (BZ-188)	EPA 1668A	10129405	NELAP	LA
9149 - 2,2',3,4',5,6-Hexachlorobiphenyl (BZ-147)	EPA 1668A	10129405	NELAP	LA
9155 - 2,2',3,4',5-Pentachlorobiphenyl (BZ-90)	EPA 1668A	10129405	NELAP	LA
9159 - 2,2',3,4',6'-Pentachlorobiphenyl (BZ-98)	EPA 1668A	10129405	NELAP	LA
9157 - 2,2',3,4',6,6'-Hexachlorobiphenyl (BZ-150)	EPA 1668A	10129405	NELAP	LA
9160 - 2,2',3,4',6-Pentachlorobiphenyl (BZ-91)	EPA 1668A	10129405	NELAP	LA
9162 - 2,2',3,4'-Tetrachlorobiphenyl (BZ-42)	EPA 1668A	10129405	NELAP	LA
9075 - 2,2',3,4,4',5',6-Heptachlorobiphenyl	EPA 1668A	10129405	NELAP	LA

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Analyte	Method Name	Method Code	Type	AB
(BZ-183) 9025 - 2,2',3,4,4',5'-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-138) 9133 - 2,2',3,4,4',5,5',6-Octachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-203) 9134 - 2,2',3,4,4',5,5'-Heptachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-180) 9136 - 2,2',3,4,4',5,6'-Heptachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-182) 9135 - 2,2',3,4,4',5,6'-Octachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-204) 9137 - 2,2',3,4,4',5,6'-Heptachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-181) 9138 - 2,2',3,4,4',5-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-137) 9140 - 2,2',3,4,4',6'-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-140) 9139 - 2,2',3,4,4',6,6'-Heptachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-184) 9141 - 2,2',3,4,4',6-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-139) 9142 - 2,2',3,4,4'-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-85) 9150 - 2,2',3,4,5',6-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-144) 8975 - 2,2',3,4,5'-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-87) 9143 - 2,2',3,4,5,5',6-Heptachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-185) 9030 - 2,2',3,4,5,5'-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-141) 9152 - 2,2',3,4,5,6'-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-143) 9145 - 2,2',3,4,5,6,6'-Heptachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-186) 9148 - 2,2',3,4,5,6-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	LA
(BZ-142) 9153 - 2,2',3,4,5-Pentachlorobiphenyl (BZ-86)	EPA 1668A	10129405	NELAP	LA
9161 - 2,2',3,4,6'-Pentachlorobiphenyl (BZ-89)	EPA 1668A	10129405	NELAP	LA
9156 - 2,2',3,4,6,6'-Hexachlorobiphenyl (BZ-145)	EPA 1668A	10129405	NELAP	LA
9158 - 2,2',3,4,6-Pentachlorobiphenyl (BZ-88)	EPA 1668A	10129405	NELAP	LA
9163 - 2,2',3,4-Tetrachlorobiphenyl (BZ-41)	EPA 1668A	10129405	NELAP	LA
9166 - 2,2',3,5',6-Pentachlorobiphenyl (BZ-95)	EPA 1668A	10129405	NELAP	LA
8945 - 2,2',3,5'-Tetrachlorobiphenyl (BZ-44)	EPA 1668A	10129405	NELAP	LA
9035 - 2,2',3,5,5',6-Hexachlorobiphenyl (BZ-151)	EPA 1668A	10129405	NELAP	LA
9164 - 2,2',3,5,5'-Pentachlorobiphenyl (BZ-92)	EPA 1668A	10129405	NELAP	LA

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9167 - 2,2',3,5,6'-Pentachlorobiphenyl (BZ-94)	EPA 1668A	10129405	NELAP	LA
9165 - 2,2',3,5,6,6'-Hexachlorobiphenyl (BZ-152)	EPA 1668A	10129405	NELAP	LA
9168 - 2,2',3,5,6-Pentachlorobiphenyl (BZ-93)	EPA 1668A	10129405	NELAP	LA
9169 - 2,2',3,5-Tetrachlorobiphenyl (BZ-43)	EPA 1668A	10129405	NELAP	LA
9171 - 2,2',3,6'-Tetrachlorobiphenyl (BZ-46)	EPA 1668A	10129405	NELAP	LA
9170 - 2,2',3,6,6'-Pentachlorobiphenyl (BZ-96)	EPA 1668A	10129405	NELAP	LA
9172 - 2,2',3,6-Tetrachlorobiphenyl (BZ-45)	EPA 1668A	10129405	NELAP	LA
9173 - 2,2',3-Trichlorobiphenyl (BZ-16)	EPA 1668A	10129405	NELAP	LA
9040 - 2,2',4,4',5,5'-Hexachlorobiphenyl (BZ-153)	EPA 1668A	10129405	NELAP	LA
9174 - 2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-154)	EPA 1668A	10129405	NELAP	LA
9175 - 2,2',4,4',5-Pentachlorobiphenyl (BZ-99)	EPA 1668A	10129405	NELAP	LA
9176 - 2,2',4,4',6,6'-Hexachlorobiphenyl (BZ-155)	EPA 1668A	10129405	NELAP	LA
9177 - 2,2',4,4',6-Pentachlorobiphenyl (BZ-100)	EPA 1668A	10129405	NELAP	LA
9178 - 2,2',4,4'-Tetrachlorobiphenyl (BZ-47)	EPA 1668A	10129405	NELAP	LA
9179 - 2,2',4,5,6-Pentachlorobiphenyl (BZ-103)	EPA 1668A	10129405	NELAP	LA
8950 - 2,2',4,5'-Tetrachlorobiphenyl (BZ-49)	EPA 1668A	10129405	NELAP	LA
8980 - 2,2',4,5,5'-Pentachlorobiphenyl (BZ-101)	EPA 1668A	10129405	NELAP	LA
9180 - 2,2',4,5,6'-Pentachlorobiphenyl (BZ-102)	EPA 1668A	10129405	NELAP	LA
9181 - 2,2',4,5-Tetrachlorobiphenyl (BZ-48)	EPA 1668A	10129405	NELAP	LA
9183 - 2,2',4,6'-Tetrachlorobiphenyl (BZ-51)	EPA 1668A	10129405	NELAP	LA
9182 - 2,2',4,6,6'-Pentachlorobiphenyl (BZ-104)	EPA 1668A	10129405	NELAP	LA
9184 - 2,2',4,6-Tetrachlorobiphenyl (BZ-50)	EPA 1668A	10129405	NELAP	LA
9185 - 2,2',4-Trichlorobiphenyl (BZ-17)	EPA 1668A	10129405	NELAP	LA
8955 - 2,2',5,5'-Tetrachlorobiphenyl (BZ-52)	EPA 1668A	10129405	NELAP	LA
9186 - 2,2',5,6'-Tetrachlorobiphenyl (BZ-53)	EPA 1668A	10129405	NELAP	LA
8930 - 2,2',5-Trichlorobiphenyl (BZ-18)	EPA 1668A	10129405	NELAP	LA
9187 - 2,2',6,6'-Tetrachlorobiphenyl (BZ-54)	EPA 1668A	10129405	NELAP	LA
9188 - 2,2',6-Trichlorobiphenyl (BZ-19)	EPA 1668A	10129405	NELAP	LA
9189 - 2,2'-Dichlorobiphenyl (BZ-4)	EPA 1668A	10129405	NELAP	LA
9224 - 2,3',4',5',6-Pentachlorobiphenyl (BZ-125)	EPA 1668A	10129405	NELAP	LA

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Analyte	Method Name	Method Code	Type	AB
9229 - 2,3,4',5'-Tetrachlorobiphenyl (BZ-76)	EPA 1668A	10129405	NELAP	LA
9222 - 2,3,4',5,5'-Pentachlorobiphenyl (BZ-124)	EPA 1668A	10129405	NELAP	LA
9230 - 2,3,4',5-Tetrachlorobiphenyl (BZ-70)	EPA 1668A	10129405	NELAP	LA
9237 - 2,3,4',6-Tetrachlorobiphenyl (BZ-71)	EPA 1668A	10129405	NELAP	LA
9239 - 2,3',4'-Trichlorobiphenyl (BZ-33)	EPA 1668A	10129405	NELAP	LA
9218 - 2,3',4,4',5',6-Hexachlorobiphenyl (BZ-168)	EPA 1668A	10129405	NELAP	LA
9000 - 2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)	EPA 1668A	10129405	NELAP	LA
9011 - 2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)	EPA 1668A	10129405	NELAP	LA
9055 - 2,3',4,4',5,5'-Hexachlorobiphenyl (BZ-167)	EPA 1668A	10129405	NELAP	LA
8995 - 2,3',4,4',5-Pentachlorobiphenyl (BZ-118)	EPA 1668A	10129405	NELAP	LA
9220 - 2,3',4,4',6-Pentachlorobiphenyl (BZ-119)	EPA 1668A	10129405	NELAP	LA
8960 - 2,3',4,4'-Tetrachlorobiphenyl (BZ-66)	EPA 1668A	10129405	NELAP	LA
9226 - 2,3',4,5',6-Pentachlorobiphenyl (BZ-121)	EPA 1668A	10129405	NELAP	LA
9231 - 2,3',4,5'-Tetrachlorobiphenyl (BZ-68)	EPA 1668A	10129405	NELAP	LA
9223 - 2,3',4,5,5'-Pentachlorobiphenyl (BZ-120)	EPA 1668A	10129405	NELAP	LA
9232 - 2,3',4,5-Tetrachlorobiphenyl (BZ-67)	EPA 1668A	10129405	NELAP	LA
9235 - 2,3',4,6-Tetrachlorobiphenyl (BZ-69)	EPA 1668A	10129405	NELAP	LA
9240 - 2,3',4-Trichlorobiphenyl (BZ-25)	EPA 1668A	10129405	NELAP	LA
9244 - 2,3',5',6-Tetrachlorobiphenyl (BZ-73)	EPA 1668A	10129405	NELAP	LA
9246 - 2,3',5'-Trichlorobiphenyl (BZ-34)	EPA 1668A	10129405	NELAP	LA
9242 - 2,3',5,5'-Tetrachlorobiphenyl (BZ-72)	EPA 1668A	10129405	NELAP	LA
8935 - 2,3',5-Trichlorobiphenyl (BZ-26)	EPA 1668A	10129405	NELAP	LA
9248 - 2,3',6-Trichlorobiphenyl (BZ-27)	EPA 1668A	10129405	NELAP	LA
9249 - 2,3'-Dichlorobiphenyl (BZ-6)	EPA 1668A	10129405	NELAP	LA
9201 - 2,3,3',4',5',6-Hexachlorobiphenyl (BZ-164)	EPA 1668A	10129405	NELAP	LA
9202 - 2,3,3',4',5'-Pentachlorobiphenyl (BZ-122)	EPA 1668A	10129405	NELAP	LA
9195 - 2,3,3',4',5,5',6-Heptachlorobiphenyl (BZ-193)	EPA 1668A	10129405	NELAP	LA
9197 - 2,3,3',4',5,5'-Hexachlorobiphenyl (BZ-162)	EPA 1668A	10129405	NELAP	LA
9199 - 2,3,3',4',5,6-Hexachlorobiphenyl (BZ-163)	EPA 1668A	10129405	NELAP	LA
9205 - 2,3,3',4',5-Pentachlorobiphenyl (BZ-107)	EPA 1668A	10129405	NELAP	LA
8990 - 2,3,3',4',6-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	LA

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(BZ-110)				
9207 - 2,3,3',4'-Tetrachlorobiphenyl (BZ-56)	EPA 1668A	10129405	NELAP	LA
9192 - 2,3,3',4,4',5',6-Heptachlorobiphenyl (BZ-191)	EPA 1668A	10129405	NELAP	LA
9045 - 2,3,3',4,4',5'-Hexachlorobiphenyl (BZ-157)	EPA 1668A	10129405	NELAP	LA
9190 - 2,3,3',4,4',5,5',6-Octachlorobiphenyl (BZ-205)	EPA 1668A	10129405	NELAP	LA
9085 - 2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ-189)	EPA 1668A	10129405	NELAP	LA
9191 - 2,3,3',4,4',5,6-Heptachlorobiphenyl (BZ-190)	EPA 1668A	10129405	NELAP	LA
9050 - 2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)	EPA 1668A	10129405	NELAP	LA
9193 - 2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158)	EPA 1668A	10129405	NELAP	LA
8985 - 2,3,3',4,4'-Pentachlorobiphenyl (BZ-105)	EPA 1668A	10129405	NELAP	LA
9200 - 2,3,3',4,5',6-Hexachlorobiphenyl (BZ-161)	EPA 1668A	10129405	NELAP	LA
9203 - 2,3,3',4,5'-Pentachlorobiphenyl (BZ-108)	EPA 1668A	10129405	NELAP	LA
9194 - 2,3,3',4,5,5',6-Heptachlorobiphenyl (BZ-192)	EPA 1668A	10129405	NELAP	LA
9196 - 2,3,3',4,5,5'-Hexachlorobiphenyl (BZ-159)	EPA 1668A	10129405	NELAP	LA
9198 - 2,3,3',4,5,6-Hexachlorobiphenyl (BZ-160)	EPA 1668A	10129405	NELAP	LA
9204 - 2,3,3',4,5-Pentachlorobiphenyl (BZ-106)	EPA 1668A	10129405	NELAP	LA
9206 - 2,3,3',4,6-Pentachlorobiphenyl (BZ-109)	EPA 1668A	10129405	NELAP	LA
9208 - 2,3,3',4-Tetrachlorobiphenyl (BZ-55)	EPA 1668A	10129405	NELAP	LA
9212 - 2,3,3',5',6-Pentachlorobiphenyl (BZ-113)	EPA 1668A	10129405	NELAP	LA
9213 - 2,3,3',5'-Tetrachlorobiphenyl (BZ-58)	EPA 1668A	10129405	NELAP	LA
9209 - 2,3,3',5,5',6-Hexachlorobiphenyl (BZ-165)	EPA 1668A	10129405	NELAP	LA
9210 - 2,3,3',5,5'-Pentachlorobiphenyl (BZ-111)	EPA 1668A	10129405	NELAP	LA
9211 - 2,3,3',5,6-Pentachlorobiphenyl (BZ-112)	EPA 1668A	10129405	NELAP	LA
9214 - 2,3,3',5-Tetrachlorobiphenyl (BZ-57)	EPA 1668A	10129405	NELAP	LA
<del>9215 - 2,3,3',6-Tetrachlorobiphenyl (BZ-59)</del>	<del>EPA 1668A</del>	<del>10129405</del>	<del>NELAP</del>	<del>LA</del>
9216 - 2,3,3'-Trichlorobiphenyl (BZ-20)	EPA 1668A	10129405	NELAP	LA
9227 - 2,3,4',5,6-Pentachlorobiphenyl (BZ-117)	EPA 1668A	10129405	NELAP	LA
9233 - 2,3,4',5-Tetrachlorobiphenyl (BZ-63)	EPA 1668A	10129405	NELAP	LA
9236 - 2,3,4',6-Tetrachlorobiphenyl (BZ-63)	EPA 1668A	10129405	NELAP	LA

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64)				
9241 - 2,3,4'-Trichlorobiphenyl (BZ-22)	EPA 1668A	10129405	NELAP	LA
9217 - 2,3,4,4',5,6-Hexachlorobiphenyl (BZ-166)	EPA 1668A	10129405	NELAP	LA
9005 - 2,3,4,4',5-Pentachlorobiphenyl (BZ-114)	EPA 1668A	10129405	NELAP	LA
9219 - 2,3,4,4',6-Pentachlorobiphenyl (BZ-115)	EPA 1668A	10129405	NELAP	LA
9221 - 2,3,4,4'-Tetrachlorobiphenyl (BZ-60)	EPA 1668A	10129405	NELAP	LA
9225 - 2,3,4,5,6-Pentachlorobiphenyl (BZ-116)	EPA 1668A	10129405	NELAP	LA
9228 - 2,3,4,5-Tetrachlorobiphenyl (BZ-61)	EPA 1668A	10129405	NELAP	LA
9234 - 2,3,4,6-Tetrachlorobiphenyl (BZ-62)	EPA 1668A	10129405	NELAP	LA
9238 - 2,3,4-Trichlorobiphenyl (BZ-21)	EPA 1668A	10129405	NELAP	LA
9243 - 2,3,5,6-Tetrachlorobiphenyl (BZ-65)	EPA 1668A	10129405	NELAP	LA
9245 - 2,3,5-Trichlorobiphenyl (BZ-23)	EPA 1668A	10129405	NELAP	LA
9247 - 2,3,6-Trichlorobiphenyl (BZ-24)	EPA 1668A	10129405	NELAP	LA
8920 - 2,3-Dichlorobiphenyl (BZ-5)	EPA 1668A	10129405	NELAP	LA
8940 - 2,4',5-Trichlorobiphenyl (BZ-31)	EPA 1668A	10129405	NELAP	LA
9255 - 2,4',6-Trichlorobiphenyl (BZ-32)	EPA 1668A	10129405	NELAP	LA
9256 - 2,4'-Dichlorobiphenyl (BZ-8)	EPA 1668A	10129405	NELAP	LA
9250 - 2,4,4',5-Tetrachlorobiphenyl (BZ-74)	EPA 1668A	10129405	NELAP	LA
9251 - 2,4,4',6-Tetrachlorobiphenyl (BZ-75)	EPA 1668A	10129405	NELAP	LA
9252 - 2,4,4'-Trichlorobiphenyl (BZ-28)	EPA 1668A	10129405	NELAP	LA
9253 - 2,4,5-Trichlorobiphenyl (BZ-29)	EPA 1668A	10129405	NELAP	LA
9254 - 2,4,6-Trichlorobiphenyl (BZ-30)	EPA 1668A	10129405	NELAP	LA
9257 - 2,4-Dichlorobiphenyl (BZ-7)	EPA 1668A	10129405	NELAP	LA
9258 - 2,5-Dichlorobiphenyl (BZ-9)	EPA 1668A	10129405	NELAP	LA
9259 - 2,6-Dichlorobiphenyl (BZ-10)	EPA 1668A	10129405	NELAP	LA
8915 - 2-Chlorobiphenyl (BZ-1)	EPA 1668A	10129405	NELAP	LA
9060 - 3,3',4,4',5,5'-Hexachlorobiphenyl (BZ-169)	EPA 1668A	10129405	NELAP	LA
9015 - 3,3',4,4',5-Pentachlorobiphenyl (BZ-126)	EPA 1668A	10129405	NELAP	LA
8965 - 3,3',4,4'-Tetrachlorobiphenyl (BZ-77)	EPA 1668A	10129405	NELAP	LA
9261 - 3,3',4,5'-Tetrachlorobiphenyl (BZ-79)	EPA 1668A	10129405	NELAP	LA
9260 - 3,3',4,5,5'-Pentachlorobiphenyl (BZ-127)	EPA 1668A	10129405	NELAP	LA
9262 - 3,3',4,5-Tetrachlorobiphenyl (BZ-78)	EPA 1668A	10129405	NELAP	LA
9263 - 3,3',4-Trichlorobiphenyl (BZ-35)	EPA 1668A	10129405	NELAP	LA
9264 - 3,3',5,5'-Tetrachlorobiphenyl (BZ-80)	EPA 1668A	10129405	NELAP	LA
9265 - 3,3',5-Trichlorobiphenyl (BZ-36)	EPA 1668A	10129405	NELAP	LA
8925 - 3,3'-Dichlorobiphenyl (BZ-11)	EPA 1668A	10129405	NELAP	LA
9268 - 3,4',5-Trichlorobiphenyl (BZ-39)	EPA 1668A	10129405	NELAP	LA
9269 - 3,4'-Dichlorobiphenyl (BZ-13)	EPA 1668A	10129405	NELAP	LA

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8970 - 3,4,4',5-Tetrachlorobiphenyl (BZ-81)	EPA 1668A	10129405	NELAP	LA
9266 - 3,4,4'-Trichlorobiphenyl (BZ-37)	EPA 1668A	10129405	NELAP	LA
9267 - 3,4,5-Trichlorobiphenyl (BZ-38)	EPA 1668A	10129405	NELAP	LA
9270 - 3,4-Dichlorobiphenyl (BZ-12)	EPA 1668A	10129405	NELAP	LA
9271 - 3,5-Dichlorobiphenyl (BZ-14)	EPA 1668A	10129405	NELAP	LA
9272 - 3-Chlorobiphenyl (BZ-2)	EPA 1668A	10129405	NELAP	LA
9273 - 4,4'-Dichlorobiphenyl (BZ-15)	EPA 1668A	10129405	NELAP	LA
9274 - 4-Chlorobiphenyl (BZ-3)	EPA 1668A	10129405	NELAP	LA
9519 - 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 8290	10187209	NELAP	LA
9516 - 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 8290	10187209	NELAP	LA
9426 - 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	EPA 8290	10187209	NELAP	LA
9420 - 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA 8290	10187209	NELAP	LA
9423 - 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA 8290	10187209	NELAP	LA
9453 - 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)	EPA 8290	10187209	NELAP	LA
9471 - 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)	EPA 8290	10187209	NELAP	LA
9456 - 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,6,7,8-Hxcdd)	EPA 8290	10187209	NELAP	LA
9474 - 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)	EPA 8290	10187209	NELAP	LA
9459 - 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)	EPA 8290	10187209	NELAP	LA
9477 - 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)	EPA 8290	10187209	NELAP	LA
9540 - 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)	EPA 8290	10187209	NELAP	LA
9543 - 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)	EPA 8290	10187209	NELAP	LA
9480 - 2,3,4,6,7,8-Hexachlorodibenzofuran	EPA 8290	10187209	NELAP	LA
9549 - 2,3,4,7,8-Pentachlorodibenzofuran	EPA 8290	10187209	NELAP	LA
9618 - 2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)	EPA 8290	10187209	NELAP	LA
9612 - 2,3,7,8-Tetrachlorodibenzofuran	EPA 8290	10187209	NELAP	LA
9438 - Total Hpcdd	EPA 8290	10187209	NELAP	LA
9444 - Total Hpcdf	EPA 8290	10187209	NELAP	LA
9468 - Total Hxcdd	EPA 8290	10187209	NELAP	LA
9483 - Total Hxcdf	EPA 8290	10187209	NELAP	LA
9555 - Total Pecdd	EPA 8290	10187209	NELAP	LA
9552 - Total Pecdf	EPA 8290	10187209	NELAP	LA
9609 - Total TCDD	EPA 8290	10187209	NELAP	LA
9615 - Total TCDF	EPA 8290	10187209	NELAP	LA
9519 - 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9516 - 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 8290A, Rev.2007	10187403	NELAP	LA
9426 - 1,2,3,4,6,7,8-Heptachlorodibenzo-p-	EPA 8290A, Rev.2007	10187403	NELAP	LA

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dioxin (1,2,3,4,6,7,8-hpcdd)				
9420 -	1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA 8290A, Rev.2007	10187403	NELAP LA
9423 -	1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA 8290A, Rev.2007	10187403	NELAP LA
9453 -	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)	EPA 8290A, Rev.2007	10187403	NELAP LA
9471 -	1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)	EPA 8290A, Rev.2007	10187403	NELAP LA
9456 -	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)	EPA 8290A, Rev.2007	10187403	NELAP LA
9474 -	1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)	EPA 8290A, Rev.2007	10187403	NELAP LA
9459 -	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)	EPA 8290A, Rev.2007	10187403	NELAP LA
9477 -	1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)	EPA 8290A, Rev.2007	10187403	NELAP LA
9540 -	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)	EPA 8290A, Rev.2007	10187403	NELAP LA
9543 -	1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)	EPA 8290A, Rev.2007	10187403	NELAP LA
9480 -	2,3,4,6,7,8-Hexachlorodibenzofuran	EPA 8290A, Rev.2007	10187403	NELAP LA
9549 -	2,3,4,7,8-Pentachlorodibenzofuran	EPA 8290A, Rev.2007	10187403	NELAP LA
9618 -	2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD)	EPA 8290A, Rev.2007	10187403	NELAP LA
9612 -	2,3,7,8-Tetrachlorodibenzofuran	EPA 8290A, Rev.2007	10187403	NELAP LA
9438 -	Total Hpcdd	EPA 8290A, Rev.2007	10187403	NELAP LA
9444 -	Total Hpcdf	EPA 8290A, Rev.2007	10187403	NELAP LA
9468 -	Total Hxcdd	EPA 8290A, Rev.2007	10187403	NELAP LA
9483 -	Total Hxcdf	EPA 8290A, Rev.2007	10187403	NELAP LA
9555 -	Total Pecdd	EPA 8290A, Rev.2007	10187403	NELAP LA
9552 -	Total Pecdf	EPA 8290A, Rev.2007	10187403	NELAP LA
9609 -	Total TCDD	EPA 8290A, Rev.2007	10187403	NELAP LA
9615 -	Total TCDF	EPA 8290A, Rev.2007	10187403	NELAP LA
9105 -	2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl (BZ-209)	EPA 1668C	10262109	NELAP LA
9095 -	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ-206)	EPA 1668C	10262109	NELAP LA
9090 -	2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194)	EPA 1668C	10262109	NELAP LA
9102 -	2,2',3,3',4,4',5,6'-Octachlorobiphenyl (BZ-196)	EPA 1668C	10262109	NELAP LA
9101 -	2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (BZ-207)	EPA 1668C	10262109	NELAP LA
9103 -	2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195)	EPA 1668C	10262109	NELAP LA
9065 -	2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170)	EPA 1668C	10262109	NELAP LA
9104 -	2,2',3,3',4,4',6,6'-Octachlorobiphenyl (BZ-197)	EPA 1668C	10262109	NELAP LA
9106 -	2,2',3,3',4,4',6-Heptachlorobiphenyl (BZ-171)	EPA 1668C	10262109	NELAP LA
9020 -	2,2',3,3',4,4'-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP LA

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(BZ-128) 9114 - 2,2',3,3',4,5',6'-Heptachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-177) 9112 - 2,2',3,3',4,5',6,6'-Octachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-201) 9115 - 2,2',3,3',4,5',6-Heptachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-175) 9117 - 2,2',3,3',4,5'-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-130) 9108 - 2,2',3,3',4,5,5',6'-Octachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-199) 9107 - 2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl (BZ-208)	EPA 1668C	10262109	NELAP	LA
9109 - 2,2',3,3',4,5,5',6-Octachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-198) 9110 - 2,2',3,3',4,5,5'-Heptachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-172) 9116 - 2,2',3,3',4,5,6'-Heptachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-174) 9111 - 2,2',3,3',4,5,6,6'-Octachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-200) 9113 - 2,2',3,3',4,5,6-Heptachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-173) 9118 - 2,2',3,3',4,5-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-129) 9120 - 2,2',3,3',4,6'-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-132) 9119 - 2,2',3,3',4,6,6'-Heptachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-176) 9121 - 2,2',3,3',4,6-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-131) 9122 - 2,2',3,3',4-Pentachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-82) 9123 - 2,2',3,3',5,5',6,6'-Octachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-202) 9124 - 2,2',3,3',5,5',6-Heptachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-178) 9125 - 2,2',3,3',5,5'-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-133) 9127 - 2,2',3,3',5,6'-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-135) 9126 - 2,2',3,3',5,6,6'-Heptachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-179) 9128 - 2,2',3,3',5,6-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-134) 9129 - 2,2',3,3',5-Pentachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-83) 9130 - 2,2',3,3',6,6'-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-136) 9131 - 2,2',3,3',6-Pentachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-84) 9132 - 2,2',3,3'-Tetrachlorobiphenyl (BZ-40)	EPA 1668C	10262109	NELAP	LA
9151 - 2,2',3,4',5',6-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-149)				

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Analyte	Method Name	Method Code	Type	AB
9154 - 2,2',3,4',5'-Pentachlorobiphenyl (BZ-97)	EPA 1668C	10262109	NELAP	LA
9080 - 2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ-187)	EPA 1668C	10262109	NELAP	LA
9144 - 2,2',3,4',5,5'-Hexachlorobiphenyl (BZ-146)	EPA 1668C	10262109	NELAP	LA
9147 - 2,2',3,4',5,6'-Hexachlorobiphenyl (BZ-148)	EPA 1668C	10262109	NELAP	LA
9146 - 2,2',3,4',5,6,6'-Heptachlorobiphenyl (BZ-188)	EPA 1668C	10262109	NELAP	LA
9149 - 2,2',3,4',5,6-Hexachlorobiphenyl (BZ-147)	EPA 1668C	10262109	NELAP	LA
9155 - 2,2',3,4',5-Pentachlorobiphenyl (BZ-90)	EPA 1668C	10262109	NELAP	LA
9159 - 2,2',3,4',6'-Pentachlorobiphenyl (BZ-98)	EPA 1668C	10262109	NELAP	LA
9157 - 2,2',3,4',6,6'-Hexachlorobiphenyl (BZ-150)	EPA 1668C	10262109	NELAP	LA
9160 - 2,2',3,4',6-Pentachlorobiphenyl (BZ-91)	EPA 1668C	10262109	NELAP	LA
9162 - 2,2',3,4'-Tetrachlorobiphenyl (BZ-42)	EPA 1668C	10262109	NELAP	LA
9075 - 2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ-183)	EPA 1668C	10262109	NELAP	LA
9025 - 2,2',3,4,4',5'-Hexachlorobiphenyl (BZ-138)	EPA 1668C	10262109	NELAP	LA
9133 - 2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ-203)	EPA 1668C	10262109	NELAP	LA
9134 - 2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ-180)	EPA 1668C	10262109	NELAP	LA
9136 - 2,2',3,4,4',5,6'-Heptachlorobiphenyl (BZ-182)	EPA 1668C	10262109	NELAP	LA
9135 - 2,2',3,4,4',5,6,6'-Octachlorobiphenyl (BZ-204)	EPA 1668C	10262109	NELAP	LA
9137 - 2,2',3,4,4',5,6-Heptachlorobiphenyl (BZ-181)	EPA 1668C	10262109	NELAP	LA
9138 - 2,2',3,4,4',5-Hexachlorobiphenyl (BZ-137)	EPA 1668C	10262109	NELAP	LA
9140 - 2,2',3,4,4',6'-Hexachlorobiphenyl (BZ-140)	EPA 1668C	10262109	NELAP	LA
9139 - 2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ-184)	EPA 1668C	10262109	NELAP	LA
9141 - 2,2',3,4,4',6-Hexachlorobiphenyl (BZ-139)	EPA 1668C	10262109	NELAP	LA
9142 - 2,2',3,4,4'-Pentachlorobiphenyl (BZ-85)	EPA 1668C	10262109	NELAP	LA
9150 - 2,2',3,4,5',6-Hexachlorobiphenyl (BZ-144)	EPA 1668C	10262109	NELAP	LA
8975 - 2,2',3,4,5'-Pentachlorobiphenyl (BZ-87)	EPA 1668C	10262109	NELAP	LA
9143 - 2,2',3,4,5,5',6-Heptachlorobiphenyl (BZ-185)	EPA 1668C	10262109	NELAP	LA
9030 - 2,2',3,4,5,5'-Hexachlorobiphenyl (BZ-141)	EPA 1668C	10262109	NELAP	LA
9152 - 2,2',3,4,5,6'-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA

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(BZ-143) 9145 - 2,2',3,4,5,6,6'-Heptachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-186) 9148 - 2,2',3,4,5,6-Hexachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-142) 9153 - 2,2',3,4,5-Pentachlorobiphenyl (BZ-86)	EPA 1668C	10262109	NELAP	LA
9161 - 2,2',3,4,6'-Pentachlorobiphenyl (BZ-89)	EPA 1668C	10262109	NELAP	LA
9156 - 2,2',3,4,6,6'-Hexachlorobiphenyl (BZ-145)	EPA 1668C	10262109	NELAP	LA
9158 - 2,2',3,4,6-Pentachlorobiphenyl (BZ-88)	EPA 1668C	10262109	NELAP	LA
9163 - 2,2',3,4-Tetrachlorobiphenyl (BZ-41)	EPA 1668C	10262109	NELAP	LA
9166 - 2,2',3,5',6-Pentachlorobiphenyl (BZ-95)	EPA 1668C	10262109	NELAP	LA
8945 - 2,2',3,5'-Tetrachlorobiphenyl (BZ-44)	EPA 1668C	10262109	NELAP	LA
9035 - 2,2',3,5,5',6-Hexachlorobiphenyl (BZ-151)	EPA 1668C	10262109	NELAP	LA
9164 - 2,2',3,5,5'-Pentachlorobiphenyl (BZ-92)	EPA 1668C	10262109	NELAP	LA
9167 - 2,2',3,5,6'-Pentachlorobiphenyl (BZ-94)	EPA 1668C	10262109	NELAP	LA
9165 - 2,2',3,5,6,6'-Hexachlorobiphenyl (BZ-152)	EPA 1668C	10262109	NELAP	LA
9168 - 2,2',3,5,6-Pentachlorobiphenyl (BZ-93)	EPA 1668C	10262109	NELAP	LA
9169 - 2,2',3,5-Tetrachlorobiphenyl (BZ-43)	EPA 1668C	10262109	NELAP	LA
9171 - 2,2',3,6'-Tetrachlorobiphenyl (BZ-46)	EPA 1668C	10262109	NELAP	LA
9170 - 2,2',3,6,6'-Pentachlorobiphenyl (BZ-96)	EPA 1668C	10262109	NELAP	LA
9172 - 2,2',3,6-Tetrachlorobiphenyl (BZ-45)	EPA 1668C	10262109	NELAP	LA
9173 - 2,2',3-Trichlorobiphenyl (BZ-16)	EPA 1668C	10262109	NELAP	LA
9040 - 2,2',4,4',5,5'-Hexachlorobiphenyl (BZ-153)	EPA 1668C	10262109	NELAP	LA
9174 - 2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-154)	EPA 1668C	10262109	NELAP	LA
9175 - 2,2',4,4',5-Pentachlorobiphenyl (BZ-99)	EPA 1668C	10262109	NELAP	LA
9176 - 2,2',4,4',6,6'-Hexachlorobiphenyl (BZ-155)	EPA 1668C	10262109	NELAP	LA
9177 - 2,2',4,4',6-Pentachlorobiphenyl (BZ-100)	EPA 1668C	10262109	NELAP	LA
9178 - 2,2',4,4'-Tetrachlorobiphenyl (BZ-47)	EPA 1668C	10262109	NELAP	LA
9179 - 2,2',4,5',6-Pentachlorobiphenyl (BZ-103)	EPA 1668C	10262109	NELAP	LA
8950 - 2,2',4,5'-Tetrachlorobiphenyl (BZ-49)	EPA 1668C	10262109	NELAP	LA
8980 - 2,2',4,5,5'-Pentachlorobiphenyl	EPA 1668C	10262109	NELAP	LA

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(BZ-101) 9180 - 2,2',4,5,6'-Pentachlorobiphenyl	EPA 1668C	10262109	NELAP	LA
(BZ-102) 9181 - 2,2',4,5-Tetrachlorobiphenyl (BZ-48)	EPA 1668C	10262109	NELAP	LA
9183 - 2,2',4,6'-Tetrachlorobiphenyl (BZ-51)	EPA 1668C	10262109	NELAP	LA
9182 - 2,2',4,6,6'-Pentachlorobiphenyl (BZ-104)	EPA 1668C	10262109	NELAP	LA
9184 - 2,2',4,6-Tetrachlorobiphenyl (BZ-50)	EPA 1668C	10262109	NELAP	LA
9185 - 2,2',4-Trichlorobiphenyl (BZ-17)	EPA 1668C	10262109	NELAP	LA
8955 - 2,2',5,5'-Tetrachlorobiphenyl (BZ-52)	EPA 1668C	10262109	NELAP	LA
9186 - 2,2',5,6'-Tetrachlorobiphenyl (BZ-53)	EPA 1668C	10262109	NELAP	LA
8930 - 2,2',5-Trichlorobiphenyl (BZ-18)	EPA 1668C	10262109	NELAP	LA
9187 - 2,2',6,6'-Tetrachlorobiphenyl (BZ-54)	EPA 1668C	10262109	NELAP	LA
9188 - 2,2',6-Trichlorobiphenyl (BZ-19)	EPA 1668C	10262109	NELAP	LA
9189 - 2,2'-Dichlorobiphenyl (BZ-4)	EPA 1668C	10262109	NELAP	LA
9224 - 2,3',4',5',6'-Pentachlorobiphenyl (BZ-125)	EPA 1668C	10262109	NELAP	LA
9229 - 2,3',4',5'-Tetrachlorobiphenyl (BZ-76)	EPA 1668C	10262109	NELAP	LA
9222 - 2,3',4',5,5'-Pentachlorobiphenyl (BZ-124)	EPA 1668C	10262109	NELAP	LA
9230 - 2,3',4',5-Tetrachlorobiphenyl (BZ-70)	EPA 1668C	10262109	NELAP	LA
9237 - 2,3',4',6-Tetrachlorobiphenyl (BZ-71)	EPA 1668C	10262109	NELAP	LA
9239 - 2,3',4'-Trichlorobiphenyl (BZ-33)	EPA 1668C	10262109	NELAP	LA
9218 - 2,3',4,4',5',6-Hexachlorobiphenyl (BZ-168)	EPA 1668C	10262109	NELAP	LA
9011 - 2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)	EPA 1668C	10262109	NELAP	LA
9055 - 2,3',4,4',5,5'-Hexachlorobiphenyl (BZ-167)	EPA 1668C	10262109	NELAP	LA
8995 - 2,3',4,4',5-Pentachlorobiphenyl (BZ-118)	EPA 1668C	10262109	NELAP	LA
9220 - 2,3',4,4',6-Pentachlorobiphenyl (BZ-119)	EPA 1668C	10262109	NELAP	LA
8960 - 2,3',4,4'-Tetrachlorobiphenyl (BZ-66)	EPA 1668C	10262109	NELAP	LA
9226 - 2,3',4,5',6-Pentachlorobiphenyl (BZ-121)	EPA 1668C	10262109	NELAP	LA
9231 - 2,3',4,5'-Tetrachlorobiphenyl (BZ-68)	EPA 1668C	10262109	NELAP	LA
9223 - 2,3',4,5,5'-Pentachlorobiphenyl (BZ-120)	EPA 1668C	10262109	NELAP	LA
9232 - 2,3',4,5-Tetrachlorobiphenyl (BZ-67)	EPA 1668C	10262109	NELAP	LA
9235 - 2,3',4,6-Tetrachlorobiphenyl (BZ-69)	EPA 1668C	10262109	NELAP	LA
9240 - 2,3',4-Trichlorobiphenyl (BZ-25)	EPA 1668C	10262109	NELAP	LA

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9244 - 2,3',5',6-Tetrachlorobiphenyl (BZ-73)	EPA 1668C	10262109	NELAP	LA
9246 - 2,3',5'-Trichlorobiphenyl (BZ-34)	EPA 1668C	10262109	NELAP	LA
9242 - 2,3',5,5'-Tetrachlorobiphenyl (BZ-72)	EPA 1668C	10262109	NELAP	LA
8935 - 2,3',5-Trichlorobiphenyl (BZ-26)	EPA 1668C	10262109	NELAP	LA
9248 - 2,3',6-Trichlorobiphenyl (BZ-27)	EPA 1668C	10262109	NELAP	LA
9249 - 2,3'-Dichlorobiphenyl (BZ-6)	EPA 1668C	10262109	NELAP	LA
9201 - 2,3,3',4',5',6-Hexachlorobiphenyl (BZ-164)	EPA 1668C	10262109	NELAP	LA
9202 - 2,3,3',4',5'-Pentachlorobiphenyl (BZ-122)	EPA 1668C	10262109	NELAP	LA
9195 - 2,3,3',4',5,5',6-Heptachlorobiphenyl (BZ-193)	EPA 1668C	10262109	NELAP	LA
9197 - 2,3,3',4',5,5'-Hexachlorobiphenyl (BZ-162)	EPA 1668C	10262109	NELAP	LA
9199 - 2,3,3',4',5,6-Hexachlorobiphenyl (BZ-163)	EPA 1668C	10262109	NELAP	LA
9205 - 2,3,3',4',5-Pentachlorobiphenyl (BZ-107)	EPA 1668C	10262109	NELAP	LA
8990 - 2,3,3',4',6-Pentachlorobiphenyl (BZ-110)	EPA 1668C	10262109	NELAP	LA
9207 - 2,3,3',4'-Tetrachlorobiphenyl (BZ-56)	EPA 1668C	10262109	NELAP	LA
9192 - 2,3,3',4,4',5',6-Heptachlorobiphenyl (BZ-191)	EPA 1668C	10262109	NELAP	LA
9045 - 2,3,3',4,4',5'-Hexachlorobiphenyl (BZ-157)	EPA 1668C	10262109	NELAP	LA
9190 - 2,3,3',4,4',5,5',6-Octachlorobiphenyl (BZ-205)	EPA 1668C	10262109	NELAP	LA
9085 - 2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ-189)	EPA 1668C	10262109	NELAP	LA
9191 - 2,3,3',4,4',5,6-Heptachlorobiphenyl (BZ-190)	EPA 1668C	10262109	NELAP	LA
9050 - 2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)	EPA 1668C	10262109	NELAP	LA
9193 - 2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158)	EPA 1668C	10262109	NELAP	LA
8985 - 2,3,3',4,4'-Pentachlorobiphenyl (BZ-105)	EPA 1668C	10262109	NELAP	LA
9200 - 2,3,3',4,5',6-Hexachlorobiphenyl (BZ-161)	EPA 1668C	10262109	NELAP	LA
9203 - 2,3,3',4,5'-Pentachlorobiphenyl (BZ-108)	EPA 1668C	10262109	NELAP	LA
9194 - 2,3,3',4,5,5',6-Heptachlorobiphenyl (BZ-192)	EPA 1668C	10262109	NELAP	LA
9196 - 2,3,3',4,5,5'-Hexachlorobiphenyl (BZ-159)	EPA 1668C	10262109	NELAP	LA
9198 - 2,3,3',4,5,6-Hexachlorobiphenyl (BZ-160)	EPA 1668C	10262109	NELAP	LA
9204 - 2,3,3',4,5-Pentachlorobiphenyl (BZ-106)	EPA 1668C	10262109	NELAP	LA
9206 - 2,3,3',4,6-Pentachlorobiphenyl (BZ-109)	EPA 1668C	10262109	NELAP	LA
9208 - 2,3,3',4-Tetrachlorobiphenyl (BZ-	EPA 1668C	10262109	NELAP	LA

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55)				
9212 - 2,3,3',5',6-Pentachlorobiphenyl (BZ-113)	EPA 1668C	10262109	NELAP	LA
9213 - 2,3,3',5'-Tetrachlorobiphenyl (BZ-58)	EPA 1668C	10262109	NELAP	LA
9209 - 2,3,3',5,5',6-Hexachlorobiphenyl (BZ-165)	EPA 1668C	10262109	NELAP	LA
9210 - 2,3,3',5,5'-Pentachlorobiphenyl (BZ-111)	EPA 1668C	10262109	NELAP	LA
9211 - 2,3,3',5,6-Pentachlorobiphenyl (BZ-112)	EPA 1668C	10262109	NELAP	LA
9214 - 2,3,3',5-Tetrachlorobiphenyl (BZ-57)	EPA 1668C	10262109	NELAP	LA
9215 - 2,3,3',6-Tetrachlorobiphenyl (BZ-59)	EPA 1668C	10262109	NELAP	LA
9216 - 2,3,3'-Trichlorobiphenyl (BZ-20)	EPA 1668C	10262109	NELAP	LA
9227 - 2,3,4',5,6-Pentachlorobiphenyl (BZ-117)	EPA 1668C	10262109	NELAP	LA
9233 - 2,3,4',5-Tetrachlorobiphenyl (BZ-63)	EPA 1668C	10262109	NELAP	LA
9236 - 2,3,4',6-Tetrachlorobiphenyl (BZ-64)	EPA 1668C	10262109	NELAP	LA
9241 - 2,3,4'-Trichlorobiphenyl (BZ-22)	EPA 1668C	10262109	NELAP	LA
9217 - 2,3,4,4',5,6-Hexachlorobiphenyl (BZ-166)	EPA 1668C	10262109	NELAP	LA
9005 - 2,3,4,4',5-Pentachlorobiphenyl (BZ-114)	EPA 1668C	10262109	NELAP	LA
9219 - 2,3,4,4',6-Pentachlorobiphenyl (BZ-115)	EPA 1668C	10262109	NELAP	LA
9221 - 2,3,4,4'-Tetrachlorobiphenyl (BZ-60)	EPA 1668C	10262109	NELAP	LA
9225 - 2,3,4,5,6-Pentachlorobiphenyl (BZ-116)	EPA 1668C	10262109	NELAP	LA
9228 - 2,3,4,5-Tetrachlorobiphenyl (BZ-61)	EPA 1668C	10262109	NELAP	LA
9234 - 2,3,4,6-Tetrachlorobiphenyl (BZ-62)	EPA 1668C	10262109	NELAP	LA
9238 - 2,3,4-Trichlorobiphenyl (BZ-21)	EPA 1668C	10262109	NELAP	LA
9243 - 2,3,5,6-Tetrachlorobiphenyl (BZ-65)	EPA 1668C	10262109	NELAP	LA
9245 - 2,3,5-Trichlorobiphenyl (BZ-23)	EPA 1668C	10262109	NELAP	LA
9247 - 2,3,6-Trichlorobiphenyl (BZ-24)	EPA 1668C	10262109	NELAP	LA
8920 - 2,3-Dichlorobiphenyl (BZ-5)	EPA 1668C	10262109	NELAP	LA
8940 - 2,4',5-Trichlorobiphenyl (BZ-31)	EPA 1668C	10262109	NELAP	LA
9255 - 2,4',6-Trichlorobiphenyl (BZ-32)	EPA 1668C	10262109	NELAP	LA
9256 - 2,4'-Dichlorobiphenyl (BZ-8)	EPA 1668C	10262109	NELAP	LA
9250 - 2,4,4',5-Tetrachlorobiphenyl (BZ-74)	EPA 1668C	10262109	NELAP	LA
9251 - 2,4,4',6-Tetrachlorobiphenyl (BZ-75)	EPA 1668C	10262109	NELAP	LA
9252 - 2,4,4'-Trichlorobiphenyl (BZ-28)	EPA 1668C	10262109	NELAP	LA
9253 - 2,4,5-Trichlorobiphenyl (BZ-29)	EPA 1668C	10262109	NELAP	LA
9254 - 2,4,6-Trichlorobiphenyl (BZ-30)	EPA 1668C	10262109	NELAP	LA
9257 - 2,4-Dichlorobiphenyl (BZ-7)	EPA 1668C	10262109	NELAP	LA
9258 - 2,5-Dichlorobiphenyl (BZ-9)	EPA 1668C	10262109	NELAP	LA

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Certificate Number: 05064

AI Number: 199920  
Activity No. ACC20210001  
Expiration Date: June 30, 2022

Clients and Customers are urged to verify the laboratory's current certification status with the Louisiana Environmental Laboratory Accreditation Program.

## Biological Tissue

Analyte	Method Name	Method Code	Type	AB
9259 - 2,6-Dichlorobiphenyl (BZ-10)	EPA 1668C	10262109	NELAP	LA
8915 - 2-Chlorobiphenyl (BZ-1)	EPA 1668C	10262109	NELAP	LA
9060 - 3,3',4,4',5,5'-Hexachlorobiphenyl (BZ-169)	EPA 1668C	10262109	NELAP	LA
9015 - 3,3',4,4',5-Pentachlorobiphenyl (BZ-126)	EPA 1668C	10262109	NELAP	LA
8965 - 3,3',4,4'-Tetrachlorobiphenyl (BZ-77)	EPA 1668C	10262109	NELAP	LA
9261 - 3,3',4,5'-Tetrachlorobiphenyl (BZ-79)	EPA 1668C	10262109	NELAP	LA
9260 - 3,3',4,5,5'-Pentachlorobiphenyl (BZ-127)	EPA 1668C	10262109	NELAP	LA
9262 - 3,3',4,5-Tetrachlorobiphenyl (BZ-78)	EPA 1668C	10262109	NELAP	LA
9263 - 3,3',4-Trichlorobiphenyl (BZ-35)	EPA 1668C	10262109	NELAP	LA
9264 - 3,3',5,5'-Tetrachlorobiphenyl (BZ-80)	EPA 1668C	10262109	NELAP	LA
9265 - 3,3',5-Trichlorobiphenyl (BZ-36)	EPA 1668C	10262109	NELAP	LA
8925 - 3,3'-Dichlorobiphenyl (BZ-11)	EPA 1668C	10262109	NELAP	LA
9268 - 3,4',5-Trichlorobiphenyl (BZ-39)	EPA 1668C	10262109	NELAP	LA
9269 - 3,4'-Dichlorobiphenyl (BZ-13)	EPA 1668C	10262109	NELAP	LA
8970 - 3,4,4',5-Tetrachlorobiphenyl (BZ-81)	EPA 1668C	10262109	NELAP	LA
9266 - 3,4,4'-Trichlorobiphenyl (BZ-37)	EPA 1668C	10262109	NELAP	LA
9267 - 3,4,5-Trichlorobiphenyl (BZ-38)	EPA 1668C	10262109	NELAP	LA
9270 - 3,4-Dichlorobiphenyl (BZ-12)	EPA 1668C	10262109	NELAP	LA
9271 - 3,5-Dichlorobiphenyl (BZ-14)	EPA 1668C	10262109	NELAP	LA
9272 - 3-Chlorobiphenyl (BZ-2)	EPA 1668C	10262109	NELAP	LA
9273 - 4,4'-Dichlorobiphenyl (BZ-15)	EPA 1668C	10262109	NELAP	LA
9274 - 4-Chlorobiphenyl (BZ-3)	EPA 1668C	10262109	NELAP	LA



ALS Canada Environmental  
Life Sciences Division  
National Quality Manual

**National Authorizations**

Authorized By:	<u>David Gurdibaniuk</u> National Quality Manager, Canada	Date:	<u>May 3, 2021</u>
Authorized By:	<u>Mark Hugdahl</u> Technical Director, Canada	Date:	<u>May 3, 2021</u>

**Local Authorization**

\_\_\_\_\_  
Laboratory Location

Authorized By: \_\_\_\_\_ Effective Date: \_\_\_\_\_  
Laboratory Manager



# OREGON

## Environmental Laboratory Accreditation Program

### ORELAP Fields of Accreditation



#### ALS Environmental, Kelso

1317 South 13th Ave.  
Kelso, WA 98626

ORELAP ID: WA100010

EPA CODE: WA01276

Certificate: WA100010 - 023

Issue Date: 2/11/2021 Expiration Date: 2/10/2022

As of 2/11/2021 this list supersedes all previous lists for this certificate number.

Matrix Reference	Analyte Code	Analyte	Method Code	Description
<b>Biological Tissue</b>				
ALS Kelso LCP-PFC 10 10	60001516			ALS Kelso - Perfluorinated Compounds by HPLC-MS-MS (Columbia Analytical Services)
	6918	Perfluorobutane sulfonic acid (PFBS)		
	9562	Perfluorodecane Sulfonate (PFDS)		
	6920	Perfluorodecane sulfonic acid (PFDS)		
	6905	Perfluorodecanoic acid (PFDA)		
	6905	Perfluorodecanoic acid (PFDA)		
	6903	Perfluorododecanoic acid (PFDoA)		
	6903	Perfluorododecanoic acid (PFDoA)		
	6908	Perfluoroheptanoic acid (PFHpA)		
	6908	Perfluoroheptanoic acid (PFHpA)		
	6927	Perfluorohexane sulfonic acid (PFHxS)		
	6913	Perfluorohexanoic acid (PFHxA)		
	6913	Perfluorohexanoic acid (PFHxA)		
	6906	Perfluorononanoic acid (PFNA)		
	6906	Perfluorononanoic acid (PFNA)		
	6931	Perfluorooctane sulfonic acid (PFOS)		
	6931	Perfluorooctane sulfonic acid (PFOS)		
	6912	Perfluorooctanoic acid (PFOA)		
	6912	Perfluorooctanoic acid (PFOA)		
	6914	Perfluoropentanoic acid (PFPeA)		
	6914	Perfluoropentanoic acid (PFPeA)		
	6904	Perfluoroundecanoic acid (PFUnA)		
	6904	Perfluoroundecanoic acid (PFUnA)		
ALS Kelso LCP-PFC 11 11	60001527			ALS Kelso - Perfluorinated Compounds by HPLC-MS-MS (Columbia Analytical Services)
	6918	Perfluorobutane sulfonic acid (PFBS)		
	6920	Perfluorodecane sulfonic acid (PFDS)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	6905	Perfluorodecanoic acid (PFDA)		
	6903	Perfluorododecanoic acid (PFDoA)		
	6908	Perfluoroheptanoic acid (PFHpA)		
	6927	Perfluorohexane sulfonic acid (PFHxS)		
	6913	Perfluorohexanoic acid (PFHxA)		
	6912	Perfluorooctanoic acid (PFOA)		
	6914	Perfluoropentanoic acid (PFPeA)		
	6904	Perfluoroundecanoic acid (PFUnA)		
CAS SOC-Butyl 10 10			60035009	Butyltin by GC/Flame Photometric Detector
	1201	Butyltin trichloride		
	1202	Dibutyltin dichloride		
	1209	Tetrabutyltin		
	1203	Tributyltin chloride		
EPA 1630			10122608	Methyl Mercury by Purge & Trap Cold Vapor Atomic Fluorescence Spectrometry
	1205	Methyl Mercury		
EPA 1631E			10237204	Mercury in Water by Oxidation, Purge & Trap, and Cold Vapor Atomic Fluorescence
	1095	Mercury		
EPA 1632A EPA 1632A EPA 1632A			10123407	Chemical Speciation of Arsenic in Water and Tissue by Hydride Generation Quartz Furnace Atomic Absorption Spectrometry
	1010	Arsenic		
	1012	Arsenite (As+3)		
EPA 3540C			10140202	Soxhlet Extraction
	8031	Extraction/Preparation		
EPA 3541			10140406	Automated Soxhlet Extraction
	8031	Extraction/Preparation		
EPA 3630C			10146802	Silica gel cleanup
	8031	Extraction/Preparation		
EPA 3640A			10147203	Gel Preparation Cleanup
	8031	Extraction/Preparation		
EPA 365.3			10070607	Phosphorous - Colorimetric, two reagent.



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1908	Total Phosphate		
EPA 3660B			10148400	Sulfur cleanup
	8031	Extraction/Preparation		
EPA 3665A			10148808	Sulfuric Acid / permanganate Cleanup
	8031	Extraction/Preparation		
EPA 6010C			10155803	ICP - AES
	1000	Aluminum		
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		
	1020	Beryllium		
	1025	Boron		
	1030	Cadmium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1070	Iron		
	1075	Lead		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		
	1140	Selenium		
	1150	Silver		
	1175	Tin		
	1185	Vanadium		
	1190	Zinc		
EPA 6010D 4 4			10155916	Metals by ICP - AES
	1000	Aluminum		
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		
	1020	Beryllium		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1025	Boron		
	1030	Cadmium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1070	Iron		
	1075	Lead		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		
	1140	Selenium		
	1150	Silver		
	1175	Tin		
	1185	Vanadium		
	1190	Zinc		
EPA 6020A 1 1			10156419	Inductively Coupled Plasma -Mass Spectrometry
	1000	Aluminum		
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		
	1020	Beryllium		
	1030	Cadmium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1070	Iron		
	1075	Lead		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		
	1140	Selenium		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1150	Silver		
	1165	Thallium		
	1185	Vanadium		
	1190	Zinc		
EPA 6020B 2 2			10156420	Inductively Coupled Plasma-Mass Spectrometry
	1000	Aluminum		
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		
	1020	Beryllium		
	1030	Cadmium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1070	Iron		
	1075	Lead		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		
	1140	Selenium		
	1150	Silver		
	1165	Thallium		
	1185	Vanadium		
	1190	Zinc		
EPA 7196A			10162400	Chromium Hexavalent colorimetric
	1045	Chromium VI		
EPA 7471B			10166402	Mercury by Cold Vapor Atomic Absorption
	1095	Mercury		
EPA 8081B			10178800	Organochlorine Pesticides by GC/ECD
	8580	2,4'-DDD		
	8585	2,4'-DDE		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	8590	2,4'-DDT		
	7355	4,4'-DDD		
	7360	4,4'-DDE		
	7365	4,4'-DDT		
	7005	Alachlor		
	7025	Aldrin		
	7110	alpha-BHC (alpha-Hexachlorocyclohexane)		
	7115	beta-BHC (beta-Hexachlorocyclohexane)		
	7250	Chlordane (tech.)		
	7300	Chlorpyrifos		
	7240	cis-chlordane (alpha-Chlordane)		
	7925	cis-Nonachlor		
	7105	delta-BHC		
	7470	Dieldrin		
	7510	Endosulfan I		
	7515	Endosulfan II		
	7520	Endosulfan sulfate		
	7540	Endrin		
	7530	Endrin aldehyde		
	7535	Endrin ketone		
	7120	gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)		
	7245	gamma-Chlordane		
	7685	Heptachlor		
	7690	Heptachlor epoxide		
	6275	Hexachlorobenzene		
	4835	Hexachlorobutadiene		
	4840	Hexachloroethane		
	7725	Isodrin		
	7810	Methoxychlor		
	7870	Mirex		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	3890	Oxychlorane		
	8250	Toxaphene (Chlorinated camphene)		
	7910	trans-Nonachlor		
EPA 8082A			10179201	Polychlorinated Biphenyls (PCBs) by GC/ECD
	9095	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ-206)		
	9090	2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194)		
	9103	2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195)		
	9065	2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170)		
	9020	2,2',3,3',4,4'-Hexachlorobiphenyl (BZ-128)		
	9112	2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ-201)		
	9116	2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-174)		
	9114	2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ-177)		
	9120	2,2',3,3',4,6'-Hexachlorobiphenyl (BZ-132)		
	9133	2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ-203)		
	9134	2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ-180)		
	9075	2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ-183)		
	9025	2,2',3,4,4',5'-Hexachlorobiphenyl (BZ-138)		
	9139	2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ-184)		
	9080	2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ-187)		
	9030	2,2',3,4,5,5'-Hexachlorobiphenyl (BZ-141)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	9151	2,2',3,4',5,6-Hexachlorobiphenyl (BZ-149)		
	8975	2,2',3,4,5'-Pentachlorobiphenyl (BZ-87)		
	9155	2,2',3,4',5-Pentachlorobiphenyl (BZ-90)		
	9154	2,2',3,4',5'-Pentachlorobiphenyl (BZ-97)		
	9035	2,2',3,5,5',6-Hexachlorobiphenyl (BZ-151)		
	9166	2,2',3,5',6-Pentachlorobiphenyl (BZ-95)		
	8945	2,2',3,5'-Tetrachlorobiphenyl (BZ-44)		
	9040	2,2',4,4',5,5'-Hexachlorobiphenyl (BZ-153)		
	9174	2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-154)		
	9175	2,2',4,4',5-Pentachlorobiphenyl (BZ-99)		
	8980	2,2',4,5,5'-Pentachlorobiphenyl (BZ-101)		
	8950	2,2',4,5'-Tetrachlorobiphenyl (BZ-49)		
	8955	2,2',5,5'-Tetrachlorobiphenyl (BZ-52)		
	8930	2,2',5-Trichlorobiphenyl (BZ-18)		
	9085	2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ-189)		
	9050	2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)		
	9045	2,3,3',4,4',5'-Hexachlorobiphenyl (BZ-157)		
	9193	2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158)		
	8985	2,3,3',4,4'-Pentachlorobiphenyl (BZ-105)		
	8990	2,3,3',4',6-Pentachlorobiphenyl (BZ-110)		
	9207	2,3,3',4'-Tetrachlorobiphenyl (BZ-56)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	9055	2,3',4,4',5,5'-Hexachlorobiphenyl (BZ-167)		
	9218	2,3',4,4',5',6-Hexachlorobiphenyl (BZ-168)		
	9005	2,3,4,4',5-Pentachlorobiphenyl (BZ-114)		
	8995	2,3',4,4',5-Pentachlorobiphenyl (BZ-118)		
	9000	2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)		
	9220	2,3',4,4',6-Pentachlorobiphenyl (BZ-119)		
	9221	2,3,4,4'-Tetrachlorobiphenyl (BZ-60)		
	8960	2,3',4,4'-Tetrachlorobiphenyl (BZ-66)		
	9230	2,3',4',5-Tetrachlorobiphenyl (BZ-70)		
	9239	2,3',4'-Trichlorobiphenyl (BZ-33)		
	8920	2,3-Dichlorobiphenyl (BZ-5)		
	9250	2,4,4',5-Tetrachlorobiphenyl (BZ-74)		
	9252	2,4,4'-Trichlorobiphenyl (BZ-28)		
	8940	2,4',5-Trichlorobiphenyl (BZ-31)		
	8915	2-Chlorobiphenyl (BZ-1)		
	9060	3,3',4,4',5,5'-Hexachlorobiphenyl (BZ-169)		
	9015	3,3',4,4',5-Pentachlorobiphenyl (BZ-126)		
	8965	3,3',4,4'-Tetrachlorobiphenyl (BZ-77)		
	8970	3,4,4',5-Tetrachlorobiphenyl (BZ-81)		
	9266	3,4,4'-Trichlorobiphenyl (BZ-37)		
	8880	Aroclor-1016 (PCB-1016)		
	8885	Aroclor-1221 (PCB-1221)		
	8890	Aroclor-1232 (PCB-1232)		
	8895	Aroclor-1242 (PCB-1242)		
	8900	Aroclor-1248 (PCB-1248)		
	8905	Aroclor-1254 (PCB-1254)		
	8910	Aroclor-1260 (PCB-1260)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	8912	Aroclor-1262 (PCB-1262)		
	8913	Aroclor-1268 (PCB-1268)		
	9105	Decachlorobiphenyl (BZ-209)		
EPA 8270D SIM	10242509			Semivolatile Organic compounds by GC/MS
	6703	1,1'-Biphenyl (BZ-0)		
	5155	1,2,4-Trichlorobenzene		
	4610	1,2-Dichlorobenzene		
	6220	1,2-Diphenylhydrazine		
	4615	1,3-Dichlorobenzene		
	4620	1,4-Dichlorobenzene		
	6380	1-Methylnaphthalene		
	9501	1-Methylphenanthrene		
	4659	2,2'-Oxybis(1-chloropropane), bis(2-Chloro-1-methylethyl)ether		
	6852	2,3,5-Trimethylnaphthalene		
	6835	2,4,5-Trichlorophenol		
	6840	2,4,6-Trichlorophenol		
	6000	2,4-Dichlorophenol		
	6130	2,4-Dimethylphenol		
	6175	2,4-Dinitrophenol		
	6185	2,4-Dinitrotoluene (2,4-DNT)		
	6188	2,6-Dimethylnaphthalene		
	6190	2,6-Dinitrotoluene (2,6-DNT)		
	5795	2-Chloronaphthalene		
	5800	2-Chlorophenol		
	6360	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)		
	6385	2-Methylnaphthalene		
	6400	2-Methylphenol (o-Cresol)		
	6460	2-Nitroaniline		
	6490	2-Nitrophenol		
	6412	3 & 4 Methylphenol		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	5660	4-Bromophenyl phenyl ether (BDE-3)		
	5700	4-Chloro-3-methylphenol		
	5825	4-Chlorophenyl phenylether		
	6410	4-Methylphenol (p-Cresol)		
	6470	4-Nitroaniline		
	6500	4-Nitrophenol		
	5500	Acenaphthene		
	5505	Acenaphthylene		
	5555	Anthracene		
	5575	Benzo(a)anthracene		
	5580	Benzo(a)pyrene		
	5605	Benzo(e)pyrene		
	5590	Benzo(g,h,i)perylene		
	9309	Benzo(j)fluoranthene		
	5600	Benzo(k)fluoranthene		
	5585	Benzo[b]fluoranthene		
	5630	Benzyl alcohol		
	5760	bis(2-Chloroethoxy)methane		
	5765	bis(2-Chloroethyl) ether		
	5670	Butyl benzyl phthalate		
	5680	Carbazole		
	5855	Chrysene		
	6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)		
	5895	Dibenz(a,h) anthracene		
	5905	Dibenzofuran		
	6070	Diethyl phthalate		
	6135	Dimethyl phthalate		
	5925	Di-n-butyl phthalate		
	6200	Di-n-octyl phthalate		
	6265	Fluoranthene		
	6270	Fluorene		



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**As of 2/11/2021 this list supersedes all previous lists for this certificate number.**

Matrix Reference	Analyte Code	Analyte	Method Code	Description
	6275	Hexachlorobenzene		
	4835	Hexachlorobutadiene		
	4840	Hexachloroethane		
	6315	Indeno(1,2,3-cd) pyrene		
	6320	Isophorone		
	5005	Naphthalene		
	5015	Nitrobenzene		
	6545	n-Nitrosodi-n-propylamine		
	6535	n-Nitrosodiphenylamine		
	6605	Pentachlorophenol		
	6608	Perylene		
	6615	Phenanthrene		
	6625	Phenol		
	6665	Pyrene		

### Drinking Water

ALS Kelso LCP-PFC 10 10

60001516 ALS Kelso - Perfluorinated Compounds by HPLC-MS-MS (Columbia Analytical Services)

6948	1H, 1H, 2H, 2H-Perfluorodecanesulfonic acid (8:2 FTS)
9616	1H, 1H, 2H, 2H-perfluorododecane sulfonic acid (10:2 FTS)
9616	1H, 1H, 2H, 2H-perfluorododecane sulfonic acid (10:2 FTS)
6946	1H, 1H, 2H, 2H-Perfluorohexanesulfonic acid (4:2 FTS)
6947	1H, 1H, 2H, 2H-Perfluorooctanesulfonic acid (6:2 FTS)
9437	4:2 Fluorotelomer sulfonate (4:2FTS)
6457	6:2 Fluorotelomersulfonate (6:2FTS)
6461	8:2 Fluorotelomersulfonate (8:2FTS)
9460	Hexafluoropropylene oxide dimer acid (HFPO-DA)



# OREGON

## Environmental Laboratory Accreditation Program

### ORELAP Fields of Accreditation



ALS Environmental, Kelso

1317 South 13th Ave.  
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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	9395	N-Ethylperfluorooctane sulfonamide (EtFOSAm)		
	9395	N-Ethylperfluorooctane sulfonamide (EtFOSAm)		
	9431	N-Ethylperfluorooctane sulfonamido ethanol (EtFOSE)		
	9431	N-Ethylperfluorooctane sulfonamido ethanol (EtFOSE)		
	4846	N-Ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)		
	4846	N-Ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)		
	4847	N-Methylperfluorooctane sulfonamido acetic acid (NMeFOSAA)		
	4847	N-Methylperfluorooctane sulfonamido acetic acid (NMeFOSAA)		
	6949	N-Methylperfluorooctane sulfonamido ethanol (MeFOSE)		
	6949	N-Methylperfluorooctane sulfonamido ethanol (MeFOSE)		
	9433	N-Methylperfluorooctanesulfonamide (MeFOSA)		
	9433	N-Methylperfluorooctanesulfonamide (MeFOSA)		
	6918	Perfluorobutane sulfonic acid (PFBS)		
	6915	Perfluorobutanoic acid (PFBA)		
	6915	Perfluorobutanoic acid (PFBA)		
	9562	Perfluorodecane Sulfonate (PFDS)		
	6920	Perfluorodecane sulfonic acid (PFDS)		
	6905	Perfluorodecanoic acid (PFDA)		
	6905	Perfluorodecanoic acid (PFDA)		
	6903	Perfluorododecanoic acid (PFDoA)		
	6903	Perfluorododecanoic acid (PFDoA)		
	9470	Perfluoroheptane sulfonic acid (PFHpS)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	9470	Perfluoroheptane sulfonic acid (PFHpS)		
	6908	Perfluoroheptanoic acid (PFHpA)		
	6908	Perfluoroheptanoic acid (PFHpA)		
	6901	Perfluorohexadecanoic acid (PFHxDA)		
	6927	Perfluorohexane sulfonic acid (PFHxS)		
	6913	Perfluorohexanoic acid (PFHxA)		
	6913	Perfluorohexanoic acid (PFHxA)		
	6929	Perfluorononane sulfonic acid (PFNS)		
	6906	Perfluorononanoic acid (PFNA)		
	6906	Perfluorononanoic acid (PFNA)		
	6917	Perfluorooctane sulfonamide (PFOSAm)		
	6917	Perfluorooctane sulfonamide (PFOSAm)		
	6931	Perfluorooctane sulfonic acid (PFOS)		
	6931	Perfluorooctane sulfonic acid (PFOS)		
	6912	Perfluorooctanoic acid (PFOA)		
	6912	Perfluorooctanoic acid (PFOA)		
	6934	Perfluoropentane sulfonic acid (PFPeS)		
	6914	Perfluoropentanoic acid (PFPeA)		
	6914	Perfluoropentanoic acid (PFPeA)		
	6902	Perfluorotetradecanoic acid (PFTDA)		
	6902	Perfluorotetradecanoic acid (PFTDA)		
	9563	Perfluorotridecanoic acid (PFTrDA)		
	9563	Perfluorotridecanoic acid (PFTrDA)		
	6904	Perfluoroundecanoic acid (PFUnA)		
	6904	Perfluoroundecanoic acid (PFUnA)		
ALS Kelso LCP-PFC 11 11	60001527	ALS Kelso - Perfluorinated Compounds by HPLC-MS-MS (Columbia Analytical Services)		
	6948	1H, 1H, 2H, 2H-		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
		Perfluorodecanesulfonic acid (8:2 FTS)		
	9616	1H, 1H, 2H, 2H-perfluorododecane sulfonic acid (10:2 FTS)		
	6946	1H, 1H, 2H, 2H-Perfluorohexanesulfonic acid (4:2 FTS)		
	6947	1H, 1H, 2H, 2H-Perfluorooctanesulfonic acid (6:2 FTS)		
	9460	Hexafluoropropylene oxide dimer acid (HFPO-DA)		
	9395	N-Ethylperfluorooctane sulfonamide (EtFOSAm)		
	9431	N-Ethylperfluorooctane sulfonamido ethanol (EtFOSE)		
	4846	N-Ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)		
	4847	N-Methylperfluorooctane sulfonamido acetic acid (NMeFOSAA)		
	6949	N-Methylperfluorooctane sulfonamido ethanol (MeFOSE)		
	9433	N-Methylperfluorooctanesulfonamide (MeFOSA)		
	6918	Perfluorobutane sulfonic acid (PFBS)		
	6915	Perfluorobutanoic acid (PFBA)		
	6920	Perfluorodecane sulfonic acid (PFDS)		
	6905	Perfluorodecanoic acid (PFDA)		
	6903	Perfluorododecanoic acid (PFDoA)		
	9470	Perfluoroheptane sulfonic acid (PFHpS)		
	6908	Perfluoroheptanoic acid (PFHpA)		
	6901	Perfluorohexadecanoic acid (PFHxDA)		
	6927	Perfluorohexane sulfonic acid (PFHxS)		
	6913	Perfluorohexanoic acid (PFHxA)		
	6929	Perfluorononane sulfonic acid (PFNS)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	6906	Perfluorononanoic acid (PFNA)		
	6917	Perfluorooctane sulfonamide (PFOSAm)		
	6931	Perfluorooctane sulfonic acid (PFOS)		
	6912	Perfluorooctanoic acid (PFOA)		
	6934	Perfluoropentane sulfonic acid (PFPeS)		
	6914	Perfluoropentanoic acid (PFPeA)		
	6902	Perfluorotetradecanoic acid (PFTDA)		
	9563	Perfluorotridecanoic acid (PFTrDA)		
	6904	Perfluoroundecanoic acid (PFUnA)		
EPA 180.1			10011402	Turbidity - Nephelometric
	2055	Turbidity		
EPA 200.7 4.4 4.4			10013806	ICP - metals
	1000	Aluminum		
	1005	Antimony		
	1015	Barium		
	1020	Beryllium		
	1025	Boron		
	1030	Cadmium		
	1035	Calcium		
	1040	Chromium		
	1055	Copper		
	1760	Hardness (calc.)		
	1070	Iron		
	1085	Magnesium		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		
	1125	Potassium		
	1990	Silica as SiO2		
	1150	Silver		
	1155	Sodium		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1185	Vanadium		
	1190	Zinc		
EPA 200.8 5.4 5.4			10014605	Metals by ICP-MS
	1000	Aluminum		
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		
	1020	Beryllium		
	1030	Cadmium		
	1040	Chromium		
	1055	Copper		
	1075	Lead		
	1090	Manganese		
	1105	Nickel		
	1140	Selenium		
	1150	Silver		
	1165	Thallium		
EPA 245.1 3 3			10036609	Mercury by Cold Vapor Atomic Absorption
	1095	Mercury		
EPA 300.0 2.1 2.1			10053200	Methods for the Determination of Inorganic Substances in Environmental Samples
	1575	Chloride		
	1730	Fluoride		
	1810	Nitrate as N		
	1840	Nitrite as N		
	2000	Sulfate		
EPA 335.4			10061208	Methods for the Determination of Inorganic Substances in Environmental Samples
	1645	Total cyanide		
EPA 353.2 2 2			10067604	Nitrate/Nitrite Nitrogen - Automated, Cadmium
	1810	Nitrate as N		
	1820	Nitrate plus Nitrite as N		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1840	Nitrite as N		
EPA 504.1			10082607	EDB/DBCP/TCP micro-extraction, GC/ECD
	5180	1,2,3-Trichloropropane		
	4570	1,2-Dibromo-3-chloropropane (DBCP)		
	4585	1,2-Dibromoethane (EDB, Ethylene dibromide)		
EPA 524.2 4.1 4.1			10088809	Volatile Organic Compounds GC/MS Capillary Column
	5105	1,1,1,2-Tetrachloroethane		
	5160	1,1,1-Trichloroethane		
	5110	1,1,2,2-Tetrachloroethane		
	5165	1,1,2-Trichloroethane		
	4630	1,1-Dichloroethane		
	4640	1,1-Dichloroethylene		
	4670	1,1-Dichloropropene		
	5150	1,2,3-Trichlorobenzene		
	5180	1,2,3-Trichloropropane		
	5155	1,2,4-Trichlorobenzene		
	5210	1,2,4-Trimethylbenzene		
	4570	1,2-Dibromo-3-chloropropane (DBCP)		
	4610	1,2-Dichlorobenzene		
	4635	1,2-Dichloroethane (Ethylene dichloride)		
	4655	1,2-Dichloropropane		
	5215	1,3,5-Trimethylbenzene		
	4615	1,3-Dichlorobenzene		
	4660	1,3-Dichloropropane		
	4620	1,4-Dichlorobenzene		
	4665	2,2-Dichloropropane		
	4535	2-Chlorotoluene		
	4540	4-Chlorotoluene		
	4910	4-Isopropyltoluene (p-Cymene)		
	4375	Benzene		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	4385	Bromobenzene		
	4390	Bromochloromethane		
	4395	Bromodichloromethane		
	4397	Bromoethane (Ethyl Bromide)		
	4400	Bromoform		
	4455	Carbon tetrachloride		
	4475	Chlorobenzene		
	4575	Chlorodibromomethane		
	4485	Chloroethane (Ethyl chloride)		
	4505	Chloroform		
	4645	cis-1,2-Dichloroethylene		
	4680	cis-1,3-Dichloropropene		
	4595	Dibromomethane (Methylene bromide)		
	4625	Dichlorodifluoromethane (Freon-12)		
	4765	Ethylbenzene		
	4835	Hexachlorobutadiene		
	4900	Isopropylbenzene (Cumene)		
	5240	m+p-xylene		
	4950	Methyl bromide (Bromomethane)		
	4960	Methyl chloride (Chloromethane)		
	5000	Methyl tert-butyl ether (MTBE)		
	4975	Methylene chloride (Dichloromethane)		
	5005	Naphthalene		
	4435	n-Butylbenzene		
	5090	n-Propylbenzene		
	5250	o-Xylene		
	4440	sec-Butylbenzene		
	5100	Styrene		
	4445	tert-Butylbenzene		
	5115	Tetrachloroethylene (Perchloroethylene)		
	5140	Toluene		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	5205	Total trihalomethanes		
	4700	trans-1,2-Dichloroethylene		
	4685	trans-1,3-Dichloropropylene		
	5170	Trichloroethene (Trichloroethylene)		
	5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)		
	5235	Vinyl chloride		
	5260	Xylene (total)		
EPA 537 1.1 1.1			10091675	Perfluorinated Alkyl Acids in Drinking Water by SPE and LC/MS/MS
	4846	N-Ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)		
	4847	N-Methylperfluorooctane sulfonamidoacetic acid (NMeFOSAA)		
	6918	Perfluorobutane sulfonic acid (PFBS)		
	6905	Perfluorodecanoic acid (PFDA)		
	6903	Perfluorododecanoic acid (PFDoA)		
	6908	Perfluoroheptanoic acid (PFHpA)		
	6927	Perfluorohexane sulfonic acid (PFHxS)		
	6913	Perfluorohexanoic acid (PFHxA)		
	6906	Perfluorononanoic acid (PFNA)		
	6931	Perfluorooctane sulfonic acid (PFOS)		
	6912	Perfluorooctanoic acid (PFOA)		
	6902	Perfluorotetradecanoic acid (PFTDA)		
	9563	Perfluorotridecanoic acid (PFTrDA)		
	6904	Perfluoroundecanoic acid (PFUnA)		
EPA 537.1 1.0 1.0			10091642	Per- and Polyfluorinated Alkyl Substances in Drinking Water by LC/MS/MS
	9490	11-chloreicosafuoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)		
	6951	4,8-Dioxa-3H-perfluorononanoic acid (DONA)		
	6952	9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	9460	Hexafluoropropylene oxide dimer acid (HFPO-DA)		
	4846	N-Ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)		
	4847	N-Methylperfluorooctane sulfonamidoacetic acid (NMeFOSAA)		
	6911	Perfluorobutane Sulfonate (PFBS)		
	6918	Perfluorobutane sulfonic acid (PFBS)		
	6905	Perfluorodecanoic acid (PFDA)		
	6903	Perfluorododecanoic acid (PFDoA)		
	6908	Perfluoroheptanoic acid (PFHpA)		
	6910	Perfluorohexane sulfonate (PFHxS)		
	6927	Perfluorohexane sulfonic acid (PFHxS)		
	6913	Perfluorohexanoic acid (PFHxA)		
	6906	Perfluorononanoic acid (PFNA)		
	6909	Perfluorooctane sulfonate (PFOS)		
	6931	Perfluorooctane sulfonic acid (PFOS)		
	6912	Perfluorooctanoic acid (PFOA)		
	6902	Perfluorotetradecanoic acid (PFTDA)		
	9563	Perfluorotridecanoic acid (PFTTrDA)		
	6904	Perfluoroundecanoic acid (PFUnA)		
EPA 552.2 1 1			10095804	Haloacetic Acid/Dalapon, Liquid/Liquid Extraction, Derivitization and GC/ECD
	9312	Bromoacetic acid		
	9315	Bromochloroacetic acid		
	9336	Chloroacetic acid		
	9357	Dibromoacetic acid		
	9360	Dichloroacetic acid		
	9414	Total haloacetic acids		
	9642	Trichloroacetic acid		
SM 2120 B-2011			20039310	Color
	1605	Color		
SM 2320 B-2011 online online			20045618	Alkalinity as CaCO3



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1505	Alkalinity as CaCO3		
SM 2340 B-2011 online online			20046611	Hardness
	1750	Hardness		
SM 2510 B-2011			20048617	Conductivity by Probe
	1610	Conductivity		
SM 2540 C-2011 online online			20050413	Residue-filterable (TDS)
	1955	Residue-filterable (TDS)		
SM 2540 G-2011 online online			20005270	Total, Fixed, and Volatile Solids
	1725	Total, fixed, and volatile residue		
SM 4500-Cl F 22nd ED 22nd ED			20080619	Chlorine (Residual) - DPD Ferrous Titrimetric Method
	1940	Total residual chlorine		
SM 4500-F <sup>-</sup> C-2011 online online			20102414	Fluoride by Ion Selective Electrode
	1730	Fluoride		
SM 4500-H+ B-2011			20105220	pH - Electrometric Measurement
	1900	pH		
SM 4500-P E-2011			20124225	Phosphorus by Ascorbic Acid Method
	1870	Orthophosphate as P		
SM 5310 C-2011 online online			20138823	TOC by Persulfate-Ultraviolet or Heated-Persulfate Oxidation Method
	2040	Total organic carbon		
SM 9215 B (PCA) 20th ED 20th ED			20181208	Heterotrophic Plate Count Pour Plate (plate count agar): Heterotrophic Bacteria
	2555	Heterotrophic plate count		
SM 9223 B (Colilert®) 20th ED 20th ED			20212208	Chromogenic/Fluorogenic Qualitative (Colilert®): Total Coliform and E. coli
	2525	Escherichia coli		
	2500	Total coliforms		
SM 9223 B (Colilert®-18 Quanti-Tray®) 20th ED 20th ED			20213201	Chromogenic/Fluorogenic Quantitative (Colilert®-18): Total Coliform and E. coli
	2525	Escherichia coli		
SM 9223 B (Colilert®-18) 20th ED 20th ED			20214204	Chromogenic/Fluorogenic Qualitative (Colilert®-18): Total Coliform and E. coli



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	2525	Escherichia coli		
	2500	Total coliforms		
SM 9223 B (Colilert®-18) 21st ED 21st ED	20214408	Chromogenic/Fluorogenic Qualitative (Colilert®-18): Total Coliform and E. coli		
	2525	Escherichia coli		
	2500	Total coliforms		
SM 9223 B (Colilert-18® Multiple-tube) 20th ED 20th ED	20229407	Chromogenic/Fluorogenic Quantitative: Total Coliform and E. coli		
	2530	Fecal coliforms		

### Non-Potable Water

AK101 GRO	90015002	Determination of Gasoline Range Organics - Alaska Department of Environmental Conservation		
	9408	Gasoline range organics (GRO)		
AK102 DRO	90015206	Determination of Diesel Range Organics - Alaska Department of Environmental Conservation		
	9369	Diesel range organics (DRO)		
AK103 RRO	90015400	Determination of Residual Range Organics - Alaska Department of Environmental Conservation		
	9499	Motor Oil		
ALS Kelso LCP-Acyl 1 1	60001712	ALS Kelso - Acrylamide by HPLC/MS/MS		
	4330	Acrylamide		
ALS Kelso LCP-PFC 10 10	60001516	ALS Kelso - Perfluorinated Compounds by HPLC-MS-MS (Columbia Analytical Services)		
	6948	1H, 1H, 2H, 2H-Perfluorodecanesulfonic acid (8:2 FTS)		
	9616	1H, 1H, 2H, 2H-perfluorododecane sulfonic acid (10:2 FTS)		
	9616	1H, 1H, 2H, 2H-perfluorododecane sulfonic acid (10:2 FTS)		
	6946	1H, 1H, 2H, 2H-Perfluorohexanesulfonic acid (4:2)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
		FTS)		
	6947	1H, 1H, 2H, 2H-Perfluorooctanesulfonic acid (6:2 FTS)		
	9437	4:2 Fluorotelomer sulfonate (4:2FTS)		
	6457	6:2 Fluorotelomersulfonate (6:2FTS)		
	6461	8:2 Fluorotelomersulfonate (8:2FTS)		
	9460	Hexafluoropropylene oxide dimer acid (HFPO-DA)		
	9395	N-Ethylperfluorooctane sulfonamide (EtFOSAm)		
	9395	N-Ethylperfluorooctane sulfonamide (EtFOSAm)		
	9431	N-Ethylperfluorooctane sulfonamido ethanol (EtFOSE)		
	9431	N-Ethylperfluorooctane sulfonamido ethanol (EtFOSE)		
	4846	N-Ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)		
	4846	N-Ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)		
	4847	N-Methylperfluorooctane sulfonamido acetic acid (NMeFOSAA)		
	4847	N-Methylperfluorooctane sulfonamido acetic acid (NMeFOSAA)		
	6949	N-Methylperfluorooctane sulfonamido ethanol (MeFOSE)		
	6949	N-Methylperfluorooctane sulfonamido ethanol (MeFOSE)		
	9433	N-Methylperfluorooctanesulfonamide (MeFOSA)		
	9433	N-Methylperfluorooctanesulfonamide (MeFOSA)		
	6918	Perfluorobutane sulfonic acid (PFBS)		
	6915	Perfluorobutanoic acid (PFBA)		
	6915	Perfluorobutanoic acid (PFBA)		



# OREGON

## Environmental Laboratory Accreditation Program

### ORELAP Fields of Accreditation



ALS Environmental, Kelso

1317 South 13th Ave.  
Kelso, WA 98626

**ORELAP ID:** WA100010

**EPA CODE:** WA01276

**Certificate:** WA100010 - 023

Issue Date: 2/11/2021 Expiration Date: 2/10/2022

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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	9562	Perfluorodecane Sulfonate (PFDS)		
	6920	Perfluorodecane sulfonic acid (PFDS)		
	6905	Perfluorodecanoic acid (PFDA)		
	6905	Perfluorodecanoic acid (PFDA)		
	6903	Perfluorododecanoic acid (PFDoA)		
	6903	Perfluorododecanoic acid (PFDoA)		
	9470	Perfluoroheptane sulfonic acid (PFHpS)		
	9470	Perfluoroheptane sulfonic acid (PFHpS)		
	6908	Perfluoroheptanoic acid (PFHpA)		
	6908	Perfluoroheptanoic acid (PFHpA)		
	6901	Perfluorohexadecanoic acid (PFHxDA)		
	6927	Perfluorohexane sulfonic acid (PFHxS)		
	6913	Perfluorohexanoic acid (PFHxA)		
	6913	Perfluorohexanoic acid (PFHxA)		
	6929	Perfluorononane sulfonic acid (PFNS)		
	6906	Perfluorononanoic acid (PFNA)		
	6906	Perfluorononanoic acid (PFNA)		
	6917	Perfluorooctane sulfonamide (PFOSAm)		
	6917	Perfluorooctane sulfonamide (PFOSAm)		
	6931	Perfluorooctane sulfonic acid (PFOS)		
	6931	Perfluorooctane sulfonic acid (PFOS)		
	6912	Perfluorooctanoic acid (PFOA)		
	6912	Perfluorooctanoic acid (PFOA)		
	6934	Perfluoropentane sulfonic acid (PFPeS)		
	6914	Perfluoropentanoic acid (PFPeA)		
	6914	Perfluoropentanoic acid (PFPeA)		
	6902	Perfluorotetradecanoic acid (PFTDA)		
	6902	Perfluorotetradecanoic acid (PFTDA)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	9563	Perfluorotridecanoic acid (PFTrDA)		
	9563	Perfluorotridecanoic acid (PFTrDA)		
	6904	Perfluoroundecanoic acid (PFUnA)		
	6904	Perfluoroundecanoic acid (PFUnA)		
ALS Kelso LCP-PFC 11 11	60001527	ALS Kelso - Perfluorinated Compounds by HPLC-MS-MS (Columbia Analytical Services)		
	6948	1H, 1H, 2H, 2H-Perfluorodecanesulfonic acid (8:2 FTS)		
	9616	1H, 1H, 2H, 2H-perfluorododecane sulfonic acid (10:2 FTS)		
	6946	1H, 1H, 2H, 2H-Perfluorohexanesulfonic acid (4:2 FTS)		
	6947	1H, 1H, 2H, 2H-Perfluorooctanesulfonic acid (6:2 FTS)		
	9460	Hexafluoropropylene oxide dimer acid (HFPO-DA)		
	9395	N-Ethylperfluorooctane sulfonamide (EtFOSAm)		
	9431	N-Ethylperfluorooctane sulfonamido ethanol (EtFOSE)		
	4846	N-Ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)		
	4847	N-Methylperfluorooctane sulfonamido acetic acid (NMeFOSAA)		
	6949	N-Methylperfluorooctane sulfonamido ethanol (MeFOSE)		
	9433	N-Methylperfluorooctanesulfonamide (MeFOSA)		
	6918	Perfluorobutane sulfonic acid (PFBS)		
	6915	Perfluorobutanoic acid (PFBA)		
	6920	Perfluorodecane sulfonic acid (PFDS)		
	6905	Perfluorodecanoic acid (PFDA)		
	6903	Perfluorododecanoic acid (PFDoA)		



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## Environmental Laboratory Accreditation Program

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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	9470	Perfluoroheptane sulfonic acid (PFHpS)		
	6908	Perfluoroheptanoic acid (PFHpA)		
	6901	Perfluorohexadecanoic acid (PFHxDA)		
	6927	Perfluorohexane sulfonic acid (PFHxS)		
	6913	Perfluorohexanoic acid (PFHxA)		
	6929	Perfluorononane sulfonic acid (PFNS)		
	6906	Perfluorononanoic acid (PFNA)		
	6917	Perfluorooctane sulfonamide (PFOSAm)		
	6931	Perfluorooctane sulfonic acid (PFOS)		
	6912	Perfluorooctanoic acid (PFOA)		
	6934	Perfluoropentane sulfonic acid (PFPeS)		
	6914	Perfluoropentanoic acid (PFPeA)		
	6902	Perfluorotetradecanoic acid (PFTDA)		
	9563	Perfluorotridecanoic acid (PFTrDA)		
	6904	Perfluoroundecanoic acid (PFUnA)		
ALS Kelso LCP-PFC_NJ 0 0			60001776	ALS Kelso - Perfluorinated Compounds by HPLC-MS-MS
	199	10:2 Fluorotelomer sulfonate (10:2FTS)		
	6948	1H, 1H, 2H, 2H-Perfluorodecanesulfonic acid (8:2 FTS)		
	6946	1H, 1H, 2H, 2H-Perfluorohexanesulfonic acid (4:2 FTS)		
	6947	1H, 1H, 2H, 2H-Perfluorooctanesulfonic acid (6:2 FTS)		
	9460	Hexafluoropropylene oxide dimer acid (HFPO-DA)		
	9395	N-Ethylperfluorooctane sulfonamide (EtFOSAm)		
	9431	N-Ethylperfluorooctane sulfonamide ethanol (EtFOSE)		



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## Environmental Laboratory Accreditation Program

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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	4846	N-Ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)		
	4847	N-Methylperfluorooctane sulfonamidoacetic acid (NMeFOSAA)		
	6949	N-Methylperfluorooctane sulfonamido ethanol (MeFOSE)		
	9433	N-Methylperfluorooctanesulfonamide (MeFOSA)		
	6918	Perfluorobutane sulfonic acid (PFBS)		
	6915	Perfluorobutanoic acid (PFBA)		
	6920	Perfluorodecane sulfonic acid (PFDS)		
	6905	Perfluorodecanoic acid (PFDA)		
	6903	Perfluorododecanoic acid (PFDoA)		
	9470	Perfluoroheptane sulfonic acid (PFHpS)		
	6908	Perfluoroheptanoic acid (PFHpA)		
	6901	Perfluorohexadecanoic acid (PFHxDA)		
	6927	Perfluorohexane sulfonic acid (PFHxS)		
	6913	Perfluorohexanoic acid (PFHxA)		
	6929	Perfluorononane sulfonic acid (PFNS)		
	6906	Perfluorononanoic acid (PFNA)		
	6917	Perfluorooctane sulfonamide (PFOSAm)		
	6931	Perfluorooctane sulfonic acid (PFOS)		
	6912	Perfluorooctanoic acid (PFOA)		
	6934	Perfluoropentane sulfonic acid (PFPeS)		
	6914	Perfluoropentanoic acid (PFPeA)		
	6902	Perfluorotetradecanoic acid (PFTDA)		
	9563	Perfluorotridecanoic acid (PFTrDA)		
	6904	Perfluoroundecanoic acid (PFUnA)		

ALS Kelso SOC-8151M 11 11

60001754 ALS Kelso - Chlorinated Pesticides by GC/ECD



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	6730	2,3,4,5-Tetrachlorophenol		
	6740	2,3,5,6-Tetrachlorophenol		
	6835	2,4,5-Trichlorophenol		
	6840	2,4,6-Trichlorophenol		
	6818	3,4,5-Trichlorophenol		
	5997	3,4-Dichlorophenol		
	6397	3,5-Dichlorophenol		
	6605	Pentachlorophenol		
ASTM D1426-08B			30007397	Ammonia by Titration
	1515	Ammonia as N		
ASTM D1426-98B			30023406	Ammonia by Titration
	1515	Ammonia as N		
ASTM D3590-02(06)A			30016819	Total Kjeldahl Nitrogen in Water
	1795	Total Kjeldahl Nitrogen (TKN)		
ASTM D3590-89B			30016809	Total Kjeldahl Nitrogen in Water
	1795	Total Kjeldahl Nitrogen (TKN)		
ASTM D4129 05 05			30018907	Total and Organic Carbon in Water by High Temperature Oxidation and by Coulometric Detection
	2040	Total organic carbon		
Brooks Rand SOP BR-0002 (1631) method ID# 1225 method ID# 1225			60002804	Selected HAPS in Condensates by GC/FID
	4930	Methanol		
CAS PestMS2 (1699 modified) 2.2			60035101	Chlorinated Pesticides by GC/MS/MS
	8580	2,4'-DDD		
	8585	2,4'-DDE		
	8590	2,4'-DDT		
	7355	4,4'-DDD		
	7360	4,4'-DDE		
	7365	4,4'-DDT		
	7025	Aldrin		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	7110	alpha-BHC (alpha-Hexachlorocyclohexane)		
	7115	beta-BHC (beta-Hexachlorocyclohexane)		
	7300	Chlorpyrifos		
	7240	cis-chlordane (alpha-Chlordane)		
	7925	cis-Nonachlor		
	7105	delta-BHC		
	7470	Dieldrin		
	7510	Endosulfan I		
	7515	Endosulfan II		
	7520	Endosulfan sulfate		
	7540	Endrin		
	7530	Endrin aldehyde		
	7535	Endrin ketone		
	7120	gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)		
	7245	gamma-Chlordane		
	7685	Heptachlor		
	7690	Heptachlor epoxide		
	6275	Hexachlorobenzene		
	7725	Isodrin		
	7810	Methoxychlor		
	7870	Mirex		
	5553	Octachlorostyrene		
	3890	Oxychlordane		
	7910	trans-Nonachlor		
CAS SOC-Butyl 10 10			60035009	Butyltin by GC/Flame Photometric Detector
	1201	Butyltin trichloride		
	1202	Dibutyltin dichloride		
	1209	Tetrabutyltin		
	1203	Tributyltin chloride		
Enterolert®			60030208	Chromogenic/Fluorogenic Quantitative



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
				(Enterolert®): Enterococci
	2520	Enterococci		
EPA 1020A			10117007	Ignitability Setaflash Closed-cup Method
	1780	Ignitability		
EPA 160.4			10256801	Total Volatile Solids, ignition @ 550 C.
	4075	Vol. residue, density, water & solids content of coatings		
EPA 1630			10122608	Methyl Mercury by Purge & Trap Cold Vapor Atomic Fluorescence Spectrometry
	1205	Methyl Mercury		
EPA 1631E			10237204	Mercury in Water by Oxidation, Purge & Trap, and Cold Vapor Atomic Fluorescence
	1095	Mercury		
EPA 1632A			10123407	Chemical Speciation of Arsenic in Water and Tissue by Hydride Generation Quartz Furnace Atomic Absorption Spectrometry
	1182	Total Inorganic Arsenic (As)		
EPA 1632A EPA 1632A EPA 1632A			10123407	Chemical Speciation of Arsenic in Water and Tissue by Hydride Generation Quartz Furnace Atomic Absorption Spectrometry
	1012	Arsenite (As+3)		
EPA 1650C			10125005	Adsorbable Organic Halides by Adsorption and Coulometric Titration
	4345	Adsorbable organic halogens (AOX)		
EPA 1653A			10125403	Chlorinated Phenolics by "In Situ" Acetylation and GC/MS
	6735	2,3,4,6-Tetrachlorophenol		
	6835	2,4,5-Trichlorophenol		
	6840	2,4,6-Trichlorophenol		
	6805	3,4,5-Trichlorocatechol		
	6815	3,4,5-Trichloroguaiacol		
	6810	3,4,6-Trichlorocatechol		
	6820	3,4,6-Trichloroguaiacol		
	6825	4,5,6-Trichloroguaiacol		
	6605	Pentachlorophenol		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	6720	Tetrachlorocatechol		
	6725	Tetrachloroguaiacol		
	6875	Trichlorosyringol		
EPA 1664A (HEM)			10127807	N-Hexane Extractable Material (Oil and Grease) by Extraction and Gravimetry
	1803	n-Hexane Extractable Material (O&G)		
	1860	Oil & Grease		
EPA 1694 Modified			812	Pharmaceuticals and Personal Care Products by HPLC/MS/MS
	6769	17a-estradiol		
	6771	17a-ethynylestradiol		
	6773	17β-estradiol		
	7052	Androstenedione		
	7065	Atrazine		
	9301	Bisphenol A		
	7194	Carbamazepine		
	7375	DEET		
	7086	Diazepam		
	7087	Diclofenac		
	7253	Estriol		
	7254	Estrone		
	7257	Fluoxetine		
	7258	Gemfibrozil		
	7219	Hydrocodone		
	7259	Ibuprofen		
	7719	Iopromide		
	7313	Meprobamate		
	7316	Methadone		
	7269	Naproxen		
	7317	Oxybenzone		
	7318	Pentoxifylline		
	7284	Progesterone		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	9585	Salicylic acid		
	7297	Sulfamethoxazole		
	7301	Testosterone		
	7304	Triclosan		
	7307	Trimethoprim		
EPA 1694 Modified EPA 1694 Modified EPA 1694 Modified			812	Pharmaceuticals and Personal Care Products by HPLC/MS/MS
	4307	Acetaminophen		
	5675	Caffeine		
	6075	Diethylstilbestrol		
EPA 180.1			10011402	Turbidity - Nephelometric
	2055	Turbidity		
EPA 200.7 4.4 4.4			10013806	ICP - metals
	1000	Aluminum		
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		
	1020	Beryllium		
	1025	Boron		
	1030	Cadmium		
	1035	Calcium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1760	Hardness (calc.)		
	1070	Iron		
	1075	Lead		
	1085	Magnesium		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		
	1125	Potassium		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1140	Selenium		
	1990	Silica as SiO2		
	1150	Silver		
	1155	Sodium		
	1160	Strontium		
	1175	Tin		
	1180	Titanium		
	1185	Vanadium		
	1190	Zinc		
EPA 200.8 5.4 5.4			10014605	Metals by ICP-MS
	1000	Aluminum		
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		
	1020	Beryllium		
	1030	Cadmium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1070	Iron		
	1075	Lead		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		
	1140	Selenium		
	1150	Silver		
	1165	Thallium		
	1184	Uranium (mass)		
	1185	Vanadium		
	1190	Zinc		
EPA 245.1 3 3			10036609	Mercury by Cold Vapor Atomic Absorption
	1095	Mercury		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
EPA 300.0 2.1 2.1			10053200	Methods for the Determination of Inorganic Substances in Environmental Samples
	1540	Bromide		
	1575	Chloride		
	1730	Fluoride		
	1810	Nitrate as N		
	1820	Nitrate plus Nitrite as N		
	1840	Nitrite as N		
	2000	Sulfate		
EPA 3005A			10133207	Acid Digestion of waters for Total Recoverable or Dissolved Metals
	1401	Acid Digestion of Aqueous samples and Extracts for Total Metals		
EPA 3010A			10133605	Acid Digestion of Aqueous samples and Extracts for Total Metals
	1401	Acid Digestion of Aqueous samples and Extracts for Total Metals		
EPA 3020A			10134404	Acid Digestion of Aqueous samples and Extracts for Total Metals for Analysis by GFAA
	1401	Acid Digestion of Aqueous samples and Extracts for Total Metals		
EPA 330.4			10059004	Residual Chlorine - DPD-FAS Titration
	1940	Total residual chlorine		
EPA 335.4			10061208	Methods for the Determination of Inorganic Substances in Environmental Samples
	1645	Total cyanide		
EPA 3510C			10138202	Separatory Funnel Liquid-liquid extraction
	1444	Separatory Funnel Liquid-Liquid Extraction		
EPA 3511			10279808	Organic Compounds in Water by Microextraction
	7538	Organic Compounds in Water by Microextraction		
EPA 3520C			10139001	Continuous Liquid-liquid extraction
	1410	Continuous Liquid-Liquid Extraction		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
EPA 353.2 2 2	1810	Nitrate as N	10067604	Nitrate/Nitrite Nitrogen - Automated, Cadmium
	1820	Nitrate plus Nitrite as N		
	1840	Nitrite as N		
EPA 3535A	1448	Solid-Phase Extraction	10139409	Solid-Phase Extraction (SPE)
EPA 3610B	1411	Alumina Cleanup	10144602	Alumina Cleanup
EPA 3620C	1414	Florisil Clean-up	10146006	Florisil Cleanup
EPA 3630C	1446	Silica Gel Clean-up	10146802	Silica gel cleanup
EPA 3640A	1418	Gel-Permeation Clean-up	10147203	Gel Preparation Cleanup
EPA 365.3	1870	Orthophosphate as P	10070607	Phosphorous - Colorimetric, two reagent.
	1908	Total Phosphate		
EPA 3660B	1456	Sulfur Clean-up	10148400	Sulfur cleanup
EPA 3665A	1458	Sulfuric Acid / Permanganate Clean-Up	10148808	Sulfuric Acid / permanganate Cleanup
EPA 420.1	1905	Total phenolics	10079206	Phenolics - Spectrophotometric, manual.
EPA 5030B	1406	Aqueous-phase Purge & Trap	10153409	Purge and trap for aqueous samples
EPA 6010C	1000	Aluminum	10155803	ICP - AES
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1020	Beryllium		
	1025	Boron		
	1030	Cadmium		
	1035	Calcium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1070	Iron		
	1075	Lead		
	1085	Magnesium		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		
	1125	Potassium		
	1140	Selenium		
	1150	Silver		
	1155	Sodium		
	1160	Strontium		
	1165	Thallium		
	1175	Tin		
	1180	Titanium		
	1185	Vanadium		
	1190	Zinc		
EPA 6010D 4 4			10155916	Metals by ICP - AES
	1000	Aluminum		
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		
	1020	Beryllium		
	1025	Boron		
	1030	Cadmium		
	1035	Calcium		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1070	Iron		
	1075	Lead		
	1085	Magnesium		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		
	1125	Potassium		
	1140	Selenium		
	1150	Silver		
	1155	Sodium		
	1160	Strontium		
	1165	Thallium		
	1175	Tin		
	1180	Titanium		
	1185	Vanadium		
	1190	Zinc		
EPA 6020A 1 1			10156419	Inductively Coupled Plasma -Mass Spectrometry
	1000	Aluminum		
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		
	1020	Beryllium		
	1030	Cadmium		
	1035	Calcium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1070	Iron		



# OREGON

## Environmental Laboratory Accreditation Program

### ORELAP Fields of Accreditation



ALS Environmental, Kelso

1317 South 13th Ave.  
Kelso, WA 98626

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**EPA CODE:** WA01276

**Certificate:** WA100010 - 023

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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1075	Lead		
	1085	Magnesium		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		
	1125	Potassium		
	1140	Selenium		
	1150	Silver		
	1155	Sodium		
	1160	Strontium		
	1165	Thallium		
	1184	Uranium (mass)		
	1185	Vanadium		
	1190	Zinc		
EPA 6020B 2 2			10156420	Inductively Coupled Plasma-Mass Spectrometry
	1000	Aluminum		
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		
	1020	Beryllium		
	1030	Cadmium		
	1035	Calcium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1070	Iron		
	1075	Lead		
	1085	Magnesium		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1125	Potassium		
	1140	Selenium		
	1150	Silver		
	1155	Sodium		
	1160	Strontium		
	1165	Thallium		
	1184	Uranium (mass)		
	1185	Vanadium		
	1190	Zinc		
EPA 608			10103603	Organochlorine Pesticides & PCBs by GC/ECD
	7355	4,4'-DDD		
	7360	4,4'-DDE		
	7365	4,4'-DDT		
	7025	Aldrin		
	7110	alpha-BHC (alpha-Hexachlorocyclohexane)		
	8880	Aroclor-1016 (PCB-1016)		
	8885	Aroclor-1221 (PCB-1221)		
	8890	Aroclor-1232 (PCB-1232)		
	8895	Aroclor-1242 (PCB-1242)		
	8900	Aroclor-1248 (PCB-1248)		
	8905	Aroclor-1254 (PCB-1254)		
	8910	Aroclor-1260 (PCB-1260)		
	7115	beta-BHC (beta-Hexachlorocyclohexane)		
	7250	Chlordane (tech.)		
	7105	delta-BHC		
	7470	Dieldrin		
	7510	Endosulfan I		
	7515	Endosulfan II		
	7520	Endosulfan sulfate		
	7540	Endrin		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	7530	Endrin aldehyde		
	7120	gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)		
	7685	Heptachlor		
	7690	Heptachlor epoxide		
	7810	Methoxychlor		
	8250	Toxaphene (Chlorinated camphene)		
EPA 608.3 GC-ECD			10296614	Organochlorine Pesticides and PCBs by GC/ECD
	7355	4,4'-DDD		
	7360	4,4'-DDE		
	7365	4,4'-DDT		
	7025	Aldrin		
	7110	alpha-BHC (alpha-Hexachlorocyclohexane)		
	8880	Aroclor-1016 (PCB-1016)		
	8885	Aroclor-1221 (PCB-1221)		
	8890	Aroclor-1232 (PCB-1232)		
	8895	Aroclor-1242 (PCB-1242)		
	8900	Aroclor-1248 (PCB-1248)		
	8905	Aroclor-1254 (PCB-1254)		
	8910	Aroclor-1260 (PCB-1260)		
	8912	Aroclor-1262 (PCB-1262)		
	8913	Aroclor-1268 (PCB-1268)		
	7115	beta-BHC (beta-Hexachlorocyclohexane)		
	7250	Chlordane (tech.)		
	7240	cis-chlordane (alpha-Chlordane)		
	7105	delta-BHC		
	7470	Dieldrin		
	7510	Endosulfan I		
	7515	Endosulfan II		
	7520	Endosulfan sulfate		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	7540	Endrin		
	7530	Endrin aldehyde		
	7535	Endrin ketone		
	7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)		
	7245	gamma-Chlordane		
	7685	Heptachlor		
	7690	Heptachlor epoxide		
	7810	Methoxychlor		
	8870	PCBs		
	8250	Toxaphene (Chlorinated camphene)		
	7972	trans-Chlordane		
EPA 624			10107207	Volatile Organic Compounds by purge and trap GC/MS
	5160	1,1,1-Trichloroethane		
	5110	1,1,2,2-Tetrachloroethane		
	5165	1,1,2-Trichloroethane		
	4630	1,1-Dichloroethane		
	4640	1,1-Dichloroethylene		
	5155	1,2,4-Trichlorobenzene		
	4610	1,2-Dichlorobenzene		
	4635	1,2-Dichloroethane (Ethylene dichloride)		
	4655	1,2-Dichloropropane		
	4615	1,3-Dichlorobenzene		
	4620	1,4-Dichlorobenzene		
	4500	2-Chloroethyl vinyl ether		
	4995	4-Methyl-2-pentanone (MIBK)		
	4325	Acrolein (Propenal)		
	4340	Acrylonitrile		
	4375	Benzene		
	4395	Bromodichloromethane		
	4400	Bromoform		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	4455	Carbon tetrachloride		
	4475	Chlorobenzene		
	4575	Chlorodibromomethane		
	4485	Chloroethane (Ethyl chloride)		
	4505	Chloroform		
	4680	cis-1,3-Dichloropropene		
	4625	Dichlorodifluoromethane (Freon-12)		
	4765	Ethylbenzene		
	4950	Methyl bromide (Bromomethane)		
	4960	Methyl chloride (Chloromethane)		
	4975	Methylene chloride (Dichloromethane)		
	5100	Styrene		
	5115	Tetrachloroethylene (Perchloroethylene)		
	5140	Toluene		
	4700	trans-1,2-Dichloroethylene		
	4685	trans-1,3-Dichloropropylene		
	5170	Trichloroethene (Trichloroethylene)		
	5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)		
	5235	Vinyl chloride		
	5260	Xylene (total)		
EPA 624.1			10298121	Purgeables by GC/MS
	5195	1,1,1-Trichloro-2,2,2-trifluoroethane (Freon 113a)		
	5110	1,1,2,2-Tetrachloroethane		
	5185	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)		
	5165	1,1,2-Trichloroethane		
	4630	1,1-Dichloroethane		
	4640	1,1-Dichloroethylene		
	4670	1,1-Dichloropropene		
	5150	1,2,3-Trichlorobenzene		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	5180	1,2,3-Trichloropropane		
	5155	1,2,4-Trichlorobenzene		
	5210	1,2,4-Trimethylbenzene		
	4570	1,2-Dibromo-3-chloropropane (DBCP)		
	4585	1,2-Dibromoethane (EDB, Ethylene dibromide)		
	4610	1,2-Dichlorobenzene		
	4635	1,2-Dichloroethane (Ethylene dichloride)		
	4655	1,2-Dichloropropane		
	5215	1,3,5-Trimethylbenzene		
	4615	1,3-Dichlorobenzene		
	4660	1,3-Dichloropropane		
	4620	1,4-Dichlorobenzene		
	4665	2,2-Dichloropropane		
	4410	2-Butanone (Methyl ethyl ketone, MEK)		
	4500	2-Chloroethyl vinyl ether		
	4535	2-Chlorotoluene		
	4860	2-Hexanone (MBK)		
	4540	4-Chlorotoluene		
	4995	4-Methyl-2-pentanone (MIBK)		
	4315	Acetone		
	4320	Acetonitrile		
	4325	Acrolein (Propenal)		
	4340	Acrylonitrile		
	4375	Benzene		
	4385	Bromobenzene		
	4390	Bromochloromethane		
	4395	Bromodichloromethane		
	4397	Bromoethane (Ethyl Bromide)		
	4400	Bromoform		
	4450	Carbon disulfide		
	4455	Carbon tetrachloride		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	4475	Chlorobenzene		
	4575	Chlorodibromomethane		
	4485	Chloroethane (Ethyl chloride)		
	4505	Chloroform		
	4645	cis-1,2-Dichloroethylene		
	4680	cis-1,3-Dichloropropene		
	4595	Dibromomethane (Methylene bromide)		
	4627	Dichlorofluoromethane (Freon 21)		
	4725	Diethyl ether		
	4765	Ethylbenzene		
	4835	Hexachlorobutadiene		
	4900	Isopropylbenzene (Cumene)		
	5240	m+p-xylene		
	4960	Methyl chloride (Chloromethane)		
	5000	Methyl tert-butyl ether (MTBE)		
	4975	Methylene chloride (Dichloromethane)		
	5005	Naphthalene		
	4435	n-Butylbenzene		
	5090	n-Propylbenzene		
	5250	o-Xylene		
	4440	sec-Butylbenzene		
	5100	Styrene		
	4445	tert-Butylbenzene		
	5115	Tetrachloroethylene (Perchloroethylene)		
	5140	Toluene		
	4700	trans-1,2-Dichloroethylene		
	4685	trans-1,3-Dichloropropylene		
	5170	Trichloroethene (Trichloroethylene)		
	5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)		
	5225	Vinyl acetate		
	5235	Vinyl chloride		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
EPA 625			10300002	Base/Neutrals and Acids by GC/MS
	5155	1,2,4-Trichlorobenzene		
	6220	1,2-Diphenylhydrazine		
	4659	2,2'-Oxybis(1-chloropropane), bis(2-Chloro-1-methylethyl)ether		
	4659	2,2'-Oxybis(1-chloropropane), bis(2-Chloro-1-methylethyl)ether		
	6840	2,4,6-Trichlorophenol		
	6000	2,4-Dichlorophenol		
	6130	2,4-Dimethylphenol		
	6175	2,4-Dinitrophenol		
	6185	2,4-Dinitrotoluene (2,4-DNT)		
	6190	2,6-Dinitrotoluene (2,6-DNT)		
	5795	2-Chloronaphthalene		
	5800	2-Chlorophenol		
	6360	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)		
	6490	2-Nitrophenol		
	5945	3,3'-Dichlorobenzidine		
	5660	4-Bromophenyl phenyl ether (BDE-3)		
	5700	4-Chloro-3-methylphenol		
	5825	4-Chlorophenyl phenylether		
	6500	4-Nitrophenol		
	5500	Acenaphthene		
	5505	Acenaphthylene		
	5555	Anthracene		
	5595	Benzidine		
	5575	Benzo(a)anthracene		
	5580	Benzo(a)pyrene		
	5590	Benzo(g,h,i)perylene		
	5600	Benzo(k)fluoranthene		
	5585	Benzo[b]fluoranthene		
	5760	bis(2-Chloroethoxy)methane		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	5765	bis(2-Chloroethyl) ether		
	5670	Butyl benzyl phthalate		
	5855	Chrysene		
	6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)		
	5895	Dibenz(a,h) anthracene		
	6070	Diethyl phthalate		
	6135	Dimethyl phthalate		
	5925	Di-n-butyl phthalate		
	6200	Di-n-octyl phthalate		
	6265	Fluoranthene		
	6270	Fluorene		
	6275	Hexachlorobenzene		
	4835	Hexachlorobutadiene		
	6285	Hexachlorocyclopentadiene		
	4840	Hexachloroethane		
	6315	Indeno(1,2,3-cd) pyrene		
	6320	Isophorone		
	5005	Naphthalene		
	5015	Nitrobenzene		
	6530	n-Nitrosodimethylamine		
	6545	n-Nitrosodi-n-propylamine		
	6535	n-Nitrosodiphenylamine		
	6605	Pentachlorophenol		
	6615	Phenanthrene		
	6625	Phenol		
	6665	Pyrene		
EPA 625.1			10300024	Base/Neutrals and Acids by GC/MS
	5155	1,2,4-Trichlorobenzene		
	4610	1,2-Dichlorobenzene		
	6220	1,2-Diphenylhydrazine		
	4615	1,3-Dichlorobenzene		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	4620	1,4-Dichlorobenzene		
	6735	2,3,4,6-Tetrachlorophenol		
	6835	2,4,5-Trichlorophenol		
	6840	2,4,6-Trichlorophenol		
	6000	2,4-Dichlorophenol		
	6130	2,4-Dimethylphenol		
	6175	2,4-Dinitrophenol		
	6185	2,4-Dinitrotoluene (2,4-DNT)		
	6190	2,6-Dinitrotoluene (2,6-DNT)		
	5795	2-Chloronaphthalene		
	5800	2-Chlorophenol		
	6385	2-Methylnaphthalene		
	6400	2-Methylphenol (o-Cresol)		
	6460	2-Nitroaniline		
	6490	2-Nitrophenol		
	5945	3,3'-Dichlorobenzidine		
	6120	3,3'-Dimethylbenzidine		
	6465	3-Nitroaniline		
	5660	4-Bromophenyl phenyl ether (BDE-3)		
	5700	4-Chloro-3-methylphenol		
	5745	4-Chloroaniline		
	5825	4-Chlorophenyl phenylether		
	6410	4-Methylphenol (p-Cresol)		
	6470	4-Nitroaniline		
	6500	4-Nitrophenol		
	5500	Acenaphthene		
	5505	Acenaphthylene		
	5545	Aniline		
	5555	Anthracene		
	5595	Benzidine		
	5575	Benzo(a)anthracene		
	5580	Benzo(a)pyrene		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	5590	Benzo(g,h,i)perylene		
	5600	Benzo(k)fluoranthene		
	5585	Benzo[b]fluoranthene		
	5610	Benzoic acid		
	5630	Benzyl alcohol		
	5760	bis(2-Chloroethoxy)methane		
	5765	bis(2-Chloroethyl) ether		
	5670	Butyl benzyl phthalate		
	5680	Carbazole		
	5855	Chrysene		
	5895	Dibenz(a,h) anthracene		
	5905	Dibenzofuran		
	6070	Diethyl phthalate		
	6135	Dimethyl phthalate		
	5925	Di-n-butyl phthalate		
	6200	Di-n-octyl phthalate		
	6265	Fluoranthene		
	6270	Fluorene		
	6275	Hexachlorobenzene		
	4835	Hexachlorobutadiene		
	6285	Hexachlorocyclopentadiene		
	4840	Hexachloroethane		
	6315	Indeno(1,2,3-cd) pyrene		
	6320	Isophorone		
	5005	Naphthalene		
	5015	Nitrobenzene		
	6530	n-Nitrosodimethylamine		
	6545	n-Nitrosodi-n-propylamine		
	6535	n-Nitrosodiphenylamine		
	6605	Pentachlorophenol		
	6615	Phenanthrene		
	6625	Phenol		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	6665	Pyrene		
	5095	Pyridine		
EPA 7196A			10162400	Chromium Hexavalent colorimetric
	1045	Chromium VI		
EPA 7470A			10165807	Mercury in Liquid Waste by Cold Vapor Atomic Absorption
	1095	Mercury		
EPA 8015C			10173805	Non-halogenated organics using GC/FID
	9369	Diesel range organics (DRO)		
	4785	Ethylene glycol		
	9408	Gasoline range organics (GRO)		
EPA 8081B			10178800	Organochlorine Pesticides by GC/ECD
	8580	2,4'-DDD		
	8585	2,4'-DDE		
	8590	2,4'-DDT		
	7355	4,4'-DDD		
	7360	4,4'-DDE		
	7365	4,4'-DDT		
	7005	Alachlor		
	7025	Aldrin		
	7110	alpha-BHC (alpha-Hexachlorocyclohexane)		
	7115	beta-BHC (beta-Hexachlorocyclohexane)		
	7250	Chlordane (tech.)		
	7300	Chlorpyrifos		
	7240	cis-chlordane (alpha-Chlordane)		
	7925	cis-Nonachlor		
	7105	delta-BHC		
	7470	Dieldrin		
	7510	Endosulfan I		
	7515	Endosulfan II		
	7520	Endosulfan sulfate		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	7540	Endrin		
	7530	Endrin aldehyde		
	7535	Endrin ketone		
	7120	gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)		
	7245	gamma-Chlordane		
	7685	Heptachlor		
	7690	Heptachlor epoxide		
	6275	Hexachlorobenzene		
	4835	Hexachlorobutadiene		
	4840	Hexachloroethane		
	7725	Isodrin		
	7810	Methoxychlor		
	7870	Mirex		
	3890	Oxychlordane		
	8250	Toxaphene (Chlorinated camphene)		
	7910	trans-Nonachlor		
EPA 8082A			10179201	Polychlorinated Biphenyls (PCBs) by GC/ECD
	9095	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ-206)		
	9090	2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194)		
	9103	2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195)		
	9065	2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170)		
	9020	2,2',3,3',4,4'-Hexachlorobiphenyl (BZ-128)		
	9112	2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ-201)		
	9116	2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-174)		
	9114	2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ-177)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	9120	2,2',3,3',4,6'-Hexachlorobiphenyl (BZ-132)		
	9133	2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ-203)		
	9134	2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ-180)		
	9075	2,2',3,4,4',5,6-Heptachlorobiphenyl (BZ-183)		
	9025	2,2',3,4,4',5'-Hexachlorobiphenyl (BZ-138)		
	9139	2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ-184)		
	9080	2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ-187)		
	9030	2,2',3,4,5,5'-Hexachlorobiphenyl (BZ-141)		
	9151	2,2',3,4',5',6-Hexachlorobiphenyl (BZ-149)		
	8975	2,2',3,4,5'-Pentachlorobiphenyl (BZ-87)		
	9155	2,2',3,4',5-Pentachlorobiphenyl (BZ-90)		
	9154	2,2',3,4',5'-Pentachlorobiphenyl (BZ-97)		
	9035	2,2',3,5,5',6-Hexachlorobiphenyl (BZ-151)		
	9166	2,2',3,5',6-Pentachlorobiphenyl (BZ-95)		
	8945	2,2',3,5'-Tetrachlorobiphenyl (BZ-44)		
	9040	2,2',4,4',5,5'-Hexachlorobiphenyl (BZ-153)		
	9174	2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-154)		
	9175	2,2',4,4',5-Pentachlorobiphenyl (BZ-99)		
	8980	2,2',4,5,5'-Pentachlorobiphenyl (BZ-101)		
	8950	2,2',4,5'-Tetrachlorobiphenyl (BZ-49)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	8955	2,2',5,5'-Tetrachlorobiphenyl (BZ-52)		
	8930	2,2',5-Trichlorobiphenyl (BZ-18)		
	9085	2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ-189)		
	9050	2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)		
	9045	2,3,3',4,4',5'-Hexachlorobiphenyl (BZ-157)		
	9193	2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158)		
	8985	2,3,3',4,4'-Pentachlorobiphenyl (BZ-105)		
	8990	2,3,3',4',6-Pentachlorobiphenyl (BZ-110)		
	9207	2,3,3',4'-Tetrachlorobiphenyl (BZ-56)		
	9055	2,3',4,4',5,5'-Hexachlorobiphenyl (BZ-167)		
	9217	2,3,4,4',5,6-Hexachlorobiphenyl (BZ-166)		
	9218	2,3',4,4',5,6-Hexachlorobiphenyl (BZ-168)		
	9005	2,3,4,4',5-Pentachlorobiphenyl (BZ-114)		
	8995	2,3',4,4',5-Pentachlorobiphenyl (BZ-118)		
	9000	2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)		
	9220	2,3',4,4',6-Pentachlorobiphenyl (BZ-119)		
	9221	2,3,4,4'-Tetrachlorobiphenyl (BZ-60)		
	8960	2,3',4,4'-Tetrachlorobiphenyl (BZ-66)		
	9230	2,3',4',5-Tetrachlorobiphenyl (BZ-70)		
	9239	2,3',4'-Trichlorobiphenyl (BZ-33)		
	8920	2,3-Dichlorobiphenyl (BZ-5)		
	9250	2,4,4',5-Tetrachlorobiphenyl (BZ-74)		
	9252	2,4,4'-Trichlorobiphenyl (BZ-28)		



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	8940	2,4',5-Trichlorobiphenyl (BZ-31)		
	9256	2,4'-Dichlorobiphenyl (BZ-8)		
	8915	2-Chlorobiphenyl (BZ-1)		
	9060	3,3',4,4',5,5'-Hexachlorobiphenyl (BZ-169)		
	9015	3,3',4,4',5-Pentachlorobiphenyl (BZ-126)		
	8965	3,3',4,4'-Tetrachlorobiphenyl (BZ-77)		
	8970	3,4,4',5-Tetrachlorobiphenyl (BZ-81)		
	9266	3,4,4'-Trichlorobiphenyl (BZ-37)		
	8880	Aroclor-1016 (PCB-1016)		
	8885	Aroclor-1221 (PCB-1221)		
	8890	Aroclor-1232 (PCB-1232)		
	8895	Aroclor-1242 (PCB-1242)		
	8900	Aroclor-1248 (PCB-1248)		
	8905	Aroclor-1254 (PCB-1254)		
	8910	Aroclor-1260 (PCB-1260)		
	8912	Aroclor-1262 (PCB-1262)		
	8913	Aroclor-1268 (PCB-1268)		
	9105	Decachlorobiphenyl (BZ-209)		
EPA 8151A			10183207	Chlorinated Herbicides by GC/ECD
	8655	2,4,5-T		
	8545	2,4-D		
	8560	2,4-DB		
	8555	Dalapon		
	8595	Dicamba		
	8605	Dichloroprop (Dichloroprop)		
	8620	Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)		
	7775	MCPA		
	7780	MCPP		
	8650	Silvex (2,4,5-TP)		
EPA 8260C			10307003	Volatile Organics: GC/MS (capillary column)



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	5105	1,1,1,2-Tetrachloroethane		
	5185	1,1,1-Trichloro-2,2,2-trifluoroethane (Freon 113a)		
	5160	1,1,1-Trichloroethane		
	5110	1,1,2,2-Tetrachloroethane		
	5195	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)		
	5165	1,1,2-Trichloroethane		
	5167	1,1,2-Trichlorofluoroethane		
	4630	1,1-Dichloroethane		
	4640	1,1-Dichloroethylene		
	4670	1,1-Dichloropropene		
	5150	1,2,3-Trichlorobenzene		
	5180	1,2,3-Trichloropropane		
	5155	1,2,4-Trichlorobenzene		
	5210	1,2,4-Trimethylbenzene		
	4570	1,2-Dibromo-3-chloropropane (DBCP)		
	4585	1,2-Dibromoethane (EDB, Ethylene dibromide)		
	4610	1,2-Dichlorobenzene		
	4635	1,2-Dichloroethane (Ethylene dichloride)		
	4655	1,2-Dichloropropane		
	6800	1,3,5-Trichlorobenzene		
	5215	1,3,5-Trimethylbenzene		
	4615	1,3-Dichlorobenzene		
	4660	1,3-Dichloropropane		
	4620	1,4-Dichlorobenzene		
	4735	1,4-Dioxane (1,4- Diethyleneoxide)		
	4510	1-Chlorohexane		
	4665	2,2-Dichloropropane		
	4410	2-Butanone (Methyl ethyl ketone, MEK)		
	4500	2-Chloroethyl vinyl ether		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	4535	2-Chlorotoluene		
	4860	2-Hexanone (MBK)		
	5020	2-Nitropropane		
	4536	4-Bromofluorobenzene		
	4540	4-Chlorotoluene		
	4910	4-Isopropyltoluene (p-Cymene)		
	4995	4-Methyl-2-pentanone (MIBK)		
	4305	Acetamide		
	4315	Acetone		
	4320	Acetonitrile		
	4325	Acrolein (Propenal)		
	4330	Acrylamide		
	4340	Acrylonitrile		
	4355	Allyl chloride (3-Chloropropene)		
	4375	Benzene		
	4385	Bromobenzene		
	4390	Bromochloromethane		
	4395	Bromodichloromethane		
	4400	Bromoform		
	4450	Carbon disulfide		
	4455	Carbon tetrachloride		
	4475	Chlorobenzene		
	4575	Chlorodibromomethane		
	4485	Chloroethane (Ethyl chloride)		
	4505	Chloroform		
	4525	Chloroprene (2-Chloro-1,3-butadiene)		
	4705	cis & trans-1,2-Dichloroethene		
	4645	cis-1,2-Dichloroethylene		
	4680	cis-1,3-Dichloropropene		
	4595	Dibromomethane (Methylene bromide)		
	4625	Dichlorodifluoromethane (Freon-12)		
	4725	Diethyl ether		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	4755	Ethyl acetate		
	4810	Ethyl methacrylate		
	4765	Ethylbenzene		
	4835	Hexachlorobutadiene		
	4870	Iodomethane (Methyl iodide)		
	4875	Isobutyl alcohol (2-Methyl-1-propanol)		
	4900	Isopropylbenzene (Cumene)		
	5240	m+p-xylene		
	4925	Methacrylonitrile		
	4950	Methyl bromide (Bromomethane)		
	4960	Methyl chloride (Chloromethane)		
	5000	Methyl tert-butyl ether (MTBE)		
	4975	Methylene chloride (Dichloromethane)		
	5245	m-Xylene		
	5005	Naphthalene		
	4435	n-Butylbenzene		
	5090	n-Propylbenzene		
	5250	o-Xylene		
	4440	sec-Butylbenzene		
	5100	Styrene		
	4370	T-amylmethylether (TAME)		
	4445	tert-Butylbenzene		
	5115	Tetrachloroethylene (Perchloroethylene)		
	5140	Toluene		
	4700	trans-1,2-Dichloroethylene		
	4685	trans-1,3-Dichloropropylene		
	4605	trans-1,4-Dichloro-2-butene		
	5170	Trichloroethene (Trichloroethylene)		
	5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)		
	5225	Vinyl acetate		
	5235	Vinyl chloride		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	5260	Xylene (total)		
EPA 8270D			10186002	Semivolatile Organic compounds by GC/MS
	6703	1,1'-Biphenyl (BZ-0)		
	6715	1,2,4,5-Tetrachlorobenzene		
	5155	1,2,4-Trichlorobenzene		
	4610	1,2-Dichlorobenzene		
	6220	1,2-Diphenylhydrazine		
	4615	1,3-Dichlorobenzene		
	4620	1,4-Dichlorobenzene		
	6380	1-Methylnaphthalene		
	4659	2,2'-Oxybis(1-chloropropane), bis(2-Chloro-1-methylethyl)ether		
	4659	2,2'-Oxybis(1-chloropropane), bis(2-Chloro-1-methylethyl)ether		
	6735	2,3,4,6-Tetrachlorophenol		
	6835	2,4,5-Trichlorophenol		
	6840	2,4,6-Trichlorophenol		
	6000	2,4-Dichlorophenol		
	6130	2,4-Dimethylphenol		
	6175	2,4-Dinitrophenol		
	6185	2,4-Dinitrotoluene (2,4-DNT)		
	6190	2,6-Dinitrotoluene (2,6-DNT)		
	5735	2-Chloroaniline		
	5795	2-Chloronaphthalene		
	5800	2-Chlorophenol		
	6360	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)		
	6385	2-Methylnaphthalene		
	6400	2-Methylphenol (o-Cresol)		
	6460	2-Nitroaniline		
	6490	2-Nitrophenol		
	6412	3 & 4 Methylphenol		
	5945	3,3'-Dichlorobenzidine		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	6405	3-Methylphenol (m-Cresol)		
	6465	3-Nitroaniline		
	5660	4-Bromophenyl phenyl ether (BDE-3)		
	5700	4-Chloro-3-methylphenol		
	5745	4-Chloroaniline		
	5825	4-Chlorophenyl phenylether		
	6410	4-Methylphenol (p-Cresol)		
	6470	4-Nitroaniline		
	6500	4-Nitrophenol		
	5500	Acenaphthene		
	5505	Acenaphthylene		
	5510	Acetophenone		
	5545	Aniline		
	5555	Anthracene		
	7065	Atrazine		
	5562	Azobenzene		
	5570	Benzaldehyde		
	5575	Benzo(a)anthracene		
	5580	Benzo(a)pyrene		
	5590	Benzo(g,h,i)perylene		
	9309	Benzo(j)fluoranthene		
	5600	Benzo(k)fluoranthene		
	5585	Benzo[b]fluoranthene		
	5610	Benzoic acid		
	5630	Benzyl alcohol		
	5760	bis(2-Chloroethoxy)methane		
	5765	bis(2-Chloroethyl) ether		
	5670	Butyl benzyl phthalate		
	7180	Caprolactam		
	5680	Carbazole		
	5855	Chrysene		
	6065	Di(2-ethylhexyl) phthalate (bis(2-		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
		Ethylhexyl)phthalate, DEHP)		
	5895	Dibenz(a,h) anthracene		
	5905	Dibenzofuran		
	6070	Diethyl phthalate		
	6135	Dimethyl phthalate		
	5925	Di-n-butyl phthalate		
	6200	Di-n-octyl phthalate		
	6265	Fluoranthene		
	6270	Fluorene		
	6275	Hexachlorobenzene		
	4835	Hexachlorobutadiene		
	6285	Hexachlorocyclopentadiene		
	4840	Hexachloroethane		
	6315	Indeno(1,2,3-cd) pyrene		
	6320	Isophorone		
	5005	Naphthalene		
	5015	Nitrobenzene		
	6530	n-Nitrosodimethylamine		
	6545	n-Nitrosodi-n-propylamine		
	6535	n-Nitrosodiphenylamine		
	6590	Pentachlorobenzene		
	6605	Pentachlorophenol		
	6615	Phenanthrene		
	6625	Phenol		
	6665	Pyrene		
	5095	Pyridine		
EPA 8270D SIM			10242509	Semivolatile Organic compounds by GC/MS
	6703	1,1'-Biphenyl (BZ-0)		
	4735	1,4-Dioxane (1,4- Diethyleneoxide)		
	6380	1-Methylnaphthalene		
	9501	1-Methylphenanthrene		
	6852	2,3,5-Trimethylnaphthalene		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	6188	2,6-Dimethylnaphthalene		
	6385	2-Methylnaphthalene		
	5500	Acenaphthene		
	5505	Acenaphthylene		
	5555	Anthracene		
	5575	Benzo(a)anthracene		
	5580	Benzo(a)pyrene		
	5605	Benzo(e)pyrene		
	5590	Benzo(g,h,i)perylene		
	9309	Benzo(j)fluoranthene		
	5600	Benzo(k)fluoranthene		
	5585	Benzo[b]fluoranthene		
	5680	Carbazole		
	5855	Chrysene		
	5895	Dibenz(a,h) anthracene		
	5905	Dibenzofuran		
	5910	Dibenzothiophene		
	6265	Fluoranthene		
	6270	Fluorene		
	6315	Indeno(1,2,3-cd) pyrene		
	5005	Naphthalene		
	6605	Pentachlorophenol		
	6608	Perylene		
	6615	Phenanthrene		
	6665	Pyrene		
EPA 8321B			10189205	Solvent Extractable non-volatile compounds by HPLC/TS/MS
	7195	Carbaryl (Sevin)		
EPA 9012B			10243206	Total and Amenable Cyanide (automated colorimetric with off-line distillation)
	1510	Amenable cyanide		
	1645	Total cyanide		
EPA 9020B			10194408	Total Organic Halides



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	2045	Total organic halides (TOX)		
EPA 9040C			10244403	pH Electrometric Measurement
	1900	pH		
EPA 9060A			10244801	Total Organic Carbon
	2040	Total organic carbon		
Kelada-01 1.2 1.2			60005303	Kelada Automated Test Methods for Total Cyanide, Acid Dissociable Cyanide, and Thiocyanate
	1645	Total cyanide		
NCASI 94.03 0 0			60031507	Methanol in Process Liquids and Wastewaters
	4930	Methanol		
NWTPH-Dx			90018409	Oregon DEQ TPH Diesel Range
	9369	Diesel range organics (DRO)		
	9506	Residual Range Organics (RRO)		
NWTPH-Gx			90018603	Oregon DEQ TPH Gasoline Range Organics by GC/FID-PID Purge & Trap
	9408	Gasoline range organics (GRO)		
NWTPH-HCID			90013200	Oregon DEQ Total Petroleum Hydrocarbon ID
	2050	Total Petroleum Hydrocarbons (TPH)		
SM 2120 B-2011			20039310	Color
	1605	Color		
SM 2310 B-2011 online online			20044615	Acidity, as CaCO3
	1500	Acidity, as CaCO3		
SM 2320 B-2011 online online			20045618	Alkalinity as CaCO3
	1505	Alkalinity as CaCO3		
SM 2340 B-2011 online online			20046611	Hardness
	1750	Hardness		
SM 2340 C-2011 22nd Ed 22nd Ed			20047614	Hardness by EDTA Titration
	1750	Hardness		
SM 2510 B-2011			20048617	Conductivity by Probe



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1610	Conductivity		
SM 2540 B-2011 2011 2011			20049416	Total Solids Dried at 103 - 105C
	1950	Residue-total		
SM 2540 C-2011 online online			20050413	Residue-filterable (TDS)
	1955	Residue-filterable (TDS)		
SM 2540 D-2011			20051212	Total Suspended Solids Dried at 103 - 105 C
	1960	Residue-nonfilterable (TSS)		
SM 2540 F-2011			20052215	Settleable Solids
	1965	Residue-settleable		
SM 2540 G-2011 online online			20005270	Total, Fixed, and Volatile Solids
	1725	Total, fixed, and volatile residue		
SM 4500-CI C-2011 online online			20085216	Chloride
	1575	Chloride		
SM 4500-CI F 22nd ED 22nd ED			20080619	Chlorine (Residual) - DPD Ferrous Titrimetric Method
	1940	Total residual chlorine		
SM 4500-CN E-2011 2011 2011			20096428	Cyanide by Colormetric Method
	1635	Cyanide		
	1645	Total cyanide		
SM 4500-CN <sup>-</sup> G 22nd ED 22nd ED			20097012	Cyanide - Cyanides Amenable to Chlorination after Distillation
	1510	Amenable cyanide		
SM 4500-F <sup>-</sup> C-2011 online online			20102414	Fluoride by Ion Selective Electrode
	1730	Fluoride		
SM 4500-H <sup>+</sup> B-2011			20105220	pH - Electrometric Measurement
	1900	pH		
SM 4500-NH3 E 22nd ED 22nd ED			20110014	Nitrogen (Ammonia) - Ammonia-Selective Electrode Method Using Known Addition
	1515	Ammonia as N		
SM 4500-NH3 G-2011			20111415	Nitrogen (Ammonia) - Automated Phenate Method



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1515	Ammonia as N		
SM 4500-O G-2011 22nd ED 22nd ED			20121668	Dissolved Oxygen by Membrane Electrode
	1880	Oxygen, dissolved		
SM 4500-S2 F-2011			20126663	Sulfide by Iodometric Method
	2005	Sulfide		
SM 4500-S2 <sup>-</sup> D-2011 online online			20125864	Sulfide by Methylene Blue Method
	2005	Sulfide		
SM 4500-SO <sub>3</sub> <sup>-</sup> B-2011			20130636	Sulfite by Iodometric Method
	2015	Sulfite-SO <sub>3</sub>		
SM 5210 B-2011 online online			20135266	Biochemical Oxygen Demand (5 days @ 20 C).
	1530	Biochemical oxygen demand		
SM 5220 C-2011			20136010	Chemical Oxygen Demand - Colorimetric, Automated.
	1565	Chemical oxygen demand		
SM 5310 C-2011 online online			20138823	TOC by Persulfate-Ultraviolet or Heated-Persulfate Oxidation Method
	2040	Total organic carbon		
SM 5540 C-2011			20145066	Surfactants as MBAS
	2025	Surfactants - MBAS		
SM 5550 B 20th ED 20th ED			20145306	Tannin and Lignin
	9597	Tannin & Lignin		
SM 9215 B (PCA) 20th ED 20th ED			20181208	Heterotrophic Plate Count Pour Plate (plate count agar): Heterotrophic Bacteria
	2555	Heterotrophic plate count		
SM 9221 B (LTB) + C MPN 20th ED 20th ED			20186805	Multiple Tube Fermentation Quantitative (LTB): Total Coliform
	2500	Total coliforms		
SM 9221 E (EC) 20th ED 20th ED			20226806	Multiple Tube Fermentation Quantitative (EC): Fecal Coliform
	2530	Fecal coliforms		
SM 9222 D (m-FC) 20th ED 20th ED			20209603	Membrane Filtration Quantitative (m-FC): Fecal Coliform



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Matrix	Reference	Analyte Code	Analyte	Method Code	Description
		2530	Fecal coliforms		
	SM 9223 B (Colilert®) 20th ED 20th ED			20212208	Chromogenic/Fluorogenic Qualitative (Colilert®): Total Coliform and E. coli
		2525	Escherichia coli		
		2500	Total coliforms		
	SM 9223 B (Colilert®-18 Quanti-Tray®) 20th ED 20th ED			20213201	Chromogenic/Fluorogenic Quantitative (Colilert®-18): Total Coliform and E. coli
		2525	Escherichia coli		
		2500	Total coliforms		
	SM 9223 B (Colilert®-18) 20th ED 20th ED			20214204	Chromogenic/Fluorogenic Qualitative (Colilert®-18): Total Coliform and E. coli
		2525	Escherichia coli		
		2500	Total coliforms		
	SM 9223 B (Colilert®-18) 21st ED 21st ED			20214408	Chromogenic/Fluorogenic Qualitative (Colilert®-18): Total Coliform and E. coli
		2525	Escherichia coli		
		2500	Total coliforms		
	WI(95) DRO			90019457	Wisconsin DNR - Modified Method for Determination of Diesel Range Organics by GC-FID
		9369	Diesel range organics (DRO)		
<b>Solids</b>					
	AK101 GRO			90015002	Determination of Gasoline Range Organics - Alaska Department of Environmental Conservation
		9408	Gasoline range organics (GRO)		
	AK102 DRO			90015206	Determination of Diesel Range Organics - Alaska Department of Environmental Conservation
		9369	Diesel range organics (DRO)		
	AK103 RRO			90015400	Determination of Residual Range Organics - Alaska Department of Environmental Conservation
		9499	Motor Oil		
	ALS Kelso LCP-Acryl 1 1			60001712	ALS Kelso - Acrylamide by HPLC/MS/MS



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	4330	Acrylamide		
ALS Kelso LCP-PFC 10 10			60001516	ALS Kelso - Perfluorinated Compounds by HPLC-MS-MS (Columbia Analytical Services)
	6948	1H, 1H, 2H, 2H-Perfluorodecanesulfonic acid (8:2 FTS)		
	9616	1H, 1H, 2H, 2H-perfluorododecane sulfonic acid (10:2 FTS)		
	9616	1H, 1H, 2H, 2H-perfluorododecane sulfonic acid (10:2 FTS)		
	6946	1H, 1H, 2H, 2H-Perfluorohexanesulfonic acid (4:2 FTS)		
	6947	1H, 1H, 2H, 2H-Perfluorooctanesulfonic acid (6:2 FTS)		
	9437	4:2 Fluorotelomer sulfonate (4:2FTS)		
	6457	6:2 Fluorotelomersulfonate (6:2FTS)		
	6461	8:2 Fluorotelomersulfonate (8:2FTS)		
	9460	Hexafluoropropylene oxide dimer acid (HFPO-DA)		
	9460	Hexafluoropropylene oxide dimer acid (HFPO-DA)		
	9395	N-Ethylperfluorooctane sulfonamide (EtFOSAm)		
	9395	N-Ethylperfluorooctane sulfonamide (EtFOSAm)		
	9431	N-Ethylperfluorooctane sulfonamido ethanol (EtFOSE)		
	9431	N-Ethylperfluorooctane sulfonamido ethanol (EtFOSE)		
	4846	N-Ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)		
	4846	N-Ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)		
	4847	N-Methylperfluorooctane sulfonamido		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
		acetic acid (NMeFOSAA)		
	4847	N-Methylperfluorooctane sulfonamido acetic acid (NMeFOSAA)		
	6949	N-Methylperfluorooctane sulfonamido ethanol (MeFOSE)		
	6949	N-Methylperfluorooctane sulfonamido ethanol (MeFOSE)		
	9433	N-Methylperfluorooctanesulfonamide (MeFOSA)		
	9433	N-Methylperfluorooctanesulfonamide (MeFOSA)		
	6918	Perfluorobutane sulfonic acid (PFBS)		
	6915	Perfluorobutanoic acid (PFBA)		
	6915	Perfluorobutanoic acid (PFBA)		
	9562	Perfluorodecane Sulfonate (PFDS)		
	6920	Perfluorodecane sulfonic acid (PFDS)		
	6905	Perfluorodecanoic acid (PFDA)		
	6905	Perfluorodecanoic acid (PFDA)		
	6903	Perfluorododecanoic acid (PFDoA)		
	6903	Perfluorododecanoic acid (PFDoA)		
	9470	Perfluoroheptane sulfonic acid (PFHpS)		
	9470	Perfluoroheptane sulfonic acid (PFHpS)		
	6908	Perfluoroheptanoic acid (PFHpA)		
	6908	Perfluoroheptanoic acid (PFHpA)		
	6901	Perfluorohexadecanoic acid (PFHxDA)		
	6927	Perfluorohexane sulfonic acid (PFHxS)		
	6913	Perfluorohexanoic acid (PFHxA)		
	6913	Perfluorohexanoic acid (PFHxA)		
	6929	Perfluorononane sulfonic acid (PFNS)		
	6906	Perfluorononanoic acid (PFNA)		
	6906	Perfluorononanoic acid (PFNA)		
	6917	Perfluorooctane sulfonamide		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
		(PFOSAm)		
	6917	Perfluorooctane sulfonamide (PFOSAm)		
	6931	Perfluorooctane sulfonic acid (PFOS)		
	6931	Perfluorooctane sulfonic acid (PFOS)		
	6912	Perfluorooctanoic acid (PFOA)		
	6912	Perfluorooctanoic acid (PFOA)		
	6934	Perfluoropentane sulfonic acid (PFPeS)		
	6914	Perfluoropentanoic acid (PFPeA)		
	6914	Perfluoropentanoic acid (PFPeA)		
	6902	Perfluorotetradecanoic acid (PFTDA)		
	6902	Perfluorotetradecanoic acid (PFTDA)		
	9563	Perfluorotridecanoic acid (PFTrDA)		
	9563	Perfluorotridecanoic acid (PFTrDA)		
	6904	Perfluoroundecanoic acid (PFUnA)		
	6904	Perfluoroundecanoic acid (PFUnA)		
ALS Kelso LCP-PFC 11 11			60001527	ALS Kelso - Perfluorinated Compounds by HPLC-MS-MS (Columbia Analytical Services)
	6948	1H, 1H, 2H, 2H-Perfluorodecanesulfonic acid (8:2 FTS)		
	9616	1H, 1H, 2H, 2H-perfluorododecane sulfonic acid (10:2 FTS)		
	6946	1H, 1H, 2H, 2H-Perfluorohexanesulfonic acid (4:2 FTS)		
	6947	1H, 1H, 2H, 2H-Perfluorooctanesulfonic acid (6:2 FTS)		
	9460	Hexafluoropropylene oxide dimer acid (HFPO-DA)		
	9395	N-Ethylperfluorooctane sulfonamide (EtFOSAm)		
	9431	N-Ethylperfluorooctane sulfonamido ethanol (EtFOSE)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	4846	N-Ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)		
	4847	N-Methylperfluorooctane sulfonamidoacetic acid (NMeFOSAA)		
	6949	N-Methylperfluorooctane sulfonamido ethanol (MeFOSE)		
	9433	N-Methylperfluorooctanesulfonamide (MeFOSA)		
	6918	Perfluorobutane sulfonic acid (PFBS)		
	6915	Perfluorobutanoic acid (PFBA)		
	6920	Perfluorodecane sulfonic acid (PFDS)		
	6905	Perfluorodecanoic acid (PFDA)		
	6903	Perfluorododecanoic acid (PFDoA)		
	9470	Perfluoroheptane sulfonic acid (PFHpS)		
	6908	Perfluoroheptanoic acid (PFHpA)		
	6901	Perfluorohexadecanoic acid (PFHxDA)		
	6927	Perfluorohexane sulfonic acid (PFHxS)		
	6913	Perfluorohexanoic acid (PFHxA)		
	6929	Perfluorononane sulfonic acid (PFNS)		
	6906	Perfluorononanoic acid (PFNA)		
	6917	Perfluorooctane sulfonamide (PFOSAm)		
	6931	Perfluorooctane sulfonic acid (PFOS)		
	6912	Perfluorooctanoic acid (PFOA)		
	6934	Perfluoropentane sulfonic acid (PFPeS)		
	6914	Perfluoropentanoic acid (PFPeA)		
	6902	Perfluorotetradecanoic acid (PFTDA)		
	9563	Perfluorotridecanoic acid (PFTTrDA)		
	6904	Perfluoroundecanoic acid (PFUnA)		

ALS Kelso SOC-8151M 11 11

60001754 ALS Kelso - Chlorinated Pesticides by GC/ECD



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	6730	2,3,4,5-Tetrachlorophenol		
	6740	2,3,5,6-Tetrachlorophenol		
	6835	2,4,5-Trichlorophenol		
	6840	2,4,6-Trichlorophenol		
	6818	3,4,5-Trichlorophenol		
	5997	3,4-Dichlorophenol		
	6397	3,5-Dichlorophenol		
	6605	Pentachlorophenol		
ASTM D1426-08B			30007397	Ammonia by Titration
	1515	Ammonia as N		
ASTM D3590-02(06)A			30016819	Total Kjeldahl Nitrogen in Water
	1795	Total Kjeldahl Nitrogen (TKN)		
ASTM D4129 05 05			30018907	Total and Organic Carbon in Water by High Temperature Oxidation and by Coulometric Detection
	2040	Total organic carbon		
ASTM D422-63			30030854	Partical Size Distribution (Grain sizing)
	6118	Distribution of particle sizes		
CAS PestMS2 (1699 modified) 2.2			60035101	Chlorinated Pesticides by GC/MS/MS
	8580	2,4'-DDD		
	8585	2,4'-DDE		
	8590	2,4'-DDT		
	7355	4,4'-DDD		
	7360	4,4'-DDE		
	7365	4,4'-DDT		
	7025	Aldrin		
	7110	alpha-BHC (alpha-Hexachlorocyclohexane)		
	7115	beta-BHC (beta-Hexachlorocyclohexane)		
	7300	Chlorpyrifos		
	7240	cis-chlordane (alpha-Chlordane)		
	7925	cis-Nonachlor		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	7105	delta-BHC		
	7470	Dieldrin		
	7510	Endosulfan I		
	7515	Endosulfan II		
	7520	Endosulfan sulfate		
	7540	Endrin		
	7530	Endrin aldehyde		
	7535	Endrin ketone		
	7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)		
	7245	gamma-Chlordane		
	7685	Heptachlor		
	7690	Heptachlor epoxide		
	6275	Hexachlorobenzene		
	7725	Isodrin		
	7810	Methoxychlor		
	7870	Mirex		
	5553	Octachlorostyrene		
	3890	Oxychlordane		
	7910	trans-Nonachlor		
CAS SOC-Butyl 10 10			60035009	Butyltin by GC/Flame Photometric Detector
	1201	Butyltin trichloride		
	1202	Dibutyltin dichloride		
	1209	Tetrabutyltin		
	1203	Tributyltin chloride		
EPA 1020A			10117007	Ignitability Setaflash Closed-cup Method
	1780	Ignitability		
EPA 1110A			10235208	Corrosivity Toward Steel
	1615	Corrosivity		
EPA 1311			10118806	Toxicity Characteristic Leaching Procedure
	1466	Toxicity Characteristic Leaching Procedure (TCLP)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
EPA 1312			10119003	Synthetic Precipitation Leaching Procedure
	1460	Synthetic Precipitation Leaching Procedure (SPLP)		
EPA 1340 Update VI Update VI			10019638	In Vitro Bioaccessability Assay for Lead in Soil
	1400	Acid Digestion of Solids		
EPA 160.3			10009800	Total Solids, dried @ 103-105 C.
	1950	Residue-total		
EPA 1630			10122608	Methyl Mercury by Purge & Trap Cold Vapor Atomic Fluorescence Spectrometry
	1205	Methyl Mercury		
EPA 1631E			10237204	Mercury in Water by Oxidation, Purge & Trap, and Cold Vapor Atomic Fluorescence
	1095	Mercury		
EPA 1664A (HEM)			10127807	N-Hexane Extractable Material (Oil and Grease) by Extraction and Gravimetry
	1803	n-Hexane Extractable Material (O&G)		
	1860	Oil & Grease		
EPA 300.0 2.1 2.1			10053200	Methods for the Determination of Inorganic Substances in Environmental Samples
	1575	Chloride		
	1730	Fluoride		
	2000	Sulfate		
EPA 3050B			10135601	Acid Digestion of Sediments, Sludges, and soils
	1400	Acid Digestion of Solids		
EPA 350.1 2 2			10063602	Ammonia Nitrogen - Colorimetric, Auto Phenate
	1515	Ammonia as N		
EPA 353.2 2 2			10067604	Nitrate/Nitrite Nitrogen - Automated, Cadmium
	1810	Nitrate as N		
	1820	Nitrate plus Nitrite as N		
	1840	Nitrite as N		
EPA 3540C			10140202	Soxhlet Extraction



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1452	Soxhlet Extraction		
EPA 3541			10140406	Automated Soxhlet Extraction
	1454	Soxhlet Extraction - Automated		
EPA 3546			10141205	Microwave Extraction
	1428	Microwave Extraction		
EPA 3550C			10142004	Ultrasonic Extraction
	1468	Ultrasonic Extraction		
EPA 3580A			10143007	Waste Dilution
	1470	Waste Dilution		
EPA 3620C			10146006	Florisil Cleanup
	1414	Florisil Clean-up		
EPA 3630C			10146802	Silica gel cleanup
	1446	Silica Gel Clean-up		
EPA 3640A			10147203	Gel Preparation Cleanup
	1418	Gel-Permeation Clean-up		
EPA 365.3			10070607	Phosphorous - Colorimetric, two reagent.
	1870	Orthophosphate as P		
	1908	Total Phosphate		
EPA 3660B			10148400	Sulfur cleanup
	1456	Sulfur Clean-up		
EPA 3665A			10148808	Sulfuric Acid / permanganate Cleanup
	1458	Sulfuric Acid / Permanganate Clean-Up		
EPA 5030B			10153409	Purge and trap for aqueous samples
	1406	Aqueous-phase Purge & Trap		
EPA 5035A			10284807	Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples
	1392	Closed-System Purge & Trap (Methanol)		
EPA 6010C			10155803	ICP - AES
	1000	Aluminum		
	1005	Antimony		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1010	Arsenic		
	1015	Barium		
	1020	Beryllium		
	1025	Boron		
	1030	Cadmium		
	1035	Calcium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1070	Iron		
	1075	Lead		
	1085	Magnesium		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		
	1125	Potassium		
	1140	Selenium		
	1150	Silver		
	1155	Sodium		
	1160	Strontium		
	1165	Thallium		
	1175	Tin		
	1180	Titanium		
	1185	Vanadium		
	1190	Zinc		
EPA 6010D 4 4			10155916	Metals by ICP - AES
	1000	Aluminum		
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		
	1020	Beryllium		
	1025	Boron		



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	1030	Cadmium		
	1035	Calcium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1070	Iron		
	1075	Lead		
	1085	Magnesium		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		
	1125	Potassium		
	1140	Selenium		
	1150	Silver		
	1155	Sodium		
	1160	Strontium		
	1165	Thallium		
	1175	Tin		
	1180	Titanium		
	1185	Vanadium		
	1190	Zinc		
EPA 6020A 1 1			10156419	Inductively Coupled Plasma -Mass Spectrometry
	1000	Aluminum		
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		
	1020	Beryllium		
	1030	Cadmium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1070	Iron		
	1075	Lead		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		
	1140	Selenium		
	1150	Silver		
	1160	Strontium		
	1165	Thallium		
	1185	Vanadium		
	1190	Zinc		
EPA 6020B 2 2			10156420	Inductively Coupled Plasma-Mass Spectrometry
	1000	Aluminum		
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		
	1020	Beryllium		
	1030	Cadmium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1070	Iron		
	1075	Lead		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		
	1140	Selenium		
	1150	Silver		
	1160	Strontium		
	1165	Thallium		
	1185	Vanadium		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1190	Zinc		
EPA 7196A			10162400	Chromium Hexavalent colorimetric
	1045	Chromium VI		
EPA 7471B			10166402	Mercury by Cold Vapor Atomic Absorption
	1095	Mercury		
EPA 8015C			10173805	Non-halogenated organics using GC/FID
	9369	Diesel range organics (DRO)		
	4785	Ethylene glycol		
	9408	Gasoline range organics (GRO)		
EPA 8081B			10178800	Organochlorine Pesticides by GC/ECD
	8580	2,4'-DDD		
	8585	2,4'-DDE		
	8590	2,4'-DDT		
	7355	4,4'-DDD		
	7360	4,4'-DDE		
	7365	4,4'-DDT		
	7005	Alachlor		
	7025	Aldrin		
	7110	alpha-BHC (alpha-Hexachlorocyclohexane)		
	7115	beta-BHC (beta-Hexachlorocyclohexane)		
	7250	Chlordane (tech.)		
	7300	Chlorpyrifos		
	7240	cis-chlordane (alpha-Chlordane)		
	7925	cis-Nonachlor		
	7105	delta-BHC		
	7470	Dieldrin		
	7510	Endosulfan I		
	7515	Endosulfan II		
	7520	Endosulfan sulfate		
	7540	Endrin		
	7530	Endrin aldehyde		



# OREGON

## Environmental Laboratory Accreditation Program

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ALS Environmental, Kelso

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Kelso, WA 98626

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**EPA CODE:** WA01276

**Certificate:** WA100010 - 023

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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	7535	Endrin ketone		
	7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)		
	7245	gamma-Chlordane		
	7685	Heptachlor		
	7690	Heptachlor epoxide		
	6275	Hexachlorobenzene		
	4835	Hexachlorobutadiene		
	4840	Hexachloroethane		
	7725	Isodrin		
	7810	Methoxychlor		
	7870	Mirex		
	3890	Oxychlordane		
	8250	Toxaphene (Chlorinated camphene)		
	7910	trans-Nonachlor		
EPA 8082A	10179201	Polychlorinated Biphenyls (PCBs) by GC/ECD		
	9095	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ-206)		
	9090	2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194)		
	9103	2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195)		
	9065	2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170)		
	9020	2,2',3,3',4,4'-Hexachlorobiphenyl (BZ-128)		
	9112	2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ-201)		
	9116	2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-174)		
	9114	2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ-177)		
	9120	2,2',3,3',4,6'-Hexachlorobiphenyl (BZ-132)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	9133	2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ-203)		
	9134	2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ-180)		
	9075	2,2',3,4,4',5,6-Heptachlorobiphenyl (BZ-183)		
	9025	2,2',3,4,4',5'-Hexachlorobiphenyl (BZ-138)		
	9139	2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ-184)		
	9080	2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ-187)		
	9030	2,2',3,4,5,5'-Hexachlorobiphenyl (BZ-141)		
	9151	2,2',3,4',5',6-Hexachlorobiphenyl (BZ-149)		
	8975	2,2',3,4,5'-Pentachlorobiphenyl (BZ-87)		
	9155	2,2',3,4',5-Pentachlorobiphenyl (BZ-90)		
	9154	2,2',3,4',5'-Pentachlorobiphenyl (BZ-97)		
	9035	2,2',3,5,5',6-Hexachlorobiphenyl (BZ-151)		
	9166	2,2',3,5',6-Pentachlorobiphenyl (BZ-95)		
	8945	2,2',3,5'-Tetrachlorobiphenyl (BZ-44)		
	9040	2,2',4,4',5,5'-Hexachlorobiphenyl (BZ-153)		
	9174	2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-154)		
	9175	2,2',4,4',5-Pentachlorobiphenyl (BZ-99)		
	8980	2,2',4,5,5'-Pentachlorobiphenyl (BZ-101)		
	8950	2,2',4,5'-Tetrachlorobiphenyl (BZ-49)		
	8955	2,2',5,5'-Tetrachlorobiphenyl (BZ-52)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	8930	2,2',5-Trichlorobiphenyl (BZ-18)		
	9085	2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ-189)		
	9050	2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)		
	9193	2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158)		
	8985	2,3,3',4,4'-Pentachlorobiphenyl (BZ-105)		
	8990	2,3,3',4',6-Pentachlorobiphenyl (BZ-110)		
	9207	2,3,3',4'-Tetrachlorobiphenyl (BZ-56)		
	9055	2,3',4,4',5,5'-Hexachlorobiphenyl (BZ-167)		
	9218	2,3',4,4',5',6-Hexachlorobiphenyl (BZ-168)		
	9005	2,3,4,4',5-Pentachlorobiphenyl (BZ-114)		
	8995	2,3',4,4',5-Pentachlorobiphenyl (BZ-118)		
	9000	2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)		
	9220	2,3',4,4',6-Pentachlorobiphenyl (BZ-119)		
	9221	2,3,4,4'-Tetrachlorobiphenyl (BZ-60)		
	8960	2,3',4,4'-Tetrachlorobiphenyl (BZ-66)		
	9230	2,3',4',5-Tetrachlorobiphenyl (BZ-70)		
	9239	2,3',4'-Trichlorobiphenyl (BZ-33)		
	8920	2,3-Dichlorobiphenyl (BZ-5)		
	9250	2,4,4',5-Tetrachlorobiphenyl (BZ-74)		
	9252	2,4,4'-Trichlorobiphenyl (BZ-28)		
	8940	2,4',5-Trichlorobiphenyl (BZ-31)		
	9256	2,4'-Dichlorobiphenyl (BZ-8)		
	8915	2-Chlorobiphenyl (BZ-1)		
	9060	3,3',4,4',5,5'-Hexachlorobiphenyl (BZ-169)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	9015	3,3',4,4',5-Pentachlorobiphenyl (BZ-126)		
	8965	3,3',4,4'-Tetrachlorobiphenyl (BZ-77)		
	8970	3,4,4',5-Tetrachlorobiphenyl (BZ-81)		
	9266	3,4,4'-Trichlorobiphenyl (BZ-37)		
	8880	Aroclor-1016 (PCB-1016)		
	8885	Aroclor-1221 (PCB-1221)		
	8890	Aroclor-1232 (PCB-1232)		
	8895	Aroclor-1242 (PCB-1242)		
	8900	Aroclor-1248 (PCB-1248)		
	8905	Aroclor-1254 (PCB-1254)		
	8910	Aroclor-1260 (PCB-1260)		
	8912	Aroclor-1262 (PCB-1262)		
	8913	Aroclor-1268 (PCB-1268)		
	9105	Decachlorobiphenyl (BZ-209)		
EPA 8151A			10183207	Chlorinated Herbicides by GC/ECD
	8655	2,4,5-T		
	8545	2,4-D		
	8560	2,4-DB		
	8555	Dalapon		
	8595	Dicamba		
	8605	Dichloroprop (Dichloroprop)		
	8620	Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)		
	7775	MCPA		
	7780	MCPP		
	8650	Silvex (2,4,5-TP)		
EPA 8260C			10307003	Volatile Organics: GC/MS (capillary column)
	5105	1,1,1,2-Tetrachloroethane		
	5185	1,1,1-Trichloro-2,2,2-trifluoroethane (Freon 113a)		
	5160	1,1,1-Trichloroethane		
	5110	1,1,2,2-Tetrachloroethane		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	5195	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)		
	5165	1,1,2-Trichloroethane		
	5167	1,1,2-Trichlorofluoroethane		
	4630	1,1-Dichloroethane		
	4640	1,1-Dichloroethylene		
	4670	1,1-Dichloropropene		
	5150	1,2,3-Trichlorobenzene		
	5180	1,2,3-Trichloropropane		
	5155	1,2,4-Trichlorobenzene		
	5210	1,2,4-Trimethylbenzene		
	4570	1,2-Dibromo-3-chloropropane (DBCP)		
	4585	1,2-Dibromoethane (EDB, Ethylene dibromide)		
	4610	1,2-Dichlorobenzene		
	4635	1,2-Dichloroethane (Ethylene dichloride)		
	4655	1,2-Dichloropropane		
	6800	1,3,5-Trichlorobenzene		
	5215	1,3,5-Trimethylbenzene		
	4615	1,3-Dichlorobenzene		
	4660	1,3-Dichloropropane		
	4620	1,4-Dichlorobenzene		
	4735	1,4-Dioxane (1,4- Diethyleneoxide)		
	4510	1-Chlorohexane		
	4665	2,2-Dichloropropane		
	4410	2-Butanone (Methyl ethyl ketone, MEK)		
	4500	2-Chloroethyl vinyl ether		
	4535	2-Chlorotoluene		
	4860	2-Hexanone (MBK)		
	5020	2-Nitropropane		
	4536	4-Bromofluorobenzene		
	4540	4-Chlorotoluene		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	4910	4-Isopropyltoluene (p-Cymene)		
	4995	4-Methyl-2-pentanone (MIBK)		
	4305	Acetamide		
	4315	Acetone		
	4320	Acetonitrile		
	4325	Acrolein (Propenal)		
	4330	Acrylamide		
	4340	Acrylonitrile		
	4355	Allyl chloride (3-Chloropropene)		
	4375	Benzene		
	4385	Bromobenzene		
	4390	Bromochloromethane		
	4395	Bromodichloromethane		
	4400	Bromoform		
	4450	Carbon disulfide		
	4455	Carbon tetrachloride		
	4475	Chlorobenzene		
	4575	Chlorodibromomethane		
	4485	Chloroethane (Ethyl chloride)		
	4505	Chloroform		
	4525	Chloroprene (2-Chloro-1,3-butadiene)		
	4705	cis & trans-1,2-Dichloroethene		
	4645	cis-1,2-Dichloroethylene		
	4680	cis-1,3-Dichloropropene		
	4595	Dibromomethane (Methylene bromide)		
	4625	Dichlorodifluoromethane (Freon-12)		
	4725	Diethyl ether		
	4755	Ethyl acetate		
	4810	Ethyl methacrylate		
	4765	Ethylbenzene		
	4835	Hexachlorobutadiene		
	4870	Iodomethane (Methyl iodide)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	4875	Isobutyl alcohol (2-Methyl-1-propanol)		
	4900	Isopropylbenzene (Cumene)		
	5240	m+p-xylene		
	4925	Methacrylonitrile		
	4950	Methyl bromide (Bromomethane)		
	4960	Methyl chloride (Chloromethane)		
	5000	Methyl tert-butyl ether (MTBE)		
	4975	Methylene chloride (Dichloromethane)		
	5245	m-Xylene		
	5005	Naphthalene		
	4435	n-Butylbenzene		
	5090	n-Propylbenzene		
	5250	o-Xylene		
	4440	sec-Butylbenzene		
	5100	Styrene		
	4370	T-amylmethylether (TAME)		
	4445	tert-Butylbenzene		
	5115	Tetrachloroethylene (Perchloroethylene)		
	5140	Toluene		
	4700	trans-1,2-Dichloroethylene		
	4685	trans-1,3-Dichloropropylene		
	4605	trans-1,4-Dichloro-2-butene		
	5170	Trichloroethene (Trichloroethylene)		
	5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)		
	5225	Vinyl acetate		
	5235	Vinyl chloride		
	5260	Xylene (total)		
EPA 8270D			10186002	Semivolatle Organic compounds by GC/MS
	6703	1,1'-Biphenyl (BZ-0)		
	6715	1,2,4,5-Tetrachlorobenzene		
	5155	1,2,4-Trichlorobenzene		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	4610	1,2-Dichlorobenzene		
	6220	1,2-Diphenylhydrazine		
	4615	1,3-Dichlorobenzene		
	4620	1,4-Dichlorobenzene		
	4659	2,2'-Oxybis(1-chloropropane), bis(2-Chloro-1-methylethyl)ether		
	4659	2,2'-Oxybis(1-chloropropane), bis(2-Chloro-1-methylethyl)ether		
	6735	2,3,4,6-Tetrachlorophenol		
	6835	2,4,5-Trichlorophenol		
	6840	2,4,6-Trichlorophenol		
	6000	2,4-Dichlorophenol		
	6130	2,4-Dimethylphenol		
	6175	2,4-Dinitrophenol		
	6185	2,4-Dinitrotoluene (2,4-DNT)		
	6190	2,6-Dinitrotoluene (2,6-DNT)		
	5735	2-Chloroaniline		
	5795	2-Chloronaphthalene		
	5800	2-Chlorophenol		
	6360	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)		
	6385	2-Methylnaphthalene		
	6400	2-Methylphenol (o-Cresol)		
	6460	2-Nitroaniline		
	6490	2-Nitrophenol		
	6412	3 & 4 Methylphenol		
	5945	3,3'-Dichlorobenzidine		
	6405	3-Methylphenol (m-Cresol)		
	6465	3-Nitroaniline		
	5660	4-Bromophenyl phenyl ether (BDE-3)		
	5700	4-Chloro-3-methylphenol		
	5745	4-Chloroaniline		
	5825	4-Chlorophenyl phenylether		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	6410	4-Methylphenol (p-Cresol)		
	6470	4-Nitroaniline		
	6500	4-Nitrophenol		
	5500	Acenaphthene		
	5505	Acenaphthylene		
	5510	Acetophenone		
	5545	Aniline		
	5555	Anthracene		
	7065	Atrazine		
	5562	Azobenzene		
	5570	Benzaldehyde		
	5575	Benzo(a)anthracene		
	5580	Benzo(a)pyrene		
	5590	Benzo(g,h,i)perylene		
	9309	Benzo(j)fluoranthene		
	5600	Benzo(k)fluoranthene		
	5585	Benzo[b]fluoranthene		
	5610	Benzoic acid		
	5630	Benzyl alcohol		
	5760	bis(2-Chloroethoxy)methane		
	5765	bis(2-Chloroethyl) ether		
	5670	Butyl benzyl phthalate		
	7180	Caprolactam		
	5680	Carbazole		
	5855	Chrysene		
	6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)		
	5895	Dibenz(a,h) anthracene		
	5905	Dibenzofuran		
	6070	Diethyl phthalate		
	6135	Dimethyl phthalate		
	5925	Di-n-butyl phthalate		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	6200	Di-n-octyl phthalate		
	6265	Fluoranthene		
	6270	Fluorene		
	6275	Hexachlorobenzene		
	4835	Hexachlorobutadiene		
	6285	Hexachlorocyclopentadiene		
	4840	Hexachloroethane		
	6315	Indeno(1,2,3-cd) pyrene		
	6320	Isophorone		
	5005	Naphthalene		
	5015	Nitrobenzene		
	6530	n-Nitrosodimethylamine		
	6545	n-Nitrosodi-n-propylamine		
	6535	n-Nitrosodiphenylamine		
	6590	Pentachlorobenzene		
	6605	Pentachlorophenol		
	6615	Phenanthrene		
	6625	Phenol		
	6665	Pyrene		
	5095	Pyridine		
EPA 8270D SIM			10242509	Semivolatile Organic compounds by GC/MS
	6703	1,1'-Biphenyl (BZ-0)		
	4735	1,4-Dioxane (1,4- Diethyleneoxide)		
	6380	1-Methylnaphthalene		
	9501	1-Methylphenanthrene		
	6852	2,3,5-Trimethylnaphthalene		
	6188	2,6-Dimethylnaphthalene		
	6385	2-Methylnaphthalene		
	5500	Acenaphthene		
	5505	Acenaphthylene		
	5555	Anthracene		
	5575	Benzo(a)anthracene		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	5580	Benzo(a)pyrene		
	5605	Benzo(e)pyrene		
	5590	Benzo(g,h,i)perylene		
	9309	Benzo(j)fluoranthene		
	5600	Benzo(k)fluoranthene		
	5585	Benzo[b]fluoranthene		
	5680	Carbazole		
	5855	Chrysene		
	5895	Dibenz(a,h) anthracene		
	5905	Dibenzofuran		
	5910	Dibenzothiophene		
	6265	Fluoranthene		
	6270	Fluorene		
	6315	Indeno(1,2,3-cd) pyrene		
	5005	Naphthalene		
	6605	Pentachlorophenol		
	6608	Perylene		
	6615	Phenanthrene		
	6665	Pyrene		
EPA 8321B			10189205	Solvent Extractable non-volatile compounds by HPLC/TS/MS
	7195	Carbaryl (Sevin)		
EPA 9012B			10243206	Total and Amenable Cyanide (automated colorimetric with off-line distillation)
	1510	Amenable cyanide		
	1645	Total cyanide		
EPA 9013A			10308802	Cyanide Extraction Procedure for Solids and Oils
	1421	Cyanide Extraction for Solids and Oils		
EPA 9030B			10195605	Acid-Soluble and Acid-Insoluble sulfides: Distillation
	2005	Sulfide		
EPA 9034			10196006	Titrimetric Procedure for Acid-Soluble and Acid-Insoluble Sulfides



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	2005	Sulfide		
EPA 9045D			10244607	Soil and Waste pH
	1900	pH		
EPA 9056A			10199607	Determination of Inorganic Anions by Ion Chromatography
	1575	Chloride		
	1730	Fluoride		
	1805	Nitrate		
	2000	Sulfate		
EPA 9071A			10201408	Oil and Grease Extraction Method for sludge and sediment samples
	1860	Oil & Grease		
NWTPH-Dx			90018409	Oregon DEQ TPH Diesel Range
	9369	Diesel range organics (DRO)		
	9506	Residual Range Organics (RRO)		
NWTPH-Gx			90018603	Oregon DEQ TPH Gasoline Range Organics by GC/FID-PID Purge & Trap
	9408	Gasoline range organics (GRO)		
NWTPH-HCID			90013200	Oregon DEQ Total Petroleum Hydrocarbon ID
	2050	Total Petroleum Hydrocarbons (TPH)		
PLUMB 1981			60006259	Extraction/Preparation
	6118	Distribution of particle sizes		
	8031	Extraction/Preparation		
WI(95) DRO			90019457	Wisconsin DNR - Modified Method for Determination of Diesel Range Organics by GC-FID
	9369	Diesel range organics (DRO)		



# Oregon Environmental Laboratory Accreditation Program



NELAP Recognized

**ALS Environmental, Kelso**

**WA100010**

1317 South 13th Ave.

Kelso, WA 98626

IS GRANTED APPROVAL BY ORELAP UNDER THE 2016 TNI STANDARDS, TO PERFORM ANALYSES ON ENVIRONMENTAL SAMPLES IN MATRICES AS LISTED BELOW :

Air	Drinking Water	Non-Potable Water	Solids and Chemical Waste	Tissue
	Chemistry	Chemistry	Chemistry	Chemistry
	Microbiology	Microbiology		

AND AS RECORDED IN THE LIST OF APPROVED ANALYTES, METHODS, ANALYTICAL TECHNIQUES, AND FIELDS OF TESTING ISSUED CONCURRENTLY WITH THIS CERTIFICATE AND REVISED AS NECESSARY.

ACCREDITED STATUS DEPENDS ON SUCCESSFUL ONGOING PARTICIPATION IN THE PROGRAM AND CONTINUED COMPLIANCE WITH THE STANDARDS.

CUSTOMERS ARE URGED TO VERIFY THE LABORATORY'S CURRENT ACCREDITATION STATUS IN OREGON.

Travis Bartholomew  
Oregon State Public Health Laboratory  
ORELAP Program Manager  
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## Quality Assurance Manual

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## 1. Scope

This Quality Assurance Manual (QAM) describes the policies, procedures and accountabilities established by the Laboratory of ALS Environmental (ALS) to ensure that the test results reported from analysis of air, water, soil, waste, and other matrices are reliable and of known and documented quality. This document describes the quality assurance and quality control procedures followed to generate reliable analytical data.

This QAM is designed to be an overview of ALS operations. Detailed methodologies and practices are written in ALS Standard Operating Procedures (SOPs). Where appropriate, ALS SOPs are referenced in this document to direct the reader to more complete information.

ALS maintains certifications pertaining to various commercial and government entities. Each certification requires that the laboratory continue to perform at levels specified by the programs issuing certification. Program requirements can be rigorous; they include performance evaluations as well as annual audits of the laboratory to verify compliance.

### Quality Assurance Policy

ALS is committed to producing legally defensible analytical data of known and documented quality acceptable for its intended use and in compliance with applicable regulatory programs. This QAM is designed to satisfy the applicable requirements of the Various States, United States Environmental Protection Agency (USEPA), TNI Volume 1 2009/2016 and ISO 17025: 2017.

ALS corporate management has committed its full support to provide the personnel, facilities, equipment, and procedures required by this QAM and other client and project related requirements.

ALS management reviews its operations on an ongoing basis and seeks input from staff and clients to make improvements.

It is the policy of ALS that all employees be familiar with all quality documentation.

### Quality System

This QAM and SOPs referenced in this document comprise the ALS management system. This management system includes all quality assurance policies and quality control procedures.

Although verbal communication with employees is essential, written and visual communication through email and computer systems is the cornerstone of effective communication at ALS. Computer workstations throughout the lab provide access to LIMS, Procedures and email systems. All information essential for effective and consistent communication of analytical requirements and details affecting quality is available through these computerized systems.

### Ethics and Data Integrity

It is the policy of ALS to perform work for clients in the most efficient manner possible, avoiding waste of resources. It is the role of both ALS management and employees to ensure that work for clients is performed most efficiently and effectively by properly utilizing ALS purchased materials, equipment, and the time and ability of personnel.

ALS policy on waste, fraud, and abuse is described in ALS SOP *Laboratory Ethics and Data Integrity* (CE-GEN-001). It is the policy of ALS to generate accurate and reliable data in accordance with contractual and regulatory requirements. As stated in the ALS policies manual, any undue pressure applied to employees in the performance of their duties must be reported as per procedures for reporting listed in ALS SOP CE-GEN-001. It is against ALS policy to improperly manipulate or falsify data or to engage in any other

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unethical conduct as defined in ALS Corporate SOP CE-GEN-001. ALS provides mandatory initial and annual refresher training for all employees on SOP CE-GEN-001.

Data integrity training is provided as a formal part of new employee orientation and a refresher is given annually for all employees as detailed in the Ethics and Data Integrity corporate SOP CE-GEN-001. Key topics covered are the organizational objective and its relationship to the critical need for honesty and full disclosure in all analytical reporting, record keeping, and reporting data integrity issues. Training includes discussion regarding all data integrity procedures, data integrity training documentation, in-depth data monitoring and data integrity procedures. Training topics also cover examples of improper actions, legal and liability implications (company and personal), causes, prevention, awareness, and reporting options. Computer security is also included, covering ALS computing security awareness, passwords and access, and related topics. Employees are required to understand that any infractions of the laboratory data integrity procedures shall result in a detailed investigation that could lead to very serious consequences including immediate termination, or civil/criminal prosecution. Evidence of training is maintained by the QA Department. See Appendix C for a copy of the ALS Ethics and Integrity Agreement.

In order to maintain compliance with the requirement to conduct and document ethics and data integrity training annually for all employees, data integrity training will be assigned on the first work day of the calendar year through the ALStar program. This will allow for completion of the training and the proper documentation within the assigned 60 day period. Any employee that does not complete the required data integrity training by the end of the 60 day assigned completion period will be removed from normal laboratory operations until the requirement is met to complete the required annual training by the end of the calendar year.

The pertinent ALS Project Manager must approve deviations from contractual requirements. The Project Manager obtains approval for any such deviations, either in writing or by phone (documented in a phone log) from pertinent contract authorities. In addition, ALS requires that deviations from contractual requirements that might affect data quality be reported to clients. Any employee who knowingly manipulates and/or falsifies data or documents or engages in any unethical conduct is subject to immediate release from employment.

ALS employees who are aware of, or reasonably suspicious of, any case of data manipulation, falsification of data, waste of resources, or other unethical practice or misconduct shall notify any manager. Under the direction of the laboratory director, every allegation of unethical conduct will be fully investigated.

## 2. Normative References

ALS relies primarily upon the most current EPA approved revisions of the references listed below for methodologies used in the laboratory. Procedures contained in these references are acceptable for use only after the lab has demonstrated and documented adequate performance with the method such as method detection limit studies, precision and accuracy studies, proficiency sample analysis, and linear calibration range studies. These studies are then routinely verified as long as the methods are in use in the laboratory.

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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ISO/IEC 17025:2017, *General Requirements for the Competence of Testing and Calibration Laboratories*.

TNI 2009 and 2016, VOLUME 1, *Management and Technical Requirements for Laboratories Performing Environmental Analysis*.

DoD/DOE QSM, *Department of Defense (DoD), Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories*.

ISO/IEC Guide 99, *International Vocabulary of Metrology — Basic and General Concepts and Associated Terms (VIM1)*.

ISO/IEC 17000, *Conformity Assessment — Vocabulary and General Principles*.

*Methods for Chemical Analysis of Water and Wastes*, U.S. Environmental Protection Agency, EPA/600/4-79/020, Revised 1983.

*Standard Methods for the Examination of Water and Wastewater*, American Public Health Association, 18th edition, 20th Edition, 21st Edition, 22nd edition, on-line.

*Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, EPA SW-846, Third Edition, 1986, Updates I, II, IIA, IIB, III, IIIA, IIIB, IV, IVA, and IVB.

40 CFR Part 136, *Guidelines Establishing Test Procedures for the Analysis of Pollutants*.

40 CFR Part 141, *National Primary Drinking Water Regulations*.

*Methods for the Determination of Organic Compounds in Drinking Water*, EPA 600/4-88/039, Rev. July 1991; Supplement I, EPA 600/4-90/020, July 1990; Supplement II, EPA 600/R-92/129, August 1992; Supplement III, EPA-600/R-95/131, August 1995.

*Methods for the Determination of Inorganic Substances in Environmental Samples*, EPA 600/R-93/100, August 1993.

*Methods for the Determination of Metals in Environmental Samples*, Supplement EPA 600/4-88/039, Rev. July 1991; Supplement I, EPA 600/R-94/111, July 1990; Supplement II, EPA 600/R-92/129, August 1992.

*Methods for the Determination of Organic and Inorganic Compounds in Drinking Water*, Volume 1, EPA815-R-00-014.

Annual Book of ASTM Standards.

### 3. Terms and Definitions

- Impartiality - presence of objectivity.
- Complaint - expression of dissatisfaction by any person or organization to a laboratory (3.6), relating to the activities or results of that laboratory, where a response is expected.
- Inter-laboratory comparison - organization, performance and evaluation of measurements or tests on the same or similar items by two or more laboratories in accordance with predetermined conditions.
- Intra-laboratory comparison - organization, performance and evaluation of measurements or tests on the same or similar items within the same laboratory in accordance with predetermined conditions.
- Proficiency testing - evaluation of participant performance against pre-established criteria by means of inter-laboratory comparisons.
- Laboratory - body that performs one or more of the following activities:
  - testing;

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- calibration;
- sampling, associated with subsequent testing or calibration
- Decision rule - rule that describes how measurement uncertainty is accounted for when stating conformity with a specified requirement.
- Verification - provision of objective evidence that a given item fulfills specified requirements.
- Validation - verification, where the specified requirements are adequate for an intended use.

## 4. General Requirements

### 4.1 Impartiality

All employees are required to enter into the following agreements:

- **Code of Conduct Agreement**

Provides a framework for decisions and actions in relation to conduct in employment. The agreement covers a wide range of topics including personal and professional behavior, conflicts of interest, gifts, confidentiality, legal compliance, security of information, among others. The code of conduct agreement is administered by the USA Human Resources department. This agreement is provided to the employee during the hiring and induction process and the agreement is reviewed and signed.

- **Confidentiality Agreement**

Describes policies for identifying and protecting information owned by ALS and its customers, and for keeping this information in confidence. The confidentiality agreement is administered by the USA Human Resources department. This agreement is provided to the employee during the hiring and induction process and the agreement is reviewed and signed.

- **Ethics and Data Integrity Agreement**

Provided to the employee as part of the hiring and induction process, and reviewed during periodic ethics refresher training. This is coordinated between the Human Resources and Quality Assurance (QA) departments. This agreement is provided to the employee during the hiring and induction process and the agreement is reviewed and signed. All employees are required to take annual ethics and data integrity refresher training.

In addition to the agreements, project managers act as a firewall to insulate the analysts from clients so that the lab personnel have no contact with clients. Lab IDs are assigned to samples and used throughout preparation and analysis to make the samples ambiguous to lab personnel. Together these agreements and procedures ensure freedom from undue internal and external commercial, financial, and other pressures or influences that could adversely affect the quality of work. They protect customers' confidential information and ALS' proprietary rights. They ensure avoidance of activities that could diminish confidence in the competence, impartiality, judgment or integrity of any ALS laboratory and staff.

It is the responsibility of all staff to comply with all procedures, be familiar with current management systems and policies, and to record all data as established by management. This and the peer review of all data will ensure that all testing is objective and conflicts of interest do not exist. As a commercial laboratory, the decision making using test results, opinions and interpretation of data is outside the scope of the laboratory activities.

### 4.2 Confidentiality

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All employees signed confidentiality statement upon employment. These are maintained by Human Resources (HR).

Documents provided to the laboratory are held in strict confidence by project management staff. Documents pertaining to quality assurance and analytical requirements are reviewed with appropriate managers and staff through the project specific meetings and LIMS. Project related information provided by clients is securely archived using procedures described in the SOP *Data Archiving* (ADM-ARCH).

The transmittal of final results is specified by clients and follows those requirements unless specific changes are made by the ALS Project Manager assigned to the client/project. Client communication procedures and documentation requirements are listed in SOP *Project Management* (ADM-PCM).

## 5. Structural Requirements

5.1 The laboratory, a legal entity, is part of ALS USA Corp and the Laboratory Director reports to the General Managers, Life Sciences, USA. There are other support functions such as human resources, accounting, safety oversight and computer systems that are provided to the laboratory by corporate entities but none of which is responsible for managing laboratory activities. The support functions of this laboratory involved with testing and services are under the direction of the laboratory director.

### 5.1.1 Limitation of Liability

Notwithstanding any other provision herein, ALS's liability and Client's exclusive remedy for any cause of action arising hereunder, whether based on contract, negligence, or any other cause of action, shall be limited to the compensation received by ALS from the Customer for the services rendered therewith. All claims, including negligence or any other cause whatsoever shall be deemed waived unless made in writing and received by ALS within ninety (90) days after ALS's completion of the services provided.

### 5.1.2 Transfer of Ownership

In the event of a transfer of ownership of the laboratory, the new owner will agree in writing, which shall be either stipulated in a purchase agreement or as a separate record retention document, that the current records shall be maintained for a period of not less than ten (10) years.

### 5.1.3 Laboratory Closure

In the event of a laboratory closure, the current owner/management will notify in writing all Customers for whom the laboratory performed sample analysis within the last ten (10) years that the laboratory will be closing. This letter will instruct the Customers to contact the laboratory to provide instructions on how previous records are to be transferred to the Customer's care.

5.2 The responsibility for this laboratory under the direction of the laboratory director. Key employees in the management systems are identified in section 5.5.

5.3 This laboratory performs a full range of inorganic and organic analyses using EPA SW-846 methods, EPA drinking water methods per 40CFR141, EPA Clean Water Methods per 40CFR136, AWWA Standard Methods current approved methods, and Accreditation agency or State Approved Methodologies;. This QAM is designed to be an overview of ALS operations. Detailed methodologies and practices are written in ALS Standard Operating Procedures (SOPs). Where appropriate, ALS SOPs are referenced in this document to direct the reader to more complete information.

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5.4 ALS is committed to producing legally defensible analytical data of known and documented quality acceptable for its intended use and in compliance with applicable regulatory programs. This QAM is designed to satisfy the applicable requirements of various states, United States Environmental Protection Agency (USEPA), TNI Volume 1 2009 or 2016 and ISO 17025: 2017.

5.5 **Org Chart and Key personnel** - see Appendix B.

5.5.1 **ALS Laboratory Director**, The Laboratory Director is responsible to ensure:

- Implementation of quality policy and applicable standards.
- Employees have sufficient experience and training to perform QAM related duties and procedures.
- That the necessary facilities and equipment are available to meet the commitments of the laboratory.
- Sample handling, instrument calibration, sample analysis, and related activities are conducted and documented as described in this QAM, its related Standard Operating Procedures (SOPs), and its referenced methods.
- That routine QC samples are prepared, analyzed, and reviewed as required by this QAM.
- That at regular intervals audits are conducted and documented to assess compliance with this QAM.
- That corrective action is initiated and completed to remedy discrepancies or problems identified in any laboratory process.
- Management review of all processes and procedures associated with the management system.
- In the absence of the Laboratory Director, either the Metals Technical Director or Client Service Manager will assume the above responsibilities. This will require assistance from corporate leadership.

5.5.2 **Quality Assurance Manager**, The Quality Assurance Manager reports directly to the laboratory Director and is responsible to:

- Ensure implementation of quality policy and applicable standards.
- Understand, monitor and evaluate the quality assurance (QA) and quality control (QC) activities described in this QAM and its references, reporting deficiencies and identifying resource requirements to the Laboratory Director.
- Conduct and document an annual internal audit of laboratory procedures to ensure compliance with this QAM and its references.
- Conduct an annual update of this QAM and review or update laboratory Standard Operating Procedures (SOPs).
- Arrange for the analysis of Proficiency Testing (PT) samples and maintains training records of demonstration of competency (DOC).
- Maintain a record of ongoing personnel training for QAM related activities, reporting training deficiencies to the Laboratory Director.
- Maintain the laboratory documentation of nonconformance, corrective action, preventive action, and improvement programs.

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- In the absence of the QA Manager, the Laboratory Director shall assume the above responsibilities. This may require assistance from the corporate Quality Improvement Manager, especially in the event of a prolonged absence.

5.5.3 **Technical Managers (Organic & Inorganic)**, The managers of these operations report directly to the Laboratory Director and are responsible to:

- Ensure implementation of quality policy and applicable standards.
- Read, understand and follow this QAM with its references.
- Ensure that method development projects meet the requirements specified in this QAM.
- Ensure that each set of reported results meets the requirements specified in this QAM and meets the client's requirements as defined in the applicable project requirements.
- Ensure that personnel are trained, authorized and utilized effectively.
- Ensure that facilities and equipment are maintained and utilized effectively.
- Ensure that supplies are available and utilized effectively.
- Immediately report technical and quality problems to the Laboratory Director or Quality Assurance Manager.
- In the event of a prolonged absence of the Organic or Inorganic manager, Supervisors within the department that possess the required qualifications and experience will assume the above responsibilities.

5.5.4 **Project Managers**, Project Managers report directly to the Client Services Manager. Project Managers are responsible to:

- Ensure implementation of quality policy and applicable standards.
- Complete and distribute project related information for each project before the laboratory starts work on the project.
- Immediately communicate to the laboratory changes made to projects in progress and document these changes as appropriate.
- Respond to client requests for information and coordinate responses to client audits.
- Ensure StarLIMS work orders are reviewed and meet client project requirements before release to the laboratory.
- Perform an initial review of results for large projects to verify that data reports submitted to the client meet all project requirements.
- Operate as approved signatories for laboratory reports.

5.5.5 **Support Management** (Computers, Client Services, Health and Safety) are responsible to:

- Ensure implementation of quality policy and applicable standards.
- Read, understand and follow this QAM with its references.
- Ensure that procedures are followed and meets the client's requirements as defined in the applicable project requirements.

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- Ensure that personnel are trained, authorized and utilized effectively.
- Ensure that facilities and equipment are maintained and utilized effectively.
- Ensure that supplies are available and utilized effectively.
- Immediately report technical and quality problems to the Laboratory Director or Quality Assurance Manager.
- Training staff to comply with all processes.

5.6 It is the responsibility of all technical and support staff to comply with all procedures and be familiar with current quality systems and policies as established by management. At ALS, improvement of the quality systems and preventive action is effected through an ongoing systems review by management using input from all staff. ALS actively seeks employee and client input for improvements through surveys and questionnaires. Internally ALS maintains a process improvement website for employees to provide suggestions for improvements. For clients, ALS surveys and gains feedback on services provided. This input to management is provided from the corporate level. To comply with these requirements all staff are responsible but not limited to the following:

- Follow project requirements as delineated by project managers to ensure analyses and commitments, including TAT, are performed as requested.
- Develop knowledge and understanding of the QAM requirements under which samples are handled and tested.
- Notify managers and Quality Assurance personnel when QA problems arise.
- Follow Quality Assurance requirements as outlined in the QAM and SOPs.
- Follow appropriate channels regarding modification of existing SOPs.
- Maintain accurate electronic and written records.
- Ensure that applicable data are included in each process in accordance with applicable SOPs.
- Record all nonconformance.
- Follow appropriate protocols when the handling and testing does not meet acceptance criteria.
- Apply integrity and professional judgment when dealing with analytical processes and laboratory operations.

5.7 Although verbal communication with employees is essential, written and visual communication through email and computer systems is the cornerstone of effective communication at ALS. Computer workstations throughout the lab provide access to LIMS, ALS Portals, Instruments used for testing, Policies and Procedures, and Email. All information essential for effective and consistent communication of analytical requirements, client requirements and details affecting quality are available through these computerized systems.

ALS management is committed to improvements of the management systems through compliance with its own policies and procedures. ALS management ensures improvements are made to the management systems and also ensures data integrity is maintained.

## 6. Resources Requirements

### 6.1 General

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6.1.1 ALS management has committed its full support to provide the personnel, facilities, equipment, and procedures required by this QAM.

## 6.2 Personnel

6.2.1 It is the responsibility of all staff to comply with all procedures, be familiar with current management systems and policies, and to record all data as established by management. This will ensure that all testing is objective and conflicts of interest do not exist. As a commercial laboratory, the decision making using test results is outside the scope of the laboratory activities. The ALS laboratory employs sufficient personnel to complete required chemical and radiochemical analyses and support activities.

6.2.2 The ALS training program specified in the SOP *Employee Training and Orientation* (ADM-TRAIN) includes quality training, technical training, safety training, and other training as described in this QAM. ALS managers are responsible to ensure that all staff training is initiated, completed, verified, and documented.

The specific training and experience of laboratory personnel is documented in individual training files maintained in accordance with ADM-TRAIN and includes records of analytical proficiency through the analysis of QC and PT samples.

Job Descriptions include requirements for education, qualification, training, technical knowledge, skills and experience. Job descriptions are maintained by the corporate Human Resource Department.

6.2.3 All ALS staff assigned to perform tasks affecting or relating to testing receives training relative to pertinent areas of responsibility, both prior to performing work on client samples and on an ongoing basis. Such training comes from internal and external sources.

6.2.4 Laboratory personnel resources needed to carry out their duties. See 5.6.

6.2.5 The laboratory procedure *Employee Training and Orientation* (ADM-TRAIN), includes the following and records are retained for:

- Determining the competence requirements.
- Selection of personnel.
- Training of personnel.
- Supervision of personnel.
- Authorization of personnel.
- Monitoring competence of personnel.

6.2.6 It is the responsibility of Technical and Support Management to authorize staff to perform specific laboratory activities. These tasks include testing methods, peer review and authorization to report results. Records are retained for the pertinent authorizations by the Quality Assurance department.

## 6.3 Facilities and Environmental conditions

6.3.1 ALS management has committed its full support to provide the personnel, facilities, equipment, and procedures required by this QAM.

6.3.2 Records are maintained for the requirements and conditions necessary for method and regulatory compliance in the facility.

6.3.3 Records are retained with analytical data for monitoring and control of environmental conditions to relevant method and regulatory specifications.

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6.3.4 See Appendix D for floor plan.

To maintain facility security and thus sample security, entrance to the ALS facility can be attained only through security access, except at the main business entrance and sample receiving entrance; these are open only during normal business hours and monitored by the receptionist at the business entrance and Sample Receipt Technicians at the sample receiving entrance. All non-employees are required to sign in with the receptionist at the main entrance.

Laboratory areas are segregated by HVAC systems to contain contamination and to eliminate potential contamination from specific laboratory areas that require low ambient chemical background levels for successful analysis.

Each area in the laboratory has adequate lighting, conditions and bench space for instrumentation and for the processes assigned to that area.

Laboratory reagent water is prepared and maintained using any combination of deionization, reverse osmosis, purging and UV radiation. See SOP *Operation and Maintenance of Laboratory reagent Water Systems* (FAC-WATER).

Fume hoods have visual indicators to ensure flow is maintained during use and are performance tested semi-annually.

All safety inspection records are kept on file for a minimum of five years.

6.3.5 Laboratory activities outside the facility are limited to sample pick-up and sample collection. Field service activities are not included in our laboratory scopes of accreditation/certification.

**6.4 Equipment**

6.4.1 A comprehensive list of instrumentation and support equipment utilized at ALS is included in Appendix E. Redundant instruments are maintained for particular analyses.

6.4.2 Laboratory equipment items such as analytical balances, pipettes, and thermometers are verified against reference standards. Laboratory reference weights and thermometers are certified by ISO accredited vendors against ISO or National Metrology Institute (NMI) traceable standards. Support equipment is maintained in proper working order and verified daily or prior to use. Support equipment is calibrated or verified as described by the SOPs *Documenting Laboratory Balance and Check Weight Verification* (ADM-BAL) and *Checking Volumetric Labware* (ADM-VOLWARE).

In the event that equipment is sent outside of the laboratory, such as a NIST thermometer, for calibration, the device shall be inspected by the laboratory prior to being put into use. If found to be of the appropriate quality per the SOP and functioning properly, the Certificate of Calibration will be maintained on file.

6.4.3 Routine maintenance is performed on laboratory instruments and equipment according to manufacturer recommendations. Maintenance is provided under warranty, through service contracts, and by ALS in-house personnel. The ALS approach to preventive maintenance is described in each analytical SOP. Records of routine maintenance and emergency maintenance are kept with the instruments or on the ALS server in hardcopy or electronic maintenance logbooks.

a) Maintenance logs contain general information about the instrument, such as the name of the manufacturer, instrument model, serial number, date of purchase, date placed into service, current instrument

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location, condition when received (e.g., new, used, reconditioned), and information concerning any service contracts maintained. They also contain information concerning any routine maintenance done by ALS personnel. Information concerning maintenance should include a brief description of the maintenance performed, the frequency required, the date performed, and the initials of personnel performing the maintenance and any comments concerning the procedure. Also to be entered in or to be stored with the log is information concerning repairs done by ALS personnel or instrument manufacturers. This information should include the date of servicing, the initials of personnel performing the service, record of why it was done and the results of the servicing relative to instrument performance. The individual logbooks are located on the server or in the laboratory with the instruments to which they pertain along with copies of manufacturer's instructions, where available. Records shall be retrievable for review and archived according to required procedures. See *Records Management Policy*, (ADM-RCRDS).

- b) It is the responsibility of the technical managers to determine the effect, if any, of an instrument defect on previous results. If an effect has been determined to have impacted the validity of any sample results, the corrective action procedure is followed. See Nonconformance and Corrective Action Procedures (ADM-NCAR).

6.4.4 All instruments are calibrated or verified before use, using reference materials with traceability established. Specific calibration requirements are detailed in the method or analytical SOP.

- a) Initial calibrations are verified for accuracy by analysis of a second source standard. This is a check standard prepared from a reference material procured from a different source than that used for the calibration. When a different source is not available or cost prohibitive, a second lot of material from the same vendor is acceptable as long as the original source used to prepare the standards is not the same.
- b) All initial calibrations are verified by analysis of continuing calibration standards and/or QC check samples. These are method or SOP specified calibration standards that are analyzed at specific frequencies as established by the method. The amount of analyte recovered is compared to the acceptance criteria of the method. Acceptable recoveries verify the stability of the calibration and lack of instrument drift throughout the analysis. Analysts perform trend analysis by monitoring instrument response and QC each day of analysis. If the acceptance criteria are not met, or sensitivity is determined to be changing, method specific corrective action must be taken. (See analytical SOPs).

6.4.5 The instrument manuals are provided in electronic format usually in the software programs, CDs, and available on network drives. Software is controlled through licensing and is the responsibility of computer support to maintain licenses required.

6.4.6 Testing instruments are calibrated as per method, regulatory and verification procedures listed in SOPs. Support equipment has verification and calibration frequencies specified in SOPs.

6.4.7 Calibration program. See 6.4.4

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- 6.4.8 Calibration and verification period are designated in support equipment and analytical method SOPs. This equipment is labeled with calibration or verification dates.
- 6.4.9 Equipment that has been subjected to overloading or mishandling, gives questionable results, or has been shown to be defective or outside specified requirements, is taken out of service. It shall be recalibrated and not returned to service until it has been verified to perform correctly. The laboratory shall examine the effect of the defect or deviation from specified requirements and shall initiate the nonconformance process as outlined in *Nonconformance and Corrective Action Procedures* (ADM-NCAR).
- 6.4.10 Support equipment is verified on the day of use and calibration verification is required on analytical instruments as per method, program and SOP requirements.
- 6.4.11 All reference materials ordered by ALS have available documentation of purity, traceability and uncertainty.
- 6.4.12 Passing verification criteria ensures that unintended adjustment of equipment is identified.
- 6.4.13 Records of instruments are retained and include specifications, manufacturer, serial numbers, identification, software version, location, status and the date of purchase. The majority of firmware has no impact on laboratory activities. There are some instruments in which the firmware is the software and can affect the laboratory operations. These instruments are usually small like pH meters, conductivity meters and auto-titrators. If an instrument does not have typical software to load and firmware is used to generate results, then the firmware version must be entered in the instruments record log and any updates to the firmware will be noted in the instrument maintenance log.
- 6.4.14 Records of calibration, maintenance, reference materials used, calibration checks or verifications are kept with analytical data.

## 6.5 Metrological Traceability

6.5.1 All measurements made by the laboratory required an unbroken chain to NMI, Reference Standards or Reference Materials.

6.5.2 Reference Standards and Reference Materials

a) Reference Standards

Reference standards used by the laboratory are calibrated at determined intervals by outside vendors for the following equipment. These reference standards are maintained under the control of QA personnel and are used for verifying intermediate materials used by the laboratory. Quality Assurance is responsible for maintaining records and schedules of calibration.

Intermediate checks are used in the laboratory to verify performance of support equipment and are verified to traceable reference standards. Records of such verifications are retained by Quality Assurance. See SOP *Documenting Laboratory Balance and Check Weight Verification*. (ADM-BAL).

b) Reference Materials

Reference materials used at ALS must be of the grade or quality specified by the pertinent analytical procedure or methodology.

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Purchased reference materials must be traceable to a National Metrology Institute (NMI) or equivalent national or international standards where possible.

#### 6.5.3 Reference Standards are calibrated by vendors certified to ISO 17025: 2017.

Reference Materials are purchased, whenever possible. ALS uses reference materials from Guide 34 or ISO 17034 accredited vendors.

Second source reference materials are purchased and used in the testing process as an independent verification of primary reference materials. The secondary reference material does not require accredited vendors.

- a) The reference standards used are those specified in the reagent sections of the respective analytical SOP.
- b) If reference materials from Guide 34 or ISO 17034 accredited vendors are not available, reference standards of the best purity and quality from a reputable supplier may be used. Determination is made by the laboratory with careful study and consideration of the chemically pure substances available.
- c) All purchased reference standards are received and verified for accuracy against the invoice. They are transferred to the appropriate department where they are entered into the standards logbooks which may be either hardcopy or electronic.
- d) Certificates of Analysis are either maintained by the ordering department. The CoA may be archived either in hardcopy, or preferably electronically.
- e) All purchased reference standards are received and verified for accuracy against what was ordered. The standards are entered into the inventory control system. The certificate of Analysis is saved by the department in either electronic or hardcopy format.
- f) Any standard reference material which is past its expiration date is removed from analytical use. Expired standards may be used for research purposes only and must be kept separate from standards used for the routine analysis of samples.

#### 6.5.4 Reagents

The quality level of reagents and materials (grade, traceability, etc.) required is specified in analytical SOPs. Department supervisors ensure that the proper materials are purchased. Inspection and verification of material ordered is performed at the time of receipt by receiving personnel. The receiving staff labels the material with the date received. Expiration dates are assigned as appropriate for the material. Storage conditions and expiration dates are specified in the analytical SOP. *Quality of Reagents and Standards* (ADM-REAG) and *Reagent and Standards Login and Tracking* (ADM-RLT) provides default expiration requirements. Supplies and services that are critical in maintaining the quality of laboratory testing are procured from pre-approved vendors. The policy and procedure for purchasing and procurement are described in *SOP Procurement and Control of Laboratory Services and Supplies* (ADM-PROC).

Receipt procedures include technical review of the purchase order/request to verify that what was received is identical to the item ordered. Verification that the chemical or reagent purchased is of the correct purity and traceability is performed by comparison of the acquired reagent to reagent listed in the *SOP Reagent and Standards Login and Tracking* (ADM-RLT).

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Each lot of chemical or reagent used is monitored and controlled for any unusual contaminants that interfere with analysis as evident in results of prescreens and/or method and reagent blanks. If a working reagent is found to be suspect, it is removed from use and traced back to the original lot number, which is then investigated. If the stock reagent is found to be the source of the problem, it is completely removed from use. Any samples contained in batches in which the suspect reagent was used for analysis will be reanalyzed if sufficient remaining sample and holding time allows, or clients will be contacted and results appropriately qualified with a sample or analyte level comment on the final report. See SOP *Reagent and Standards Login and Tracking* (ADM-RLT) for procedure to verify targeted critical reagents.

## 6.6 Externally Provided Products and Services

6.6.1 Analytical services are subcontracted when the laboratory needs to balance workload or when the requested analyses are not performed by the laboratory. Subcontracting is only done with the knowledge and approval of the client and to qualified laboratories. Subcontracting to another ALS Environmental Group laboratory is preferred over external-laboratory subcontracting. Further, subcontracting is done using capable and qualified laboratories. Established procedures are used to qualify external subcontract laboratories. These procedures are described in SOP *Qualification of Subcontract Laboratories and Internal Subcontracting Protocol* (ADM-SUBCONT).

- a) ALS advises its customers in each proposal of its intention to subcontract any portion of the testing to a third party, or non-ALS laboratory. If it is necessary to subcontract work to a non-ALS laboratory as a result of unforeseen circumstances, customers will be contacted by their project manager to gain their permission. This approval is documented by the Project Manager.
- b) Any subcontracted analysis is noted as such on ALS's final report with an identification of the appropriate subcontractor. The original subcontractor analysis report, or a true duplicate thereof, is also attached to the associated ALS laboratory report.

*Procurement and Control of Laboratory Services and Supplies* (ADM-PROC) outlines the process, evaluation, criteria and records maintained from the evaluation and reevaluation of supplies and services. Corporate personnel are responsible for vendor approval and evaluation. Records are maintained by the corporate purchasing office.

Processes are designed to ensure that materials and services purchased meet the quality specifications of ALS. Procurement and receiving services are provided at ALS by administrative personnel. Procurement and receiving quality requirements established by ALS are followed. All requisitions for purchase are approved by ALS operations management and specify 1) the level of service required or 2) the quality/specifications of material required. The receipt of materials not meeting specification in the purchase requisition require investigation.

## 7. Process Requirements

### Review of Requests Tenders and Contracts

Project Managers are responsible for maintaining, archiving, and retrieving all contracts, project requirements and QAPPs provided to ALS by clients and related to projects completed by ALS. They are also responsible for the destruction of

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materials provided on unsuccessful proposals and bidding opportunities. Specific procedures for client communication and required documentation are listed in the SOP *Project Management* (ADM-PCM).

### Selection, Verification, and Validation of Methods

Reference methods for environmental samples are drawn primarily from the current version of Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), Third Edition. Reference methods for water analysis are taken from Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, March, 1983 with its updates, and from 40 CFR, Part 136. Methods referenced in ALS SOPs also come from ASTM guides, and from Standard Methods for the Examination of Water and Waste Water.

Reference Methods for microbiology are from Standard Methods for the Examination of Water and Wastewater.

SOPs are written for all environmental testing methods, any modified reference methods for industrial hygiene testing and any in-house developed methods. SOPs may be copies of reference methods that are not modified. All SOPs are reviewed using document control procedure. See SOP *Establishing Standard Operating Procedures* (ADM-SOP).

All analytical methods and preparatory method combinations are routinely tracked and ALS maintains statistical control limits and reporting limits. The laboratory can perform using limits provided by clients or from referenced sources in the absence of historical data. The SOP *Trending, Control Charts, and Uncertainty* (ADM-TREND) describes how control limits are established and updated.

ALS policy is that all SOPs be compliant with the reference method. In the event that several methods are referenced in an SOP, all procedures must be compliant with all referenced methods. All SOPs include a section describing changes and clarifications from the reference method. In the event that an analytical method is modified, the SOP documentation must include a description of the modification, any justification of the method modification which includes, but is not limited to, method performance and recovery data, any other supporting data, and approval from the Technical Managers, Quality Assurance Manager, and Laboratory Director. In the event that an analytical method must be modified or is modified to perform on specific sample matrices, the modification and reason must be stated in the case narrative. All modified methods will be identified on the analytical report.

The policy of ALS is to apply analytical methods that have been approved, validated, and published by government agencies, professional societies and organizations, respected private entities, and other recognized authorities. These methods have been validated for their intended use and ALS uses the demonstration of competency procedures, calibration of instruments and LOD/LOQ procedures to verify laboratory capability.

Published methods may be modified as a result of the request of the client or operational conditions prevailing in the laboratory. Operational conditions might relate to, for example, the availability of equipment or the performance of the method as determined by calibration processes, detection limits, or the results obtained for quality control samples.

Validation procedures describe three different classifications of validations for method modification. New methods, permanent modifications to a published method which will be used in subsequent laboratory determinations, and temporary

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modifications applied only to immediate analytical projects. These methods are used with approval from the clients.

The essential quality control elements for modification and validation include:

Calibration - The number of levels and acceptance criteria must meet or exceed requirements of ALS analytical SOPs. Additional criteria for organic chromatography methods are included in *Calibration of Instruments for Organic Chromatographic analyses* (SOC-CAL).

QC Samples - QC samples prepared in the specific matrix, are assessed. If possible the recoveries are compared to method or historical control limits used for the reference method.

Sensitivity - Method Detection and Reporting Limit, Method Detection Limit is the lowest analyte concentration that produces a response detectable above the noise level of the system and Reporting Limit is the lowest level at which the analyte can be accurately and precisely measured. Method Detection Limits, if required, are generated. A reporting limit verification is accomplished using SOP *Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Quantitation* (ADM-MDL/CE-QA011).

If validation reports are required to validate methods, these reports must address the following elements and follow established testing industry protocols:

Calibration - a demonstration of a concentration range where the analyte response is proportional to concentration.

Sensitivity - Method Detection Limit is the lowest analyte concentration that produces a response detectable above the noise level of the system and Reporting Limit is the lowest level at which the analyte can be accurately and precisely measured.

Selectivity - the ability of the method to accurately measure the analyte response in the presence of all potential sample components.

Precision and Bias - Precision - the type of variability that can be expected among test results. Bias - systematic error that contributes to the difference between the mean of a large number of test results and an accepted reference value.

Robustness - the ability of the procedure to remain unaffected by small changes in parameters or matrix.

## 7.1 Sampling

In order to produce meaningful analytical data, ALS must have samples that are representative of the system from which they were taken. If the representation and integrity of the samples received in the laboratory cannot be verified due to inadequate sampling procedures, the usefulness of the analytical data produced for these samples is limited. The laboratory cannot accept responsibility for improper sampling of client-procured samples and will document the condition of the samples and analyze them as received. If an incorrect sampling procedure is suspected, the client will be notified as soon as possible by the Project Manager. ALS will postpone testing, if the holding time will not be exceeded, pending client response. Sampling instructions and acceptance criteria are made available to clients.

Where sampling, as in obtaining sample aliquots from a submitted sample, is carried out as part of the test method, the laboratory uses documented procedures as outlined in SOP *Subsampling and Compositing of Samples* (SOILPREP-ALIQUOT) to obtain a representative sub sample.

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## 7.2 Handling of Test or Calibration Items

Procedures for receiving, processing, and storing samples and for ensuring continuity of the chain-of-custody are detailed in the following SOPs: *Sample Receiving* (SMO-GEN) and *Sample Tracking and Internal Chain of Custody* (SMO-SCOC).

The ALS Sample Receiving area is isolated from areas of the laboratory where analyses are performed. The area is equipped with ventilation hoods and adequate bench space to ensure that the sample receiving process is safe, efficient, and not a source of cross-contamination in the laboratory.

### Sample Tracking

Sample handling in the laboratory is tracked using a computer-based Laboratory Information Management System or through the signatures on the hand-carried chain of custody documents. After samples are received by the laboratory, as described above, sample receiving personnel enter the sample information into the LIMS. See *Sample Receiving* (SMO-GEN) and *Sample Tracking and Internal Chain of custody* (SMO-SCOC).

When multiple analyses require splitting a sample, the custody documents are copied such that each split can be independently traced to its origin and appropriate entries can be entered into LIMS.

### Sample Storage and Security

Following receipt, samples are stored in accordance with analytical method requirements for storage and preservation. Water samples for organic and inorganic analysis are stored in trays and placed in refrigerators in the designated analysis laboratory. Soil samples will be forwarded to the SoilPrep group for Aliquoting. Samples to be analyzed for volatile testing are stored separately from all other samples in a refrigerator. See *Sample Receiving* (SMO-GEN) and *Sample Tracking and Internal Chain of custody* (SMO-SCOC).

To maintain facility security and thus sample security, entrance to the ALS facility can be attained only through security access, except at the main business entrance and sample receiving entrance; these are open only during normal business hours and monitored by administrative personnel at the business entrance and Sample Receipt Technicians at the sample receiving entrance. All non-employees, other than those delivering samples, are required to sign in at the main entrance.

### Chain-of-Custody

In order to ensure that legally defensible data are produced at ALS, chain-of-custody procedures are established and are described in SOP *Sample Tracking and Internal Chain of Custody* (SMO-SCOC).

## 7.3 Technical Records

ALS maintains records on the most part electronically and in accordance with SOP *Records Management* (ADM-RCRDS). ALS personnel are responsible for the retention, retrieval, and disposition of final records of laboratory data and activities. This includes: data packages, analyst laboratory notebooks, instrument maintenance logs, and training records, as established by procedure.

Data Packages - All documentation which pertains to the analysis of a sample or group of samples that are being reported together must be compiled as a data package. The SOP *Report Generation* (ADM-RG) address the preparation and control of data packages.

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Electronic records or scans of records that relate to the analysis of field samples are compiled into folders on network drives for storage. These data packages are generally stored electronically as per SOP *Records Management* (ADM-RCRDS). Unless specified by contract, applicable statute, or program, data packages are retained for ten years.

Laboratory Notebooks and Logbooks - Laboratory notebooks and logbooks are retained by ALS for ten years and are not released to clients. Laboratory notebooks are assigned to specific analysts or areas. If corrections are made it requires a single-line cross-out, initials and date are entered. In some instances the reason for the change should be documented.

Quality Assurance Records - Quality control sample results data are retained in LIMS. Records of internal audits, nonconformance reports, and corrective action reports are retained and stored electronically for an indefinite period on networked drives.

The Quality Assurance Manager is responsible for maintaining and retrieving all records of audits, proficiency testing results, demonstration of competency, nonconformance and corrective action records and reports. Some of these records can be internally accessed by employees on network drives.

Client-Related Information - Project Managers are responsible for maintaining, archiving, and retrieving all contracts, project requirements and QAPPs provided to ALS by clients and related to projects completed by ALS. They are also responsible for the destruction of materials provided on unsuccessful proposals and bidding opportunities. Specific procedures for client communication and required documentation are listed in the SOP *Project Management* (ADM-PCM).

ALS ensures that amendments to technical records are tracked to previous versions or to original observations. Both the original and amended data and files are retained, including the date of alteration, an indication of the altered aspects and the personnel responsible for the alterations.

#### 7.4 Evaluation of Measurement Uncertainty

Uncertainty is associated with most of the results obtained in the laboratory testing conducted by ALS. It is meaningful to estimate the extent of the uncertainty associated with each result generated by the laboratory. It is also useful to recognize that this measurement of uncertainty is likely to be much less than that associated with sample collection activities.

In practice, the uncertainty of a result may arise from many possible sources. ALS has considered the relative contribution of major sources of error. The approach to estimating uncertainty adopted by the laboratory resulted in the conclusion that many sources of error are insignificant compared to the processes of sample preparation, calibration, and instrumental measurement. The uncertainty associated with the processes can be estimated from quality control data. Accordingly, ALS estimates uncertainty from data derived from quality control samples carried through the entire analytical process. A description of the uncertainty calculation is presented in SOP *Trending, Control Charts, and Uncertainty* (ADM-TREND). The estimation of uncertainty applied by ALS relates only to measurements conducted in the laboratory. Uncertainty associated with processes conducted external to the laboratory (e.g., sampling activities) are not considered.

Calculation of uncertainty may use the precision measurement values for duplicate samples when LCS or QC samples are not used in testing.

The calculation of uncertainty is not required for qualitative tests. The process is assessed for contributors to uncertainty but the calculation of uncertainty has limited value when empirical values are not available.

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## 7.5 Ensuring the Validity of Results

Before samples are analyzed, the analytical system must be in a controlled, reproducible state from which results of known and acceptable quality can be obtained. That state is verified through the use of Quality Control (QC) procedures intended to ensure accuracy, precision, selectivity, sensitivity, freedom from interference, and freedom from contamination. The QC procedures performed at ALS include: calibration and calibration verification; analysis and comparison of resultant data to predetermined control limits for method blanks, laboratory control samples, spiked matrix samples, duplicate matrix samples, and surrogates added to samples; analysis of performance evaluation samples; determination of Reporting Limits; and the tracking and evaluation of precision and accuracy. For specific analytical methods, other QC procedures are implemented as required by the method.

These QC procedures are performed and evaluated on a batch basis. A preparation batch must not exceed 20 field samples that are of a similar matrix type without additional method QC in the batch, unless specified differently in an SOP or reference method. The samples in a batch are processed together, through each step of the preparation and analysis, to ensure that all samples receive consistent and equal treatment. Consequently, results from the batch QC samples, not including field sample QC, are used to evaluate the results for all samples in the batch.

In general terms, instrument calibration, method quality control, and data evaluation is described in analytical SOPs.

All QC parameters set by the applicable ALS SOP or method reference shall not be exceeded without initiation of a NCAR. See *SOP Nonconformance and Corrective Action Procedures* (ADM-NCAR).

The hierarchy of quality control requirements begins with:

- Client Requirements (if specified and documented).
- Method and/or SOP requirements.
- Guidance from QAM and other general SOPs.

### Calibration and Calibration Verification

Instrument calibration is a QC measure taken to verify selectivity and sensitivity. Calibration of instruments at ALS is accomplished through the use of reference materials of the highest quality obtainable. ISO or National Metrology Institute (NMI) traceable reference materials are procured and used if they are available. When ISO or National Metrology Institute (NMI) traceable reference materials are not available, certified reference materials from government agencies or reliable vendors are used. In all cases, written records are maintained that allow all analytical results to be traced unambiguously to the reference materials used for calibration.

In general, analytical instruments are initially calibrated with standard solutions made from the reference materials at levels appropriate for the analysis. This is called the initial calibration (IC). This calibration is verified with a standard solution independently prepared from a different lot of the reference material, preferably from a different vendor. This step is called initial calibration verification or ICV. At specified intervals throughout the analytical sequence, the calibration is re-verified again through the analysis of a calibration check solution, usually the mid-point standard solution. This process is called the continuing calibration verification or CCV. If the IC, the ICV, or any CCV fails criteria in the analytical method, the system is recalibrated or the results are narrated. It is ALS' intention to only report results generated under

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acceptable calibration conditions. Specific calibration procedures are found in the SOPs associated with each method of analysis.

Alternative calibration sequences or procedures will be discussed with clients.

Calibration parameters set by the applicable SOP or method reference shall not be exceeded without initiation of a NCAR.

### Analysis of Method Blanks

The method blank (or preparation blank) contains no sample material; it is treated as a sample in every other way. It is analyzed to monitor any contamination to which the analytical batch might have been exposed during preparation and analysis. A method blank is analyzed with every analytical batch. Criteria set by the applicable ALS SOP or method reference shall not be exceeded without initiation of a NCAR.

### Analysis of Laboratory Control Samples and QC Samples

A control sample (LCS or QC) contains the analyte(s) of interest in known concentration(s) in a laboratory matrix; it is used to monitor accuracy. It measures the success of the analysis in recovering the analyte(s) of interest from a QC matrix. Soil samples and other solid matrices are analyzed with an LCS made of clean sand or appropriate substrate spiked with the analyte(s) of interest. Water samples and other liquid matrices are analyzed with a method blank spiked with the analyte(s) of interest.

The results of the LCS are reported as percent recovery:

$$\% \text{ Recovery} = \frac{X}{K} \times 100$$

Where: X = Measured value

K = Expected value

LCS/QC criteria set by the applicable ALS SOP or method reference shall not be exceeded without initiation of a NCAR.

### Analysis of Spiked Matrix Samples

Matrix QC samples are generally used to determine acceptability of methods chosen on a field sample and are therefore not used to determine batch acceptability. If the analysis of matrix spike is not possible, as with industrial hygiene, dietary supplements or other samples of limited matrix amount, a duplicate LCS or QC should be analyzed in the batch.

A known concentration of the analyte(s) of interest is added to a second representative portion of a field sample to prepare a matrix spike. The matrix spike is used to determine acceptability of the method chosen on a specific field matrix. It measures the success of the analysis in recovering the analyte(s) of interest from the type of field sample matrix in the batch. A matrix spike is analyzed with every analytical batch of environmental samples. The results are reported as percent recovery.

$$\% \text{ Recovery} = \frac{(X_S - X_U)}{K} \times 100$$

Where: X<sub>s</sub> = Measured value in the spiked sample

X<sub>u</sub> = Measured value in the unspiked sample

K = Expected value



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Laboratory criteria will be used in the absence of client-specified criteria. Failure to meet these criteria will be noted as per client instructions.

### Analysis of Duplicate Matrix Samples

Matrix QC samples are generally used to determine acceptability of methods chosen on a field sample and are therefore not used to determine batch acceptability. If the analysis of matrix spike is not possible, as with industrial hygiene, dietary supplements or other samples of limited sample amount, a duplicate LCS or QC should be analyzed in the batch.

A duplicate matrix spike sample or duplicate matrix sample is used to monitor the precision (repeatability) of the method chosen on a field sample. If a sufficient amount of the analyte(s) of interest is present in the field sample, a matrix duplicate sample is analyzed directly. If the analyte(s) of interest are not present in a sufficient amount, two additional portions of field sample are spiked with the analyte(s) of interest to ensure that meaningful results are obtained. A pair of duplicate samples (matrix/matrix duplicate or matrix spike/matrix spike duplicate) is analyzed with every analytical batch of environmental samples. The results of the analysis of duplicate samples are reported as relative percent difference (RPD).

$$RPD = \frac{|X_1 - X_2|}{[(X_1 + X_2)/2]} \times 100$$

Where:  $|X_1 - X_2|$  = The absolute value of the difference between the two sample values  
 $[(X_1 + X_2)/2]$  = The average of the two sample values

Laboratory criteria will be used in the absence of client-specified criteria. Failure to meet these criteria will be noted as per the analytical SOP instructions, or as per client instructions for project specific requirements.

### Analysis of Surrogates Added to Samples

Surrogates are compounds similar to the analyte(s) of interest but that are known not to be present in the environment. Examples are fluorinated or deuterated homologues of the organic analyte(s) of interest. When appropriate compounds are available, their use is specified in the analytical method SOP. When surrogates are used, they are added to the calibration solutions and to each field and QC sample in the batch. Surrogate recovery is a measure of the accuracy and selectivity of the method in the sample matrix. Surrogate results are reported as percent recovery.

$$\% \text{ Recovery} = \frac{X}{K} \times 100$$

Where: X = Measured value  
K = Expected value

Surrogate criteria set by the applicable SOP or method reference on method QC samples shall not be exceeded without initiation of a NCAR.

The same criteria will be used for field samples although failure to meet these criteria will be noted in report, narrative comments, or as per client requirements.

### Reporting Limit Verification Sample(s) (RLVS)

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An RLVS is a control sample that contains the analyte(s) of interest at or below the stated reporting limit(s) in an applicable QC matrix; it is used to monitor sensitivity and assess uncertainty at the reporting limit. These samples are not used for batch acceptance and should be recovered at  $\geq \frac{1}{2}$  the stated reporting limit. The analyst shall raise the reporting limit if systematic failures are apparent.

- An RLVS is required for every sample batch for environmental and industrial hygiene testing.
- Reporting limits must be at or above the lowest calibration standard.

### Analysis of Performance Evaluation Samples (PT)

Proficiency testing (PT) samples are prepared by an authorized independent organization outside the laboratory. They are received and analyzed at regular intervals to monitor laboratory accuracy. ALS Laboratories sends the PT sample results to the independent organization, where they are evaluated and then forwarded directly from that organization to accreditation bodies as needed. PT samples are introduced into the regular sample stream of the laboratory and analyzed as routine samples by analysts who regularly perform the method. Laboratory personnel follow all instructions provided by the PT provider.

The Laboratory Director, Technical Managers or the Quality Assurance Manager can institute the analysis of additional PT samples or modify the performance evaluation program as appropriate.

The following guidelines are followed by ALS:

- Averaging results is prohibited.
- Only qualified ALS laboratory employees analyze PT samples.
- Results are not discussed with outside entities or other ALS laboratories prior to the deadline for receipt of the results.
- ALS does not subcontract to other laboratories or receive from other laboratories any PT samples.

When a PT sample result is scored as “Not Acceptable”, an NCAR is issued by the QA Manager, as per ADM-NCAR, to initiate corrective action to determine and correct any problem(s) leading to the unacceptable result.

Participation in Proficiency Testing programs provides the laboratory with evidence of correlation of results with other laboratories and national standards. A four year proficiency testing schedule is maintained by the QA Manager as required by the DoD QSM.

When no commercial Proficiency Testing (PT) sample is available for an analyte that is routinely reported by ALS to a client, the QA Department will use demonstration of capabilities (DOCs) to monitor and evaluate the precision and accuracy of the analytical procedure against defined acceptance criteria documented in the Standard Operating Procedure.

### Tracking and Evaluation of Accuracy and Precision

When evaluating batch QC the analyst makes a sequence of decisions before reporting sample results regarding calibration, the method blank, LCS, surrogate recovery, matrix spike, and matrix spike duplicate recovery results.

Assessment of the accuracy of an analytical measurement is based upon the analysis of samples of known composition. ALS relies upon the analysis of LCS/QC samples to

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track accuracy. The percent recovery relative to the expected value is calculated and can be plotted.

Assessment of the precision (repeatability) of an analytical measurement is based upon repeated analysis of equivalent samples of known or unknown composition. ALS relies upon the analysis of pairs of LCS/QC samples, duplicate samples, or spiked matrix samples (MS/MSD) to assess precision. The range of the pair is expressed as a relative percent difference (RPD).

Control limits for the accuracy and precision of each method are included in the analytical SOPs, and are based on set limits as indicated by the client (project specific), in the reference method or program, or as calculated using in-house data. Control limits for accuracy and precision charts are calculated assuming a normal (Gaussian) distribution of results. Historical data points are used to calculate mean values, two-standard deviation warning limits, and three-standard deviation control limits. The establishment and updating of control limits is described in *SOP Trending, Control Charts, and Uncertainty (ADM-TREND)*.

### Trending

In addition to evaluating individual batch QC results against control limits, QC results from successive batches are also evaluated for possible trends. While a trend is not necessarily an out-of-control situation in itself, it can provide an early warning of a condition that can cause the system to go out of control. *SOP Trending, Control Charts, and Uncertainty (ADM-TREND)* describes in detail the assessment of QC data in the laboratory. The following conditions are trends that may initiate action and/or monitoring.

- A series of successive points on the same side of the mean.
- A series of successive points going in the same direction.
- Two successive points between warning limits and control limits.

ALS relies on analytical staff to identify trends in analytical systems. Quality Assurance can produce control charts as needed to assess trends but this activity by QA is not preventive and is only used to verify trends exist. The occurrence of a trend does not invalidate data that are otherwise in control. However, trends do require attention to determine whether a cause can be assigned to the trend so that appropriate preventive action can be undertaken.

Long term trends in control limits are evaluated quarterly and annually by quality assurance and technical operations. See *SOP Trending, Control Charts, and Uncertainty (ADM-TREND)*.

## 7.6 Reporting of Results

ALS relies upon a system of peer review to ensure the quality of analytical reports. Peer review procedures are specified in the *SOP Laboratory Data Review Process (ADM-DREV)*. An analyst, familiar with the analytical method used to produce the results (peer reviewer), reviews each report. The peer reviewer verifies that the calibration standards, type of calibration, and sample set with associated QC samples were selected correctly. The peer reviewer also verifies any manual transcriptions and calculations. The applicable Technical Manager can perform additional technical review.

Project Managers perform an initial review of results for large projects to verify that data reports submitted to the client meet all project and client requirements.

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When the peer review has been completed, a final report is generated. In most situations the report is produced from LIMS. In some cases part or all of the report can be produced from the data system of the analytical instrument. The reports produced by ALS meet the following requirements:

- The report identifies the method used. If the method is modified, it is noted as “modified” in the report.
- Any abnormal sample conditions, deviation from hold time, irregularities in preservation or other situations that might affect the analytical results are noted in the report and associated with the analytical results.

The contents of the report include:

- The report title with the name, address, and telephone number of the laboratory.
- The name of the client or project and the client identification number.
- Sample description and laboratory identification number.
- The dates of sample collection, sample receipt, sample preparation, and analysis.
- The time of sample preparation and/or analysis if the required hold time for either activity is 48 hours or less.
- A method identifier for each method, including methods for preparation steps.
- The MDL or minimum reporting limit for the analytical results.
- The analytical results with qualifiers as required.
- A description of any quality control failures and deviations from the accepted method.
- The name (electronic signature) and title of the individual(s) who accept responsibility for the content of the report.
- The date the report is issued.
- Clear identification of any results generated by a subcontract laboratory.
- Page numbers and total number of pages.
- Electronic Data Deliverables (EDDs) can be developed and generated per client or agency specific specifications, and may contain a subset of components included on the final report. See SOP Report Generation (ADM-RG).

ALS does not evaluate or interpret results.

ALS does not perform calibration services.

Sampling activities are not performed by ALS.

The laboratory reports results based on the sample provided by the customer. If ALS reports to a specification it is only for the sample results and not involved with decision rules applied to the sampling site.

ALS does not make any statements concerning opinions and interpretation of results.

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Amended reports of analytical results are issued to correct errors. Amended reports require the following items:

Amendments to analytical reports will only be made in supplemental documents and shall contain identification similar to “Amended”.

Include the date amended or released to the client.

Amended reports shall meet all reporting and client requirements.

Amended Reports are stored with the original report, are uniquely identified, and make reference to original reports.

A peer review process is used to ensure amended results are accurate.

Any information changed in the report must have the reason for the change documented in the report.

### 7.7 Complaints

ALS has a documented process for how complaints are received and evaluated. Nonconformance or corrective actions are generated to ensure decisions and outcomes are monitored and communicated. These outcomes are reviewed by the Quality Assurance department. The SOP on handling complaints is *SOP Handling Customer Feedback* (ADM-FDBK).

### 7.8 Nonconforming Work

The ALS SOP for handling nonconformance is *SOP Nonconformance and Corrective Action Procedures* (ADM-NCAR).

This laboratory procedure shall be implemented when any aspect of its laboratory activities or results of this work do not conform to its own procedures or the agreed requirements of the customer. The procedure ensures that:

- The responsibilities and authorities for the management of nonconforming work are defined;
- Actions (including halting or repeating of work and withholding of reports, as necessary) are based upon the risk levels established by the laboratory.
- Any employee may stop work when a task cannot be performed safely or the quality of data is determined to be or could be negatively affected. Metrics utilized for work stoppage may include but are not limited to exceeding instrument or sample control limits, QC trending, instrument problems, etc. The appropriate manager shall be consulted for any work stoppage;
- An evaluation is made of the significance of the nonconforming work, including an impact analysis on previous results;
- A decision is taken on the acceptability of the nonconforming work;
- Where necessary, the customer is notified and work is recalled;
- The responsibility for authorizing the resumption of work is defined.

The laboratory retains records on all nonconformance.

Quality Assurance Manager or designee reviews all nonconformance for completeness and adds comments as necessary on the acceptance. If this evaluation determines the problem has or can reoccur or it is against the laboratories own policies or procedures the event requires a corrective action as described in section 8.7.

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## 7.9 Control of Data and Information Management

The laboratory has access to all data and information through the internet, intranet, network locations and hard copy.

7.9.1 All of the software used for data reduction, verification, and reporting is documented and validated by the ALS computer support staff or by the vendor from whom it is purchased. ALS software is controlled and secured according to SOP *Software Quality Assurance and Data Security* (ADM-SWQADATA). A continuing effort is made at ALS to increase the use of automated data handling, improve efficiency, and minimize human error.

Software errors are treated as a nonconformance under section 7.10 or as a corrective action under 8.7.

7.9.2 Access to ALS networks are controlled through passwords and windows security. Network drives are backed up and disaster planning is evident.

7.9.3 ALS uses offsite locations from the laboratory but internal to ALS for data storage and is managed in accordance with these procedures.

7.9.4 Access to network locations is managed with windows security and roles throughout the system.

7.9.5 Calculations and data transfers are checked using the peer review process and through documentation of computer programs by the IT staff.

## 8. Management System Requirements

### 8.1 Options

8.1.1 The laboratory has implemented **Option A** from the ISO/IEC 17025:2017 standard as a management system. The following sections 8.2 through 8.9 address the required elements of Option A. This manual addresses management systems and demonstrates compliance with this document.

### 8.2 Management System Documentation

8.2.1 This manual describes the policies and objectives of the ALS management system. The laboratory procedures describe the details on how objectives are accomplished.

8.2.2 Policies and objectives of the management system address how competence is demonstrated and assessed, how testing is objectively reviewed and how consistent operations are accomplished. These are addressed in various procedures that define the processes used.

8.2.3 Evidence of commitment is the review of the manual annually and the records of reading by all employees. Additionally, employees are assigned pertinent procedures as needed to ensure objectivity and consistency.

8.2.4 The policies are supported in this management system with references to the procedures as appropriate.

8.2.5 All employees have access to the Quality Assurance Manual and the supporting procedures.

### 8.3 Control of Management System Documents

8.3.1 SOPs and the QAM are maintained under document control procedures described in SOP *Document Control* (ADM-DOC\_CTRL). External documents, such as reference methods, accreditation policies and requirements, and reference

manuals are maintained under document control policies through the use of hardcopy and network drives. Additionally, quality assurance program documents, project plan documents, and contractual Statement of Work documents generated by a client can be designated as controlled documents at the discretion of the ALS Project Manager, Quality Assurance Manager, or the Laboratory Director.

- 8.3.2 Revisions are made to uniquely identified internal documents in accordance with SOP *Document Control* (ADM-DOC\_CTRL) and the following table. Assignments are made to the responsible ALS manager or designee to review and update SOPs applicable to the area of responsibility. At times it is also necessary to obtain approval by specific clients before written SOPs can be modified. After revision, the appropriate Manager, Quality Assurance Manager, and Laboratory Director must approve the updated SOP. Updated SOPs are then distributed on-line by the Kelso network. All obsolete copies are removed from access and stored for historical purposes.

SOP Type	Review Cycle
Environmental Testing SOPs (DoD)	12 Months
Environmental Testing SOPs (TNI ONLY)	24 Months
Management Systems SOPs	36 Months
All other SOPs	24 Months

#### 8.4 Control of Records

- 8.4.1 ALS maintains records on the most part electronically and in accordance with SOP *Records Management* (ADM-RCRDS). ALS personnel are responsible for retention, retrieval, and disposition of final records of laboratory data and activities. This includes: data packages, laboratory notebooks, instrument maintenance logs, and training records.

#### 8.5 Data Packages

- 8.5.1 All documentation which pertains to the analysis of a sample or group of samples that are being reported together must be compiled as a data package.
- 8.5.2 Electronic records or scans of records that relate to the analysis of field samples are compiled into folders on network drives for storage. These data packages are stored electronically as per SOP *Records Management* (ADM-RCRDS). Unless specified by contract, applicable statute, or program, data packages are retained for ten years.
- 8.5.3 Laboratory Notebooks and Logbooks
- Laboratory notebooks and logbooks are retained by ALS for twelve years and are not released to clients. Laboratory notebooks are assigned to specific analysts, who are responsible for their maintenance. If corrections are required, a single-line cross-out, initials and date are entered.

#### 8.6 Quality Assurance Records

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8.6.1 Quality control sample results data are retained in LIMS. Records of internal audits, nonconformance reports, and corrective action reports are retained and stored electronically for an indefinite period on networked drives.

8.6.2 The Quality Assurance Manager is responsible for maintaining and retrieving all records of audits, proficiency testing results, demonstration of competency, nonconformance and corrective action records and reports.

Client-Related Information

8.6.3 Project Managers are responsible for maintaining, archiving, and retrieving all contracts, project requirements and QAPPs provided to ALS by clients and related to projects completed by ALS. They are also responsible for the destruction of materials provided on unsuccessful proposals and bidding opportunities. Specific procedures for client communication and required documentation are listed in the SOP *Project Management* (ADM-PCM).

**8.7 Actions to Address Risks and Opportunities**

8.7.1 ALS views risk management as a key component of its corporate governance responsibilities and an essential process in achieving and mandating a viable organization. ALS is committed to enterprise wide risk management to ensure its corporate governance responsibilities are met and its strategic goals are realized.

8.7.2 Refer to ALS Limited Risk Management Policy and Framework CAR-GL-GRP-POL-007 and Risk Appetite and Tolerance Statement CAR-GL-POL-011 for details.

8.7.3 Risk is defined at ALS as the effect of uncertainty on objectives. Objectives for the organization have different attributes and aspects, such as financial, service, quality, health & safety, environmental stewardship, and are considered at different levels, such as enterprise-wide, operational, and project levels. ALS interprets risk as anything that could impact meeting its corporate strategic objectives, and believes risks can provide positive opportunities as well as having negative impacts.

8.7.4 Tools for evaluating and managing risk include routine procedures such as employee evaluations, control limits trending, RLVS data evaluation, corrective action reports, nonconforming events, SOP review, internal and external audits, and PT results.

8.7.5 Risk reporting mechanisms vary from routine reporting mechanisms and immediate action for lower risk situations to immediate notification of the ALS CEO in extreme cases.

8.7.6 Regardless of the mechanism used, the policies and tools provide a framework for categorizing, assessing, analyzing, and addressing risk, as well as monitoring and reviewing actions taken. Roles and responsibilities are defined in the relevant procedures.

8.7.7 Risk severity is evaluated during the decision making process. For each risk there is an opportunity.

8.8 Risks to our business and how we address them include:

**Chemical Exposure**

8.8.1 Failure to practice procedures as trained, issues with the facility, and poor engineering controls can result in injury to employees, lost time, med/hospital situation, contamination, and can close the site.

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8.8.2 We have policies, chemical exposure training, and readily available SDS sheets. Employees are expected to offer suggestions for improvement and formally report any conditions where concern for safety is recognized.

### 8.9 Explosion/Chemical Fire

8.9.1 Improper chemical storage and usage along with lack of equipment and facility upkeep can result in loss of life, loss of property, and laboratory down time.

8.9.2 We perform inspections and training, keep an inventory of chemicals, establish storage locations, and maintain minimal quantities of chemicals.

### 8.10 Supply Disruption

8.10.1 Natural disaster and vendors unable to provide needed supplies can disrupt the business, increase expenses, and result in lost production and lost clients.

8.10.2 We maintain multiple sources for supplies, develop relationships with our vendors, and emphasize communication between analysts, managers, purchasing and vendors.

### 8.11 Loss of Key Employees

8.11.1 Resignation, leave for personal reasons or for other employment can negatively impact the business.

8.11.2 Communication, cross-training, designated backups, and having a pool of potential replacements minimizes this risk. We provide a positive atmosphere for employees and provide small perks to reward dedication.

### 8.12 Computer and Instrument Issues

8.12.1 Computer, instrument, or other IT failures can result in loss of revenue, loss of service, and loss of data.

8.12.2 We provide necessary IT resources for instruments and computers including replacing older computers, keeping related systems in good repair, and replacing when necessary. We continue to build robust data systems and make provisions for stellar back-up storage for all data.

### 8.13 Reputation

8.13.1 Falsifying test results can result in loss of credibility, loss of clients, loss of revenue, and suspension.

8.13.2 All new employees must sign an ethics agreement and have initial ethics and data integrity training. Annually, all employees must take ethics and data integrity refresher training. All data undergoes a proper peer review. We maintain a strong quality system.

### 8.14 Legal Ramifications

8.14.1 Not following workplace and environmental laws and failure to practice procedures as trained can result in license revocation, fines, and disruption of the business.

8.14.2 Targeted and ongoing training, inspections, and having established procedures minimizes this risk. We continue to follow all laws and regulations.

### 8.15 Loss Time Injury

8.15.1 Failure to practice procedures as trained and not having proper safeguards in place can result in injury to employees, lost time, med/hospital situation, contamination, and can close the site.

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8.15.2 Policies, specific task related training, targeted and ongoing training, inspections, workplace safeguards, cross training, and designated backups, minimize this risk. We continue to grow the safety program and culture.

#### 8.16 Loss of Revenue

8.16.1 Can be caused by various audit fines and contract penalties for late data resulting in loss of revenue and disruption in business.

8.16.2 Policies, specific quality training, targeted and ongoing training, inspections, workplace safeguards, and internal audits minimize this risk. We continue to perform lab operations at the highest level.

#### 8.17 Improvement

8.17.1 ALS management is committed to continually improving the effectiveness of the management and quality systems by implementing the requirements of this quality manual. ALS is also committed to improvements of the management systems through compliance with its own policies and procedures. ALS management is also committed to compliance with requirements related to current EPA CLP SOWs, DoD/DOE QSM, and other client and project related requirements. Internally ALS maintains a process improvement website for employees to provide suggestions for improvements.

8.17.2 ALS surveys clients and gains feedback on services provided. This input to management is managed at a corporate level and is reviewed monthly and during the management review processes.

#### 8.18 Corrective Actions

8.18.1 ALS Laboratory operations are governed by documented procedures, requirements, quality assurance plans, project plans, and contracts. When any operation, for any reason, does not conform to the requirements of the governing documents, the aberrant event, item, or situation must be properly documented and evaluated. In addition, appropriate corrective action must be initiated. Procedures for the documentation and resolution of corrective action are detailed in the SOP *Nonconformance and Corrective Action Procedures* (ADM-NCAR). It is the policy of ALS that any corrective action which impacts results of testing must include notification to clients.

#### 8.19 Internal Audits

8.19.1 Internal audits are conducted in accordance with SOP *Internal Audits* (ADM-AUDIT). When internal and external audits or data assessments reveal a cause for concern with the quality of the data an investigation is initiated by quality assurance personnel to determine the extent of the problem. Internal audits include examination of laboratory practice, the use of data handling systems, documentation and document control, personnel qualification and training records, procurement activities, and other systems that support and augment the laboratory analytical function. All audit findings and any event that casts doubt on the validity of the testing results requires corrective action and client notification within two weeks.

#### 8.20 Management Review

8.20.1 Review of the Management System is completed on an ongoing basis in accordance with SOP *Lab Management Review* (ADM-LABMGMT).

8.20.2 Inputs to management reviews may be kept in agenda notes and include but are not limited to:

- a) Changes in internal and external issues that are relevant to the laboratory;
- b) Fulfilment of objectives;
- c) Suitability of policies and procedures;
- d) Status of actions from previous management reviews;
- e) Outcome of recent internal audits;
- f) Corrective actions;
- g) Assessments by external bodies;
- h) Changes in the volume and type of the work or in the range of laboratory activities;
- i) Customer and personnel feedback;
- j) Complaints;
- k) Effectiveness of any implemented improvements;
- l) Adequacy of resources;
- m) Results of risk and opportunity identification;
- n) Outcome of the assurance of the validity of results; and
- o) Other relevant factors, such as monitoring activities and training.

8.20.3 The outputs from the management review shall record all decisions and actions related to at least:

- a) The effectiveness of the management system and its processes;
- b) Improvement of the laboratory activities related to the fulfilment of the requirements of this document;
- c) Provision of required resources;
- d) Any need for change.

A summary of these outputs is generated annually.

## 9. Change History

Revision Number	Effective Date	Document Editor	Description of Changes
28.0	10/21/2020	T.Caron K. Clarkson	Updated QAM signatories, Organizational Charts and Key Personnel. Minor typographical, grammatical, and formatting changes. Updated master list of controlled documents, laboratory accreditations and Cooler Receipt documentation.

## 10. Appendices

The documents listed in this section are dynamic; accordingly they can change without notice or revision to this QAM. Appendices are current as of the effective date of this SOP. Please contact the laboratory for the most current documents.

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- APPENDIX A - Data Quality Objectives and Definitions
- APPENDIX B - Organization Charts and Key Personnel
- APPENDIX C - Ethics and Data Integrity Agreement
- APPENDIX D - Laboratory Floor Plan
- APPENDIX E - Analytical & Support Equipment
- APPENDIX F - Sample Preservation, Containers, and Hold Times
- APPENDIX G - Standard Operating Procedures
- APPENDIX H - Data Qualifiers
- APPENDIX I - Master List of Controlled Documents
- APPENDIX J - Laboratory Accreditations
- APPENDIX K - Chain of Custody and Cooler Receipt Forms

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## Appendix A

### Data Quality Objectives and Definitions

#### Data Quality Objectives

The data quality objectives discussed below ensure that data will be gathered and presented in accordance with procedures appropriate for its intended uses, and that the data will be of known and documented quality able to withstand scientific and legal scrutiny. The quality of the measurement data can be defined in terms of completeness, accuracy, precision and traceability.

**Completeness** - Completeness is defined as the percentage of measurements that are judged to be valid measurements. Factors negatively affecting completeness include the following: sample leakage or breakage in transit or during handling, missed method prescribed holding times, lost sample during laboratory analysis through accident or improper handling, improper documentation such that traceability is compromised, or rejection of sample results due to failure to conform to QC criteria specifications.

**Accuracy** - Accuracy is the measure of agreement between an analytical result and its “true” or accepted value. Deviations from a standard value represent a change in the measurement system. Potential sources of deviations include (but are not limited to) the sampling process, sample preservation, sample handling, matrix effects, sample analysis and data reduction. Sampling accuracy is typically assessed by collecting and analyzing field and trip blanks for the parameters of interest. Analytical laboratory accuracy is determined by comparing results from the analysis of laboratory control samples or check standards to their known values. Accuracy results are generally expressed as percent recovery.

**Precision** - Precision is the determination of the reproducibility of measurements under a given set of conditions, or a quantitative measure of the variability of a group of measurements compared to their average value. Precision is typically measured by analyzing field duplicates and laboratory duplicates (sample duplicate, matrix spike duplicate, check standard duplicate and/or laboratory duplicate). Precision is most frequently expressed as standard deviation, percent relative standard deviation or relative percent difference.

**Traceability** - Traceability is the extent to which reported analytical results can be substantiated by supporting documentation. Traceability documentation exists in two essential forms: those which link the quantitation process to authoritative standards and those which explicitly describe the history of each sample from collection to analysis and disposal.

#### Laboratory Quality Control Definitions

Technical personnel are responsible for complying with all quality assurance/quality control requirements that pertain to their technical functions. ALS uses the following internal quality controls to verify that the data produced by the laboratory has the required degree of accuracy and precision and is free from contamination due to laboratory processes. All samples are normally processed in preparation and analytical batches of no more than 20 samples per batch. The following quality control checks defined below are appropriate for the various methods performed in the laboratory. Individual SOPs will further define the specific checks to be analyzed with each method. Additionally, a Customer’s individual Quality Assurance Project Manual may require the laboratory to include additional checks for analysis depending on the *site* requirements.

**Method Blank** - A method blank is an analytical control consisting of all reagents, internal standards, and surrogate standards that is carried through the entire analytical procedure. The method blank is used to define the level of laboratory background and reagent contamination contributed from the preparation or processing of the sample.

**Reagent Blank** - A reagent blank is an analyte-free sample that contains all the reagents used in a particular method. It is prepared and analyzed to determine if contamination is present at detectable levels that can be attributed to the reagents used in the process.

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**Field Blank** - A field blank consists of reagent water that is transported to the sampling site, transferred from one vessel to another at the site, and preserved with the appropriate reagents. This serves as a check on reagent and environmental contamination.

**Trip Blank** - A trip blank consists of reagent water that is transported to the sampling site and returned to the laboratory without being opened. This serves as a check on sample contamination originating from sample transport, shipping, and from the site conditions. The holding time for the trip blank begins when received by the laboratory, unless otherwise specified by the client, such as the time when field samples were collected.

**Refrigerator / Storage Blank** - Refrigerator/storage blanks are placed in VOA refrigerators on a weekly basis and analyzed by GC/MS for the full Volatile Organic Analytes/Target Compound List (VOA-TCL). These blanks are used to monitor the volatile storage refrigerators for the presence of sample cross-contamination. In order to maintain continuous measurement within each refrigerator these blanks are prepared and logged into the Laboratory Information Management System (LIMS) by the Sample Custodian for specific turnaround times. This ensures that at least one blank is present in each volatile refrigerator at all times. If contamination is found the analyst is required to take corrective action to prevent the problem from affecting other stored samples. All samples associated with a positive blank will then be qualified on the analytical report. The QC Department reviews these results and maintains these files for review by regulatory agencies for a period of 10 years.

**Quality Control Reference Sample or Calibration Verification Standard (Second Source Standard)** - A QC reference sample is a sample prepared from a source other than that used for calibration at a concentration within the calibration range. It is used to verify that the calibration standards were prepared accurately. It is analyzed after every initial calibration performed in the laboratory.

**Laboratory Control Sample (LCS/LFB)** - A Laboratory Control Sample (aka Laboratory Fortified Blank) is a laboratory blank fortified at a known concentration. Aqueous and solid LCSs are analyzed using the same sample preparation, reagents, and analytical methods employed for the samples. An LCS is analyzed with each preparative or analytical batch as required by the method. It provides a measure of the accuracy of the analytical system in the absence of matrix effects.

**Surrogate Standards** - Surrogates are organic compounds which are similar to analytes of interest in chemical composition, extraction, and chromatography, but which are not normally found in environmental samples. These compounds are spiked into all blanks, calibration and check standards, samples (including duplicates and QC reference samples), and spiked samples prior to an organic analysis. Percent recoveries are calculated for each surrogate to detect problems in the sample preparation process and monitor the efficiency of the process.

**Duplicate** - A duplicate is a second aliquot of a sample that is prepared and analyzed in the same manner as the original sample in order to determine the precision of the method. Samples selected for duplicate analysis are rotated among Customer samples so that various matrix problems may be noted and/or addressed. Poor precision in a sample duplicate may indicate a problem with the sample composition and shall be reported to the Customer whose sample was used for the duplicate analysis.

**Matrix Spike/Matrix Spike Duplicate** - A matrix spike/matrix spike duplicate is the addition of a known amount of a target analyte to a sample that is subjected to the entire analytical procedure. Samples selected for matrix spiking are rotated among Customer samples so that various matrix problems may be noted and/or addressed. Poor performance in a matrix spike may indicate a problem with the sample composition and shall be reported to the Customer whose sample was used for the spike.

**Method Detection Limit (MDL)** - The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.

**Reportable Detection Limit (RDL)** - The reportable detection limit on the laboratory report is a concentration at which the laboratory routinely reports results. The RDL may also be the method

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detection limit and is based on whether the Customer requires the result reported down to the MDL. It is laboratory policy to indicate on the laboratory report when the method detection limit is used as the RDL.

**Common Laboratory Contaminants** - Some common laboratory contaminants include: methylene chloride, acetone, 2-Butanone, hexane, phthalates, aluminum, and zinc. These analytes are sometimes seen in laboratory blanks due to their use in the processing of samples. When blank contamination occurs it is required that samples associated with these blanks be reprocessed. However, if reprocessing cannot occur due to lack of sample, holding time issues, or Customer turnaround time a comment will be placed on the analytical report defining the problem.

**Internal Standard (IS)** - A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method (NELAP).

**Minimum Reporting Level (MRL)** - Minimum Reporting Levels represent an estimate of the lowest concentration of a compound that can be quantitatively measured by a group of experienced drinking water laboratories.

**Detection Limit (DL) for DoD** - The smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration at the 99% level of confidence. At the DL, the false positive rate (Type I error) is 1%.

**Limit of Detection (LOD) for DoD** - The smallest amount or concentration of a substance that must be present in a sample in order to be detected at a high level of confidence (99%). At the LOD, the false negative rate (Type II error) is 1%.

**Limit of Quantitation (LOQ) for DoD** - The lowest concentration that produces a quantitative result within specified limits of precision and bias. For DoD projects, the LOQ shall be set at or above the concentration of the lowest initial calibration standard.

**Holding Times** - Samples are prepared and analyzed within method prescribed holding times per SOP 19-Sample Preservation Protocol and the appropriate method SOP. Holding time is the time from sampling until the start of analysis unless otherwise specified by a project QAPP. The date and time of sampling documented on the chain of custody establishes the time zero. If the holding time is specified to be measured in hours, then each hour is measured from the minute the sample was collected in 60-minute intervals. When the maximum allowable holding time is expressed in days, the holding time is based on calendar day measured from time zero, the date the sample was collected. The first day of holding time is not passed until midnight of the day after the sample was collected. Holding times for analysis include any necessary re-analysis due to instrument failure or analyst error that does not yield useful data. If sample re-analysis is necessary due to sample matrix, such as a dilution or matrix spike failure due to matrix interference, the holding time still applies. A comment is added to the final report stating that further analysis was required past hold time. The sampling time must be documented on the chain of custody form by the Customer.

**Turn Around Time** - Turnaround time is the time from receipt of samples to the transmittal of analytical data by mail, electronically or facsimile. The day the chain-of-custody is signed by the sample custodian is day zero in the turnaround time. Samples results will be due by the close of business on the last day of the turnaround time unless alternate arrangements have been made with the laboratory. The turnaround time is based on working business days, excluding weekends and holidays.



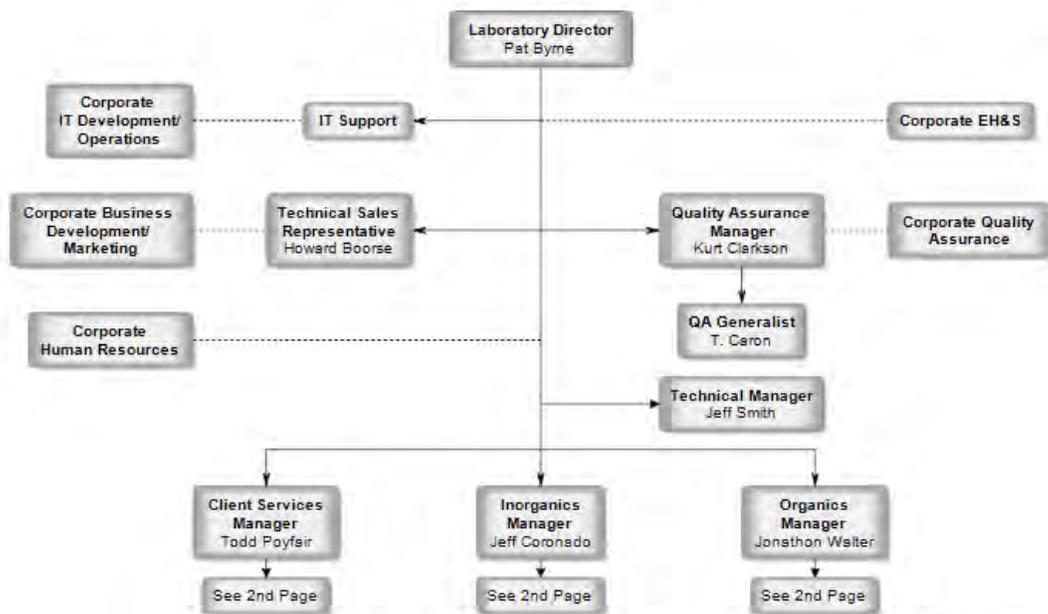
## Appendix B Organizational Charts and Key Personnel



### Kelso, WA Laboratory

#### Organizational Chart

October 19, 2020



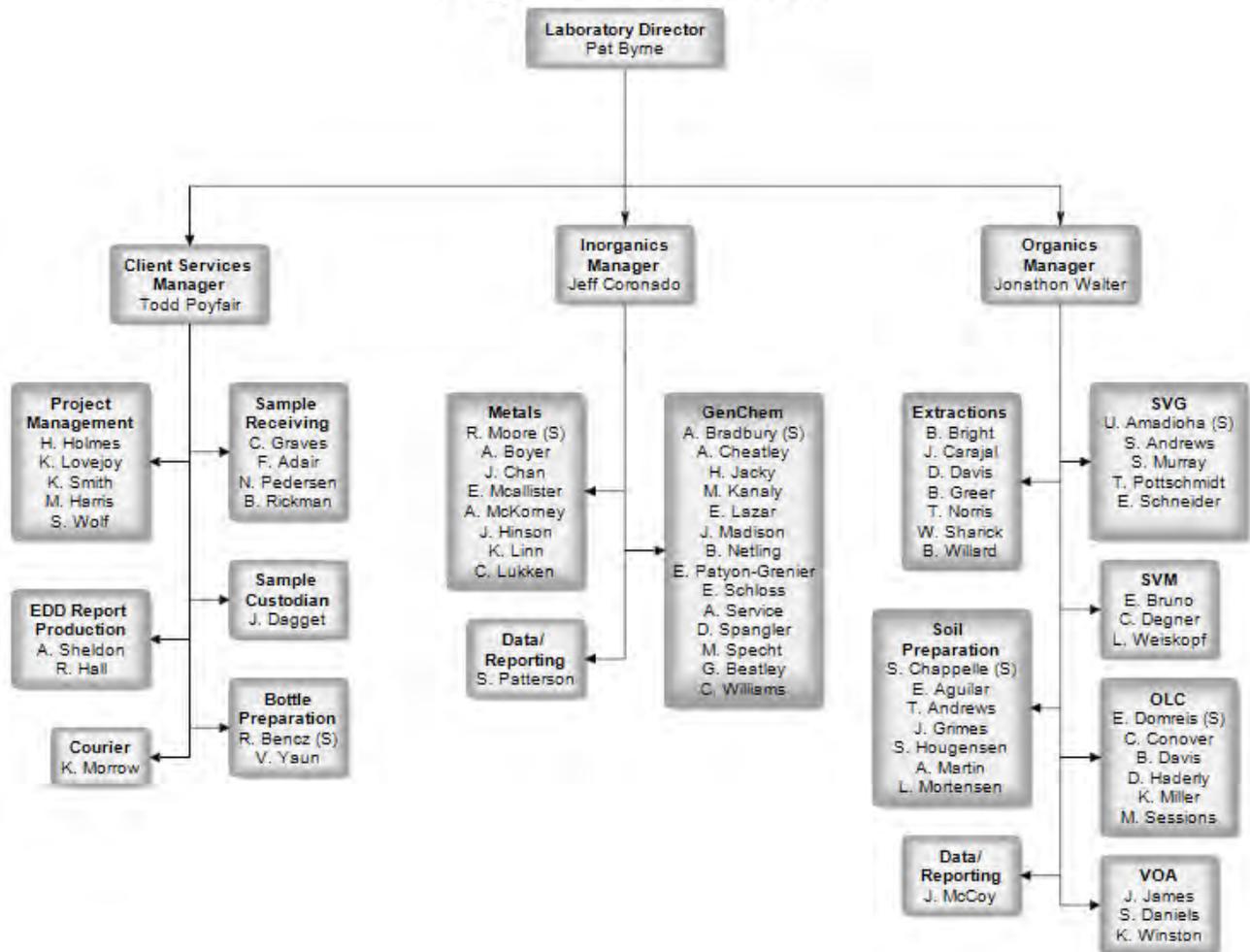
Revised 10/19/2020



Appendix B  
Organizational Charts and Key Personnel



### Kelso, WA Laboratory Organizational Chart





ALS Group USA, Corp.  
10450 Stancliff Road, Suite 210  
Houston, TX 77099  
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# Charles Patrick Byrne

Laboratory Director 03-20 to Present  
Kelso Washington

Implementation of quality policy and applicable standards. Ensure that Employees have sufficient experience and training to perform QAM related duties and procedures. Ensure that the necessary facilities and equipment are available to meet the commitments of the laboratory. Ensure that sample handling, instrument calibration, sample analysis, and related activities are conducted and documented as described in this QAM, its related Standard Operating Procedures (SOPs), and its referenced methods. Ensure that routine QC samples are prepared, analyzed, and reviewed as required by this QAM. That at regular intervals audits are conducted and documented to assess compliance with this QAM. That corrective action is initiated and completed to remedy discrepancies or problems identified in any laboratory process. Management review of all processes and procedures associated with the management system. In the absence of the Inorganic Manager, Organics Manager, Technical Director will assume the above responsibilities.

CEO Principal  
Various Companies  
Baton Rouge Louisiana 2010-2019

Acted as consultant to various laboratories in the area of process improvement. Owner Operator of several owned business entities including: Residential Property restoration and management, Commercial property management, Retail sales organization with sales in excess of 6m annually, manufacturing company with sales in excess of 4m.

CEO Principal Owner  
Gulf Coast Analytical Laboratories  
Baton Rouge Louisiana 1997-2012

Organized the purchase of the Baton Rouge facility of Inhcpe Testing Services. Led the organization through a period of substantial growth from 4-13m. Set industry record productivity metrics in the environmental laboratory sector. Ultimately negotiated the sale of the organization to Private Equity Partners. Remained to transition the business and led the merger and acquisition efforts of the company resulting in the successful acquisition of additional facilities.

## EDUCATION

Louisiana State University  
Baton Rouge Louisiana  
DEGREE IN PROGRAM  
1990

## AWARDS & ACHIEVEMENTS

Johnson School Cornell  
University

Executive Development

Series I and II

1992 and 1994

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Led the company through key projects such as:  
Benzene Barge- Multi-Million dollar emergency response effort on the Mississippi River involving an overturned Barge in downtown Baton Rouge. Sloe provider of analytical data with 48 Hour results and 30 day Level IV Packages.

Katrina Emergency Response-Provided analytical support under the EPA START contract.

Murphy Oil Release-Analysis of samples for Client and split samples for EPA in support of the release following the Katrina. Project scope included the analysis of over 45,000 samples.

### Laboratory Manager-General Manager Division Inchcape Testing Services

Baton Rouge Louisiana 1997-2012

Supervise division managers to ensure client expectations are met. Led the installation of LIMS system and follow-up customization that produced significant process improvement and productivity gains in the laboratory. Implemented reporting module that provided automated Level IV reporting. Personally designed the EDD generator that automated the production of complex Multi file EDD deliverables such as EQUIS, ADR, ERPIMS and Terra-base. Conducted daily production meetings to ensure on-time delivery to clients. Supervise multi-state sales force to ensure controlled growth and expansion of petrochemical clients.

### Organics Manager Inchcape Testing Services

Baton Rouge Louisiana 1991-1992

Supervise organics section consisting of Sample Preparation, Pesticide, PCB, Volatile GC and GCMS, Semi-volatile GC and GCMS. Direct report to Lab Manager. Responsible for data quality and Turnaround time compliance with client objectives. Perform method validation and development. Troubleshoot analytical equipment. Supervise approximately 20 staff members.

### Volatile GCMS Supervisor ETC Toxicon

Baton Rouge Louisiana 1990-1991

Analysis of organic components under the EPA CLP Program. Experience with Pesticide, PCBs, Volatile and Semi-volatile contaminants using Gas Chromatography and Mass Spectrometry. Preparation of CLP Data Packages using Form-master.



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# Kurt Clarkson

QA Manager 2020 - Present  
ALS-Kelso

Responsible for maintaining the quality systems and ensuring data integrity standards are implemented for the Kelso Laboratory. This includes upholding the requirements of analytical certifications, maintaining QA documents (QA Manual, SOPs, and QA records), coordinating PE/PT testing, conducting internal audits, and acting as a primary point of contact for external audits.

Additional current responsibilities: Safety Committee member, 2017-Present

## Previous Experience

Senior Project Manager, 2017-2020  
ALS Environmental, Kelso  
Kelso, WA

Responsible for technical project management, ensuring overall data quality and compliance with customer requirements. Provide technical support to clients regarding laboratory application to projects including regulatory interpretation assistance, as well as project organization of work.

Additional positions held at ALS-Kelso:  
Client Services Manager, 2016-2017  
Project Manager 2, 2015-2016

## Positions held prior to ALS Environmental, Kelso:

Client Services Manager, 2013-2015  
Western Environmental Testing Laboratory  
Sparks, Nevada

Client Services Manager, 2012-2013  
STAT Analysis  
Chicago, IL

Project Manager/Chemist Analyst, 2008-2011  
SGS  
Anchorage, AK

## EDUCATION

Walden University -  
Minneapolis, MN  
PhD - Business  
Management (candidate)  
Currently in dissertation  
stage

University of Alaska  
Anchorage -  
Anchorage, AK  
Master's in Business  
Administration - MBA  
2011

University of Nevada Reno -  
Reno, NV  
Bachelors in Biology  
2007

University of Nevada Reno -  
Reno, NV  
Bachelors in Business  
2002



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# JEFF CORONADO

**Manager - Specialty Laboratory Area, Metals Department Manager, 1992 - Present, General Chemistry Department Manager, 2017 - Present, Kelso Laboratory**

Management of the Kelso General Chemistry and Metals Departments with a staff of 28 and annual revenues in excess of \$5 million. Responsible for data quality and timeliness, revenues, expenses, workload coordination, method development efforts, and resource allocation. Participation in multiple LIMS development teams responsible for defining the ALS product.

## PREVIOUS EXPERIENCE

**Supervisor, GFAA Laboratory, 1989-1992**  
Columbia Analytical Services, Inc.  
Kelso, WA

Responsibilities included supervision of metals analysis by graphite furnace atomic absorption following SW 846 and EPA CLP methodologies. Duties include workload scheduling, data review, instrument maintenance, personnel training and evaluation.

## EDUCATION

Western Washington  
University -  
Bellingham, WA  
**BS Chemistry**  
1988

Western Washington  
University - Bellingham, WA  
**BA Business  
Administration**  
1985

**Winter Conference on  
Plasma Spectrochemistry  
- Tucson, AZ, 2012**

**LC/ICP-MS Training  
Course - PerkinElmer,  
2008**

**Field Immunoassay  
Training Course - EnSys  
Inc., 1995**

**Winter Conference on  
Plasma Spectrochemistry  
- San Diego, CA, 1994**

**ICP-MS Training Course -  
VG-Elemental, 1992**



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## Jonathon Walter

**Organics Manager**  
ALS Environmental, Kelso Laboratory  
Mar 2020 - Present

Responsible for directing the organic sample preparation teams and organic instrumentation teams. Responsible for ensuring that ALS quality systems and data integrity standards are followed. Manage workflow for departments ensuring client needs are met and working with PCs on special projects. Responsible for development of employees, method development efforts, quality and timeliness of data to clients.

### PREVIOUS EXPERIENCE

**Sample Preparation Manager**  
ALS Environmental, Kelso Laboratory  
June 2018 - Mar 2020

Responsible for directing the sample preparation teams, organic extractions and soil prep. Responsible for ensuring that ALS quality systems and data integrity standards are followed. Manage workflow for departments ensuring client needs are met and working with PCs on special projects. Responsible for development of employees, method development efforts, quality and timeliness of samples to labs.

**Laboratory Manager**  
Analytical Resources, Inc.  
Feb 2018 - Jun 2018

Plan and implement the overall laboratory policies, procedures, and services for each division. Ensure efficient and effective departmental operations, as well that departments follow industry standards and safety regulations. Provide input to strategic decisions for the company. Train supervisors in leading their respective sections, including coaching and mentoring supervisors to become better leaders.

**Organic Extraction Laboratory Supervisor**  
Analytical Resources, Inc.  
Oct 2016 - Feb 2018

Oversee the preparation of samples for semi-volatile, polynuclear aromatic hydrocarbons, chlorinated pesticides, chlorinated phenols, PCBs, PCB congeners, and extractable petroleum hydrocarbons. Responsible for ensuring deadlines are met, all extraction methods and daily QA/QC practices are upheld, scheduling and training employees, along with maintaining the budget and supplies for the lab section.

**GC/GC-MS Analyst/HRGCMS Analyst**  
Analytical Resources, Inc.  
Aug 2012 - Nov 2016

Analyzed TPHG, TPHD, SVOA, VOA, Dioxin by GC, GCMS, HRGCMS. Processed, reported and peer reviewed data for all analysis and performed maintenance as needed on instruments.

**Dioxin Laboratory Supervisor and Tech**  
Analytical Resources, Inc.  
Supervisor Aug 2012 - Feb 2018  
Tech July 2010-Aug 2012

Oversee workload, interpretation of data, development of new extraction techniques and cleanups. Always ensuring all regulatory requirements are met. Responsible for the extraction and cleanup of solids, tissues and waters for Dioxin and Furan analysis by 1613, 8290, and EPA methods.

### EDUCATION

Washington State University  
Pullman, WA  
BS Chemistry 2008



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# TODD POYFAIR

**Client Services Manager, 2020 - Present**  
Kelso Laboratory

Management of the Client Services Departments: Project Management, Electronic Data Deliverables & Report Production, Sample Management, Sample Control, Bottle Preparation, General Lab Receiving & Shipping, and Courier Services. Responsible for employee supervision, workload coordination, and adherence to all departmental standard operating procedures including the Client Service Guidelines.

## PREVIOUS EXPERIENCE

**Organics Manager, 2017 - 2020**

Kelso Laboratory

Oversee the operation of the Volatiles, Semi-volatiles, and OLC laboratories. Responsibilities included organizing and prioritizing workload, training and development of staff, working with PMs on client-specific project requirements, workload coordination, method development efforts and resource allocation.

**Technical Scientific and Business Development Representative, 2012-2017**

ALS Group USA, Corp.  
Kelso, WA

Worked with clients to define project requirements and expectations. Responsible for project development and technical project management, ensuring overall data quality and compliance with client requirements. Serve as liaison to clients and regulatory agencies functioning as a technical consultant to clients, coordinating technical proposals and sales for ALS Kelso.

**Corporate IT Director / Vice President 2010-2012**

Kelso, WA  
Columbia Analytical Services  
Phoenix, AZ

**Laboratory Director / Vice President 2008-2010**

Columbia Analytical Services  
Phoenix, AZ

Responsible for all phases of laboratory operations at the Phoenix and Tucson Laboratories, including project planning, budgeting and quality assurance. Primary duties include the direct management and operational oversight of the Kelso laboratory and all department managers.

**Department Manager 1993-2009**

Columbia Analytical Services  
Kelso, WA

## EDUCATION

Portland State University  
BS Chemistry  
BA Foreign  
Language/German  
1990/1991

## ADDITIONAL EXPERIENCE

Laboratory Manager  
04/1993 - 09/2008  
Columbia Analytical  
Services, Kelso, WA

Chemist, Project Manager  
08/1991 - 09/2008  
Columbia Analytical  
Services, Kelso, WA



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# SCOTT CHAPPELLE

Site Safety Representative - 2017 - present  
Soil Prep Supervisor - 2016 - present

Responsibilities include development, support and implementation of Environmental, Health and Safety policies for the Kelso laboratory, including policies for respiratory protection and hazardous waste generation. Also responsible for incident reporting and investigation, maintenance of all safety related equipment, review of monthly safety audits, and completion of all Federal and State mandated EH&S reports.

As soil prep supervisor my responsibilities include supporting the staff and ensuring that all sample aliquots are delivered correctly and in as timely a manner as possible. Training of staff and keeping all records current. Resolving any issues that arise with samples or procedures.

## PREVIOUS EXPERIENCE

**Chemist I Volatile Organics Laboratory, 2014-2016**  
ALS Group USA, Corp.  
Kelso, WA

Performing various analyses on both GC and GC/MS instruments. Prepping soil samples for analysis for both gases and volatiles analyses. Reviewing and reporting of data from the analyses I would run.

**Analyst General Chemistry, 2010-2014**  
Columbia Analytical Services, Inc.  
Kelso, WA

Running various analyses from Grainsize to Oil and grease. Operating the IC instrument as well as the discrete analyzer. Performing prep on samples and assisting in analyses. Data reporting and peer review.

## ADDITIONAL TRAINING

DOT Hazardous Materials Transportation, 2017  
DOT Emergency Response Operations Level, 2019  
WA Dangerous Waste Course, 2019

## EDUCATION

Lower Columbia Community  
College, 2010-2012

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**Appendix C**  
**Ethics and Data Integrity Agreement**

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**ETHICS AND DATA INTEGRITY AGREEMENT**  
ALS Environmental - USA

I state that I understand the high standards of integrity required of me with regard to the duties I perform and the data I report in connection with my employment at ALS.

I agree that in the performance of my duties at ALS:

1. I shall not intentionally report data values that are not the actual values obtained;
2. I shall not intentionally report the dates, times and method citations of data analyses that are not the actual dates, times and method citations of analyses;
3. I shall not intentionally represent another individual's work as my own;
4. I shall not intentionally report data values that do not meet established quality control criteria as set forth in the Method and/or Standard Operating Procedures, or as defined by company policy.
5. I agree to inform ALS of any accidental or intentional reporting of non-authentic data by other employees.
6. I have read this ethics and data integrity agreement and understand that failure to comply with the conditions stated above will result in disciplinary action, up to and including termination.
7. I agree to adhere to the following protocols and principals of ethical conduct in my work at ALS. All work assigned to me will be performed using ALS approved methods and procedures and in compliance with the quality assurance protocols defined in the ALS Quality System.
8. I will not intentionally falsify nor improperly manipulate any sample or QC data in any manner. Furthermore, I will not modify data values unless the modification can be technically justified through a measurable analytical process or method acceptable to ALS. All such modifications and their justification will be clearly and thoroughly documented in the raw data and appropriate laboratory record, and will include my initials or signature and the date.
9. I will not make false statements to, or seek to otherwise deceive ALS staff, managers or clients. I will not knowingly, through acts of commission, omission, erasure or destruction, improperly report any test results or conclusions, be they for client samples, QC samples, or standards.
10. I will not condone any accidental or intentional reporting of unauthentic data by other ALS staff and will immediately report such occurrences to my Supervisor, Lab Director, Quality Assurance Manager, or Human Resources. I understand that failure to report such occurrences may subject me to immediate discipline, including termination.

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11. If a supervisor, manager, director or other member of the ALS leadership group requests me to engage in or perform an activity that I feel is compromising data validity or defensibility, I have the right to not comply with the request. I also have the right to appeal this action through an ALS local Quality Staff, Corporate Quality Assurance or Human Resources.
12. I understand that if my job includes supervisory responsibilities, I will not instruct, request or direct any subordinate to perform any unethical or non-defensible laboratory practice. Nor will I discourage, intimidate or inhibit a staff member who may choose to appropriately appeal my supervisory instruction, request or directive that may be perceived to be improper, nor retaliate against those who do so.
13. I understand that employees who report violations of this policy will be kept free from intimidation and recrimination arising from such reporting.

I have read, and understand the above policy and realize that failure to adhere to it may result in disciplinary action, up to and including termination. Compliance with this policy will be strictly enforced with all personnel employed by the company.

Employee Name \_\_\_\_\_

Signature \_\_\_\_\_

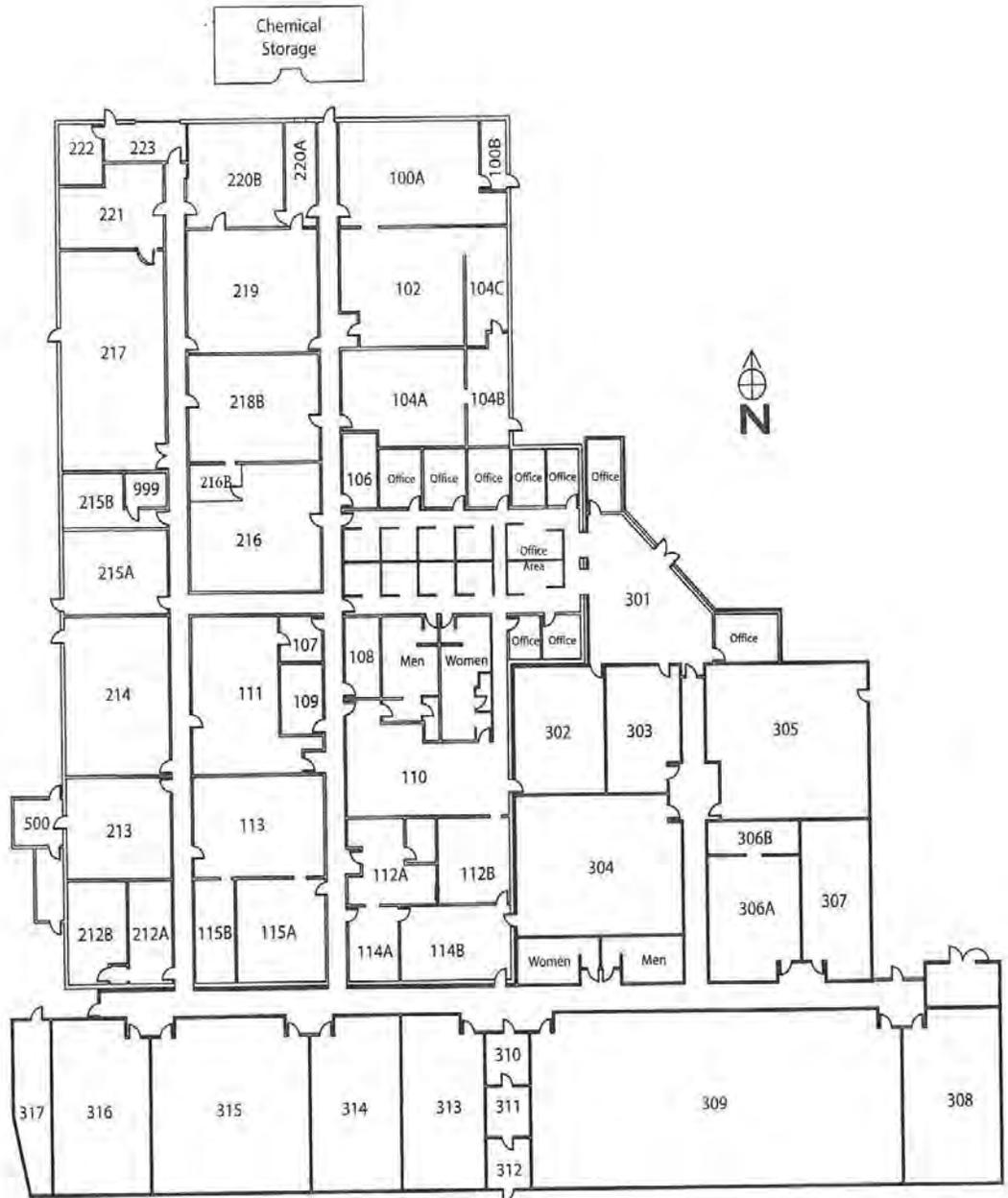
ALS Location \_\_\_\_\_

Date \_\_\_\_\_



### Appendix D Laboratory Floor Plan

- 100A SVO-GC INSTRUMENT LAB
- 100B ELECTRICAL ROOM
- 102A SVO-GC OFFICE
- 104A VOA
- 104B SVG/SVM OFFICE
- 104C SVO-GC INSTRUMENT
- 106 DI WATER ROOM
- 107 OVEN ROOM
- 108 TCLP LAB
- 109 STOCK ROOM/ SAFETY SUPPLY
- 111 GENERAL CHEMISTRY LAB
- 110 LUNCHROOM
- 112A GENERAL CHEMISTRY LAB
- 112B COPY CENTER
- 113 METALS / ICP-MS LAB
- 114A GRAIN SIZE LAB
- 114B TOTAL SOLIDS/PREP LAB
- 115A METALS / ICP-OES LAB
- 115B METALS OFFICE
- 212A METALS / HYDRIDE, MERCURY
- 212B LOW LEVEL MERCURY LAB
- 213A GENERAL CHEMISTRY LAB
- 214 GENERAL CHEMISTRY LAB
- 215A GENERAL CHEMISTRY LAB
- 215B IT
- 216 WIP FILES / VOA OFFICE
- 216B VOA PREP
- 217 SAMPLE STORAGE
- 218 VOA
- 219 SVO-GCMS INSTRUMENT LAB
- 220A SVO-GCMS OFFICE
- 220B SVO-GCMS PREP LAB
- 221 SAMPLE CONTROL OFFICES
- 222 PURCHASING
- 223 RECEIVING
- 301 MAIN OFFICE AREA
- 302 TRAINING ROOM
- 303 CONFERENCE ROOM
- 304 SOIL PREP
- 305 SAMPLE MANAGEMENT OFFICE
- 306 MICROBIOLOGY
- 306B MICROBIOLOGY
- 307 OLC INSTRUMENTS
- 308 OLC PREP LAB
- 309 ORGANIC EXTRACTIONS LAB
- 310 Maintenance/ COM room
- 311 ELECTRICAL ROOM
- 312 FIRE ROOM
- 313 DISHWASHING
- 314 METALS LOW LEVEL PREP LAB
- 315 METALS DIGESTIONS
- 316 TISSUE PREP LAB
- 317 BOILER ROOM
- 500 MAINTENANCE ROOM





**Appendix E**  
**Analytical and Support Equipment**

GENERAL CHEMISTRY/WATER CHEMISTRY LABORATORY			
Equipment Description	Year Acquired	Manufacturer or Laboratory Maintained (MM/LM)	# of Trained Operators
Analytical Balances (10): Sartorius, Mettler, Ohaus, Fisher scientific	1990-2011	LM	13
Autoclave - Market Forge Sterilmatic	1988	LM	5
Autoclave – Tutnauer	2010	LM	3
Autotitrator – Thermo Orion 500	2007	LM	3
Calorimeters (2): Parr 1241 EA Adiabatic	1987	LM	2
Parr 6300 Isoparabolic	2005	LM	2
Centrifuge – Beckman Coulter	2019	LM	13
Colony Counter - Quebec Darkfield	1988	LM	5
Conductivity Meter (1): YSI Model 3200	2004	LM	3
Digestion Systems (4): COD (2)	1989	LM	3
Kjeldahl, Lachat 46-place (1)	1999	LM	2
Skalar Micro Digester, 120 place (1)	2016	LM	2
Dissolved Oxygen Meter (2) - YSI Model 5000 & 5100	1988, 1991	LM	4
Distillation apparatus - Easy Still (2), Simple Dist (1)	2000	LM	3
Drying Ovens (6): Shel-Lab and VWR models	1990-2010	LM	13
Flash Point Tester (1): Petroleum Systems Services	2005	LM	2
Flow-Injection Analyzers (2): Bran-Leubbe	2002	LM	3
Lachat 8500	2007	LM	3
Ion Chromatographs (3) Thermo/Dionex ICS-2000	2006	LM	3
Thermo/Dionex ICS-1600	2009	LM	3
Thermo/Dionex ICS-1600	2015	LM	3
Meters (ISE and pH) (5) Orion Star A211	2019	LM	3
Orion Star A214	2016	LM	13
Orion Dual Star	2016	LM	13
VWR Symphony (2)	2004, 2013		
Microscope - Olympus	1988	LM	1
Muffle Furnace- Sybron Thermolyne Model F-A1730	1991	LM	13
Total Organic Carbon (TOC) Analyzers (4)			



Coulemetrics Model 5012	1997	LM	3
Teledyne Tekmar Fusion 1	2009	LM	2
Analytik Jena 2500	2013	LM	3
Total Organic Halogen (TOX) Analyzers (3):			
Mitsubishi TOX-100 (2)	2001	LM	3
Mitsubishi AOX-200	2015	LM	3
Turbidimeter - Hach Model 2100N	1996	LM	5
UV-Visible Spectrophotometers (1):			
Perkin Elmer Lambda 25	2008	LM	6
Vacuum Pumps (3):			
Welch Duo-Seal Model 1376	1990	LM	13
Busch R-5 Series Single Stage	1991	LM	13
Chem Star 1402N-01	2011	LM	13
Water Baths/Incubators (9):			
Various Fisher Scientific and VWR Models	1986 - 2009	LM	13
Drill Press – Craftsman	2012	-	4
<b>SOIL PREP</b>			
<b>Equipment Description</b>	<b>Year Acquired</b>	<b>Manufacturer or Laboratory Maintained (MM/LM)</b>	<b># of Trained Operators</b>
Analytical Balance (12)			
Mettler AE200	1999-2015	MM	5
Sartorius Quintix, Practum	2016-2019	MM	5
Shatter Box (2):			
GP 1000	1989	LM	5
SPEX 8530	2011	LM	5
Sieve Shakers (1):			
WS Tyler - RX 86	1991	LM	5
Thomas-Wiley Laboratory Mill, Model 4	1989	LM	5
Milkshaker (1)			
Hamilton Beach	2010	LM	4
Blender (1)			
Warin Laboratory	2013	LM	5
<b>METALS LABORATORY</b>			
<b>Equipment Description</b>	<b>Year Acquired</b>	<b>Manufacturer or Laboratory Maintained (MM/LM)</b>	<b># of Trained Operators</b>
Analytical Balance (9)			
Mettler AE 200 analytical balance	1988-2018	MM	12
Various Mettler, Sartorius, and Ohaus models			
Atomic Absorption Spectrophotometers (3):			
CETAC Mercury Analyzer M-6100	2010	LM	3
Buck AA Spectrophotometer Model 205 (2)	2008/2015	LM	3
Atomic Fluorescence Spectrophotometer (2)			
Brooks-Rand Model III	2005	LM	3



Brooks-Rand Merx	2014	LM	3
Centrifuge - IEC Model Clinical Centrifuge	1990	LM	12
Drying Oven - VWR Model 1370F	1990	LM	12
Freeze Dryers (1) - Labconco	2010	LM	5
Inductively Coupled Plasma Atomic Emission Spectrometer (ICP-AES) (2)			
Thermo Scientific Model iCAP 6500	2007	MM	3
Thermo Scientific Model iCAP 6500	2012	MM	3
Inductively Coupled Plasma Mass Spectrometers (ICP-MS) (4):			
Agilent 7700	2014	MM	2
Agilent 7800	2016	MM	2
Nexion Model 300D	2011	MM	2
Muffle Furnace (2) - Thermolyne Furnatrol - 53600	1991, 2005	LM	5
Shaker - Burrell Wrist Action Model 75	1990	LM	12
TCLP Extractors (3)	1989, 2002	LM	5

**SEMIVOLATILE ORGANICS SAMPLE PREPARATION LABORATORY**

Equipment Description	Year Acquired	Manufacturer or Laboratory Maintained (MM/LM)	# of Trained Operators
Analytical Balance (3)			
Mettler PM480, AG204, AE240	1999 - 2015	MM	12
Ohaus Explorer Pro	2016	MM	12
Centrifuge – Beckman Coulter Avanti J-15R	2019	LM	7
Drying Ovens (2)			
Fisher Model 655G	1991	LM	8
VWR Model 1305U	1999	LM	8
Evaporators/concentrators			
Organomation N-Evap (7)	1990-2010	LM	6
Organomation S-Evap (10)	1990-2010	LM	7
Biotage Turbovap (2)	2013 - 2016	LM	6
Extractor Heaters: Lab-Line Multi-Unit for Soxhlet and Continuous Liquid-Liquid Extractions (78)	1987-2007	LM	7
Solids Extractors:			
Sonic Bath VWR	1994	LM	5
Sonic Horn (4)	1994	LM	4
Soxtherm	2000	LM	3
Gerhardt (4)	2008	LM	3
OI Analytical (5)			
Extractors, TCLP (8):			
Millipore TCLP Zero Headspace Extractors (10)	1992-2011	LM	4
TCLP 12 position Extractor/Tumbler (2)	1989-2011	LM	4



Gel Permeation Chromatography (GPC) (4) J2 Scientific AccuPrep (3) Gilson (1)	2005, 2010 2013	LM LM	4 4
Muffle Furnace (2)	2006, 2009	LM	2
Solid Phase Extractors (8) – Horizon SPE-Dex 4790	2003-2008	LM	3
Microwave Extractor – Mars 6 (2)	2014, 2019	LM	4
Edmund Buhler 3-Storey top frame VKS 'Shaker table' (1)	2016	LM	5

**GC SEMIVOLATILE ORGANICS INSTRUMENT LABORATORY**

Equipment Description	Year Acquired	Manufacturer or Laboratory Maintained (MM/LM)	# of Trained Operators
Gas Chromatographs (16): Agilent 6890 GC with Agilent 7683 Autosampler and Dual ECD Detectors (6)	2001, 2005, 2007, 2011	LM	5
Agilent 6890 GC with Agilent 7683 Autosampler and Dual FPD Detectors (1)	2003	LM	4
Agilent 7890A Dual ECD Detectors Agilent 7683B autosampler (4)	2010 - 2014	LM	5
Hewlett-Packard 5890 GC with HP 7673 Autosampler and FID Detector (1)	1995	LM	4
Agilent 6890 with Dual FID Detectors and Agilent 7873 Autosampler (4)	2001, 2005	LM	4
Agilent 7890A Dual NPD Detectors and Agilent 7683B autosampler (1)	2012	LM	1

**GC/MS SEMIVOLATILE ORGANICS INSTRUMENT LABORATORY**

Equipment Description	Year Acquired	Manufacturer or Laboratory Maintained (MM/LM)	# of Trained Operators
Analytical Balance - Mettler AB 104-S	2000	MM	6
Semivolatile GC/MS Systems (10): Agilent 6890/5973 with ATAS Optic2 LVI and HP 7673 Autosampler (2)	1997, 2001	LM	5
Agilent 5890/5970 with HP 7673 Autosampler	1990	LM	5
Agilent 5890/5972 with ATAS Optic2 LVI and HP 7673 Autosampler (1)	1994	LM	5
Agilent 6890/5973 with ATAS Optic3 LVI and HP 7683 Autosampler (1)	2005	LM	5
Agilent 6890/5973 with Agilent PTV Injector and 7683 Autosampler (1)	2007	LM	5
Agilent 7890A/5975C with Agilent 7693 Autosampler (4)	2010 - 2011	LM	5
Semivolatile GC/MS/MS (2): Waters Quattro Micro GC Micromass with Agilent 6890, Agilent PTV Injector, 7683B	2008	MM	2



Autosampler Agilent 7010B Triple Quad with Agilent 7890B, Agilent PTV Injector, 7693 Autosampler	2018	MM	2
<b>HPLC LABORATORY</b>			
<b>Equipment Description</b>	<b>Year Acquired</b>	<b>Manufacturer or Laboratory Maintained (MM/LM)</b>	<b># of Trained Operators</b>
Analytical Balance – (2) Mettler AT250 Mettler AB104-S		MM MM	8 8
Drying Oven – Binder ED53		LM	8
Evaporator – Bitage Turbo Vap LV	2016	LM	8
Centrifuge (2) Beckman Coulter Allegra 6 Eppendorf 5415C		LM LM	8 8
Ultrasonic Bath (2) VWR Symphony 5.7 L VWR Symphony 20.8 L		LM LM	8 8
High-Performance Liquid Chromatographs (3): Agilent 1260 Infinity with Diode Array UV Detector	2011	LM	4
High-Performance LC/MS (4) AB Sciex API 5000 LC/MS/MS with 2x Shimadzu LC-20AD HPLC pumps and SIL-20AC autosampler AB Sciex Triple-Quad 5500 and with 2x Shimadzu LC-20AD HPLC pumps and SIL-20AC autosampler Shimadzu LCMS-8050 with 2x LC-30AD UHPLC pumps and SIL-30AC MP autosampler (2)	2008  2011  2016	MM  MM  MM	4  4  4
<b>VOLATILE ORGANICS LABORATORY</b>			
<b>Equipment Description</b>	<b>Year Acquired</b>	<b>Manufacturer or Laboratory Maintained (MM/LM)</b>	<b># of Trained Operators</b>
Analytical Balance - Mettler PE 160	1989	MM	5
Fisher Vortex Mixer	1989	LM	5
Drying Ovens (1): Boekel 107801	1989	LM	5
Sonic Water Bath - Branson Model 2200	1989	LM	5
Volatile GC/MS Systems (8): Agilent 5890/5970 Tekmar 3000 Purge and Trap Concentrator Dynatech ARCHON 5100 Autosampler Agilent 6890/5973 Tekmar 3100 Purge and Trap Concentrator Encon Centurion Autosampler Agilent 6890/5973	1989 1995 1996 2001 2001 2001 2005	LM LM LM LM LM LM LM	5   5   5



Tekmar Velocity Purge and Trap Concentrator	2005	LM	
Tekmar Aquatech Autosampler	2005	LM	
Agilent 7980A/5975C (2)	2010, 2011	LM	5
Teledyne Tekmar-Atomx	2010, 2011	LM	
Agilent 6890/5973	2013	LM	5
Encon Evolution Purge and Trap Concentrator	2013	LM	
Encon Centurion Autosampler	2013	LM	
Agilent 7890/5977A	2014	LM	5
Encon Evolution Purge and Trap Concentrator	2014	LM	
Encon Centurion Autosampler	2014	LM	
Agilent 7890B/5977B	2016	LM	5
Teledyne Tekmar Atomx	2016	LM	
Agilent 7890 GC with FID			
Encon Evolution Purge and Trap Concentrator	2013	LM	3
Encon Centurion Autosampler			
Agilent 7890 GC with FID	2013		
Encon Evolution Purge and Trap Concentrator	2016	LM	3
Encon Centurion Autosampler			

**AUTOMATED DATA PROCESSING EQUIPMENT**

Equipment Description	Year Acquired	Manufacturer or Laboratory Maintained (MM/LM)	# of Trained Operators
1 - WAN: LIMS Sample Manager using Oracle 11gR2 Enterprise RDBMS running on Red Hat Enterprise Linux Advanced Server v.6.6 platform connected via DMVPN circuits (100 Mbps)	2013	LM	NA
1 - Network Server for reporting and data acquisition running Windows Server 2008 R2 with a 1.4 TB capacity, 1 - Application server running Windows Server 2008 R2	2012	LM	NA
Approximately 90+ HP (3015, 4000, 4014, 4050, 4200, 4250, 4300), Dell 1720dn, and Lexmark M5155 printers.	2010 - 2015	LM	NA
Approximately 220+ Dell/HP PC workstations running Windows XP/Windows 7 on LAN connected via 100BT/1GigE network	2010 - 2015	LM	NA
Microsoft Office 2013 Professional as the base office application suite for all PC workstations. Some systems using Microsoft Office 2003/2007/2010	1996 - 2014	LM	NA
E-mail via Office365.com with webmail via Outlook Web Access. Microsoft Outlook 2013 is standard email client, with some using Outlook 2010	2011 - 2014	LM	NA
Facsimile Machines - Brother 4750e, Brother 2920, and Brother 1860	2005 - 2008	LM	NA
Copier/Scanners - BizHub 283, BizHub 600, BizHub 601 (2), BizHub 654, BizHUB754e (2), BizHub 951, BizHub 1050.	2005 - 2015	LM	NA

	STANDARD OPERATING PROCEDURE	Quality Assurance Manual
	ALS   Environmental - Kelso	ALKLS-QAM, Rev. 28.0
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Thru-Put, MARRS, Stealth, Harold, Blackbird, EDDGE, CASLIMS, & LabCoat reporting software systems.	1998 - 2014	LM	NA
Data processing terminals (79) - EnviroQuant, Target, Saturn, MassHunter, Chromeleon, MassLynx, Insight.	1996 - 2016	LM	NA



**Appendix F**  
**Sample Preservation, Containers, and Hold Times**

DETERMINATION <sup>a</sup>	MATRIX <sup>b</sup>	CONTAINER <sup>c</sup>	PRESERVATION	HOLDING TIME
<b>Bacterial Tests</b>				
Coliform, Colilert (SM 9223)	W, DW	P, Bottle or Bag	Cool, 4°C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>d</sup>	6-24 hours <sup>e</sup>
Coliform, Fecal and Total (SM 9221, 9222D)	W, S, DW	P,G	Cool, 4°C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>d</sup>	6-24 hours <sup>e</sup>
Enterococci (Enterolert)	W	P	Cool, 4°C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>d</sup>	8 hours
<b>Inorganic Tests</b>				
Acidity (SM 2310B)	W	P,G	Cool, 4°C	14 days <sup>EPA</sup>
Alkalinity (SM 2320B)	W, DW	P,G	Cool, 4°C	14 days <sup>EPA</sup>
Ammonia (SM 4500 NH <sub>3</sub> )	W, DW	P,G	Cool, 4°C, H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days
Biochemical Oxygen Demand(SM 5210B)	W	P,G	Cool, 4°C	48 hours
Chemical Oxygen Demand (SM 5220C)	W	P,G	Cool, 4°C, H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days
Chloride (EPA 300.0)	W, DW	P,G	Cool, 4°C	28 days
Chloride (EPA 9056)	W, S	P,G	Cool, 4°C	28 days
Chlorine, Total Residual (SM 4500 Cl F)	W, S	P,G	Cool, 4°C	24 hours
Chlorophyll-A (SM 11200H)	W	G Amber	Cool, 4°C	48 hours
Chromium VI (EPA 7196A)	W	P,G	Cool, 4°C	24 hours
Color (SM 2120B)	W, DW	P,G	Cool, 4°C	48 hours
Cyanide, Total and Amenable to Chlorination (EPA 335.4, 9010, 9012, Kelada-01) (SM 4500 CN E,G)	W, S, DW	P,G	Cool, 4°C, NaOH to pH>12, plus 0.6 g Ascorbic Acid	14 days
Cyanide, Weak Acid Dissociable (SM 4500 CN I)	W, S	P,G	Cool, 4°C, NaOH to pH >12	14 days
Ferrous Iron (ALS SOP)	W, D	G Amber	Cool, 4°C	24 hours
Fluoride (EPA 300.0, 9056, SM 4500 F-C)	W, S	P,G	Cool, 4°C	28 days
Formaldehyde (ASTM D6303)	W	G Amber	Cool, 4°C	48 hours



DETERMINATION <sup>a</sup>	MATRIX <sup>b</sup>	CONTAINER <sup>c</sup>	PRESERVATION	HOLDING TIME
Hardness (SM 2340 C)	W, DW	P,G	HNO <sub>3</sub> to pH<2	6 months
Hydrogen Ion (pH) (SM 4500 H <sup>+</sup> B)	W, DW	P,G	Cool, 4°C	Analyze immediately
Kjeldahl and Organic Nitrogen (ASTM D3590-89)	W	P,G	Cool, 4°C, H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days
Nitrate (EPA 300.0)	W, DW	P,G	Cool, 4°C	48 hours
Nitrate (EPA 9056)	W, S	P,G	Cool, 4°C	48 hours
Nitrate-Nitrite (EPA 353.2)	W, DW	P,G	Cool, 4°C, H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days
Nitrite (EPA 300.0)	W, DW	P,G	Cool, 4°C	48 hours
Nitrite (EPA 353.2)	W, S	P,G	Cool, 4°C, H <sub>2</sub> SO <sub>4</sub> to pH<2	48 hours
Nitrite (EPA 9056)	W, S	P,G	Cool, 4°C	48 hours
Nitrocellulose	S	G	Cool, 4°C	28 days
Oil and Grease, Hexane Extractable Material (EPA 1664)	W	G, Teflon Lined Cap	Cool, 4°C, H <sub>2</sub> SO <sub>4</sub> or HCL to pH<2	28 days
Organic Carbon, Total (9060 & SM 5310 C)	W	P,G	Cool, 4°C, H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days
Organic Carbon, Total (ASTM-D4129)	S	P,G	Cool, 4°C	28 days
Organic Halogens, Adsorbable (EPA 1650B)	W	G, Teflon Lined Cap	Cool, 4°C, HNO <sub>3</sub> to pH<2	6 months
Organic Halogens, Total (EPA 9020)	W	G, Teflon Lined Cap	Cool, 4°C, H <sub>2</sub> SO <sub>4</sub> to pH<2, No headspace	28 days
Orthophosphate (SM 4500 P- E)	W, DW	P,G	Cool, 4°C	48 hours
Oxygen, Dissolved (Probe) (SM 4500 O G)	W, DW	G, Bottle and Top	None Required	24 hours
Oxygen, Dissolved (Winkler)	W, DW	G, Bottle and Top	Fix on Site and Store in Dark	8 hours
Phenolics, Total (EPA 420.1, 9056)	W, S	G Amber	Cool, 4°C, H <sub>2</sub> SO <sub>4</sub> to pH<4	28 days
Phosphorus, Total (EPA 365.3)	W	P,G	Cool, 4°C, H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days
Residue, Filterable (TDS) (SM 2540 C)	W	P,G	Cool, 4°C	7 days
Residue, Nonfilterable (TSS) (SM 2540 D)	W	P,G	Cool, 4°C	7 days
Residue, Settleable (SM 2540 F)	W	P,G	Cool, 4°C	48 hours



DETERMINATION <sup>a</sup>	MATRIX <sup>b</sup>	CONTAINER <sup>c</sup>	PRESERVATION	HOLDING TIME
Residue, Total (SM 2540 B)	W	P,G	Cool, 4°C	7 days
Residue, Volatile (EPA 160.4)	W	P,G	Cool, 4°C	7 days
Silica (SM 4500 SiO <sub>2</sub> C)	W	P Only	Cool, 4°C	28 days
Specific Conductance (SM 2510 B)	W, DW	P,G	Cool, 4°C	28 days
Sulfate (EPA 300.0)	W, DW	P,G	Cool, 4°C	28 days
Sulfate (EPA 9056)	W, S	P,G	Cool, 4°C	28 days
Sulfide (9030/934)	W, S	P,G	Cool, 4°C, Add Zinc Acetate, plus Sodium Hydroxide to pH>9	7 days
Sulfide (SM 4500 S <sub>2</sub> D)	W	P,G	Cool, 4°C, Add Zinc Acetate, plus Sodium Hydroxide to pH>9	7 days
Sulfide (SM 4500 S <sub>2</sub> F)	W	P,G	Cool, 4°C, Add Zinc Acetate, plus Sodium Hydroxide to pH>9	7 days
Sulfite (SM 4500 SO <sub>3</sub> B)	W	P,G	Cool, 4°C	24 hours
Sulfides, Acid Volatile	S	G	Cool, 4°C	14 days
Surfactants (MBAS) (SM 5540 C)	W	P,G	Cool, 4°C	48 hours
Tannin and Lignin (SM 5550 B)	W	P,G	Cool, 4°C	28 days
Turbidity (EPA 180.1)	W, DW	P,G	Cool, 4°C	48 hours
<b>Metals</b>				
Arsenic Species 1632	W	G	HCL to pH<2, Cool < 4°C	28 days
Mercury (1631E)	W	F	Cool, 4°C, HCl or H <sub>2</sub> SO <sub>4</sub> to pH<2	90 days
Mercury (1631E)	S	F	Freeze < -15°C	1 year
Mercury (7471)	S	P,G	Cool, 4°C	28 days
Mercury (EPA 245.1, 7470, 7471)	W, DW	P,G	HNO <sub>3</sub> to pH<2	28 days
Metals (200.7, 200.8, 6010, 6020)	W, DW	P,G	HNO <sub>3</sub> to pH<2	6 months
Metals (200.7, 200.8, 6010, 6020)	S	G, Teflon Lined cap	Cool, 4°C	6 months



DETERMINATION <sup>a</sup>	MATRIX <sup>b</sup>	CONTAINER <sup>c</sup>	PRESERVATION	HOLDING TIME
Methyl Mercury 1630	W, S, T	F	HCL to pH<2	6 months
<b>Volatile Organics</b>				
Gasoline Range Organics (8015, NWTPH-Gx)	W	G, Teflon-Lined, Septum Cap	Cool, 4°C, HCl to pH<2, No headspace	14 days
Gasoline Range Organics (8015, NWTPH-Gx)	S	G, Teflon- Lined Cap	Cool, 4°C, Minimize Headspace	14 days
Purgeable Halocarbons (624, 8260)	W	G, Teflon-Lined, Septum Cap	No Residual Chlorine Present; HCl to pH<2, Cool, 4°C, No Headspace	14 days
Purgeable Halocarbons (624, 8260)	W	G, Teflon-Lined, Septum Cap	Residual Chlorine Present; 10% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> , HCl to pH<2, Cool, 4°C	14 days
Purgeable Halocarbons (8260)	S	G, Teflon- Lined Cap	Cool, 4°C, Minimize Headspace	14 days
Purgeable Halocarbons (8260)	S	Method 5035	Terracore/Encore device, Freeze at -20°C Methanol, Cool, 4°C	48 hr. to prepare from device, 14 days after preparing.
Purgeable Halocarbons (8260)	S	Method 5035	Sodium Bisulfate Cool, 4°C	48 hr. to prepare, 14 days after preparation
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8260)	W	G, Teflon-Lined Septum Cap, No Headspace	No Residual Chlorine Present: HCl to pH<2, Cool, 4°C, No Headspace	14 days
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8260)	W	G, Teflon-Lined Septum Cap, No Headspace	Residual Chlorine Present: 10% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> , HCl to pH<2, Cool, 4°C	14 days
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8260)	S	G, Teflon- Lined Cap	Cool, 4°C, Minimize Headspace	14 days
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8260)	S	Method 5035	Encore, Freeze at -20°C Methanol, Cool, 4°C	48 hr. to prepare from Encore, 14 days after preparation.
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8260)	S	Method 5035	Sodium Bisulfate, Cool, 4°C	48 hr. to prepare from Encore, 14 days after preparation



DETERMINATION <sup>a</sup>	MATRIX <sup>b</sup>	CONTAINER <sup>c</sup>	PRESERVATION	HOLDING TIME
Acrolein, Acrylonitrile, Acetonitrile (624, 8260)	W	G, Teflon - Lined Septum Cap	Adjust pH to 4-5, Cool, 4°C, No headspace	14 days
2-chloroethyl vinyl ether (8260)	W	G, Teflon - Lined Septum Cap	Cool, 4°C, Minimize Headspace	7 days
<b>Semivolatile Organics</b>				
Nonylphenols	W	G, Teflon-Lined Cap	H <sub>2</sub> SO <sub>4</sub> to pH<2, Cool, 4°C	28 days until extraction; 40 days after extraction
Organotins (ALS SOP)	W, S	G, Teflon-Lined Cap	Cool, 4°C	7 <sup>f</sup> days until extraction; 40 days after extraction
Otto Fuel	W, S	G, Teflon-Lined Cap	Cool, 4°C	7 <sup>f</sup> days until extraction; 40 days after extraction
Methanol in Process Liquid NCASI 94.03	L	G, Teflon-Lined Cap	Cool, 4°C	30 days
HAPS - Condensates NCASI 99.01		G, Teflon-Lined Cap	Cool, 4°C	14/30 days
HAPS - Impinger/Canisters NCASI 99.02			Cool, 4°C	21 days
Acrylamide by HPLC/MS/MS (ALS SOP LCP-ACRYL)	W, S	G, P	Cool, 4°C	14 days until extraction; 40 days after extraction
Carbamate Pesticides by HPLC/MS/MS (EPA 8321B)	W, S	Amber G, Teflon-Lined Cap	1.2 mL ChlorAC Buffer Cool, 4°C	7 <sup>f</sup> days until extraction; 40 days after extraction
Per- and Polyfluoroalkyl Substances (PFAS) by HPLC/MS/MS (ALS SOP LCP-PFC)	W, S	HDPE, Polypropylene	Cool, 4°C	14 days until extraction; 40 days after extraction
PBDE/PBB - ROHS GC/MS	W, S, T	G	Cool, 4°C	40 days after extraction
Pharmaceuticals & Personal Care Products (PPCP) by HPLC/MS/MS (EPA 1694)	W, S	Amber G, Teflon-Lined Cap	50 mg ascorbic acid if residual chlorine present, Cool, < 6°C	7 days until extraction; 30 days after extraction



DETERMINATION <sup>a</sup>	MATRIX <sup>b</sup>	CONTAINER <sup>c</sup>	PRESERVATION	HOLDING TIME
Petroleum Hydrocarbons, Extractable (Diesel-Range Organics) (EPA 8015)	W, S	G, Teflon-Lined Cap	Cool, 4°C	7 <sup>f</sup> days until extraction, 40 days after extraction
Alcohols and Glycols (EPA 8015)	W, S	G, Teflon-Lined Cap	Cool, 4°C <sup>g</sup>	7 <sup>f</sup> days until extraction; 40 days after extraction
Acid Extractable Semivolatile Organics (EPA 625, 8270)	W	G, Teflon-Lined Cap	Cool, 4°C <sup>g</sup>	7 <sup>f</sup> days until extraction; 40 days after extraction
Base/Neutral Extractable Semivolatile Organics (EPA 625, 8270)	W	G, Teflon-Lined Cap	Cool, 4°C <sup>g</sup>	7 <sup>f</sup> days until extraction; 40 days after extraction
Acid Extractable Semivolatile Organics (EPA 8270)	S	G, Teflon-Lined Cap	Cool, 4°C <sup>g</sup>	14 days until extraction; 40 days after extraction
Base/Neutral Extractable Semivolatile Organics (EPA 8270)	S	G, Teflon-Lined Cap	Cool, 4°C <sup>g</sup>	14 days until extraction; 40 days after extraction
Chlorinated Herbicides (EPA 8151)	W, S	G, Teflon-Lined Cap	Cool, 4°C <sup>g</sup>	7 <sup>f</sup> days until extraction; 40 days after extraction
Chlorinated Phenolics (EPA 1653)	W	G, Teflon-Lined Cap	H <sub>2</sub> SO <sub>4</sub> to pH<2, Cool, 4°C <sup>g</sup>	30 days until extraction; 30 days after extraction
Polynuclear Aromatic Hydrocarbons (EPA 625, 8270)	W, S	G, Teflon-Lined Cap	Cool, 4°C, Store in Dark <sup>g</sup>	7 <sup>f</sup> days until extraction; 40 days after extraction
Organochlorine Pesticides and PCBs (EPA 608, 8081, 8082, GC/MS/MS)	W, S	G, Teflon-Lined Cap	Cool, 4°C	7 <sup>f</sup> days until extraction; 40 days after extraction
Organophosphorus Pesticides (GC/MS/MS)	W, S	G, Teflon-Lined Cap	Cool, 4°C, Store in Dark <sup>g</sup>	7 <sup>f</sup> days until extraction; 40 days after extraction
<b>Drinking Water Organics</b>				
EDB, DBCP, and TCP (EPA 504.1)	W	G, Teflon-Lined Cap	Cool, 4°C, 3 mg Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> , No Headspace	14 days



DETERMINATION <sup>a</sup>	MATRIX <sup>b</sup>	CONTAINER <sup>c</sup>	PRESERVATION	HOLDING TIME
Purgeable Organics (EPA 524.2)	DW	G, Teflon-Lined, Septum cap	Ascorbic Acid, HCl to pH <sub>≤</sub> 2, Cool, 4°C, No Headspace	14 days
Per- and Polyfluoroalkyl Substances (PFAS) by HPLC/MS/MS (EPA 537 ver1.1)	DW, W	Polypropylene	1,25 g Trizma, Cool, 10°C shipment, 6°C storage	14 days until extraction; 28 days after extraction
Haloacetic Acids (EPA 552.2)	DW	G, Amber, Teflon-Lined Cap	100 mg/L NH <sub>4</sub> Cl, Cool, 4°C	14 days until extraction; 7 days after extraction
<b>Toxicity Characteristic Leaching Procedure (TCLP)</b>				
Semivolatile Organics (EPA 1311/8270)	HW	G, Teflon - Lined Cap	Sample: Cool, 4°C, Store in dark <sup>g</sup>	14 days until TCLP extraction
			TCLP extract: Cool, 4°C, Store in dark <sup>g</sup>	7 days until extraction; 40 days after extraction
Organochlorine Pesticides (EPA 1311/8081)	HW	G, Teflon Lined Cap	Sample: Cool, 4°C	14 days until TCLP extraction
			TCLP extract: Cool, 4°C	7 days until extraction; 40 days after extraction
Chlorinated Herbicides (EPA 1311/8151)	HW	G, Teflon Lined Cap	Sample: Cool, 4°C	14 days until TCLP extraction
			TCLP extract: Cool, 4°C	7 days until extraction; 40 days after extraction
Mercury (EPA 1311/7470)	HW	P,G	Sample: Cool, 4°C	28 days until extraction
			TCLP extract: HNO <sub>3</sub> to pH<2	28 days after extraction
Metals, except Mercury (EPA 1311/6010)	HW	P,G	Sample: Cool, 4°C	180 days until extraction;
			TCLP extract: HNO <sub>3</sub> to pH<2	14 days until TCLP extraction
Volatile Organics (EPA 1311/8260)	HW	G, Teflon Lined Cap	Sample: Cool, 4°C, Minimize Headspace	14 days until TCLP extraction
			Extract: Cool 4°C, HCL to pH,2, No Headspace	14 days after extraction

## Appendix G Standard Operating Procedures

Data Archiving		<a href="#">ADM-ARCH</a>	8.0
Internal Auditing		<a href="#">ADM-AUDIT</a>	0.0
Documenting Laboratory Balance and Check Weight Verification		<a href="#">ADM-BAL</a>	9.0
Sample Batches		<a href="#">ADM-BATCH</a>	13.0
Continuous Quality Improvement		<a href="#">ADM-CQI</a>	0.0
Document Control		<a href="#">ADM-DOC_CTRL</a>	0.0
Department of Defense Projects Laboratory Practices and Project Management - OSM 5.X	DOD QSM v5.1 & 5.0	<a href="#">ADM-DOD5</a>	3.0
Laboratory Data Review Process		<a href="#">ADM-DREV</a>	13.0
Contingency Plan for Laboratory Equipment Failure		<a href="#">ADM-ECP</a>	6.1
Making Entries Onto Analytical Records		<a href="#">ADM-ENTRIES</a>	0.0
Handling Customer Feedback		<a href="#">ADM-FDBK</a>	0.0
New Instrument Suitability and Validation		ADM-INST	0.0
Laboratory Management Review		<a href="#">ADM-LABMGMT</a>	1.0
Use of Accreditation Organization Names, Symbols, and Logos		<a href="#">ADM-LOGO</a>	0.0
Method Development		ADM-MDEV	0.0
Performing and Documenting Method Detection Limit Studies and Establishing Limits of Detection and Quantitation		<a href="#">ADM-MDL</a>	0.0
Manual Integration of Chromatographic Peaks		<a href="#">ADM-MI</a>	4.0
Management of Change		<a href="#">ADM-MOC</a>	0.0
Nonconformance and Corrective Action Procedures		<a href="#">ADM-NCAR</a>	1.1
Preventive Action		<a href="#">ADM-PA</a>	0.0
Project Management		<a href="#">ADM-PCM</a>	16.0
Procurement and Control of Laboratory Services and Supplies		<a href="#">ADM-PROC</a>	0.0
Proficiency Testing		<a href="#">ADM-PT</a>	0.1
Records Management		<a href="#">ADM-RCRDS</a>	0.1
Quality of Reagents and Standards		<a href="#">ADM-REAG</a>	0.0
Data Recall		<a href="#">ADM-RECALL</a>	0.0
Data Reporting and Report Generation		<a href="#">ADM-RG</a>	10.1



Data Archiving		<a href="#">ADM-ARCH</a>	8.0
Reagent and Standards Login and Tracking		<a href="#">ADM-RLT</a>	7.0
Support Equipment Monitoring and Calibration		<a href="#">ADM-SEMC</a>	15.0
Establishing Standard Operating Procedures		<a href="#">ADM-SOP</a>	1.0
Qualification of Subcontract Laboratories and Internal Subcontracting Protocol		<a href="#">ADM-SUBCONT</a>	0.0
Software Quality Assurance and Data Security		<a href="#">ADM-SWOADATA</a>	1.2
Employee Training and Orientation		<a href="#">ADM-TRAIN</a>	5.0
Trending, Control Charts, and Uncertainty		<a href="#">ADM-TREND</a>	2.0
Checking Volumetric Labware		<a href="#">ADM-VOIWARE</a>	8.0
Quality Assurance Manual		<a href="#">ALSKL-QM</a>	27.0
Coliform, Fecal	SM 9221 E EPA 1680	<a href="#">BIO-9221FC</a>	11.0
Coliform, Total	SM 9221 B	<a href="#">BIO-9221TC</a>	6.0
Coliform, Total (Membrane Filter Procedure)	SM 9222 B	<a href="#">BIO-9222B</a>	1.0
Coliform, Fecal (Membrane Filter Procedure)	SM 9222 D	<a href="#">BIO-9222D</a>	5.0
Colilert <sup>®</sup> , Colilert-18 <sup>®</sup> , & Colisure <sup>®</sup>	SM 9223B Colilert	<a href="#">BIO-9223</a>	11.0
Enterolert	ASTM D6503-99 Enterolert	<a href="#">BIO-ENT</a>	4.0
Heterotrophic Plate Count	SM 9215 B	<a href="#">BIO-HPC</a>	8.0
Microbiology Quality Assurance and Quality Control	SM 9020	<a href="#">BIO-QAQC</a>	18.0
Sheen Screen/Oil Degrading Microorganisms	SM 9221 C	<a href="#">BIO-SHEEN</a>	4.0
Separatory Funnel Liquid-Liquid Extraction	EPA 3510C	<a href="#">EXT-3510</a>	13.0
Organic Compounds in Water by Microextraction	EPA 3511	<a href="#">EXT-3511</a>	1.0
Continuous Liquid-Liquid Extraction	EPA 3520C	<a href="#">EXT-3520</a>	18.0
Solid Phase Extraction	EPA 3535A	<a href="#">EXT-3535</a>	8.0
Soxhlet Extraction	EPA 3540C	<a href="#">EXT-3540</a>	13.0
Automated Soxhlet Extraction	EPA 3541	<a href="#">EXT-3541</a>	12.0
Microwave Extraction	EPA 3546	<a href="#">EXT-3546</a>	2.0
Ultrasonic Extraction	EPA 3550B	<a href="#">EXT-3550</a>	14.0
Waste Dilution Extraction	EPA 3580A	<a href="#">EXT-3580</a>	8.0



Data Archiving		<a href="#">ADM-ARCH</a>	8.0
Silica Gel Cleanup	EPA 3630C	<a href="#">EXT-3630</a>	6.0
Gel Permeation Chromatography	EPA 3640A	<a href="#">EXT-3640A</a>	11.0
Removal of Sulfur Using Copper	EPA 3660B	<a href="#">EXT-3660</a>	9.0
Sulfuric Acid Cleanup	EPA 3665A	<a href="#">EXT-3665</a>	8.0
Carbon Cleanup	Restek #EVAN1197	<a href="#">EXT-CARCU</a>	6.0
Diazomethane Preparation		<a href="#">EXT-DIAZ</a>	9.1
FDA Extractives		<a href="#">EXT-FDAEX</a>	4.0
Florasil Cleanup	EPA 3620C	<a href="#">EXT-FLOR</a>	8.0
Organic Extractions Glassware Cleaning		<a href="#">EXT-GC</a>	10.0
Percent Lipids in Tissues	PSEP Bligh & Dyer	<a href="#">EXT-LIPID</a>	7.0
Extraction Method for Organotins in Sediments, Water, and Tissue		<a href="#">EXT-OSWT</a>	11.0
Preparation of Reagents and Blank Matrices Used in Semivolatile Organics Analysis		<a href="#">EXT-REAG</a>	5.0
Addition of Spikes and Surrogates		<a href="#">EXT-SAS</a>	11.0
Zero Headspace Extraction (EPA Method 1311)	EPA 1311	<a href="#">EXT-ZHE</a>	1.0
Facility and Laboratory Cleaning		<a href="#">FAC-CLEAN</a>	5.0
Operation and Maintenance of Laboratory Reagent Water Systems		<a href="#">FAC-WATER</a>	5.0
Flashpoint Determination - Setaflash	EPA 1020A	<a href="#">GEN-1020</a>	10.0
Color	SM 2120 B EPA 110.2	<a href="#">GEN-110.2</a>	8.0
Total Solids	SM 2540 B EPA 160.3	<a href="#">GEN-160.3</a>	16.0
Solids, Total Volatile and Percent Ash In Soil and Solid Samples	SM 2540 E EPA 160.4	<a href="#">GEN-160.4</a>	9.0
Settleable Solids	SM 2540 F EPA 160.5	<a href="#">GEN-160.5</a>	7.0
Halides, Adsorbable Organic (AOX)	EPA 1650C	<a href="#">GEN-1650</a>	6.0
Gravimetric Determination of Hexane Extractable Material (1664)	EPA 1664A/9071B	<a href="#">GEN-1664</a>	12.0
Alkalinity, Total	SM 2320 B	<a href="#">GEN-2320</a>	12.0
Hardness, Total	SM 2340 C	<a href="#">GEN-2340</a>	11.0
Chloride (Titrimetric, Mercuric Nitrate)	SM 4500-CL: C EPA 325.3	<a href="#">GEN-325.3</a>	7.0



Data Archiving		<a href="#">ADM-ARCH</a>	8.0
Chlorine, Total/Free Residual	SM 4500-Cl F EPA 330.4	<a href="#">GEN-330.4</a>	4.0
Total Residual Chlorine - Method 330.5	SM 4500-Cl G EPA 330.5	<a href="#">GEN-330.5</a>	3.0
Ammonia by Flow Injection Analysis	SM 4500-NH <sub>3</sub> G EPA 350.1	<a href="#">GEN-350.1</a>	14.0
Nitrate/Nitrite, Nitrite by Flow Injection Analysis	EPA 353.2	<a href="#">GEN-353.2</a>	11.0
Phosphorous Determination Using Colorimetric Procedure	EPA 365.3	<a href="#">GEN-365.3</a>	14.0
Phenolics, Total	EPA 420.1/9065	<a href="#">GEN-420.1</a>	16.0
Ammonia as Nitrogen by Ion Specific Electrode	SM 4500-NH <sub>3</sub> E	<a href="#">GEN-4500 NH3 E</a>	8.0
Orthophosphate Determination Using Colorimetric Procedure	SM 4500-P E	<a href="#">GEN-4500 P-F</a>	4.0
Dissolved Silica	SM 4500-SiO <sub>2</sub> C	<a href="#">GEN-4500 SIO2C</a>	5.0
Sulfide, Methylene Blue	SM 4500-S <sup>2-</sup> D	<a href="#">GEN- 4500S2D</a>	6.0
Sulfide, Titrimetric (Iodine)	SM 4500-S <sup>2-</sup> F EPA 9034	<a href="#">GEN- 4500S2F</a>	4.0
Halogens, Total as Chloride by Bomb Digestion	SM 4500-Cl C EPA 5050	<a href="#">GEN-5050</a>	4.0
Biochemical Oxygen Demand	SM 5210 B, 4500-O G	<a href="#">GEN-5210B</a>	7.0
Determination of Methylene Blue Active Substances (MBAS)	SM 5540 C	<a href="#">GEN-5540C</a>	9.0
Tannin and Lignin	SM 5550 B	<a href="#">GEN-5550</a>	7.0
Halides, Total Organic (TOX)	EPA 9020B	<a href="#">GEN-9020</a>	10.0
Total Sulfides by Methylene Blue Determination	SM 4500-S <sup>2-</sup> D EPA 9030B	<a href="#">GEN-9030</a>	12.0
Cation-Exchange of Soils - Ammonium Acetate	EPA 9080	<a href="#">GEN-9080</a>	0.0
Acidity	SM 2310 B EPA 305.2	<a href="#">GEN- ACIDITY</a>	6.1
Total Carbon in Soil	ASTM 4129-05 Lloyd	<a href="#">GEN-ASTM</a>	13.0
Sulfides, Acid Volatile	EPA 1629	<a href="#">GEN-AVS</a>	9.0
Heat of Combustion	ASTM D240-87 ASTM D5865-	<a href="#">GEN-BTU</a>	5.0
Chlorophyll-a by Colorimetry	SM 10200 H	<a href="#">GEN-CHLOR</a>	4.0
Total Cyanides and Cyanides Amenable to Chlorination	SM 4500-CN E, G EPA	<a href="#">GEN-CN</a>	20.0
Cyanide, Weak Acid Dissociable	SM 4500-CN I	<a href="#">GEN- CNWAD</a>	2.0
Chemical Oxygen Demand	SM 5220 C	<a href="#">GEN-COD</a>	10.1
Conductivity and Salinity in Water and Wastes	SM 2510 B EPA	<a href="#">GEN-COND</a>	12.0



Data Archiving		<a href="#">ADM-ARCH</a>	8.0
Corrosivity Towards Steel	EPA 1110	<a href="#">GEN-CORR</a>	3.0
Hexavalent Chromium - Colorimetric	EPA 7196A, 3060A	<a href="#">GEN-CR6</a>	16.0
Standard Test Methods for Determining Sediment Concentration in Water Samples	ASTM 3977-97	<a href="#">GEN-D3977</a>	3.0
Carbonate (CO <sub>3</sub> ) by Evolution and Coulometric Titration	ASTM D513-82M	<a href="#">GEN-D513M</a>	3.0
Sulfide, Soluble Determination of Soluble Sulfide in Sediment	EPA 376.2	<a href="#">GEN-DIS.S2</a>	3.0
Bulk Density of Solid Waste Fractions	ASTM E1109-86	<a href="#">GEN-E1109</a>	1.0
Free Cyanide in Water, Wastewater, and Soil by Microdiffusion	ASTM D4282-83 EPA	<a href="#">GEN-FCN</a>	0.0
Ferrous Iron in Water	Lovely/Phillips	<a href="#">GEN-FelI</a>	6.0
Fluoride by Ion Selective Electrode	SM 4500-F C	<a href="#">GEN-FISE</a>	10.0
Formaldehyde Colorimetric Procedure	ASTM D6303-98 NCASI	<a href="#">GEN-FORM</a>	3.0
Hydrazine in Water Using Colorimetric Procedure	ASTM D1385-88	<a href="#">GEN-HYD</a>	3.0
Total Sulfur for Ion Chromatography	EPA 300.0	<a href="#">GEN-ICS</a>	3.0
Ion Chromatography	EPA 300.0, 9056A	<a href="#">GEN-IONC</a>	20.0
Color, NCASI	NCASI Bull. #253	<a href="#">GEN-NCASI</a>	5.0
Oxygen Consumption Rate	SM 2710 B	<a href="#">GEN-O2RATE</a>	2.0
Carbon, Total Organic Determination (Walkley Black Method)	Walkley Black	<a href="#">GEN-OSU</a>	4.0
pH in Soil and Solids	EPA 9045D	<a href="#">GEN-pHS</a>	17.0
pH in Water	SM 4500-H <sup>+</sup> B EPA 9040C EPA	<a href="#">GEN-pHW</a>	17.0
Sulfides, Reactive	EPA 9030A	<a href="#">GEN-RS</a>	5.0
Total Sulfide by PSEP	PSEP TC-3991-04	<a href="#">GEN-S2PS</a>	2.0
Sulfite	SM 4500-SO <sub>3</sub> <sup>2-</sup> EPA 377.1	<a href="#">GEN-SO3</a>	3.0
Specific Gravity	SM 2710 F ASTM D854-83	<a href="#">GEN-SPGRAV</a>	2.0
Solids, Total Dissolved (TDS)	SM 2540 C	<a href="#">GEN-TDS</a>	14.0
Thiocyanate	SM 4500-CN: M	<a href="#">GEN-THIOCN</a>	3.0
Nitrogen, Total and Soluble Kjeldahl		<a href="#">GEN-TKN</a>	16.0
Total Nitrogen and Total Phosphorous by Alkaline Persulfate Digestion NCASI Method TNTP-W10900	NCASI TNTP-W10900	<a href="#">GEN-TNTP</a>	2.0



Data Archiving		<a href="#">ADM-ARCH</a>	8.0
Total Organic Carbon in Water	SM 5310 C EPA 9060A	<a href="#">GEN-TOC</a>	15.0
Solids, Total Suspended (TSS)	SM 2540 D	<a href="#">GEN-TSS</a>	14.0
Turbidity Measurement	SM 2130 B EPA 180.1	<a href="#">GEN-TURB</a>	8.0
Labware Washing for Inorganic Analyses		<a href="#">GEN-WASH</a>	6.1
Pharmaceuticals, Personal Care Products, and Endocrine Disrupting Compounds by HPLC/Tandem Mass Spectrometry	EPA 1694	<a href="#">LCP-1694</a>	6.0
Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS)	EPA 537	<a href="#">LCP-537</a>	6.0
Determination of Selected Per- and Polyfluorinated Alkyl Substances in Drinking Water by Solid Phase Extraction & Quantitative Determination of Carbamate Pesticides in Solid Matrices by High Performance Liquid	EPA 537.1	<a href="#">LCP-537.1</a>	0.0
Determination of Carbamates in Water by EPA 8321 Using LC Tandem Mass Spectrometry	EPA 8321B	<a href="#">LCP-8321S</a>	2.0
Acrylamide by High Performance Liquid Chromatography/tandem mass spectrometry (HPLC/mMS/MS)	EPA 8321B	<a href="#">LCP-8321W</a>	3.0
Per- and Polyfluoroalkyl Substances (PFAS) by HPLC MS/MS		<a href="#">LCP-PFC</a>	10.0
Per- and Polyfluoroalkyl Substances (PFAS) by HPLC MS/MS - NJ Edition		<a href="#">LCP-PFC_NJ</a>	0.0
Total Oxidative Precursor (TOP) Assay of Poly- and Perfluoroalkyl Substances		<a href="#">LCP-TOP</a>	0.0
Methyl Mercury in Soil and Sediments by Cold Vapor Atomic Fluorescence Spectrometry	EPA 1630	<a href="#">MET-1630S</a>	5.0
Methyl Mercury in Tissue by Alcoholic Potassium Hydroxide Digestion, Ethylation, Purge and Trap, and Cold Vapor Atomic	EPA 1630	<a href="#">MET-1630T</a>	4.0
Methyl Mercury in Water by Distillation, Aqueous Ethylation, Purge and Trap, and Cold Vapor Atomic Fluorescence	EPA 1630	<a href="#">MET-1630W</a>	5.0
Mercury by Oxidation, Purge & Trap, and Cold Vapor Atomic Fluorescence Spectrometry	EPA 1631E	<a href="#">MET-1631</a>	16.0
Determination of Arsenic Species by Hydride Generation Cryogenic Trapping Gas Chromatography Atomic Absorption	EPA 1632A	<a href="#">MET-1632</a>	5.0
Mercury in Water	EPA 245.1	<a href="#">MET-245.1</a>	17.0
Metals Digestion	EPA 3010A	<a href="#">MET-3010A</a>	16.0
Metals Digestion	EPA 3020A	<a href="#">MET-3020A</a>	19.0
Metals Digestion	EPA 3050B	<a href="#">MET-3050B</a>	17.0
Closed Vessel Oil Digestion	EPA 3051A	<a href="#">MET-3051M</a>	5.1
Closed Vessel Digestion of Siliceous and Organically Based Matrices	EPA 3052	<a href="#">MET-3052M</a>	6.0
Determination of Metals & Trace Elements by Inductively Coupled Plasma-MS (Method 6020)	EPA 6020B	<a href="#">MET-6020</a>	18.0
Mercury in Liquid Waste	EPA 7470A	<a href="#">MET-7470A</a>	19.0
Mercury in Solid of Semisolid Waste	EPA 7471A/B	<a href="#">MET-7471</a>	20.0



Data Archiving		<a href="#">ADM-ARCH</a>	8.0
Bioaccessibility of Metals in Soil and Solid Waste		<a href="#">MET-BIOACC</a>	5.0
Metals Digestion of Aqueous Samples	CLP ILM04.0 EPA 200 series	<a href="#">MET-DIG</a>	19.0
Sample Filtration for Metals Analysis		<a href="#">MET-FILT</a>	6.0
Metals Laboratory Glassware Cleaning		<a href="#">MET-GC</a>	9.0
Determination of Metals and Trace Elements by ICP/AES	EPA 200.7/6010D	<a href="#">MET-ICP</a>	27.0
Determination of Metals and Trace Elements by Inductively Coupled Plasma-MS (METHOD 200.8)	EPA 200.8	<a href="#">MET-ICPMS</a>	18.1
Trace Metals in Water by Preconcentration Using Reductive Precipitation Followed by ICP-MS		<a href="#">MET-RPMS</a>	10.0
Metals and Semivolatiles SPLP Extractions (EPA Method 1312)	EPA 1312	<a href="#">MET-SPLP</a>	3.0
Waste Extraction Est (WET) Procedure (STLC) for Nonvolatile and Semivolatile Parameters	CA Title 22	<a href="#">MET-STLC</a>	5.0
Metals and Semivolatiles TCLP Extraction (EPA Method 1311)	EPA 1311	<a href="#">MET-TCLP</a>	10.0
Sample Preparation fo Biological Tissues for Metals Analysis by ICP-OES and ICP-MS		<a href="#">MET-TDIG</a>	6.0
Tissue Sample Preparation		<a href="#">MET-TISP</a>	11.0
Analysis of Water and Solid Samples for Aliphatic Hydrocarbons	EPA 8015C	<a href="#">PET-ALIPHAT</a>	2.0
Analysis of Waters, Solids, and Soluble Waste Samples for Semi-Volatile Fuel Hydrocarbons	EPA 8015C NWTPH-Dx	<a href="#">PET-SVF</a>	16.0
Analysis of Water and Solid Samples for Total Petroleum Hydrocarbons	EPA 8015C NWTPH-Dx	<a href="#">PET-TPH</a>	2.0
Analysis of Solid and Aqueous Samples for State of Wisconsin Diesel Range Organics	WI DNR DRO	<a href="#">PHC-WIDRO</a>	5.0
Bottle Order Preparation and Shipping		<a href="#">SMO-BORD</a>	18.0
Sample Disposal		<a href="#">SMO-DISP</a>	15.0
Foreign Soils Handling Treatment		<a href="#">SMO-FSHT</a>	12.0
Sample Receiving		<a href="#">SMO-GEN</a>	38.0
Sample Tracking and Internal Chain of Custody		<a href="#">SMO-SCOC</a>	
Organochlorine Pesticides and PCBs (Method 608)	EPA 608	<a href="#">SOC-608</a>	9.0
Organochlorine Pesticides and PCBs (Method 608.3)	EPA 608.3	<a href="#">SOC-608.3</a>	0.1
Glycols		<a href="#">SOC-8015</a>	14.0
Organochlorine Pesticides by Gas Chromatography; Capillary Column Technique	EPA 8081B	<a href="#">SOC-8081</a>	21.0
PCBs as Aroclors	EPA 8082A	<a href="#">SOC-8082Ar</a>	19.0
Congener-Specific Determination of PCBs by GC/ECD	EPA 8082A	<a href="#">SOC-8082Co</a>	16.0



Data Archiving		<a href="#">ADM-ARCH</a>	8.0
Chlorinated Herbicides	EPA 8151A	<a href="#">SOC-8151</a>	18.0
Chlorinated Phenols Method 8151 Modified	EPA 8151A	<a href="#">SOC-8151M</a>	12.0
Methanol in Process Liquids and Stationary Source Emissions	NCASI 94.03	<a href="#">SOC-9403</a>	9.0
Hazardous Air Pollutants (HAPS) in Pulp and Paper Industry Condensates	NCASI 99.01	<a href="#">SOC-9901</a>	6.0
HAPS and Other Compounds in Impinger/Canister Samples from Wood Product Facilities	NCASI 99.02	<a href="#">SOC-9902</a>	5.0
Alcohols	EPA 8015C	<a href="#">SOC-ALC</a>	3.0
Butyltins		<a href="#">SOC-BUTYL</a>	15.0
Calibration of Instruments for Organic Chromatographic Analyses		<a href="#">SOC-CAL</a>	10.0
Confirmation Procedure for GC and HPLC Analyses		<a href="#">SOC-CONF</a>	8.0
Determination of Otto Fuel in Water		<a href="#">SOC-OTTO</a>	3.0
Aliquoting of Samples		<a href="#">SOILPREP-ALIQUT</a>	2.0
Subsampling and Compositing of Samples		<a href="#">SOILPREP-SUBS</a>	2.0
Particle Size Determination - ASTM Procedure	ASTM D421-85 ASTM D422-63	<a href="#">SOIL-PSASTM</a>	5.0
Particle Size Determination	ASTM D422 Plumb/PSEP	<a href="#">SOIL-PSP</a>	10.0
Total, Fixed, and Volatile Solids in Solid and Semi-Solid Samples	EPA 160.3M, EPA 160.4. SM	<a href="#">SOIL-SOLIDS</a>	2.0
1,2-Dibromoethane, 1,2-Dibromo-3-Chloropropane, and 1,2,3-TCP BY GC	EPA 504.1	<a href="#">SVD-504</a>	12.0
Haloacetic Acids in Drinking Water	EPA 552.2	<a href="#">SVD-552</a>	9.1
Chlorinated Phenolics by In-Situ Acetylation and GC/MS	EPA 1653A	<a href="#">SVM-1653A</a>	11.0
Semivolatile Organic Compounds by GC/MS	EPA 625	<a href="#">SVM-625</a>	8.0
Semivolatile Organic Compounds by GC/MS	EPA 625.1	<a href="#">SVM-625.1</a>	0.0
Semivolatile Organic Compounds by GC/MS - Method 8270D	EPA 8270D	<a href="#">SVM-8270D</a>	6.0
Semivolatile Organic Compounds by GC/MS - Low Level Procedure	EPA 8270D	<a href="#">SVM-8270L</a>	10.0
Polynuclear Aromatic Hydrocarbons by Gas Chromatography/Mass Spectrometry SIM	EPA 8270D	<a href="#">SVM-8270P</a>	11.0
Semivolatile Organic Compounds by GC/MS Selected Ion Monitoring	EPA 8270D	<a href="#">SVM-8270S</a>	8.0
Anthraquinone in Paperboards by GC/MS Selective Ion Monitoring	NCASI AQ-S108.01. EPA	<a href="#">SVM-AQ</a>	1.0
Diisopropyl Methylphosphonate by GC/MS Selective Ion Monitoring	Cert. Method UK16. SOP 217	<a href="#">SVM-DIMP</a>	0.0
Nonylphenols Isomers and Nonylphenol Ethoxylates	ASTM D7065-06	<a href="#">SVM-NONYL</a>	6.0



Data Archiving		<a href="#">ADM-ARCH</a>	8.0
Organophosphorous Pesticides by Method 8270E	EPA 8270E	<a href="#">SVM-OPPMS2</a>	3.0
Chlorinated Pesticides by GC/MS/MS		<a href="#">SVM-PESTMS2</a>	6.0
Polybrominated Diphenyl Ethers (PBDEs) and Polybrominated Biphenyls (PBBs) by GC/MS	EPA 8270	<a href="#">SVM-ROHS</a>	2.0
Purge and Trap for Aqueous Samples	EPA 5030B	<a href="#">VOC-5030</a>	11.0
Purge and Trip/Extraction for VOC in Soil and Waste Samples, Closed System	EPA 5035A	<a href="#">VOC-5035</a>	14.0
Volatile Organic Compounds by GC/MS	EPA 524.2	<a href="#">VOC-524.2</a>	19.0
Volatile Organic Compounds In Water by GC/MS SIM	CA SRL 524.2M	<a href="#">VOC-524.2SIM</a>	2.0
Volatile Organic Compounds by GC/MS	EPA 624.1	<a href="#">VOC-624</a>	14.0
Volatile Organic Compounds by GC/MS	EPA 8260C	<a href="#">VOC-8260</a>	21.0
Volatile Organic Compounds by GC/MS Selective Ion Monitoring		<a href="#">VOC-8260S</a>	4.0
VOA Storage Blanks		<a href="#">VOC-BLAN</a>	11.0
Sample Screening for Volatile Organic Compounds in Soil, Water, and Misc. Matrices		<a href="#">VOC-BVOC</a>	9.0
Gasoline Range Organics by Gas Chromatography	EPA 8015C NWTPH-Gx	<a href="#">VOC-GRO</a>	13.0

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**Appendix H**  
**Data Qualifiers**



#### Inorganic Data Qualifiers

- \* The result is an outlier. See case narrative.
- # The control limit criteria is not applicable. See case narrative.
- B The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
- E The result is an estimate amount because the value exceeded the instrument calibration range.
- J The result is an estimated value.
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.  
*DOD-QSM definition*: Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- i The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
- X See case narrative.
- Q See case narrative. One or more quality control criteria was outside the limits.
- H The holding time for this test is immediately following sample collection. The samples were analyzed as soon as possible after receipt by the laboratory.

#### Metals Data Qualifiers

- # The control limit criteria is not applicable. See case narrative.
- J The result is an estimated value.
- E The percent difference for the serial dilution was greater than 10%, indicating a possible matrix interference in the sample.
- M The duplicate injection precision was not met.
- N The Matrix Spike sample recovery is not within control limits. See case narrative.
- S The reported value was determined by the Method of Standard Additions (MSA).
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.  
*DOD-QSM definition*: Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- W The post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.
- i The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
- X See case narrative.
- + The correlation coefficient for the MSA is less than 0.995.
- Q See case narrative. One or more quality control criteria was outside the limits.

#### Organic Data Qualifiers

- \* The result is an outlier. See case narrative.
- # The control limit criteria is not applicable. See case narrative.
- A A tentatively identified compound, a suspected aldol-condensation product.
- B The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
- C The analyte was qualitatively confirmed using GC/MS techniques, pattern recognition, or by comparing to historical data.
- D The reported result is from a dilution.
- E The result is an estimated value.
- J The result is an estimated value.
- N The result is presumptive. The analyte was tentatively identified, but a confirmation analysis was not performed.
- p The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two analytical results.
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.  
*DOD-QSM definition*: Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- i The MRL/MDL or LOQ/LOD is elevated due to a chromatographic interference.
- X See case narrative.
- Q See case narrative. One or more quality control criteria was outside the limits.

#### Additional Petroleum Hydrocarbon Specific Qualifiers

- F The chromatographic fingerprint of the sample matches the elution pattern of the calibration standard.
- L The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
- H The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of heavier molecular weight constituents than the calibration standard.
- O The chromatographic fingerprint of the sample resembles an oil, but does not match the calibration standard.
- Y The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.
- Z The chromatographic fingerprint does not resemble a petroleum product.

**Appendix I**  
**Master List of Controlled Documents**

Internal QA Documents	Location
Quality Assurance Manual	Q:\QA Manual\QAM.rXX.DOC
ALS-Kelso Certifications/Accreditations	QA Department and online access
MDL/LOD/LOQ Tracking Spreadsheet	MDL_LIST_Master.xls
Technical Training Summary Database	TrainDat.mdb
Approved Signatories List	QAM App A
Personnel resumes/qualifications	HR Department
Personnel Job Descriptions	HR Department/QA Training Files
ALS - Kelso Data Quality Objectives	Kelso DQO table-QA Maintained.xls
Master Logbook of Laboratory Logbooks	QA Masterlog-001
Standard Operating Procedures and Spreadsheet	1_ Kelso SOP.xls
Proficiency Testing Schedule and Tracking Spreadsheet	PT_Schedule.xls
External Normative Documents	Location
USEPA Manual for the Certification of Laboratories Analyzing Drinking Water, 5th Edition, EPA 815-B-97-001 (January 2005)	QA Department and online access
USEPA 40 CFR Part 136, Guidelines for Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act, and EPA Method Update Rule 2007, 2012, 2017.	QA Department and online access
USEPA 40 CFR Part 141, National Primary Drinking Water Regulations and EPA Method Update Rule 2007.	QA Department and online access
National Environmental Laboratory Accreditation Program (NELAP), 2009 Quality Standards.	QA Department
Quality Standards. American National Standard General requirements for the competence of testing and calibration laboratories, ANSI/ISO/IEC 17025:2005(E).	QA Department
DoD Quality Systems Manual for Environmental Laboratories, Versions 4.2, 5.0, and 5.1.	QA Department and online access
Analytical Methods (see References section).	Laboratory Departments and Online access

## Appendix J Laboratory Accreditations

The list of accreditations, certifications, licenses, and permits existing at the time of this QA Manual revision is given below, followed by the entire primary NELAP and DOD ELAP accreditations (un-numbered attachments). Current accreditation information is available at any time by contacting the laboratory or viewing the ALS Global website [www.alsglobal.com](http://www.alsglobal.com).

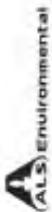
Program	Number
<b><u>National Programs</u></b>	
ISO:IEC 17025:2017	L18-129
DoD ELAP	L18-128
<b><u>State Programs</u></b>	
Alaska DEC CSLAP	17-004
Arizona DHS	AZ0339
Arkansas - DEQ	88-0637
California DHS	2795
Florida DOH	E87412
Hawaii DOH	-
Louisiana DEQ	3016
Maine DHS	WA01276
Minnesota DOH	053-999-457
Nevada DEP	WA35
New Jersey DEP	WA005
New York DoH	12060
North Carolina DWQ	605
Oregon - DOH (primary NELAP)	WA100010
South Carolina DHEC	61002
Texas CEQ	T104704427-16-11
Washington DOE	C544
Wyoming/EPA Region 8	R 8 Drinking Water
	Reciprocal Cert.
<b><u>Miscellaneous</u></b>	
Foreign Soil Permit	USDA
Plant Import Permit	USDA

		Quality Assurance Manual
	STANDARD OPERATING PROCEDURE	ALKLS-QAM, Rev. 28.0
	ALS   Environmental - Kelso	Effective: 10/21/2020
		Page 79 of 81

**Appendix K**  
**Chain of Custody and Cooler Receipt Forms**



**CHAIN OF CUSTODY**



1317 South 13th Ave., Kelso, WA 98626 | 360.577.7222 | 800.895.7222 | 360.636.1068 (fax)

SR# \_\_\_\_\_ OF \_\_\_\_\_ COCH# \_\_\_\_\_

PROJECT NAME PROJECT NUMBER PROJECT MANAGER COMPANY NAME ADDRESS CITY/STATE/ZIP E-MAIL ADDRESS PHONE # SAMPLE SIGNATURE		DATE TIME LAB I.D. MATRIX		NUMBER OF CONTAINERS		REMARKS
Volatile Organics by GC/MS 625 <input type="checkbox"/> 6270 <input type="checkbox"/> 6270LL <input type="checkbox"/> SIM PAH <input type="checkbox"/> Volatile Organics 624 <input type="checkbox"/> 6260 <input type="checkbox"/> Hydrocarbons (see below) Gas <input type="checkbox"/> Diesel <input type="checkbox"/> Oil <input type="checkbox"/> Oil & Grease/TSPH 1664 HEM <input type="checkbox"/> PCBs 1664 SGT <input type="checkbox"/> Aroclors Congeners <input type="checkbox"/> Pesticides/Herbicides 608 <input type="checkbox"/> 808T <input type="checkbox"/> Chlorophenolics - B151M 814 <input type="checkbox"/> 815T <input type="checkbox"/> Metals, Total or Dissolved (See List Below) Cyanide <input type="checkbox"/> Hex-Chrom <input type="checkbox"/> NO <sub>3</sub> BOB, TSS, TDS, Turb (conc) pH Cond, Cl, SO <sub>4</sub> , PO <sub>4</sub> , F, NO <sub>2</sub> , (conc) NH <sub>3</sub> -N, COD, TKN, TOC, DOC, NO <sub>2</sub> -NO <sub>3</sub> , T-Phos TOX 9020 <input type="checkbox"/> AOX 1650 <input type="checkbox"/> SO <sub>6</sub> <input type="checkbox"/> HCO <sub>3</sub> <input type="checkbox"/> Alkalinity <input type="checkbox"/> CO <sub>2</sub> <input type="checkbox"/> Dissolved Gases 1613 <input type="checkbox"/> 8290 <input type="checkbox"/> RSK 175 <input type="checkbox"/> Methane <input type="checkbox"/> Ethane <input type="checkbox"/> Ethanol <input type="checkbox"/>						
<b>REPORT REQUIREMENTS</b> I. Routine Report: Method Blank, Surrogate, as required II. Report Dup., MS, MSD as required III. CLP Like Summary (no raw data) IV. Data Validation Report V. EDD		<b>INVOICE INFORMATION</b> P.O. # _____ Bill To: _____		<b>TURNAROUND REQUIREMENTS</b> 24 hr. _____ 48 hr. _____ 5 day _____ Standard (15 working days) Provides FAX Results Requested Report Date _____		*INDICATE STATE HYDROCARBON PROCEDURE: AK CA WI NORTHWEST OTHER: _____ (CIRCLE ONE) SPECIAL INSTRUCTIONS/COMMENTS: _____ <input type="checkbox"/> Sample Shipment contains USDA regulated soil samples (check box if applicable)
<b>RELINQUISHED BY:</b> Signature _____ Date/Time _____ Printed Name _____ Firm _____		<b>RELINQUISHED BY:</b> Signature _____ Date/Time _____ Printed Name _____ Firm _____		<b>RECEIVED BY:</b> Signature _____ Date/Time _____ Printed Name _____ Firm _____		



**Cooler Receipt and Preservation Form**

PM \_\_\_\_\_

Client \_\_\_\_\_ Service Request **K20**  
Received: \_\_\_\_\_ Opened: \_\_\_\_\_ By: \_\_\_\_\_ Unloaded: \_\_\_\_\_ By: \_\_\_\_\_

- Samples were received via? *USPS Fed Ex UPS DHL PDX Courier Hand Delivered*
  - Samples were received in: (circle) *Cooler Box Envelope Other NA*
  - Were custody seals on coolers? *NA Y N* If yes, how many and where? \_\_\_\_\_  
If present, were custody seals intact? *Y N* If present, were they signed and dated? *Y N*
  - Was a Temperature Blank present in cooler? *NA Y N* If yes, notate the temperature in the appropriate column below:  
If no, take the temperature of a representative sample bottle contained within the cooler; notate in the column "Sample Temp":
  - Were samples received within the method specified temperature ranges? *NA Y N*  
If no, were they received on ice and same day as collected? If not, notate the cooler # below and notify the PM. *NA Y N*
- If applicable, tissue samples were received: *Frozen Partially Thawed Thawed*

Temp Blank	Sample Temp	IR Gun	Cooler #/COC ID / NA	Out of temp Indicate with "X"	PM Notified If out of temp	Tracking Number	NA	Filed

- Packing material: *Inserts Baggies Bubble Wrap Gel Packs Wet Ice Dry Ice Sleeves* \_\_\_\_\_
- Were custody papers properly filled out (ink, signed, etc.)? *NA Y N*
- Were samples received in good condition (unbroken) *NA Y N*
- Were all sample labels complete (ie. analysis, preservation, etc.)? *NA Y N*
- Did all sample labels and tags agree with custody papers? *NA Y N*
- Were appropriate bottles/containers and volumes received for the tests indicated? *NA Y N*
- Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* *NA Y N*
- Were VOA vials received without headspace? *Indicate in the table below.* *NA Y N*
- Was C12/Res negative? *NA Y N*

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Head- space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

Notes, Discrepancies, Resolutions: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## **APPENDIX A.2**

### **Analytical Resources, Inc. Laboratory Information**

The ARI SOPs listed in Worksheet #23 and the laboratory QA Manual are confidential business information and have not been included in this appendix. These documents are available on request from the ARI point of contact listed in Worksheet #3/5. The SOP and QA Manual cover and signature pages are included in this appendix for reference.

## **APPENDIX A.2**

### **Analytical Resources, Inc. Laboratory Information**

The ARI SOPs listed in Worksheet #23 and the laboratory QA Manual are confidential business information and have not been included in this appendix. These documents are available on request from the ARI point of contact listed in Worksheet #3/5. The SOP and QA Manual cover and signature pages are included in this appendix for reference.



# OREGON

## Environmental Laboratory Accreditation Program

### ORELAP Fields of Accreditation



Analytical Resources Inc.

4611 S. 134th Place, Suite 100  
Tukwila, WA 98168-3240

**ORELAP ID:** WA100006

**EPA CODE:** WA00037

**Certificate:** WA100006 - 014

Issue Date: 6/15/2021 Expiration Date: 5/12/2022

**As of 6/15/2021 this list supersedes all previous lists for this certificate number.**

Matrix Reference	Analyte Code	Analyte	Method Code	Description
<b>Biological Tissue</b>				
EPA 1613B			10120602	Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution GC/HRMS
	9516	1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)		
	9519	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)		
	9420	1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)		
	9426	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)		
	9423	1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)		
	9471	1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)		
	9453	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)		
	9474	1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)		
	9456	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)		
	9477	1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)		
	9459	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)		
	9543	1,2,3,7,8-		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
		Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)		
	9540	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)		
	9480	2,3,4,6,7,8-Hexachlorodibenzofuran		
	9549	2,3,4,7,8-Pentachlorodibenzofuran		
	9618	2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)		
	9612	2,3,7,8-Tetrachlorodibenzofuran		
	9438	Hpcdd, total		
	9444	Hpcdf, total		
	9468	Hxcdd, total		
	9483	Hxcdf, total		
	9555	Pecdd, total		
	9552	Pecdf, total		
	9609	TCDD, total		
	9615	TCDF, total		
EPA 200.7 5			10014003	ICP - metals
	1000	Aluminum		
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		
	1020	Beryllium		
	1025	Boron		
	1030	Cadmium		
	1035	Calcium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1070	Iron		
	1075	Lead		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1085	Magnesium		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		
	1125	Potassium		
	1140	Selenium		
	1145	Silicon		
	1150	Silver		
	1155	Sodium		
	1160	Strontium		
	1165	Thallium		
	1175	Tin		
	1180	Titanium		
	1185	Vanadium		
	1190	Zinc		
EPA 200.8 5.5			10014809	Metals by ICP-MS
	1000	Aluminum		
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		
	1020	Beryllium		
	1030	Cadmium		
	1035	Calcium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1070	Iron		
	1075	Lead		
	1085	Magnesium		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1125	Potassium		
	1140	Selenium		
	1150	Silver		
	1155	Sodium		
	1165	Thallium		
	1185	Vanadium		
	1190	Zinc		
EPA 245.5			10037602	Mercury in Sediment by Cold Vapor Atomic Absorption
	1095	Mercury		
EPA 3050B			10135601	Acid Digestion of Sediments, Sludges, and soils
	8031	Extraction/Preparation		
EPA 3540C			10140202	Soxhlet Extraction
	9822	Extraction/Preparation		
EPA 3550C			10142004	Ultrasonic Extraction
	9822	Extraction/Preparation		
EPA 3580A			10143007	Waste Dilution
	9822	Extraction/Preparation		
EPA 3640A			10147203	Gel Preparation Cleanup
	9822	Extraction/Preparation		
EPA 3660B			10148400	Sulfur cleanup
	9822	Extraction/Preparation		
EPA 5000			10152600	Sample Preparation for Volatile Organics
	9822	Extraction/Preparation		
EPA 5035			10154004	Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples
	9822	Extraction/Preparation		
EPA 6010D 4			10155916	Metals by ICP - AES
	1000	Aluminum		
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1020	Beryllium		
	1025	Boron		
	1030	Cadmium		
	1035	Calcium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1070	Iron		
	1075	Lead		
	1085	Magnesium		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		
	1125	Potassium		
	1140	Selenium		
	1145	Silicon		
	1150	Silver		
	1155	Sodium		
	1160	Strontium		
	1165	Thallium		
	1175	Tin		
	1180	Titanium		
	1185	Vanadium		
	1190	Zinc		
EPA 6020B 2			10156420	Inductively Coupled Plasma-Mass Spectrometry
	1000	Aluminum		
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		
	1020	Beryllium		
	1030	Cadmium		
	1035	Calcium		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1070	Iron		
	1075	Lead		
	1085	Magnesium		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		
	1125	Potassium		
	1140	Selenium		
	1150	Silver		
	1155	Sodium		
	1165	Thallium		
	1185	Vanadium		
	1190	Zinc		
EPA 7471B			10166402	Mercury by Cold Vapor Atomic Absorption
	1095	Mercury		
EPA 8041A			10176804	Phenols by Gas Chromatography
	6730	2,3,4,5-Tetrachlorophenol		
	6735	2,3,4,6-Tetrachlorophenol		
	6740	2,3,5,6-Tetrachlorophenol		
	6830	2,3,6-Trichlorophenol (4C)		
	6835	2,4,5-Trichlorophenol		
EPA 8081B			10178800	Organochlorine Pesticides by GC/ECD
	8580	2,4'-DDD		
	8585	2,4'-DDE		
	8590	2,4'-DDT		
	7355	4,4'-DDD		
	7360	4,4'-DDE		
	7365	4,4'-DDT		
	7025	Aldrin		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	7110	alpha-BHC (alpha-Hexachlorocyclohexane)		
	7115	beta-BHC (beta-Hexachlorocyclohexane)		
	7250	Chlordane (tech.)		
	7240	cis-chlordane (alpha-Chlordane)		
	7925	cis-Nonachlor		
	7105	delta-BHC		
	7470	Dieldrin		
	7510	Endosulfan I		
	7515	Endosulfan II		
	7520	Endosulfan sulfate		
	7540	Endrin		
	7530	Endrin aldehyde		
	7535	Endrin ketone		
	7120	gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)		
	7245	gamma-Chlordane		
	7685	Heptachlor		
	7690	Heptachlor epoxide		
	6275	Hexachlorobenzene		
	4835	Hexachlorobutadiene		
	7810	Methoxychlor		
	7870	Mirex		
	3890	Oxychlordane		
	8250	Toxaphene (Chlorinated camphene)		
	7910	trans-Nonachlor		
EPA 8082A			10179201	Polychlorinated Biphenyls (PCBs) by GC/ECD
	9902	2,2',3,3',4,4',5,5',6-Nonabromodiphenyl ether (BDE-206)		
	9890	2,2',3,3',4,4',5,5'-		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
		Octabromodiphenyl ether (BDE-194)		
9090	2,2',3,3',4,4',5,5'-	Octachlorobiphenyl (BZ-194)		
9903	2,2',3,3',4,4',5,6,6'-	Nonabromodiphenyl ether (BDE-207)		
9891	2,2',3,3',4,4',5,6-	Octabromodiphenyl ether (BDE-195)		
9892	2,2',3,3',4,4',5,6'-	Octabromodiphenyl ether (BDE-196)		
9103	2,2',3,3',4,4',5,6-	Octachlorobiphenyl (BZ-195)		
9866	2,2',3,3',4,4',5-	Heptabromodiphenyl ether (BDE-170)		
9065	2,2',3,3',4,4',5-	Heptachlorobiphenyl (BZ-170)		
9020	2,2',3,3',4,4'-	Hexachlorobiphenyl (BZ-128)		
9112	2,2',3,3',4,5',6,6'-	Octachlorobiphenyl (BZ-201)		
9873	2,2',3,3',4',5,6-	Heptabromodiphenyl ether (BDE-177)		
9116	2,2',3,3',4,5,6'-	Heptachlorobiphenyl (BZ-174)		
9114	2,2',3,3',4,5',6'-	Heptachlorobiphenyl (BZ-177)		
9120	2,2',3,3',4,6'-	Hexachlorobiphenyl (BZ-132)		
9133	2,2',3,4,4',5,5',6-	Octachlorobiphenyl (BZ-203)		
9134	2,2',3,4,4',5,5'-	Heptachlorobiphenyl (BZ-180)		
9878	2,2',3,4,4',5,6'-	Heptabromodiphenyl ether		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
		(BDE-182)		
9075		2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ-183)		
9835		2,2',3,4,4',5'-Hexabromodiphenyl ether (BDE-138)		
9025		2,2',3,4,4',5'-Hexachlorobiphenyl (BZ-138)		
9784		2,2',3,4,4'-Pentabromodiphenyl ether (BDE-85)		
9080		2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ-187)		
9030		2,2',3,4,5,5'-Hexachlorobiphenyl (BZ-141)		
9151		2,2',3,4',5',6-Heptachlorobiphenyl (BZ-149)		
9796		2,2',3',4,5-Pentabromodiphenyl ether (BDE-97)		
8975		2,2',3,4,5'-Pentachlorobiphenyl (BZ-87)		
9154		2,2',3,4',5'-Pentachlorobiphenyl (BZ-97)		
9797		2,2',3',4,6-Pentabromodiphenyl ether (BDE-98)		
9035		2,2',3,5,5',6-Hexachlorobiphenyl (BZ-151)		
9166		2,2',3,5',6-Pentachlorobiphenyl (BZ-95)		
8945		2,2',3,5'-Tetrachlorobiphenyl (BZ-44)		
9569		2,2',4,4',5,5'-Hexabromodiphenyl ether (BDE-153)		
9040		2,2',4,4',5,5'-Hexachlorobiphenyl (BZ-153)		
9850		2,2',4,4',5',6-		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
		Hexabromodiphenyl ether (BDE-154)		
	9571	2,2',4,4',5-Pentabromodiphenyl ether (BDE-99)		
	9175	2,2',4,4',5-Pentachlorobiphenyl (BZ-99)		
	9572	2,2',4,4',6-Pentabromodiphenyl ether (BDE-100)		
	9773	2,2',4,4'-Tetrabromodiphenyl ether (BDE-47)		
	8980	2,2',4,5,5'-Pentachlorobiphenyl (BZ-101)		
	8950	2,2',4,5'-Tetrachlorobiphenyl (BZ-49)		
	9716	2,2',4-Tribromodiphenyl ether (BDE-17)		
	8955	2,2',5,5'-Tetrachlorobiphenyl (BZ-52)		
	8930	2,2',5-Trichlorobiphenyl (BZ-18)		
	9050	2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)		
	9193	2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158)		
	8985	2,3,3',4,4'-Pentachlorobiphenyl (BZ-105)		
	9819	2',3,3',4,5-Pentabromodiphenyl ether (BDE-122)		
	8990	2,3,3',4',6-Pentachlorobiphenyl (BZ-110)		
	9207	2,3,3',4'-Tetrachlorobiphenyl (BZ-56)		
	9820	2',3,4,4',5-Pentabromodiphenyl ether (BDE-123)		
	8995	2,3',4,4',5-		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
		Pentachlorobiphenyl (BZ-118)		
	9758	2,3,4,4'-Tetrabromodiphenyl ether (BDE-60)		
	9764	2,3',4,4'-Tetrabromodiphenyl ether (BDE-66)		
	9221	2,3,4,4'-Tetrachlorobiphenyl (BZ-60)		
	8960	2,3',4,4'-Tetrachlorobiphenyl (BZ-66)		
	9821	2',3,4,5,5'-Pentabromodiphenyl ether (BDE-124)		
	9822	2',3,4,5,6'-Pentabromodiphenyl ether (BDE-125)		
	9775	2',3,4,5-Tetrabromodiphenyl ether (BDE-76)		
	9230	2,3',4',5-Tetrachlorobiphenyl (BZ-70)		
	9760	2,3,4,6-Tetrabromodiphenyl ether (BDE-62)		
	9769	2,3',4',6-Tetrabromodiphenyl ether (BDE-71)		
	9732	2',3,4-Tribromodiphenyl ether (BDE-33)		
	9239	2,3',4'-Trichlorobiphenyl (BZ-33)		
	9733	2',3,5-Tribromodiphenyl ether (BDE-34)		
	9250	2,4,4',5-Tetrachlorobiphenyl (BZ-74)		
	9727	2,4,4'-Tribromodiphenyl ether (BDE-28)		
	9252	2,4,4'-Trichlorobiphenyl (BZ-28)		
	8940	2,4',5-Trichlorobiphenyl (BZ-31)		
	9256	2,4'-Dichlorobiphenyl (BZ-8)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	8880	Aroclor-1016 (PCB-1016)		
	8885	Aroclor-1221 (PCB-1221)		
	8890	Aroclor-1232 (PCB-1232)		
	8895	Aroclor-1242 (PCB-1242)		
	8900	Aroclor-1248 (PCB-1248)		
	8905	Aroclor-1254 (PCB-1254)		
	8910	Aroclor-1260 (PCB-1260)		
	8912	Aroclor-1262 (PCB-1262)		
	8913	Aroclor-1268 (PCB-1268)		
EPA 8260D			10307127	Volatile Organic Compounds By GC/MS
	5105	1,1,1,2-Tetrachloroethane		
	5160	1,1,1-Trichloroethane		
	5110	1,1,2,2-Tetrachloroethane		
	5185	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)		
	5165	1,1,2-Trichloroethane		
	4630	1,1-Dichloroethane		
	4640	1,1-Dichloroethylene		
	4670	1,1-Dichloropropene		
	5150	1,2,3-Trichlorobenzene		
	5180	1,2,3-Trichloropropane		
	5155	1,2,4-Trichlorobenzene		
	5210	1,2,4-Trimethylbenzene		
	4570	1,2-Dibromo-3-chloropropane (DBCP)		
	4585	1,2-Dibromoethane (EDB, Ethylene dibromide)		
	4610	1,2-Dichlorobenzene		
	4635	1,2-Dichloroethane (Ethylene dichloride)		
	4655	1,2-Dichloropropane		
	5215	1,3,5-Trimethylbenzene		
	4615	1,3-Dichlorobenzene		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	4660	1,3-Dichloropropane		
	4620	1,4-Dichlorobenzene		
	4665	2,2-Dichloropropane		
	4410	2-Butanone (Methyl ethyl ketone, MEK)		
	4500	2-Chloroethyl vinyl ether		
	4535	2-Chlorotoluene		
	4860	2-Hexanone (MBK)		
	4540	4-Chlorotoluene		
	4910	4-Isopropyltoluene (p-Cymene)		
	4995	4-Methyl-2-pentanone (MIBK)		
	4315	Acetone		
	4325	Acrolein (Propenal)		
	4340	Acrylonitrile		
	4375	Benzene		
	4385	Bromobenzene		
	4390	Bromochloromethane		
	4395	Bromodichloromethane		
	4400	Bromoform		
	4450	Carbon disulfide		
	4455	Carbon tetrachloride		
	4475	Chlorobenzene		
	4575	Chlorodibromomethane		
	4485	Chloroethane (Ethyl chloride)		
	4505	Chloroform		
	4645	cis-1,2-Dichloroethylene		
	4680	cis-1,3-Dichloropropene		
	4595	Dibromomethane (Methylene bromide)		
	4625	Dichlorodifluoromethane (Freon-12)		
	4765	Ethylbenzene		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	4835	Hexachlorobutadiene		
	4870	Iodomethane (Methyl iodide)		
	4900	Isopropylbenzene (Cumene)		
	5240	m+p-xylene		
	4950	Methyl bromide (Bromomethane)		
	4960	Methyl chloride (Chloromethane)		
	5000	Methyl tert-butyl ether (MTBE)		
	4975	Methylene chloride (Dichloromethane)		
	5005	Naphthalene		
	4435	n-Butylbenzene		
	5090	n-Propylbenzene		
	5250	o-Xylene		
	4440	sec-Butylbenzene		
	5100	Styrene		
	4445	tert-Butylbenzene		
	5115	Tetrachloroethylene (Perchloroethylene)		
	5140	Toluene		
	4700	trans-1,2-Dichloroethylene		
	4685	trans-1,3-Dichloropropylene		
	4605	trans-1,4-Dichloro-2-butene		
	5170	Trichloroethene (Trichloroethylene)		
	5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)		
	5225	Vinyl acetate		
	5235	Vinyl chloride		
EPA 8270E			10242543	Semivolatle Organic compounds by GC/MS
	6703	1,1'-Biphenyl (BZ-0)		
	6715	1,2,4,5-Tetrachlorobenzene		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	5155	1,2,4-Trichlorobenzene		
	4610	1,2-Dichlorobenzene		
	4615	1,3-Dichlorobenzene		
	4620	1,4-Dichlorobenzene		
	4735	1,4-Dioxane (1,4-Diethyleneoxide)		
	6380	1-Methylnaphthalene		
	4659	2,2'-Oxybis(1-chloropropane), bis(2-Chloro-1-methylethyl)ether		
	6835	2,4,5-Trichlorophenol		
	6840	2,4,6-Trichlorophenol		
	6000	2,4-Dichlorophenol		
	6130	2,4-Dimethylphenol		
	6175	2,4-Dinitrophenol		
	6185	2,4-Dinitrotoluene (2,4-DNT)		
	6190	2,6-Dinitrotoluene (2,6-DNT)		
	5795	2-Chloronaphthalene		
	5800	2-Chlorophenol		
	6360	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)		
	6385	2-Methylnaphthalene		
	6400	2-Methylphenol (o-Cresol)		
	6460	2-Nitroaniline		
	6490	2-Nitrophenol		
	5945	3,3'-Dichlorobenzidine		
	6465	3-Nitroaniline		
	5660	4-Bromophenyl phenyl ether (BDE-3)		
	5700	4-Chloro-3-methylphenol		
	5745	4-Chloroaniline		
	5825	4-Chlorophenyl phenylether		
	4910	4-Isopropyltoluene (p-Cymene)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	6410	4-Methylphenol (p-Cresol)		
	6470	4-Nitroaniline		
	6500	4-Nitrophenol		
	5500	Acenaphthene		
	5505	Acenaphthylene		
	5510	Acetophenone		
	7005	Alachlor		
	6700	alpha-Terpineol		
	5545	Aniline		
	5555	Anthracene		
	7075	Azinphos-methyl (Guthion)		
	5562	Azobenzene		
	5595	Benzidine		
	5575	Benzo(a)anthracene		
	5580	Benzo(a)pyrene		
	5605	Benzo(e)pyrene		
	5590	Benzo(g,h,i)perylene		
	5600	Benzo(k)fluoranthene		
	5585	Benzo[b]fluoranthene		
	5610	Benzoic acid		
	5630	Benzyl alcohol		
	5760	bis(2-Chloroethoxy)methane		
	5765	bis(2-Chloroethyl) ether		
	7125	Bolstar (Sulprofos)		
	5670	Butyl benzyl phthalate		
	5671	Butyl diphenyl Phosphate		
	5673	Butylated Hydroxy Toluene (BHT)		
	5680	Carbazole		
	7255	Chlorfenvinphos		
	7300	Chlorpyrifos		
	5855	Chrysene		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	7315	Coumaphos		
	7330	Crotoxyphos		
	7385	Demeton-s		
	6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)		
	7410	Diazinon		
	5895	Dibenz(a,h) anthracene		
	5905	Dibenzofuran		
	5912	Dibutyl phenyl Phosphatate		
	7465	Dicrotophos		
	6070	Diethyl phthalate		
	7475	Dimethoate		
	6135	Dimethyl phthalate		
	5925	Di-n-butyl phthalate		
	6200	Di-n-octyl phthalate		
	8625	Disulfoton		
	7550	EPN		
	7565	Ethion		
	7570	Ethoprop		
	7600	Fensulfothion		
	7605	Fenthion		
	6265	Fluoranthene		
	6270	Fluorene		
	6275	Hexachlorobenzene		
	4835	Hexachlorobutadiene		
	6285	Hexachlorocyclopentadiene		
	4840	Hexachloroethane		
	6315	Indeno(1,2,3-cd) pyrene		
	6320	Isophorone		
	7770	Malathion		
	7785	Merphos		
	7825	Methyl parathion (Parathion,		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
		methyl)		
	7850	Mevinphos		
	7880	Monocrotophos		
	7905	Naled		
	5005	Naphthalene		
	5015	Nitrobenzene		
	6530	n-Nitrosodimethylamine		
	6545	n-Nitrosodi-n-propylamine		
	6535	n-Nitrosodiphenylamine		
	7955	Parathion, ethyl		
	6605	Pentachlorophenol		
	6615	Phenanthrene		
	6625	Phenol		
	7985	Phorate		
	6665	Pyrene		
	5095	Pyridine		
	6683	Retene		
	8110	Ronnel		
	8155	Sulfotepp		
	8200	Tetrachlorvinphos (Stirophos, Gardona) Z-isomer		
	8245	Tokuthion (Prothiophos)		
	8262	Tributyl phosphate		
	8275	Trichloronate		
	8282	Triphenyl phosphate		
EPA 8270E SIM			10242565	Semivolatle Organic compounds by GC/MS
	6703	1,1'-Biphenyl (BZ-0)		
	6380	1-Methylnaphthalene		
	6385	2-Methylnaphthalene		
	5500	Acenaphthene		
	5505	Acenaphthylene		
	5555	Anthracene		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	5575	Benzo(a)anthracene		
	5580	Benzo(a)pyrene		
	5605	Benzo(e)pyrene		
	5590	Benzo(g,h,i)perylene		
	9309	Benzo(j)fluoranthene		
	5600	Benzo(k)fluoranthene		
	5585	Benzo[b]fluoranthene		
	5680	Carbazole		
	5855	Chrysene		
	5895	Dibenz(a,h) anthracene		
	5905	Dibenzofuran		
	5913	Dibutyltin		
	6265	Fluoranthene		
	6270	Fluorene		
	6315	Indeno(1,2,3-cd) pyrene		
	1206	Monobutyltin		
	5005	Naphthalene		
	6608	Perylene		
	6615	Phenanthrene		
	6665	Pyrene		
	1209	Tetrabutyltin		
	1213	Tributyltin		
EPA 8290A			10187403	Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by GC/HRMS
	9516	1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)		
	9519	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)		
	9420	1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)		
	9426	1,2,3,4,6,7,8-		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
		Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)		
	9423	1,2,3,4,7,8,9- Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)		
	9471	1,2,3,4,7,8- Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)		
	9453	1,2,3,4,7,8- Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)		
	9474	1,2,3,6,7,8- Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)		
	9456	1,2,3,6,7,8- Hexachlorodibenzo-p- dioxin(1,2,3,6,7,8-Hxcdd)		
	9477	1,2,3,7,8,9- Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)		
	9459	1,2,3,7,8,9- Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)		
	9543	1,2,3,7,8- Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)		
	9540	1,2,3,7,8-Pentachlorodibenzo- p-dioxin (1,2,3,7,8-Pecdd)		
	9480	2,3,4,6,7,8- Hexachlorodibenzofuran		
	9549	2,3,4,7,8- Pentachlorodibenzofuran		
	9618	2,3,7,8-Tetrachlorodibenzo- p- dioxin (2,3,7,8-TCDD)		
	9612	2,3,7,8- Tetrachlorodibenzofuran		
	9438	Hpcdd, total		
	9444	Hpcdf, total		
	9468	Hxcdd, total		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	9483	Hxcdf, total		
	9555	Pecdd, total		
	9552	Pecdf, total		
	9609	TCDD, total		
	9615	TCDF, total		

### Non-Potable Water

AK101 GRO-MS AK101 GRO-MS	9408	Gasoline range organics (GRO)	90015159	Determination of Gasoline Range Organics by GC/MS - Alaska Department of Environmental Conservation
AK102 DRO AK102 DRO	9369	Diesel range organics (DRO)	90015206	Determination of Diesel Range Organics - Alaska Department of Environmental Conservation
AK103 RRO	9499	Motor Oil	90015400	Determination of Residual Range Organics - Alaska Department of Environmental Conservation
EPA 120.1	1610	Conductivity	10006209	Conductance - Specific @ 25 C
EPA 1311	9822	Extraction/Preparation	10118806	Toxicity Characteristic Leaching Procedure
EPA 1312	9822	Extraction/Preparation	10119003	Synthetic Precipitation Leaching Procedure
EPA 160.4	1970	Residue-volatile	10010409	Total Volatile Solids, ignition @ 550 C.
EPA 1613B	9516	1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	10120602	Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution GC/HRMS
	9519	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)		
	9420	1,2,3,4,6,7,8-		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
		Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)		
	9426	1,2,3,4,6,7,8- Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)		
	9423	1,2,3,4,7,8,9- Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)		
	9471	1,2,3,4,7,8- Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)		
	9453	1,2,3,4,7,8- Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)		
	9474	1,2,3,6,7,8- Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)		
	9456	1,2,3,6,7,8- Hexachlorodibenzo-p- dioxin(1,2,3,6,7,8-Hxcdd)		
	9477	1,2,3,7,8,9- Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)		
	9459	1,2,3,7,8,9- Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)		
	9543	1,2,3,7,8- Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)		
	9540	1,2,3,7,8-Pentachlorodibenzo- p-dioxin (1,2,3,7,8-Pecdd)		
	9480	2,3,4,6,7,8- Hexachlorodibenzofuran		
	9549	2,3,4,7,8- Pentachlorodibenzofuran		
	9618	2,3,7,8-Tetrachlorodibenzo- p- dioxin (2,3,7,8-TCDD)		
	9612	2,3,7,8- Tetrachlorodibenzofuran		
	9438	Hpcdd, total		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	9444	Hpcdf, total		
	9468	Hxcdd, total		
	9483	Hxcdf, total		
	9555	Pecdd, total		
	9552	Pecdf, total		
	9609	TCDD, total		
	9615	TCDF, total		
EPA 1664B (SGT-HEM) EPA 1664B (SGT-HEM)			10260628	Silica Gel Treated n-Hexane Extractable Material (Oil & Grease)
	2050	Total Petroleum Hydrocarbons (TPH)		
EPA 1664B EPA 1664B			10261617	N-Hexane Extractable Material (Oil and Grease) by Extraction and Gravimetry
	1803	n-Hexane Extractable Material (O&G)		
EPA 180.1 2			10011800	Turbidity - Nephelometric
	2055	Turbidity		
EPA 200.7 5			10014003	ICP - metals
	1000	Aluminum		
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		
	1020	Beryllium		
	1025	Boron		
	1030	Cadmium		
	1035	Calcium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1070	Iron		
	1075	Lead		
	1085	Magnesium		
	1090	Manganese		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1100	Molybdenum		
	1105	Nickel		
	1125	Potassium		
	1140	Selenium		
	1145	Silicon		
	1150	Silver		
	1155	Sodium		
	1160	Strontium		
	1165	Thallium		
	1175	Tin		
	1180	Titanium		
	1185	Vanadium		
	1190	Zinc		
EPA 200.8 5.5			10014809	Metals by ICP-MS
	1000	Aluminum		
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		
	1020	Beryllium		
	1030	Cadmium		
	1035	Calcium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1070	Iron		
	1075	Lead		
	1085	Magnesium		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		
	1125	Potassium		
	1140	Selenium		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1150	Silver		
	1155	Sodium		
	1165	Thallium		
	1185	Vanadium		
	1190	Zinc		
EPA 245.1 4.1			10271008	Mercury by Cold Vapor Atomic Absorption
	1095	Mercury		
EPA 300.0 2.1			10053200	Methods for the Determination of Inorganic Substances in Environmental Samples
	1540	Bromide		
	1575	Chloride		
	1730	Fluoride		
	1810	Nitrate as N		
	1840	Nitrite as N		
	1870	Orthophosphate as P		
EPA 3005A			10133207	Acid Digestion of waters for Total Recoverable or Dissolved Metals
	9822	Extraction/Preparation		
EPA 3010A			10133605	Acid Digestion of Aqueous samples and Extracts for Total Metals
	9822	Extraction/Preparation		
EPA 3020A			10134404	Acid Digestion of Aqueous samples and Extracts for Total Metals for Analysis by GFAA
	9822	Extraction/Preparation		
EPA 335.4 1.0			10061402	Methods for the Determination of Inorganic Substances in Environmental Samples
	1510	Amenable cyanide		
	1635	Cyanide		
	1645	Total cyanide		
EPA 351.2 2			10065404	Total Kjeldahl Nitrogen - Block Digest, Phenate
	1795	Total Kjeldahl Nitrogen (TKN)		
	1795	Total Kjeldahl Nitrogen (TKN)		
EPA 3510C			10138202	Separatory Funnel Liquid-liquid extraction



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Matrix	Reference	Analyte Code	Analyte	Method Code	Description
		9822	Extraction/Preparation		
EPA	3520C			10139001	Continuous Liquid-liquid extraction
		9822	Extraction/Preparation		
EPA	353.2 2			10067604	Nitrate/Nitrite Nitrogen - Automated, Cadmium
		1810	Nitrate as N		
		1820	Nitrate plus Nitrite as N		
		1840	Nitrite as N		
EPA	3550C			10142004	Ultrasonic Extraction
		9822	Extraction/Preparation		
EPA	3580A			10143007	Waste Dilution
		9822	Extraction/Preparation		
EPA	3611B			10145207	Alumina Column Cleanup and separation of petroleum wastes
		8031	Extraction/Preparation		
EPA	3620C			10146006	Florisil Cleanup
		8031	Extraction/Preparation		
EPA	3630C			10146802	Silica gel cleanup
		8031	Extraction/Preparation		
EPA	3640A			10147203	Gel Preparation Cleanup
		9822	Extraction/Preparation		
EPA	3650B			10147805	Acid base partition cleanup
		8031	Extraction/Preparation		
EPA	3660B			10148400	Sulfur cleanup
		9822	Extraction/Preparation		
EPA	3665A			10148808	Sulfuric Acid / permanganate Cleanup
		9822	Extraction/Preparation		
EPA	375.2 4			10073004	Sulfate - Colorimetric, Automated, Methylthymol.
		2000	Sulfate		
EPA	410.4 2			10077404	Chemical Oxygen Demand - Colorimetric, Automated.
		1565	Chemical oxygen demand		
EPA	420.1			10079400	Phenolics - Spectrophotometric, manual.



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1905	Total phenolics		
EPA 5000			10152600	Sample Preparation for Volatile Organics
	9822	Extraction/Preparation		
EPA 5030B			10153409	Purge and trap for aqueous samples
	9822	Extraction/Preparation		
EPA 6010D 4			10155916	Metals by ICP - AES
	1000	Aluminum		
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		
	1020	Beryllium		
	1025	Boron		
	1030	Cadmium		
	1035	Calcium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1070	Iron		
	1075	Lead		
	1085	Magnesium		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		
	1125	Potassium		
	1140	Selenium		
	1145	Silicon		
	1150	Silver		
	1155	Sodium		
	1165	Thallium		
	1175	Tin		
	1180	Titanium		
	1185	Vanadium		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1190	Zinc		
EPA 6020B 2			10156420	Inductively Coupled Plasma-Mass Spectrometry
	1000	Aluminum		
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		
	1020	Beryllium		
	1030	Cadmium		
	1035	Calcium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1070	Iron		
	1075	Lead		
	1085	Magnesium		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		
	1125	Potassium		
	1140	Selenium		
	1150	Silver		
	1155	Sodium		
	1165	Thallium		
	1185	Vanadium		
	1190	Zinc		
EPA 7196A			10162400	Chromium Hexavalent colorimetric
	1045	Chromium VI		
EPA 7470A			10165807	Mercury in Liquid Waste by Cold Vapor Atomic Absorption
	1095	Mercury		
EPA 8015C			10173805	Non-halogenated organics using GC/FID
	9369	Diesel range organics (DRO)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	9408	Gasoline range organics (GRO)		
EPA 8015D			10305609	Nonhalogenated Organics Using GC/FID
	9506	Residual Range Organics (RRO)		
EPA 8041A			10176804	Phenols by Gas Chromatography
	6730	2,3,4,5-Tetrachlorophenol		
	6735	2,3,4,6-Tetrachlorophenol		
	6740	2,3,5,6-Tetrachlorophenol		
	6830	2,3,6-Trichlorophenol (4C)		
	6835	2,4,5-Trichlorophenol		
	6605	Pentachlorophenol		
EPA 8081B			10178800	Organochlorine Pesticides by GC/ECD
	8580	2,4'-DDD		
	8585	2,4'-DDE		
	8590	2,4'-DDT		
	7355	4,4'-DDD		
	7360	4,4'-DDE		
	7365	4,4'-DDT		
	7025	Aldrin		
	7110	alpha-BHC (alpha-Hexachlorocyclohexane)		
	7115	beta-BHC (beta-Hexachlorocyclohexane)		
	7250	Chlordane (tech.)		
	7240	cis-chlordane (alpha-Chlordane)		
	7925	cis-Nonachlor		
	7105	delta-BHC		
	7470	Dieldrin		
	7510	Endosulfan I		
	7515	Endosulfan II		
	7520	Endosulfan sulfate		
	7540	Endrin		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	7530	Endrin aldehyde		
	7535	Endrin ketone		
	7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)		
	7245	gamma-Chlordane		
	7685	Heptachlor		
	7690	Heptachlor epoxide		
	6275	Hexachlorobenzene		
	4835	Hexachlorobutadiene		
	7810	Methoxychlor		
	7870	Mirex		
	3890	Oxychlordane		
	8250	Toxaphene (Chlorinated camphene)		
	7910	trans-Nonachlor		
EPA 8082A			10179201	Polychlorinated Biphenyls (PCBs) by GC/ECD
	9902	2,2',3,3',4,4',5,5',6-Nonabromodiphenyl ether (BDE-206)		
	9890	2,2',3,3',4,4',5,5'-Octabromodiphenyl ether (BDE-194)		
	9090	2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194)		
	9903	2,2',3,3',4,4',5,6,6'-Nonabromodiphenyl ether (BDE-207)		
	9891	2,2',3,3',4,4',5,6-Octabromodiphenyl ether (BDE-195)		
	9892	2,2',3,3',4,4',5,6'-Octabromodiphenyl ether (BDE-196)		
	9103	2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	9866	2,2',3,3',4,4',5- Heptabromodiphenyl ether (BDE-170)		
	9065	2,2',3,3',4,4',5- Heptachlorobiphenyl (BZ-170)		
	9020	2,2',3,3',4,4'- Hexachlorobiphenyl (BZ-128)		
	9112	2,2',3,3',4,5',6,6'- Octachlorobiphenyl (BZ-201)		
	9873	2,2',3,3',4',5,6- Heptabromodiphenyl ether (BDE-177)		
	9116	2,2',3,3',4,5,6'- Heptachlorobiphenyl (BZ-174)		
	9114	2,2',3,3',4,5',6'- Heptachlorobiphenyl (BZ-177)		
	9120	2,2',3,3',4,6'- Hexachlorobiphenyl (BZ-132)		
	9133	2,2',3,4,4',5,5',6- Octachlorobiphenyl (BZ-203)		
	9878	2,2',3,4,4',5,6'- Heptabromodiphenyl ether (BDE-182)		
	9075	2,2',3,4,4',5,6- Heptachlorobiphenyl (BZ-183)		
	9835	2,2',3,4,4',5'- Hexabromodiphenyl ether (BDE-138)		
	9025	2,2',3,4,4',5'- Hexachlorobiphenyl (BZ-138)		
	9784	2,2',3,4,4'- Pentabromodiphenyl ether (BDE-85)		
	9080	2,2',3,4',5,5',6- Heptachlorobiphenyl (BZ-187)		
	9030	2,2',3,4,5,5'- Hexachlorobiphenyl (BZ-141)		
	9151	2,2',3,4',5',6- Hexachlorobiphenyl (BZ-149)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	9796	2,2',3',4,5'- Pentabromodiphenyl ether (BDE-97)		
	8975	2,2',3,4,5'- Pentachlorobiphenyl (BZ-87)		
	9154	2,2',3,4',5'- Pentachlorobiphenyl (BZ-97)		
	9797	2,2',3',4,6'- Pentabromodiphenyl ether (BDE-98)		
	9035	2,2',3,5,5',6'- Hexachlorobiphenyl (BZ-151)		
	9166	2,2',3,5',6'- Pentachlorobiphenyl (BZ-95)		
	8945	2,2',3,5'-Tetrachlorobiphenyl (BZ-44)		
	9569	2,2',4,4',5,5'- Hexabromodiphenyl ether (BDE-153)		
	9040	2,2',4,4',5,5'- Hexachlorobiphenyl (BZ-153)		
	9850	2,2',4,4',5',6'- Hexabromodiphenyl ether (BDE-154)		
	9571	2,2',4,4',5'- Pentabromodiphenyl ether (BDE-99)		
	9175	2,2',4,4',5'- Pentachlorobiphenyl (BZ-99)		
	9572	2,2',4,4',6'- Pentabromodiphenyl ether (BDE-100)		
	9773	2,2',4,4'-Tetrabromodiphenyl ether (BDE-47)		
	8980	2,2',4,5,5'- Pentachlorobiphenyl (BZ-101)		
	8950	2,2',4,5'-Tetrachlorobiphenyl (BZ-49)		
	9716	2,2',4-Tribromodiphenyl ether		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
		(BDE-17)		
	8955	2,2',5,5'-Tetrachlorobiphenyl (BZ-52)		
	8930	2,2',5-Trichlorobiphenyl (BZ-18)		
	9050	2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)		
	9193	2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158)		
	8985	2,3,3',4,4'-Pentachlorobiphenyl (BZ-105)		
	9819	2',3,3',4,5-Pentabromodiphenyl ether (BDE-122)		
	8990	2,3,3',4',6-Pentachlorobiphenyl (BZ-110)		
	9207	2,3,3',4'-Tetrachlorobiphenyl (BZ-56)		
	9820	2',3,4,4',5-Pentabromodiphenyl ether (BDE-123)		
	8995	2,3',4,4',5-Pentachlorobiphenyl (BZ-118)		
	9758	2,3,4,4'-Tetrabromodiphenyl ether (BDE-60)		
	9764	2,3',4,4'-Tetrabromodiphenyl ether (BDE-66)		
	9221	2,3,4,4'-Tetrachlorobiphenyl (BZ-60)		
	8960	2,3',4,4'-Tetrachlorobiphenyl (BZ-66)		
	9821	2',3,4,5,5'-Pentabromodiphenyl ether (BDE-124)		
	9822	2',3,4,5,6'-Pentabromodiphenyl ether (BDE-125)		
	9775	2',3,4,5-Tetrabromodiphenyl ether (BDE-76)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	9230	2,3',4',5-Tetrachlorobiphenyl (BZ-70)		
	9760	2,3,4,6-Tetrabromodiphenyl ether (BDE-62)		
	9769	2,3',4',6-Tetrabromodiphenyl ether (BDE-71)		
	9732	2',3,4-Tribromodiphenyl ether (BDE-33)		
	9239	2,3',4'-Trichlorobiphenyl (BZ-33)		
	9733	2',3,5-Tribromodiphenyl ether (BDE-34)		
	9250	2,4,4',5-Tetrachlorobiphenyl (BZ-74)		
	9727	2,4,4'-Tribromodiphenyl ether (BDE-28)		
	9252	2,4,4'-Trichlorobiphenyl (BZ-28)		
	8940	2,4',5-Trichlorobiphenyl (BZ-31)		
	9256	2,4'-Dichlorobiphenyl (BZ-8)		
	8880	Aroclor-1016 (PCB-1016)		
	8885	Aroclor-1221 (PCB-1221)		
	8890	Aroclor-1232 (PCB-1232)		
	8895	Aroclor-1242 (PCB-1242)		
	8900	Aroclor-1248 (PCB-1248)		
	8905	Aroclor-1254 (PCB-1254)		
	8910	Aroclor-1260 (PCB-1260)		
	8912	Aroclor-1262 (PCB-1262)		
	8913	Aroclor-1268 (PCB-1268)		
EPA 8260D			10307127	Volatile Organic Compounds By GC/MS
	5105	1,1,1,2-Tetrachloroethane		
	5160	1,1,1-Trichloroethane		
	5110	1,1,2,2-Tetrachloroethane		
	5185	1,1,2-Trichloro-1,2,2-		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
		trifluoroethane (Freon 113)		
	5165	1,1,2-Trichloroethane		
	4630	1,1-Dichloroethane		
	4640	1,1-Dichloroethylene		
	4670	1,1-Dichloropropene		
	5150	1,2,3-Trichlorobenzene		
	5180	1,2,3-Trichloropropane		
	5155	1,2,4-Trichlorobenzene		
	5210	1,2,4-Trimethylbenzene		
	4570	1,2-Dibromo-3-chloropropane (DBCP)		
	4585	1,2-Dibromoethane (EDB, Ethylene dibromide)		
	4610	1,2-Dichlorobenzene		
	4635	1,2-Dichloroethane (Ethylene dichloride)		
	4655	1,2-Dichloropropane		
	5215	1,3,5-Trimethylbenzene		
	4615	1,3-Dichlorobenzene		
	4660	1,3-Dichloropropane		
	4620	1,4-Dichlorobenzene		
	4665	2,2-Dichloropropane		
	4410	2-Butanone (Methyl ethyl ketone, MEK)		
	4500	2-Chloroethyl vinyl ether		
	4535	2-Chlorotoluene		
	4860	2-Hexanone (MBK)		
	4540	4-Chlorotoluene		
	4910	4-Isopropyltoluene (p-Cymene)		
	4995	4-Methyl-2-pentanone (MIBK)		
	4315	Acetone		
	4325	Acrolein (Propenal)		
	4340	Acrylonitrile		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	4375	Benzene		
	4385	Bromobenzene		
	4390	Bromochloromethane		
	4395	Bromodichloromethane		
	4400	Bromoform		
	4450	Carbon disulfide		
	4455	Carbon tetrachloride		
	4475	Chlorobenzene		
	4575	Chlorodibromomethane		
	4485	Chloroethane (Ethyl chloride)		
	4505	Chloroform		
	4645	cis-1,2-Dichloroethylene		
	4680	cis-1,3-Dichloropropene		
	4560	Cyclohexanone		
	4595	Dibromomethane (Methylene bromide)		
	4625	Dichlorodifluoromethane (Freon-12)		
	4725	Diethyl ether		
	9375	Di-isopropylether (DIPE)		
	4765	Ethylbenzene		
	4770	Ethyl-t-butylether (ETBE) (2-Ethoxy-2-methylpropane)		
	9408	Gasoline range organics (GRO)		
	4835	Hexachlorobutadiene		
	4870	Iodomethane (Methyl iodide)		
	4900	Isopropylbenzene (Cumene)		
	5240	m+p-xylene		
	4950	Methyl bromide (Bromomethane)		
	4960	Methyl chloride (Chloromethane)		
	5000	Methyl tert-butyl ether (MTBE)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	4975	Methylene chloride (Dichloromethane)		
	5005	Naphthalene		
	4435	n-Butylbenzene		
	5090	n-Propylbenzene		
	5250	o-Xylene		
	4440	sec-Butylbenzene		
	5100	Styrene		
	4370	T-amylmethylether (TAME)		
	4420	tert-Butyl alcohol		
	4445	tert-Butylbenzene		
	5115	Tetrachloroethylene (Perchloroethylene)		
	5140	Toluene		
	4700	trans-1,2-Dichloroethylene		
	4685	trans-1,3-Dichloropropylene		
	4605	trans-1,4-Dichloro-2-butene		
	5170	Trichloroethene (Trichloroethylene)		
	5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)		
	5225	Vinyl acetate		
	5235	Vinyl chloride		
EPA 8260D SIM			10307138	Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry Selected Ion Monitoring (GC/MS SIM)
	5105	1,1,1,2-Tetrachloroethane		
	4640	1,1-Dichloroethylene		
	4635	1,2-Dichloroethane (Ethylene dichloride)		
	4375	Benzene		
	4645	cis-1,2-Dichloroethylene		
	5115	Tetrachloroethylene (Perchloroethylene)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	4700	trans-1,2-Dichloroethylene		
	5170	Trichloroethene (Trichloroethylene)		
	5235	Vinyl chloride		
EPA 8270E			10242543	Semivolatle Organic compounds by GC/MS
	6703	1,1'-Biphenyl (BZ-0)		
	6715	1,2,4,5-Tetrachlorobenzene		
	5155	1,2,4-Trichlorobenzene		
	4610	1,2-Dichlorobenzene		
	4615	1,3-Dichlorobenzene		
	4620	1,4-Dichlorobenzene		
	4735	1,4-Dioxane (1,4-Diethyleneoxide)		
	6380	1-Methylnaphthalene		
	4659	2,2'-Oxybis(1-chloropropane), bis(2-Chloro-1-methylethyl)ether		
	6835	2,4,5-Trichlorophenol		
	6840	2,4,6-Trichlorophenol		
	6000	2,4-Dichlorophenol		
	6130	2,4-Dimethylphenol		
	6175	2,4-Dinitrophenol		
	6185	2,4-Dinitrotoluene (2,4-DNT)		
	6190	2,6-Dinitrotoluene (2,6-DNT)		
	5795	2-Chloronaphthalene		
	5800	2-Chlorophenol		
	6360	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)		
	6385	2-Methylnaphthalene		
	6400	2-Methylphenol (o-Cresol)		
	6460	2-Nitroaniline		
	6490	2-Nitrophenol		
	5945	3,3'-Dichlorobenzidine		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	6465	3-Nitroaniline		
	5660	4-Bromophenyl phenyl ether (BDE-3)		
	5700	4-Chloro-3-methylphenol		
	5745	4-Chloroaniline		
	5825	4-Chlorophenyl phenylether		
	4910	4-Isopropyltoluene (p-Cymene)		
	6410	4-Methylphenol (p-Cresol)		
	6470	4-Nitroaniline		
	6500	4-Nitrophenol		
	5500	Acenaphthene		
	5505	Acenaphthylene		
	5510	Acetophenone		
	7005	Alachlor		
	6700	alpha-Terpineol		
	5545	Aniline		
	5555	Anthracene		
	7075	Azinphos-methyl (Guthion)		
	5562	Azobenzene		
	5595	Benzidine		
	5575	Benzo(a)anthracene		
	5580	Benzo(a)pyrene		
	5605	Benzo(e)pyrene		
	5590	Benzo(g,h,i)perylene		
	5600	Benzo(k)fluoranthene		
	5585	Benzo[b]fluoranthene		
	5610	Benzoic acid		
	5630	Benzyl alcohol		
	5760	bis(2-Chloroethoxy)methane		
	5765	bis(2-Chloroethyl) ether		
	7125	Bolstar (Sulprofos)		
	5670	Butyl benzyl phthalate		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	5671	Butyl diphenyl Phosphate		
	5673	Butylated Hydroxy Toluene (BHT)		
	5680	Carbazole		
	7255	Chlorfenvinphos		
	7300	Chlorpyrifos		
	5855	Chrysene		
	7315	Coumaphos		
	7330	Crotoxyphos		
	7385	Demeton-s		
	6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)		
	7410	Diazinon		
	5895	Dibenz(a,h) anthracene		
	5905	Dibenzofuran		
	5912	Dibutyl phenyl Phosphahate		
	7465	Dicrotophos		
	6070	Diethyl phthalate		
	7475	Dimethoate		
	6135	Dimethyl phthalate		
	5925	Di-n-butyl phthalate		
	6200	Di-n-octyl phthalate		
	8625	Disulfoton		
	7550	EPN		
	7565	Ethion		
	7570	Ethoprop		
	7600	Fensulfothion		
	7605	Fenthion		
	6265	Fluoranthene		
	6270	Fluorene		
	6275	Hexachlorobenzene		
	4835	Hexachlorobutadiene		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	6285	Hexachlorocyclopentadiene		
	4840	Hexachloroethane		
	6315	Indeno(1,2,3-cd) pyrene		
	6320	Isophorone		
	7770	Malathion		
	7785	Merphos		
	7825	Methyl parathion (Parathion, methyl)		
	7850	Mevinphos		
	7880	Monocrotophos		
	7905	Naled		
	5005	Naphthalene		
	5015	Nitrobenzene		
	6530	n-Nitrosodimethylamine		
	6545	n-Nitrosodi-n-propylamine		
	6535	n-Nitrosodiphenylamine		
	7955	Parathion, ethyl		
	6605	Pentachlorophenol		
	6615	Phenanthrene		
	6625	Phenol		
	7985	Phorate		
	6665	Pyrene		
	5095	Pyridine		
	6683	Retene		
	8110	Ronnel		
	8155	Sulfotepp		
	8200	Tetrachlorvinphos (Stirophos, Gardona) Z-isomer		
	8245	Tokuthion (Prothiophos)		
	8262	Tributyl phosphate		
	8275	Trichloronate		
	8282	Triphenyl phosphate		

EPA 8270E SIM

10242565 Semivolatile Organic compounds by Gas



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
				Chromatography/Mass Spectrometry (GC/MS-SIM)
	4735	1,4-Dioxane (1,4-Diethyleneoxide)		
	6380	1-Methylnaphthalene		
	6385	2-Methylnaphthalene		
	5500	Acenaphthene		
	5505	Acenaphthylene		
	5555	Anthracene		
	5575	Benzo(a)anthracene		
	5580	Benzo(a)pyrene		
	5605	Benzo(e)pyrene		
	5590	Benzo(g,h,i)perylene		
	9309	Benzo(j)fluoranthene		
	5600	Benzo(k)fluoranthene		
	5585	Benzo[b]fluoranthene		
	5680	Carbazole		
	5855	Chrysene		
	5895	Dibenz(a,h) anthracene		
	5905	Dibenzofuran		
	5913	Dibutyltin		
	6265	Fluoranthene		
	6270	Fluorene		
	6315	Indeno(1,2,3-cd) pyrene		
	1206	Monobutyltin		
	5005	Naphthalene		
	6608	Perylene		
	6615	Phenanthrene		
	6665	Pyrene		
	1209	Tetrabutyltin		
	1213	Tributyltin		
EPA 8290A			10187403	Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
				GC/HRMS
	9516	1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)		
	9519	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)		
	9420	1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)		
	9426	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)		
	9423	1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)		
	9471	1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)		
	9453	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)		
	9474	1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)		
	9456	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)		
	9477	1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)		
	9459	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)		
	9543	1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)		
	9540	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)		
	9480	2,3,4,6,7,8-		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
		Hexachlorodibenzofuran		
	9549	2,3,4,7,8-Pentachlorodibenzofuran		
	9618	2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)		
	9612	2,3,7,8-Tetrachlorodibenzofuran		
	9438	Hpcdd, total		
	9444	Hpcdf, total		
	9468	Hxcd, total		
	9483	Hxcd, total		
	9555	Pecdd, total		
	9552	Pecdf, total		
	9609	TCDD, total		
	9615	TCDF, total		
EPA 9010C			10243002	Total and Amenable Cyanide by Distillation and UV-Vis
	1510	Amenable cyanide		
	1645	Total cyanide		
EPA 9014			10193803	Titrimetric and Manual Spectrophotometric Determinative Methods for Cyanide
	1510	Amenable cyanide		
	1635	Cyanide		
	1645	Total cyanide		
EPA 9030B			10195605	Acid-Soluble and Acid-Insoluble sulfides: Distillation
	2005	Sulfide		
EPA 9034			10196006	Titrimetric Procedure for Acid-Soluble and Acid-Insoluble Sulfides
	2005	Sulfide		
EPA 9036			10196404	Sulfate (Colorimetric, Automated, Methylthymol Blue, AA II)
	2000	Sulfate		
EPA 9040C			10244403	pH Electrometric Measurement



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1900	pH		
EPA 9050A			10198808	Specific Conductance
	1610	Conductivity		
EPA 9056A			10199607	Determination of Inorganic Anions by Ion Chromatography
	1540	Bromide		
	1575	Chloride		
	1730	Fluoride		
	1810	Nitrate as N		
	1840	Nitrite as N		
	1870	Orthophosphate as P		
EPA 9060A			10244801	Total Organic Carbon
	2040	Total organic carbon		
EPA 9065			10200405	Phenolics (Spectrophotometric, Manual 4-AAP with Distillation)
	1905	Total phenolics		
EPA 9214			10206403	Potentiometric Determination of Fluoride in Aqueous Samples with Ion-Selective Electrode
	1730	Fluoride		
EPA 9251			10207406	Chloride (Colorimetric, Automated Ferricyanide AAll)
	1575	Chloride		
EPA RSK-175 (GC-FID)			10212905	Methane, Ethane, and Ethene in water by Headspace GC/FID
	4323	Acetylene		
	4747	Ethane		
	4752	Ethene		
	4926	Methane		
	5029	n-Propane		
NWTPH-Dx			90018409	Oregon DEQ TPH Diesel Range
	9369	Diesel range organics (DRO)		
	9488	Jet Fuel		
	9499	Motor Oil		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	2050	Total Petroleum Hydrocarbons (TPH)		
NWTPH-GX (GC/MS)			90018658	Oregon DEQ TPH Gasoline Range Organics by GC/MS Purge & Trap
	9408	Gasoline range organics (GRO)		
NWTPH-HCID			90013200	Oregon DEQ Total Petroleum Hydrocarbon ID
	2050	Total Petroleum Hydrocarbons (TPH)		
Puget Sound Estuary Program (PSEP): Conventional Sediment Variables			60006408	PSEP: Organotins, TOC, and Sulfide
	1201	Butyltin trichloride		
	5913	Dibutyltin		
	1202	Dibutyltin dichloride		
	1206	Monobutyltin		
	1209	Tetrabutyltin		
	1213	Tributyltin		
	1203	Tributyltin chloride		
SM 2120 B-2011			20039310	Color
	1605	Color		
SM 2130 B-2011			20048220	Turbidity by Nephelometric Method
	2055	Turbidity		
SM 2320 B-2011 online			20045618	Alkalinity as CaCO <sub>3</sub>
	1505	Alkalinity as CaCO <sub>3</sub>		
SM 2340 B-2011 online			20046611	Hardness
	1750	Hardness		
SM 2510 B-2011			20048617	Conductivity by Probe
	1610	Conductivity		
SM 2520 B-2011			20040088	Salinity by Electrical Conductivity Method
	1975	Salinity		
SM 2540 B-2011 2011			20049416	Total Solids Dried at 103 - 105C
	1950	Residue-total		
SM 2540 C-2011 online			20050413	Residue-filterable (TDS)



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1955	Residue-filterable (TDS)		
SM 2540 D-2011			20051212	Total Suspended Solids Dried at 103 - 105 C
	1960	Residue-nonfilterable (TSS)		
SM 2540 E-2011 2011			20051596	Fixed & Volatile Solids Ignited at 550 C
	1725	Total, fixed, and volatile residue		
SM 2540 F-2011			20052215	Settleable Solids
	1965	Residue-settleable		
SM 2540 G-2011 online			20005270	Total, Fixed, and Volatile Solids
	1725	Total, fixed, and volatile residue		
SM 2580 B-2011			20054062	Oxidation-Reduction Potential Measurement in Clean Water
	1871	O-R Potential		
SM 3500-Cr B-2011			20066266	Chromium by Colorimetric Method
	1040	Chromium		
SM 3500-Fe B-2011			20069016	Iron by Phenanthroline Method
	1070	Iron		
SM 4110 B-2011			20076919	Anions by Ion Chromatography with Chemical Suppression of Eluent
	1540	Bromide		
	1575	Chloride		
	1730	Fluoride		
	1810	Nitrate as N		
	1820	Nitrate plus Nitrite as N		
	1840	Nitrite as N		
	1870	Orthophosphate as P		
SM 4500-Cl <sup>-</sup> E-97 online			20086800	Chloride by Automated Ferricyanide Method
	1575	Chloride		
SM 4500-CN E-2011 2011			20096428	Cyanide by Colormetric Method
	1645	Total cyanide		
SM 4500-CN <sup>-</sup> C-2011			20065663	Cyanide (Total) After Distillation
	1645	Total cyanide		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
SM 4500-CN <sup>-</sup> G-2011			20097227	Cyanides Amenable to Chlorination after Distillation
	1510	Amenable cyanide		
SM 4500-CN <sup>-</sup> I-2011			20098026	Weak Acid Dissociable Cyanide
	2074	Weak Acid Dissociable Cyanide		
SM 4500-F <sup>-</sup> C-2011 online			20102414	Fluoride by Ion Selective Electrode
	1730	Fluoride		
SM 4500-H <sup>+</sup> B-2011			20105220	pH - Electrometric Measurement
	1900	pH		
SM 4500-NH <sub>3</sub> D-2011 online			20109415	Ammonia Nitrogen by Selective Ion Probe
	1515	Ammonia as N		
SM 4500-NH <sub>3</sub> H-2011 online			20112214	Ammonia Nitrogen by Flow Injection Analysis
	1515	Ammonia as N		
SM 4500-NO <sub>3</sub> <sup>-</sup> I-2011			20118574	Nitrate by Cadmium Reduction Flow Injection
	1810	Nitrate as N		
	1840	Nitrite as N		
	1825	Total nitrate+nitrite		
SM 4500-Norg D-2011			20120289	Organic Nitrogen by Block Digestion and Flow Injection Analysis
	1795	Total Kjeldahl Nitrogen (TKN)		
SM 4500-O C-2001			20120836	Dissolved Oxygen by Azide Modification
	1880	Oxygen, dissolved		
SM 4500-P B4-2011 online			20123415	Phosphorus Digestion with Sulfuric Acid - Nitric Acid
	1910	Phosphorus, total		
SM 4500-P B5-2011			20123368	Phosphorus by Persulfate Digestion Method
	1910	Phosphorus, total		
SM 4500-P E-2011			20124225	Phosphorus by Ascorbic Acid Method
	1870	Orthophosphate as P		
	1910	Phosphorus, total		
SM 4500-S2 F-2011			20126663	Sulfide by Iodometric Method
	2005	Sulfide		



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Matrix	Reference	Analyte Code	Analyte	Method Code	Description
	SM 4500-S2 <sup>-</sup> D-2011 online			20125864	Sulfide by Methylene Blue Method
		2005	Sulfide		
	SM 4500-SO3 <sup>-</sup> B-2011			20130636	Sulfite by Iodometric Method
		2015	Sulfite-SO3		
	SM 4500-SO4 G-2011			20134412	Sulfate - Methylthymol Blue Flow Injection Analysis
		2000	Sulfate		
	SM 5210 B-2011 online			20135266	Biochemical Oxygen Demand (5 days @ 20 C).
		1530	Biochemical oxygen demand		
		1555	Carbonaceous BOD, CBOD		
	SM 5220 D-2011 2011			20136816	Chemical Oxygen Demand by Closed Reflux and Colorimetric Determination
		1565	Chemical oxygen demand		
	SM 5310 B-2011 2011			20137820	TOC by High-Temperature Combustion Method
		1710	Dissolved organic carbon (DOC)		
		2040	Total organic carbon		
	SM 5520 B-2011			20141666	Oil and Grease by Partition-Gravimetric Method
		1803	n-Hexane Extractable Material (O&G)		
	SM 5520 D-2005 SM 5520 D-2005			20142409	Oil and Grease by Soxhlet Extraction Method
		1860	Oil & Grease		
	SM 5520 F-2011			20143413	Oil and Grease Hydrocarbons
		1803	n-Hexane Extractable Material (O&G)		
		1860	Oil & Grease		
	SM 5520 G-2011			20143617	Oil and Grease by Solid-Phase, Partition-Gravimetric Method
		1803	n-Hexane Extractable Material (O&G)		
		1860	Oil & Grease		
	SM 5530 D 22nd ED			20143720	Phenols by Direct Photometric Method
		1905	Total phenolics		
	WA EPH			60015001	Extractable Petroleum Hydrocarbons
		6220	1,2-Diphenylhydrazine		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	6211	EPH Aliphatic >C10-C12		
	6212	EPH Aliphatic >C12-C16		
	6214	EPH Aliphatic >C16-C21		
	6216	EPH Aliphatic >C21-C34		
	6222	EPH Aliphatic C9-C18		
	6224	EPH Aromatic >C10-C12		
	6226	EPH Aromatic >C12-C16		
	6228	EPH Aromatic >C16-C21		
	6236	EPH Aromatic C8-C10		
WA VPH			60015056	Volatile Petroleum Hydrocarbons (VPH) by GC/PID Purge & Trap
	5300	VPH Aliphatic >C10-C12		
	5301	VPH Aliphatic >C6-C8		
	5302	VPH Aliphatic >C8-C10		
	5303	VPH Aliphatic C5-C6		
	5308	VPH Aromatic >C10-C12		
	5309	VPH Aromatic >C12-C13		
	5310	VPH Aromatic >C8-C10		
<b>Solids</b>				
AK101 GRO-MS AK101 GRO-MS			90015159	Determination of Gasoline Range Organics by GC/MS - Alaska Department of Environmental Conservation
	9408	Gasoline range organics (GRO)		
AK102 DRO AK102 DRO			90015206	Determination of Diesel Range Organics - Alaska Department of Environmental Conservation
	9369	Diesel range organics (DRO)		
AK103 RRO			90015400	Determination of Residual Range Organics - Alaska Department of Environmental Conservation
	9499	Motor Oil		
EPA 1311			10118806	Toxicity Characteristic Leaching Procedure
	9822	Extraction/Preparation		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
EPA 1312			10119003	Synthetic Precipitation Leaching Procedure
	9822	Extraction/Preparation		
EPA 1613B			10120602	Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution GC/HRMS
	9516	1,2,3,4,6,7,8,9- Octachlorodibenzofuran (OCDF)		
	9519	1,2,3,4,6,7,8,9- Octachlorodibenzo-p-dioxin (OCDD)		
	9420	1,2,3,4,6,7,8- Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)		
	9426	1,2,3,4,6,7,8- Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)		
	9423	1,2,3,4,7,8,9- Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)		
	9471	1,2,3,4,7,8- Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)		
	9453	1,2,3,4,7,8- Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)		
	9474	1,2,3,6,7,8- Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)		
	9456	1,2,3,6,7,8- Hexachlorodibenzo-p- dioxin(1,2,3,6,7,8-Hxcdd)		
	9477	1,2,3,7,8,9- Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)		
	9459	1,2,3,7,8,9- Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)		
	9543	1,2,3,7,8- Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	9540	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)		
	9480	2,3,4,6,7,8-Hexachlorodibenzofuran		
	9549	2,3,4,7,8-Pentachlorodibenzofuran		
	9618	2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)		
	9612	2,3,7,8-Tetrachlorodibenzofuran		
	9438	Hpcdd, total		
	9444	Hpcdf, total		
	9468	Hxcdd, total		
	9483	Hxcdf, total		
	9555	Pecdd, total		
	9552	Pecdf, total		
	9609	TCDD, total		
	9615	TCDF, total		
EPA 200.7 5			10014003	ICP - metals
	1000	Aluminum		
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		
	1020	Beryllium		
	1025	Boron		
	1030	Cadmium		
	1035	Calcium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1070	Iron		
	1075	Lead		
	1085	Magnesium		
	1090	Manganese		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1100	Molybdenum		
	1105	Nickel		
	1125	Potassium		
	1140	Selenium		
	1145	Silicon		
	1150	Silver		
	1155	Sodium		
	1160	Strontium		
	1165	Thallium		
	1175	Tin		
	1180	Titanium		
	1185	Vanadium		
	1190	Zinc		
EPA 200.8 5.5			10014809	Metals by ICP-MS
	1000	Aluminum		
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		
	1020	Beryllium		
	1030	Cadmium		
	1035	Calcium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1070	Iron		
	1075	Lead		
	1085	Magnesium		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		
	1125	Potassium		
	1140	Selenium		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1150	Silver		
	1155	Sodium		
	1165	Thallium		
	1185	Vanadium		
	1190	Zinc		
EPA 245.5			10037602	Mercury in Sediment by Cold Vapor Atomic Absorption
	1095	Mercury		
EPA 300.0 2.1			10053200	Methods for the Determination of Inorganic Substances in Environmental Samples
	1540	Bromide		
	1575	Chloride		
	1730	Fluoride		
	1810	Nitrate as N		
	1840	Nitrite as N		
	1870	Orthophosphate as P		
	2000	Sulfate		
EPA 3050B			10135601	Acid Digestion of Sediments, Sludges, and soils
	9822	Extraction/Preparation		
EPA 3060A			10136604	Alkaline Digestion for Hexavalent Chromium
	9822	Extraction/Preparation		
EPA 351.2 2			10065404	Total Kjeldahl Nitrogen - Block Digest, Phenate
	1795	Total Kjeldahl Nitrogen (TKN)		
	1795	Total Kjeldahl Nitrogen (TKN)		
EPA 353.2 2			10067604	Nitrate/Nitrite Nitrogen - Automated, Cadmium
	1810	Nitrate as N		
	1820	Nitrate plus Nitrite as N		
	1840	Nitrite as N		
EPA 3540C			10140202	Soxhlet Extraction
	9822	Extraction/Preparation		
EPA 3546			10141205	Microwave Extraction
	8031	Extraction/Preparation		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
EPA 3550C	9822	Extraction/Preparation	10142004	Ultrasonic Extraction
EPA 3580A	9822	Extraction/Preparation	10143007	Waste Dilution
EPA 3611B	8031	Extraction/Preparation	10145207	Alumina Column Cleanup and separation of petroleum wastes
EPA 3620C	8031	Extraction/Preparation	10146006	Florisil Cleanup
EPA 3630C	8031	Extraction/Preparation	10146802	Silica gel cleanup
EPA 3640A	9822	Extraction/Preparation	10147203	Gel Preparation Cleanup
EPA 3650B	8031	Extraction/Preparation	10147805	Acid base partition cleanup
EPA 3660B	9822	Extraction/Preparation	10148400	Sulfur cleanup
EPA 3665A	9822	Extraction/Preparation	10148808	Sulfuric Acid / permanganate Cleanup
EPA 420.1	1905	Total phenolics	10079400	Phenolics - Spectrophotometric, manual.
EPA 5000	9822	Extraction/Preparation	10152600	Sample Preparation for Volatile Organics
EPA 5035	9822	Extraction/Preparation	10154004	Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples
EPA 6010D 4	1000	Aluminum	10155916	Metals by ICP - AES
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		
	1020	Beryllium		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1025	Boron		
	1030	Cadmium		
	1035	Calcium		
	1040	Chromium		
	1050	Cobalt		
	1055	Copper		
	1070	Iron		
	1075	Lead		
	1085	Magnesium		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		
	1125	Potassium		
	1140	Selenium		
	1145	Silicon		
	1150	Silver		
	1155	Sodium		
	1160	Strontium		
	1165	Thallium		
	1175	Tin		
	1180	Titanium		
	1185	Vanadium		
	1190	Zinc		
EPA 6020B 2			10156420	Inductively Coupled Plasma-Mass Spectrometry
	1000	Aluminum		
	1005	Antimony		
	1010	Arsenic		
	1015	Barium		
	1020	Beryllium		
	1030	Cadmium		
	1035	Calcium		
	1040	Chromium		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1050	Cobalt		
	1055	Copper		
	1070	Iron		
	1075	Lead		
	1085	Magnesium		
	1090	Manganese		
	1100	Molybdenum		
	1105	Nickel		
	1125	Potassium		
	1140	Selenium		
	1150	Silver		
	1155	Sodium		
	1165	Thallium		
	1185	Vanadium		
	1190	Zinc		
EPA 7196A			10162400	Chromium Hexavalent colorimetric
	1045	Chromium VI		
EPA 7471B			10166402	Mercury by Cold Vapor Atomic Absorption
	1095	Mercury		
EPA 8015C			10173805	Non-halogenated organics using GC/FID
	9369	Diesel range organics (DRO)		
	9408	Gasoline range organics (GRO)		
EPA 8041A			10176804	Phenols by Gas Chromatography
	6730	2,3,4,5-Tetrachlorophenol		
	6735	2,3,4,6-Tetrachlorophenol		
	6740	2,3,5,6-Tetrachlorophenol		
	6830	2,3,6-Trichlorophenol (4C)		
	6835	2,4,5-Trichlorophenol		
	6605	Pentachlorophenol		
EPA 8081B			10178800	Organochlorine Pesticides by GC/ECD
	8580	2,4'-DDD		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	8585	2,4'-DDE		
	8590	2,4'-DDT		
	7355	4,4'-DDD		
	7360	4,4'-DDE		
	7365	4,4'-DDT		
	7025	Aldrin		
	7110	alpha-BHC (alpha-Hexachlorocyclohexane)		
	7115	beta-BHC (beta-Hexachlorocyclohexane)		
	7250	Chlordane (tech.)		
	7240	cis-chlordane (alpha-Chlordane)		
	7925	cis-Nonachlor		
	7105	delta-BHC		
	7470	Dieldrin		
	7510	Endosulfan I		
	7515	Endosulfan II		
	7520	Endosulfan sulfate		
	7540	Endrin		
	7530	Endrin aldehyde		
	7535	Endrin ketone		
	7120	gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)		
	7245	gamma-Chlordane		
	7685	Heptachlor		
	7690	Heptachlor epoxide		
	6275	Hexachlorobenzene		
	4835	Hexachlorobutadiene		
	7810	Methoxychlor		
	7870	Mirex		
	3890	Oxychlordane		
	8250	Toxaphene (Chlorinated)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
		camphene)		
	7910	trans-Nonachlor		
EPA 8082A			10179201	Polychlorinated Biphenyls (PCBs) by GC/ECD
	9902	2,2',3,3',4,4',5,5',6-Nonabromodiphenyl ether (BDE-206)		
	9890	2,2',3,3',4,4',5,5'-Octabromodiphenyl ether (BDE-194)		
	9090	2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194)		
	9903	2,2',3,3',4,4',5,6,6'-Nonabromodiphenyl ether (BDE-207)		
	9891	2,2',3,3',4,4',5,6'-Octabromodiphenyl ether (BDE-195)		
	9892	2,2',3,3',4,4',5,6'-Octabromodiphenyl ether (BDE-196)		
	9103	2,2',3,3',4,4',5,6'-Octachlorobiphenyl (BZ-195)		
	9866	2,2',3,3',4,4',5-Heptabromodiphenyl ether (BDE-170)		
	9065	2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170)		
	9020	2,2',3,3',4,4'-Hexachlorobiphenyl (BZ-128)		
	9112	2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ-201)		
	9873	2,2',3,3',4',5,6-Heptabromodiphenyl ether (BDE-177)		
	9116	2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-174)		
	9114	2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ-177)		
	9120	2,2',3,3',4,6'-		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
		Hexachlorobiphenyl (BZ-132)		
9133		2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ-203)		
9134		2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ-180)		
9878		2,2',3,4,4',5,6'-Heptabromodiphenyl ether (BDE-182)		
9075		2,2',3,4,4',5,6'-Heptachlorobiphenyl (BZ-183)		
9835		2,2',3,4,4',5'-Hexabromodiphenyl ether (BDE-138)		
9025		2,2',3,4,4',5'-Hexachlorobiphenyl (BZ-138)		
9784		2,2',3,4,4'-Pentabromodiphenyl ether (BDE-85)		
9080		2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ-187)		
9030		2,2',3,4,5,5'-Hexachlorobiphenyl (BZ-141)		
9151		2,2',3,4',5',6-Hexachlorobiphenyl (BZ-149)		
9796		2,2',3',4,5-Pentabromodiphenyl ether (BDE-97)		
8975		2,2',3,4,5'-Pentachlorobiphenyl (BZ-87)		
9154		2,2',3,4',5'-Pentachlorobiphenyl (BZ-97)		
9797		2,2',3',4,6-Pentabromodiphenyl ether (BDE-98)		
9035		2,2',3,5,5',6-Hexachlorobiphenyl (BZ-151)		
9166		2,2',3,5',6-Pentachlorobiphenyl (BZ-95)		
8945		2,2',3,5'-Tetrachlorobiphenyl		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
		(BZ-44)		
9569		2,2',4,4',5,5'-Hexabromodiphenyl ether (BDE-153)		
9040		2,2',4,4',5,5'-Hexachlorobiphenyl (BZ-153)		
9850		2,2',4,4',5,6'-Hexabromodiphenyl ether (BDE-154)		
9571		2,2',4,4',5-Pentabromodiphenyl ether (BDE-99)		
9175		2,2',4,4',5-Pentachlorobiphenyl (BZ-99)		
9572		2,2',4,4',6-Pentabromodiphenyl ether (BDE-100)		
9773		2,2',4,4'-Tetrabromodiphenyl ether (BDE-47)		
8980		2,2',4,5,5'-Pentachlorobiphenyl (BZ-101)		
8950		2,2',4,5'-Tetrachlorobiphenyl (BZ-49)		
9716		2,2',4-Tribromodiphenyl ether (BDE-17)		
8955		2,2',5,5'-Tetrachlorobiphenyl (BZ-52)		
8930		2,2',5-Trichlorobiphenyl (BZ-18)		
9050		2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)		
9193		2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158)		
8985		2,3,3',4,4'-Pentachlorobiphenyl (BZ-105)		
9819		2',3,3',4,5-Pentabromodiphenyl ether (BDE-122)		
8990		2,3,3',4',6-		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
		Pentachlorobiphenyl (BZ-110)		
	9207	2,3,3',4'-Tetrachlorobiphenyl (BZ-56)		
	9820	2',3,4,4',5'-Pentabromodiphenyl ether (BDE-123)		
	8995	2,3',4,4',5'-Pentachlorobiphenyl (BZ-118)		
	9758	2,3,4,4'-Tetrabromodiphenyl ether (BDE-60)		
	9764	2,3',4,4'-Tetrabromodiphenyl ether (BDE-66)		
	9221	2,3,4,4'-Tetrachlorobiphenyl (BZ-60)		
	8960	2,3',4,4'-Tetrachlorobiphenyl (BZ-66)		
	9821	2',3,4,5,5'-Pentabromodiphenyl ether (BDE-124)		
	9822	2',3,4,5,6'-Pentabromodiphenyl ether (BDE-125)		
	9775	2',3,4,5-Tetrabromodiphenyl ether (BDE-76)		
	9230	2,3',4',5-Tetrachlorobiphenyl (BZ-70)		
	9760	2,3,4,6-Tetrabromodiphenyl ether (BDE-62)		
	9769	2,3',4',6-Tetrabromodiphenyl ether (BDE-71)		
	9732	2',3,4-Tribromodiphenyl ether (BDE-33)		
	9239	2,3',4'-Trichlorobiphenyl (BZ-33)		
	9733	2',3,5-Tribromodiphenyl ether (BDE-34)		
	9250	2,4,4',5-Tetrachlorobiphenyl (BZ-74)		



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EPA CODE: WA00037

Certificate: WA100006 - 014

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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	9727	2,4,4'-Tribromodiphenyl ether (BDE-28)		
	9252	2,4,4'-Trichlorobiphenyl (BZ-28)		
	8940	2,4',5'-Trichlorobiphenyl (BZ-31)		
	9256	2,4'-Dichlorobiphenyl (BZ-8)		
	8880	Aroclor-1016 (PCB-1016)		
	8885	Aroclor-1221 (PCB-1221)		
	8890	Aroclor-1232 (PCB-1232)		
	8895	Aroclor-1242 (PCB-1242)		
	8900	Aroclor-1248 (PCB-1248)		
	8905	Aroclor-1254 (PCB-1254)		
	8910	Aroclor-1260 (PCB-1260)		
	8912	Aroclor-1262 (PCB-1262)		
	8913	Aroclor-1268 (PCB-1268)		
EPA 8260D	10307127	Volatile Organic Compounds By GC/MS		
	5105	1,1,1,2-Tetrachloroethane		
	5160	1,1,1-Trichloroethane		
	5110	1,1,2,2-Tetrachloroethane		
	5185	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)		
	5165	1,1,2-Trichloroethane		
	4630	1,1-Dichloroethane		
	4640	1,1-Dichloroethylene		
	4670	1,1-Dichloropropene		
	5150	1,2,3-Trichlorobenzene		
	5180	1,2,3-Trichloropropane		
	5155	1,2,4-Trichlorobenzene		
	5210	1,2,4-Trimethylbenzene		
	4570	1,2-Dibromo-3-chloropropane (DBCP)		
	4585	1,2-Dibromoethane (EDB, Ethylene dibromide)		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	4610	1,2-Dichlorobenzene		
	4635	1,2-Dichloroethane (Ethylene dichloride)		
	4655	1,2-Dichloropropane		
	5215	1,3,5-Trimethylbenzene		
	4615	1,3-Dichlorobenzene		
	4660	1,3-Dichloropropane		
	4620	1,4-Dichlorobenzene		
	4665	2,2-Dichloropropane		
	4410	2-Butanone (Methyl ethyl ketone, MEK)		
	4500	2-Chloroethyl vinyl ether		
	4535	2-Chlorotoluene		
	4860	2-Hexanone (MBK)		
	4540	4-Chlorotoluene		
	4910	4-Isopropyltoluene (p-Cymene)		
	4995	4-Methyl-2-pentanone (MIBK)		
	4325	Acrolein (Propenal)		
	4340	Acrylonitrile		
	4375	Benzene		
	4385	Bromobenzene		
	4390	Bromochloromethane		
	4395	Bromodichloromethane		
	4400	Bromoform		
	4450	Carbon disulfide		
	4455	Carbon tetrachloride		
	4475	Chlorobenzene		
	4575	Chlorodibromomethane		
	4485	Chloroethane (Ethyl chloride)		
	4505	Chloroform		
	4645	cis-1,2-Dichloroethylene		
	4680	cis-1,3-Dichloropropene		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	4595	Dibromomethane (Methylene bromide)		
	4625	Dichlorodifluoromethane (Freon-12)		
	9375	Di-isopropylether (DIPE)		
	4765	Ethylbenzene		
	4770	Ethyl-t-butylether (ETBE) (2-Ethoxy-2-methylpropane)		
	9408	Gasoline range organics (GRO)		
	4835	Hexachlorobutadiene		
	4870	Iodomethane (Methyl iodide)		
	4900	Isopropylbenzene (Cumene)		
	5240	m+p-xylene		
	4950	Methyl bromide (Bromomethane)		
	4960	Methyl chloride (Chloromethane)		
	5000	Methyl tert-butyl ether (MTBE)		
	4975	Methylene chloride (Dichloromethane)		
	5005	Naphthalene		
	4435	n-Butylbenzene		
	5090	n-Propylbenzene		
	5250	o-Xylene		
	4440	sec-Butylbenzene		
	5100	Styrene		
	4370	T-amylmethylether (TAME)		
	4420	tert-Butyl alcohol		
	4445	tert-Butylbenzene		
	5115	Tetrachloroethylene (Perchloroethylene)		
	5140	Toluene		
	4700	trans-1,2-Dichloroethylene		
	4685	trans-1,3-Dichloropropylene		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	4605	trans-1,4-Dichloro-2-butene		
	5170	Trichloroethene (Trichloroethylene)		
	5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)		
	5225	Vinyl acetate		
	5235	Vinyl chloride		
EPA 8270E			10242543	Semivolatile Organic compounds by GC/MS
	6703	1,1'-Biphenyl (BZ-0)		
	5155	1,2,4-Trichlorobenzene		
	4610	1,2-Dichlorobenzene		
	4615	1,3-Dichlorobenzene		
	4620	1,4-Dichlorobenzene		
	4735	1,4-Dioxane (1,4-Diethyleneoxide)		
	6380	1-Methylnaphthalene		
	4659	2,2'-Oxybis(1-chloropropane), bis(2-Chloro-1-methylethyl)ether		
	6835	2,4,5-Trichlorophenol		
	6840	2,4,6-Trichlorophenol		
	6000	2,4-Dichlorophenol		
	6130	2,4-Dimethylphenol		
	6175	2,4-Dinitrophenol		
	6185	2,4-Dinitrotoluene (2,4-DNT)		
	6190	2,6-Dinitrotoluene (2,6-DNT)		
	5795	2-Chloronaphthalene		
	5800	2-Chlorophenol		
	6360	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)		
	6385	2-Methylnaphthalene		
	6400	2-Methylphenol (o-Cresol)		
	6460	2-Nitroaniline		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	6490	2-Nitrophenol		
	5945	3,3'-Dichlorobenzidine		
	6465	3-Nitroaniline		
	5660	4-Bromophenyl phenyl ether (BDE-3)		
	5700	4-Chloro-3-methylphenol		
	5745	4-Chloroaniline		
	5825	4-Chlorophenyl phenylether		
	4910	4-Isopropyltoluene (p-Cymene)		
	6410	4-Methylphenol (p-Cresol)		
	6470	4-Nitroaniline		
	6500	4-Nitrophenol		
	5500	Acenaphthene		
	5505	Acenaphthylene		
	5510	Acetophenone		
	7005	Alachlor		
	6700	alpha-Terpineol		
	5545	Aniline		
	5555	Anthracene		
	7075	Azinphos-methyl (Guthion)		
	5562	Azobenzene		
	5595	Benzidine		
	5575	Benzo(a)anthracene		
	5580	Benzo(a)pyrene		
	5605	Benzo(e)pyrene		
	5590	Benzo(g,h,i)perylene		
	5600	Benzo(k)fluoranthene		
	5585	Benzo[b]fluoranthene		
	5610	Benzoic acid		
	5630	Benzyl alcohol		
	5760	bis(2-Chloroethoxy)methane		
	5765	bis(2-Chloroethyl) ether		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	7125	Bolstar (Sulprofos)		
	5670	Butyl benzyl phthalate		
	5671	Butyl diphenyl Phosphate		
	5673	Butylated Hydroxy Toluene (BHT)		
	5680	Carbazole		
	7255	Chlorfenvinphos		
	7300	Chlorpyrifos		
	5855	Chrysene		
	7315	Coumaphos		
	7330	Crotoxyphos		
	7385	Demeton-s		
	6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)		
	7410	Diazinon		
	5895	Dibenz(a,h) anthracene		
	5905	Dibenzofuran		
	5912	Dibutyl phenyl Phosphahate		
	7465	Dicrotophos		
	6070	Diethyl phthalate		
	7475	Dimethoate		
	6135	Dimethyl phthalate		
	5925	Di-n-butyl phthalate		
	6200	Di-n-octyl phthalate		
	8625	Disulfoton		
	7550	EPN		
	7565	Ethion		
	7570	Ethoprop		
	7600	Fensulfothion		
	7605	Fenthion		
	6265	Fluoranthene		
	6270	Fluorene		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	6275	Hexachlorobenzene		
	4835	Hexachlorobutadiene		
	6285	Hexachlorocyclopentadiene		
	4840	Hexachloroethane		
	6315	Indeno(1,2,3-cd) pyrene		
	6320	Isophorone		
	7770	Malathion		
	7785	Merphos		
	7825	Methyl parathion (Parathion, methyl)		
	7850	Mevinphos		
	7880	Monocrotophos		
	7905	Naled		
	5005	Naphthalene		
	5015	Nitrobenzene		
	6530	n-Nitrosodimethylamine		
	6545	n-Nitrosodi-n-propylamine		
	6535	n-Nitrosodiphenylamine		
	7955	Parathion, ethyl		
	6605	Pentachlorophenol		
	6615	Phenanthrene		
	6625	Phenol		
	7985	Phorate		
	6665	Pyrene		
	5095	Pyridine		
	6683	Retene		
	8110	Ronnel		
	8155	Sulfotepp		
	8200	Tetrachlorvinphos (Stirophos, Gardona) Z-isomer		
	8245	Tokuthion (Prothiophos)		
	8262	Tributyl phosphate		
	8275	Trichloronate		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	8282	Triphenyl phosphate		
EPA 8270E SIM			10242565	Semivolatile Organic compounds by GC/MS
	6703	1,1'-Biphenyl (BZ-0)		
	6380	1-Methylnaphthalene		
	6385	2-Methylnaphthalene		
	5500	Acenaphthene		
	5505	Acenaphthylene		
	5555	Anthracene		
	5575	Benzo(a)anthracene		
	5580	Benzo(a)pyrene		
	5605	Benzo(e)pyrene		
	5590	Benzo(g,h,i)perylene		
	9309	Benzo(j)fluoranthene		
	5600	Benzo(k)fluoranthene		
	5585	Benzo[b]fluoranthene		
	5680	Carbazole		
	5855	Chrysene		
	5895	Dibenz(a,h) anthracene		
	5905	Dibenzofuran		
	5913	Dibutyltin		
	6265	Fluoranthene		
	6270	Fluorene		
	6315	Indeno(1,2,3-cd) pyrene		
	1206	Monobutyltin		
	5005	Naphthalene		
	6608	Perylene		
	6615	Phenanthrene		
	6665	Pyrene		
	1209	Tetrabutyltin		
	1213	Tributyltin		
EPA 8290A			10187403	Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
				GC/HRMS
	9516	1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)		
	9519	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)		
	9420	1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)		
	9426	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)		
	9423	1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)		
	9471	1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)		
	9453	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)		
	9474	1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)		
	9456	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)		
	9477	1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)		
	9459	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)		
	9543	1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)		
	9540	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)		
	9480	2,3,4,6,7,8-		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
		Hexachlorodibenzofuran		
	9549	2,3,4,7,8-Pentachlorodibenzofuran		
	9618	2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)		
	9612	2,3,7,8-Tetrachlorodibenzofuran		
	9438	Hpcdd, total		
	9444	Hpcdf, total		
	9468	Hxcd, total		
	9483	Hxcd, total		
	9555	Pecdd, total		
	9552	Pecdf, total		
	9609	TCDD, total		
	9615	TCDF, total		
EPA 9010C			10243002	Total and Amenable Cyanide by Distillation and UV-Vis
	1510	Amenable cyanide		
	1645	Total cyanide		
EPA 9013			10193609	Cyanide Extraction Procedure for Solids and Oils
	8031	Extraction/Preparation		
EPA 9014			10193803	Titrimetric and Manual Spectrophotometric Determinative Methods for Cyanide
	1510	Amenable cyanide		
	1635	Cyanide		
	1645	Total cyanide		
EPA 9030B			10195605	Acid-Soluble and Acid-Insoluble sulfides: Distillation
	2005	Sulfide		
EPA 9034			10196006	Titrimetric Procedure for Acid-Soluble and Acid-Insoluble Sulfides
	2005	Sulfide		
EPA 9045D			10244607	Soil and Waste pH
	1900	pH		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
EPA 9056A	10199607			Determination of Inorganic Anions by Ion Chromatography
	1540	Bromide		
	1575	Chloride		
	1730	Fluoride		
	1810	Nitrate as N		
	1840	Nitrite as N		
	1870	Orthophosphate as P		
	2000	Sulfate		
EPA 9065	10200405			Phenolics (Spectrophotometric, Manual 4-AAP with Distillation)
	1905	Total phenolics		
EPA 9071B	10201602			Oil and Grease Extraction Method for sludge and sediment samples
	1860	Oil & Grease		
EPA 9080	10203200			Cation-Exchange Capacity of Soils (Ammonium Acetate)
	1560	Cation exchange capacity		
EPA 9214	10206403			Potentiometric Determination of Fluoride in Aqueous Samples with Ion-Selective Electrode
	1730	Fluoride		
NWTPH-Dx	90018409			Oregon DEQ TPH Diesel Range
	9369	Diesel range organics (DRO)		
	9488	Jet Fuel		
	9499	Motor Oil		
	2050	Total Petroleum Hydrocarbons (TPH)		
NWTPH-GX (GC/MS)	90018658			Oregon DEQ TPH Gasoline Range Organics by GC/MS Purge & Trap
	9408	Gasoline range organics (GRO)		
NWTPH-HCID	90013200			Oregon DEQ Total Petroleum Hydrocarbon ID
	2050	Total Petroleum Hydrocarbons (TPH)		
PLUMB 1981	60006259			Extraction/Preparation



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	8031	Extraction/Preparation		
Puget Sound Estuary Program (PSEP): Conventional Sediment Variables			60006408	PSEP: Organotins, TOC, and Sulfide
	1201	Butyltin trichloride		
	5913	Dibutyltin		
	1202	Dibutyltin dichloride		
	1206	Monobutyltin		
	2005	Sulfide		
	1209	Tetrabutyltin		
	2040	Total organic carbon		
	1213	Tributyltin		
	1203	Tributyltin chloride		
SM 2510 B-2011			20048617	Conductivity by Probe
	1610	Conductivity		
SM 2540 B-2011 2011			20049416	Total Solids Dried at 103 - 105C
	1950	Residue-total		
SM 2540 E-2011 2011			20051596	Fixed & Volatile Solids Ignited at 550 C
	1725	Total, fixed, and volatile residue		
SM 2540 G-2011 online			20005270	Total, Fixed, and Volatile Solids
	1725	Total, fixed, and volatile residue		
SM 2580 B-2011			20054062	Oxidation-Reduction Potential Measurement in Clean Water
	1871	O-R Potential		
SM 3500-Cr B-2011			20066266	Chromium by Colorimetric Method
	1040	Chromium		
SM 3500-Fe B-2011			20069016	Iron by Phenanthroline Method
	1070	Iron		
SM 4110 B-2011			20076919	Anions by Ion Chromatography with Chemical Suppression of Eluent
	1540	Bromide		
	1575	Chloride		



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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1730	Fluoride		
	1810	Nitrate as N		
	1820	Nitrate plus Nitrite as N		
	1840	Nitrite as N		
	1870	Orthophosphate as P		
	2000	Sulfate		
SM 4500-CN E-2011 2011			20096428	Cyanide by Colormetric Method
	1645	Total cyanide		
SM 4500-CN <sup>-</sup> C-2011			20065663	Cyanide (Total) After Distillation
	1645	Total cyanide		
SM 4500-CN <sup>-</sup> I-2011			20098026	Weak Acid Dissociable Cyanide
	2074	Weak Acid Dissociable Cyanide		
SM 4500-F <sup>-</sup> C-2011 online			20102414	Fluoride by Ion Selective Electrode
	1730	Fluoride		
SM 4500-H <sup>+</sup> B-2011			20105220	pH - Electrometric Measurement
	1900	pH		
SM 4500-NH3 D-2011 online			20109415	Ammonia Nitrogen by Selective Ion Probe
	1515	Ammonia as N		
SM 4500-NH3 H-2011 online			20112214	Ammonia Nitrogen by Flow Injection Analysis
	1515	Ammonia as N		
SM 4500-NO3 <sup>-</sup> I-2011			20118574	Nitrate by Cadmium Reduction Flow Injection
	1810	Nitrate as N		
	1840	Nitrite as N		
	1825	Total nitrate+nitrite		
SM 4500-Norg D-2011			20120289	Organic Nitrogen by Block Digestion and Flow Injection Analysis
	1795	Total Kjeldahl Nitrogen (TKN)		
SM 4500-P B5-2011			20123368	Phosphorus by Persulfate Digestion Method
	1910	Phosphorus, total		
SM 4500-P E-2011			20124225	Phosphorus by Ascorbic Acid Method
	1870	Orthophosphate as P		



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Tukwila, WA 98168-3240

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EPA CODE: WA00037

Certificate: WA100006 - 014

Issue Date: 6/15/2021 Expiration Date: 5/12/2022

As of 6/15/2021 this list supersedes all previous lists for this certificate number.

Matrix Reference	Analyte Code	Analyte	Method Code	Description
	1910	Phosphorus, total		
SM 4500-S2 F-2011			20126663	Sulfide by Iodometric Method
	2005	Sulfide		
SM 4500-S2 <sup>-</sup> D-2011 online			20125864	Sulfide by Methylene Blue Method
	2005	Sulfide		
SM 4500-SO3 <sup>-</sup> B-2011			20130636	Sulfite by Iodometric Method
	2015	Sulfite-SO3		
SM 4500-SO4 G-2011			20134412	Sulfate - Methylthymol Blue Flow Injection Analysis
	2000	Sulfate		
SM 5310 B-2011 2011			20137820	TOC by High-Temperature Combustion Method
	2040	Total organic carbon		
SM 5520 B-2011			20141666	Oil and Grease by Partition-Gravimetric Method
	1803	n-Hexane Extractable Material (O&G)		
SM 5520 D-2005 SM 5520 D-2005			20142409	Oil and Grease by Soxhlet Extraction Method
	1860	Oil & Grease		
SM 5520 E-05 online			20142807	Oil and Grease by Extraction Method for Sludge Samples
	1860	Oil & Grease		
SM 5520 F-2011			20143413	Oil and Grease Hydrocarbons
	1803	n-Hexane Extractable Material (O&G)		
	1860	Oil & Grease		
SM 5520 G-2011			20143617	Oil and Grease by Solid-Phase, Partition-Gravimetric Method
	1803	n-Hexane Extractable Material (O&G)		
	1860	Oil & Grease		
SM 5530 D-2005			20143764	Phenols by Direct Photometric Method
	1905	Total phenolics		
WA EPH			60015001	Extractable Petroleum Hydrocarbons
	6220	1,2-Diphenylhydrazine		
	6211	EPH Aliphatic >C10-C12		



# OREGON

## Environmental Laboratory Accreditation Program

### ORELAP Fields of Accreditation



Analytical Resources Inc.

4611 S. 134th Place, Suite 100  
Tukwila, WA 98168-3240

ORELAP ID: WA100006

EPA CODE: WA00037

Certificate: WA100006 - 014

Issue Date: 6/15/2021 Expiration Date: 5/12/2022

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Matrix Reference	Analyte Code	Analyte	Method Code	Description
	6212	EPH Aliphatic >C12-C16		
	6214	EPH Aliphatic >C16-C21		
	6216	EPH Aliphatic >C21-C34		
	6222	EPH Aliphatic C9-C18		
	6224	EPH Aromatic >C10-C12		
	6226	EPH Aromatic >C12-C16		
	6228	EPH Aromatic >C16-C21		
	6236	EPH Aromatic C8-C10		
WA VPH			60015056	Volatile Petroleum Hydrocarbons (VPH) by GC/PID Purge & Trap
	5300	VPH Aliphatic >C10-C12		
	5301	VPH Aliphatic >C6-C8		
	5302	VPH Aliphatic >C8-C10		
	5303	VPH Aliphatic C5-C6		
	5308	VPH Aromatic >C10-C12		
	5309	VPH Aromatic >C12-C13		
	5310	VPH Aromatic >C8-C10		

**Analytical  
Resources Inc.  
Quality  
Assurance  
Plan**



Analytical Resources, Incorporated  
Analytical Chemists and Consultants

## Quality Assurance Plan

Analytical Resources, Inc.  
4611 S. 134<sup>th</sup> Place, Suite 100  
Tukwila, WA 98168-3240

Revision 17.0  
6/11/2020

**Uncontrolled Copy  
When Printed**

This Quality Assurance Plan is approved and authorized for release by:

Mark Weidner, Laboratory Technical Director

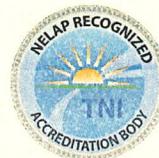
Brian N. Bebee, Organic Analysis Section Technical Director

Eric Larson, Inorganic Analysis Section Technical Director

Bob Congleton, Quality Assurance Manager



# Oregon Environmental Laboratory Accreditation Program



NELAP Recognized

**Analytical Resources Inc.**

**WA100006**

4611 S. 134th Place, Suite 100

Tukwila, WA 98168-3240

IS GRANTED APPROVAL BY ORELAP UNDER THE 2016 TN1 STANDARDS, TO PERFORM ANALYSES ON ENVIRONMENTAL SAMPLES IN MATRICES AS LISTED BELOW :

Air	Drinking Water	Non-Potable Water	Solids and Chemical Waste	Tissue
		Chemistry	Chemistry	Chemistry

AND AS RECORDED IN THE LIST OF APPROVED ANALYTES, METHODS, ANALYTICAL TECHNIQUES, AND FIELDS OF TESTING ISSUED CONCURRENTLY WITH THIS CERTIFICATE AND REVISED AS NECESSARY.

ACCREDITED STATUS DEPENDS ON SUCCESSFUL ONGOING PARTICIPATION IN THE PROGRAM AND CONTINUED COMPLIANCE WITH THE STANDARDS.

CUSTOMERS ARE URGED TO VERIFY THE LABORATORY'S CURRENT ACCREDITATION STATUS IN OREGON.

Travis Bartholomew  
Oregon State Public Health Laboratory  
ORELAP Program Manager  
7202 NE Evergreen Parkway, Suite 100  
Hillsboro, OR 97124

EFFECTIVE DATE : 5/13/2021  
EXPIRATION DATE : 5/12/2022  
Certificate No : WA100006 - 014





**Analytical Resources, Incorporated**  
Analytical Chemists and Consultants

## **Standard Operating Procedure**

### **Polychlorinated Biphenyls (Aroclor) Analysis**

**SOP 403S**  
**Revision 26**

**Revision Date: 2/11/2020**  
**Effective Date: 2/11/2020**

Prepared by:

Josh Rains, Van Spohn

---

Approvals:

A handwritten signature in blue ink that reads "Brian N. Bebee".

Brian N. Bebee, Laboratory Section Manager

A handwritten signature in blue ink that reads "David R. Mitchell".

David R. Mitchell, Quality Assurance Mgr.



**Analytical Resources, Incorporated**  
Analytical Chemists and Consultants

# Standard Operating Procedure

## Metals Sample Preparation Method 3050B (SWN)

**SOP 509S**  
**Version 011.1**

**Revision Date: 2/22/17**  
**Effective Date: 2/22/17**

Prepared by:

Jay Kuhn

---

Approvals:

A handwritten signature in blue ink, appearing to read "Eric Larson".

---

Eric Larson, Inorganics Division Manager

A handwritten signature in blue ink, appearing to read "David R. Mitchell".

---

David R. Mitchell, Quality Assurance Manager



Analytical Resources, Incorporated  
Analytical Chemists and Consultants

## Standard Operating Procedure

### Metals Sample Preparation Mercury EPA Method 7471B ARI Prep Code: SWM

SOP 532S  
Version 008.1

Revision Date: 2/23/17  
Effective Date: 2/23/17

Prepared By:

Jay Kuhn

Approvals:

Jay Kuhn  
Laboratory Manager

David R. Mitchell  
Quality Assurance



Analytical Resources, Incorporated  
Analytical Chemists and Consultants

## Standard Operating Procedure

### Metals Sample Preparation Method 200.8 / 3010A - REN

SOP 536S  
Version 007.1

Revision Date: 2/23/17  
Effective Date: 2/23/17

Prepared by:

Jay Kuhn / Eric Larson

---

Approvals:

A handwritten signature in blue ink, appearing to read "Eric Larson".

Eric Larson, Inorganics Division Manager

---

A handwritten signature in blue ink, appearing to read "David R. Mitchell".

David R. Mitchell, Quality Assurance Manager

---

Annual Review



**Analytical Resources, Incorporated**  
Analytical Chemists and Consultants

# **Standard Operating Procedure**

## **Metals Analysis – Nexlon ICP-MS**

**SOP 543S**  
**Version 004.1**

**Revision Date: 6/1/20**  
**Effective Date: 6/1/20**

Prepared by:  
Tyler Hightower

Approvals:

A handwritten signature in blue ink that reads "Tyler Hightower".

---

Tyler Hightower, Inorganics Division Manager

A handwritten signature in blue ink that reads "Bob Congleton".

---

Bob Congleton, Quality Assurance Manager



**Analytical Resources, Incorporated**  
Analytical Chemists and Consultants

# Standard Operating Procedure

## Mercury Cold Vapor Analysis

**SOP 547S**  
**Version 001**

**Revision Date: 3/27/19**  
**Effective Date: 3/27/19**

Prepared by:

Eric Larson / Tyler Hightower

---

Approvals:

A handwritten signature in blue ink that reads "Eric Larson".

---

Eric Larson, Inorganics Division Manager

A handwritten signature in blue ink that reads "David R. Mitchell".

---

David R. Mitchell, Quality Assurance Manager

# Standard Operating Procedure

## Effluent Elutriate Test

**SOP 1143  
Revision 001**

**Revision Date: 09/20/2021  
Effective Date: 09/20/2021**

Prepared By: Harold Benny

---

Approvals:

---

Laboratory / Section Manager

---

Quality Assurance

---



**Analytical Resources, Incorporated**  
Analytical Chemists and Consultants

## **Standard Operating Procedure**

### **Extraction of Soil/Sediment Samples Using Sonication or Microwave (MARS) (EPA Methods 3550C and 3546)**

**SOP 3304S**

**Revision 6.2**

**Revision Date: 10/26/20**

**Effective Date: 10/26/20**

Prepared By:

Warren Woodard

---

Approvals:

A handwritten signature in blue ink, appearing to read "Brian N. Bebee".

---

Brian N. Bebee, Laboratory Section Manager



**Analytical Resources, Incorporated**  
Analytical Chemists and Consultants

## **Standard Operating Procedure**

### **Extraction of Aqueous Samples using Separatory Funnel or Continuous Liquid-Liquid Extraction (EPA Methods 3510C and 3520C)**

**SOP 3311S  
Revision 004.4  
Revision Date: 2/12/2020  
Effective Date: 2/12/2020**

Prepared By:

Warren Woodard

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Approvals:

A handwritten signature in blue ink that reads "Brian N. Bebee".

Brian N. Bebee, Laboratory Section Manager

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A handwritten signature in blue ink that reads "David R. Mitchell".



**Analytical Resources, Incorporated**  
Analytical Chemists and Consultants

## **Standard Operating Procedure**

**Shared Task Instructions for Water Soil/Sed and Tissues**

**Using**

**SOPs 3304S, 3311S or 3328S**

**SOP 3327S**

**Revision 4.0**

**Revision Date: 10/24/19**

**Effective Date: 10/23/19**

Prepared By:

Warren Woodard

Approvals:

A handwritten signature in blue ink that reads "Brian N. Bebee".

Brian N. Bebee, Laboratory Section Manager

A handwritten signature in blue ink that reads "Bob Congleton".

Bob Congleton, Quality Assurance Manager

# Standard Operating Procedure

## Total Solids

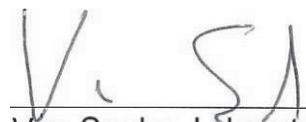
SOP 1023S  
Revision 003

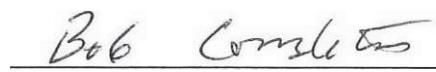
Revision Date: 9/23/20  
Effective Date: 9/23/20

Prepared by:

Van, Spohn, Dave Mitchell

Approvals:

  
Van Spohn, Laboratory Section Manager

  
Bob Congleton, Quality Assurance Manager

Annual Review

## **APPENDIX A.3**

### **Cape Fear Analytical Laboratory Information**

## **APPENDIX A.3**

### **Cape Fear Analytical Laboratory Information**

**STANDARD OPERATING PROCEDURE**  
**FOR**  
**DIOXIN/FURAN/PCB CONGENER SAMPLE PROCESSING**  
**CF-OA-E-001**

APPLICABLE TO DIOXIN METHODS:  
EPA SW-846 Method 8290A, EPA Method 1613B, TO-9a and EPA Method 23

AND PCB METHODS:  
EPA Method 1668A and EPA Method 1668C

**PROPRIETARY INFORMATION**

This document contains proprietary information that is the exclusive property of Cape Fear Analytical, LLC (CFA). No contents of this document may be reproduced or otherwise used for the benefit of others except by express written permission of CFA.

CFA's Document Control Officer certifies this document to be a true copy of the fully executed original.

Date: 17-Jun-2020



Process Owner

(Sign)

Mike Medwedeff  
(Print Name)



Quality Director

(Sign)

Coleman Corzine  
(Print Name)



Laboratory Director

(Sign)

Chris Cornwell  
(Print Name)

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## **1.0 STANDARD OPERATING PROCEDURE FOR DIOXIN/FURAN/PCB CONGENER SAMPLE PROCESSING**

### **2.0 METHOD OBJECTIVE, PURPOSE, CODES, AND SUMMARY**

- 2.1 This standard operating procedure provides the necessary instructions for the preparation, extraction and cleanup of environmental samples for analysis by high-resolution GC/MS methods listed below, for the determination of polychlorinated dibenzo-dioxins/furans(PCDDs/PCDFs) and polychlorinated biphenyls (PCBs).
- 2.2 Solid and tissue samples are homogenized as needed and extracted by soxhlet/Dean-Stark (SDS) or microwave. Aqueous samples are extracted by continuous liquid-liquid extraction (CLLE). Sample extracts are fractionated and prepared for analysis using a variety of cleanup procedures, including silica gel and florisil column chromatography.
- 2.3 Analytical methods
  - 2.3.1 EPA SW-846 Method 8290A
  - 2.3.2 EPA Method 1613B
  - 2.3.3 EPA Method TO-9a
  - 2.3.4 EPA Method 23
  - 2.3.5 EPA Method 1668A
  - 2.3.6 EPA Method 1668C
- 2.4 Extraction techniques
  - 2.4.1 Method 3520C (CLLE) Continuous Liquid-Liquid Extraction
  - 2.4.2 Method 3540C (SDS/SOX) Soxhlet/Soxhlet Dean-Stark Extraction
  - 2.4.3 Method 3546 (MWV) Microwave Extraction
- 2.5 Cleanup techniques
  - 2.5.1 Method 3620C (Florisil)
  - 2.5.2 Method 3630C (Silica)

### **3.0 APPLICABLE MATRICES**

This SOP is applicable to solid (soil, sediment, sludge), aqueous (groundwater, surface water, leachate, drinking water), air (PUF, XAD-2) and tissue matrices.

### **4.0 METHOD SCOPE, APPLICABILITY, AND DETECTION LIMIT**

- 4.1 Calibration ranges and PQLs may be found in the appropriate analytical SOPs.
- 4.2 Analysts must demonstrate proficiency prior to work under this SOP. Demonstrated proficiency may be in the form of an IDOC or PT study. Records are maintained in the Quality Department.

### **5.0 METHOD VARIATIONS**

- 5.1 Aqueous samples containing >1% solids are filtered prior to extraction. The aqueous portion is extracted by CLLE, and the filter and solids are extracted by SOX. The fractions are re-combined prior to cleanup.
- 5.2 Aqueous samples are adjusted to a pH of  $\leq 7$  using 50:50 sulfuric acid. Samples with an initial pH >10 are re-checked after acidifying to ensure a pH of  $\leq 7$ .
- 5.3 EPA Method 3520C, Continuous Liquid-Liquid Extraction and EPA Method 3540C, Soxhlet Extraction include the use and control of laboratory equipment not in use at

Cape Fear Analytical, LLC. The laboratory SOP correctly reflects the equipment used to perform the preparatory methods of reference.

- 5.4 EPA Method 3546 may be used as an alternative extraction procedure for Method 1613B, Method 8290A, Method 1668A, and Method 1668C in recognition of advances that are occurring in analytical technology that use less solvent and take less time than the Soxhlet procedure.

## 6.0 DEFINITIONS

- 6.1 AlphaLIMS: The Laboratory Information Management System used at CFA, LLC.
- 6.2 Blank: An aliquot of reagent water or other blank matrix that is treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents, and standard additions that are used with other samples. The LMB (Lab Method Blank) is used to determine if method analytes or other interferences are present in the laboratory environment, the reagents, or the apparatus. Contamination may be derived during sampling, transportation, storage or analysis. The blank may be used to establish a background value.
- 6.3 Cleanup Standards: Isotopes added prior to cleanup that are used to measure the efficiency of the fractionation step alone. Method 1613B uses one compound (37Cl4-2378-TCDD) as the Cleanup Standard. Method 1668A/C uses three compounds as cleanup standards. Method 8290A does not address the use of cleanup standards.
- 6.4 Extraction Standards: Isotopes added prior to extraction that serve as internal standards. In addition, to measure the overall extraction and fractionation efficiencies.
- 6.5 Laboratory Control Standard/Duplicate (LCS/LCSD): Aliquots of reagent water or other blank matrix to which known quantities of the method analytes are added in the laboratory. The LCS/LCSD are analyzed exactly like a sample, and their purpose is to determine whether the methodology is in control, and whether the laboratory is capable of making accurate and precise measurements.
- 6.6 Laboratory Duplicate (DUP): Aliquots of a sample taken from the same container and processed in the same manner under identical laboratory conditions. The duplicate aliquot is analyzed independently from the parent sample and the results are compared to measure precision and accuracy.
- 6.7 Matrix Spike and Matrix Spike Duplicate (MS and MSD): Two separate aliquots of an environmental sample to which known quantities of the method analytes are added in the laboratory. The MS and MSD are analyzed exactly like a sample, and their purpose is to determine whether the sample matrix contributes bias to the analytical results. The concentrations of the analytes in the sample matrix must be determined in a separate aliquot and the measured values in the MS/MSD adjusted. Percent recovery is calculated for both aliquots, and RPD is calculated between the two.

## 7.0 INTERFERENCES/LIMITATIONS

- 7.1 Contaminants found in extraction glassware, solvents, and other sample processing hardware may jeopardize the integrity of this method.
- 7.2 Glassware must be scrupulously cleaned as soon as possible after extraction.
- 7.3 Reagents and solvents should be purified and tested before use, or alternatively, they should be purchased pre-cleaned by the manufacturer.

- 7.4 PCB extracts must not be allowed to concentrate to dryness due to the potential for loss of low molecular weight chlorinated biphenyls.

## 8.0 SAFETY PRECAUTIONS AND WARNINGS

### WARNING

METHYLENE CHLORIDE IS A SUSPECTED CARCINOGEN AND A KNOWN SKIN IRRITANT. NO OCCUPATIONAL EXPOSURE LIMIT FOR DIOXIN HAS BEEN ESTABLISHED. IT IS A KNOWN AND PROBABLE HUMAN CARCINOGEN.

PCBs HAVE BEEN TENTATIVELY CLASSIFIED AS KNOWN OR SUSPECTED HUMAN OR MAMMALIAN CARCINOGENS.

CONTACT WITH OXIDIZERS MAY GENERATE EXPLOSIVE MIXTURES.

PREVENT SKIN AND EYE CONTACT BY USING SPECIFIED PERSONAL PROTECTIVE EQUIPMENT WHEN MAKING STOCK REAGENTS.

WORK UNDER A HOOD TO PREVENT INHALATION WHEN MAKING STOCK REAGENTS FROM SOLIDS.

- 8.1 Eye protection should be worn when handling samples, reagents, or standards.  
NOTE: Contact lenses pose a special problem; soft lenses may absorb irritants and all lenses concentrate them. DO NOT wear contact lenses in the laboratory.
- 8.2 Treat all chemicals and samples as potential health hazards and reduce exposure to these chemicals to the lowest level possible. CFA maintains a reference file of Safety Data Sheets (SDS). These documents and individual sample SDS provided by clients are maintained in the laboratory.
- 8.3 Personal Protective Equipment (PPE)
- 8.3.1 Gloves and eye protection should be worn when handling reagents, solvents, standards and samples.
- 8.3.2 Analysts should prepare samples and standards under the hood.
- 8.4 Prior to handling radioactive samples, analysts must have had radiation safety training and must understand their full responsibilities in radioactive sample handling. Some general guidelines follow:
- 8.4.1 Proper PPE should be worn at all times when handling radioactive samples. Gloves, safety glasses, and a lab coat should be worn when handling radioactive samples. In addition, a disposable lab apron may be worn over the lab coat.
- 8.4.2 Protect counter tops with counter paper, or work from radioactive sample handling trays.
- 8.4.3 Post signs indicating radioactive samples are in the area.
- 8.4.4 Swipes of the counter tops should be taken upon completion of work.
- 8.4.5 Segregate radioactive wastes. Radioactive and non-radioactive wastes are segregated in the waste satellite area. Radioactive waste containers are obtained from Waste Management.
- 8.5 All samples, chemicals, extracts, and extraction residues must be transferred, delivered, and disposed of safely according to all related SOPs.
- 8.6 Never leave gas cylinders unchained or untied.
- 8.7 In the event of an accident or medical emergency, call for help immediately. When time and safety permit, management should be notified of all accidents.

8.8 Fire escape routes are posted in the lab, and all personnel should be familiar with them. In addition, fire safety equipment such as fire extinguishers and fire blankets are located in the lab. Training is available on the proper operation of this equipment.

8.9 For further safety instructions, consult the Safety, Health and Chemical Hygiene Plan, CF-LB-N-001.

## 9.0 APPARATUS, EQUIPMENT AND INSTRUMENTATION

9.1 Equipment associated with this SOP includes:

- Soxhlet/Continuous Liquid-Liquid Extraction Rack
- Soxhlet/Dean-Stark (SDS) glassware apparatus
- Continuous Liquid-Liquid (CLLE) glassware apparatus
- Balances
- Fume hoods
- Thermolyne 1400 furnace
- Turbovap
- Dry weight oven
- Buchner funnels
- Vacuum pump
- 2 L vacuum flask
- Microwave Extractor

9.2 Materials and supplies:

- Boiling chips
- Cellulose thimbles
- Spatulas
- Aluminum dry weight pans
- pH strips
- 5 3/4" disposable pipets and rubber pipet bulbs
- Filter paper
- Nitrogen
- 500mL test tubes
- 60 mL vials with PTFE caps
- 60 mL vial racks
- 25 mL drying columns
- 10 mL drying columns
- Glass wool
- 10-100 µL air displacement pipet and disposable tips
- 100-1000 µL air displacement pipet and disposable tips
- 1000 mL graduated cylinder

## 10.0 REAGENTS AND STANDARDS

10.1 Reagents, chemicals, and standards:

- Methylene chloride
- Toluene
- Hexane
- Carbon - Carbopack C or equivalent
- Corn oil – Carbon purified
- Celite
- Tridecane: Plug a 25 mL drying column with glass wool; add 1 g sodium sulfate; add approximately 1-2 g carbon-coated celite. Percolate the tridecane from the supplier's bottle through the carbon column. Collect into a clean and properly labeled container; document preparation in the Supply Prep logbook.
- Nonane
- Deionized water
- Sodium sulfate

- Concentrated sulfuric acid
- 1 N Sodium hydroxide
- High purity potassium hydroxide
- Neutral silica
- Acid-coated silica: 44.0 g concentrated sulfuric acid to 100 g neutral silica. Add 1 to 2 mL acid to the silica and shake vigorously; continue until all acid has been added. Document preparation in the Supply Prep logbook; affix appropriate label to jar. A one year expiration date is assigned.
- NaOH-coated silica: 30.0 g 1 N NaOH to 100 g neutral silica. Add 1 to 2 mL base to the silica and shake vigorously; continue until all base has been added. Document preparation in the Supply Prep logbook; affix appropriate label to jar.
- KOH-coated silica: Dissolve 56 g high purity KOH in 300 mL methanol. Add 100 grams neutral silica; stir on hot plate at 60° to 70°C for 1 to 2 hours. Decant liquid and rinse with two 100 mL aliquots methanol. Rinse once with 100 mL methylene chloride. Spread potassium silicate on foil and dry for 1 to 2 hours in a fume hood. Activate at 200 °C for 18 hours. Stir in 37 g neutral silica (This is a deviation from the methods, intended to reduce the strength of the KOH-coated silica to prevent recovery losses in the samples). Document preparation in the Supply Prep logbook; affix appropriate label to jar. A one year expiration date is assigned.
- Florisil: Fill a 200mL beaker with magnesium silicate and bake at 650°C overnight (1 hour minimum). Store in a glass reagent bottle with ground glass stopper to protect from moisture.
- Sand – White quartz, or other similar solid matrix: Bake at 450°C (842°F) for four hours minimum.
- Salt (sodium sulfate): Bake at 450°C (842°F) for four hours minimum.
- Source Standards: Source Standards are purchased directly from vendors and may be diluted to make stock, intermediate, or working standards. These include extraction standard, matrix spiking standard, cleanup standard, injection standard. Source standards expire per the vendor expiration date or after five years from the date opened, whichever is shorter. Please reference CF-LB-E-007 for further information regarding standards and their preparation.
- Dioxin Injection Standard - A Nonane solution containing two recovery standards, 13C-1,2,3,4-TCDD and 13C-1,2,3,7,8,9-HxCDD (see App. I for spike concentrations). The former is used to determine the percent recoveries of tetra- and pentachlorinated PCDD/PCDF labeled congeners, while the latter is used to determine the percent recoveries of the hexa-, hepta- and octachlorinated PCDD/PCDF labeled congeners. 10 to 50 µl, depending on the matrix, will be spiked into each sample extract during final concentration.
- Dioxin Cleanup Standard – A nonane standard containing 37Cl -2,3,7,8-TCDD in that is added to all method 1613 extracts prior to cleanup to measure the efficiency of the cleanup process.
- Dioxin Extraction Standard – A nonane standard containing 13C labeled dioxin and furans. Method 1613 and 8290 versions of this standard contain different numbers of labeled parameters. The method 1613 version contains all of the

labeled standards for use in method 8290. This standard is spiked into all samples prior to extraction to measure the efficiency of the extraction and cleanup processes together and to quantify native parameters.

- Dioxin Matrix Spike Standard – A nonane solution containing the 17 2378 substituted dioxin/furan parameters. This standard is spiked into certain samples for the purpose of providing positive controls such as the measurement of accuracy and precision.
- PCB Injection Standard - A nonane solution containing labeled CBs 9, 52, 101, 138, and 194. These parameters are used to quantify extraction and cleanup standards added earlier in the sample preparation process. This standard is spiked into all sample extracts during final concentration.
- PCB Cleanup Standard – A nonane solution containing labeled CBs 28, 111, and 178. This standard is added to sample extracts prior to cleanup to measure the efficiency of the cleanup process.
- PCB Extraction Standard – A nonane standard containing 27 13C labeled CBs which include toxic WHO parameters and window defining CBs. This standard is spiked into all samples prior to extraction to measure the efficiency of the extraction and cleanup processes together and to quantify native parameters.
- PCB Matrix Spike Standard – A nonane solution containing the 209 native CBs. This standard is spiked into certain samples for the purpose of providing positive controls such as the measurement of accuracy and precision.

## 11.0 SAMPLE HANDLING AND PRESERVATION

- 11.1 For method 8290A, there are no restrictions on when samples must be extracted after collection. For methods 1613B and 1668A/C, samples must be extracted within 365 days of collection. Sample extracts have no maximum recommended holding time from the date of extraction by method 8290A and a 365 day holding time from the date of extraction by 1613B and 1668A/C. For method TO-9a, cartridges are considered clean for up to 30 days from date of certification when stored in their sealed containers. Extraction must be performed within 7 days of sampling and analysis within 40 days after extraction. For method 23, cartridges are considered clean for up to 14 days (no method requirement) from date of certification when stored in their sealed containers. All samples must be extracted within 30 days of collection and analyzed within 45 days of extraction.
- 11.2 Samples should be collected in amber glass containers with PTFE-lined caps.
- 11.3 Aqueous samples should be checked in the field for the presence of residual chlorine, and if present, preserved with 80 mg sodium thiosulfate. If sample labels do not indicate whether they have been checked/preserved, the samples should be checked at the time of receipt, and preserved if necessary.
- 11.4 Samples should be maintained at  $0 \leq 6$  °C after collection until such time as they may be disposed by the laboratory.
- 11.5 Custody of samples is monitored using the AlphaLIMS sample tracking system. Each analyst should scan the samples planned to extract into their custody.
- 11.6 All samples and sample extracts should be treated with caution as potential health hazards. Refer to Section 8.0 on safety.

## 12.0 SAMPLE PREPARATION

- 12.1 Sample preparation and conditioning

### 12.1.1 Homogenization of tissue

- Vegetation samples can require special procedures to prevent cross contamination from other matrices. Some vegetation can be difficult to reduce in particle size and homogenize. Vegetation sample processing is handled on a case-by-case basis with project management to client communication.
- Tissue samples should be received and maintained at -10 to -20°C. If a sample is received as a whole specimen (fish, rodent, etc.), a project manager should verify with the client which portion of the specimen is to be analyzed.
- If specific portions must be dissected from the whole specimen, the remaining tissue can be refrozen. When the entire sample, usually fish, requires analysis, reduce the sample down to manageable means using a butcher knife.

**NOTE: Great care must be exercised when reducing a frozen fish with a knife. Cut-resistant gloves must be worn to protect the hands as well as to hold the fish in place.**

- When analyzing specific portions, such as a fillet, dissect the required portion under stringent safety guidelines to prevent injury as well as to ensure the integrity of the sample.
- Once reduced in size or dissected to the appropriate portion, process the tissue through a meat grinder, if required, and collect into an amber glass jar.
- To ensure a homogeneous mixture, grind the sample two more times.
- Record any observations on the bench sheet.

### 12.1.2 Compositing

Specific procedures for compositing may be found in SOP CF-LB-E-031.

### 12.1.3 Percent solids determination

Specific procedures for determination of percent solids (moisture content) may be found in SOP CF-OA-E-020.

### 12.1.4 Percent lipids determination

Specific procedures for determination of percent lipids may be found in SOP CF-OA-E-021.

### 12.1.5 Sub-Sampling

Sample matrices and mechanisms of contamination are infinitely variable and require judgments to be made. If the client provides no instructions, it is advisable that experienced analysts decide which sub-sampling techniques are employed. For solid samples, mixing is the preferred process. For liquid samples without obvious layers, the entire container is used and rinsed. Documentation of these two forms of sub-sampling is not required due to the frequency of their use.

All other selected sub-sampling techniques should be documented. If the sample integrity or composition does not match that anticipated by the laboratory, the client must be contacted to confirm or clarify any sub-sampling instructions. An example of a time when client direction is required can be demonstrated with the receipt of a coring sleeve. If upon opening the container, the analyst notices obvious heterogeneous composition of the sample, (clay in one end of the sleeve, and sand at

the other end), appropriate instructions from the client must be obtained prior to beginning analysis.

Anytime the analytical result will obviously be biased, it must be documented, and the client should be notified prior to beginning any sub-sampling technique. An example of a time when this occurs is when interferences or target contamination require the use of a reduced extraction volume for a liquid sample preventing a container rinse.

#### 12.1.6 Air Cartridge/Trap Preparation

TO-9a sampling cartridges are available pre-cleaned and assembled. Method 23 traps that have been through the glassware cleaning procedure are empty and require laboratory personnel to load XAD resin into them and secure the resin with glass wool prior to fortification.

Prior to field deployment, the laboratory adds surrogate compounds (i.e., chemically inert compounds not expected to occur in an environmental sample) to the center bed of the PUF cartridge or XAD trap, using a pipette. The surrogate compounds must be added to each cartridge or trap assembly.

The laboratory will use the recoveries of the surrogate compounds to monitor for unusual matrix effects and gross sampling processing errors.

## 12.2 Sample Extraction

### 12.2.1 Pre-extraction for both Soxhlet and Dean-Stark (SOX and SDS) Extraction

#### 12.2.1.1 Pre-extraction

- Add one scoop of boiling chips to a round-bottom.
- Fill 500 mL round-bottom flask with 350 mL extraction solvent (methylene chloride for all tissues and PCB solids; toluene for dioxin/furan solids).
- Add a soxhlet to the round-bottom flask and clamp the apparatus securely to the extraction rack.
- If pre-extracting for PCB samples, include glass wool.
- Dean-Stark adapters are cleaned as needed and are not required during pre-extraction. Sand and silica are cleaned separately for use later in the process.
- Attach the condenser.
- Pull out emergency stops to energize heater controllers.
- Set the heating mantle controller to '65' for toluene or '50' for methylene chloride, turn power switch to 'on', and allow to reflux for 3 to 4 hours.
- Turn power switch to 'off' and allow apparatus to cool.
- Hit emergency stops to turn off controllers.
- Thimbles are used only for dioxins and are used as received from the manufacturer.
- Disassemble extraction apparatus and transfer the solvent into appropriate waste container.
- Glassware is now prepared for extraction.

### 12.2.2 Soxhlet (SOX) Extraction of PCB Solid Samples

This procedure is used for PCB solids and tissues.

- Refill the round-bottom flask with 350 mL extraction solvent.

- Add one scoop fresh boiling chips.
- Reassemble the glassware apparatus, clamping securely to the extraction rack.
- Weigh a 10 g dry weight equivalent sample aliquot into a clean glass beaker. Record the sample weight. For wet samples, a shallow layer of salt may be used on the bottom of the beaker.
- Re-seal the sample container and prepare it to be returned to cold storage. If this aliquotting depleted the sample's volume then re-seal the container and scan it to warm storage.
- Add the appropriate type and amount of extraction standard to the sample (see Appendix 1). Add the appropriate type and amount of matrix spike to the LCS/LCSD. Using a small amount of acetone, incorporate the standard into the sample matrix.
- Allow the sample at least 1 hour for equilibration.
- Manually mix approximately 10-15g of salt (sodium sulfate) into the sample with a spatula. Carefully breaking up any large clumps of sample. Additional salt may be required to fully dry the sample to free flowing.
- Add the mixed sample into the appropriately labeled soxhlet. If the sample/salt mixture exceeds the capacity of the soxhlet, a second soxhlet will be used.
- Rinse the beaker with extraction solvent and transfer to the soxhlet.
- Attach the condenser.
- Pull out emergency stops.
- Set the heating mantle controller to '50' for methylene chloride to ensure 4 to 6 cycles per hour. Turn power switch to 'on', and allow to reflux for 18 to 24 hours. When the last sample has been turned on, record this as the start time for the extraction.
- At the end of the extraction period, open the stopcock on the soxhlet and allow the solvent to drain to waste. When the first sample has had its stopcock opened, record this as the stop time for the extraction.
- When the solvent level reaches 30 to 40 mL, turn off the heating mantle controller and allow the apparatus to cool.
- Hit emergency stops.
- Remove the condenser and soxhlet from the round-bottom flask, and place the sample and glass wool into the appropriate waste can.
- Quantitatively transfer the extract from the round-bottom flask to an appropriately labeled 60 mL vial.
- Normally, 100% of the extract is delivered to cleanup. If splitting or archiving of the extract is required, perform that step now.
- Concentrate the extract under nitrogen in a Turbovap. PCB extracts should be concentrated to approximately 2 to 3 mL to avoid analyte loss. **DO NOT TAKE PCB EXTRACTS TO DRYNESS.**

- Add the appropriate type and amount of cleanup standard to the extract (see Appendix 1).
- The extract is now ready for cleanup.

### 12.2.3 Soxhlet (SOX) Extraction of Dioxin Solid Samples

This procedure is used for dry dioxin samples such as filters, wipes, etc. This procedure is also used for dioxin tissues. Dioxin soils, which may contain water are extracted by soxhlet also, but with a dean-stark trap. See the next section for use of the dean-stark trap.

- Refill the round-bottom flask with 350 mL extraction solvent.
- Add one scoop fresh boiling chips.
- Add 500 uL tridecane as a keeper solvent. **Please Note: This step is not performed for SC samples.**
- Reassemble the glassware apparatus, clamp securely to the extraction rack.
- For tissue samples, place a thimble into a labeled clean container such as a glass beaker. Weigh a 10 g sample aliquot into the thimble.
- Re-seal the sample container and prepare it to be returned to cold storage. If this aliquotting depleted the sample's volume then re-seal the container and scan it to warm storage.
- For wipes or filters, place the entire sample directly into the soxhlet.
- Add the appropriate type and amount of extraction standard (spike) to the thimble (see Appendix 1). Also add matrix spike mix as appropriate. Mix in the standards (for tissues). A small amount of acetone or methanol, 1-2 mL, is used to aid in mixing in the standards.
- Allow the sample at least 1 hour for equilibration.
- Manually mix approximately 10-15g of salt into the sample with a spatula. Carefully break up any large clumps of sample.
- Place the thimble into the appropriately labeled soxhlet.
- Attach the condenser.
- Pull out emergency stops.
- Set the heating mantle controller to '65' for toluene or '50' for methylene chloride to ensure 4 to 6 cycles per hour. Turn power switch to 'on', and allow to reflux for 18 to 24 hours. (8290 requires at least 16 hours). When the last sample has been turned on, record this as the start time for the extraction.
- At the end of the extraction period, open the stopcock on the soxhlet and allow the solvent to drain to waste. When the first sample has had its stopcock opened, record this as the stop time for the extraction.
- When the solvent level reaches 30 to 40 mL, turn off the heating mantle controller and allow the apparatus to cool.
- Hit emergency stops.
- Remove the condenser from the soxhlet and place it in its holder.

- Remove the soxhlet from the round-bottom flask. Place the cellulose thimble into the appropriate waste can and place the soxhlet in the fume hood.
- Quantitatively transfer the extract from the round-bottom flask to an appropriately labeled 60 mL vial.
- Normally, 100% of the extract is delivered to cleanup. If splitting or archiving of the extract is required, perform that step now.
- Concentrate the extract under nitrogen in a Turbovap. Extracts should be concentrated to 500  $\mu$ L (tridecane) and exchanged with hexane.
- Add the appropriate type and amount of cleanup standard to the extract (see Appendix 1).
- The extract is now ready for cleanup.

#### 12.2.4 Soxhlet Dean-Stark (SDS) Extraction of Dioxin Solid Samples

This procedure is a soxhlet procedure that uses a dean-stark trap. It is employed for dioxin soils/solids that may contain water such as sediments, soils and XAD resin. See the next section for air extraction.

- Refill the round-bottom flask with 350 mL extraction solvent.
- Add one scoop fresh boiling chips.
- Add 500  $\mu$ L tridecane as a keeper solvent. **Please Note: This step is not performed for SC samples.**
- Reassemble the glassware apparatus, clamp securely to the extraction rack.
- Place pre-extracted cellulose thimbles into labeled clean containers such as glass beakers. Weigh a 10 g dry weight equivalent sample aliquot into the thimble. A beaker may be used for this purpose and the sample added to the thimble just prior to placing it in a soxhlet.
- Re-seal the sample container and prepare it to be returned to cold storage. If this aliquoting depleted the samples volume then re-seal the container and scan it to warm storage.
- Add the appropriate type and amount of extraction standard (spike) to the thimble (see Appendix 1). Also add matrix spike mix as appropriate. Mix in the standards. A small amount of acetone (or methanol), 1-2 mL, is used to aid in mixing in the standards.
- Allow the sample at least 1 hour for equilibration.
- Manually mix approximately 10-15g of sand into the sample with a clean spatula. Carefully break up any large clumps of sample. Do not disturb the silica layer during this process. Additional sand may be required to fully disperse the sample. If clumping is suspected, the beaker may be used to further inspect the sample and break up the clumps. If this step is performed in a beaker, add the mixed sample back to the thimble. If the sample/sand mixture exceeds the capacity of the thimble, a second thimble and soxhlet will be used.

- Place the thimble into the appropriately labeled soxhlet.
- Rinse the beaker with extraction solvent and transfer to the soxhlet.
- Add a Dean-Stark adaptor, charge it with solvent, and attach the condenser.
- Pull out emergency stops.
- Set the heating mantle controller to '65' for toluene to ensure 4 to 6 cycles per hour. Turn power switch to 'on', and allow to reflux 18 to 24 hours. (8290 requires at least 16 hours). When the last sample has been turned on, record this as the start time for the extraction.
- Drain the Dean-Stark adapter's water reservoir as needed.
- At the end of the extraction period, open the stopcock on the soxhlet and allow the solvent to drain to waste. When the first sample has had its stopcock opened, record this as the stop time for the extraction.
- When the solvent level reaches 30 to 40 mL, turn off the heating mantle controller and allow the apparatus to cool.
- Hit emergency stops.
- Remove the condenser from the soxhlet and place it in its holder. Using a beaker, drain the traps reservoir. Remove the trap from the soxhlet.
- Remove the soxhlet from the round-bottom flask. Place the cellulose thimble into the appropriate waste can and place the soxhlet in the fume hood.
- Quantitatively transfer the extract from the round-bottom flask to an appropriately labeled 60 mL vial.
- Normally, 100% of the extract is delivered to cleanup. If splitting or archiving of the extract is required, perform that step now.
- Concentrate the extract under nitrogen in a Turbovap. Extracts should be concentrated to 500  $\mu$ L (tridecane) and exchanged with hexane.
- Add the appropriate type and amount of cleanup standard to the extract (see Appendix 1).
- The extract is now ready for cleanup.

#### 12.2.5 Extraction of Air Samples

- Refill the round-bottom flask with 350 mL of toluene.
- Add one scoop fresh boiling chips.
- For dioxin/furan extractions, add 500  $\mu$ L tridecane as a keeper solvent. Do NOT add tridecane for PCB extractions.
- Reassemble the glassware apparatus, clamp securely to the extraction rack.
- For TO-9A place the filter then the PUF directly into thimble holder.
- For M23 transfer XAD into a cellulose thimble

- Add the appropriate type and amount of extraction standard (spike) to the thimble/PUF (see Appendix 1). Also add matrix spike mix as appropriate.
- Allow the sample at least 1 hour for equilibration. The sample may be allowed to equilibrate on the soxhlet.
- Place the thimble into the appropriately labeled soxhlet.
- Attach the condenser.
- Pull out emergency stops.
- Set the heating mantle controller to '65' for toluene to ensure 4 to 6 cycles per hour. Turn power switch to 'on', and allow to reflux for 16 hours. (TO-9a and M23 require 16 hours). When the last sample has been turned on, record this as the start time for the extraction.
- At the end of the extraction period, open the stopcock on the soxhlet and allow the solvent to drain to waste. When the first sample has had its stopcock opened, record this as the stop time for the extraction.
- When the solvent level reaches 30 to 40 mL, turn off the heating mantle controller and allow the apparatus to cool.
- Hit emergency stops.
- Remove the condenser from the soxhlet and place it in its holder. Using a beaker, drain the traps reservoir. Remove the trap from the soxhlet.
- Remove the soxhlet from the round-bottom flask, and place the cellulose thimble/PUF into the appropriate waste can. Place the soxhlet in the fume hood.
- Quantitatively transfer the extract from the round-bottom flask to an appropriately labeled 60 mL vial.
- Archive 50% of the extract.
- Concentrate the extract under nitrogen in a Turbovap. Dioxin/furan extracts should be concentrated to 250  $\mu$ L (tridecane) and exchanged with hexane. PCB extracts should be concentrated to approximately 2 to 3 mL to avoid analyte loss. **DO NOT TAKE PCB EXTRACTS TO DRYNESS.**
- The extract is now ready for cleanup.

#### 12.2.6 Microwave (MWV) Extraction of Dioxin and PCB Solid Samples

This procedure is for extracting dioxins/furans and PCBs from soils, tissues, clays, sediments, sludges, and solid wastes. Microwave energy is used to produce elevated temperature and pressure conditions in a closed vessel containing the sample and organic solvent(s) to achieve analyte recoveries equivalent to those from Soxhlet extraction (method 3540), using less solvent and taking significantly less time than the Soxhlet procedure. This method (3546) was developed and validated on commercially-available solvent extraction systems for solid matrices containing up to 5,000 ng/g of PCBs and 6000 pg/g of PCDDs/PCDFs.

- Locate 500mL test tubes.

- Weigh a 10 g dry weight equivalent sample aliquot into a glass beaker. (QC samples are 10g sand, 10 grams salt)
- Re-seal the sample container and prepare it to be returned to cold storage. If this aliquoting depleted the samples volume then re-seal the container and scan it to warm storage.
- To a spiking vial containing 100-250uL of acetone, add the appropriate type and amount of extraction standard (see Appendix 1). Also add matrix spike mix as appropriate.
- Manually mix approximately 10-15g of salt into the sample with a clean spatula. Carefully break up any large clumps of sample. Additional salt may be required to fully disperse the sample. If clumping is suspected, inspect the sample and break up the clumps. (If the sample/salt mixture exceeds the capacity of the 500 mL test tube, a beaker will be used.)
- Add the prepared spike in acetone to the sample in the tube/beaker, mix, and allow the sample at least 1 hour for equilibration. Complete the spike transfer with rinse of the vial with extraction solvent (1:1 hexane/acetone).
- Add 30mL of extraction solvent to the 500mL tube.
- Load the tube into a microwavable vessel and place in the turntable. Seal the tube with torque gun.
- Load turntable into microwave and seal the door.
- Using the microwaves software, load the sample extraction method and start the extraction. Record start time/date.
- After cooling, remove the turntable.
- Add 500 uL tridecane as a keeper solvent to collection vials. Transfer solvent from 500mL tube to 60mL vial through a salt funnel. Rinse the 500mL tube with 10-20 mL of extraction solvent.
- Normally, 100% of the extract is delivered to cleanup. If splitting or archiving of the extract is required, perform that step now.
- Concentrate the extract under nitrogen in a Turbovap. Extracts should be concentrated to 500  $\mu$ L (tridecane) and exchanged with hexane.
- Add the appropriate type and amount of cleanup standard to the extract (see Appendix 1).
- The extract is now ready for cleanup.

## 12.2.7 Aqueous Extraction

### 12.2.6.1 Continuous Liquid-Liquid Pre-extraction

- Verify water level in circulation tank.
- Turn the two-way valves to 'extract' and turn on the pump switch to 'extract'. Verify water is flowing.
- Turn on the water heater to 160 °F.
- Add 1 to 2 boiling chips to the concentrator, fill the drying adapter halfway with sodium sulfate, and assemble the glassware apparatus.

- Securely attach the apparatus to the CLLE extraction rack. Attach the water hoses to the concentrator.
- Add 200 mL methylene chloride to the extractor body. Then add 1 L deionized water, being careful not to allow any water into the sidearm.
- Attach the condenser to the apparatus.
- Verify chiller temperature and flow.
- Open the water valves to allow hot water to flow through the concentrator.
- Open the sidearm stopcock to allow methylene chloride to flow over to the drying adapter.
- Allow pre-extraction to run for at least 1 hour.
- Close stopcock and allow methylene chloride to concentrate to 15-20 mL.
- Turn off heater, close water valves, turn two-way valves to 'drain', and turn pump switch to 'drain'.
- Once the water has drained, turn the pump switch to 'off'.
- Remove the concentrator and drying adapter and pour remaining methylene chloride into the appropriate waste container, leaving the boiling chips inside.
- Rinse twice more with methylene chloride and dump to waste.
- Re-attach the drying adapter.
- Remove the extractor body and dump the deionized water and methylene chloride in the appropriate waste container.
- Re-attach the entire apparatus to the extraction rack.
- Glassware is now ready for sample extraction.

#### 12.2.6.2 High- solids (>1%) Procedure

- Remove water sample from cold storage and allow to come to room temperature.
- Prepare QC samples by adding 10g of glass beads and DI water into a 1L container.
- Shake the sample to thoroughly homogenize.
- Pour the dry weight equivalent into a secondary 1L container on balance. NOTE: If a second container of sample is to be used (normally in cases of re-extraction), be sure a %solids measurement has been taken on the additional container.
- Add 40uL of nonane as a 'keeper' solvent.
- Spike the sample with the appropriate type and amount of extraction standard (See Appendix 1).
- Allow sample to equilibrate for 1-2 hours.
- Attach a large funnel and filter assembly directly to the liquid extraction vessel.
- Slowly pour in the sample and allow it to filter.
- Rinse the sample bottle with 50mL deionized water and pour into funnel.

- Rinse the sample bottle with 50mL dichloromethane and pour into funnel.
- Allow all fluid to flow through the filter.
- Transfer the filter with the remaining solids into a cellulose thimble.
- Rinse the funnel with dichloromethane.
- Add salt as needed to the filter cake. For dioxins, dean-stark adapters may be used.
- Extract the liquid using the procedure in Section 12.2.6.3 and the solid using procedures in 12.2.2. NOTE: SAMPLE HAS ALREADY BEEN SPIKED. DO NOT RESPIKE.

#### 12.2.6.3 Low-solids (<1%) Extraction by Continuous Liquid-Liquid (CLLE)

- Fill extractor body with 250 mL methylene chloride.
- Remove water sample from the cooler and allow to come to room temperature.
- If the pH is above 7, add 2 mL 50:50 sulfuric acid to the extractor body. If initial pH was >10, re-check pH; if still > 7, continue adding acid to achieve a pH  $\leq 7$ .
- If the sample is decanted, such as to extract a smaller volume than nominal, then re-seal the original sample container and prepare it to be scanned to cold storage. Mark the sample as decanted in LIMS.
- Place sample on balance and record the initial weight.
- Spike the sample with the appropriate type and amount of extraction standard (see Appendix 1). Add 10mL of methylene chloride to the standard vial.
- Shake to thoroughly homogenize the sample and allow 1 hour for equilibration.
- Pour into the appropriately labeled extractor body, being sure the sample does not get into the sidearm.
- Reweigh the sample bottle on the tared scale and record the resulting sample volume on the bench sheet.
- Add approximately 50mL of methylene chloride to the sample bottle, cap and shake to rinse the bottle. Open the bottle carefully to vent any potential solvent pressure. Pour the methylene chloride from the bottle rinse and standard vial rinse into the extractor body.
- Attach the condenser.
- Turn the two-way valves to 'extract' and turn on the pump switch to 'extract'.
- Turn on the water heater.
- Open the water valves.
- Open the stopcock. When the last sample has been opened, record this as the start time for the extraction.
- Allow the sample to extract for 18 to 24 hours at 1 to 2 drops/second.

- Close the stopcock and allow the extract to concentrate down to the nipple of the concentrator. When the first sample has been closed, record this as the stop time for the extraction. If samples are for PCB analysis, only concentrate to 5 to 10 mL to avoid analyte loss.
- Turn heater off, close water valves, switch two-way valves to 'drain' and turn pump to 'drain'.
- When water has drained, turn pump to 'off'.
- Remove concentrator and drying adapter.
- Pour contents of extractor body into the appropriate waste container.
- Remove drying adapter from concentrator and dump sodium sulfate into appropriate waste container.
- Quantitatively transfer the extract to an appropriately labeled 60 mL vial.
- Add the appropriate type and amount of cleanup standard to the vial. For dioxin/furan extracts, add 100  $\mu$ L tridecane to the vial.
- Concentrate the extracts down to the 100  $\mu$ L tridecane in the Turbovap at 45 °C. For PCB extracts, only concentrate down to 2 to 3 mL.
- Remove the vial and cap.
- Extract is now ready for cleanup.

#### 12.2.8 Waste Dilution Procedures

Typically performed on oily wastes, but is useful for samples with high levels of interferences, target parameters, incidental odor, etc.

- Prepare labeled 60mL vials.
- Weigh 1 gram of a solid matrix into the vial. Surrogate matrix is used to prepare QC vials.
- Add 50mL of the appropriate dilution solvent, typically hexane.
- If the sample matrix dissolves in the solvent then one may proceed to aliquot. If the sample matrix does not dissolve, one can try heat and sonication to speed up the process. Please note any discrepancies.
- Prepare a second set of labeled vials.
- Aliquot 1mL of each diluted sample into the second set of vials. Archive the dilution vials.
- Spike the 1mL sample vials with the appropriate type and amount of extraction standard.
- Extract is now ready for cleanup.

#### 12.3 Cleanup Procedures

The preparation guide in the appendix may be used to assist in assembling cleanup columns.

##### 12.3.1 Mini Acid/Base Silica Column (for dioxin/furan samples)

- A smaller version of this column as follows is used for samples with less potential contaminating interferences such as drinking waters. Insert a glass wool plug into a 25 mL drying column and

pack the column from bottom to top as follows: 4g acidic silica gel, 1 g neutral silica gel, 2 g sodium sulfate.

- Rinse the column with 20 mL dichloromethane and catch in a rinsate container.
- Rinse the column with 20 mL hexane and catch in a rinsate container.
- Position a 60 mL vial under the column.
- Quantitatively transfer the 1mL extract onto the column and follow with a 5mL rinse with hexane.
- Elute the sample with 25 mL hexane.
- Remove the 60 mL vial and cap.
- Concentrate the vial in the Turbovap at 45 °C.
- If the extract requires additional cleanup, concentrate to approximately 1 to 2 mL and proceed to another cleanup step.
- If the extract is ready for analysis, concentrate to 0.5 mL.
- Quantitatively transfer the extract to a labeled GC vial and deliver to the GC/MS analyst.

#### 12.3.2 Acid/Base Silica Column (for PCB samples)

- Insert a glass wool plug into a 25 mL drying column and pack the column from bottom to top as follows: 1 g neutral silica gel, 4 g basic silica gel, 1 g neutral silica gel, 8 g acidic silica gel, 2 g neutral silica gel, 4 g sodium sulfate.
- Rinse the column with 100mL of DCM and a 50mL aliquot of hexane and catch in a waste container.
- Position a 60 mL vial under the column.
- Quantitatively transfer the extract onto the column.
- Begin elution the sample with 50mL hexane into a collection vial. Place a second vial in position and elute with another 50mL aliquot of hexane. One may begin to concentrate the first vial as soon as it is full. Continue concentrating the first vial to approximately 5mL so that it can be added to the second.
- If the extract requires additional cleanup, concentrate to approximately 1 to 2 mL in the Turbovap at 45 °C and proceed to another cleanup step.
- If the extract is ready for analysis, concentrate to 0.5 mL. DO NOT let PCB extracts go to dryness.
- Quantitatively transfer the extract to a labeled GC vial containing 18 µL nonane and deliver to the GC/MS analyst.

#### 12.3.3 Anthropogenic Isolation Column (for all tissue samples)

- Insert a glass wool plug into a 25 mL drying column and pack the column as follows: 2 g neutral silica gel, 2 g potassium silicate, 2 g sodium sulfate, 10 g acid silica gel, 2 g sodium sulfate.
- Elute the column with 100 mL hexane and collect to a waste container.
- Quantitatively transfer the extract to the column.

- Elute with 200 mL hexane and collect into an appropriate sample container.
- If the sample requires further cleanup, concentrate the extract to approximately 1 to 2 mL hexane in the Turbovap at 45 °C and proceed with another cleanup.
- If no further cleanup is required, concentrate to 0.5 mL for dioxin/furan samples. For PCB samples, concentrate only to approximately 0.5 mL. DO NOT take PCB samples to dryness.
- Quantitatively transfer the extract to a labeled GC vial and deliver to the GC/MS analyst.

#### 12.3.4 Acid/Base Back-Extraction (for PCB samples)

- Partition the extract against 50 mL potassium hydroxide solution.
- Shake for 2 minutes, venting periodically.
- Remove and discard the aqueous layer.
- Repeat until no color is visible in the aqueous layer, to a maximum of four washings.
- Partition the extract against 50 mL sodium chloride solution.
- Discard the aqueous layer.
- Partition the extract against 50 mL sulfuric acid.
- Discard the aqueous layer.
- Repeat until no color is visible in the aqueous layer, to a maximum of four washings.
- Partition the extract against 50 mL sodium chloride solution.
- Discard the aqueous layer.
- Transfer the extract to a drying column containing 7-10 grams sodium sulfate.
- Concentrate the extract to 1 to 2 mL hexane in the Turbovap at 45°C and proceed with additional cleanup steps.

#### 12.3.5 Acid/Base/Florisil Column Extraction (for Dioxin samples)

- Prepare a silica gel column as follows: Insert a glass wool plug into a 25 mL drying column and pack the column from bottom to top as follows: 1 g neutral silica gel, 4 g basic silica gel, 1 g neutral silica gel, 8 g acidic silica gel, 2 g neutral silica gel, 4 g sodium sulfate.
- Rinse the silica gel column with 30mL of DCM and then 30 mL hexane and catch in a waste container.
- Prepare the florisil column as follows: Insert a glass wool plug into a 10 mL disposable pipet, pack with 1.5 g florisil, and top with 1 g sodium sulfate.
- Rinse the column with 10 mL methylene chloride, 10 mL hexane, and discard to waste.
- Position the columns so that the florisil column receives the silica gel effluent.
- Quantitatively transfer the 3mL extract onto the column followed by two 2mL rinses.

- Elute the sample with 50 mL hexane to waste.
- Elute the sample with 50 mL hexane a second time to waste.
- Remove the silica gel column.
- Elute the florisil column with 20 mL 2% methylene chloride/hexane and discard to waste.
- Position a 60 mL vial under the column.
- Elute with an additional 55 mL DCM.
- Concentrate to approximately 0.5 ml in the Turbovap at 45°C.
- Quantitatively transfer the extract to a labeled GC vial and deliver to the GC/MS analyst.

### **13.0 QUALITY CONTROL SAMPLES AND REQUIREMENTS**

#### **13.1 Method Blank (MB)**

A method blank is extracted with each extraction batch of 20 samples or less. The method blank should be a reagent-free matrix similar to that of the batch, such as deionized water, glass beads, PUF (a polyurethane foam, supplied 1-3 inch cylinders approximately 3 inches long), XAD (a hydrophobic crosslinked polystyrene copolymer resin, supplied as 20-60 mesh size white insoluble beads), or purified corn oil. The method blank is spiked in the same manner as the samples. The method blank is subjected to the same extraction and cleanup procedures as the samples, and is used as a measure of laboratory contamination. Method blank acceptance criteria may be found in the appropriate analytical SOP.

#### **13.2 Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)**

A laboratory control sample is extracted with each extraction batch of 20 samples or less. The LCS should be a reagent-free matrix (as listed above), and is subjected to the same extraction and cleanup procedures. The LCS is spiked with native analytes in addition to the extraction standards added to all samples. The LCS is subjected to the same extraction and cleanup procedures as the samples, and is used as a measure of system performance. A LCSD may also be performed as required by the analytical method. LCS/LCSD acceptance criteria may be found in the appropriate analytical SOP.

#### **13.3 Matrix Spike/Matrix Spike Duplicate (MS/MSD)**

A MS/MSD pair may be performed as required by the analytical method, or as requested by a specific client. A matrix spike is a second aliquot of sample which is spiked with native analytes prior to extraction, and is used as another measure of system performance. MS/MSD acceptance criteria (if available) may be found in the appropriate analytical SOP.

### **14.0 INSTRUMENT CALIBRATION, STANDARDIZATION AND PERFORMANCE**

Samples are analyzed using a Waters Autospec Premier high-resolution GC/MS system. Instrument calibration, standardization and performance information may be found in the appropriate analytical SOP.

### **15.0 PROCEDURE FOR ANALYSIS AND INSTRUMENT OPERATION**

Procedures for analysis and instrument operation may be found in the appropriate analytical SOP.

### **16.0 EQUIPMENT AND INSTRUMENT MAINTENANCE**

16.1 Chiller water levels should be checked monthly.

16.2 Chromalox heater water level should be checked each day of use.

**16.3 Balance**

Procedures for balance calibration and maintenance may be found in SOP CF-LB-E-002 for Balances.

**16.4 Fume Hood**

Fume hood monitoring and maintenance may be found in SOP CF-FC-E-003.

16.5 Dry weight oven temperature should be verified each day of use.

**17.0 DATA RECORDING, CALCULATION AND REDUCTION METHODS**

17.1 Data such as sample weights/volumes, dry weights, pH, spike amounts and lot numbers are input to the LIMS.

17.2 Calculations such as percent moisture and percent lipids are calculated in the LIMS.

**18.0 POLLUTION/CONTAMINATION**

18.1 Work areas should be maintained free of dust and dirt accumulations.

18.2 Whenever possible, work should be performed in a fume hood to reduce the spread of solvent fumes and airborne contaminants.

18.3 Glassware should be washed and prepared in a designated area.

**19.0 DATA REVIEW, APPROVAL AND TRANSMITTAL**

Bench data are input manually to AlphaLIMS. The data recorded in AlphaLIMS are checked by the analyst for accuracy and completeness.

**20.0 CORRECTIVE ACTION FOR OUT-OF-CONTROL OR UNACCEPTABLE DATA**

Corrective action for out-of-control data may require instrument maintenance, re-extraction, the use of a new spike mix, or a more complex set of actions. When troubleshooting measures (Section 21) fail to bring an analytical process or data into control, a nonconformance report (NCR) and/or corrective action should be initiated in accordance with CF-QS-E-004 for the Documentation of Nonconformance Reporting and Dispositioning and Control of Nonconforming Items, and CF-QS-E-002 for Conducting Corrective Action.

**21.0 CONTINGENCIES FOR HANDLING THESE SITUATIONS**

Troubleshooting is used to determine the appropriate action to take when a sample or QC fails to meet defined acceptance criteria. Troubleshooting may involve one or more of the following actions:

21.1 When a method blank fails the defined criteria, the analyst must find and eliminate the source of contamination before proceeding with the analysis. This may involve the further testing of reagents, solvents, equipment or glassware. If the contamination is believed to be from a highly contaminated sample in the batch, the sample may be removed from the batch and the remaining batch re-processed.

21.2 If an extraction standard recovery fails the specified criteria, the sample must be evaluated as to why the failure may have occurred. If matrix interferences are apparent, the extract may need further cleanup steps, or the sample may need to be re-extracted at a reduced weight/volume.

21.3 If any native analyte recoveries in the LCS are outside specified limits, the process should be examined. Corrective action may include repeating the extraction or analysis, utilizing a new spike mix, or more complex actions.

21.4 If normal equipment and software operating procedures do not resolve troubleshooting efforts, the manuals for software, hardware and other equipment discussed in this SOP are available for consultation and resolution. On-line support may be

available from software and instrument manufacturers, as well. Any revisions, repairs or corrective actions required must be documented in accordance with the laboratory's Quality System as described in CF-QS-B-001.

## 22.0 RECORDS MANAGEMENT

- 22.1 Bench data logbooks are stored in the lab in storage boxes as long as there is space available. When space runs out, the boxes are sent to off-site storage.
- 22.2 Records generated as a result of this procedure are maintained as quality documents in accordance with CF-QS-E-008 for Quality Records Management and Disposition.

## 23.0 LABORATORY WASTE HANDLING AND DISPOSAL

Laboratory waste is disposed in accordance with the Laboratory Waste Management Plan, CF-LB-G-001.

## 24.0 REFERENCES

- 24.1 Method 8290, Test Methods for Evaluating Solid Waste: Laboratory Manual Physical/ Chemical Methods, Volume 1B, SW-846, 3<sup>rd</sup> Edition, Feb. 2007. Method 8290A, "Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by High Resolution Gas Chromatography/ High Resolution Mass Spectrometry (HRGC/HRMS)," Rev. 1, Feb. 2007. USEPA, Office of Solid Waste and Emergency Response, Washington, DC 20460.
- 24.2 Method 1613, "Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution HRGC/HRMS," Rev. B, Oct. 1994. USEPA<sup>A</sup>, Office of Water, Engineering and Analysis Division, 401 M Street SW, Washington, DC 20460.
- 24.3 Method TO-9a, Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air Second Edition Compendium Method TO-9A Determination Of Polychlorinated, Polybrominated And Brominated/Chlorinated Dibenzo-p-Dioxins And Dibenzofurans In Ambient Air January 1999
- 24.4 Method 23, Method 23 - Determination of Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans from Municipal Waste Combustors
- 24.5 Method 1668A, Chlorinated Biphenyl Congeners in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS August 2003
- 24.6 Method 1668C, Chlorinated Biphenyl Congeners in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS April 2010

## 25.0 HISTORY

- Revision 11. Cleanup solvent volume corrections, pH strip dip allowed in CLLE.
- Revision 12. Radiation safety additions in section 8.
- Revision 13. Addition of Method 8280B. Clarifications to extractions procedures.
- Revision 14. Removed duplicate step in PCB SOX procedure.
- Revision 15. Removed water rinse from CLLE sample prep; Removed 8280B references; refinements to PCB SOX.
- Revision 16. Consolidated cleanup steps; updated spike profile for 1613 CS and 8280.
- Revision 17. Added cleanup column prep guide; changed prep of sand to include baking.
- Revision 18. Added clarification as to what steps mark the extraction start and stop times to be recorded.
- Revision 19. Added details to CLLE section. Added 3546 extraction procedure.
- Revision 20. Added florisol preparation procedure.
- Revision 21. Added details to tridecane preparation.

Revision 22. Update 3546 extraction procedure. Added sodium sulfate preparation procedure.

Revision 23. Added extraction rates.

Revision 24. Updated method variations to include microwave extraction. Updated 3546 extraction procedure. Added reference for percent lipid determination.

Revision 25. Update 8290 holding times.

## Appendix 1: Spike Profiles

<b>1613/8290</b>	Volume ( $\mu\text{L}$ )	[Conc] (ng/ $\mu\text{L}$ )	Amt. (ng)	Final Vol. ( $\mu\text{L}$ )	[Inst] (pg/ $\mu\text{L}$ )	[Sx] (pg/g)
8290ES	40	0.05	2		100	200
1613MX*	40	0.005	0.2		10	20
1613CS	20	0.01	0.2		10	20
8290JS	20	0.1	2	20	100	200
<b>TO-9a</b>	Volume ( $\mu\text{L}$ )	[Conc] (ng/ $\mu\text{L}$ )	Amt. (ng)	Final Vol. ( $\mu\text{L}$ )	[Inst]** (pg/ $\mu\text{L}$ )	[Sx] (ng)
M23SS	80	0.05	4		200	8
8290ES	80	0.05	4		200	8
1613MX*	80	0.005	0.4		20	0.8
8290JS	20	0.1	2	20	100	200
<b>M23</b>	Volume ( $\mu\text{L}$ )	[Conc] (ng/ $\mu\text{L}$ )	Amt. (ng)	Final Vol. ( $\mu\text{L}$ )	[Inst]** (pg/ $\mu\text{L}$ )	[Sx] (ng)
M23SS	80	0.05	4		200	8
8290ES	80	0.05	4		200	8
1613MX*	80	0.005	0.4		20	0.8
8290JS	20	0.1	2	20	100	200
<b>1668</b>	Volume ( $\mu\text{L}$ )	[Conc] (ng/ $\mu\text{L}$ )	Amt. (ng)	Final Vol. ( $\mu\text{L}$ )	[Inst] (pg/ $\mu\text{L}$ )	[Sx] (pg/g)
1668ES	40	0.05	2		100	200
1668MX	40	0.0125	0.5		25	50
1668CS	40	0.05	2		100	200
1668JS	2	1	2	20	100	200

## Sample Fortification:

- Line up vials to match the rack. Label the vials: With the sample id, or if using a labeled rack, just label, or otherwise indicate, the LCS/LCSD/MS/MSD, or with the rack position number and indicate the LCS/LCSD/MS/MSD.
- Add approximately 100-250  $\mu\text{L}$  of acetone to each vial.
- Print the witness sheet and get a witness.
- Witness: Check the labeling (vial labels, rack labels, glassware labels). Check the standards and pipet settings. Witness the spike of the vials with the required standards. Add the appropriate type and amount of extraction standard to the acetone (see Table 2). Add the appropriate type and amount of matrix spike to the MS/MSD/LCS/LCSD. Note: Witnessing is complete, please initial the witness page.
- Pour each vial into its corresponding rack location (i.e. beaker, extraction vessel, sample container). Add approximately 1 mL of acetone to each vial as a rinse and pour that into the corresponding rack location also. (For solids, do not disturb the silica layer during this process.)

\* Standard is interchangeable between methods 8290, 1613, TO-9a, and M23.

\*\* 50% archive prior to analysis.

Complete compound lists for each standard may be found in the standards logbook.

## Appendix 2: Cleanup Column Preparation Guide

**Standard Mixed Bed Silica Gel:**

		Glass Wool in bottom of pipette
1	1/4 tsp	Neutral silica gel
1	1/2 tsp	Basic silica gel (NaOH; KOH for tissue)
1	1/4 tsp	Neutral silica gel
3	tsp	Acidic silica gel (H <sub>2</sub> SO <sub>4</sub> )
1	1/2 tsp	Neutral silica gel
1	1/4 tsp	Sodium sulfate

**Standard Florisil:**

		Glass Wool in bottom of pipette
2	1/4 tsp	Florisil
1	1/4 tsp	Sodium sulfate

**STANDARD OPERATING PROCEDURE**

**FOR**

**THE ANALYSIS OF POLYCHLORINATED DIBENZO-p-DIOXINS**

**AND POLYCHLORINATED DIBENZOFURANS (PCDDs/PCDFs)**

**BY**

**HIGH-RESOLUTION GAS CHROMATOGRAPHY/HIGH-RESOLUTION MASS SPECTROMETRY (HRGC/HRMS)**

**CF-OA-E-002**

APPLICABLE TO METHODS:

EPA SW-846 Method 8290A, EPA Method 1613B, EPA SW-846 Method 0023A, EPA Method TO-9a

**PROPRIETARY INFORMATION**

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Date: 26-Mar-2021



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## **1.0 STANDARD OPERATING PROCEDURE FOR THE ANALYSIS OF POLYCHLORINATED DIBENZO-P-DIOXINS AND POLYCHLORINATED DIBENZOFURANS (PCDD/PCDF) BY HIGH-RESOLUTION GAS CHROMATOGRAPHY/HIGH-RESOLUTION MASS SPECTROMETRY (HRGC/HRMS)**

### **2.0 METHOD OBJECTIVE, PURPOSE, CODE, AND SUMMARY**

This standard operating procedure (SOP) covers the analytical determination of PCDD/PCDFs according to the following methods:

- 2.1 SW-846 Method 8290A
- 2.2 EPA Method 1613B
- 2.3 SW-846 Method 0023A
- 2.4 EPA Method TO-9a (Jan 99)

### **3.0 APPLICABLE MATRICES**

Applicable matrices for methods 8290A and 1613B include groundwater, wastewater, surface water, leachate, soil, sediment, sludge, oil, and tissue. The applicable matrix for method 0023A is an air sampling train, which may contain XAD resin (a hydrophobic crosslinked polystyrene copolymer resin, supplied as 20-60 mesh size white insoluble beads), filters, impinger water and solvent rinses. TO-9a is an ambient air sampling train which may contain polyurethane foam (PUF, a polyurethane foam, supplied as 1-3 inch cylinders approximately 3 inches long), XAD resin, filters, and solvent rinses.

### **4.0 METHOD SCOPE, APPLICABILITY, AND DETECTION LIMIT**

- 4.1 Methods 8290A, 1613B and 0023A may be used to quantify PCDD/PCDFs that are soluble in methylene chloride and/or toluene. The compounds are separated using a gas chromatograph (GC) and detected using a high-resolution double focusing mass spectrometer (HRMS). Appendix 1 lists the analytes currently analyzed using these methods and their practical quantitation limits.
- 4.2 The practical quantitation limit (PQL) is the lowest level in the calibration curve. The PQL is the lowest level at which compounds may be accurately quantitated and is compound dependent. The calibration curve typically ranges from 1.0 ng/mL to 1000 ng/mL for methods 8290A, 0023A, and TO-9a, and from 0.5 ng/mL to 2000 ng/mL for method 1613B. These ranges reflect instrument readings, which are in ng/mL (ppb). It should be noted that the calibration range may vary between calibrations and instruments.
- 4.3 Method detection limit studies (MDLs) are performed and/or verified on an annual basis. MDLs are done for aqueous, solid, tissue and XAD matrices. For more information regarding MDLs, refer to The Determination of Method Detection Limits, CF-LB-E-001.
- 4.4 Qualified analysts must demonstrate proficiency initially and annually thereafter with an IDOC, CDOC, or PT study. Acceptability criteria may be found in the applicable analytical method.
  - 4.4.1 To establish the ability to generate acceptable accuracy and precision, the analyst should perform an "analyst validation study" or Initial Demonstration of Capability. Four LCS standards are extracted and analyzed. Calculate the average recovery and the standard deviation of the recovery for each analyte of interest using the four results. Then compare the average and the standard deviation with the corresponding criteria found in Table 6 of method 1613B,

or with the determined limits for methods 8290A and 0023A. If the average and the standard deviation for all analytes of interest meet the acceptance criteria, then the analyst may begin work on actual samples. If the validation study fails for one or more of the compounds, then the study must be repeated for those compounds which failed.

## 5.0 METHOD VARIATIONS

- 5.1 Cape Fear Analytical analyzes a calibration point at 0.25 ng/mL, which is below the method required low point.
- 5.2 Standards and sample extracts are stored at room temperature to avoid analyte loss. Many of the target analytes in these methods form a strong cohesive bond with solids such as glass in cold temperatures; this type of analyte loss is not addressed in the method. (This is a variance from the following method recommendations:  $\leq 6^\circ$  per method 8290A;  $< -10^\circ\text{C}$  per 1613B;  $-10^\circ$  to  $-20^\circ\text{C}$  per DoD QSM.)
- 5.3 Cape Fear Analytical utilizes the DB-5ms GC column (and may use the ultra inert version), which is capable of better resolution of the TCDF isomers. This column exhibits a different elution pattern than the DB-5 column referenced in the analytical methods. Relative retention time limits have been determined for this column for use with method 1613B, and are listed in Table 9.
- 5.4 Method 1613B does not address the reporting of EDL and EMPC. These values are reported for this method only when requested by the client.
- 5.5 See document CF-UD-F-133 for a list of personnel performing this SOP with the preceding method 1613B modifications.

## 6.0 DEFINITIONS

- 6.1 Accuracy: The degree of agreement between an observed value and an accepted reference value.
- 6.2 AlphaLIMS: The Laboratory Information Management System used at CFA, LLC.
- 6.3 Blank: An aliquot of reagent water or other blank matrix that is treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents, and standard additions that are used with other samples. The LMB (Lab Method Blank) is used to determine if method analytes or other interferences are present in the laboratory environment, the reagents, or the apparatus. Contamination may be derived during sampling, transportation, storage or analysis. The blank may be used to establish a background value.
- 6.4 Calibration Standard (CAL): An aliquot of a primary standard solution or stock standard solution. The CAL solutions are used to calibrate the instrument response with respect to analyte concentration.
- 6.5 Calibration Verification Standard (CVS, CCAL, CS3WT): A solution of target analytes with a concentration near the mid-point of the calibration range. It should be obtained from a second source vendor and is used to verify the initial calibration on a basis described in the determinative method. This solution may also contain the window defining analytes and the column performance mix.
- 6.6 Cleanup Standards: Isotopes added prior to cleanup that are used to measure the efficiency of the fractionation step alone. Method 1613B uses one compound (37Cl4-2378-TCDD) as the Cleanup Standard. Method 8290A does not address the use of cleanup standards.

- 6.7 Duplicate Analysis: The analysis or measurement of the variable of interest performed identically on two field subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision of sample, preservation, or storage internal to the laboratory.
- 6.8 Estimated Detection Limit (EDL): A calculation of the concentration of a given analyte required to produce a signal with a peak height of at least 2.5 times the background signal level. The EDL is calculated for each 2378-substituted congener that is not identified.
- 6.9 Estimated Maximum Possible Concentration (EMPC): A calculation for a peak characterized by a response with a signal-to-noise ratio of at least 2.5 for both the quantitation ions, and meeting all identification criteria except ion ratio. EMPC is a worst-case estimate of the concentration.
- 6.10 Extraction Standards: Isotopes added prior to extraction that serve as internal standards for many 2,3,7,8 substituted congeners. In addition, to measure the overall extraction and fractionation efficiencies. Method 8290A names them Internal Standards while Method 1613B uses the Labeled Compounds terminology.
- 6.11 Injection Standards: Isotopes added prior to injection to determine the recoveries of the Extraction and Cleanup Standards. Method 8290A names them Recovery Standards while Method 1613B calls them Internal Standards.
- 6.12 Internal Standard (ISTD): A known amount of standard added to a test portion of a sample as a reference for evaluating the retention time and concentration of dependent analytes and controlling the precision and bias of the applied analytical method.
- 6.13 Laboratory Control Standard (LCS): An aliquot of reagent water or other blank matrix to which known quantities of the method analytes are added in the laboratory. The LCS is analyzed exactly like a sample, and its purpose is to determine whether the methodology is in control, and whether the laboratory is capable of making accurate and precise measurements.
- 6.14 Laboratory Duplicate (DUP): Aliquots of a sample taken from the same container and processed in the same manner under identical laboratory conditions. The aliquot is analyzed independently from the parent sample and the results are compared to measure precision and accuracy.
- 6.15 Matrix Spike and Matrix Spike Duplicate (MS and MSD): Two separate aliquots of an environmental sample to which known quantities of the method analytes are added in the laboratory. The MS and MSD are analyzed exactly like a sample, and their purpose is to determine whether the sample matrix contributes bias to the analytical results. The concentrations of the analytes in the sample matrix must be determined in a separate aliquot and the measured values in the MS/MSD adjusted. Percent recovery is calculated for both aliquots, and RPD is calculated between the two.
- 6.16 Method Detection Limit (MDL): The minimum concentration of an analyte that can be identified, measured and reported with 99% confidence that the analyte concentration is greater than zero.
- 6.17 Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves, a data quality

indicator. Precision is usually expressed as standard deviation, variance or range in either absolute or relative terms.

- 6.18 Quantitation Limits (also PQL, RL): The value at which an instrument can accurately measure an analyte at a specific concentration (i.e., a specific numeric concentration can be quantified). These points are established by the upper and lower limits of the linear calibration range.
- 6.19 Sampling Standards: Isotopes added prior to field sampling for Method 0023A and Method TO-9a that are used to measure the efficiency of the sampling step alone.

## 7.0 INTERFERENCES/LIMITATIONS

- 7.1 Contaminants found in extraction glassware, solvents, and other sample processing hardware may jeopardize the integrity of this method.
- 7.2 Glassware must be scrupulously cleaned as soon as possible after extraction.
- 7.3 Contamination may also occur in the GC/MS system. High boiling materials tend to build up in the injection port and the front end of the column. The analyst should maintain a thorough working knowledge of keeping the injection port free of contamination, including changing out the septum, injection port liner, O-ring, ferrule, and gold seal.
- 7.4 Contamination by carryover can occur whenever high-level and low-level samples are sequentially analyzed. To reduce carryover, the sample syringe must be rinsed with solvent between samples. If carryover is suspected, potentially impacted samples must be re-analyzed after any needed maintenance, solvent replacement, and/or cleaning has been done.
- 7.5 Upon review of a completed sequence, if one is required to perform a 200x or greater dilution because of a sample's target concentrations, that the rinse vials on the instrument that determined this dilution need must have its solvent replaced. This action should be documented in the maintenance log.

## 8.0 SAFETY PRECAUTIONS AND WARNINGS

METHYLENE CHLORIDE IS A SUSPECTED CARCINOGEN AND A KNOWN SKIN IRRITANT. NO OCCUPATIONAL EXPOSURE LIMIT FOR DIOXIN HAS BEEN ESTABLISHED. IT IS A KNOWN AND PROBABLE HUMAN CARCINOGEN.

CONTACT WITH OXIDIZERS MAY GENERATE EXPLOSIVE MIXTURES.

PREVENT SKIN AND EYE CONTACT BY USING SPECIFIED PERSONAL PROTECTIVE EQUIPMENT WHEN MAKING STOCK REAGENTS.

WORK UNDER A HOOD TO PREVENT INHALATION WHEN USING METHYLENE CHLORIDE.

- 8.1 Eye protection should be worn when handling samples, reagents, or standards.  
NOTE: Contact lenses pose a special problem; soft lenses may absorb irritants and all lenses concentrate them. DO NOT wear contact lenses in the laboratory.
- 8.2 Treat all chemicals and samples as potential health hazards and reduce exposure to these chemicals to the lowest level possible. CFA maintains a current reference file of Material Safety Data Sheets (MSDS). These documents and individual sample MSDS provided by clients are maintained in the laboratory.
- 8.3 Personal Protective Equipment (PPE)
- 8.3.1 Gloves and eye protection should be worn when handling reagents, solvents, standards and samples.

- 8.3.2 Analysts should prepare samples and standards under the hood.
- 8.4 All samples, chemicals, extracts, and extraction residues must be transferred, delivered, and disposed of safely according to all related SOPs.
- 8.5 Never leave gas cylinders unchained or untied.
- 8.6 In the event of an accident or medical emergency, call for help immediately. When time and safety permit, management should be notified of all accidents.
- 8.7 Fire escape routes are posted in the lab, and all personnel should be familiar with them. In addition, fire safety equipment such as fire extinguishers and fire blankets are located in the lab. Training is available on the proper operation of this equipment.
- 8.8 The analyst must use care when assembling and operating instrumentation. Check to see that the gas chromatograph equipment is properly assembled and hooked up to the proper gas cylinder and power, referencing the appropriate manual. Analytical equipment must only be operated by qualified personnel.
- 8.9 For further safety instructions, consult the Safety Manual, CF-LB-N-001.
- 9.0 APPARATUS, EQUIPMENT AND INSTRUMENTATION**
- 9.1 Equipment associated with this method includes:
- 9.1.1 Gas tight syringes
  - 9.1.2 2 mL high recovery (conical) autosampler vials and storage racks
  - 9.1.3 Teflon crimp tops
  - 9.1.4 Crimper/De-crimper
  - 9.1.5 GC Columns
    - 9.1.5.1 Agilent DB5-MS or equivalent (i.e. ui); 60 m, 0.25 mm, 0.25 um
    - 9.1.5.2 Agilent DB-225 or equivalent; 30 m, 0.25 mm, 0.25 um
  - 9.1.6 Quartz/Glass injection port liners
  - 9.1.7 Injection port liner O-ring seals
  - 9.1.8 Gold seals
  - 9.1.9 Ferrules
  - 9.1.10 Column cleaving tool
  - 9.1.11 Septa (thermogreen)
  - 9.1.12 10-100 uL adjustable air displacement pipette with disposable tips
- 9.2 Instrumentation
- 9.2.1 Waters Autospec Premier high resolution mass spectrometer
    - 9.2.1.1 The MassLynx workstation software is used for instrument control and data acquisition of the AutoSpec-NT SIOS hardware embedded PC based system running the industry standard VxWorks real-time. The workstation operating system used is Windows XP SP2 or SP3 to support Masslynx v4.1.
    - 9.2.1.2 The TargetLynx Application Manager is used for post-acquisition processing and general data manipulation. The workstation operating system used is Windows XP SP2 or SP3 to support Targetlynx v4.1. Post-acquisition processing and

general data manipulation can be carried out by an additional computer workstation and software installation.

## 9.2.2 Agilent 7890 Gas Chromatograph

### 9.2.2.1 A suggested temperature program for primary analysis follows:

Initial Temp.	140° C
Hold Time	1.0 min.
Rate 1	20° C/min.
Temperature 2	180° C
Time 2	2°/min
Temperature 3	235° C
Rate 3	30° C/min.
Final Temp.	290° C
Hold Time	13 min.
Run Time:	45 minutes (may vary due to column length or flow rate)
Solvent Delay:	18.0 min.
Splitless Valve Time:	1.5 min.
Flow:	1.8 mL/min.
Mass Range:	See descriptor definitions (Table 2)

**NOTE:** These instrument conditions and rates are guidelines which may change.

## 9.2.3 LEAP Technologies GC PAL Autosampler

### 9.2.3.1 Suggested parameters:

Sample volume – 1 µL
Air volume – 0.5 µL
Solvent push volume – 1 µL
Number of sample washes - 0
Solvent washes - 30
Sample viscosity wait – 1 second
Number of sample pumps - 0
Injection mode - Fast

## 10.0 REAGENTS AND STANDARDS

### 10.1 Reagents and standards

#### 10.1.1 Nonane

10.1.2 Source Standards: Source Standards are purchased directly from vendors and may be diluted to make stock, intermediate, or working standards. These may include extraction standard, matrix spiking standard, cleanup standard, injection standard, as well as others. Source standards expire per the vendor expiration date or after five years from the date opened, whichever is shorter. Please reference CF-LB-E-007 and CF-OA-E-002 for further information regarding standards and their preparation.

- 10.1.3 Initial Calibration (ICAL) Standards: Certified calibration standards are purchased from commercial vendors at a minimum of five concentration levels. One of the calibration standards is at a concentration near, but above, the method detection limit; the others should correspond to the expected range of compounds found in samples. Calibration standards expire after a maximum of five years and should be monitored frequently for signs of degradation.
- 10.1.4 Calibration Verification Standards (CVS, CCAL, CS3WT): A certified CVS is purchased from a second source commercial vendor at a concentration that is near to the midpoint of the calibration curve.
- 10.1.5 Window Defining Mix and Column Performance Mix (WDM and CPM): A standard containing the first and last eluters for each homolog group, as well as the dioxin and furan isomers used to demonstrate isomer specificity on the GC column in use. These may be contained in the same standard as the calibration verification (known as CS3WT).

## 11.0 SAMPLE HANDLING AND PRESERVATION

- 11.1 Sample extracts have no maximum recommended holding time from the date of extraction by method 8290A, and a 365 day holding time from the date of extraction by 1613B. Sample extracts have a 45-day holding time from the date of extraction by 0023A. TO-9a cartridges are considered clean for 30 days from preparation; samples must be extracted 7 days from collection and analyzed 40 days from extraction. See Table 13.
- 11.2 Sample extracts are delivered from the prep lab to the instrument lab and are stored in a darkened hood at room temperature. The extracts are usually grouped according to preparation batches and are accompanied by the batch pull sheet and other pertinent paperwork.
- 11.3 Custody of samples is monitored using the AlphaLIMS sample tracking system. Each analyst should scan the samples planned to run into their custody prior to analysis.
- 11.4 All sample extracts should be treated with caution as potential health hazards. Refer to Section 8.0 on safety.

## 12.0 SAMPLE PREPARATION

- 12.1 Before extracts can be analyzed on the instrument, they must first be evaporated to dryness under nitrogen and then spiked with injection standard to set the final volume nominally at 20  $\mu$ L. A determination must also be made as to whether the extract should be diluted. The decision to dilute a sample extract is based on a number of factors: sample screening, historical data about the sample or sample site, the appearance of the extract (color, viscosity, incidental odor, turbidity, etc.), or regulatory considerations. The experience of the analyst is invaluable in making this determination.

**NOTE:** Sample extracts may contain multiple layers or sediment. Samples that contain sediment are returned to cleanup. Multiple layers are treated on a case-by-case basis. If the extract can be homogenized, then a uniform sample is achieved. If the extract remains bi-phasic, the PM and client are contacted for further guidance.

- 12.2 If a sample is to be analyzed without dilution ('neat'), 2 nanograms of injection standard solution is added to the extract using a pipette (20  $\mu$ L of a 0.1 ng/ $\mu$ L = 100

pg/ $\mu$ L extract concentration). A cap is then placed on the vial and secured by crimping before vortexing the sample to ensure complete mixing and vial wall washing.

- 12.3 If samples require dilution, the dilution is made using nonane or appropriate solvent. If not previously added, 2 nanograms of JS is added to the autosampler vial. Dilution prep may involve the addition of supplemental extraction standard (ES) and is documented in the injection prep logbook.
- 12.4 Once samples are prepped, they are ready to be injected onto the instrument. An autosampler is used to inject standards and sample extracts on the instrument.
- 12.5 The need for dilution may also be determined after analysis is performed, and may still be performed as above. Under normal circumstances, a sample would be diluted if any chromatographic peaks saturate the detector.

### 13.0 QUALITY CONTROL REQUIREMENTS

Typically a blank (LMB), laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) are extracted and analyzed with each prep batch. Other client requirements may include a matrix spike (MS) and matrix spike duplicate (MSD) or sample duplicate (DUP).

#### 13.1 Blanks

- 13.1.1 A blank is extracted with each batch of 20 or fewer samples to demonstrate that interferences from glassware, reagents and the analytical system are under control. Blanks are carried through all stages of sample preparation and analysis.
  - 13.1.1.1 For Method 1613B, an acceptable blank must be below the minimum levels listed in Table 2 of the method for all analytes.
  - 13.1.1.2 For Methods 8290A, 0023A, and TO-9a, all analytes must be below the Lower Method Calibration Limits.
  - 13.1.1.3 For DOD work, an acceptable blank must have no analytes detected  $> 1/2$  the laboratory's LOQ or  $> 1/10$ th the amount measured in any sample or  $1/10$ th the regulatory limit, whichever is greater. (see QSM v5.3 table B-6)
- 13.1.2 The percent recovery of each labeled standard (extraction and cleanup) is calculated as shown in Sec. 17.4.5. Recoveries must be within the limits in Table 7 for method 1613B. For methods 8290A and 0023A, extraction standard recoveries must be within 40-135%. Sampling standards for Method 0023A must be within 70-130%. For method TO-9a, extraction standards must be within 50-120% for tetra- through hexa- and within 40-120% for hepta- and OCDD. Sampling standards for Method TO-9a must be within 50-120%.

#### 13.2 Laboratory Control Samples and Matrix Spikes

- 13.2.1 The spiking standard for LCS/LCSDs and MS/MSDs contains all analytes listed in Table 5. For each LCS, LCSD, MS and MSD, the concentration of each analyte and its percent recovery are calculated as shown in Sec. 17.4.1 and 17.4.5. For methods 8290A and 0023A, percent recoveries should be within 70-130%. For method 1613B, recovered concentrations should be within the limits in Table 6.
- 13.2.2 If recovery is not within these limits, the data may need to be re-checked for errors, or the samples and QC may need to be re-analyzed. In addition, the

instrumentation may need to be checked for performance problems. If the LCS fails to meet acceptance criteria due to low recovery, the associated samples may have to be re-extracted and re-analyzed when possible. If one or more recoveries are high in the LCS and these analytes are not detected in the samples, the event should be documented and data may be reported. If the MS and MSD both fail due to matrix interference and/or dilution, data may be reported provided the associated LCS passes acceptance criteria.

**NOTE:** Many clients have contract specific criteria that must be considered when evaluating recovery of the Quality Control samples.

- 13.2.3 The percent recovery of each labeled standard (extraction and cleanup) is calculated as shown in Sec. 17.4.5. Recoveries must be within the limits in Table 6 for method 1613B. For methods 8290A and 0023A, extraction standard recoveries must be within 40-135%. Sampling standards for Method 0023A must be within 70-130%. For method TO-9a, extraction standards must be within 50-120% for tetra- through hexa- and within 40-120% for hepta- and OCDD. Sampling standards for Method TO-9a must be within 50-120%.

### 13.3 Samples

- 13.3.1 The percent recovery of each labeled standard (as listed in SOP CF-OA-E-001) is calculated as shown in Sec. 17.4.5. Recoveries must be within the limits in Table 7 for method 1613B or 40-135% for method 8290A. For method TO-9a, extraction standards must be within 50-120% for tetra- through hexa- and within 40-120% for hepta- and OCDD. Sampling standards for Method TO-9a must be within 50-120%.
- 13.3.2 Calculated EDLs should be below the PQLs in Table 1. Any reported EDLs above the PQLs should be noted in the case narrative.

## 14.0 INSTRUMENT CALIBRATION, STANDARDIZATION, AND PERFORMANCE

### 14.1 Mass spectrometer performance

- 14.1.1 The mass spectrometer is operated in electron ionization mode. A static resolving power of at least 10,000 (10 percent valley definition) must be demonstrated at appropriate masses before any analysis is performed. Static resolving power checks must be performed at the beginning and at the end of each 12-hr period of operation. Corrective action must be implemented whenever the resolving power does not meet the requirement.
- 14.1.1.1 Chromatography time for PCDDs and PCDFs exceeds the long term mass stability of the mass spectrometer. Because the instrument is operated in the high-resolution mode, mass drifts of a few ppm (e.g., 5 ppm in mass) can have serious adverse effects on instrument performance. Therefore, a mass drift correction is mandatory. A lock-mass ion from the reference compound PFK is used for tuning the mass spectrometer. The selection of the lock-mass ion is dependent on the masses of the ions monitored within each descriptor. Lock mass ions may be found in the descriptor table, Table 2. The level of the reference compound (PFK) metered into the ion chamber during HRGC/HRMS analyses should be adjusted so that the amplitude of the most intense selected lock-mass ion signal (regardless of the descriptor number) does not

exceed 10 percent of the full scale deflection for a given set of detector parameters. Under these conditions, sensitivity changes that might occur during the analysis can be more effectively monitored. NOTE: Excessive PFK (or any other reference substance) may cause noise problems and contamination of the ion source resulting in an increase in downtime for source cleaning.

- 14.1.2 Documentation of the instrument resolving power must be accomplished by recording the peak profile of the high-mass reference signal ( $m/z$  380.9760) obtained during the above peak matching experiment by using the low mass PFK ion at  $m/z$  304.9824 as a reference. The minimum resolving power of 10,000 must be demonstrated on the high-mass ion while it is transmitted at a lower accelerating voltage than the low-mass reference ion, which is transmitted at full sensitivity. The format of the peak profile representation (Figure 2) must allow manual determination of the resolution, i.e., the horizontal axis must be a calibrated mass scale (amu or ppm per division). The result of the peak width measurement (performed at 5 percent of the maximum, which corresponds to the 10 percent valley definition) must appear on the hard copy and cannot exceed 100 ppm at  $m/z$  380.9760 (or 0.038 amu at that particular mass).

## 14.2 System Performance

System performance criteria are presented below. The laboratory may use the recommended GC column described in Sec. 9.1. The laboratory must document that all applicable system performance criteria are met before sample analysis begins. Sec. 9.2.2 provides recommended GC conditions that may be used to satisfy the required criteria. Mass spectrometer resolving power checks must be performed at the beginning and the end of each 12-hr period of operation. A GC column performance check is required at the beginning of each 12-hr period during which samples are analyzed. For Method 1613B, a continuing calibration must be performed at the beginning of the sequence, while for Methods 0023A and 8290A, continuing calibrations must be performed at both the beginning and the end of a sequence. An ending continuing calibration may also serve as the beginning check for the next sequence.

### 14.2.1 GC Column performance check

- 14.2.1.1 Inject 1  $\mu$ L of an aliquot of the column performance check solution (Sec. 10.1.5) and acquire selected ion monitoring (SIM) data within a total cycle time of  $\leq 1$  second. The chromatographic separation between 2,3,7,8-TCDD and the peaks representing any other unlabeled TCDD isomers must be resolved with a valley of  $\leq 25$  percent (Figure 1), where:

$$\text{Valley percent} = (x/y) \times 100$$

x = measured as in Figure 1 from the 2,3,7,8-closest TCDD eluting isomer

y = the peak height of 2,3,7,8-TCDD

For 2378-TCDF confirmatory analysis, the chromatographic separation between 2378-TCDF and its closest eluters must be resolved with a valley of  $\leq 25$  percent.

- 14.2.1.2 It is the responsibility of the laboratory to verify the conditions suitable for the appropriate resolution of 2,3,7,8-TCDD from all other TCDD isomers. The GC column performance check solution also contains the known first and last PCDD/PCDF eluters under the conditions described in this SOP. Their retention times are used to determine the five homologue retention time windows that are used for qualitative (Sec. 15.3.1.1) and quantitative purposes. All peaks (including  $^{13}\text{C}_{12}$ -2,3,7,8-TCDD) should be labeled and identified on the chromatograms. All first eluters of a homologous series should be labeled with the letter "F," and all last eluters of a homologous series should be labeled with the letter "L". Any individual selected ion current profile (SICP) or the reconstructed homologue ion current constitutes an acceptable form of data presentation. A SICP for the labeled compounds is also required.
- 14.2.1.3 Particular caution should be exercised for the switching time between the last tetra-chlorinated congener (1,2,8,9-TCDF) and the first penta-chlorinated congener (1,3,4,6,8-PeCDF), as these two compounds elute within 15 sec of each other on the 60m DB-5 column, and overlap on the 60m DB-5ms column. Both congeners must be acquired within one analysis.
- 14.2.1.4 The absolute retention time of  $^{13}\text{C}_{12}$ -1,2,3,4-TCDD must exceed 25.0 minutes on the primary GC column in use, and 15.0 minutes on the confirmatory GC column.
- 14.3 Initial Calibration
- 14.3.1 Prior to running a multi-level calibration, take precautions to ensure that the instrument meets system performance criteria. The analyst must document that all system performance criteria are met before analyzing an initial calibration.
- 14.3.2 Initial calibration is required before any samples are analyzed for PCDDs and PCDFs and must meet the acceptance criteria listed below. Initial calibration is also required if any routine calibration does not meet the required criteria listed in Sec. 15.2, and at a minimum, annually.
- 14.3.3 At a minimum, all five high-resolution concentration calibration solutions listed in Table 5 must be used for the initial calibration.
- 14.3.4 Tune the instrument with PFK to meet the above-specified system performance criteria.
- 14.3.5 Inject the GC column performance check solution and acquire SIM mass spectral data. The total cycle time for each descriptor must be < 1 second. The laboratory must not perform any further analysis until it is demonstrated and documented that the criteria listed in Sec. 15.1.1.1 are met.
- 14.3.6 By using the same conditions (GC and MS) that produced acceptable results with the column performance check solution, analyze each of the five concentration calibration solutions. Each injection must meet the following ion ratio and signal-to-noise (S/N) requirements:
- 14.3.6.1 The ratio of the areas of the integrated ion current for the ions appearing in Table 2 (homologous series quantitation ions) must be

within the indicated control limits (set for each homologous series) in Table 3. These ion ratio requirements must be within the specified control limits simultaneously in one run. It is the analyst's responsibility to take corrective action if the ion abundance ratios are outside the limits.

- 14.3.6.2 For each selected ion current profile (SICP) and for each GC signal corresponding to the elution of a target analyte and of its labeled standards, the S/N ratio must be better than or equal to 10. Manual measurement of S/N is required for any GC peak that has an apparent S/N of less than 15:1. The result of the calculation must appear on the SICP above the GC peak in question.
- 14.3.7 Calculate the 17 relative response factors (RF) for unlabeled target analytes relative to their appropriate internal standards (see Table 10). Also calculate the RFs for the ESs and CSs relative to the appropriate injection standards according to the following formula:

$$RF = \frac{A_x C_{is}}{A_{is} C_x}$$

Where:

A<sub>x</sub> = Sum of the Areas of the two characteristic ions for the compound being measured.

A<sub>is</sub> = Sum of the Areas of the two characteristic ions for the specific internal standard.

C<sub>is</sub> = Concentration of the specific internal standard.

C<sub>x</sub> = Concentration of the compound being measured.

The RF is a dimensionless quantity; the units used to express C<sub>is</sub> and C<sub>x</sub> must be the same.

- 14.3.8 The RF for other isomers within a homolog group shall be determined from the average RF of the 2,3,7,8-substituted isomers. For example, the RF for non-2,3,7,8-substituted HxCDD isomers (totals peaks) is the average of the three 2,3,7,8-substituted isomers. NOTE: If only one 2,3,7,8-substituted isomer is present in the calibration then use that isomer's RF for all isomers within its homolog group.
- 14.3.9 Because more than five calibration levels may be analyzed, the analyst may choose to deactivate one or more levels. The low standard representing the PQL cannot be deactivated. CFA only includes calibration points below the PQL at the request of the client (drinking water states, TMDL, etc.). If warranted, a mid-level standard is deactivated for all analytes (globally) in that calibration mixture. An upper level(s) standard may be deactivated to meet method criteria for single compounds. This practice results in a narrower calibration range. The analyst must get supervisory approval before deactivating any calibration levels within the method calibration range. Following approval, management will document the situation, including reasonable cause for calibration level removal. Calibrations with rejected mid-level points are not used for DOE clients. Please note that this practice

does not represent “cherry picking,” which is acknowledged as an unacceptable laboratory practice.

14.3.10 The average RF must be calculated for each compound as follows:

$$RF_{avg} = \frac{\sum_{i=1}^n X}{n}$$

Where:

$N$  = number of calibration levels

$X_i$ ;  $i=1$  to  $n$ , are the compounds RF values for each calibration point

14.3.11 Criteria for acceptable initial calibration

The criteria listed below for acceptable calibration must be met before sample analyses are performed.

14.3.11.1 Per method 8290A, the percent relative standard deviations for the mean response factors from the 17 unlabeled standards must not exceed  $\pm 20$  percent, and those for the nine labeled reference compounds must not exceed  $\pm 20$  percent. These limits also apply to Method 0023A. Per method 1613B, the percent relative standard deviations for the mean response factors from the 17 unlabeled standards must not exceed  $\pm 20$  percent, and those for the fifteen labeled reference compounds must not exceed  $\pm 35$  percent. See Table 12 for method TO-9a minimum requirements.

$$\%RSD = \frac{SD}{\bar{x}} \times 100$$

Where:

RSD = relative standard deviation

$\bar{x}$  = mean of 5 or more initial RFs for a compound

SD = standard deviation of average RFs for a compound

$$SD = \sqrt{\frac{\sum_{i=1}^n (X - A)^2}{n - 1}}$$

where:

$n$  = number of calibration levels

$X_i$ ;  $i=1$  to  $n$ , are the compounds RF values for each calibration point

$A$  = average of the RFs from above

## 15.0 PROCEDURE FOR ANALYSIS AND INSTRUMENT OPERATION

### 15.1 Resolution check

15.1.1 At the beginning and end of each 12-hour window, mass resolution must be tuned and/or verified. A static resolving power of at least 10,000 must be demonstrated at appropriate masses before analysis is performed.

15.1.2 Using a PFK molecular leak, tune the instrument to the minimum required resolving power of 10,000 at  $m/z$  330.9792 (for day to day operations, the

instrument may be tuned to approximately 11,000). Verify that the exact mass of m/z 380.9760 is within 5 ppm of the required value.

## 15.2 Column Performance/Window Defining/Continuing Calibration Check (CS3WT)

15.2.1 Inject 1 uL of the CS3WT or CPM. This standard is obtained from a different manufacturer or is a different lot from the same manufacturer than the initial calibration standard. Note that for NC drinking waters a different manufacture must be used. Verify that all column performance and window defining criteria in Section 14.2.1 have been met.

15.2.2 The CS3WT also contains the analytes for continuing calibration. The initial calibration curve for each compound of interest must be verified once every 12 hours.

Calculate the percent difference using:

$$\% \text{ Difference} = \frac{|\overline{RF}_i - RF_c|}{\overline{RF}_i} \times 100$$

Where:

$\overline{RF}_i$  = average response factor from initial calibration

$RF_c$  = response factor from current CS3WT

Calculate analyte concentrations using:

$$[PCDD / PCDF] = \frac{(A_{unk}^{ion1} + A_{unk}^{ion2})}{(A_{ES}^{ion1} + A_{ES}^{ion2})} \times \frac{Q_{ES}}{RF}$$

Where:

$A_{unk}$  and  $A_{ES}$  = the integrated area for each ion monitored.

$Q_{ES}$  = the amount of extraction standard in pg/uL

$RF$  = Average RF from the ICAL for the compound

15.2.2.1 For methods 0023A and 8290A, if the percent difference for each native analyte in the CS3WT is  $\leq 20\%$ , and for each labeled analyte is  $\leq 30\%$ , the initial calibration is assumed to be valid. For method 1613B, analyte concentrations must fall within the limits in Table 8. If the criteria are not met, corrective action should be taken. If no source of the problem can be determined after corrective action has been taken, a new calibration may need to be generated. For Method TO-9a See Table 12 for minimum requirements.

15.2.2.2 All ion ratios must be within the limits in Table 3.

15.2.2.3 For methods 0023A and 8290A, if no more than two unrelated compounds in the continuing calibration check performed at the end of a 12-hour period fail by no more than  $\pm 25\%$  for the 17 unlabeled compounds and  $\pm 35\%$  for the 9 labeled compounds, the average RF values from the beginning and ending continuing calibration checks should be used to compute the analyte concentrations, instead of the RF values obtained from the initial calibration. No further sample analyses should be performed until an acceptable calibration is achieved.

## 15.3 Sample Analysis

### 15.3.1 Data Interpretation

#### 15.3.1.1 Qualitative Determination

For a peak to be identified as a PCDD or PCDF, it must meet all of the criteria listed below.

- 15.3.1.1.1 The signals for the two m/z's being monitored must be present and maximize within  $\pm 2$  seconds of each other.
- 15.3.1.1.2 The signal-to-noise ratio between the two m/z's must be  $\geq 2.5$  for native compounds and  $\geq 10$  for labeled compounds.
- 15.3.1.1.3 Ion ratios must be within the limits in Table 3.
- 15.3.1.1.4 Relative Retention Times
  - 15.3.1.1.4.1 For Methods 0023A and 8290A, congeners which have an isotopically labeled compound must fall within -1 to +3 seconds of the labeled compound. Congeners with no labeled compound must be within 0.005 retention time units of the RRT measured in the continuing calibration. (See Table 11.) For method TO-9a, congeners which have an isotopically labeled compound must fall within -3 to +3 seconds of the labeled compound. Congeners with no labeled compound must be within 0.005 retention time units of the RRT measured in the continuing calibration.
  - 15.3.1.1.4.2 For Method 1613B, relative retention times must be within the RRT limits found in Table 9.
  - 15.3.1.1.4.3 For non-2378 peaks, retention times must be within the retention time windows established by the analysis of the window defining mixture (Sec. 14.2.1.2).
- 15.3.1.1.5 For PCDFs, no peak may be present in the associated PCDPE channel at the same retention time. If a PCDPE peak is present, the PCDF peak should be reported with a flag denoting the interference.
- 15.3.1.1.6 Any sample in which 2378-TCDF has been identified at or above the method reporting limit must be confirmed on a second column (DB-225 or equivalent).

#### 15.3.1.2 Calibration Limit Exceedance

- 15.3.1.2.1 If a compound in a sample exceeds the upper calibration limit, all subsequent samples must be checked for carryover contamination.
- 15.3.1.2.2 When a subsequent sample is non-detect for the compound in question, the sequence is again considered acceptable for reporting.
- 15.3.1.2.3 All affected samples between the exceeding sample and the non-detect sample must be re-analyzed.

## 16.0 EQUIPMENT AND INSTRUMENT MAINTENANCE

- 16.1 Preventive maintenance on a HRGC/HRMS system involves the following basic areas:
  - 16.1.1 Vane type vacuum pumps for the inlets, source, and analyzer need a change of oil and scroll type pumps may need tip seals changed about every year or when system performance indicates it is needed.
  - 16.1.2 The GC injection port is cleaned as needed, approximately once a week. It is recommended that the septum and injection port liner be replaced at the time of cleaning. Additionally, the gold plated seal should be cleaned or replaced.
  - 16.1.3 Ion source maintenance is usage dependent. The type and quantity of samples that have been injected determine the frequency of ion source cleaning and filament replacement.
  - 16.1.4 Autosampler maintenance is primarily that of cleanliness. Most autosamplers need their moving parts to be clean and lightly lubricated. The most frequent corrective maintenance is that of changing the syringe, usually about once per month.
  - 16.1.5 Instrument maintenance logs are kept with each instrument and serve as a record of all the maintenance that has been done on the instrument.
- 16.2 Non-Routine Maintenance Procedures (Special, Operational or Failure Mode Maintenance)
  - 16.2.1 Service is provided to the instrument via the analyst, the in-house instrument service engineer, or a technical support specialist from the manufacturer. When instrument failure occurs, different parts of the instrument are isolated to determine the root cause. For example, the injection port may be capped off if a leak is suspected to prove the leak is/is not coming from that source. Instrument maintenance logbooks are kept for each instrument detailing the type of maintenance performed on the instrument and when it was performed. Preventive maintenance visits are scheduled annually for the mass spectrometers.
  - 16.2.2 Analytical GC columns are clipped or replaced when the existing column shows signs of excessive degradation or the inability to properly resolve chromatographic peaks. Excessive peak tailing, poor responses, and baseline disturbances may also indicate that the column needs to be replaced.

## 17.0 DATA RECORDING, CALCULATION AND REDUCTION METHODS

- 17.1 Data are evaluated qualitatively and quantitatively using a software program such as Waters MassLynx, or equivalent data system.

17.2 Data are reviewed, and a hard copy is generated. If manual integrations are made, a hard copy of the manual integration is printed and initialed by the analyst and included with the raw data.

17.3 Additional supporting documentation, such as totals pages generated by the software may be included with the data.

#### 17.4 Quantitative Analysis

17.4.1 The concentration (ng/L for aqueous, ng/g for solids) of each identified compound in the sample is calculated as follows:

$$[PCDD / PCDF] = \frac{(A_{unk}^{ion1} + A_{unk}^{ion2})}{(A_{ES}^{ion1} + A_{ES}^{ion2})} \times \frac{Q_{ES}}{W_{unk} \times D \times \overline{RF}}$$

Where:

$A_{unk}$  and  $A_{ES}$  = the integrated area for each ion monitored.

$Q_{ES}$  = the amount of extraction standard added to the sample in nanograms

$W_{unk}$  = the initial sample aliquot size, in liters for waters and in grams for solids.

$D$  = (% moisture in sample)/100, or 1 for waters

$\overline{RF}$  = Average RF from the ICAL for the compound

17.4.2 The estimated detection limit (EDL) is calculated as follows:

$$[EDL_{ppt}] = 2.5 \times \frac{(H_{unk}^{ion1} + H_{unk}^{ion2})}{(H_{ES}^{ion1} + H_{ES}^{ion2})} \times \frac{Q_{ES}}{W_{unk} \times \overline{RF}}$$

Where:

$H_{unk}$  = the height of the noise present in each ion monitored.

$H_{ES}$  = the height of the extraction standard peak in each ion monitored.

2.5 = signal-to-noise factor for minimum height of peak.

17.4.3 The estimated maximum possible concentration (EMPC) is calculated in the same manner as a concentration (Section 17.4.1).

17.4.4 The concentration of each extraction and cleanup standard is calculated as follows:

$$[ES_{ng}] = \frac{(A_{ES}^{ion1} + A_{ES}^{ion2})}{(A_{JS}^{ion1} + A_{JS}^{ion2})} \times \frac{Q_{JS}}{\overline{RF}}$$

Where:

$A_{ES}$  and  $A_{JS}$  = the integrated area for each ion monitored.

$Q_{JS}$  = the amount of injection standard added to the sample in nanograms

$\overline{RF}$  = Average RF from the ICAL for the compound

The cleanup standard concentration is calculated as above, substituting the area of the individual cleanup standard ions for the extraction standard ions.

17.4.5 Percent recovery is calculated as follows:

$$\%R = \frac{R_{ng}}{S_{ng}} \times 100$$

Where:

$R_{ng}$  = the amount of standard recovered in nanograms.

$S_{ng}$  = the amount of standard spiked in nanograms.

## 18.0 POLLUTION/CONTAMINATION

- 18.1 Work area should be maintained free of dust and dirt accumulations.
- 18.2 Fume hoods are utilized to remove fumes and reduce the risk of airborne contaminants to ensure personnel safety. Hoods are monitored in accordance with CF-FC-E-003 for Fume Hood Face Velocity Performance Checks.
- 18.3 The laboratory area is restricted to authorized personnel.

## 19.0 DATA REVIEW, APPROVAL AND TRANSMITTAL

- 19.1 A review process is used to insure the quality of the data. Raw data are reviewed first by the analyst, then by a second (peer) analyst or a data validator. When the analyst is satisfied that the data have been correctly processed and uploaded to the LIMS, a data report is generated from AlphaLIMS. The AlphaLIMS report along with the raw data and supporting documentation, such as a run log and case narrative, are submitted for review to the data validator or another experienced analyst. The reviewer goes through the raw data as if he/she was working it up for the first time and verifies that they are correct. In addition, he/she must make sure that the data have been correctly entered into AlphaLIMS. AlphaLIMS reports may be self-reviewed. If errors are discovered in either the raw data or the AlphaLIMS report, then the two analysts should discuss the differences and how best to resolve them. In some cases, the peer review process may uncover errors that lead to a sample being re-extracted or re-run. In cases such as these, a nonconformance report (NCR) should be completed and submitted to the Quality department. It is recommended that a copy of the NCR be given to the prep analyst if it involves a re-extraction and that a copy be kept with the original data.
- 19.2 Once the data review has been completed by the reviewer, the batch is returned to the analyst for corrections (if applicable) and the status is updated from REVW to DONE in AlphaLIMS.
- 19.3 Data may be transmitted automatically to AlphaLIMS. This automatic "upload" procedure may be activated prior to data review or after data review is complete. In either case, the data recorded in AlphaLIMS are checked by the analyst for accuracy and completeness.

## 20.0 CORRECTIVE ACTION FOR OUT-OF-CONTROL OR UNACCEPTABLE DATA

Corrective action for out-of-control data may require instrument maintenance, re-analysis, re-extraction, or a more complex set of actions. When troubleshooting measures fail to bring an analytical process or data into control, a nonconformance report and/or corrective action should be initiated in accordance with CF-QS-E-004 for the Documentation of Nonconformance Reporting and Dispositioning and Control of Nonconforming Items, and CF-QS-E-002 for Conducting Corrective Action.

## 21.0 CONTINGENCIES FOR HANDLING THESE SITUATIONS

Troubleshooting is used to determine the appropriate action to take when an initial or continuing calibration, blank and/or laboratory control sample fails to meet the acceptance criteria defined for the method. Troubleshooting may involve one or more of the following actions:

- 21.1 If analytes in a multi-point calibration fail to meet specified criteria, additional standards for the failing compounds may need to be reanalyzed. If they still do not meet specifications, instrument maintenance or new standards may be required before work is continued.

- 21.2 If a continuing calibration fails to meet specified criteria, instrument tuning or inlet maintenance may be required. If routine maintenance procedures fail to produce a second consecutive calibration verification within acceptance criteria, then the laboratory must demonstrate acceptable performance after further corrective action with two consecutive calibration verifications, or a new initial calibration must be analyzed.
- 21.3 If a method blank fails to meet defined criteria, the source of contamination should be found and eliminated before proceeding with analysis.
- 21.4 If normal equipment and software operating procedures do not resolve troubleshooting efforts, the manuals for software, hardware and other equipment discussed in this SOP are available for consultation and resolution. On-line support may be available from software and instrument manufacturers, as well. Any revisions, repairs or corrective actions required must be documented in accordance with the laboratory's Quality System as described in CF-QS-B-001.

## 22.0 RECORDS MANAGEMENT

- 22.1 Run logs are generated for each instrument each day that the instrument is run. These run logs serve as records of what is run on the instrument, including samples, QC, calibrations, tunes, etc. Additional information is provided in the run log, including the analyst's initials, run date and time, and file name.
- 22.2 Raw data are stored in the lab in filing cabinets and/or boxes as long as there is space available. When space runs out, the data are boxed and sent to storage.
- 22.3 All records generated as a result of this procedure are maintained as quality documents in accordance with CF-QS-E-008 for Quality Records Management and Disposition.

## 23.0 LABORATORY WASTE HANDLING AND DISPOSAL

Sample extracts that have been run are temporarily stored in case they have to be reanalyzed. Once space is no longer available to keep them in the lab, they are moved to Waste Disposal where they are handled and disposed in accordance with the Laboratory Waste Management Plan, CF-LB-G-001.

## 24.0 REFERENCES

- 24.1 Test Methods for Evaluating Solid Waste: Laboratory Manual Physical/ Chemical Methods, Volume 1B, SW-846, 3<sup>rd</sup> Edition, Feb. 2007. Method 8290A, "Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by High Resolution Gas Chromatography/ High Resolution Mass Spectrometry (HRGC/HRMS)," Rev. 1, Feb. 2007. USEPA, Office of Solid Waste and Emergency Response, Washington, DC 20460.
- 24.2 Method 1613, "Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution HRGC/HRMS," Rev. B, Oct. 1994. USEPA, Office of Water, Engineering and Analysis Division, 401 M Street SW, Washington, D.C. 20460.
- 24.3 Test Methods for Evaluating Solid Waste: Laboratory Manual Physical/ Chemical Methods, Volume 1B, SW-846, 3<sup>rd</sup> Edition, Feb. 2007. Method 0023A, "Sampling Method for Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofuran Emissions From Stationary Sources," Rev. 1, Dec. 1996. USEPA, Office of Solid Waste and Emergency Response, Washington, DC 20460.
- 24.4 Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition. "Compendium Method TO-9A, Determination of Polychlorinated, Polybrominated and Brominated/Chlorinated Dibenzo-p-Dioxins

and Dibenzofurans in Ambient Air.” January 1999. Center for Environmental Research Information, Office of Research and Development, USEPA, Cincinnati, OH 45268.

24.5 The NELAC Institute, (TNI) 2009 Standard, EL-V1-2009.

## 25.0 HISTORY

Revision 1: Section 15.3.1.2 added.

Revision 2: Absolute RT information added in 14.2.1.4; Calibration limit exceedance information added in section 15.3.1.2; Table 8 footnote describing RRT window adjustment to column used.

Revision 3: Method 0023A requirements added.

Revision 4: 2378-TCDF confirmation procedure and requirements added.

Revision 5: Injection standard changed from Tridecane to nonane. Discussion of equipment use and operation instructions was added, per DoD ELAP gray box 22.

Revision 6: Added TO-9a support and additional Tables for Method 8290.

Revision 7: Removed references to 8290 cleanup standard. Added TO-9a reference.

Revision 8: RRT limits for 1613 adjusted to method limits, except for three which have methods widths but db-5ms centers.

Revision 9: Added air matrix descriptions.

Revision 10: Table 9 updated. Maintenance rule for highly contaminated samples. TNI reference updated.

Revision 11: Changed EDL signal to noise value to 2.5. Updated Table references.

Revision 12: Added Table 13, Method Holding Times.

Revision 13: Added a NC requirement that a 1613 DW CCAL standard must only be obtained from a different manufacturer.

Revision 14: Adjusted TO-9a SS limits, added DB-5ms ui column use.

Revision 15: Added a document reference for Method 1613.

Revision 16: Updated section 9 to include hardware and software requirements.

Revision 17: Updated 8290 holding times.

Revision 18: Added DoD MB acceptance limits.

Revision 19: Updated 14.3.9 to clarify calibration level deactivation protocol.

Revision 20: Improved 14.3.9.

**TABLE 1: METHOD ANALYTES AND PQLs**

Analyte	Solid/Tissues (pg/g)	Aqueous (pg/L)	Air (pg)	CAS Number*
2378-TCDD	1	10	10	1746-01-6
12378-PeCDD	5	50	50	40321-76-4
123478-HxCDD	5	50	50	39227-28-6
123678-HxCDD	5	50	50	57653-85-7
123789-HxCDD	5	50	50	19408-74-3
1234678-HpCDD	5	50	50	35822-39-4
OCDD	10	100	100	3268-87-9
2378-TCDF	1	10	10	51207-31-9
12378-PeCDF	5	50	50	57117-41-6
23478-PeCDF	5	50	50	57117-31-4
123478-HxCDF	5	50	50	70648-26-9
123678-HxCDF	5	50	50	57117-44-9
234678-HxCDF	5	50	50	60851-34-5
123789-HxCDF	5	50	50	72918-21-9
1234678-HpCDF	5	50	50	67562-39-4
1234789-HpCDF	5	50	50	55673-89-7
OCDF	10	100	100	39001-02-0

\* Chemical Abstract Services number

**TABLE 2: MASS DESCRIPTORS**

Function (#)	Channel (#)	Mass (amu)	Dwell Time (ms)	I.C. Delay (ms)
1	1	303.9016	50	10
1	2	305.8987	50	10
1	3	315.9419	50	10
1	4	304.9824	50	10
1	5	304.9824	(Lock)	10
1	6	317.9389	50	10
1	7	319.8965	50	10
1	8	321.8936	50	10
1	9	327.8847	50	10
1	10	331.9368	50	10
1	11	333.9339	50	10
1	12	339.8597	50	10
1	13	341.8568	50	10
1	14	375.8364	50	10
2	1	339.8597	50	10
2	2	341.8568	50	10
2	3	351.9	50	10
2	4	353.897	50	10
2	5	355.8546	50	10
2	6	357.8517	50	10
2	7	366.9792	50	10
2	8	366.9792	(Lock)	10
2	9	367.8949	50	10
2	10	369.8919	50	10
2	11	409.7974	50	10
3	1	373.8207	50	10
3	2	375.8178	50	10
3	3	380.976	50	10

Function (#)	Channel (#)	Mass (amu)	Dwell Time (ms)	I.C. Delay (ms)
3	4	380.976	(Lock)	10
3	5	383.8639	50	10
3	6	385.861	50	10
3	7	389.8156	50	10
3	8	391.8127	50	10
3	9	401.8559	50	10
3	10	403.853	50	10
3	11	445.7555	50	10
4	1	407.7818	50	10
4	2	409.7788	50	10
4	3	417.8253	50	10
4	4	419.822	50	10
4	5	423.7767	50	10
4	6	425.7737	50	10
4	7	430.9728	50	10
4	8	430.9728	(Lock)	10
4	9	435.8169	50	10
4	10	437.814	50	10
4	11	479.7165	50	10
5	1	441.7427	50	10
5	2	443.7398	50	10
5	3	454.9728	50	10
5	4	454.9728	(Lock)	10
5	5	457.7377	50	10
5	6	459.7348	50	10
5	7	469.778	50	10
5	8	471.775	50	10
5	9	513.6775	50	10

**TABLE 3: THEORETICAL ION RATIOS AND CONTROL LIMITS**

Level of Chlorination	Theoretical Ratio	Control Limits	
		Lower	Upper
4	0.77	0.65	0.89
5	1.55	1.32	1.78
6	1.24	1.05	1.43
6 <sup>a</sup>	0.51	0.43	0.59
7	1.05	0.88	1.20
7 <sup>b</sup>	0.44	0.37	0.51
8	0.89	0.76	1.02

<sup>a</sup> Used only for <sup>13</sup>C-HxCDF<sup>b</sup> Used only for <sup>13</sup>C-HpCDF**TABLE 4: 1613B LIMITS FOR TETRA ONLY TESTS**

Compound Name	Test Conc. (pg/μL)	CCAL Limits (pg/μL)	OPR Limits (pg/μL)	Sample Limits (pg/μL)
2,3,7,8-TCDD	10	8.2 - 12.3	7.3 - 14.6	-
2,3,7,8-TCDF	10	8.6 - 11.6	8.0 - 14.7	-
<sup>13</sup> C <sub>12</sub> -2,3,7,8-TCDD	100	85 - 117	25 - 141	31 - 137
<sup>13</sup> C <sub>12</sub> -2,3,7,8-TCDF	100	76 - 131	26 - 126	29 - 140
<sup>37</sup> Cl <sub>4</sub> -2,3,7,8-TCDD	10	8.3 - 12.1	3.7 - 15.8	4.2 - 16.4

TABLE 5: INITIAL CALIBRATION CONCENTRATIONS

Analyte	Concentration (pg/uL)				
	CS-0.5	CS-2	CS-3	CS-4	CS-5
2378-TCDD	0.25	2	10	40	200
2378-TCDF	0.25	2	10	40	200
12378-PeCDD	1.25	10	50	200	1000
12378-PeCDF	1.25	10	50	200	1000
23478-PeCDF	1.25	10	50	200	1000
123478-HxCDD	1.25	10	50	200	1000
123678-HxCDD	1.25	10	50	200	1000
123789-HxCDD	1.25	10	50	200	1000
123478-HxCDF	1.25	10	50	200	1000
123678-HxCDF	1.25	10	50	200	1000
123789-HxCDF	1.25	10	50	200	1000
234678-HxCDF	1.25	10	50	200	1000
1234678-HpCDD	1.25	10	50	200	1000
1234678-HpCDF	1.25	10	50	200	1000
1234789-HpCDF	1.25	10	50	200	1000
OCDD	2.5	20	100	400	2000
OCDF	2.5	20	100	400	2000
<u>Extraction Standards</u>					
<sup>13</sup> C-2378-TCDD	100	100	100	100	100
<sup>13</sup> C-2378-TCDF	100	100	100	100	100
<sup>13</sup> C-12378-PeCDD	100	100	100	100	100
<sup>13</sup> C-12378-PeCDF	100	100	100	100	100
<sup>13</sup> C-23478-PeCDF	100	100	100	100	100
<sup>13</sup> C-123678-HxCDD	100	100	100	100	100
<sup>13</sup> C-123478-HxCDD	100	100	100	100	100
<sup>13</sup> C-123478-HxCDF	100	100	100	100	100
<sup>13</sup> C-123678-HxCDF	100	100	100	100	100
<sup>13</sup> C-123789-HxCDF	100	100	100	100	100
<sup>13</sup> C-234678-HxCDF	100	100	100	100	100
<sup>13</sup> C-1234678-HpCDD	100	100	100	100	100
<sup>13</sup> C-1234678-HpCDF	100	100	100	100	100
<sup>13</sup> C-1234789-HpCDF	100	100	100	100	100
<sup>13</sup> C-OCDD	200	200	200	200	200
<u>Cleanup Standards</u>					
<sup>37</sup> Cl-2378-TCDD	0.25	2	10	40	200
<u>Injection Standards</u>					
<sup>13</sup> C-1234-TCDD	100	100	100	100	100
<sup>13</sup> C-123789-HxCDD	100	100	100	100	100

**TABLE 6: METHOD 1613B LCS LIMITS**

<b>LCS Recovery Limits</b>		
<b>Analyte</b>	<b>Amount Spiked</b>	<b>Limit</b>
	<b>(pg/uL)</b>	<b>(pg/uL)</b>
2378-TCDD	10	6.7-15.8
12378-PeCDD	50	35-71
123478-HxCDD	50	35-82
123678-HxCDD	50	38-67
123789-HxCDD	50	32-81
1234678-HpCDD	50	35-70
OCDD	100	78-144
2378-TCDF	10	7.5-15.8
12378-PeCDF	50	40-67
23478-PeCDF	50	34-80
123478-HxCDF	50	36-67
123678-HxCDF	50	42-65
123789-HxCDF	50	39-65
234678-HxCDF	50	35-78
1234678-HpCDF	50	41-61
1234789-HpCDF	50	39-69
OCDF	100	63-170
<sup>13</sup> C-2378-TCDD	100	20-175
<sup>13</sup> C-12378-PeCDD	100	21-227
<sup>13</sup> C-123478-HxCDD	100	21-193
<sup>13</sup> C-123678-HxCDD	100	25-163
<sup>13</sup> C-1234678-HpCDD	100	26-166
<sup>13</sup> C-OCDD	200	26-397
<sup>13</sup> C-2378-TCDF	100	22-152
<sup>13</sup> C-12378-PeCDF	100	21-192
<sup>13</sup> C-23478-PeCDF	100	13-328
<sup>13</sup> C-123478-HxCDF	100	19-202
<sup>13</sup> C-123678-HxCDF	100	21-159
<sup>13</sup> C-123789-HxCDF	100	17-205
<sup>13</sup> C-234678-HxCDF	100	22-176
<sup>13</sup> C-1234678-HpCDF	100	21-158
<sup>13</sup> C-1234789-HpCDF	100	20-186
<sup>37</sup> Cl-2378-TCDD	10	3.1-19.1

**TABLE 7: METHOD 1613B ES (SAMPLES & LMB) RECOVERY LIMITS**

Compound Name	Amount Spiked (pg/ $\mu$ L)	Limits %
<sup>13</sup> C <sub>12</sub> -2,3,7,8-TCDD	100	25 - 164
<sup>13</sup> C <sub>12</sub> -1,2,3,7,8-PeCDD	100	25 - 181
<sup>13</sup> C <sub>12</sub> -1,2,3,4,7,8-HxCDD	100	32 - 141
<sup>13</sup> C <sub>12</sub> -1,2,3,6,7,8-HxCDD	100	28 - 130
<sup>13</sup> C <sub>12</sub> -1,2,3,4,6,7,8-HpCDD	100	23 - 140
<sup>13</sup> C <sub>12</sub> -OCDD	200	17 - 157
<sup>13</sup> C <sub>12</sub> -2,3,7,8-TCDF	100	24 - 169
<sup>13</sup> C <sub>12</sub> -1,2,3,7,8-PeCDF	100	24 - 185
<sup>13</sup> C <sub>12</sub> -2,3,4,7,8-PeCDF	100	21 - 178
<sup>13</sup> C <sub>12</sub> -1,2,3,4,7,8-HxCDF	100	26 - 152
<sup>13</sup> C <sub>12</sub> -1,2,3,6,7,8-HxCDF	100	26 - 123
<sup>13</sup> C <sub>12</sub> -2,3,4,6,7,8-HxCDF	100	28 - 136
<sup>13</sup> C <sub>12</sub> -1,2,3,7,8,9-HxCDF	100	29 - 147
<sup>13</sup> C <sub>12</sub> -1,2,3,4,6,7,8-HpCDF	100	28 - 143
<sup>13</sup> C <sub>12</sub> -1,2,3,4,7,8,9-HpCDF	100	26 - 138
<sup>37</sup> Cl <sub>4</sub> -2,3,7,8-TCDD	10	35 - 197

**TABLE 8: METHOD 1613B CONTINUING CALIBRATION LIMITS**

Compound Name	CCAL (pg/ $\mu$ L)	Limits (pg/ $\mu$ L)	Compound Name	CCAL (pg/ $\mu$ L)	Limits (pg/ $\mu$ L)
2,3,7,8-TCDD	10	7.8 - 12.9	<sup>13</sup> C <sub>12</sub> -2,3,7,8-TCDD	100	82 - 121
1,2,3,7,8-PeCDD	50	39 - 65	<sup>13</sup> C <sub>12</sub> -1,2,3,7,8-PeCDD	100	62 - 160
1,2,3,4,7,8-HxCDD	50	39 - 64	<sup>13</sup> C <sub>12</sub> -1,2,3,4,7,8-HxCDD	100	85 - 117
1,2,3,6,7,8-HxCDD	50	39 - 64	<sup>13</sup> C <sub>12</sub> -1,2,3,6,7,8-HxCDD	100	85 - 118
1,2,3,7,8,9-HxCDD	50	41 - 61	<sup>13</sup> C <sub>12</sub> -1,2,3,4,6,7,8-HpCDD	100	72 - 138
1,2,3,4,6,7,8-HpCDD	50	43 - 58	<sup>13</sup> C <sub>12</sub> -OCDD	200	96 - 415
OCDD	100	79 - 126	<sup>13</sup> C <sub>12</sub> -2,3,7,8-TCDF	100	71 - 140
2,3,7,8-TCDF	10	8.4 - 12	<sup>13</sup> C <sub>12</sub> -1,2,3,7,8-PeCDF	100	76 - 130
1,2,3,7,8-PeCDF	50	41 - 60	<sup>13</sup> C <sub>12</sub> -2,3,4,7,8-PeCDF	100	77 - 130
2,3,4,7,8-PeCDF	50	41 - 61	<sup>13</sup> C <sub>12</sub> -1,2,3,4,7,8-HxCDF	100	76 - 131
1,2,3,4,7,8-HxCDF	50	45 - 56	<sup>13</sup> C <sub>12</sub> -1,2,3,6,7,8-HxCDF	100	70 - 143
1,2,3,6,7,8-HxCDF	50	44 - 57	<sup>13</sup> C <sub>12</sub> -2,3,4,6,7,8-HxCDF	100	73 - 137
2,3,4,6,7,8-HxCDF	50	44 - 57	<sup>13</sup> C <sub>12</sub> -1,2,3,7,8,9-HxCDF	100	74 - 135
1,2,3,7,8,9-HxCDF	50	45 - 56	<sup>13</sup> C <sub>12</sub> -1,2,3,4,6,7,8-HpCDF	100	78 - 129
1,2,3,4,6,7,8-HpCDF	50	45 - 55	<sup>13</sup> C <sub>12</sub> -1,2,3,4,7,8,9-HpCDF	100	77 - 129
1,2,3,4,7,8,9-HpCDF	50	43 - 58	<sup>37</sup> Cl <sub>4</sub> -2,3,7,8-TCDD	10	7.9 - 12.7
OCDF	100	63 - 159			

**TABLE 9: METHOD 1613B RELATIVE RETENTION TIME LIMITS**

Compound	RRT Reference	RRT Limits
2,3,7,8-TCDD	13C -2,3,7,8-TCDD	0.999 - 1.002
1,2,3,7,8-PeCDD	13C -1,2,3,7,8-PeCDD	0.999 - 1.002
1,2,3,4,7,8-HxCDD	13C -1,2,3,4,7,8-HxCDD	0.999 - 1.001
1,2,3,6,7,8-HxCDD	13C -1,2,3,6,7,8,-HxCDD	0.997 - 1.003
1,2,3,7,8,9-HxCDD	13C -1,2,3,6,7,8,-HxCDD	0.997 - 1.016
1,2,3,4,6,7,8-HpCDD	13C -1,2,3,4,6,7,8-HpCDD	0.999 - 1.001
OCDD	13C -OCDD	0.999 - 1.001
2,3,7,8-TCDF	13C -2,3,7,8-TCDF	0.999 - 1.003
1,2,3,7,8-PeCDF	13C -1,2,3,7,8-PeCDF	0.999 - 1.002
2,3,4,7,8-PeCDF	13C -2,3,4,7,8-PeCDF	0.999 - 1.002
1,2,3,4,7,8-HxCDF	13C -1,2,3,4,7,8-HxCDF	0.999 - 1.001
1,2,3,6,7,8-HxCDF	13C -1,2,3,6,7,8-HxCDF	0.996 - 1.004
2,3,4,6,7,8-HxCDF	13C -2,3,4,6,7,8,-HxCDF	0.999 - 1.001
1,2,3,7,8,9-HxCDF	13C -1,2,3,7,8,9-HxCDF	0.999 - 1.001
1,2,3,4,6,7,8-HpCDF	13C -1,2,3,4,6,7,8-HpCDF	0.999 - 1.001
1,2,3,4,7,8,9-HpCDF	13C -1,2,3,4,7,8,9-HpCDF	0.999 - 1.001
OCDF	13C -OCDD	1.002 - 1.011
13C -2,3,7,8-TCDD	13C -1,2,3,4-TCDD	0.986 - 1.053
13C -1,2,3,7,8-PeCDD	13C -1,2,3,4-TCDD	0.849 - 1.416
13C -1,2,3,4,7,8-HxCDD	13C -1,2,3,7,8,9-HxCDD	0.980 - 1.003
13C -1,2,3,6,7,8-HxCDD	13C -1,2,3,7,8,9-HxCDD	0.983 - 1.005
13C -1,2,3,4,6,7,8-HpCDD	13C -1,2,3,7,8,9-HxCDD	1.068 - 1.092
13C -OCDD	13C -1,2,3,7,8,9-HxCDD	1.050 - 1.329
13C -2,3,7,8-TCDF	13C -1,2,3,4-TCDD	0.904 - 1.084
13C -1,2,3,7,8-PeCDF	13C -1,2,3,4-TCDD	0.893 - 1.318
13C -2,3,4,7,8-PeCDF	13C -1,2,3,4-TCDD	0.869 - 1.384
13C -1,2,3,4,7,8-HxCDF	13C -1,2,3,7,8,9-HxCDD	0.960 - 0.986
13C -1,2,3,6,7,8-HxCDF	13C -1,2,3,7,8,9-HxCDD	0.962 - 0.988
13C -2,3,4,6,7,8,-HxCDF	13C -1,2,3,7,8,9-HxCDD	0.957 - 1.019
13C -1,2,3,7,8,9-HxCDF	13C -1,2,3,7,8,9-HxCDD	0.973 - 1.043
13C -1,2,3,4,6,7,8-HpCDF	13C -1,2,3,7,8,9-HxCDD	1.026 - 1.068
13C -1,2,3,4,7,8,9-HpCDF	13C -1,2,3,7,8,9-HxCDD	1.050 - 1.144
37Cl -2,3,7,8-TCDD	13C -1,2,3,4-TCDD	0.988 - 1.051

**Due to the use of the DB-5ms column, some compounds exhibit slightly different elution times, resulting in RRT limits which vary from the method. The widths of the limits are the same as the method, only the center of the window has been adjusted to the DB-5ms's elution times.**

**TABLE 10: Method 8290 IS assignments****Internal Standard References  
Method 8290**

<b>Analytes</b>	<b>Internal Standards</b>
2378-TCDD	<sup>13</sup> C-2378-TCDD
12378-PeCDD	<sup>13</sup> C-12378-PeCDD
123478-HxCDD	<sup>13</sup> C-123678-HxCDD
123678-HxCDD	<sup>13</sup> C-123678-HxCDD
123789-HxCDD	<sup>13</sup> C-123678-HxCDD
1234678-HpCDD	<sup>13</sup> C-1234678-HpCDD
OCDD	<sup>13</sup> C-OCDD
2378-TCDF	<sup>13</sup> C-2378-TCDF
12378-PeCDF	<sup>13</sup> C-12378-PeCDF
23478-PeCDF	<sup>13</sup> C-12378-PeCDF
123478-HxCDF	<sup>13</sup> C-123678-HxCDF
123678-HxCDF	<sup>13</sup> C-123678-HxCDF
123789-HxCDF	<sup>13</sup> C-123678-HxCDF
234678-HxCDF	<sup>13</sup> C-123678-HxCDF
1234678-HpCDF	<sup>13</sup> C-1234678-HpCDF
1234789-HpCDF	<sup>13</sup> C-1234678-HpCDF
OCDF	<sup>13</sup> C-OCDD
<b>Extraction Standards</b>	<b>Injection Standards</b>
<sup>13</sup> C-2378-TCDD	<sup>13</sup> C-1234-TCDD
<sup>13</sup> C-12378-PeCDD	<sup>13</sup> C-1234-TCDD
<sup>13</sup> C-123678-HxCDD	<sup>13</sup> C-123789-HxCDD
<sup>13</sup> C-1234678-HpCDD	<sup>13</sup> C-123789-HxCDD
<sup>13</sup> C-OCDD	<sup>13</sup> C-123789-HxCDD
<sup>13</sup> C-2378-TCDF	<sup>13</sup> C-1234-TCDD
<sup>13</sup> C-12378-PeCDF	<sup>13</sup> C-1234-TCDD
<sup>13</sup> C-123678-HxCDF	<sup>13</sup> C-123789-HxCDD
<sup>13</sup> C-1234678-HpCDF	<sup>13</sup> C-123789-HxCDD
<b>Injection Standards</b>	
<sup>13</sup> C-1234-TCDD	NA
<sup>13</sup> C-123789-HxCDD	NA

**TABLE 11: 8290 Retention time limits****Retention Time Limits**  
*Method 8290*

<b>Analytes</b>	<b>Description</b>	<b>Limits</b>
2378-TCDD	2,3,7,8-substituted congeners, which have an isotopically-labeled standard present in the sample extract	must be within -1 to +3 seconds of the isotopically-labeled standard
12378-PeCDD		
123678-HxCDD		
123789-HxCDD		
1234678-HpCDD		
OCDD		
2378-TCDF		
12378-PeCDF		
123678-HxCDF		
123789-HxCDF		
1234678-HpCDF		
123478-HxCDD	2,3,7,8-substituted compounds that do not have an isotopically-labeled standard present in the sample extract	must fall within 0.005 retention time units of the relative retention time as determined from the daily routine calibration
23478-PeCDF		
123478-HxCDF		
234678-HxCDF		
1234789-HpCDF		
OCDF	Non-2,3,7,8-substituted target compounds	must be within the corresponding homologous retention time windows established by analyzing the column performance check solution, relative to an isotopically-labeled standard in the sample
Total TCDDs		
Total PeCDDs		
Total HxCDDs		
Total HpCDDs		
Total TCDFs		
Total PeCDFs		
Total HxCDFs		
Total HpCDFs	Isotopically-labeled standards	No method limits: allowed to shift as long as the predicted RT of the native window defining isomers established by analyzing the column performance check solution remain within the descriptor switching time
<sup>13</sup> C-2378-TCDD		
<sup>13</sup> C-12378-PeCDD		
<sup>13</sup> C-123678-HxCDD		
<sup>13</sup> C-1234678-HpCDD		
<sup>13</sup> C-OCDD		
<sup>13</sup> C-2378-TCDF		
<sup>13</sup> C-12378-PeCDF		
<sup>13</sup> C-123678-HxCDF		
<sup>13</sup> C-1234678-HpCDF		
<sup>13</sup> C-1234-TCDD		
<sup>13</sup> C-123789-HxCDD		

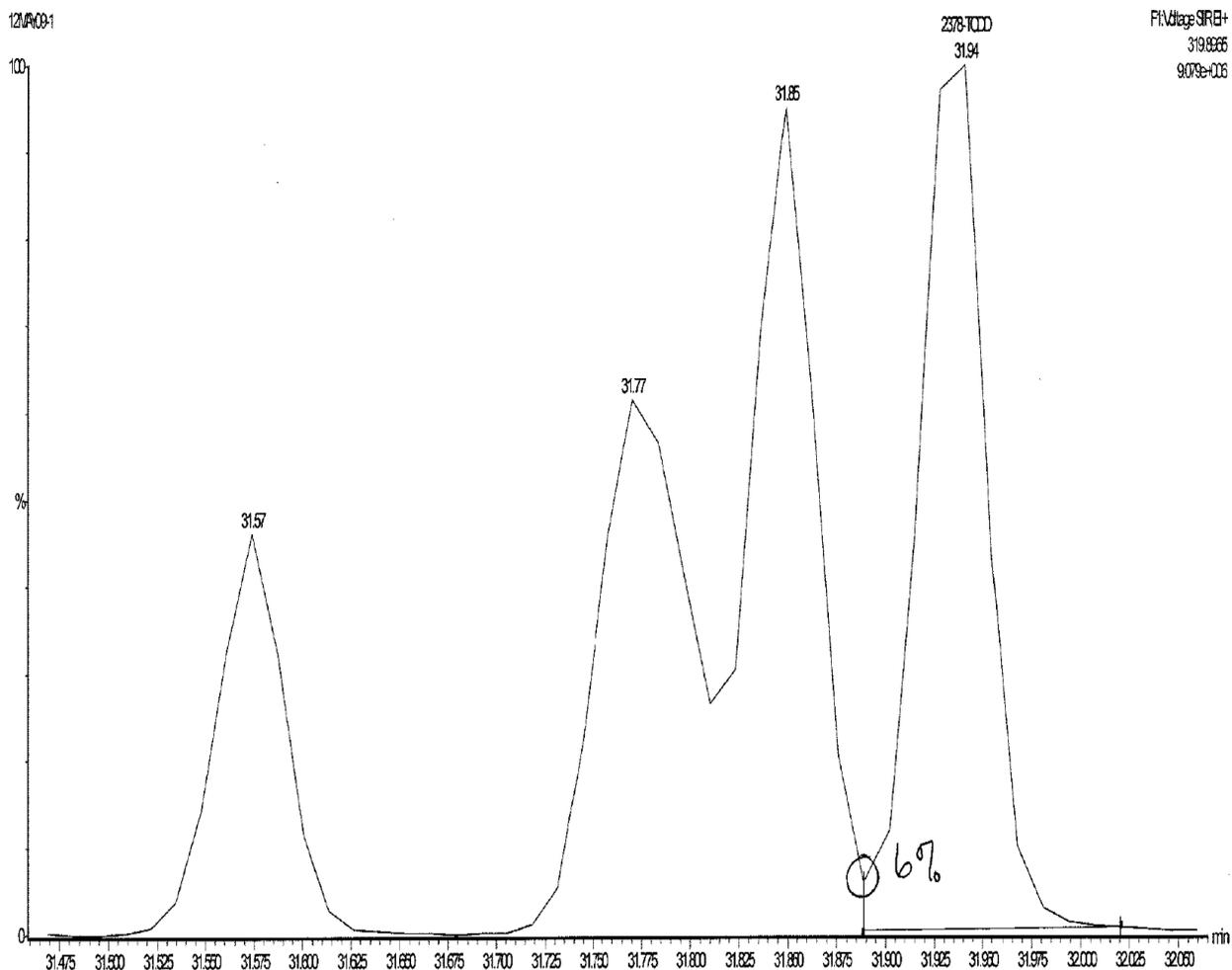
**TABLE 12: METHOD TO-9A MINIMUM REQUIREMENTS FOR INITIAL AND DAILY****CALIBRATION**

<b>Unlabeled Analytes</b>	<b>ICAL (RSD)</b>	<b>CVS (%D)</b>
2,3,7,8-TCDD	25	25
2,3,7,8-TCDF	25	25
1,2,3,7,8-PeCDD	25	25
1,2,3,7,8-PeCDF	25	25
2,3,4,7,8-PeCDF	25	25
1,2,4,5,7,8-HxCDD	25	25
1,2,3,6,7,8-HxCDD	25	25
1,2,3,7,8,9-HxCDD	25	25
1,2,3,4,7,8-HxCDF	25	25
1,2,3,6,7,8-HxCDF	25	25
1,2,3,7,8,9-HxCDF	25	25
2,3,4,6,7,8-HxCDF	25	25
1,2,3,4,6,7,8-HpCDD	25	25
1,2,3,4,6,7,8-HpCDF	25	25
OCDD	25	25
OCDF	30	30
<b>Internal Standards</b>		
13C-2,3,7,8-TCDD	25	25
13C-1,2,3,7,8-PeCDD	30	30
13C-1,2,3,6,7,8-HxCDD	25	25
13C-1,2,3,4,6,7,8-HpCDD	30	30
13C-OCDD	30	30
13C-2,3,7,8-TCDF	30	30
13C-1,2,3,7,8-PeCDF	30	30
13C-1,2,3,4,7,8-HxCDF	30	30
13C-1,2,3,4,6,7,8-HpCDF	30	30
<b>Surrogate Sampling Standards</b>		
37Cl-2,3,7,8-TCDD	25	25
13C-2,3,4,7,8-PeCDF	25	25
13C-1,2,3,4,7,8-HxCDD	25	25
13C-1,2,3,4,7,8-HxCDF	25	25
13C-1,2,3,4,7,8,9-HpCDF	25	25

**TABLE 13: METHOD HOLDING TIMES**

<b>Method</b>	<b>Collection to Extraction</b>	<b>Extraction to Analysis</b>
8290A	None	
1613B	365 days	365 days
DLM02.2	365 days	365 days
M23	30 days	45 days
TO-9a	7 days	40 days
CBC01.2	35 days collect to analysis	
1668A/C	365 days	365 days

**FIGURE 1: 2378-TCDD CHROMATOGRAPHIC SEPARATION**



**FIGURE 2: INSTRUMENT RESOLVING POWER (EXAMPLE)**

Experiment Calibration Report

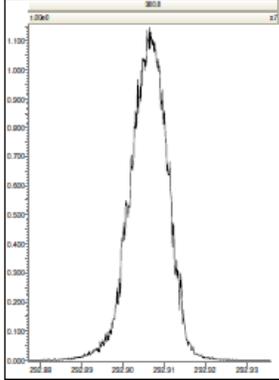
MassLynx 4.1

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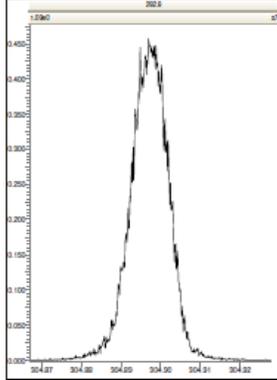
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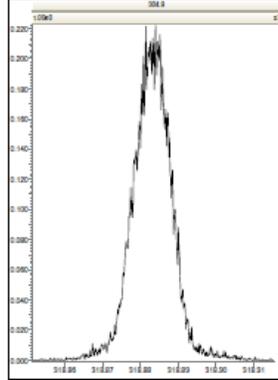
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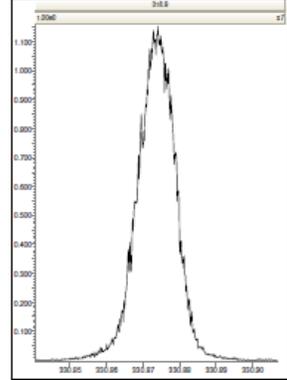
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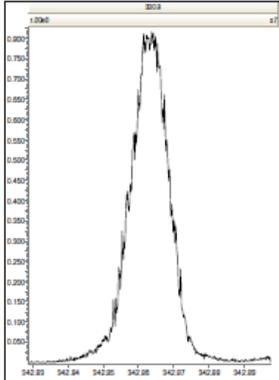
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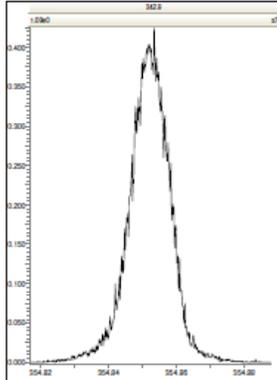
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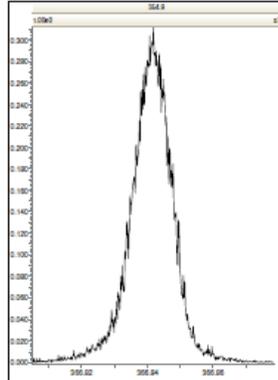
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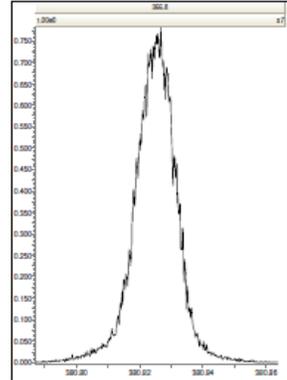
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M 366.9792 R 12500



M 380.9760 R 13093



**STANDARD OPERATING PROCEDURE**  
**FOR**  
**THE ANALYSIS OF POLYCHLORINATED BIPHENYLS (PCBs)**  
**BY**  
**HIGH-RESOLUTION GAS CHROMATOGRAPHY/HIGH-**  
**RESOLUTION MASS SPECTROMETRY (HRGC/HRMS)**  
**(CF-OA-E-003)**

APPLICABLE TO METHOD:  
EPA Method 1668A and C

PROPRIETARY INFORMATION

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Laboratory Director		

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## **1.0 STANDARD OPERATING PROCEDURE FOR THE ANALYSIS OF POLYCHLORINATED BIPHENYLS (PCB) BY HIGH-RESOLUTION GAS CHROMATOGRAPHY/HIGH-RESOLUTION MASS SPECTROMETRY (HRGC/HRMS)**

### **2.0 METHOD OBJECTIVE, PURPOSE, CODE AND SUMMARY**

This standard operating procedure (SOP) covers the analytical determination of PCBs according to EPA Method 1668, Revisions A & C.

### **3.0 APPLICABLE MATRICES**

Applicable matrices include groundwater, wastewater, surface water, leachate, soil, sediment, sludge, oil, and tissue.

### **4.0 METHOD SCOPE, APPLICABILITY AND DETECTION LIMIT**

4.1 Method 1668 may be used to quantify PCBs that are soluble in methylene chloride and/or toluene. The compounds are separated using a gas chromatograph (GC) and detected using a high-resolution double focusing mass spectrometer (HRMS). Appendix 1 lists the analytes currently analyzed using these methods and their practical quantitation limits.

4.2 The practical quantitation limit (PQL) is the lowest level in the calibration curve. The PQL is the lowest level at which compounds may be accurately quantitated and is compound dependent. The calibration curve typically ranges from 0.5 ng/mL to 2000 ng/mL. These ranges reflect instrument readings, which are in ng/mL (ppb). It should be noted that the calibration range may vary between calibrations and instruments.

4.3 Method detection limit studies (MDLs) are performed and/or verified on an annual basis. MDLs are done for aqueous, solid, and tissue matrices. For more information regarding MDLs, refer to The Determination of Method Detection Limits, CF-LB-E-001.

4.4 Qualified analysts must demonstrate proficiency initially and annually thereafter with an IDOC, CDOC or PT study. Acceptability criteria may be found in the analytical method.

4.4.1 To establish the ability to generate acceptable accuracy and precision, the analyst should perform an "analyst validation study" or Initial Demonstration of Capability. Four LCS standards are extracted and analyzed. Calculate the average recovery and the standard deviation of the recovery for each analyte of interest using the four results. Then compare the average and the standard deviation with the corresponding criteria found in Table 6 of Method 1668A or C as appropriate. If the average and the standard deviation for all analytes of interest meet the acceptance criteria, then the analyst may begin work on actual samples. If the validation study fails for one or more of the compounds, then the study must be repeated for those compounds which failed.

### **5.0 METHOD VARIATIONS**

5.1 Sample extracts are stored at room temperature to avoid analyte loss. Many of the target analytes in these methods form a strong cohesive bond with solids such as glass in cold temperatures; this type of analyte loss is not addressed in the method. (This is a variance from the following method recommendations: -10° to -20° C per DoD QSM.)

5.2 The analytical method does not address the reporting of EDL and EMPC. These values are reported only when requested by the client.

- 5.3 Project specific modifications are allowed to meet the data quality objectives of the Delaware River Basin Commission.

## 6.0 DEFINITIONS

- 6.1 Accuracy: The degree of agreement between an observed value and an accepted reference value.
- 6.2 AlphaLIMS: The Laboratory Information Management System used at CFA, LLC.
- 6.3 Blank: An aliquot of reagent water or other blank matrix that is treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents, and standard additions that are used with other samples. The LMB (Lab Method Blank) is used to determine if method analytes or other interferences are present in the laboratory environment, the reagents, or the apparatus. Contamination may be derived during sampling, transportation, storage or analysis. The blank may be used to establish a background value.
- 6.4 Calibration Standard (CAL): An aliquot of a primary standard solution or stock standard solution. The CAL solutions are used to calibrate the instrument response with respect to analyte concentration.
- 6.5 Calibration Verification Standard (CVS, CCAL): A solution of target analytes with a concentration near the mid-point of the calibration range. It should be obtained from a second source vendor and is used to verify the initial calibration on a basis described in the determinative method.
- 6.6 Cleanup Standards: Isotopes added prior to cleanup that are used to measure the efficiency of the fractionation step alone. Method 1668 uses three compounds as the Cleanup Standards.
- 6.7 Duplicate Analysis: The analysis or measurement of the variable of interest performed identically on two field subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision of sample, preservation, or storage internal to the laboratory.
- 6.8 Estimated Detection Limit (EDL): A calculation of the concentration of a given analyte required to produce a signal with a peak height of at least 2.5 times the background signal level. The EDL is calculated for each congener that is not identified.
- 6.9 Estimated Maximum Possible Concentration (EMPC): A calculation for a peak characterized by a response with a signal-to-noise ratio of at least 2.5 for both the quantitation ions, and meeting all identification criteria except ion ratio. EMPC is a worst-case estimate of the concentration.
- 6.10 Extraction Standards: Isotopes added prior to extraction that serve as internal standards for many PCB congeners. In addition, to measure the overall extraction and fractionation efficiencies. Method 1668 names them Labeled Compounds.
- 6.11 Injection Standards: Isotopes added prior to injection to determine the recoveries of the Extraction and Cleanup Standards. Method 1668 calls them Internal Standards.
- 6.12 Internal Standard (ISTD): A known amount of standard added to a test portion of a sample as a reference for evaluating the retention time and concentration of dependent analytes and controlling the precision and bias of the applied analytical method.
- 6.13 Laboratory Control Standard/Duplicate (LCS/LCSD): Aliquots of reagent water or other blank matrix to which known quantities of the method analytes are added in the

laboratory. The LCS/LCSD are analyzed exactly like a sample, and the purpose is to determine whether the methodology is in control, and whether the laboratory is capable of making accurate and precise measurements.

- 6.14 Laboratory Duplicate (DUP): Aliquots of a sample taken from the same container and processed in the same manner under identical laboratory conditions. The aliquot is analyzed independently from the parent sample and the results are compared to measure precision and accuracy.
- 6.15 Matrix Spike and Matrix Spike Duplicate (MS and MSD): Two separate aliquots of an environmental sample to which known quantities of the method analytes are added in the laboratory. The MS and MSD are analyzed exactly like a sample, and their purpose is to determine whether the sample matrix contributes bias to the analytical results. The concentrations of the analytes in the sample matrix must be determined in a separate aliquot and the measured values in the MS/MSD adjusted. Percent recovery is calculated for both aliquots, and RPD is calculated between the two.
- 6.16 Method Detection Limit (MDL): The minimum concentration of an analyte that can be identified, measured and reported with 99% confidence that the analyte concentration is greater than zero.
- 6.17 Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves, a data quality indicator. Precision is usually expressed as standard deviation, variance or range in either absolute or relative terms.
- 6.18 Quantitation Limits (also PQL, RL): The value at which an instrument can accurately measure an analyte at a specific concentration (i.e., a specific numeric concentration can be quantified). These points are primarily established by the upper and lower limits of the linear calibration range, but may be elevated as needed.

## 7.0 INTERFERENCES/LIMITATIONS

- 7.1 Contaminants found in extraction glassware, solvents, and other sample processing hardware may jeopardize the integrity of this method.
- 7.2 Glassware must be scrupulously cleaned as soon as possible after extraction.
- 7.3 Contamination may also occur in the GC/MS system. High boiling materials tend to build up in the injection port and the front end of the column. The analyst should maintain a thorough working knowledge of keeping the injection port free of contamination, including changing out the septum, injection port liner, O-ring, ferrule, and gold seal.
- 7.4 Contamination by carryover can occur whenever high-level and low-level samples are sequentially analyzed. To reduce carryover, the sample syringe must be rinsed with solvent between samples. If carryover is suspected, potentially impacted samples should be re-analyzed after any needed maintenance, solvent replacement, and/or cleaning has been done.

## 8.0 SAFETY PRECAUTIONS AND WARNINGS

METHYLENE CHLORIDE IS A SUSPECTED CARCINOGEN AND A KNOWN SKIN IRRITANT. PCBs HAVE BEEN TENTATIVELY CLASSIFIED AS KNOWN OR SUSPECTED MAMMALIAN CARCINOGENS.

CONTACT WITH OXIDIZERS MAY GENERATE EXPLOSIVE MIXTURES.

PREVENT SKIN AND EYE CONTACT BY USING SPECIFIED PERSONAL PROTECTIVE EQUIPMENT WHEN MAKING STOCK REAGENTS.

WORK UNDER A HOOD TO PREVENT INHALATION WHEN MAKING STOCK REAGENTS FROM SOLIDS.

- 8.1 Eye protection should be worn when handling samples, reagents, or standards.  
NOTE: Contact lenses pose a special problem; soft lenses may absorb irritants and all lenses concentrate them. DO NOT wear contact lenses in the laboratory.
- 8.2 Treat all chemicals and samples as potential health hazards and reduce exposure to these chemicals to the lowest level possible. CFA maintains a reference file of Material Safety Data Sheets (MSDS) for each chemical and standard. These documents and individual sample MSDS provided by clients are maintained in the laboratory.
- 8.3 Personal Protective Equipment (PPE)
  - 8.3.1 Gloves and eye protection should be worn when handling reagents, solvents, standards and samples.
  - 8.3.2 Analysts should prepare samples and standards under the hood.
- 8.4 All samples, chemicals, extracts, and extraction residues must be transferred, delivered, and disposed of safely according to all related SOPs.
- 8.5 Never leave gas cylinders unchained or untied.
- 8.6 In the event of an accident or medical emergency, call for help immediately. When time and safety permit, management should be notified of all accidents.
- 8.7 Fire escape routes are posted in the lab, and all personnel should be familiar with them. In addition, fire safety equipment such as fire extinguishers and fire blankets are located in the lab. Training is available on the proper operation of this equipment.
- 8.8 The analyst must use care when assembling and operating instrumentation. Check to see that the gas chromatograph equipment is properly assembled and hooked up to the proper gas cylinder and power, referencing the appropriate manual. Analytical equipment must only be operated by qualified personnel.
- 8.9 For further safety instructions, consult the Safety, Health and Chemical Hygiene Plan, CF-LB-N-001.

## 9.0 APPARATUS, EQUIPMENT AND INSTRUMENTATION

- 9.1 Equipment associated with this method includes:
  - 9.1.1 Gas tight syringes
  - 9.1.2 2 mL high recovery (conical) autosampler vials and storage racks
  - 9.1.3 Teflon crimp tops
  - 9.1.4 Crimper/De-crimper
  - 9.1.5 GC Column (SPB-Octyl or equivalent; 30m, 0.25 mm, 0.25 um)
  - 9.1.6 Quartz/Glass injection port liners
  - 9.1.7 Injection port liner O-ring seals
  - 9.1.8 Gold seals
  - 9.1.9 Ferrules
  - 9.1.10 Column cleaving tool
  - 9.1.11 Septa (thermogreen)
  - 9.1.12 0.5-10 uL adjustable air displacement pipette with disposable tips

## 9.2 Instrumentation

### 9.2.1 Waters Autospec Premier high resolution mass spectrometer

9.2.1.1 The MassLynx workstation software is used for instrument control and data acquisition of the AutoSpec-NT SIOS hardware embedded PC based system running the industry standard VxWorks real-time. The workstation operating system used is Windows XP SP2 or SP3 to support Masslynx v4.1.

9.2.1.2 The TargetLynx Application Manager is used for post-acquisition processing and general data manipulation. The workstation operating system used is Windows XP SP2 or SP3 to support Targetlynx v4.1. Post-acquisition processing and general data manipulation can be carried out by an additional computer workstation and software installation.

### 9.2.2 Agilent 7890 Gas Chromatograph

9.2.2.1 A suggested temperature program follows:

Temperature 1	150° C
Time 1	2.0 min.
Rate	5° C/min.
Temperature 2	180° C
Time 2	1.5°/min
Final Temperature	265° C
Run Time:	55 minutes (may vary due to column length or flow rate)
Solvent Delay:	6.0 min.
Splitless Valve Time:	2.0 min.
Flow:	1.0 mL/min.
Mass Range:	See descriptor definitions (Table 2)

**NOTE:** These instrument conditions and rates are guidelines which may change.

### 9.2.3 LEAP Technologies GC PAL Autosampler

9.2.3.1 Suggested parameters:

Sample volume –	1 µL
Air volume –	0.5 µL
Solvent push volume –	1 µL
Number of sample washes -	0
Solvent washes -	30
Sample viscosity wait –	1 second
Number of sample pumps -	0
Injection mode -	Fast

## 10.0 REAGENTS AND STANDARDS

### 10.1 Reagents and standards

#### 10.1.1 Nonane

- 10.1.2 Source Standards: Source Standards are purchased directly from vendors and may be diluted to make stock, intermediate, or working standards. These may include extraction standard, matrix spiking standard, cleanup standard, injection standard, as well as others. Source standards expire per the vendor expiration date or after five years from the date opened, whichever is shorter. Please reference CF-LB-E-007 for further information regarding standards and their preparation.
- 10.1.3 Initial Calibration (ICAL) Standards: Certified calibration standards are purchased from commercial vendors at a minimum of five concentration levels. One of the calibration standards is at a concentration near, but above, the method detection limit; the others should correspond to the expected range of compounds found in samples. Calibration standards expire after a maximum of five years and should be monitored frequently for signs of degradation.
- 10.1.4 Calibration Verification Standards (CVS, CCAL, CS3): A certified CVS is purchased from a second source commercial vendor at a concentration that is near to the midpoint of the calibration curve.
- 10.1.5 Window Defining Mix and Column Performance Mix (WDM and CPM): A standard containing the first and last eluters for each homolog group, as well as the isomers used to demonstrate isomer specificity on the GC column in use. Usually contained in the daily 209 injection mix.

## 11.0 SAMPLE HANDLING AND PRESERVATION

- 11.1 Samples have a one year holding time from the date of collection, and a one year holding time from the date of extraction.
- 11.2 Sample extracts are delivered from the prep lab to the instrument lab and are stored in a darkened hood at room temperature. The extracts are usually grouped according to batches and are accompanied by the batch pull sheet and other pertinent paperwork.
- 11.3 Custody of samples is monitored using the AlphaLIMS sample tracking system. Each analyst should scan the samples planned to run into their custody prior to analysis.
- 11.4 All sample extracts should be treated with caution as potential health hazards. Refer to Section 8.0 on safety.

## 12.0 SAMPLE PREPARATION

- 12.1 Before extracts can be analyzed on the instrument, they must first be evaporated to 18 uL nonane (added after cleanup steps) under nitrogen and then spiked with injection standard to set the final volume nominally at 20  $\mu$ L. A determination must also be made as to whether the extract should be diluted. The decision to dilute a sample extract is based on a number of factors: sample screening, historical data about the sample or sample site, the appearance of the extract (color, viscosity, incidental odor, turbidity, etc.), or regulatory considerations. The experience of the analyst is invaluable in making this determination.

**NOTE:** Sample extracts may contain multiple layers or sediment. Samples that contain sediment are returned to cleanup. Multiple layers are treated on a case-by-case basis. If the extract can be homogenized, then a uniform sample is achieved. If the extract remains bi-phasic, the PM and client are contacted for further guidance.

- 12.2 If a sample is to be analyzed without dilution ('neat'), 2 nanograms of injection standard solution is added to the extract using a pipette (2  $\mu$ L of a 1.0 ng/ $\mu$ L = 100

pg/ $\mu$ L extract concentration). A cap is then placed on the vial and secured by crimping before vortexing the sample to ensure complete mixing and vial wall washing.

- 12.3 If samples require dilution, the dilution is made using nonane or appropriate solvent. If not previously added, 2 nanograms of JS is added to the autosampler vial. Dilution prep may involve the addition of supplemental extraction standard (ES) and is documented in the injection prep logbook.
- 12.4 Once samples are prepped, they are ready to be injected onto the instrument. An autosampler is used to inject standards and sample extracts on the instrument.
- 12.5 The need for dilution may also be determined after analysis is performed, and may still be performed as above. Under normal circumstances, a sample would be diluted if any chromatographic peaks saturate the detector.

### 13.0 QUALITY CONTROL SAMPLES AND REQUIREMENTS

Typically a blank (LMB), laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) are extracted and analyzed with each prep batch. Other client requirements may include a matrix spike (MS) and matrix spike duplicate (MSD) or sample duplicate (DUP).

#### 13.1 Blanks

- 13.1.1 A blank is extracted with each batch of 20 or fewer samples to demonstrate that interferences from glassware, reagents and the analytical system are under control. Blanks are carried through all stages of sample preparation and analysis. An acceptable blank must be below the minimum levels listed in Table 2 of the method for all analytes.
- 13.1.2 The percent recovery of each labeled standard (extraction and cleanup) is calculated as shown in Sec. 19.1.3. Recoveries must be within the limits in Table 5.

#### 13.2 Laboratory Control Samples and Matrix Spikes

- 13.2.1 The spiking standard for LCS/LCSDs and MS/MSDs contains all analytes listed in Table 4. For each LCS, LCSD, MS and MSD, the concentration of each analyte and its percent recovery are calculated as shown in Sec. 19.1.1 and 19.1.3. Recovered concentrations should be within the limits in Table 5.
- 13.2.2 If recovery is not within these limits, the data may need to be re-checked for errors, or the samples and QC may need to be re-analyzed. In addition, the instrumentation may need to be checked for performance problems. If the LCS fails to meet acceptance criteria due to low recovery, the associated samples may have to be re-extracted and re-analyzed when possible. If one or more recoveries are high in the LCS and these analytes are not detected in the samples, the event should be documented and data may be reported. If the MS and MSD both fail due to matrix interference and/or dilution, data may be reported provided the associated LCS passes acceptance criteria.  
**NOTE:** Many clients have contract specific criteria that must be considered when evaluating recovery of the Quality Control samples.
- 13.2.3 The percent recovery of each labeled standard (extraction and cleanup) is calculated as shown in Sec. 19.1.3. Recoveries must be within the limits in Table 5.

#### 13.3 Samples

- 13.3.1 The percent recovery of each labeled standard (as outlined in SOP CF-OA-E-001) is calculated as shown in Sec. 19.1.3. Recoveries must be within the limits in Table 5.
- 13.3.2 Calculated EDLs should be below the PQLs. Any reported EDLs above the PQLs should be noted in the case narrative.

#### 14.0 INSTRUMENT CALIBRATION, STANDARDIZATION AND PERFORMANCE

##### 14.1 Mass spectrometer performance

- 14.1.1 The mass spectrometer is operated in electron ionization mode. A static resolving power of at least 10,000 (10 percent valley definition) must be demonstrated at appropriate masses before any analysis is performed. Static resolving power checks must be performed at the beginning and at the end of each 12-hr period of operation. Corrective action must be implemented whenever the resolving power does not meet the requirement.

14.1.1.1 Chromatography time for PCBs exceeds the long term mass stability of the mass spectrometer. Because the instrument is operated in the high-resolution mode, mass drifts of a few ppm (e.g., 5 ppm in mass) can have serious adverse effects on instrument performance. Therefore, a mass drift correction is mandatory. A lock-mass ion from the reference compound PFK is used for tuning the mass spectrometer. The selection of the lock-mass ion is dependent on the masses of the ions monitored within each descriptor. Lock mass ions may be found in the descriptor table, Table 2. The level of the reference compound (PFK) metered into the ion chamber during HRGC/HRMS analyses should be adjusted so that the amplitude of the most intense selected lock-mass ion signal (regardless of the descriptor number) does not exceed 10 percent of the full scale deflection for a given set of detector parameters. Under these conditions, sensitivity changes that might occur during the analysis can be more effectively monitored. NOTE: Excessive PFK (or any other reference substance) may cause noise problems and contamination of the ion source resulting in an increase in downtime for source cleaning.

- 14.1.2 Documentation of the instrument resolving power must be accomplished by recording the peak profile of the high-mass reference signal ( $m/z$  380.9760) obtained during the above peak matching experiment by using the low mass PFK ion at  $m/z$  304.9824 as a reference. The minimum resolving power of 10,000 must be demonstrated on the high-mass ion while it is transmitted at a lower accelerating voltage than the low-mass reference ion, which is transmitted at full sensitivity. The format of the peak profile representation must allow manual determination of the resolution, i.e., the horizontal axis must be a calibrated mass scale (amu or ppm per division). The result of the peak width measurement (performed at 5 percent of the maximum, which corresponds to the 10 percent valley definition) must appear on the hard copy and cannot exceed 100 ppm at  $m/z$  380.9760 (or 0.038 amu at that particular mass).

##### 14.2 System Performance

System performance criteria are presented below. The laboratory may use the recommended GC column described in Sec. 9.1.5. The laboratory must document that all applicable system performance criteria were met before sample analysis begins. Sec. 9.2.2.1 provides recommended GC conditions that may be used to satisfy the required criteria. A GC column performance check is required at the beginning of each 12-hr period during which samples are analyzed. A continuing calibration must be performed at the beginning of the sequence.

#### 14.2.1 Daily 209 injection mix

- 14.2.1.1 Inject 1 uL of the daily 209 injection mix solution and acquire selected ion monitoring (SIM) data within a total cycle time of  $\leq 1.5$  second. The chromatographic separation between congeners 34-TrCB and 23-TrCB, and between congeners 187-HxCB and 182-HxCB, must be resolved with a valley of  $\leq 40$  percent, where:

$$\text{Valley percent} = (x/y) \times 100$$

x = the height of the valley

y = the peak height of the shorter of the two peaks

Congeners 156-HxCB and 157-HxCB must also co-elute within 2 seconds.

- 14.2.1.2 The daily 209 injection mix contains all 209 PCB congeners, and may thus be used to identify the first and last PCB eluters in each congener group, and in each analytical descriptor. Their retention times are used to determine the seven homologue retention time windows that are used for qualitative (Sec. 15.4.1.1) and quantitative purposes.

### 14.3 Initial Calibration

- 14.3.1 Prior to running a multi-level calibration, take precautions to ensure that the instrument meets system performance criteria. The analyst must document that all system performance criteria are met before analyzing an initial calibration.
- 14.3.2 Initial calibration is required before any samples are analyzed for PCBs and must meet the acceptance criteria in this section. Initial calibration is also required if any routine calibration does not meet the required criteria listed in Sec. 15.3, and at a minimum, annually.
- 14.3.3 At a minimum, all five high-resolution concentration calibration solutions listed in Table 4 must be used for the initial calibration. A lower calibration point of 0.5pg/ul is used for DRBC.
- 14.3.4 Tune the instrument with PFK to meet the above-specified system performance criteria.
- 14.3.5 Inject the daily 209 injection mix solution and acquire SIM mass spectral data. The laboratory must not perform any further analysis until it is demonstrated and documented that the criteria listed in Sec. 14.2.1 are met.
- 14.3.6 By using the same conditions (GC and MS) that produced acceptable results with the 209 injection mix solution, analyze each of the five concentration calibration solutions. Each injection must meet the following ion ratio and signal-to-noise (S/N) requirements:

- 14.3.6.1 The ratio of integrated ion current for the ions appearing in Table 2 (homologous series quantitation ions) must be within the indicated control limits (set for each homologous series) in Table 3. These ion ratio requirements must be within the specified control limits simultaneously in one run. It is the analyst's responsibility to take corrective action if the ion abundance ratios are outside the limits.
- 14.3.6.2 For each selected ion current profile (SICP) and for each GC signal corresponding to the elution of a target analyte and of its labeled standards, the S/N ratio must be better than or equal to 10. Manual measurement of S/N is required for any GC peak that has an apparent S/N of less than 15:1. The result of the measurement must appear on the SICP above the GC peak in question. NOTE: An interference with PFK m/z 223.9872 may preclude meeting this requirement for DiCB congeners. Suspected column bleed interference may preclude meeting this requirement in other congeners groups. These interferences are noted in the low calibration levels, CS1 and below. If interference occurs, 10:1 S/N must be met at the CS2 level. The lower calibration points are still included in the initial calibration.
- 14.3.6.3 Manual integrations, if required, are performed and documented according to SOP CF-LB-E-017.
- 14.3.7 Calculate the relative response factors (RF) for unlabeled target analytes relative to their appropriate internal standards. Also calculate the RFs for the ESs and CSs relative to the appropriate injection standards according to the following formula:

$$RF = \frac{A_x C_{is}}{A_{is} C_x}$$

Where:

A<sub>x</sub> = Sum of the Areas of the two characteristic ions for the compound being measured.

A<sub>is</sub> = Sum of the Areas of the two characteristic ions for the specific internal standard.

C<sub>is</sub> = Concentration of the specific internal standard.

C<sub>x</sub> = Concentration of the compound being measured.

The RF is a dimensionless quantity; the units used to express C<sub>is</sub> and C<sub>x</sub> must be the same.

- 14.3.8 Because more than five calibration levels may be analyzed, the analyst may choose to deactivate one or more levels. The low standard representing the PQL cannot be deactivated. CFA only includes calibration points below the PQL at the request of the client (drinking water states, TMDL, etc.). If warranted, a mid-level standard is deactivated for all analytes (globally) in that calibration mixture. An upper level(s) standard may be deactivated to meet method criteria for single compounds. This practice results in a narrower calibration range. The analyst must get supervisory approval before deactivating any calibration levels within the method calibration range. Following approval, management will document the situation,

including reasonable cause for calibration level removal. Calibrations with rejected mid-level points are not used for DOE clients. Please note that this practice does not represent “cherry picking,” which is acknowledged as an unacceptable laboratory practice.

14.3.9 The average RF must be calculated for each compound as follows:

$$RF_{avg} = \frac{\sum_{i=1}^n X}{n}$$

Where:

$N$  = number of calibration levels

$X_i$ ;  $i=1$  to  $n$ , are the compounds RF values for each calibration point

14.3.10 Criteria for acceptable initial calibration

The criteria listed below for acceptable calibration must be met before sample analyses are performed.

14.3.10.1 The percent relative standard deviations for the mean response factors from the unlabeled standards must not exceed  $\pm 20$  percent.

$$\%RSD = \frac{SD}{\bar{x}} \times 100$$

Where:

RSD = relative standard deviation

$\bar{x}$  = mean of 5 or more initial RFs for a compound

SD = standard deviation of average RFs for a compound

$$SD = \sqrt{\frac{\sum_{i=1}^n (X - A)^2}{n - 1}}$$

where:

$n$  = number of calibration levels

$X_i$ ;  $i=1$  to  $n$ , are the compounds RF values for each calibration point

$A$  = average of the RFs from above

14.3.10.2 The percent relative standard deviations for the mean response factors from the labeled standards must not exceed  $\pm 30$  percent.

## 15.0 PROCEDURE FOR ANALYSIS AND INSTRUMENT OPERATION

### 15.1 Resolution check

15.1.1 At the beginning and end of each 12-hour window, mass resolution must be tuned and/or verified. A static resolving power of at least 10,000 must be demonstrated at appropriate masses before analysis is performed.

15.1.2 Using a PFK molecular leak, tune the instrument to the minimum required resolving power of 10,000 at  $m/z$  330.9792 (for day to day operations, the instrument may be tuned to approximately 11,000). Verify that the exact mass of  $m/z$  380.9760 is within 5 ppm of the required value. Due to the

wide mass ranges required for PCB analysis, resolution may drop to 8000 at either end of the descriptor, but should be >10,000 at the midpoint.

## 15.2 Daily 209 injection mix

Inject 1 uL of the daily 209 mix. Verify that all column performance and window defining criteria in Section 14.2.1 have been met.

## 15.3 Continuing Calibration

15.3.1 The initial calibration curve for each compound of interest must be verified once every 12 hours. Inject 1 uL of the CS3 standard. For 1668C, the Daily 209 injection mix is used to satisfy the calibration verification criteria.

Calculate the percent difference using:

$$\% \text{ Difference} = \frac{|\overline{\text{RF}}_i - \text{RF}_c|}{\overline{\text{RF}}_i} \times 100$$

Where:

$\overline{\text{RF}}_i$  = average response factor from initial calibration

$\text{RF}_c$  = response factor from current CS3

15.3.1.1 For Method 1668A, if the percent difference for each native analyte is  $\leq 30\%$ , and for each labeled analyte is  $\leq 50\%$ , the calibration is assumed to be valid. Method 1668C criteria are listed in Table 7. If the criteria are not met, corrective action should be taken. If no source of the problem can be determined after corrective action has been taken, a new initial calibration may need to be generated.

15.3.1.2 All ion ratios must be within the limits in Table 3.

## 15.4 Sample Analysis

### 15.4.1 Data Interpretation

#### 15.4.1.1 Qualitative Analysis

For a peak to be identified as a PCB, it must meet all of the criteria listed below.

15.4.1.1.1 The signals for the two m/z's being monitored must be present and maximize within the same two scans.

15.4.1.1.2 The signal-to-noise ratio between the two m/z's must be  $\geq 2.5$  for each PCB detected in a sample extract, and  $\geq 10$  for all PCBs in the calibration and verification standards. (DiCBs suffer from PFK interference and are not required to meet 10:1 until the CS2. Other PCBs suffer from suspected column bleed interference and are only required to meet 2.5:1 in calibration points below the CS1.)

15.4.1.1.3 Ion ratios must be within the limits in Table 3.

15.4.1.1.4 The relative retention time of the peak for a PCB must be within the RRT limits calculated as specified in Table 8 based on the RT limits provided.

15.4.1.1.5 Congener overlap, interfering substances, or the loss of chlorine from a higher chlorinated congener may make

it difficult to meet all identification criteria. In these cases, an experienced spectrometrists must determine the presence or absence of the congener.

#### 15.4.1.2 Calibration Limit Exceedance

15.4.1.2.1 If a compound in a sample exceeds the upper calibration limit, all subsequent samples must be checked for carryover contamination.

15.4.1.2.2 When a subsequent sample is non-detect for the compound in question, the sequence is again considered acceptable for reporting.

15.4.1.2.3 All affected samples between the exceeding sample and the non-detect sample must be re-analyzed.

## 16.0 EQUIPMENT AND INSTRUMENT MAINTENANCE

16.1 Preventive maintenance on a HRGC/HRMS system involves the following basic areas:

16.1.1 Vacuum pumps for the inlets, source, and analyzer need a change of oil about every year or when system performance indicates it is needed.

16.1.2 The GC injection port is cleaned as needed, approximately once a week. It is recommended that the septum and injection port liner be replaced at the time of cleaning. Additionally, the gold plated seal should be cleaned or replaced.

16.1.3 Ion source maintenance is usage dependent. The type and quantity of samples that have been injected determine the frequency of ion source cleaning and filament replacement.

16.1.4 Autosampler maintenance is primarily that of cleanliness. Most autosamplers need their moving parts to be clean and lightly lubricated. The most frequent corrective maintenance is that of changing the syringe, usually about once per month.

16.1.5 Instrument maintenance logs are kept with each instrument and serve as a record of all the maintenance that has been done on the instrument.

16.2 Non-Routine Maintenance Procedures (Special, Operational or Failure Mode Maintenance)

16.2.1 Service is provided to the instrument via the analyst, the in-house instrument service engineer, or a technical support specialist from the manufacturer. When instrument failure occurs, different parts of the instrument are isolated to determine the root cause. For example, the injection port may be capped off if a leak is suspected to prove the leak is/is not coming from that source. Instrument maintenance logbooks are kept for each instrument detailing the type of maintenance performed on the instrument and when it was performed. Preventive maintenance visits are scheduled annually for the mass spectrometers.

16.2.2 Analytical GC columns are clipped or replaced when the existing column shows signs of excessive degradation or the inability to properly resolve chromatographic peaks. Excessive peak tailing, poor responses, and baseline disturbances may also indicate that the column needs to be replaced.

**17.0 DATA RECORDING, CALCULATION AND REDUCTION METHODS**

- 17.1 Data are evaluated qualitatively and quantitatively using a software program such as Waters MassLynx, or equivalent data system.
- 17.2 Data are reviewed, and a hard copy is generated. If manual integrations are made, a hard copy of the manual integration is printed and initialed by the analyst and included with the raw data.
- 17.3 Additional supporting documentation, such as totals pages generated by the software may be included with the data.
- 17.4 Quantitative Analysis

- 17.4.1 The concentration (ng/L for aqueous, ng/g for solids) of each identified compound in the sample is calculated as follows:

$$[PCB] = \frac{(A_{unk}^{ion1} + A_{unk}^{ion2})}{(A_{ES}^{ion1} + A_{ES}^{ion2})} \times \frac{Q_{ES}}{W_{unk} \times D \times \overline{RF}}$$

Where:

$A_{unk}$  and  $A_{ES}$  = the integrated area for each ion monitored.

$Q_{ES}$  = the amount of extraction standard added to the sample in nanograms

$W_{unk}$  = the initial sample aliquot size, in liters for waters and in grams for solids.

$D$  = (% moisture in sample)/100, or 1 for waters

$\overline{RF}$  = Average RF from the ICAL for the compound

- 17.4.2 The concentration of each extraction and cleanup standard is calculated as follows:

$$[ES_{ng}] = \frac{(A_{ES}^{ion1} + A_{ES}^{ion2})}{(A_{JS}^{ion1} + A_{JS}^{ion2})} \times \frac{Q_{JS}}{\overline{RF}}$$

Where:

$A_{ES}$  and  $A_{JS}$  = the integrated area for each ion monitored.

$Q_{JS}$  = the amount of injection standard added to the sample in nanograms

$\overline{RF}$  = Average RF from the ICAL for the compound

The cleanup standard concentration is calculated as above, substituting the area of the individual cleanup standard ions for the extraction standard ions.

- 17.4.3 Percent recovery is calculated as follows:

$$\%R = \frac{R_{ng}}{S_{ng}} \times 100$$

Where:

$R_{ng}$  = the amount of standard recovered in nanograms.

$S_{ng}$  = the amount of standard spiked in nanograms.

**18.0 POLLUTION/CONTAMINATION**

- 18.1 Work area should be maintained free of dust and dirt accumulations.
- 18.2 Fume hoods are utilized to remove fumes and reduce the risk of airborne contaminants to ensure personnel safety. Hoods are monitored in accordance with CF-FC-E-003 for Fume Hood Face Velocity Performance Checks.
- 18.3 The laboratory area is restricted to authorized personnel.

**19.0 DATA REVIEW, APPROVAL AND TRANSMITTAL**

- 19.1 A review process is used to insure the quality of the data. Raw data are reviewed first by the analyst, then by a second (peer) analyst or a data validator. When the analyst is satisfied that the data have been correctly processed and uploaded to the LIMS, a data report is generated from AlphaLIMS. The AlphaLIMS report along with the raw data and supporting documentation, such as a run log and case narrative, are submitted for review to the data validator or another experienced analyst. The reviewer goes through the raw data as if he/she was working it up for the first time and verifies that they are correct. In addition, he/she must make sure that the data have been correctly entered into AlphaLIMS. AlphaLIMS reports may be self-reviewed. If errors are discovered in either the raw data or the AlphaLIMS report, then the two analysts should discuss the differences and how best to resolve them. In some cases, the peer review process may uncover errors that lead to a sample being re-extracted or re-run. In cases such as these, a nonconformance report (NCR) should be completed and submitted to the Quality department. It is recommended that a copy of the NCR be given to the prep analyst if it involves a re-extraction and that a copy be kept with the original data.
- 19.2 Once the data review has been completed by the reviewer, the batch is returned to the analyst for corrections (if applicable) and the status is updated from REVW to DONE in AlphaLIMS.
- 19.3 Data may be transmitted automatically to AlphaLIMS. This automatic "upload" procedure may be activated prior to data review or after data review is complete. In either case, the data recorded in AlphaLIMS are checked by the analyst for accuracy and completeness.

**20.0 CORRECTIVE ACTION FOR OUT-OF-CONTROL OR UNACCEPTABLE DATA**

Corrective action for out-of-control data may require instrument maintenance, re-analysis, re-extraction, or a more complex set of actions. When troubleshooting measures fail to bring an analytical process or data into control, a nonconformance report and/or corrective action should be initiated in accordance with CF-QS-E-004 for the Documentation of Nonconformance Reporting and Dispositioning and Control of Nonconforming Items, and CF-QS-E-002 for Conducting Corrective Action.

**21.0 CONTINGENCIES FOR HANDLING THESE SITUATIONS**

Troubleshooting is used to determine the appropriate action to take when an initial or continuing calibration, blank and/or laboratory control sample fails to meet the acceptance criteria defined for the method. Troubleshooting may involve one or more of the following actions:

- 21.1 If analytes in a multi-point calibration fail to meet specified criteria, additional standards for the failing compounds may need to be reanalyzed. If they still do not meet specifications, instrument maintenance or new standards may be required before work is continued.
- 21.2 If a continuing calibration fails to meet specified criteria, instrument tuning or inlet maintenance may be required. If these attempts fail, a new initial calibration must be analyzed.
- 21.3 If a method blank fails to meet defined criteria, the source of contamination should be found and eliminated before proceeding with analysis.
- 21.4 If a LCS fails to meet specified criteria, the process should be reviewed to identify potential areas for failure. Any problem areas should be corrected before re-extraction or re-analysis is performed.

21.5 If a sample fails to meet recovery or detection limit criteria, the data should be reviewed to determine whether matrix interferences are present, and if further cleanup or a smaller volume extraction might improve recoveries.

## **22.0 RECORDS MANAGEMENT**

22.1 Run logs are generated for each instrument each day that the instrument is run. These run logs serve as records of what is run on the instrument, including samples, QC, calibrations, tunes, etc. Additional information is provided in the run log, including the analyst's initials, run date and time, and file name.

22.2 Raw data are stored in the lab in filing cabinets and/or boxes as long as there is space available. When space runs out, the data are boxed and sent to storage.

22.3 All records generated as a result of this procedure are maintained as quality documents in accordance with CF-QS-E-008 for Quality Records Management and Disposition.

## **23.0 LABORATORY WASTE HANDLING AND DISPOSAL**

Sample extracts that have been run are temporarily stored in case they have to be reanalyzed. Once space is no longer available to keep them in the lab, they are moved to Waste Disposal where they are handled and disposed in accordance with the Laboratory Waste Management Plan, CF-LB-G-001.

## **24.0 REFERENCES**

Method 1668, Revision A, "Chlorinated Biphenyl Congeners in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS" with corrections and changes through August 20, 2003

Method 1668C Chlorinated Biphenyl Congeners in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS April 2010

DELAWARE RIVER ESTUARY STAGE 2 PCB TMDL Polychlorinated Biphenyls - EPA Method 1668A Project Quality Control Requirements 02/03/05

## **25.0 HISTORY**

Revision 1: Section 15.4.1.2 added.

Revision 2: Calibration upper limit exceedance clarified.

Revision 3: Tables 1, 4, 5, and 6 updated. Table 8 added. 1668A references added. Tridecane use removed. 1668C references and limits added.

Revision 4: Removed references to Version B.

Revision 5: Comments regarding DRBC modifications and references. Additions for DRBC ICAL exceptions.

Revision 6: Added holding time table.

Revision 7: Removing PQLs from and adding CAS numbers to SOP.

Revision 8: Updated section 9 to include hardware and software requirements. Updated 14.3.8 to clarify calibration level deactivation protocol.

Revision 9: Improved 14.3.8.

**TABLE 1: METHOD ANALYTES**

2-Chlorobiphenyl (1)	2051-60-7	2,3,3',4'-Tetrachlorobiphenyl (55)	74338-24-2
3-Chlorobiphenyl (2)	2051-61-8	2,3,3',4'-Tetrachlorobiphenyl (56)	41464-43-1
4-Chlorobiphenyl (3)	2051-62-9	2,3,3',5'-Tetrachlorobiphenyl (57)	70424-67-8
2,2'-Dichlorobiphenyl (4)	13029-08-8	2,3,3',5'-Tetrachlorobiphenyl (58)	41464-49-7
2,3-Dichlorobiphenyl (5)	16605-91-7	2,3,3',6'-Tetrachlorobiphenyl (59)	74472-33-6
2,3'-Dichlorobiphenyl (6)	25569-80-6	2,3,4,4'-Tetrachlorobiphenyl (60)	33025-41-1
2,4-Dichlorobiphenyl (7)	33284-50-3	2,3,4,5'-Tetrachlorobiphenyl (61)	33284-53-6
2,4'-Dichlorobiphenyl (8)	34883-43-7	2,3,4,6'-Tetrachlorobiphenyl (62)	54230-22-7
2,5-Dichlorobiphenyl (9)	34883-39-1	2,3,4',5'-Tetrachlorobiphenyl (63)	74472-34-7
2,6-Dichlorobiphenyl (10)	33146-45-1	2,3,4',6'-Tetrachlorobiphenyl (64)	52663-58-8
3,3'-Dichlorobiphenyl (11)	2050-67-1	2,3,5,6'-Tetrachlorobiphenyl (65)	33284-54-7
3,4-Dichlorobiphenyl (12)	2974-92-7	2,3',4,4'-Tetrachlorobiphenyl (66)	32598-10-0
3,4'-Dichlorobiphenyl (13)	2974-90-5	2,3',4,5'-Tetrachlorobiphenyl (67)	73575-53-8
3,5-Dichlorobiphenyl (14)	34883-41-5	2,3',4,5'-Tetrachlorobiphenyl (68)	73575-52-7
4,4'-Dichlorobiphenyl (15)	2050-68-2	2,3',4,6'-Tetrachlorobiphenyl (69)	60233-24-1
2,2',3-Trichlorobiphenyl (16)	38444-78-9	2,3',4',5'-Tetrachlorobiphenyl (70)	32598-11-1
2,2',4-Trichlorobiphenyl (17)	37680-66-3	2,3',4',6'-Tetrachlorobiphenyl (71)	41464-46-4
2,2',5-Trichlorobiphenyl (18)	37680-65-2	2,3',5,5'-Tetrachlorobiphenyl (72)	41464-42-0
2,2',6-Trichlorobiphenyl (19)	38444-73-4	2,3',5',6'-Tetrachlorobiphenyl (73)	74338-23-1
2,3,3'-Trichlorobiphenyl (20)	38444-84-7	2,4,4',5'-Tetrachlorobiphenyl (74)	32690-93-0
2,3,4-Trichlorobiphenyl (21)	55702-46-0	2,4,4',6'-Tetrachlorobiphenyl (75)	32598-12-2
2,3,4'-Trichlorobiphenyl (22)	38444-85-8	2',3,4,5'-Tetrachlorobiphenyl (76)	70362-48-0
2,3,5-Trichlorobiphenyl (23)	55720-44-0	3,3',4,4'-Tetrachlorobiphenyl (77)	32598-13-3
2,3,6-Trichlorobiphenyl (24)	55702-45-9	3,3',4,5'-Tetrachlorobiphenyl (78)	70362-49-1
2,3',4-Trichlorobiphenyl (25)	55712-37-3	3,3',4,5'-Tetrachlorobiphenyl (79)	41464-48-6
2,3',5-Trichlorobiphenyl (26)	38444-81-4	3,3',5,5'-Tetrachlorobiphenyl (80)	33284-52-5
2,3',6-Trichlorobiphenyl (27)	38444-76-7	3,4,4',5'-Tetrachlorobiphenyl (81)	70362-50-4
2,4,4'-Trichlorobiphenyl (28)	7012-37-5	2,2',3,3',4'-Pentachlorobiphenyl (82)	52663-62-4
2,4,5-Trichlorobiphenyl (29)	15862-07-4	2,2',3,3',5'-Pentachlorobiphenyl (83)	60145-20-2
2,4,6-Trichlorobiphenyl (30)	35693-92-6	2,2',3,3',6'-Pentachlorobiphenyl (84)	52663-60-2
2,4',5-Trichlorobiphenyl (31)	16606-02-3	2,2',3,4,4'-Pentachlorobiphenyl (85)	65510-45-4
2,4',6-Trichlorobiphenyl (32)	38444-77-8	2,2',3,4,5'-Pentachlorobiphenyl (86)	55312-69-1
2',3,4-Trichlorobiphenyl (33)	38444-86-9	2,2',3,4,5'-Pentachlorobiphenyl (87)	38380-02-8
2',3,5-Trichlorobiphenyl (34)	37680-68-5	2,2',3,4,6'-Pentachlorobiphenyl (88)	55215-17-3
3,3',4-Trichlorobiphenyl (35)	37680-69-6	2,2',3,4,6'-Pentachlorobiphenyl (89)	73575-57-2
3,3',5-Trichlorobiphenyl (36)	38444-87-0	2,2',3,4',5'-Pentachlorobiphenyl (90)	68194-07-0
3,4,4'-Trichlorobiphenyl (37)	38444-90-5	2,2',3,4',6'-Pentachlorobiphenyl (91)	68194-05-8
3,4,5-Trichlorobiphenyl (38)	53555-66-1	2,2',3,5,5'-Pentachlorobiphenyl (92)	52663-61-3
3,4',5-Trichlorobiphenyl (39)	38444-88-1	2,2',3,5,6'-Pentachlorobiphenyl (93)	73575-56-1
2,2',3,3'-Tetrachlorobiphenyl (40)	38444-93-8	2,2',3,5,6'-Pentachlorobiphenyl (94)	73575-55-0
2,2',3,4-Tetrachlorobiphenyl (41)	52663-59-9	2,2',3,5',6'-Pentachlorobiphenyl (95)	38379-99-6
2,2',3,4'-Tetrachlorobiphenyl (42)	36559-22-5	2,2',3,6,6'-Pentachlorobiphenyl (96)	73575-54-9
2,2',3,5-Tetrachlorobiphenyl (43)	70362-46-8	2,2',3',4,5'-Pentachlorobiphenyl (97)	41464-51-1
2,2',3,5'-Tetrachlorobiphenyl (44)	41464-39-5	2,2',3',4,6'-Pentachlorobiphenyl (98)	60233-25-2
2,2',3,6-Tetrachlorobiphenyl (45)	70362-45-7	2,2',4,4',5'-Pentachlorobiphenyl (99)	38380-01-7
2,2',3,6'-Tetrachlorobiphenyl (46)	41464-47-5	2,2',4,4',6'-Pentachlorobiphenyl (100)	39485-83-1
2,2',4,4'-Tetrachlorobiphenyl (47)	2437-79-8	2,2',4,5,5'-Pentachlorobiphenyl (101)	37680-73-2
2,2',4,5-Tetrachlorobiphenyl (48)	70362-47-9	2,2',4,5,6'-Pentachlorobiphenyl (102)	68194-06-9
2,2',4,5'-Tetrachlorobiphenyl (49)	41464-40-8	2,2',4,5',6'-Pentachlorobiphenyl (103)	60145-21-3
2,2',4,6-Tetrachlorobiphenyl (50)	62796-65-0	2,2',4,6,6'-Pentachlorobiphenyl (104)	56558-16-8
2,2',4,6'-Tetrachlorobiphenyl (51)	68194-04-7	2,3,3',4,4'-Pentachlorobiphenyl (105)	32598-14-4
2,2',5,5'-Tetrachlorobiphenyl (52)	35693-99-3	2,3,3',4,5'-Pentachlorobiphenyl (106)	70424-69-0
2,2',5,6'-Tetrachlorobiphenyl (53)	41464-41-9	2,3,3',4',5'-Pentachlorobiphenyl (107)	70424-68-9
2,2',6,6'-Tetrachlorobiphenyl (54)	15968-05-5	2,3,3',4,5'-Pentachlorobiphenyl (108)	70362-41-3

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2,3,3',4,6-Pentachlorobiphenyl (109)	74472-35-8	2,3,3',4',5,6-Hexachlorobiphenyl (163)	74472-44-9
2,3,3',4',6-Pentachlorobiphenyl (110)	38380-03-9	2,3,3',4',5',6-Hexachlorobiphenyl (164)	74472-45-0
2,3,3',5,5'-Pentachlorobiphenyl (111)	39635-32-0	2,3,3',5,5',6-Hexachlorobiphenyl (165)	74472-46-1
2,3,3',5,6-Pentachlorobiphenyl (112)	74472-36-9	2,3,4,4',5,6-Hexachlorobiphenyl (166)	41411-63-6
2,3,3',5',6-Pentachlorobiphenyl (113)	68194-10-5	2,3',4,4',5,5'-Hexachlorobiphenyl (167)	52663-72-6
2,3,4,4',5-Pentachlorobiphenyl (114)	74472-37-0	2,3',4,4',5',6-Hexachlorobiphenyl (168)	59291-65-5
2,3,4,4',6-Pentachlorobiphenyl (115)	74472-38-1	3,3',4,4',5,5'-Hexachlorobiphenyl (169)	32774-16-6
2,3,4,5,6-Pentachlorobiphenyl (116)	18259-05-7	2,2',3,3',4,4',5-Heptachlorobiphenyl (170)	35065-30-6
2,3,4',5,6-Pentachlorobiphenyl (117)	68194-11-6	2,2',3,3',4,4',6-Heptachlorobiphenyl (171)	52663-71-5
2,3',4,4',5-Pentachlorobiphenyl (118)	31508-00-6	2,2',3,3',4,5,5'-Heptachlorobiphenyl (172)	52663-74-8
2,3',4,4',6-Pentachlorobiphenyl (119)	56558-17-9	2,2',3,3',4,5,6-Heptachlorobiphenyl (173)	68194-16-1
2,3',4,5,5'-Pentachlorobiphenyl (120)	68194-12-7	2,2',3,3',4,5,6'-Heptachlorobiphenyl (174)	38411-25-5
2,3',4,5',6-Pentachlorobiphenyl (121)	56558-18-0	2,2',3,3',4,5',6-Heptachlorobiphenyl (175)	40186-70-7
2',3,3',4,5-Pentachlorobiphenyl (122)	76842-07-4	2,2',3,3',4,6,6'-Heptachlorobiphenyl (176)	52663-65-7
2',3,4,4',5-Pentachlorobiphenyl (123)	65510-44-3	2,2',3,3',4,4',5,6-Heptachlorobiphenyl (177)	52663-70-4
2',3,4,5,5'-Pentachlorobiphenyl (124)	70424-70-3	2,2',3,3',5,5',6-Heptachlorobiphenyl (178)	52663-67-9
2',3,4,5,6'-Pentachlorobiphenyl (125)	74472-39-2	2,2',3,3',5,6,6'-Heptachlorobiphenyl (179)	52663-64-6
3,3',4,4',5-Pentachlorobiphenyl (126)	57465-28-8	2,2',3,4,4',5,5'-Heptachlorobiphenyl (180)	35065-29-3
3,3',4,5,5'-Pentachlorobiphenyl (127)	39635-33-1	2,2',3,4,4',5,6-Heptachlorobiphenyl (181)	74472-47-2
2,2',3,3',4,4'-Hexachlorobiphenyl (128)	38380-07-3	2,2',3,4,4',5,6'-Heptachlorobiphenyl (182)	60145-23-5
2,2',3,3',4,5-Hexachlorobiphenyl (129)	55215-18-4	2,2',3,4,4',5',6-Heptachlorobiphenyl (183)	52663-69-1
2,2',3,3',4,5'-Hexachlorobiphenyl (130)	52663-66-8	2,2',3,4,4',6,6'-Heptachlorobiphenyl (184)	74472-48-3
2,2',3,3',4,6-Hexachlorobiphenyl (131)	61798-70-7	2,2',3,4,5,5',6-Heptachlorobiphenyl (185)	52712-05-7
2,2',3,3',4,6'-Hexachlorobiphenyl (132)	38380-05-1	2,2',3,4,5,6,6'-Heptachlorobiphenyl (186)	74472-49-4
2,2',3,3',5,5'-Hexachlorobiphenyl (133)	35694-04-3	2,2',3,4',5,5',6-Heptachlorobiphenyl (187)	52663-68-0
2,2',3,3',5,6-Hexachlorobiphenyl (134)	52704-70-8	2,2',3,4',5,6,6'-Heptachlorobiphenyl (188)	74487-85-7
2,2',3,3',5,6'-Hexachlorobiphenyl (135)	52744-13-5	2,3,3',4,4',5,5'-Heptachlorobiphenyl (189)	39635-31-9
2,2',3,3',6,6'-Hexachlorobiphenyl (136)	38411-22-2	2,3,3',4,4',5,6-Heptachlorobiphenyl (190)	41411-64-7
2,2',3,4,4',5-Hexachlorobiphenyl (137)	35694-06-5	2,3,3',4,4',5',6-Heptachlorobiphenyl (191)	74472-50-7
2,2',3,4,4',5'-Hexachlorobiphenyl (138)	35065-28-2	2,3,3',4,5,5',6-Heptachlorobiphenyl (192)	74472-51-8
2,2',3,4,4',6-Hexachlorobiphenyl (139)	56030-56-9	2,3,3',4',5,5',6-Heptachlorobiphenyl (193)	69782-91-8
2,2',3,4,4',6'-Hexachlorobiphenyl (140)	59291-64-4	2,2',3,3',4,4',5,5'-Octachlorobiphenyl (194)	35694-08-7
2,2',3,4,5,5'-Hexachlorobiphenyl (141)	52712-04-6	2,2',3,3',4,4',5,6-Octachlorobiphenyl (195)	52663-78-2
2,2',3,4,5,6-Hexachlorobiphenyl (142)	41411-61-4	2,2',3,3',4,4',5,6'-Octachlorobiphenyl (196)	42740-50-1
2,2',3,4,5,6'-Hexachlorobiphenyl (143)	68194-15-0	2,2',3,3',4,4',6,6'-Octachlorobiphenyl (197)	33091-17-7
2,2',3,4,5',6-Hexachlorobiphenyl (144)	68194-14-9	2,2',3,3',4,5,5',6-Octachlorobiphenyl (198)	68194-17-2
2,2',3,4,6,6'-Hexachlorobiphenyl (145)	74472-40-5	2,2',3,3',4,5,5',6'-Octachlorobiphenyl (199)	52663-75-9
2,2',3,4',5,5'-Hexachlorobiphenyl (146)	51908-16-8	2,2',3,3',4,5,6,6'-Octachlorobiphenyl (200)	52663-73-7
2,2',3,4',5,6-Hexachlorobiphenyl (147)	68194-13-8	2,2',3,3',4,5',6,6'-Octachlorobiphenyl (201)	40186-71-8
2,2',3,4',5,6'-Hexachlorobiphenyl (148)	74472-41-6	2,2',3,3',5,5',6,6'-Octachlorobiphenyl (202)	2136-99-4
2,2',3,4',5',6-Hexachlorobiphenyl (149)	38380-04-0	2,2',3,4,4',5,5',6-Octachlorobiphenyl (203)	52663-76-0
2,2',3,4',6,6'-Hexachlorobiphenyl (150)	68194-08-1	2,2',3,4,4',5,6,6'-Octachlorobiphenyl (204)	74472-52-9
2,2',3,5,5',6-Hexachlorobiphenyl (151)	52663-63-5	2,3,3',4,4',5,5',6-Octachlorobiphenyl (205)	74472-53-0
2,2',3,5,6,6'-Hexachlorobiphenyl (152)	68194-09-2	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (206)	40186-72-9
2,2',4,4',5,5'-Hexachlorobiphenyl (153)	35065-27-1	2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (207)	52663-79-3
2,2',4,4',5,6'-Hexachlorobiphenyl (154)	60145-22-4	2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl (208)	52663-77-1
2,2',4,4',6,6'-Hexachlorobiphenyl (155)	33979-03-2	2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl (209)	2051-24-3
2,3,3',4,4',5-Hexachlorobiphenyl (156)	38380-08-4	Total Monochlorobiphenyl PCBs	27323-18-8
2,3,3',4,4',5'-Hexachlorobiphenyl (157)	69782-90-7	Total Dichlorobiphenyl PCBs	25512-42-9
2,3,3',4,4',6-Hexachlorobiphenyl (158)	74472-42-7	Total Trichlorobiphenyl PCBs	25323-68-6
2,3,3',4,5,5'-Hexachlorobiphenyl (159)	39635-35-3	Total Tetrachlorobiphenyl PCBs	26914-33-0
2,3,3',4,5,6-Hexachlorobiphenyl (160)	41411-62-5	Total Pentachlorobiphenyl PCBs	25429-29-2
2,3,3',4,5',6-Hexachlorobiphenyl (161)	74472-43-8	Total Hexachlorobiphenyl PCBs	26601-64-9
2,3,3',4',5,5'-Hexachlorobiphenyl (162)	39635-34-2	Total Heptachlorobiphenyl PCBs	28655-71-2

**TABLE 2: MASS DESCRIPTORS**

F1	Description*	Mass	Ion
1	13C-MoCB 1	200.0795	M
2	13C-MoCB 2	202.0766	M+2
3	13C-DiCB 1	234.0406	M
4	13C-DiCB 2	236.0376	M+2
5	MoCB 1	188.0393	M
6	MoCB 2	190.0363	M+2
7	DiCB 1	222.0003	M
8	DiCB 2	223.9974	M+2
9	Lock Mass	218.9856	PFK
F2	Description	Mass	Ion
1	13C-DiCB 1	234.0406	M
2	13C-DiCB 2	236.0376	M+2
3	13C-TrCB 1	268.0016	M
4	13C-TrCB 2	269.9986	M+2
5	13C-TeCB 1	301.9626	M
6	13C-TeCB 2	303.9597	M+2
7	DiCB 1	222.0003	M
8	DiCB 2	223.9974	M+2
9	TrCB 1	255.9613	M
10	TrCB 2	257.9584	M+2
11	TeCB 1	289.9224	M
12	TeCB 2	291.9194	M+2
-	DiCB 35 IC	255.9613	M
13	DiCB 35 ICQ	220.9924	M-35Cl
-	TrCB 35 IC	289.9224	M
14	TrCB 35 ICQ	254.9535	M-35Cl
15	Lock Mass	230.9856	PFK
F3	Description	Mass	Ion
1	13C-TrCB 1	268.0016	M
2	13C-TrCB 2	269.9986	M+2
3	13C-TeCB 1	301.9626	M
4	13C-TeCB 2	303.9597	M+2
5	13C-PeCB 1	337.9207	M+2
6	13C-PeCB 2	339.9178	M+4
7	TrCB 1	255.9613	M
8	TrCB 2	257.9584	M+2
9	TeCB 1	289.9224	M
10	TeCB 2	291.9194	M+2
11	PeCB 1	325.8804	M+2
12	PeCB 1	323.8834	M
13	PeCB 2	327.8775	M+4
-	TrCB 35 IC	289.9224	M

14	TrCB 35 ICQ	254.9535	M-35Cl
-	TeCB 35 IC	325.8804	M+2
15	TeCB 35 ICQ	288.9145	M-35Cl
-	TrCB 70 IC	325.8804	M+2
16	TrCB 70 ICQ	253.9457	M-35Cl2
17	Lock Mass	330.9792	PFK
F4	Description	Mass	Ion
1	13C-TeCB 1	301.9626	M
2	13C-TeCB 2	303.9597	M+2
3	13C-PeCB 1	337.9207	M+2
4	13C-PeCB 2	339.9178	M+4
5	13C-HxCB 1	371.8817	M+2
6	13C-HxCB 2	373.8788	M+4
7	TeCB 1	289.9224	M
8	TeCB 2	291.9194	M+2
9	PeCB 1	323.8834	M
10	PeCB2	325.8804	M+2
11	PeCB 3	327.8775	M+4
12	HxCB 1	359.8415	M+2
13	HxCB 2	361.8385	M+4
-	TeCB 35 IC	325.8804	M
14	TeCB 35 ICQ	288.9145	M-35Cl
-	PeCB 35 IC	359.8415	M+2
15	PeCB 35 ICQ	322.8756	M-35Cl
-	TeCB 70 IC	359.8415	M+2
16	TeCB 70 ICQ	287.9067	M-35Cl2
17	Lock Mass	330.9792	PFK
F5	Description	Mass	Ion
1	13C-PeCB 1	337.9207	M+2
2	13C-PeCB 2	339.9178	M+4
3	13C-HxCB 1	371.8817	M+2
4	13C-HxCB 2	373.8788	M+4
5	13C-HpCB 1	405.8428	M+2
6	13C-HpCB 2	407.8398	M+4
7	PeCB 1	323.8834	M
8	PeCB 2	325.8804	M+2
9	PeCB 3	327.8775	M+4
10	HxCB 1	359.8415	M+2
11	HxCB 2	361.8385	M+4
12	HpCB 1	393.8025	M+2
13	HpCB 2	395.7995	M+4
-	PeCB 35 IC	359.8415	M+2
14	PeCB 35 ICQ	322.8756	M-1
-	HxCB 35 IC	393.8025	M+2

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15	HxCB 35 ICQ	356.8366	M-35Cl
-	PeCB 70 IC	393.8025	M+2
16	PeCB 70 ICQ	321.8677	M-35Cl2
17	Lock Mass	330.9792	PFK
<b>F6</b>	<b>Description</b>	<b>Mass</b>	<b>Ion</b>
1	13C-HxCB 1	371.8817	M+2
2	13C-HxCB 2	373.8788	M+4
3	13C-HpCB 1	405.8428	M+2
4	13C-HpCB 2	407.8398	M+4
5	13C-OcCB 1	439.8038	M+2
6	13C-OcCB 2	441.8008	M+4
7	HxCB 1	359.8415	M+2
8	HxCB 2	361.8385	M+4
9	HpCB 1	393.8025	M+2
10	HpCB 2	395.7995	M+4
11	OcCB 1	427.7635	M+2
12	OcCB 2	429.7606	M+4
-	HxCB 35 IC	393.8025	M+2
13	HxCB 35 ICQ	356.8366	M-35Cl
-	HpCB 35 IC	427.7635	M+2
14	HpCB 35 ICQ	390.7976	M-35Cl
-	HxCB 70 IC	427.7635	M+2
15	HxCB 70 ICQ	355.8288	M-35Cl2
16	Lock Mass	380.9760	PFK
<b>F7</b>	<b>Description</b>	<b>Mass</b>	<b>Ion</b>
1	13C-HpCB 1	405.8428	M+2
2	13C-HpCB 2	407.8398	M+4
3	13C-OcCB 1	439.8038	M+2
4	13C-OcCB 2	441.8008	M+4
5	13C-NoCB 1	473.7648	M+2
6	13C-NoCB 2	475.7619	M+4
7	13C-DeCB 1	509.7229	M+4
8	13C-DeCB 2	511.7199	M+6
9	HpCB 1	393.8025	M+2
10	HpCB 2	395.7995	M+4
11	OcCB 1	427.7635	M+2
12	OcCB 2	429.7606	M+4
13	NoCB 1	461.7246	M+2
14	NoCB 2	463.7216	M+4
15	DeCB 1	497.6826	M+4
16	DeCB 2	499.6797	M+6
17	Lock Mass	430.9728	PFK

\* IC – Interference Check ion

ICQ – Interference Check Quantitation ion

**TABLE 3: THEORETICAL ION RATIOS AND CONTROL LIMITS**

<b>Homolog Group</b>	<b>M/Z Forming Ratio</b>	<b>Theoretical Ratio</b>	<b>Lower Limit</b>	<b>Upper Limit</b>
Mono	M/M+2	3.13	2.66	3.60
Di	M/M+2	1.56	1.33	1.79
Tri	M/M+2	1.04	0.88	1.20
Tetra	M/M+2	0.77	0.65	0.89
Penta	M/M+2	0.61	0.52	0.71
Penta	M+2/M+4	1.55	1.32	1.78
Hexa	M+2/M+4	1.24	1.05	1.43
Hepta	M+2/M+4	1.05	0.89	1.21
Octa	M+2/M+4	0.89	0.76	1.02
Nona	M+2/M+4	0.77	0.65	0.89
Deca	M+4/M+6	1.16	0.99	1.33

**TABLE 4: INITIAL CALIBRATION CONCENTRATIONS**

Congener (#)	CS0.5	CS1	CS2	CS3	CS4	CS5
<b>Native Analytes</b>						
2-MoCB (1)	0.5	1	5	50	400	2000
4-MoCB (3)	0.5	1	5	50	400	2000
2,2'-DiCB (4)	0.5	1	5	50	400	2000
4,4'-DiCB (15)	0.5	1	5	50	400	2000
2,2',6'-TrCB (19)	0.5	1	5	50	400	2000
3,4,4'-TrCB (37)	0.5	1	5	50	400	2000
2,2',6,6'-TeCB (54)	0.5	1	5	50	400	2000
3,3',4,4'-TeCB (77)	0.5	1	5	50	400	2000
3,4,4',5'-TeCB (81)	0.5	1	5	50	400	2000
2,2',4,6,6'-PeCB (104)	0.5	1	5	50	400	2000
2,3,3',4,4'-PeCB (105)	0.5	1	5	50	400	2000
2,3,4,4',5'-PeCB (114)	0.5	1	5	50	400	2000
2,3',4,4',5'-PeCB (118)	0.5	1	5	50	400	2000
2',3,4,4',5'-PeCB (123)	0.5	1	5	50	400	2000
3,3',4,4',5'-PeCB (126)	0.5	1	5	50	400	2000
2,2',4,4',6,6'-HxCB (155)	0.5	1	5	50	400	2000
2,3,3',4,4',5'-HxCB (156)	0.5	1	5	50	400	2000
2,3,3',4,4',5'-HxCB (157)	0.5	1	5	50	400	2000
2,3',4,4',5,5'-HxCB (167)	0.5	1	5	50	400	2000
3,3',4,4',5,5'-HxCB (169)	0.5	1	5	50	400	2000
2,2',3,4',5,6,6'-HpCB (188)	0.5	1	5	50	400	2000
2,3,3',4,4',5,5'-HpCB (189)	0.5	1	5	50	400	2000
2,2',3,3',5,5',6,6'-OcCB (202)	0.5	1	5	50	400	2000
2,3,3',4,4',5,5',6'-OcCB (205)	0.5	1	5	50	400	2000
2,2',3,3',4,4',5,5',6'-NoCB (206)	0.5	1	5	50	400	2000
2,2',3,3',4',5,5',6,6'-NoCB (208)	0.5	1	5	50	400	2000
DeCB (209)	0.5	1	5	50	400	2000
<b>Extraction Standards</b>						
13C12-2-MoCB (1L)	100	100	100	100	100	100
13C12-4-MoCB (3L)	100	100	100	100	100	100
13C12-2,2'-DiCB (4L)	100	100	100	100	100	100
13C12-4,4'-DiCB (15L)	100	100	100	100	100	100
13C12-2,2',6'-TrCB (19L)	100	100	100	100	100	100
13C12-3,4,4'-TrCB (37L)	100	100	100	100	100	100
13C12-2,2',6,6'-TeCB (54L)	100	100	100	100	100	100
13C12-3,3',4,4'-TeCB (77L)	100	100	100	100	100	100
13C12-3,4,4',5'-TeCB (81L)	100	100	100	100	100	100
13C12-2,2',4,6,6'-PeCB (104L)	100	100	100	100	100	100
13C12-2,3,3',4,4'-PeCB (105L)	100	100	100	100	100	100
13C12-2,3,4,4',5'-PeCB (114L)	100	100	100	100	100	100
13C12-2,3',4,4',5'-PeCB (118L)	100	100	100	100	100	100
13C12-2',3,4,4',5'-PeCB (123L)	100	100	100	100	100	100
13C12-3,3',4,4',5'-PeCB (126L)	100	100	100	100	100	100
13C12-2,2',4,4',6,6'-HxCB (155L)	100	100	100	100	100	100
13C12-2,3,3',4,4',5'-HxCB (156L)	100	100	100	100	100	100
13C12-2,3,3',4,4',5'-HxCB (157L)	100	100	100	100	100	100
13C12-2,3',4,4',5,5'-HxCB (167L)	100	100	100	100	100	100
13C12-3,3',4,4',5,5'-HxCB (169L)	100	100	100	100	100	100
13C12-2,2',3,4',5,6,6'-HpCB (188L)	100	100	100	100	100	100
13C12-2,3,3',4,4',5,5'-HpCB (189L)	100	100	100	100	100	100
13C12-2,2',3,3',5,5',6,6'-OcCB (202L)	100	100	100	100	100	100

**(CONTD)**

13C12-2,3,3',4,4',5,5',6'-OcCB (205L)	100	100	100	100	100	100
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13C12-2,2',3,3',4,4',5,5',6-NoCB (206L)	100	100	100	100	100	100
13C12-2,2',3,3',4',5,5',6,6'-NoCB (208L)	100	100	100	100	100	100
13C12-DeCB (209L)	100	100	100	100	100	100
<b>Cleanup Standards</b>						
13C12-2,4,4'-TrCB (28L)	100	100	100	100	100	100
13C12-2,3,3',5,5'-PeCB (111L)	100	100	100	100	100	100
13C12-2,2',3,3',5,5',6-HpCB (178L)	100	100	100	100	100	100
<b>Injection Standards</b>						
13C12-2,5-DiCB (9L)	100	100	100	100	100	100
13C12-2,2',5,5'-TeCB (52L)	100	100	100	100	100	100
13C12-2,2',4',5,5'-PeCB (101L)	100	100	100	100	100	100
13C12-2,2',3',4,4',5'-HxCB (138L)	100	100	100	100	100	100
13C12-2,2',3,3',4,4',5,5'-OcCB (194L)	100	100	100	100	100	100

**TABLE 5: LCS LIMITS**

## Method 1668A

Native Analytes	Lower	Upper	Extraction Standards	Lower	Upper
	%	%		%	%
2-MoCB (1)	50	150	13C12-2-MoCB (1L)	15	140
4-MoCB (3)	50	150	13C12-4-MoCB (3L)	15	140
2,2'-DiCB (4)	50	150	13C12-2,2'-DiCB (4L)	30	140
4,4'-DiCB (15)	50	150	13C12-4,4'-DiCB (15L)	30	140
2,2',6'-TrCB (19)	50	150	13C12-2,2',6'-TrCB (19L)	30	140
3,4,4'-TrCB (37)	50	150	13C12-3,4,4'-TrCB (37L)	30	140
2,2',6,6'-TeCB (54)	50	150	13C12-2,2',6,6'-TeCB (54L)	30	140
3,3',4,4'-TeCB (77)	50	150	13C12-3,3',4,4'-TeCB (77L)	30	140
3,4,4',5'-TeCB (81)	50	150	13C12-3,4,4',5'-TeCB (81L)	30	140
2,2',4,6,6'-PeCB (104)	50	150	13C12-2,2',4,6,6'-PeCB (104L)	30	140
2,3,3',4,4'-PeCB (105)	50	150	13C12-2,3,3',4,4'-PeCB (105L)	30	140
2,3,4,4',5'-PeCB (114)	50	150	13C12-2,3,4,4',5'-PeCB (114L)	30	140
2,3',4,4',5'-PeCB (118)	50	150	13C12-2,3',4,4',5'-PeCB (118L)	30	140
2',3,4,4',5'-PeCB (123)	50	150	13C12-2',3,4,4',5'-PeCB (123L)	30	140
3,3',4,4',5'-PeCB (126)	50	150	13C12-3,3',4,4',5'-PeCB (126L)	30	140
2,2',4,4',6,6'-HxCB (155)	50	150	13C12-2,2',4,4',6,6'-HxCB (155L)	30	140
2,3,3',4,4',5'-HxCB (156)	50	150	13C12-2,3,3',4,4',5'-HxCB (156L)	30	140
2,3,3',4,4',5'-HxCB (157)	50	150	13C12-2,3,3',4,4',5'-HxCB (157L)	30	140
2,3',4,4',5,5'-HxCB (167)	50	150	13C12-2,3',4,4',5,5'-HxCB (167L)	30	140
3,3',4,4',5,5'-HxCB (169)	50	150	13C12-3,3',4,4',5,5'-HxCB (169L)	30	140
2,2',3,4',5,6,6'-HpCB (188)	50	150	13C12-2,2',3,4',5,6,6'-HpCB (188L)	30	140
2,3,3',4,4',5,5'-HpCB (189)	50	150	13C12-2,3,3',4,4',5,5'-HpCB (189L)	30	140
2,2',3,3',5,5',6,6'-OcCB (202)	50	150	13C12-2,2',3,3',5,5',6,6'-OcCB (202L)	30	140
2,3,3',4,4',5,5',6-OcCB (205)	50	150	13C12-2,3,3',4,4',5,5',6-OcCB (205L)	30	140
2,2',3,3',4,4',5,5',6-NoCB (206)	50	150	13C12-2,2',3,3',4,4',5,5',6-NoCB (206L)	30	140
2,2',3,3',4',5,5',6,6'-NoCB (208)	50	150	13C12-2,2',3,3',4',5,5',6,6'-NoCB (208L)	30	140
DeCB (209)	50	150	13C12-DeCB (209L)	30	140
			Cleanup Standards		
			13C12-2,4,4'-TrCB (28L)	40	125
			13C12-2,3,3',5,5'-PeCB (111L)	40	125
			13C12-2,2',3,3',5,5',6-HpCB (178L)	40	125

## Method 1668C (LCS Limits)

Native Analytes	Lower	Upper	Extraction Standards	Lower	Upper
	%	%		%	%
2-MoCB (1)	60	135	13C12-2-MoCB (1L)	15	145
4-MoCB (3)	60	135	13C12-4-MoCB (3L)	15	145
2,2'-DiCB (4)	60	135	13C12-2,2'-DiCB (4L)	15	145
4,4'-DiCB (15)	60	135	13C12-4,4'-DiCB (15L)	15	145
2,2',6'-TrCB (19)	60	135	13C12-2,2',6'-TrCB (19L)	15	145
3,4,4'-TrCB (37)	60	135	13C12-3,4,4'-TrCB (37L)	15	145
2,2',6,6'-TeCB (54)	60	135	13C12-2,2',6,6'-TeCB (54L)	15	145
3,3',4,4'-TeCB (77)	60	135	13C12-3,3',4,4'-TeCB (77L)	40	145
3,4,4',5'-TeCB (81)	60	135	13C12-3,4,4',5'-TeCB (81L)	40	145
2,2',4,6,6'-PeCB (104)	60	135	13C12-2,2',4,6,6'-PeCB (104L)	40	145
2,3,3',4,4'-PeCB (105)	60	135	13C12-2,3,3',4,4'-PeCB (105L)	40	145
2,3,4,4',5'-PeCB (114)	60	135	13C12-2,3,4,4',5'-PeCB (114L)	40	145
2,3',4,4',5'-PeCB (118)	60	135	13C12-2,3',4,4',5'-PeCB (118L)	40	145
2',3,4,4',5'-PeCB (123)	60	135	13C12-2',3,4,4',5'-PeCB (123L)	40	145
3,3',4,4',5'-PeCB (126)	60	135	13C12-3,3',4,4',5'-PeCB (126L)	40	145
2,2',4,4',6,6'-HxCB (155)	60	135	13C12-2,2',4,4',6,6'-HxCB (155L)	40	145
2,3,3',4,4',5'-HxCB (156)	60	135	13C12-2,3,3',4,4',5'-HxCB (156L)	40	145
2,3,3',4,4',5'-HxCB (157)	60	135	13C12-2,3,3',4,4',5'-HxCB (157L)	40	145
2,3',4,4',5,5'-HxCB (167)	60	135	13C12-2,3',4,4',5,5'-HxCB (167L)	40	145
3,3',4,4',5,5'-HxCB (169)	60	135	13C12-3,3',4,4',5,5'-HxCB (169L)	40	145
2,2',3,4',5,6,6'-HpCB (188)	60	135	13C12-2,2',3,4',5,6,6'-HpCB (188L)	40	145
2,3,3',4,4',5,5'-HpCB (189)	60	135	13C12-2,3,3',4,4',5,5'-HpCB (189L)	40	145
2,2',3,3',5,5',6,6'-OcCB (202)	60	135	13C12-2,2',3,3',5,5',6,6'-OcCB (202L)	40	145
2,3,3',4,4',5,5',6'-OcCB (205)	60	135	13C12-2,3,3',4,4',5,5',6'-OcCB (205L)	40	145
2,2',3,3',4,4',5,5',6'-NoCB (206)	60	135	13C12-2,2',3,3',4,4',5,5',6'-NoCB (206L)	40	145
2,2',3,3',4,4',5,5',6,6'-NoCB (208)	60	135	13C12-2,2',3,3',4,4',5,5',6,6'-NoCB (208L)	40	145
DeCB (209)	60	135	13C12-DeCB (209L)	40	145
Cleanup Standards					
			13C12-2,4,4'-TrCB (28L)	15	145
			13C12-2,3,3',5,5'-PeCB (111L)	40	145
			13C12-2,2',3,3',5,5',6'-HpCB (178L)	40	145

**TABLE 6: SAMPLE AND LMB RECOVERY LIMITS**

Method 1668A		
Extraction Standards	Lower	Upper
	%	%
13C12-2-MoCB (1L)	15	150
13C12-4-MoCB (3L)	15	150
13C12-2,2'-DiCB (4L)	25	150
13C12-4,4'-DiCB (15L)	25	150
13C12-2,2',6'-TrCB (19L)	25	150
13C12-3,4,4'-TrCB (37L)	25	150
13C12-2,2',6,6'-TeCB (54L)	25	150
13C12-3,3',4,4'-TeCB (77L)	25	150
13C12-3,4,4',5'-TeCB (81L)	25	150
13C12-2,2',4,6,6'-PeCB (104L)	25	150
13C12-2,3,3',4,4'-PeCB (105L)	25	150
13C12-2,3,4,4',5'-PeCB (114L)	25	150
13C12-2,3',4,4',5'-PeCB (118L)	25	150
13C12-2',3,4,4',5'-PeCB (123L)	25	150
13C12-3,3',4,4',5'-PeCB (126L)	25	150
13C12-2,2',4,4',6,6'-HxCB (155L)	25	150
13C12-2,3,3',4,4',5'-HxCB (156L)	25	150
13C12-2,3,3',4,4',5'-HxCB (157L)	25	150
13C12-2,3',4,4',5,5'-HxCB (167L)	25	150
13C12-3,3',4,4',5,5'-HxCB (169L)	25	150
13C12-2,2',3,4',5,6,6'-HpCB (188L)	25	150
13C12-2,3,3',4,4',5,5'-HpCB (189L)	25	150
13C12-2,2',3,3',5,5',6,6'-OcCB (202L)	25	150
13C12-2,3,3',4,4',5,5',6'-OcCB (205L)	25	150
13C12-2,2',3,3',4,4',5,5',6'-NoCB (206L)	25	150
13C12-2,2',3,3',4',5,5',6,6'-NoCB (208L)	25	150
13C12-DeCB (209L)	25	150
Cleanup Standards		
13C12-2,4,4'-TrCB (28L)	30	135
13C12-2,3,3',5,5'-PeCB (111L)	30	135
13C12-2,2',3,3',5,5',6'-HpCB (178L)	30	135

## Method 1668C (Sample and LMB Recovery Limits)

Extraction Standards	Lower %	Upper %
13C12-2-MoCB (1L)	5	145
13C12-4-MoCB (3L)	5	145
13C12-2,2'-DiCB (4L)	5	145
13C12-4,4'-DiCB (15L)	5	145
13C12-2,2',6'-TrCB (19L)	5	145
13C12-3,4,4'-TrCB (37L)	5	145
13C12-2,2',6,6'-TeCB (54L)	5	145
13C12-3,3',4,4'-TeCB (77L)	10	145
13C12-3,4,4',5'-TeCB (81L)	10	145
13C12-2,2',4,6,6'-PeCB (104L)	10	145
13C12-2,3,3',4,4'-PeCB (105L)	10	145
13C12-2,3,4,4',5'-PeCB (114L)	10	145
13C12-2,3',4,4',5'-PeCB (118L)	10	145
13C12-2',3,4,4',5'-PeCB (123L)	10	145
13C12-3,3',4,4',5'-PeCB (126L)	10	145
13C12-2,2',4,4',6,6'-HxCB (155L)	10	145
13C12-2,3,3',4,4',5'-HxCB (156L)	10	145
13C12-2,3,3',4,4',5'-HxCB (157L)	10	145
13C12-2,3',4,4',5,5'-HxCB (167L)	10	145
13C12-3,3',4,4',5,5'-HxCB (169L)	10	145
13C12-2,2',3,4',5,6,6'-HpCB (188L)	10	145
13C12-2,3,3',4,4',5,5'-HpCB (189L)	10	145
13C12-2,2',3,3',5,5',6,6'-OxCB (202L)	10	145
13C12-2,3,3',4,4',5,5',6-OxCB (205L)	10	145
13C12-2,2',3,3',4,4',5,5',6-NoCB (206L)	10	145
13C12-2,2',3,3',4',5,5',6,6'-NoCB (208L)	10	145
13C12-DeCB (209L)	10	145
Cleanup Standards		
13C12-2,4,4'-TrCB (28L)	5	145
13C12-2,3,3',5,5'-PeCB (111L)	10	145
13C12-2,2',3,3',5,5',6-HpCB (178L)	10	145

**TABLE 7: CONTINUING CALIBRATION LIMITS (VER)**  
Methods 1668A

Native Analytes	Lower	Upper	Extraction Standards	Lower	Upper
	%	%		%	%
2-MoCB (1)	70	130	13C12-2-MoCB (1L)	50	150
4-MoCB (3)	70	130	13C12-4-MoCB (3L)	50	150
2,2'-DiCB (4)	70	130	13C12-2,2'-DiCB (4L)	50	150
4,4'-DiCB (15)	70	130	13C12-4,4'-DiCB (15L)	50	150
2,2',6'-TrCB (19)	70	130	13C12-2,2',6'-TrCB (19L)	50	150
3,4,4'-TrCB (37)	70	130	13C12-3,4,4'-TrCB (37L)	50	150
2,2',6,6'-TeCB (54)	70	130	13C12-2,2',6,6'-TeCB (54L)	50	150
3,3',4,4'-TeCB (77)	70	130	13C12-3,3',4,4'-TeCB (77L)	50	150
3,4,4',5'-TeCB (81)	70	130	13C12-3,4,4',5'-TeCB (81L)	50	150
2,2',4,6,6'-PeCB (104)	70	130	13C12-2,2',4,6,6'-PeCB (104L)	50	150
2,3,3',4,4'-PeCB (105)	70	130	13C12-2,3,3',4,4'-PeCB (105L)	50	150
2,3,4,4',5'-PeCB (114)	70	130	13C12-2,3,4,4',5'-PeCB (114L)	50	150
2,3',4,4',5'-PeCB (118)	70	130	13C12-2,3',4,4',5'-PeCB (118L)	50	150
2',3,4,4',5'-PeCB (123)	70	130	13C12-2',3,4,4',5'-PeCB (123L)	50	150
3,3',4,4',5'-PeCB (126)	70	130	13C12-3,3',4,4',5'-PeCB (126L)	50	150
2,2',4,4',6,6'-HxCB (155)	70	130	13C12-2,2',4,4',6,6'-HxCB (155L)	50	150
2,3,3',4,4',5'-HxCB (156)	70	130	13C12-2,3,3',4,4',5'-HxCB (156L)	50	150
2,3,3',4,4',5'-HxCB (157)	70	130	13C12-2,3,3',4,4',5'-HxCB (157L)	50	150
2,3',4,4',5,5'-HxCB (167)	70	130	13C12-2,3',4,4',5,5'-HxCB (167L)	50	150
3,3',4,4',5,5'-HxCB (169)	70	130	13C12-3,3',4,4',5,5'-HxCB (169L)	50	150
2,2',3,4',5,6,6'-HpCB (188)	70	130	13C12-2,2',3,4',5,6,6'-HpCB (188L)	50	150
2,3,3',4,4',5,5'-HpCB (189)	70	130	13C12-2,3,3',4,4',5,5'-HpCB (189L)	50	150
2,2',3,3',5,5',6,6'-OcCB (202)	70	130	13C12-2,2',3,3',5,5',6,6'-OcCB (202L)	50	150
2,3,3',4,4',5,5',6'-OcCB (205)	70	130	13C12-2,3,3',4,4',5,5',6'-OcCB (205L)	50	150
2,2',3,3',4,4',5,5',6'-NoCB (206)	70	130	13C12-2,2',3,3',4,4',5,5',6'-NoCB (206L)	50	150
2,2',3,3',4,4',5,5',6,6'-NoCB (208)	70	130	13C12-2,2',3,3',4,4',5,5',6,6'-NoCB (208L)	50	150
DeCB (209)	70	130	13C12-DeCB (209L)	50	150
Cleanup Standards					
13C12-2,4,4'-TrCB (28L)				60	130
13C12-2,3,3',5,5'-PeCB (111L)				60	130
13C12-2,2',3,3',5,5',6'-HpCB (178L)				60	130

## Method 1668C Continuing Calibration Limit (VER)

Native Analytes	Lower	Upper	Extraction Standards	Lower	Upper
	%	%		%	%
2-MoCB (1)	75	125	13C12-2-MoCB (1L)	50	145
4-MoCB (3)	75	125	13C12-4-MoCB (3L)	50	145
2,2'-DiCB (4)	75	125	13C12-2,2'-DiCB (4L)	50	145
4,4'-DiCB (15)	75	125	13C12-4,4'-DiCB (15L)	50	145
2,2',6'-TrCB (19)	75	125	13C12-2,2',6'-TrCB (19L)	50	145
3,4,4'-TrCB (37)	75	125	13C12-3,4,4'-TrCB (37L)	50	145
2,2',6,6'-TeCB (54)	75	125	13C12-2,2',6,6'-TeCB (54L)	50	145
3,3',4,4'-TeCB (77)	75	125	13C12-3,3',4,4'-TeCB (77L)	50	145
3,4,4',5-TeCB (81)	75	125	13C12-3,4,4',5-TeCB (81L)	50	145
2,2',4,6,6'-PeCB (104)	75	125	13C12-2,2',4,6,6'-PeCB (104L)	50	145
2,3,3',4,4'-PeCB (105)	75	125	13C12-2,3,3',4,4'-PeCB (105L)	50	145
2,3,4,4',5-PeCB (114)	75	125	13C12-2,3,4,4',5-PeCB (114L)	50	145
2,3',4,4',5-PeCB (118)	75	125	13C12-2,3',4,4',5-PeCB (118L)	50	145
2',3,4,4',5-PeCB (123)	75	125	13C12-2',3,4,4',5-PeCB (123L)	50	145
3,3',4,4',5-PeCB (126)	75	125	13C12-3,3',4,4',5-PeCB (126L)	50	145
2,2',4,4',6,6'-HxCB (155)	75	125	13C12-2,2',4,4',6,6'-HxCB (155L)	50	145
2,3,3',4,4',5-HxCB (156)	75	125	13C12-2,3,3',4,4',5-HxCB (156L)	50	145
2,3,3',4,4',5'-HxCB (157)	75	125	13C12-2,3,3',4,4',5'-HxCB (157L)	50	145
2,3',4,4',5,5'-HxCB (167)	75	125	13C12-2,3',4,4',5,5'-HxCB (167L)	50	145
3,3',4,4',5,5'-HxCB (169)	75	125	13C12-3,3',4,4',5,5'-HxCB (169L)	50	145
2,2',3,4',5,6,6'-HpCB (188)	75	125	13C12-2,2',3,4',5,6,6'-HpCB (188L)	50	145
2,3,3',4,4',5,5'-HpCB (189)	75	125	13C12-2,3,3',4,4',5,5'-HpCB (189L)	50	145
2,2',3,3',5,5',6,6'-OcCB (202)	75	125	13C12-2,2',3,3',5,5',6,6'-OcCB (202L)	50	145
2,3,3',4,4',5,5',6-OcCB (205)	75	125	13C12-2,3,3',4,4',5,5',6-OcCB (205L)	50	145
2,2',3,3',4,4',5,5',6-NoCB (206)	75	125	13C12-2,2',3,3',4,4',5,5',6-NoCB (206L)	50	145
2,2',3,3',4',5,5',6,6'-NoCB (208)	75	125	13C12-2,2',3,3',4',5,5',6,6'-NoCB (208L)	50	145
DeCB (209)	75	125	13C12-DeCB (209L)	50	145
Cleanup Standards					
			13C12-2,4,4'-TrCB (28L)	65	135
			13C12-2,3,3',5,5'-PeCB (111L)	75	125
			13C12-2,2',3,3',5,5',6-HpCB (178L)	75	125

**TABLE 8: RETENTION TIME LIMITS (and example relative retention time limits)**

Reference 209 Mix Analyte	Example		Example		Window		Example	
	RT (min)	RT Ref	RT Ref (min)	low	high	Resulting RRT Limits		
MoCB-1	6.99	1L	6.98	-3	3	0.994	-	1.009
MoCB-2	8.64	3L	8.77	-3	3	0.979	-	0.991
MoCB-3	8.78	3L	8.77	-3	3	0.995	-	1.007
DiCB-4	8.99	4L	8.97	-3	3	0.997	-	1.008
DiCB-10	9.13	4L	8.97	-3	3	1.012	-	1.023
DiCB-9	10.65	4L	8.97	-3	3	1.182	-	1.193
DiCB-7	10.80	4L	8.97	-3	3	1.198	-	1.210
DiCB-6	11.01	4L	8.97	-3	3	1.222	-	1.233
DiCB-5	11.27	4L	8.97	-3	3	1.251	-	1.262
DiCB-8	11.38	4L	8.97	-3	3	1.263	-	1.274
DiCB-14	12.87	15L	14.25	-3	3	0.900	-	0.907
DiCB-11	13.66	15L	14.25	-3	3	0.955	-	0.962
DiCB-13/12	13.98	15L	14.25	-3	3	0.978	-	0.985
DiCB-15	14.26	15L	14.25	-3	3	0.997	-	1.004
TrCB-19	11.66	19L	11.65	-3	3	0.997	-	1.005
TrCB-18/30	13.35	19L	11.65	-3	3	1.142	-	1.150
TrCB-17	13.77	19L	11.65	-3	3	1.178	-	1.186
TrCB-27	13.96	19L	11.65	-3	3	1.194	-	1.203
TrCB-24	14.11	19L	11.65	-3	3	1.207	-	1.215
TrCB-16	14.22	19L	11.65	-3	3	1.216	-	1.225
TrCB-32	14.72	19L	11.65	-3	3	1.259	-	1.268
TrCB-34	15.98	19L	11.65	-3	3	1.367	-	1.376
TrCB-23	16.16	19L	11.65	-3	3	1.383	-	1.391
TrCB-26/29	16.49	19L	11.65	-5	5	1.408	-	1.423
TrCB-25	16.71	37L	21.93	-3	3	0.760	-	0.764
TrCB-31	17.04	37L	21.93	-3	3	0.775	-	0.779
TrCB-20/28	17.38	37L	21.93	-5	5	0.789	-	0.796
TrCB-21/33	17.61	37L	21.93	-5	5	0.799	-	0.807
TrCB-22	18.06	37L	21.93	-3	3	0.821	-	0.826
TrCB-36	19.81	37L	21.93	-3	3	0.901	-	0.906
TrCB-39	20.23	37L	21.93	-3	3	0.920	-	0.925
TrCB-38	20.93	37L	21.93	-3	3	0.952	-	0.957
TrCB-35	21.47	37L	21.93	-3	3	0.977	-	0.981
TrCB-37	21.96	37L	21.93	-3	3	0.999	-	1.004
TeCB-54	14.58	54L	14.55	-3	3	0.999	-	1.005
TeCB-50/53	16.77	54L	14.55	-5	5	1.147	-	1.158
TeCB-45/51	17.56	54L	14.55	-5	5	1.201	-	1.213

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TeCB-46	17.82	54L	14.55	-3	3	1.221	-	1.228
TeCB-52	19.38	54L	14.55	-3	3	1.329	-	1.335
TeCB-73	19.54	54L	14.55	-3	3	1.340	-	1.346
TeCB-43	19.67	54L	14.55	-3	3	1.348	-	1.355
TeCB-69/49	19.92	54L	14.55	-5	5	1.363	-	1.375
TeCB-48	20.29	54L	14.55	-3	3	1.391	-	1.398
TeCB-44/65/47	20.59	54L	14.55	-5	5	1.409	-	1.421
TeCB-59/62/75	20.93	54L	14.55	-5	5	1.433	-	1.444
TeCB-42	21.17	54L	14.55	-3	3	1.452	-	1.458
TeCB-41	21.63	54L	14.55	-5	5	1.481	-	1.492
TeCB-40/71	21.76	54L	14.55	-5	5	1.490	-	1.501
TeCB-64	22.03	54L	14.55	-3	3	1.511	-	1.518
TeCB-72	23.04	81L	30.73	-3	3	0.748	-	0.751
TeCB-68	23.40	81L	30.73	-3	3	0.760	-	0.763
TeCB-57	23.93	81L	30.73	-3	3	0.777	-	0.780
TeCB-58	24.23	81L	30.73	-3	3	0.787	-	0.790
TeCB-67	24.45	81L	30.73	-3	3	0.794	-	0.797
TeCB-63	24.79	81L	30.73	-3	3	0.805	-	0.808
TeCB-61/76/70/74	25.20	81L	30.73	-6	6	0.817	-	0.823
TeCB-66	25.63	81L	30.73	-3	3	0.832	-	0.836
TeCB-55	25.84	81L	30.73	-3	3	0.839	-	0.842
TeCB-56	26.49	81L	30.73	-3	3	0.860	-	0.864
TeCB-60	26.78	81L	30.73	-3	3	0.870	-	0.873
TeCB-80	27.34	81L	30.73	-3	3	0.888	-	0.891
TeCB-79	29.39	81L	30.73	-3	3	0.955	-	0.958
TeCB-78	30.16	81L	30.73	-3	3	0.980	-	0.983
TeCB-81 WHO	30.76	81L	30.73	-3	3	0.999	-	1.003
TeCB-77 WHO	31.54	77L	31.51	-3	3	0.999	-	1.003
PeCB-104	20.51	104L	20.48	-3	3	0.999	-	1.004
PeCB-96	20.93	104L	20.48	-5	5	1.018	-	1.026
PeCB-103	23.28	104L	20.48	-3	3	1.134	-	1.139
PeCB-94	23.55	104L	20.48	-3	3	1.147	-	1.152
PeCB-95	24.09	104L	20.48	-5	5	1.172	-	1.180
PeCB-93/100	24.39	104L	20.48	-5	5	1.187	-	1.195
PeCB-102/98	24.57	104L	20.48	-5	5	1.196	-	1.204
PeCB-88/91	25.19	104L	20.48	-6	6	1.225	-	1.235
PeCB-84	25.47	104L	20.48	-3	3	1.241	-	1.246
PeCB-89	26.10	104L	20.48	-3	3	1.272	-	1.277
PeCB-121	26.67	104L	20.48	-3	3	1.300	-	1.305
PeCB-92	27.15	123L	34.37	-3	3	0.788	-	0.791
PeCB-113/90/101	27.91	123L	34.37	-5	5	0.810	-	0.814
PeCB-83	28.55	123L	34.37	-6	6	0.828	-	0.834
PeCB-99	28.72	123L	34.37	-5	5	0.833	-	0.838

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PeCB-112	28.87	123L	34.37	-3	3	0.839	-	0.841
PeCB-86/87/97/109/119/125	29.38	123L	34.37	-8	8	0.851	-	0.859
PeCB-117/116/85	30.38	123L	34.37	-5	5	0.881	-	0.886
PeCB-110/115	30.73	123L	34.37	-5	5	0.892	-	0.897
PeCB-82	31.05	123L	34.37	-3	3	0.902	-	0.905
PeCB-111	31.62	123L	34.37	-3	3	0.919	-	0.921
PeCB-120	32.28	123L	34.37	-3	3	0.938	-	0.941
PeCB-108/124	33.88	123L	34.37	-8	8	0.982	-	0.990
PeCB-107	34.23	123L	34.37	-5	5	0.994	-	0.998
PeCB-123 WHO	34.40	123L	34.37	-3	3	0.999	-	1.002
PeCB-106	34.56	123L	34.37	-3	3	1.004	-	1.007
PeCB-118 WHO	34.86	118L	34.85	-3	3	0.999	-	1.002
PeCB-122	35.36	118L	34.85	-3	3	1.013	-	1.016
PeCB-114 WHO	35.64	114L	35.60	-3	3	1.000	-	1.003
PeCB-105 WHO	36.57	105L	36.54	-3	3	0.999	-	1.002
PeCB-127	38.78	105L	36.54	-3	3	1.060	-	1.063
PeCB-126 WHO	41.17	126L	41.14	-3	3	1.000	-	1.002
HxCB-155	27.64	155L	27.61	-3	3	0.999	-	1.003
HxCB-152	27.88	155L	27.61	-3	3	1.008	-	1.012
HxCB-150	28.12	155L	27.61	-3	3	1.017	-	1.020
HxCB-136	28.58	155L	27.61	-3	3	1.033	-	1.037
HxCB-145	29.00	155L	27.61	-3	3	1.049	-	1.052
HxCB-148	31.10	155L	27.61	-3	3	1.125	-	1.128
HxCB-151/135	31.94	155L	27.61	-5	5	1.154	-	1.160
HxCB-154	32.29	155L	27.61	-5	5	1.166	-	1.173
HxCB-144	32.72	155L	27.61	-3	3	1.183	-	1.187
HxCB-147/149	33.22	155L	27.61	-5	5	1.200	-	1.206
HxCB-134	33.48	155L	27.61	-5	5	1.210	-	1.216
HxCB-143	33.64	155L	27.61	-5	5	1.215	-	1.221
HxCB-139/140	34.08	155L	27.61	-5	5	1.231	-	1.237
HxCB-131	34.35	155L	27.61	-3	3	1.242	-	1.246
HxCB-142	34.58	155L	27.61	-3	3	1.251	-	1.254
HxCB-132	35.01	155L	27.61	-5	5	1.265	-	1.271
HxCB-133	35.77	155L	27.61	-3	3	1.294	-	1.297
HxCB-165	36.36	167L	44.03	-3	3	0.825	-	0.827
HxCB-146	36.73	167L	44.03	-3	3	0.833	-	0.835
HxCB-161	36.92	167L	44.03	-3	3	0.837	-	0.840
HxCB-153/168	37.68	167L	44.03	-5	5	0.854	-	0.858
HxCB-141	37.89	167L	44.03	-3	3	0.859	-	0.862
HxCB-130	38.49	167L	44.03	-3	3	0.873	-	0.875
HxCB-137	38.85	167L	44.03	-3	3	0.881	-	0.883
HxCB-164	39.00	167L	44.03	-3	3	0.885	-	0.887

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HxCB-138/163/129	39.48	167L	44.03	-7	7	0.894	-	0.899
HxCB-160	39.71	167L	44.03	-5	5	0.900	-	0.904
HxCB-158	40.06	167L	44.03	-3	3	0.909	-	0.911
HxCB-128/166	41.31	167L	44.03	-5	5	0.936	-	0.940
HxCB-159	42.90	167L	44.03	-3	3	0.973	-	0.975
HxCB-162	43.33	167L	44.03	-3	3	0.983	-	0.985
HxCB-167 WHO	44.06	167L	44.03	-3	3	1.000	-	1.002
HxCB-156/157 WHO	45.81	156L	45.76	-3	3	1.000	-	1.002
HxCB-169 WHO	50.88	169L	50.83	-3	3	1.000	-	1.002
HpCB-188	35.64	188L	35.61	-3	3	0.999	-	1.002
HpCB-179	36.11	188L	35.61	-3	3	1.013	-	1.015
HpCB-184	36.92	188L	35.61	-3	3	1.035	-	1.038
HpCB-176	37.41	188L	35.61	-3	3	1.049	-	1.052
HpCB-186	38.08	188L	35.61	-3	3	1.068	-	1.071
HpCB-178	40.17	188L	35.61	-3	3	1.127	-	1.129
HpCB-175	41.12	188L	35.61	-3	3	1.153	-	1.156
HpCB-187	41.54	188L	35.61	-3	3	1.165	-	1.168
HpCB-182	41.86	188L	35.61	-3	3	1.174	-	1.177
HpCB-183/185	42.48	188L	35.61	-3	3	1.192	-	1.194
HpCB-174	42.80	188L	35.61	-3	3	1.201	-	1.203
HpCB-177	43.47	188L	35.61	-3	3	1.219	-	1.222
HpCB-181	44.09	188L	35.61	-3	3	1.237	-	1.240
HpCB-173/171	44.41	188L	35.61	-5	5	1.245	-	1.249
HpCB-172	46.99	189L	54.86	-3	3	0.856	-	0.857
HpCB-192	47.42	189L	54.86	-3	3	0.863	-	0.865
HpCB-193/180	47.93	189L	54.86	-3	3	0.873	-	0.875
HpCB-191	48.55	189L	54.86	-3	3	0.884	-	0.886
HpCB-170	49.94	189L	54.86	-3	3	0.909	-	0.911
HpCB-190	50.77	189L	54.86	-3	3	0.925	-	0.926
HpCB-189 WHO	54.89	189L	54.86	-3	3	1.000	-	1.001
OcCB-202	43.68	202L	43.65	-3	3	1.000	-	1.002
OcCB-201	45.11	202L	43.65	-5	5	1.032	-	1.035
OcCB-204	46.16	202L	43.65	-3	3	1.056	-	1.059
OcCB-197/200	46.51	202L	43.65	-3	3	1.064	-	1.067
OcCB-198/199	51.05	202L	43.65	-5	5	1.168	-	1.171
OcCB-196	52.12	205L	58.97	-3	3	0.883	-	0.885
OcCB-203	52.44	205L	58.97	-3	3	0.888	-	0.890
OcCB-195	54.48	205L	58.97	-3	3	0.923	-	0.925
OcCB-194	58.26	205L	58.97	-3	3	0.987	-	0.989
OcCB-205	59.00	205L	58.97	-3	3	1.000	-	1.001
NoCB-208	54.14	208L	54.11	-3	3	1.000	-	1.001
NoCB-207	55.63	208L	54.11	-3	3	1.027	-	1.029
NoCB-206	61.88	206L	61.85	-3	3	1.000	-	1.001

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DeCB-209	64.86	209L	64.81	-3	3	1.000	-	1.002
MoCB-1L	6.98	9L	10.63	-15	15	0.633	-	0.680
MoCB-3L	8.77	9L	10.63	-15	15	0.802	-	0.849
DiCB-4L	8.97	9L	10.63	-15	15	0.820	-	0.867
DiCB-15L	14.25	9L	10.63	-10	10	1.325	-	1.356
TrCB-19L	11.65	9L	10.63	-15	15	1.072	-	1.119
TrCB-37L	21.93	52L	19.37	-15	15	1.119	-	1.145
TeCB-54L	14.55	52L	19.37	-10	10	0.743	-	0.760
TeCB-81L	30.73	52L	19.37	-10	10	1.578	-	1.595
TeCB-77L	31.51	52L	19.37	-10	10	1.618	-	1.635
PeCB-104L	20.48	101L	27.90	-10	10	0.728	-	0.740
PeCB-123L	34.37	101L	27.90	-10	10	1.226	-	1.238
PeCB-118L	34.85	101L	27.90	-10	10	1.243	-	1.255
PeCB-114L	35.60	101L	27.90	-10	10	1.270	-	1.282
PeCB-105L	36.54	101L	27.90	-10	10	1.304	-	1.316
PeCB-126L	41.14	101L	27.90	-10	10	1.469	-	1.481
HxCB-155L	27.61	138L	39.43	-10	10	0.696	-	0.704
HxCB-167L	44.03	138L	39.43	-10	10	1.112	-	1.121
HxCB-156L/157L	45.76	138L	39.43	-10	10	1.156	-	1.165
HxCB-169L	50.83	138L	39.43	-10	10	1.285	-	1.293
HpCB-188L	35.61	194L	58.23	-10	10	0.609	-	0.614
HpCB-189L	54.86	194L	58.23	-10	10	0.939	-	0.945
OcCB-202L	43.65	194L	58.23	-10	10	0.747	-	0.752
OcCB-205L	58.97	194L	58.23	-15	15	1.008	-	1.017
NoCB-208L	54.11	194L	58.23	-10	10	0.926	-	0.932
NoCB-206L	61.85	194L	58.23	-15	15	1.058	-	1.066
DeCB-209L	64.81	194L	58.23	-15	15	1.109	-	1.117
TrCB-28L CU	17.35	9L	19.37	-10	10	0.887	-	0.904
PeCB-111L CU	31.59	101L	27.90	-10	10	1.126	-	1.138
HpCB-178L CU	40.12	138L	39.43	-10	10	1.013	-	1.022
DiCB-9L IS	10.63	138L	39.43	-12.5	12.5	0.264	-	0.275
TeCB-52L IS	19.37	138L	39.43	-12.5	12.5	0.486	-	0.497
PeCB-101L IS	27.90	138L	39.43	-12.5	12.5	0.702	-	0.713
HxCB-138L IS	39.43	138L	39.43	-50	50	0.979	-	1.021
OcCB-194 IS	58.23	138L	39.43	-12.5	12.5	1.472	-	1.482

The retention time limits are applied to the daily 209 mix resulting in RRT limits for calibrations and samples, including QC samples.

OcCB-194 IS upper limit example:  $(58.23+(12.5/60))/39.43=1.482$

**TABLE 9: METHOD HOLDING TIMES**

<b>Method</b>	<b>Collection to Extraction</b>	<b>Extraction to Analysis</b>
8290A *	30 days	45 days
1613B	365 days	365 days
DLM02.2	365 days	365 days
M23	30 days	45 days
TO-9a	7 days	40 days
CBC01.2	35 days collect to analysis	
1668A/C	365 days	365 days

\* NOTE: The holding times listed in method 8290 are recommendations. PCDDs and PCDFs are very stable in a variety of matrices, and holding times under the conditions listed in this section may be as long as a year for certain matrices.

**STANDARD OPERATING PROCEDURE  
FOR  
PERCENT MOISTURE**

**CF-OA-E-020**

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**1.0 STANDARD OPERATING PROCEDURE FOR PERCENT MOISTURE****2.0 PURPOSE**

To describe the procedure by which to calculate percent moisture of soil, sludge, and other solid matrices.

**3.0 DISCUSSION**

Determination of percent moisture is necessary when sample results are desired on a dry weight basis. This determination can be made by comparing weights of a known amount of sample before and after drying the sample in an oven at a temperature just above the evaporation temperature of water.

**4.0 METHOD VARIATIONS**

The recommended mass for determining percent moisture is 20 g (when available). When sample is limited, sample mass will be reduced to 5 to 10 g.

**5.0 DEFINITIONS**

- 5.1 Batch: Environmental samples prepared and/or analyzed together with the same process and personnel. A batch consists of 20 or less samples.
- 5.2 Laboratory Duplicate (DUP): Aliquots of a sample taken from the same container under the same laboratory conditions that are processed and analyzed independently.

**6.0 INTERFERENCES/LIMITATIONS**

Not applicable.

**7.0 SAFETY PRECAUTIONS AND WARNINGS**

- 7.1 Personnel performing this analytical procedure are trained in and follow the safe laboratory practices outlined in the Safety, Health, and Chemical Hygiene Plan, CF-LB-N-001.
- 7.2 If there is any question regarding the safety of any laboratory practice, **stop immediately**, and consult qualified senior personnel such as a group or team leader.

**8.0 APPARATUS, EQUIPMENT, AND INSTRUMENTATION**

- 8.1 Drying oven
- 8.2 Balance, with 0.01 g readability
- 8.3 Sample containers
- 8.4 Desiccator cabinet with a hygroscopic desiccant

**9.0 REAGENTS AND STANDARDS**

Not applicable.

**10.0 SAMPLE HANDLING AND PRESERVATION**

Samples should be unpreserved and can be stored in glass or plastic containers. Samples should be stored in airtight containers at a temperature between 3 and 30 °C and in an area that prevents direct contact with sunlight. The percent moisture determination should be done as soon as possible after sampling.

**11.0 PROCEDURES**

- 11.1 Dry Weight Determination for Soils/Solids
- 11.1.1 Turn on oven. Set temperature to 110°C.
- 11.1.2 Write sample number on the drying container.

- 11.1.3 Record weight of sample container (grams),  $W_p$  in AlphaLIMS.
- 11.1.4 Weigh out an appropriate amount of sample and record weight,  $W_i$  in AlphaLIMS. The recommended sample size is approximately 10 g, when sufficient sample is available. (When sample is limited, sample mass will be reduced to 2 to 5 g.)
- 11.1.5 Record temperature of oven. Oven must be stable and within limits to begin a drying cycle ( $110 \pm 5^\circ\text{C}$ ).
- 11.1.6 When the samples are added to the oven, use the LIMS to populate the start time.
- 11.1.7 Leave the samples in the drying oven for minimum of 4 hours (preferably overnight).

**NOTE:** HRSM samples require a minimum of 12 hours of drying time before proceeding to constant weight measurements.

- 11.1.8 Move the samples from the oven to a desiccator. After allowing sample to cool, weigh sample container, and record weight,  $W_f$  in AlphaLIMS. (Enter the extension data link and enter the weigh back time as instance 1.) Replace sample in drying oven for a minimum of 1 hour.
- 11.1.9 Repeat previous step until a constant weight is obtained. (Each weigh back must be associated with an entry in extension data that records the weigh back time. Increment the instance for each weigh back.) A constant weight is defined as a weight difference of less than about 0.1% (i.e. for a 10 g aliquot, the change in weight should be less than 0.01 g). Contact management after 3 unsuccessful tries.

**NOTE:** The time required to obtain constant mass will vary depending on the type of material, size of samples, oven type and capacity, and other factors. The influence of these factors generally can be established by good judgment, experience with the materials being tested, and the apparatus being used.

- 11.1.10 Once no more weigh backs are needed. Place the sample material in the associated dry weigh material container kept in a fume hood.
- 11.1.11 Calculate % moisture:

$W_i$  = weight of sample and container, before drying

$W_f$  = weight of sample and container, after drying

$W_p$  = weight of container

% Moisture =  $((W_i - W_p) - (W_f - W_p)) / (W_i - W_p) \times 100\%$

## 11.2 Wet Weight Determination for Waters/Liquids

- 11.2.1 Turn on oven. Set temperature to  $110^\circ\text{C}$ .
- 11.2.2 Write sample number on the drying container.
- 11.2.3 Record weight of sample container (grams),  $W_p$  in AlphaLIMS.
- 11.2.4 Shake the sample to suspend the solids. Weigh out an appropriate amount of sample and record weight,  $W_i$  in AlphaLIMS. The recommended sample size is approximately 10 g (mL).
- 11.2.5 Ensure that the temperature of the oven is correct and recorded. Oven must be stable and within limits to begin a drying cycle ( $110 \pm 5^\circ\text{C}$ ).

- 11.2.6 When the samples are added to the oven, use the LIMS to populate the start time.
- 11.2.7 Leave the samples in the drying oven for minimum of 4 hours (preferably overnight).
- NOTE:** HRSM samples require a minimum of 12 hours of drying time before proceeding to constant weight measurements.
- 11.2.8 Move the samples from the oven to a desiccator. After allowing sample to cool, weigh sample container, and record weight,  $W_i$  in AlphaLIMS. (Enter the extension data link and enter the weigh back time as instance 1.) Replace sample in drying oven for a minimum of 1 hour.
- 11.2.9 Repeat previous step until a constant weight is obtained. (Each weigh back must be associated with an entry in extension data that records the weigh back time. Increment the instance for each weigh back.) A constant weight is defined as a weight difference of less than about 0.1% (i.e. for a 10 g aliquot, the change in weight should be less than 0.01 g). Contact management after 3 unsuccessful tries.
- NOTE:** The time required to obtain constant mass will vary depending on the type of material, size of samples, oven type and capacity, and other factors. The influence of these factors generally can be established by good judgment, experience with the materials being tested, and the apparatus being used.
- 11.2.10 Once no more weigh backs are needed. Place the sample material in the associated dry weigh material container kept in a fume hood.
- 11.2.11 Calculate % Solids and a 10g equivalent weight:
- $W_i$  = weight of sample and container, before drying  
 $W_f$  = weight of sample and container, after drying  
 $W_p$  = weight of container

$$\% \text{ Solids} = 100 \times \left[ \frac{(W_i - W_p) - (W_f - W_p)}{(W_i - W_p)} \right]$$

$$10 \text{ gram equivalent} = \frac{1000}{\% \text{ Solids}}$$

## 12.0 QUALITY CONTROL SAMPLES AND REQUIREMENTS

A duplicate of a sample shall be run with every batch of 20 or less samples. The relative percent difference (RPD) between the sample and the duplicate (DUP) should be less than 20% if both results are greater than 15% moisture. If either result is less than 15% moisture, the RPD limits do not apply.

## 13.0 CALIBRATION

- 13.1 Balances are calibrated and verified in accordance with CF-LB-E-002.
- 13.2 Temperature monitoring devices are verified in accordance with CF-QS-E-007.

**14.0 RECORDS MANAGEMENT**

All logbooks and data generated as a result of this procedure are maintained as quality records in accordance with CF-QS-E-008 for Quality Records Management and Disposition.

**15.0 LABORATORY WASTE HANDLING AND DISPOSAL**

For the proper disposal of sample and reagent wastes from this procedure, refer to the Laboratory Waste Management Plan, CF-LB-G-001.

**16.0 REFERENCES**

ASTM, Vol. 4.08, D2216-05, "Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass."

**17.0 HISTORY**

Revision 0: New document.

Revision 1: Section 11.5 added to address temperature recording.

Revision 2: Paragraph reference fixed in 11.8.

Revision 3: Added 12 hour drying time for HRSM and clarified the recording of the weigh back times.

Revision 4: Added the use of a desiccator to cool samples.

Revision 5: Added disposition of spent dry weight material in queue for disposal.

Revision 6: Added wet weight procedure.

**CAPE FEAR ANALYTICAL, LLC**  
**QUALITY ASSURANCE PLAN**  
**CF-QS-B-001**

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**SECTION 1  
INTRODUCTION****1. SECTION 1 - INTRODUCTION**

Cape Fear Analytical, LLC (CFA) is a privately owned environmental laboratory dedicated to providing personalized client services of the highest quality. Our mission is to employ innovative thinking and state-of-the-art analyses to solve analytical challenges. Well trained professional personnel and modern reporting tools will be an integral part of the businesses success. Implementation of a quality control and assurance program will provide a focus for productive work and the basis of state and regulating agency certifications.

CFA was established as an analytical testing laboratory in 2009. Our analytical laboratory uses state of the art equipment and methods to provide data of the highest quality and related support services to meet the needs of our clients.

This Quality Assurance Plan (QAP) provides an overview of our quality assurance program for analytical services. Outlined in this plan are the responsibilities, policies, and processes essential to maintaining client satisfaction and our high quality of performance. The Quality Manager is responsible for revising, controlling, and distributing the QAP. It is reviewed and updated at least annually.

Everyone on our staff is expected to understand the policies, objectives, and procedures that are described in this plan and to fully appreciate our commitment to quality and their respective roles and responsibilities with regard to quality. We also expect any analytical subcontractors we employ to perform in accordance with the quality assurance requirements delineated in this plan.

This Quality Assurance Plan has been prepared according to the standards and requirements of the US Environmental Protection Agency (EPA), ANSI/ISO/IEC 17025-2017, the National Environmental Laboratory Accreditation Program (NELAP 2003), and The NELAC Institute Quality Systems Standards effective July 2009 (TNI 2016).

**1.1 QUALITY POLICY**

CFA's quality policy is a demonstrated commitment to excellence in professional practice and to the quality of the data provided to its clients. The laboratory strives to provide high quality, personalized services that enable its clients to meet their analytical testing needs quickly and cost effectively. All CFA employees are required to be familiar with the quality management system and the necessity for documentation and implementation of its policies and procedures in meeting client and regulatory requirements. Continual improvement to effective, ethical implementation of all quality systems measured is expected throughout the laboratory operations.

We define quality as "consistently meeting the needs and exceeding the expectations of our clients in a highly ethical manner." As such, we strive to:

- meet or exceed client and regulatory requirements
- be technically correct and accurate
- be defensible within contract specifications

- provide services in a cost-effective, timely and efficient manner

At CFA, quality is emphasized at every level—from the owners and directors down to the newest of employees. Management’s commitment to good professional practice and to the quality of our testing services for our customers is demonstrated by their dedication of personnel and resources to develop, implement, assess, and continually improve our technical and management operations.

The purpose of CFA’s quality assurance program is to establish policies, procedures, and processes to meet or exceed the expectations of our clients. To achieve this, all personnel that support these services to our clients are introduced to the program and policies during their initial orientation, and annually thereafter during company-wide training sessions.

CFA’s management is committed to compliance with and continual improvement of our quality assurance program. The program is designed to comply with the guidelines and specifications outlined in the following:

- NELAC 2003
- TNI 2016
- ANSI/ISO/IEC 17025-2017
- Department of Defense Quality Systems Manual
- Current U.S. EPA CLP statements of work for organic analyses

### 1.2 Quality Goals

CFA’s primary goals are to:

- Ensure that all measurement data generated are scientifically and legally defensible, of known and acceptable quality per the data quality objectives (DQOs), and thoroughly documented to provide sound support for environmental decisions.
- Ensure compliance with all contractual requirements, environmental standards, and regulations established by local, state and federal authorities.
- Additional goals include:
- A comprehensive quality assurance program to ensure the timely and effective completion of each measurement effort.
- A commitment to excellence and improvement at all levels of the organization.
- Early detection of deficiencies that might adversely affect data quality.
- Adequate document control.
- Effective quality assurance objectives for measurement systems and for quality data in terms of accuracy, precision, completeness, and comparability through the use of proven methods.
- The establishment of procedures that demonstrate that the analytical systems are in a state of statistical control.
- The implementation of corrective actions and improvements to ensure the integrity of data.
- Reduction of data entry errors through automated data handling procedures.
- The development and implementation of good laboratory practices and standard operating procedures (SOPs).
- Ability to customize quality assurance procedures to meet a client’s specific requirements for data quality.
- Good control of instruments, services, and chemical procurement.
- A continuously capable laboratory information management system (AlphaLIMS).
- Validated and documented computer hardware and software.

### 1.3 Key Quality Elements

A sound quality assurance program is essential to our ability to provide data and services that consistently meet our high standards of integrity. The key features of our program are:

- A formal quality policy and QAP.
- Management review.
- Stated data quality objectives.
- A comprehensive employee training program.
- Ethics policy and education program.
- Internal audits and self-evaluations.
- A closed-loop corrective action program.
- State-of-the-art facilities and instruments.
- Adherence to standard operating procedures.
- EPA/NIST traceable reference materials.
- Electronically based document control.
- Chain of custody and electronic sample tracking.
- Inter-laboratory comparison programs.
- Formal laboratory accreditations.
- The evaluation of subcontractor laboratories.
- Statistical controls for analytical precision and accuracy.
- Replicate, method blank, matrix spike, internal standards, and surrogate measurements.
- The preventive maintenance of instrumentation and equipment.
- Independently prepared blind standard reference materials.
- Multi-level review processes.
- Focus on client satisfaction.
- Electronic tracking of client commitments, nonconformances and corrective actions.
- Trend analysis of nonconforming items.

### 1.4 Management Reviews

The effectiveness of the Quality System is reviewed at least annually by Senior Management. These reviews address issues that impact quality, and the results of the reviews are used to develop and implement improvements to the system. Records of the review meetings are maintained as quality documents.

### 1.5 Disposition of Client Records

In the event that the laboratory should change ownership, the responsibility for the maintenance and disposition of client records shall transfer to the new owners. In the unlikely event that the laboratory ceases to conduct business, clients shall be notified and asked to provide instructions as to how their records should be returned or disposed. If a client does not provide instructions, those records will be maintained and disposed in a manner consistent with regulations and good laboratory practices for quality records.

### 1.6 Supporting Documents

Our laboratory operations and the quality of our analytical data comply with the specifications described in the documents listed in Appendix A.

### 1.7 Definitions

Applicable definitions are listed in Appendix B.

## 1.8 Test Methods

1.9 The following test methods are performed at Cape Fear Analytical:

- SW846 Method 8290A
- EPA Method 1613B
- EPA Methods 1668A and 1668C
- EPA TO-9a
- EPA DLM02.2
- EPA CBC01.2
- EPA HRSM01.2
- EPA HRSM02.0
- SW846 3546

**SECTION 2  
ORGANIZATION, MANAGEMENT, AND PERSONNEL****2. SECTION 2 - ORGANIZATION, MANAGEMENT, AND PERSONNEL**

The chart found in Appendix C depicts our organization, chain of command and flow of responsibility. The illustration in this appendix is designed to ensure the overall quality and cost efficiency of our company's analytical products and services. Our relationship to our parent corporation is shown by the dotted lines on the organizational chart in appendix C. We have the use of the parent corporation's Chief of Operations to help with items such as laboratory direction, the evaluation of new work, and management review. CFA accesses the Quality Director of the parent corporation to provide help with annual quality systems review, allocation of additional quality resources to support heavy work loads in order to maintain quality, and vendor and subcontractor audit support. CFA depends upon its parent corporation for IT support, maintenance of AlphaLIMS and electronic deliverables.

Our structure is based on a customer-focused approach that follows a project from the point of initial contact to the final invoicing of work. This approach includes expertise in project management, sample receipt and custody, sample preparation and analysis, data review, and data packaging. Our Quality Manager monitors the adherence of these departments to the Quality Assurance Program.

The general responsibilities associated with the following position levels are discussed in this section:

- Laboratory Director
- Technical Director
- Client Services Manager
- Production Manager
- Laboratory and Technical Staff

An overview of CFA's employee training protocol is also provided at Section 2.7.

**2.1 Laboratory Director**

The Laboratory Director is responsible for the daily operations of the laboratory and client services (see Section 2.4). He/she is also responsible for strategic planning, profitability and growth, personnel management and business development. Other responsibilities include the following:

- Ensuring that the individuals who staff our technical and quality positions have the necessary education, training, and experience to competently perform their jobs.
- Ensuring that all staff members receive ancillary training, as needed, to enhance performance in assigned positions.
- Budgeting, staffing, managing, and equipping the laboratory to meet current and future analytical program requirements.
- Monitoring and meeting profitability and growth objectives of the division.
- Establishing and implementing short and long range objectives and policies that support CFA's goals.

- Overseeing the implementation and overall effectiveness of our Quality Assurance Plan, health and safety initiatives, and environmental programs.
- Authorizes stop-work orders. In the absence of the Quality Manager, authorizes return-to-work orders after a major out-of-control situation.
- Managing production and cost control activities.
- Supervising all personnel employed in the laboratory.
- Ensuring development of capabilities in response to new or revised regulations, instrumentation and procedures, and quality assurance initiatives.
- Ensuring compliance with regulatory standards, including ISO/IEC 17025 and the Department of Defense Quality Systems Manual.
- Representing the company to the public and to clients.
- Ensuring the appropriate delegation of authorities during periods of absence.
- Ensuring that the laboratory has policies to avoid involvement in activities or relationships which might negatively affect confidence in the laboratory's competence, impartiality, judgment or operational integrity.
- Ensuring that management and personnel are free from undue internal and external pressures and influences that may adversely affect their impartiality, affecting the quality of their work, by mitigating pressures.

The Laboratory Director also manages the implementation and ongoing development of our Human Resources. Responsibilities include:

- Administration, orientation, and indoctrination of all new employees.
- Administration and compliance with Federal, State, and Local employment regulations.
- Sourcing candidates for all functional positions to maintain and strengthen the technical services provided by CFA.
- Management of occupational health and safety as it relates to Federal, State, and OSHA regulations.

## 2.2 Technical Director

The Technical Director is ultimately responsible for the technical content and quality of work performed within each department. Other responsibilities include:

- Defining the minimum level of qualification, experience, and skills necessary for positions in each department.
- Establishing and implementing policies and procedures that support our quality standards.
- Ensuring that technical laboratory staff demonstrates initial and continuing proficiency in the activities for which they are responsible.
- Documenting all analytical and operational activities of the laboratory.
- Ensuring that all sample acceptance criteria are verified and that samples are logged into the sample tracking system, properly labeled, and stored.
- Documenting the quality of all data reported by the laboratory.
- Developing internal mechanisms and measurements to improve efficiency.
- Overseeing activities designed to ensure compliance with laboratory health and safety requirements.
- Allocating the resources necessary to support an effective and ongoing quality assurance program.
- Ensuring compliance with regulatory standards, including ISO/IEC 17025 and the Department of Defense Quality Systems Manual.
- Maintaining MDL, PQL, LOD and LOQ studies in the laboratory LIMs

- Due to high volume and the variety of analytical tests performed in the laboratory, the Technical Director has the assistance of a Production Manager (see Section 2.5).
- Ensuring that the laboratory has policies to avoid involvement in activities or relationships which might negatively affect confidence in the laboratory's competence, impartiality, judgment or operational integrity.
- Ensuring that management and personnel are free from undue internal and external pressures and influences that may adversely affect their impartiality, affecting the quality of their work, by mitigating pressures.

The Technical Director also oversees our physical facility, laboratory safety program, and instrumentation. This includes the following responsibilities:

- Planning, evaluating, and making recommendations for facility maintenance.
- Implementation of the Chemical Hygiene program.
- Aiding in the Installation, maintenance, repair, and modification of analytical instrumentation.
- Providing technical expertise and training in instrumentation operation, calibration, and maintenance.
- Monitoring and ensuring regulatory compliance for waste management operations and off-site disposal.

The Technical Director at CFA also manages the implementation and maintenance of our quality systems in a timely, accurate, and consistent manner. These responsibilities may be found in Section 3.

### 2.3 Quality Systems Review

The effectiveness of the Quality System is reviewed on a regular basis during management meetings, which are held as frequently as needed. These meetings address issues that impact quality, and the subsequent discussions are used to design and implement improvements to the system. At least annually, a management assessment of CFA's Quality System is conducted and reported. The Quality Manager maintains records of these assessments.

### 2.4 Client Services Manager

Project Managers (PMs) serve as primary liaisons to our clients. Employees function as PMs, under the guidance of the Client Services Manager, to manage the company's interaction with clients. They are the client's first point of contact and have responsibility for client satisfaction and for communicating project specifications and changes to the appropriate laboratory areas.

In addition to overseeing project management, other responsibilities include:

- Retaining clients and soliciting new work.
- Managing multiple sample delivery orders and preparing quotes.
- Working with clients to define analytical methodologies, quality assurance requirements, reports, deliverables, and pricing.
- Overseeing sample management and informing laboratory staff of the anticipated arrival of samples for analysis.
- Conducting a review of client documents (i.e. quotes, invoices, routine and specialized reports).
- Working with the accounting team on invoicing and collection issues.
- Working with the Laboratory Director and Production Manager to project workloads and determine schedules.

- Ensuring that the laboratory has policies to avoid involvement in activities or relationships which might negatively affect confidence in the laboratory's competence, impartiality, judgment or operational integrity.
- Ensuring that management and personnel are free from undue internal and external pressures and influences that may adversely affect their impartiality, affecting the quality of their work, by mitigating pressures.

### 2.5 Production Manager

The Production Manager is a critical link between project management, lab personnel, and support staff. He/she reports to the Laboratory Director and has the following responsibilities:

- Planning and coordinating the operations of the laboratory to meet client expectations.
- Scheduling sample preparation and analyses according to holding times, quality criteria, and client due dates.
- Ensuring a multi-level review of 100% of data generated by the laboratory.
- Coordinating non-conformances and corrective actions in conjunction with the Quality Manager.
- Serving as a technical resource to the laboratory, including data review.
- Managing special projects, reviewing new work proposals, and overseeing the successful implementation of new methods.
- Monitoring and controlling expenses incurred by the laboratory such as overtime and consumables.
- Providing performance and career development feedback to laboratory staff.
- Ensuring compliance with regulatory standards, including ISO/IEC 17025 and the Department of Defense Quality Systems Manual.
- Ensuring that the laboratory has policies to avoid involvement in activities or relationships which might negatively affect confidence in the laboratory's competence, impartiality, judgment or operational integrity.
- Ensuring that management and personnel are free from undue internal and external pressures and influences that may adversely affect their impartiality, affecting the quality of their work, by mitigating pressures.

### 2.6 Laboratory and Technical Staff - General Requirements

At CFA, every effort is made to ensure that the laboratory is sufficiently staffed with personnel who have the training, education, and skills to perform their assigned jobs competently.

Depending upon the specific position, laboratory personnel are responsible for:

- Complying with quality assurance and quality control requirements that pertain to their group and/or technical function.
- Demonstrating a specific knowledge of their particular function and a general knowledge of laboratory operations.
- Understanding analytical test methods and standard operating procedures that are applicable to their job function.
- Documenting their activities and sample interactions in accordance with analytical methods and standard operating procedures.
- Implementing the quality assurance program as it pertains to their respective job functions.
- Identifying potential sources of error and reporting any observed substandard conditions or practices.
- Identifying and correcting any problems affecting the quality of analytical data.

### 2.7 Employee Training

To ensure that our clients receive the highest quality services possible, we train our employees in the general policies and practices of the company, as well as the specific operating procedures relative to their positions. We conduct and document this training according to CF-HR-E-002 for Employee Training and CF-QS-E-017 for Maintaining Technical Training Records.

New employees participate in a company orientation shortly after they are hired. During orientation they receive information on quality systems, ethics/data integrity, laboratory safety, and employment practices. Each new employee is also provided a manual that reiterates our policies on equal opportunity, benefits, leave, conflicts of interest, employee performance, and disciplinary action. Employees can access standard operating procedures, the Quality Assurance Plan, Safety, Health, and Chemical Hygiene Plan, and the Laboratory Waste Management Plan on CFA's Intranet.

Other training provided on an ongoing basis may include:

- Demonstration of initial proficiency in analytical methods and training to SOPs conducted by a trainer who has been documented as qualified and proficient in the process for which training is being provided.
- Demonstration of continued analyst proficiency is updated annually, usually during the first quarter of each year. Proficiency is demonstrated using the same processes as those used for initial Demonstration of Capability. (Refer to Section 8.3.1.)
- Company-wide, onsite training.
- Courses or workshops on specific equipment and analytical techniques.
- University courses.
- Professional and trade association conferences, seminars, and courses.
- MDL studies are maintained with training records where applicable (Kentucky Certification Manual).

Documentation of employee training is the joint responsibility of the employee and the Quality Manager or Production Manager. If an SOP is revised during the course of the year, training to the revised SOP must be documented.

## 2.8 Ethics and Data Integrity

Employees attend ethics education programs that focus on the high standards of data integrity and ethical behavior mandated by our company and expected by our clients.

The annual ethics training includes:

- Specific examples of unethical behaviors for the industry and for the laboratory.
- Explanation of Internal Auditing for unethical behaviors and practices.
- CFA use of electronic audit functions using instrument and AlphaLIMS software.
- Examples of consequences of inappropriate or unethical behaviors/practices.
- Examples of impartiality from commercial, financial or other pressures, both external and internal.

CFA's policy on confidential reporting of potential integrity issues is presented during the initial and continuing Ethics and Data Integrity training. Potential business or data integrity issues are handled and reviewed in a confidential manner until such time as a follow-up evaluation, full investigation, or other appropriate actions have been completed and issues clarified. All investigations are confidentially processed by CFA's Quality Manager, or other members of CFA's Laboratory Management staff under the direction of the QM. All investigations that

result in finding of inappropriate activity are properly documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients. The QM is responsible for updating CFA's Executive Committee on the progress of integrity investigations during regularly scheduled meetings.

All employees sign an Ethics and Data Integrity Agreement that reflects their commitment to always performing their duties with these high standards. (Refer to Appendix F.)

### 2.9 Confidentiality

The laboratory maintains the confidentiality and proprietary rights of information including the type of work performed and results of analysis. Laboratory personnel and staff are informed of this policy and sign a confidentiality agreement.

A confidentiality statement accompanies the electronic transfer of data from CFA via telefacsimile (fax) or electronic mail systems (email). Government affiliated auditing agencies have access to pertinent laboratory records. However, contract, third party, and client auditors have access only to those records that may be applicable to their inspection and shall not be granted access to client records that may be considered in conflict with their interests, unless prior authorization has been given by the submitting client. Confidential information may be purged of references to client identity, project and/or sample identity by the laboratory so that records may be provided to other entities (e.g. auditors) for review.

### 2.10 Impartiality

The laboratory is committed to Impartiality in producing valid results derived under its range of activities or scope of work. Results are provided accurately, objectively, clearly and in a report format which includes all the information necessary for the interpretation of the results. All information required by the method used and agrees with the customer is reported. The laboratory strives to maintain impartiality from commercial, financial or other pressures which might compromise impartiality. In addition to internal management structure mitigating undue pressures on employees, the laboratory reviews requests and tenders for possible risks to impartiality prior to bidding on work.

Our Core Values, along with procedures, plans, and policies outlined in the Quality Assurance Plan, scheduled management meetings, and monitoring of key performance indicators help in the management of risks on an on-going basis.

### 2.11 Appointment of Deputies for Key Managerial Personnel

Deputy personnel are assigned to key management personnel so that the responsibilities associated with the key position will be attended to by the deputy. The laboratory appoints the following deputies for the following positions:

Management - The deputy Laboratory Director shall be the Production Manager.

Technical – The deputy Production Manager shall be the Laboratory Director.

Quality - The deputy Quality Manager shall be Packaging/Technical Support.

Customer Service – The deputy Project Manager shall be the Laboratory Director.

**SECTION 3  
QUALITY SYSTEMS****3. SECTION 3 - QUALITY SYSTEMS**

Our Quality Systems include all quality assurance (QA) policies and quality control (QC) procedures necessary to plan, implement, and assess the work we perform. CFA's QA Program establishes a quality management system (QMS) that governs all of the activities of our organization.

CFA's quality management system is designed to conform to the requirements specified in the standards referenced in Appendix A. Essential elements of our quality management system are described in this section.

**3.1 Quality Manager**

The Quality Manager is responsible for managing CFA's Quality Assurance Program. This person functions independently of the systems he/she monitors.

Following is a summary of the responsibilities of this position:

- Reports to the Laboratory Director
- Demonstrates strict adherence to and support of the company ethics policy
- Serves as management's representative for quality
- Responsible for the implementation and maintenance of the QMS
- Responsible for ensuring communication takes place at all levels within CFA, pertaining to issues included in this section.
- Responsible for evaluating the effectiveness of the quality system through various quality measures such as internal and external assessment, non-conformances and management review
- Initiates and recommends preventive action and solutions to quality problems
- Implements appropriate action to control quality problems until solutions are implemented and verified to be effective
- Verifies that effective solutions are implemented
- Authorizes stop-work and return-to-work orders after a major out-of-control situation
- Demonstrates knowledge of the Quality System as defined by NELAC, TNI, ANSI/ISO/IEC 17025, DoD and DoE.
- Plans, schedules and participates in CFA's client audits, internal audits, and subcontractor audits
- Conducts conformance audits as necessary to verify implementation and closure of audit action items
- Serves as liaison to client and third party auditors
- Coordinates laboratory responses to audit reports and prepares final response
- Monitors progress of corrective actions
- Demonstrates the ability to evaluate data objectively without outside influence
- Has knowledge of analytical methods
- Ensures the monitoring of balances and weights, and temperature regulation of ovens, water baths, and refrigerators
- Writes and reviews quality documents and standard operating procedures
- Provides training in quality systems, ethics, confidentiality and good laboratory practices.

- Evaluates effectiveness of training and makes recommendations when additional training or re-training is required
- Manages laboratory certification and licensing processes. Performs notification of changes at our lab with respect to ownership, technical direction or location.
- Coordinates the receipt and disposition of external and internal performance evaluation samples.
- Developing and evaluating quality assurance policies and procedures pertinent to our laboratory functions, and communicating these with the division directors and managers.
- Ensuring that laboratory activities are in compliance with local, state, and federal environmental laws and regulations.
- Manage performance, evaluation and implementation of MDL, PQL and SPC determinations.
- Reviewing project-specific quality assurance plans.
- Performing independent quality reviews of randomly selected data reports and laboratory practices including facilities and instruments.
- Communicating system deficiencies, recommending corrective action to improve the system, and defining the validity of data generated during out of control situations.
- Administering our document control system.
- Designating quality systems authorities in times of absence to one or more appropriately knowledgeable individuals.
- Submittal of Quarterly Progress Reports (QPR) to the DOE contractor SMO.
- Ensuring that the laboratory has policies to avoid involvement in activities or relationships which might negatively affect confidence in the laboratory's competence, impartiality, judgment or operational integrity.
- Ensuring that management and personnel are free from undue internal and external pressures and influences that may adversely affect their impartiality, affecting the quality of their work, by mitigating pressures.
- Ensuring that employee competence measurements are established and monitored.

### 3.2 Quality Documents

Our Quality Systems policies and procedures are documented in the QA Plan (CF-QS-B-001) and other supporting documents. CFA's management approves all company quality documents. Pre-approval is secured for any departures from such documents that may affect quality. Any departures are documented and provided to the client.

In addition to the QA Plan, Quality Systems allows for QA Project Plans (QAPjP) and includes standard operating procedures and any other quality assurance program requirements defined by individual contracts. The QA Plan describes the quality standards that we apply to our laboratory operations. We use Quality Assurance Project Plans to specify individual project requirements. The QA Plan and supporting documents are verified to be understood and are implemented throughout the laboratory fractions to which they apply.

Finally, our Standard Operating Procedures (SOPs) are used to describe in detail those activities that affect quality. SOPs are prepared, authorized, changed, revised, released, and retired in accordance with CF-ADM-E-001. SOPs are accessible electronically via CFA's Intranet.

### 3.3 Document Control

The control of quality documents is critical to the effective implementation of our Quality Systems. We define and control this process in accordance with CF-DC-E-001 for Document

Control. Responsibilities for document control are divided between the Production Manager and the Quality Manager.

The Production Manager is responsible for:

- Supporting the development and maintenance of controlled documents that apply to their respective departments.
- Ensuring through documentation that the affected employees are aware of revisions to documents or manuals.

The Quality Manager is responsible for:

- Electronic maintenance of all records required for control, re-creation, and maintenance of analytical documentation.
- Maintenance of electronic copies of archived data and the electronic log of how they were determined.
- Demonstrating strict adherence to and support of the company ethics policy as it pertains to Document Control.
- Managing the system for the preparation, authorization, change, revision, release, and retirement of the Quality Manual, QAP, project plans, and standard operating procedures.
- Ensuring that current controlled documents are accessible via CFA's Intranet.
- Managing a system to document current revision numbers and revision dates for all distributed documents and manuals.
- Managing a system to identify the nature of document revisions.
- Maintaining hard or electronic copies of obsolete documents and original copies of controlled documents.

### 3.4 Controlled Document Review

Internally generated controlled documents undergo a multi-level review and approval process before they are issued. These levels include a procedural review, technical and/or quality review and final authorization by the appropriate manager or director. To ensure that new or revised standard operating procedures are not implemented prematurely, SOPs are effective upon the date of the final approval signature.

### 3.5 Review of New Work

Prior to submitting proposals for new work, all available information, including but not limited to, statements of work (SOW), requests for proposal (RFP) and client communications are reviewed. Review is conducted by the Laboratory Director, Project Manager, Quality Manager, and Production Manager. This review is performed in order to ascertain the appropriateness of CFA's resources and facilities.

### 3.6 Quality Records

Quality records provide evidence that specified quality requirements have been met and documented. We generate them in accordance with applicable procedures, programs, and contracts. Quality records include but are not limited to:

- Observations
- Calculations
- Calibration data
- Certificates of analysis
- Certification records

- Chains of custody
- Audit records
- Run logs, instrument data, and analytical logbooks
- Instrument, equipment, and building maintenance logs
- Material requisition forms
- Monitoring logs
- Nonconformance reports and corrective actions
- Method development and start-up procedures including method detection limit studies
- Technical training records
- Waste management records
- Standard logs
- Software validation documentation
- Standard Operating Procedures (SOPs)
- Sample collection and field data

Our quality records are:

- Documented in a legible manner.
- Indexed and filed in a manner conducive to ready retrieval.
- Stored in a manner that protects them from loss, damage, and unauthorized alterations.
- Retained and disposed in the identified time period.

The generation, validation, indexing, storage, retrieval, and disposition of our quality records are detailed in CF-QS-E-008 for Quality Records Management and Disposition. The quality records of subcontracted services are also required to meet the conditions established in this SOP.

### 3.7 Internal and Supplier Quality Audits

We conduct internal audits annually to verify that our operations comply with the requirements of our QA program and those of our clients. We perform supplier audits as necessary to ensure that they too meet the requirements of these programs. Both internal and supplier audits are conducted in accordance with CF-QS-E-001 for the Conduct of Quality Audits.

#### 3.7.1 Audit Frequency

Internal audits are conducted at least annually in accordance with a schedule approved by the Quality Manager. Supplier audits are contingent upon the categorization of the supplier, and may or may not be conducted prior to the use of a supplier or subcontractor (Refer to CF-QS-E-001.) Type I suppliers and subcontractors, regardless of how they were initially qualified, are re-evaluated at least once every three years.

Additional internal and supplier audits may be scheduled if deemed necessary.

#### 3.7.2 Audit Team Responsibilities

Internal and supplier audits are conducted by qualified staff under the direction of the Quality Manager. A qualified audit team member shall have the technical expertise to examine the assigned activities.

We do not allow staff to audit activities for which they are responsible or in which they are directly involved. It is the responsibility of the Quality Manager to ensure that such conflicts of interest are avoided when the audit team is assembled.

Management has a significant role in the internal audit process, including:

- Provision of audit personnel
- Empowerment of the audit team with authority to make the audit effective
- Development and implementation of timely corrective action plans

### 3.7.3 Identification and verification of OFIs

Opportunities for Improvement are identified conditions that may adversely affect the quality of products or services. Several examples of objective evidence are used to support an OFI, which might be classified as a finding, concern, observation, and/or recommendation.

The Quality Manager may initiate a Nonconformance Report (NCR) or Corrective Action Request and Report (CARR) referencing the OFI. The NCR or CARR is then entered into the NCR system per CF-QS-E-012 for NCR Database Operation.

Implementation of a corrective action is later verified by a re-audit of the deficient area, review of new or revised documents, or, if the OFI does not warrant immediate action, the corrective action may be verified during the next scheduled audit. Such long term follow-up will document the implementation and effectiveness of the corrective action.

### 3.8 Managerial and Audit Review

Laboratory management reviews the audit process at least annually. This ensures the effectiveness of the corrective action plan and provides the opportunity to introduce changes and improvements.

We document all review findings and corrective actions. Implementation plans and schedules are monitored by the Quality Manager.

### 3.9 Nonconformances

Processes, materials, and services that do not meet specifications or requirements are defined as nonconforming. Such nonconformances can include items developed in-house or purchased from vendors, samples received from clients, work in progress, and client reports.

At CFA, we have a nonconformance reporting system (NCR) that helps us prevent the entry of defective goods and services into our processes and the release of nonconforming goods and services to our clients. Our NCR system provides a means for documenting the disposition of nonconforming items and for communicating these to the persons involved in the process affected by the adverse condition(s).

Nonconformances are documented according to CF-QS-E-004 for the Documentation of Nonconformance Reporting and Dispositioning and Control of Nonconforming Items. We regularly review SOPs, client complaints, and quality records, including completed NCRs, to promptly identify conditions that might result in situations or services that do not conform to specified quality requirements.

Our Quality Manager processes, categorizes and trends nonconformances. Trending information may be provided to management.

### 3.10 Corrective Action

There are two categories of corrective action at CFA. One is corrective action implemented at the analytical and data review level in accordance with the analytical SOP. The other is formal corrective action documented by the Quality Manager in accordance with CF-QS-E-002.

Formal corrective action is initiated when a nonconformance reoccurs or is so significant that permanent elimination or prevention of the problem is required.

We include quality requirements in most analytical SOPs to ensure that data are reported only if the quality control criteria are met or the quality control measures that did not meet the acceptance criteria are documented.

Formal corrective action is implemented according to CF-QS-E-002 for Conducting Corrective/Preventive Action and Identifying Opportunities for Improvement and documented according to CF-QS-E-012 for NCR Database Operation.

Any employee at CFA can identify and report a nonconformance and request that corrective action be taken. Any CFA employee can participate on a corrective action team as requested by the Quality Manager or Production Manager. The steps for conducting corrective action are detailed in CF-QS-E-002.

In the event that correctness or validity of the laboratory's test results is doubted, the laboratory will take corrective action. If investigations show that the results have been impacted, affected clients will be informed of the issue in writing within 21 calendar days of the discovery.

### 3.11 Performance Audits

In addition to internal and client audits, our laboratory participates in annual performance evaluation studies conducted by independent providers. We routinely participate in the following types of performance audits:

- Proficiency testing and other inter-laboratory comparisons.
- Performance requirements necessary to retain certifications (Appendix D).
- Evaluation of recoveries of certified reference and in-house secondary reference materials using statistical process control (SPC) data.
- Evaluation of relative percent difference between measurements through SPC data.

NOTE: Once PE samples have been prepared in accordance with the instructions provided by the PE vendor, they are managed and analyzed in the same manner as environmental samples from clients. The analytical and reporting processes for PE samples are not handled differently than for authentic samples. SOP CF-QS-E-013 more completely describes the laboratory policies and practices for managing proficiency evaluation samples.

We also participate in a number of proficiency testing programs for federal and state agencies and as required by contracts. It is our policy that no proficiency evaluation samples be analyzed in any special manner.

Our annual performance evaluation participation generally includes a combination of studies that support the following:

- Water Pollution (WP). Biannual program for waste methodologies.
- Water Supply (WS): Biannual program for drinking water methodologies.

At CFA, we also evaluate our analytical performance on a regular basis through statistical process control acceptance criteria. Where feasible, this criterion is applied to both measures of precision and accuracy and is specific to sample matrix.

We establish environmental process control limits for the LCS, MS and MSD at least annually. CFA's current process control limits are maintained in LIMS. The upper and lower control limits (UCL and LCL respectively) for precision are plus or minus three times the standard deviation from the mean of a series of relative percent differences. For DoD QSM projects the

laboratory initially uses the limits provided in the current DoD QSM tables and when unavailable, uses the laboratory derived limits. When the laboratory has enough data points to establish statistical limits, it will derive these limits in accordance with its normal procedures, using DoD QSM project sample results.

CFA's procedure for establishing precision and bias at the LOQ is to collect data from LOQ and LOQV determinations until there are enough points to generate valid statistical limits. These limits are reported with the LOQ results in data packages. Where there is not adequate laboratory data available, the laboratory uses 50 -150% for UCL and LCL, with 45% - 155% ME limits.

CFA also measures precision through the use of matrix duplicates and/or matrix spike duplicates. The upper and lower control limits (UCL and LCL respectively) for precision are the same as those used for the LCS, in accordance with the DoD QSM.

For non-DoD QSM projects, the upper and lower control limits (UCL and LCL respectively) for precision are plus or minus three times the standard deviation from the mean of a series of relative percent differences.

Accuracy is measured through laboratory control samples and/or matrix spikes, as well as surrogates and internal standards. The UCLs and LCLs for accuracy are plus or minus three times the standard deviation from the mean of a series of recoveries. Specific instructions for out-of-control situations are provided in the applicable analytical SOP.

### 3.12 Essential Quality Control Measures

Some quality control measures are method-specific. There are, however, general quality control measures that are essential to our quality system. These quality measures include:

- Monitoring of negative and positive controls
- Defining variability and reproducibility through duplicates
- Ensuring the accuracy of test data including calibration and/or continuing calibrations, use of certified reference materials, proficiency test samples, etc.
- Evaluating test performance using method detection limits and quantitation limits or range of applicability such as linearity
- Selecting the appropriate method of data reduction
- A copy of CFA's Ethics and Integrity Agreement is provided in Appendix F.

### 3.13 Control Charts

Control charts are a graphical representation of data taken from a repetitive measurement or process. Control charts may be developed for various characteristics (e.g. mean, standard deviation, range, etc.) of the data. A control chart has two basic uses, as a tool to judge if a process was in control and as an aid in achieving and maintaining statistical control.

The Quality Manager utilizes the LIMS to automatically generate and evaluate control chart data once a week. Tables of the data are emailed to the Quality Manager for review. This assists with monitoring out of control situations due to laboratory contamination or analyst error. The QA Officer shall be able to stop unsatisfactory work and prevent further loss in quality.

The Quality Manager also may utilize the LIMS and the Computer Services Team (CST) to trend data as control charts for method blank levels, surrogate recoveries, etc. At this time, any out of control conditions will be identified and a corrective action initiated.

Many of the quality control limits are dictated by our clients and the methods employed by CFA. In certain cases where no guidance exists, or at a client's request, in-house limits are generated and used to control data. CFA's Quality Manager or designee shall review such control charts during the period when the LIMS program queries data points for analyses that require in-house limits for quality control parameters. This is performed on a biannual basis. In-house limits for new control parameters are generally developed when more than 20 data points are available for review. Data points may be determined as outliers based on the process knowledge of the procedure being evaluated and the professional opinion of the data reviewer.

**SECTION 4  
FACILITIES****4. SECTION 4 - FACILITIES**

Our laboratory is designed with a full-service approach to handling environmental needs. The layout provides dedicated space for organic extractions and dioxin/PCB analyses.

The laboratory and support offices occupy approximately 5,400 square feet engineered to meet the stringent quality control and utility requirements of the modern environmental laboratory. Records are temporarily stored on-site then warehoused in a secured building off-site. The diagram in Appendix H depicts the layout of the laboratories.

Discussed in this section are:

- Facility security
- Utility services and deionized water
- Prevention of contamination
- Assessment of contamination

**4.1 Facility Security**

Our facility features secured laboratory and storage areas. Restricted entry assures sample integrity and client confidentiality, which satisfies clients' and potential national security interests.

Visitors cannot gain entry without being escorted through the laboratory by authorized personnel. A designated sample custodian and a bar-coded chain-of-custody provide a second level of security.

CFA implements standard security mechanisms to restrict sensitive data and applications to only those who are authorized to view or use it. Security efforts are taken to secure applications, CFA employees, and CFA's computing environment from external intruders.

For GLP/GMP compliant systems, computer screensaver programs with password protection shall be set to control access to the computer if it is left unattended for more than five minutes (or lowest setting if 5 minutes is not available) or the user may lock the computer if leaving the computer unattended. Note that some instrument control software is incompatible with screen savers.

**4.2 Utility Services**

The laboratory area is equipped with the following utilities:

- Cold water
- Hot water
- Deionized water
- Compressed air
- Vacuum (at selected stations)
- 120 Volt AC
- 208 Volt AC (at selected stations)
- Specialty gases (as required)

#### 4.2.1 Deionized Water

We have one fully functioning deionized water system which services the whole laboratory. DI water is made from city water flowing through a deionization system capable of producing 5 gallons per minute of Type II laboratory water.

We monitor the unit by using the service/replacement indicator light on the filter assemblies. Because the laboratory requires water of purity such that scaling of glassware and analytes of interest are not detected, locally purchased distilled water may also be used.

#### 4.3 Prevention of Contamination

Work areas that are free of sample contaminants, constituents and measurement interferences are important to the generation of quality data. With this in mind, we designed our laboratory to prevent contamination and reinforce this design with good laboratory practices.

In addition to keeping our work areas free of dust and dirt accumulations, policies and features that prevent or minimize contamination include:

- Fume hoods to remove fumes and reduce the risk of aerosol and airborne contaminants and personal safety hazards are monitored in accordance with CF-FC-E-003 for Fume Hood Face Velocity Performance Checks.
- Restricted access to the laboratory (authorized personnel only).
- Designated area for glassware preparation wherein all glassware used in sample prep and analysis is cleaned according to CF-LB-E-003 for Glassware Preparation.
- Production, use, and monitoring of Type II DI water.
- Tracking and trending of any significant sample and/or reagent spills using the AlphaLIMS NCR system, allowing efficient analysis of any potential contamination.

#### 4.4 Assessment of Contamination Levels

We evaluate contamination resulting from the following sources on the basis of quality assurance and quality control data derived from the analytical method and method blanks:

- Sample containers
- Reagent water
- Reagents and solvents
- Sample storage
- Chemical and physical interference
- Constituent carryover during analysis

**SECTION 5  
EQUIPMENT AND REFERENCE MATERIALS****5. SECTION 5 - EQUIPMENT AND REFERENCE MATERIALS**

CFA's ability to efficiently generate data that are reproducible, accurate, and legally defensible is attributable to our use of high-quality instruments, equipment, and reference materials.

Provided in this section are:

- CFA's policies governing instruments, equipment, and reference materials
- Identification of instrumentation and support equipment
- Procurement protocol

**5.1 General Policies**

It is our policy to purchase instrumentation, equipment and high-quality reference materials that meet or exceed the method and regulatory requirements for the analyses for which we are accredited. If we need to use instruments or equipment not under our permanent control, we ensure that it also meets these standards.

Instrumentation and equipment are placed into service on the basis of ability to meet method or regulatory specified operating conditions such as range and accuracy. All laboratory instrumentation and testing equipment is maintained in accordance with standard operating procedures (SOPs).

Instrumentation and equipment is used in a manner that assures, where possible, that measurement uncertainty is known and consistent with specified quality requirements. Instruments and equipment are taken out of service and segregated or labeled as such under the following conditions:

- Mishandling and/or overloading
- Results produced are suspect
- Demonstrated defect or malfunction

Tagged or segregated instruments and equipment remain out of service until repaired and documented by test, calibration, or verification to perform satisfactorily. Instruments that are in service and normally calibrated prior to and during use are not tagged.

Each item of equipment, including reference materials is, if appropriate, labeled, marked or otherwise identified to indicate its calibration status. We maintain records for each major item of equipment, instrumentation, and all reference materials significant to quality performance. These records are often in the form of maintenance logs, which are kept in accordance with CF-LB-E-008 for Basic Requirements for the Use and Maintenance of Laboratory Notebooks, Logbooks, Forms, and Other Recordkeeping Devices.

Documentation included in these records includes but is not limited to:

- Equipment name
- Manufacturer's name
- Type identification
- Serial number or other unique identification
- Date received and date placed in service (if available)

- Current location
- Condition when received (if known)
- Manufacturer's instruction, where available
- Dates and results of calibrations and or verifications
- Date of next calibration and/or verification, where written procedures do not specify frequency
- Details of maintenance carried out to date and planned for the future
- History of any damage, malfunction, modification or repair

### 5.2 Instrumentation and Support Equipment

Appendix G lists the instruments we use for the analysis of environmental samples. Where feasible, our instruments are equipped with autosamplers that improve efficiency and facilitate consistent sample introduction to the sample detector. Instruments are also connected to an area network to facilitate data transfer.

Devices that may not be the actual test instrument but are necessary to support laboratory operations are referred to as support equipment. We also maintain this equipment in proper working order. Support equipment utilized at CFA includes:

- balances
- ovens
- refrigerators
- freezers
- water baths
- temperature measuring devices
- volumetric dispensing devices
- muffle furnaces
- grinders and homogenizers
- hot plates and heating mantles.

Guidelines for the required calibration and evaluation of this equipment are discussed in Section 7.

SOPs are used to describe our procedures for all routine analyses performed by our labs. These procedures include step-by-step instructions for sample collection, storage, preparation, analysis, instrument calibration, quality control, disposal, and data reporting.

### 5.3 CONTROL OF PURCHASED ITEMS

Materials, equipment, and services that affect the quality of our products are designated as Quality Materials, Equipment, and Services and are purchased from pre-approved suppliers whenever possible. Suppliers are approved and documented according to CF-QS-E-001 for the Conduct of Quality Audits.

At CFA, we maintain documentation of specific quality requirements for materials and services. Records that document the quality of a product or service may include:

- certificates of analysis and traceability
- verifications of chemical quality
- inspections of equipment or materials
- verifications or inspections of vendor product specifications

**SECTION 6  
HEALTH AND SAFETY****6. SECTION 6 - HEALTH AND SAFETY**

CFA maintains a safe work environment and promotes healthy work practices. CF-LB-N-001 is the laboratory Safety, Health and Chemical Hygiene Plan. Procedures outlined in the plan are consistent with OSHA, CERCLA and the EPA.

All employees are trained in the safety practices applicable to their job functions. This training is conducted in accordance with CF-HR-E-002 for Employee Training.

**6.1 Fire Safety**

Our facility is equipped with smoke detectors in key areas of the facility. Automatic halon extinguishers are used in areas with higher risk of fire such as the organic sample preparation lab fume hood. Fire blankets and dry chemical extinguishers are located at strategic points throughout the lab. We routinely inspect these extinguishers in accordance with CF-FC-E-004. Lab personnel are trained in the proper use and selection of fire extinguishers. In order to decrease the risk of fire, bulk solvents are stored in flammables cabinets.

**6.2 Evacuation**

In the unlikely event of a fire (or other emergency), we have defined evacuation routes depicted in Appendix H. This diagram is posted in pertinent areas of the facility.

**6.3 Safety Equipment**

Safety equipment, including safety glasses, lab coats, safety goggles and protective gloves, is available to all employees as needed. Eyewashes and overhead showers are located in the laboratory. We routinely inspect these as directed in CF-FC-E-002 for Testing Emergency Eyewash and Shower Equipment

**SECTION 7  
MEASUREMENT, TRACEABILITY, AND CALIBRATION****7. SECTION 7 - TRACEABILITY AND CALIBRATION**

Traceability of measurements and the calibration of testing equipment are imperative to our ability to produce accurate and legally defensible data. As such, we have implemented procedures to ensure that equipment calibration and measurement verification are traceable to nationally recognized standards.

Standards are obtained from the National Institute of Standards and Technology (NIST) or accredited reference material producer (RMP) with traceability to NIST. Reference materials purchased outside the United States must be traceable back to each country's national standards laboratory or another national or international reference organization such as ILAC, APLAC and/or IAAC. The RMP may also have established acceptability by its approval as an ISO Guide 34 RMP. ISO guide approval is only required for initial calibration standards.

Where possible, calibration certificates provide traceability to national standards of measurement. Calibration certificates provide measurement results and any associated uncertainty of measurement, and/or a statement of compliance with the identified specification. Calibration certifications are maintained as quality records.

When traceability to a national standard is not applicable, verification of measurement is achieved through inter-laboratory comparisons, proficiency tests, or independent analyses.

The following measurement and traceability practices are described in this section:

- Calibration criteria for support equipment
- General requirements
- Balances
- Temperature-sensitive devices and temperature monitoring
- Air displacement pipets
- Instrument calibration
- Calibration verification

**7.1 Calibration Criteria for Support Equipment**

This section addresses calibration protocols for support equipment, including balances, temperature -sensitive equipment, and air displacement pipets. The general criteria applicable to the calibration of support equipment are as follows:

- Equipment is maintained in proper working order. Records of all maintenance activities including service calls are kept.
- Calibrations or verifications over the entire range of use, using NIST-traceable references when available, are conducted at least annually.
- Temperature measuring devices with digital readouts are calibrated quarterly.
- Prior to use each day, balances, ovens, freezers, refrigerators, incubators, and water baths are checked with NIST-traceable references (where possible) in the expected use range.
- If prescribed by the test method, additional monitoring is performed for a device used in a critical test (such as an incubator or water bath).

- Reference standards of measurement such as Class S or equivalent weights or traceable thermometers may be used for calibration when demonstrated that their performance as reference standards will not be invalidated.
- Reference standards of measurement are calibrated by a body that can provide, where possible, traceability to a national standard.
- Reference standards and measuring and testing equipment are subject to in-service checks between calibrations and verifications, in accordance with ANSI/ISO/IEC 17025-2017.
- Mechanical volumetric dispensing devices used for quantitative measurements are checked daily for accuracy prior to use.
- If results of calibration and verification are not within the specifications for the equipment's application, then the equipment is removed from service until repaired. Under certain conditions, a deviation curve may be prepared. All measurements are corrected for the deviation, recorded and maintained.

#### 7.1.1 Balances

Our balances undergo annual calibration, maintenance, and cleaning. Each balance is labeled with a serial number, service date, date of next service, and signature of the service technician.

Balances are set up, calibrated, and operated in the range required by the analytical method in accordance with CF-LB-E-002 for Balances. Prior to using a balance, the analyst is responsible for checking its calibration.

Calibration and calibration verification are performed using weights that are or have been calibrated against Class S or equivalent weights. These weights are traceable to NIST and calibrated annually by a calibration service provider that meets the requirements of the ANSI/ISO/IEC 17025-2017 standard.

Calibration and calibration verification are recorded in the balance calibration logbook. If the calibration or calibration verification does not meet the specified acceptance criteria, the balance is recalibrated. If the calibration criteria are still not met, the balance is removed from service and tagged as such.

#### 7.1.2 Refrigerators, Freezers, Ovens, Water Baths, and Similar Devices

Careful control of temperature is often central to the production of acceptable data.

Temperature excursions beyond the established limits may invalidate a procedure and the associated data. Constant monitoring in accordance with CF-LB-E-004 for Temperature Monitoring and Documentation Requirements for Refrigerators, Freezers, Ovens, and Other Similar Devices assures us that regulatory and/or method temperature requirements are being met.

We measure temperatures with thermometers that are verified annually against a NIST-traceable thermometer. The NIST traceable thermometers are independently verified at least annually by a verification service that meets the requirements of the ANSI/ISO/IEC 17025-2017 standard. The protocol for thermometer verification is described in CF-QS-E-007. We monitor the temperature of the following equipment according to CF-LB-E-004:

- Refrigerators and freezers used to store samples, standards, and other temperature-sensitive materials
- Ovens
- Water baths

We monitor the temperatures of refrigerators and freezers prior to use each day. The temperatures of ovens, water baths, and other devices used as part of an analytical process must be monitored prior to, during, and immediately after use.

Temperature measurements are documented on logs specific to each piece of equipment. The logs are posted on or near each water bath, oven, or other temperature control device. Refrigerator and freezer logs are stored electronically. Each log includes the following information:

- Date and time of each measurement
- Initials of person taking measurement
- Acceptance limits for device being monitored
- Whether device conforms with specifications at time of measurement
- Name, location, and number of device being monitored
- Notation of any out-of-control condition

When the process to maintain and document temperatures within acceptance limits does not conform to specifications, a nonconformance report (NCR) is issued. Appropriate action is then taken to disposition the nonconformance according to CF-QS-E-004 for Documentation of Nonconformance Reporting and Dispositioning and Control of Nonconforming Items.

Examples of nonconformances are:

- Failure to maintain process temperature within acceptance limits
- Failure of device to achieve calibration
- Total failure of temperature control device
- Failure to monitor the temperature as required

### 7.1.3 Air Displacement Pipets

Air displacement pipets offer a level of precision and accuracy exceeded only by Class A transfer pipets. Due to the use of disposable tips, these pipets eliminate the possibility of cross-contamination.

We calibrate air displacement pipets quarterly using five replicate measurements of a frequently used volume setting in accordance with CF-LB-E-010 for Maintenance and Use of Air Displacement Pipets.

The acceptance criteria for each measurement are based on the average of the five calibration measurements. Tolerance limits for commonly used verification volumes and accuracy and precision checks are included in the pipet calibration logbook. Calibrations are traceable to each pipet using the unique identification found on its label.

If a pipet does not meet the calibration tolerance limits, it is removed from service until it again demonstrates compliance after being cleaned and/or repaired. Analysts whose jobs may require the use of air displacement pipets are trained in their proper use and calibration.

## 7.2 Instrument Calibrations

To ensure that the data generated by an instrument are accurate, we calibrate the instrument using standards containing known concentrations of target analytes. The stability of the instrument over the calibration range is verified by the analysis of a continuing calibration verification standard (CCV) obtained from a second source whenever possible.

Traceability of calibration, calibration verification, and other quality control standards to the recognized standard are documented per CF-LB-E-007 for Laboratory Standards Documentation. Individual identification numbers are assigned to each source standard and each subsequent intermediate and working standard prepared.

The identification number makes it possible to trace a standard to a parent standard and ultimately to the source standard and its Certificate of Analysis. The date each standard is prepared, the protocol used in the preparation, the person preparing the standard, and the standard's expiration date are documented in the appropriate standards log, maintained in AlphaLIMS. The information is accessible via the standard ID number.

We record standard and reagent ID numbers on instrument run logs, analytical logbooks, sample preparation logs, and instrument raw data. Calibration standards that are used in the analysis of a particular sample or group of samples can be traced to NIST, US EPA, or other nationally recognized standards.

#### 7.2.1 Initial Instrument Calibration

Calibration procedures for specific instruments, and the frequencies of performance for defined methods, are described in the applicable operating or analytical SOP. Calibration is discussed in general terms in CF-QS-E-014 and includes standard laboratory practices and formulas used for determinations made by these practices. General guidelines include:

- Preparation of calibration curves as specified in the reference method.
- If a test method does not specify the number of calibration standards, the minimum number is two, not including blanks, with one at the lowest quantitation limit. The reference SOP must establish the initial calibration requirements.
- Verification of initial calibrations with a standard obtained from a second source (unless one is not available).

#### 7.3 Calibration Verification

When an initial calibration curve is not established on the day of analysis, the integrity of the curve should be verified prior to sample analysis. Verification requires the analysis of a standard from a second source. The standard concentration should be at the method-defined level. If not specified, a standard at a mid-level concentration may be used.

If the calibration verification does not meet acceptance criteria, the analytical procedure is stopped and evaluated, and appropriate corrective measures are taken. Calibration verification (CCV) must be acceptable before any samples are analyzed. CCVs are analyzed at a frequency described in the referenced method. If an instrument consistently drifts outside the acceptance criteria before the next calibration, the frequency is increased.

If the recovery of a CCV does not meet the acceptance criteria and routine corrective actions fail to produce a second consecutive check within acceptance criteria, a new initial calibration curve should be constructed. Analytes of interest found in corresponding environmental samples may be reported, however, only if all of these criteria are met:

1. CCV recovery for target analyte exceeds the acceptance criteria (biased high)
2. Target analyte in the environmental sample is not detected at a concentration exceeding the level required by client contract (i.e., MDL, PQL).

Non-detects that meet these criteria are also referred to as "passable non-detects."

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If the CCV recovery does not meet the acceptance criteria, and samples are found to contain target analytes at concentrations above the PQL, the affected samples must be re-analyzed.

**SECTION 8**  
**ANALYTICAL METHODS AND STANDARD OPERATING PROCEDURES**

**8. SECTION 8 - ANALYTICAL METHODS AND STANDARD OPERATING PROCEDURES (SOPs)**

We provide an array of parameters including dioxins/furans and PCB congeners. The procedures we use to determine these parameters are consistently executed due to our extensive system of SOPs and our training requirements for analytical staff.

A list of our SOPs and the analytical methods they represent (if applicable) is provided in Appendix I. Discussed here are:

- Selection of analytical methods
- Standard operating procedures
- Method validation and initial demonstration of capability
- Sample aliquots
- Data verifications
- Standard and reagent documentation and labeling (Refer to Section 10.1)
- Computers and data requirements

**8.1 Selection of Analytical Method**

CFA's Project Managers are ultimately responsible for selecting the test codes and methods assigned to a client based on client requirements and sample collection techniques. In selecting methods, our goal is to meet the specific needs and requirements of the client while providing data that are scientifically valid.

When the use of a specific test method is mandated, only that method is used. If the analysis cannot be performed by the client-requested method, we notify the client. We do not perform method substitutions without the client's consent. We recommend that clients who submit data to regulatory agencies also obtain the agency's approval of method modifications.

When clients have specific process or reporting deviations from CFA's standard practices, the laboratory may document the deviations in contracts, case narratives and/or with specific work instructions from the Project Management Team to the laboratory. Approval of the deviations is made after consideration of all safety and quality concerns have been resolved by CFA's management.

A Project Management AlphaLIMS Manual (CF-CS-M-001) is available to assist those managing client projects in selecting test codes and methods and communicating the client's analytical and data reporting specifications.

**8.2 Standard Operating Procedures (SOPs)**

We determine each parameter by the protocol detailed in the corresponding SOP. The defined protocol originates from the analytical method or methods referenced in the SOP and may incorporate regulatory and client requirements. Descriptions of the methods we employ can be found in:

- EPA SW-846, 3rd Edition, Revision III
- American Society for Testing and Materials (ASTM)
- Code of Federal Regulations (CFR) Titles 40 and 49

- EPA CLP

Laboratory sections have access to CFA's SOPs to ensure that each operational system and analytical procedure is performed in a uniform manner. SOPs are controlled according to CF-DC-E-001 for Document Control and are posted on the Intranet by the Quality Manager.

We write and issue SOPs in accordance with CF-ADM-E-001 for the Preparation, Authorization, Change, Revision, and Release of Standard Operating Procedures. A technical and/or quality review is made of each new or revised SOP prior to its implementation.

Technical reviews ensure that procedures are technically sound and method-compliant, and are conducted by a senior analyst or data reviewer. The quality review is an independent review by a member of management and ensures that the quality requirements of the method, regulatory agencies, and CFA are adequately and accurately identified.

SOPs are modified when:

- Instruments or equipment change
- An error is identified
- Improvements in technology and/or reagents need to be incorporated
- Reference methods are revised or discontinued

Proposed revisions are submitted for review on Documentation Initiation and Revision Request (DIRR) forms. Changes are not implemented without a technical and quality review.

We review our SOPs at least annually and revise them as necessary. Analytical SOPs either contain or reference other SOPs that contain:

- reference method
- applicable matrix or matrices
- method detection limit
- scope and application including parameters to be analyzed
- method summary
- definitions
- interferences and limitations
- specific safety requirements
- required equipment and supplies
- reagents and standards
- sample collection, preservation, shipment, and storage
- quality control
- calibration and standardization
- procedure
- calculations
- method performance
- pollution prevention
- data assessment and acceptance criteria for quality control measures
- corrective actions for out of control or unacceptable data
- waste management
- references
- tables, diagrams, flowcharts, validation data
- identification of any modifications we have made to the published procedure
- history of changes to the SOP

Administrative SOPs typically do not require all of the above sections. CFA's SOP CF-ADM-E-001 discusses more fully the laboratory practices and policies related to SOP creation and maintenance.

### 8.3 Method Validation and Initial Demonstration of Capability

An initial demonstration of method performance is required before a new analytical method is implemented and any time that there is a significant change in instrumentation or methodology. Exempted from this requirement are any tests for which spiking solutions are not available.

We conduct the initial demonstration as described in Section 8.3.1. Records of initial demonstration are maintained in accordance with CF-QS-E-008 for Quality Records Management and Disposition. These records are available upon request.

After we demonstrate our ability to perform a specific analysis, we continue to demonstrate method performance through the analysis of laboratory control samples and performance evaluation samples.

If spiking solutions or quality control samples are not available, an analyst is trained by a qualified trainer to conduct the analysis. Analyst capability and proficiency is evaluated by the Production Manager before the analyst is qualified to perform the analysis on client samples. The evaluation is documented and maintained according to CF-QS-E-017 for Maintaining Technical Training Records.

#### 8.3.1 Procedure for Initial and Continuing Demonstrations of Capability (IDOC and CDOC)

We conduct initial demonstrations of capability for mandated analytical or EPA reference test methods following the procedure outlined below. This procedure is adapted from the EPA test method published in 40 CFR part 136, Appendix A, NELAC 2003 and the 2016 TNI Standard. IDOCs are completed whenever there is a change in instrument type, method or personnel. CDOCs are completed annually.

Step 1: A quality control sample is obtained from an outside source (if possible). If one is not available, the sample may be prepared internally using stock standards that are prepared independently from those used in instrument calibration. The concentration is not known to the analyst.

Step 2: The QC sample is diluted in a volume of clean matrix. Sufficient volume of the diluted QC sample is prepared so that at least four aliquots of the required method are analyzed. Alternatively, four matrix spike samples may be evaluated for levels of precision and accuracy.

Step 3: Four aliquots of the diluted quality control sample are prepared and analyzed according to the analytical test method. This may occur concurrently or over a period of days.

Step 4: With the results obtained from the analysis of the diluted QC sample, the average recovery ( $\bar{x}$ ) in the appropriate reporting units (such as  $\mu\text{g/L}$ ) and the standard deviation of the population sample ( $s$ ) (in the same units) are calculated for each parameter of interest.

Step 5: For each parameter, the standard deviation ( $s$ ) and the average recovery ( $\bar{x}$ ) are compared to the corresponding acceptance criteria for precision and accuracy in the test method (if applicable) or in laboratory-generated acceptance criteria. If " $s$ " and " $\bar{x}$ " for all parameters meet the acceptance criteria, analysis of samples may begin. If any one parameter exceeds the acceptance range, the performance is unacceptable for that parameter.

Step 6: When one or more tested parameters fail one or more of the acceptance criteria, we locate and correct the source of the problem and repeat the test for every parameter of interest.

Other options for successful IDOCs are the following:

- PT Study- successful analysis of a PT Sample. The PT sample may be single-blind to the analyst or double blind to the laboratory.
- Supervised Analysis- where other options are not practical, supervised analysis of a procedure may be used to demonstrate capability.
- Analysis of authentic sample with results statistically matching those obtained by another trained analyst.
- Other – this option may be used for certain personnel having sufficient analytical skills to develop a new procedure, as deemed appropriate by the supervisor or Quality Assurance personnel.

#### 8.4 Sample Aliquots

When obtaining aliquots from a sample, it is imperative that the subsamples be representative of the parent sample. This ensures that the results obtained from the analysis of the aliquots are representative of the entire parent sample, not just the subsample. We employ different techniques to obtain subsamples. CFA's SOP for sample compositing is CF-LB-E-031. The appropriate techniques for obtaining sample aliquots for designated analyses are discussed in the applicable SOPs.

#### 8.5 Data Verification

All of the data we include in final reports to our clients undergoes extensive data verification. At CFA, we have a multi-level review process that takes place in all areas of the laboratory beginning with sample login. This process and the responsibilities of each level of review are delineated in the procedure for data review and packaging, CF-LB-E-005.

##### 8.5.1 Sample Login:

Samples are analyzed by the methods and for the target analytes identified when samples are logged into our database. If there is an error in this entry that is not promptly identified, the incorrect analytical method may be used or certain analytes may not be determined.

To prevent this, the person who enters the information into the database is generally the client's assigned Project Manager. This entered information is reviewed against the client confirmation letter and/or chain of custody. If errors are identified, they are immediately corrected.

##### 8.5.2 Data Validation in the Laboratory

The multi-level review process in our laboratory includes initial review by the analyst, a final review by the data reviewer, and a completeness review by the project manager.

Our analytical data reviews ensure that:

- The analytical procedures comply with current SOPs.
- Quality control samples are analyzed at the frequency specified in the SOP or client specifications.
- The acceptance criteria for quality control samples are met, including recoveries of matrix spikes and laboratory control samples, the relative percent difference for matrix duplicates, matrix spike duplicates, laboratory control sample duplicates, and concentrations of target analytes in the method blank.

- Instrument data, run logs, and logbooks are reviewed to ensure that all method quality control criteria were met (e.g., initial calibration and continuing calibration verifications).
- Documentation is sufficient to reconstruct the analytical procedure.
- Data are maintained according to CF-LB-E-008 for Basic Requirements for the Use and Maintenance of Laboratory Notebooks, Logbooks, Forms, and Other Recordkeeping Devices.
- Raw data are in agreement with the computer generated batch sheets and data reports.
- The calculations, dilution factors, concentration reported, and nominal concentrations are verified.
- Comments, qualifiers, or nonconformances for noncompliant or questionable data are documented.
- Data generated when the analytical process appears to be out of statistical control are not reported.

### 8.5.3 Validation of Data Reports and Packages

Before data is reported to the client, the data report is reviewed for package accuracy, completeness, and client specifications. Responsibilities for review are dependent upon the type of report or package being generated. (Refer to Section 11 for Laboratory Report Formats.)

The Project Manager (PM) reviews client information for accuracy, completeness and the addition of pertinent comments made by the laboratory about the analysis or sample. The PM also reviews data for consistency as described in the Project Management AlphaLIMS Manual, CF-CS-M-001.

The data validator reviews the analyst-prepared case narrative for accuracy and to assure its consistency with the information included on the certificate of analysis and Quality Control Summary Report. Each laboratory fraction of data is reviewed by that fraction's data validator. The data are then compiled into a final data package.

A minimum of 10% of all DoD ELAP data packages will be reviewed by the Quality Manager (or designee) for technical completeness and accuracy. This review is not required to be performed prior to release of the data to the client. The Quality Manager, or designee, must maintain documentation of the reviews to establish the minimum requirement having been met.

### 8.6 Standard and Reagent Documentation and Labeling

The documentation and labeling of standards and reagents is addressed in CF-LB-E-007 for Laboratory Standards Documentation, and in Section 10.1 of the QAP, Recordkeeping System and Design.

### 8.7 Computer and Electronic Data Related Requirements

Our Information Management System (IT) SOPs describe the way in which our software programs and hardware systems are managed. Control of software development and modification activities is described in the SOP for Requirements, Design, Operation, Validation, and Removal of Hardware and Software Systems. All development and revision activities are validated, verified, and controlled with revision software or other procedures prior to production use.

Analytical software that is purchased from a vendor is validated and verified in accordance with the SOP for Requirements, Design, Operation, Validation, and Removal of Applications. Documentation requirements are also described in this SOP.

**SECTION 9  
SAMPLE HANDLING, ACCEPTANCE, RECEIPT, AND INTERNAL CHAIN OF CUSTODY****9. SECTION 9 - SAMPLE HANDLING, ACCEPTANCE, RECEIPT, AND INTERNAL CHAIN OF CUSTODY**

The way we receive and handle samples is critical to providing our clients with data that are of the highest quality and are legally defensible. We have strict policies that govern the acceptance and receipt of a sample, sample handling and integrity, maintenance of the internal chain of custody, and storage of the sample upon completion of the required analytical processes. This section describes the policies and practices that we employ, including the following:

- Agreements to perform analysis
- Proper labeling of submitted samples
- Chains of custody
- Sample receipt procedures
- Sample tracking
- Sample storage
- Sample disposal
- Emergency Sample Storage

**9.1 Agreement to Perform Analysis**

Before we accept samples, we should have an agreement with the client that specifies the analytical methods, the number of samples to be analyzed, the price for the analysis, the date by which the client will receive results, and the reporting format. Any special requirements the client may have, such as non-routine methods and reporting limits, should be part of that agreement.

An agreement to perform analysis should be in one of three forms, further detailed in our SOPs for Delegated Authority to Commit the Company and Request for Proposal (RFP) and Contract Review (CF-CO-E-002 and CF-CO-E-003):

- Client confirmation letter (CCL) between the client and project manager for a specific group of samples. This letter includes the cost, turn-around time, requested analysis, sample matrix, number of samples, and type of client report.
- Sample acceptance by the Project Manager from an established client based on previously agreed conditions and confirmed by the client's submission of the sample(s).
- Contractual agreement for analytical services over a designated time period or project that delineates the agreed upon specifications.

When the laboratory agrees to perform analyses with exceptional departures from normal processes, these exceptions are clearly defined in the client-laboratory agreement.

**9.2 Sample Labels and Chain of Custody Forms**

Once an agreement is established, we assume joint responsibility with the client to ensure that the samples submitted are properly labeled and accompanied by full and complete documentation that includes chain of custody and, where possible, material safety data sheets. Samples that are submitted without proper documentation may be refused.

Sample labels should include:

- client sample identification
- location, date, and time of collection
- collector's name
- chemical preservatives used
- constituents of interest (if space permits)

When requested, we ship labeled sample containers with appropriate preservatives and a chain of custody to the client for use during sample collection. There are several advantages to using these containers, including:

- Dedication of appropriate type sample container for the intended analyte or analytical method.
- Proper sample preservation for analytical test
- Traceability of bottle lot number to the manufacturer's certification that the containers are clean and show no signs of contamination.

Chain of custody forms include the following information and are initiated at the time of sample collection:

- name and address of client
- client sample identification
- date and time of sample collection
- sample matrix
- description of sampling site location
- number of containers
- methods, chemical and physical constituents for which the analyses are to be conducted
- preservatives
- date and signature of person who collected the sample
- date of transfer and signature of person relinquishing sample to the laboratory.

Our standard chain of custody forms are available to our clients and are included with each shipment of pre-labeled and preserved containers. CFA chain of custody forms should always be used unless otherwise agreed to by contract.

### 9.3 Sample Conditions

In addition to properly documenting sample container labels and the chain of custody form, we need to make sure that samples meet the established requirements for analytical testing. This is particularly critical for samples that are being analyzed to meet regulatory requirements.

Samples should be collected in the appropriate type of container, preserved as directed, and stored under the conditions specified in the analytical method or established regulatory guidelines. In addition, samples should be submitted with sufficient time to conduct the specified analysis within the regulatory or method holding time. Aliquots should be of sufficient volume to perform the requested analyses. A summary of these conditions and holding times for routine analyses can be found in Appendix J.

### 9.4 Sample Receipt

Samples submitted to us are received in a central sample receiving area by our sample custodian or login clerk. Every sample is subject to the protocols established in CF-SR-E-001 for Sample Receipt, Login and Storage.

Our sample custodian acknowledges receipt of a sample by signing the chain of custody and recording the date and time custody was transferred from the client to the laboratory. The date, time, and person receiving the sample are also recorded on a standard or client-specific Sample Receipt Checklist (SRC) form.

The sample custodian is also responsible for noting the condition of a sample upon its arrival. This information is recorded on both the sample chain of custody and the Sample Review Receipt form. As detailed in CF-SR-E-001, the sample custodian should:

- Document whether custody seals are present and intact on the outside of the sample cooler.
- Inspect all sample containers for integrity.
- Document any unusual physical damage or signs of tampering with custody seals.
- Place any samples that appear to be leaking or have unusual odor under the fume hood while notifying the responsible project manager.
- Review the chain of custody submitted by the client for completeness.
- Compare descriptions and other information on the sample container labels to that listed on the chain of custody.
- Verify the sample is within the regulatory holding time for the analyses.
- Measure and record the temperature of the cooler using the temperature blank (if provided) or a representative sample container.
- Measure and record the pH of all sample aliquots submitted for analyses that require chemical preservation to a specific pH
- Check water samples for residual chlorine if dioxin/furan or PCB analysis is requested. If residual chlorine is present, preserve with sodium thiosulfate as directed in CF-SR-E-001, and document on the SRC.
- Verify that there are adequate sample aliquots for the requested analyses.
- Verify that appropriate sample containers were used for requested analyses.

If the sample custodian discovers any abnormalities or departures from standard conditions, the PM is informed immediately. The PM will then notify the client as quickly as possible so that a decision can be made to proceed with the analysis or submit another sample or additional sample aliquots.

Common abnormalities or departures from standard conditions include:

- Sample containers with signs of damage, leaking, or tampering.
- Incomplete/missing chain of custody.

NOTE: If a sample has no chain of custody, the sample custodian should initiate one. "INITIATED ON RECEIPT" should be documented on the chain of custody.

- Discrepancies between the information on the chain of custody and the sample container labels.
- Method or regulatory holding time is exceeded.
- Sample is not preserved to the method or regulatory-required pH.
- The sample container does not meet method or regulatory criteria.
- The sample temperature exceeds or falls below the thermal preservation regulation or method requirement of 0° - 6° C.

NOTE: If a sample is hand-delivered to the laboratory immediately after collection with evidence that the chilling process has begun (arrival on ice), the sample shall be deemed acceptable.

## 9.5 SAMPLE TRACKING

We track the samples we receive by a unique laboratory identification number that is automatically assigned when information pertaining to the sample is first entered into our database. Pursuant to CF-SR-E-001, the following information is entered for each sample received:

- client and/or project code
- client sample ID
- sample matrix
- chemical preservative (if applicable)
- date and time of collection
- date received
- initials of person making entries
- number of containers submitted for the sample
- requested analyses
- pertinent observations or comments affecting the sample analysis or rejection
- container type

As soon as this information is entered, AlphaLIMS automatically assigns a unique number to the sample and its containers. We use these numbers to track the location of a sample container and to link to any subsamples and subsequent leachates and extracts.

The unique laboratory identification number is printed on a durable barcode label that contains the client identification, sample date and time. Once labeled, the sample container's identification number is uploaded into the database by scanning the barcode. Information included in the database at the time of sample scanning is the container's storage location, bottle type and volume, physical characteristics of the bottle, preservative, and the initials of the person entering this information. Entering of this information into the database is an important part of initiating our electronic internal chain of custody.

#### 9.6 INTERNAL CHAIN OF CUSTODY

Chain of custody procedures ensure traceability and sample integrity. Our legal and evidentiary chain of custody protocol establishes a continuous record of the physical possession, storage, and disposal of sample containers, collected samples and aliquots, and sample digestates or extracts.

The internal chain of custody starts with the scanning of a container's barcode label into an electronic database while identifying the location of the sample and the person having custody, or placing the sample in a secured storage area. If we supply the containers, the chain of custody may begin when the containers are provided to the client.

With regard to the internal chain of custody, a sample is defined as being in someone's custody if:

- It is in one's actual physical possession, or
- It is in one's view after being in one's physical possession, or
- It is in one's possession and then is locked up so that no tampering may occur, or
- It is kept in a secured area restricted to authorized personnel only.

The protocol for ensuring sample integrity using the internal chain of custody is detailed in CF-LB-E-012 for Verifying the Maintenance of Sample Integrity. The electronic internal chain of custody works in conjunction with the chain of custody submitted by the client with a sample to:

- Account for all time associated with a sample, its subsamples, and extracts or digestates from the time the sample is received at CFA to its disposal
- Identify all individuals who physically handled the sample
- Provide evidence that the sample was stored in accordance with method and regulatory protocols

The electronic internal chain of custody is stored in AlphaLIMS so that information demonstrating the proper maintenance of custody can be provided to the client on the data reports or electronic data deliverables.

### 9.7 SAMPLE STORAGE

In order to ensure the maintenance of sample integrity, all aliquots are stored in secured areas designated for sample storage. The storage location of each sample aliquot can be tracked using the internal chain of custody. Areas designated for sample storage include:

- Main cooler where most samples requiring maintenance at a temperature range of 0° - 6° C are stored.
- Ambient storage for samples not requiring refrigeration.
- Freezers for the storage of samples requiring maintenance at a temperature of <-10°C (i.e. tissues).

The temperature of each refrigerated sample storage unit is monitored daily and documented per CF-LB-E-004 for Temperature Monitoring and Documentation Requirements for Refrigerators, Freezers, Ovens and Other Similar Devices. In addition, the main cooler is monitored twenty-four hours a day by temperature sensor that is connected to our main security system. If the temperatures exceed the required range, an alarm is sounded and the security system notifies the laboratory manager or his designee immediately. This allows corrective actions to be initiated promptly.

Prior to and immediately after analysis, samples and their leachates and extracts are stored in compliance with the requirements of the requested analytical methods and CF-SR-E-001 for Sample Receipt, Login, and Storage. If a single aliquot is supplied for analyses by several methods, the most stringent analytical storage requirements are applied to the sample.

After all analyses are complete and results are submitted to the client, sample aliquots are transferred to the sample archive area. They are stored in this area until they are disposed.

### 9.8 SAMPLE DISPOSAL

Our policies concerning sample disposal are described in the Laboratory Waste Management Plan, CF-LB-G-001 and can be divided into two categories: those governing the disposal of sample laboratory waste, and those directing the disposal of remaining sample aliquots after the completion of all analyses.

#### 9.8.1 Laboratory waste

Unless otherwise requested by contract, laboratory sample waste is collected throughout the laboratory in designated satellite containers found in sample collection and accumulation areas. Sample wastes are segregated based on the type of analysis by which they were generated and by matrix. This contains certain process contaminants thus decreasing the amount of waste material that may be labeled hazardous. It also ensures that solid and aqueous wastes are not mixed.

The composited sample wastes then undergo hazardous waste characterization. The analyses allow CFA to properly characterize the waste according to EPA regulations.

Sample waste is disposed in accordance with the Laboratory Waste Management Plan, CF-LB-G-001.

#### 9.8.2 Remaining Sample Aliquots

Samples not consumed during the sample preparation or analytical procedures are either returned to the client in accordance with CF-SR-E-002 for Transportation and Shipping of Samples and Pre-Preserved Sample Containers or disposed pursuant to the Laboratory Waste Management Plan. Samples are returned to a client under the conditions and terms agreed to by contract. A chain of custody listing the laboratory waste technician as the relinquishing party is enclosed with each set of samples being returned to a client. Unless otherwise specified by the client, all samples are shipped by an approved package carrier. The procedure for shipment is delineated in CF-SR-E-002 for Transportation and Shipping of Samples and Pre-Preserved Sample Containers.

It is our policy to hold samples for a minimum of thirty days after invoicing and before disposal, unless otherwise specified by contract or if the sample is part of litigation. If the sample is part of litigation, disposal of the physical sample shall occur only with concurrence of the affected legal authority, sample data user, and/or client.

When sample analyses are complete and regulatory and/or contractual holding times have expired, samples are moved from their storage locations to the sample archives. Samples that are to be returned to the client or held for an extended time period are segregated from the other samples.

When internal or client-specified storage time expires, samples with like matrices are composited into appropriate containers. The composites are then subject to the same treatment and disposal protocol as described in 9.8.1. Samples that are approved for disposal are scanned into our database and assigned the status of "Disposed."

#### 9.9 EMERGENCY SAMPLE STORAGE

In the event of an impending disaster (such as a hurricane), the laboratory will make arrangements to store samples and their extracts at an approved off-site facility. CF-QS-E-001 is used to identify acceptable storage facilities that meet the requirements of the laboratory policies pertaining to proper storage conditions and documented chain-of-custody.

#### 9.10 SAMPLE HOLDING TIMES

Ensuring that the holding times are met for every sample is the responsibility of the production manager. CFA requests that the samples arrive in such condition that sufficient time remains for our processes. Holding times for the persistent organic pollutants that are the bulk of the target analytes of the methods offered by CFA are typically one year from collection to analysis and 40 days from extraction to analysis. It is not uncommon for clients to hold or request that we hold samples for months or years before requesting analysis. In these situations, the client is informed of the holding times and CFA follows the client's direction with narration of any issues. CFA routinely meets holding times by followings it's SOPs, having redundant instrumentation, cross-trained employees, maintenance contracts, etc.

Our sample receipt process identifies the sampling date and evaluates the remaining time. Our quality records include extraction and analysis dates so that there is sufficient information to

verify holding time compliance. The client is consulted when there are short hold times remaining until extraction or analysis.

**SECTION 10  
RECORDS****10. SECTION 10 - RECORDS**

Our quality records provide the documentation we need to support analytical results and conclusions. Documented evidence that quality assurance and quality control requirements have been met is critical to providing data that fulfill the specifications of applicable procedures, programs, and contracts.

As described in Section 3 of this Quality Assurance Plan (QAP), quality records include but are not limited to:

- Observations
- Calculations
- Calibration data
- Certificates of analysis
- Certification records
- Chains of custody
- External, supplier, and internal audits
- Run logs
- Instrument data and analytical logbooks
- Instrument, equipment and building maintenance logs
- Material requisition forms
- Monitoring logs
- Nonconformance reports
- Corrective actions
- Method development and start-up procedures including MDL, LOD and LOQ verification studies
- Training records
- Waste management records
- Standard logs
- Software validation
- Standard operating procedures (SOPs)
- Sample collection and field data

Our procedures to provide a legal and evidentiary chain of custody are described in Section 9 of this QAP. Described in this section are:

- Recordkeeping system and design
- Records management and storage
- Sample handling records
- Records of support activities
- Analytical records
- Administrative records

**10.1 RECORDKEEPING SYSTEM AND DESIGN**

We manage, maintain and store our quality records according to CF-QS-E-008 for Quality Records Management and Disposition. The protocols established in this document work in

conjunction with those for specific types of records addressed in other SOPs to govern our record keeping system. Our record keeping system allows the historical reconstruction of all laboratory activities that produce analytical data.

We facilitate historical reconstruction by maintaining the following records and information, from the time a sample is received until it is disposed.

- A master list of all employee signatures and initials is maintained by the Quality Manager. This allows the identification of any CFA personnel who accept, handle, analyze, prepare, review, store, or dispose of a sample, its subsamples, associated data and reports, and other related documentation.
- If we provide bottles and containers to a client or sampling personnel, these records are kept in accordance with CF-SR-E-002 Transportation and Shipping of Sample and Pre-preserved Sample Containers.

The person or agency responsible for collecting a sample is documented on the chain of custody and entered into AlphaLIMS. Other records supporting the acceptance of a sample may include:

- Date and time of sample receipt
- Person accepting sample
- Condition of sample upon receipt
- Client chain of custody
- Electronically generated sample ID numbers specific to each sample aliquot and linked to the client's sample description, sample collection and receipt information, and analyses to be performed.
- Identification of each person who has custody of a sample, its subsamples, extracts, or leachates, as requested. (This is provided through the internal chain of custody procedures described in Section 9.)

Documentation that materials purchased for use in the analysis or preparation of samples meet specifications is maintained in accordance with CF-RC-E-001 for Receipt and Inspection of Material and Services.

Records of equipment calibrations are maintained and traceable by date and unique ID number to a specific analysis. These records include certifications of calibration and service that have been initialed or signed.

Our thermometers are verified against the NIST traceable thermometer and records of this verification are maintained as described in CF-QS-E-007 for Thermometer Verification. Records of the daily calibration verifications of our analytical balances are kept in accordance with CF-LB-E-002 for Balances. The calibration records for our air-displacement pipets are maintained in pipet calibration logs specific to each pipet according to CF-LB-E-010 for Maintenance and Use of Air Displacement Pipets.

When methods and/or regulations specify that samples, subsamples, extracts, and/or leachates be stored at designated temperatures, or when the method itself has temperature sensitive steps, we document those temperatures on monitoring logs at the frequency defined in the corresponding SOPs. We can trace the specific storage location of a sample through the internal chain of custody.

We require that the initials of all personnel responsible for monitoring temperatures be recorded in the temperature monitoring logs pursuant to CF-LB-E-004 for Temperature

Monitoring and Documentation Requirements for Refrigerators, Freezers, Ovens and Other Similar Devices. The logs are reviewed for completeness in accordance with CF-QS-E-005 for Review of Monitoring Device Logs.

Documentation on the instruments and equipment used for the analysis of samples is recorded in run logs, laboratory logbooks, instrument data and/or sample preparation logs. Routine or corrective maintenance that is performed on equipment or instruments is recorded in the maintenance log specific to the instrument. We document these records in accordance with CF-LB-E-008 for Basic Requirements for the Use and Maintenance of Laboratory Notebooks, Logbooks, Forms and Other Recordkeeping Devices.

The standards containing known quantities of target analytes that we use in instrument calibration, calibration verification, and as quality control samples, such as matrix spikes and laboratory control samples, are documented according to CF-LB-E-007 for Laboratory Standards Documentation. These records contain the following information:

- Protocol by which each standard was prepared
- Traceability of each child standard to its parent
- Date each standard was prepared
- Initials of person preparing the standard
- Expiration dates
- Concentration of each standard
- Certificate of Analysis, provided by the supplier (if available)

This information allows us to document that the standards used were prepared in accordance with the established protocol, produced using source standards that meet the method and regulatory criteria, and used prior to their expiration date.

If required, reagents used in the preparation, dilution, and analysis of samples are verified to be free of interferences or target analytes. We record these verifications in the reagent logs in accordance with CF-LB-E-008 for Basic Requirements for the Use and Maintenance of Laboratory Notebooks, Logbooks, Forms and Other Recordkeeping Devices.

Analytical and sample preparation methods applied to each sample aliquot are documented via the internal chain of custody, method information, and information recorded in lab notebooks, sample preparation logs, run logs, and instrument data. The laboratory protocol we employ during analysis is dictated by the SOP in effect at the time the sample was analyzed or prepared by a specific method.

Run logs, laboratory notebooks, instrument data and sample preparation logs are used to document the preparation and analysis of samples and the associated instrument calibrations. These logs and notebooks are governed by CF-LB-E-009 for Run Logs and CF-LB-E-008 for Basic Requirements for the Use and Maintenance of Laboratory Notebooks, Logbooks, Forms, and Other Recordkeeping Devices. As stated in these SOPs, sample preparation and analytical records that are not electronically generated should be:

- Legible
- Recorded in permanent ink
- Corrected using one line marked through the error, initialed and dated
- Initialed by the responsible party

We maintain electronic records for each analytical batch. These records include the ID numbers of each client and quality control sample prepared and/or analyzed together, the method of preparation and analysis, and the matrix of the samples included in the batch.

Through our electronic statistical process control system (SPC), the acceptance criteria applied for all quality control (QC) samples are stored and maintained as described in CF-QS-E-014. The acceptance limits for target analytes are method, matrix, and time-period specific, which allow us to generate the criteria applied to QC samples associated with identified client samples.

Our Quality Manager maintains the records of nonconformances and corrective actions associated with specific samples, batches, and processes. We maintain these records according to CF-QS-E-004 for the Documentation of Nonconformance Reporting and Dispositioning and Control of Nonconforming Items, and CF-QS-E-002 for Conducting Corrective/Preventative Action and Identifying Opportunities for Improvement.

Electronic data records are maintained in a secured database designed to protect the integrity of the data. Data that are uploaded directly from instruments and that are manually entered are backed up by a second system.

Permanent records of electronic data deliverables are maintained along with the corresponding sample preparation and analytical data review records. This documentation includes the initials of the reviewer and date of the review.

Records of the data we report to our clients are maintained in a manner that protects client confidentiality, as well as any potential national security concerns. These records include copies of certificates of analysis, quality control summary reports, case narratives, CLP forms, and other information we provided to the client. The copies may be paper or electronic.

Records of samples being disposed or returned to the client are documented in accordance with CF-SR-E-002 for Transportation and Shipping of Samples and Pre-Preserved Sample Containers. Such records include the date samples are returned or disposed, the destination of the samples, and name of the person transferring the samples.

## 10.2 RECORD STORAGE

We store quality records in compliance with CF-QS-E-008 for Quality Records Management and Disposition. The records are:

- Stored in a secured area to maintain data integrity and protect client confidentiality, including any national security concerns.
- Kept in areas where they are protected from fire loss, environmental deterioration, and, in the case of electronic records, electronic or magnetic sources.
- Indexed and filed in a manner allowing for ready retrieval.
- Retained for an identified period of time that equals or exceeds five years as determined by applicable law and client contract requirements.

Electronic data records are stored on compact disks.

All of the hardware and software we need to reconstruct data is maintained according to the SOP for Requirements, Design, Operation, Validation and Removal of Hardware and Software Systems. Records that are stored or generated by network or personal computers have either hard copy or write-protected backup.

### 10.3 SAMPLE HANDLING POLICY

Records of all procedures applicable to samples are maintained in our possession. These records include documents that pertain to:

- Preservation, including sample container and holding time
- Sample identification, receipt, acceptance or rejection, and login
- Sample storage and tracking including shipping receipts, transmittal forms, routing and assignment records
- Sample preparation (ID codes, cleanup and separation protocols, volumes, weights, instrument printouts, meter readings, calculations, reagents)
- Sample analysis
- Standard and reagent origin, receipt, preparation, and use
- Equipment receipt, use, specification, operating conditions and preventive maintenance
- Instrument calibration frequency and acceptance criteria
- Data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions
- Method performance criteria including expected quality control requirements
- Quality control protocols
- Electronic data security, software documentation and verification, software and hardware audits, backups and records of any changes to automated data entries
- Disposal of hazardous samples

### 10.4 RECORDS OF LABORATORY SUPPORT ACTIVITIES

In addition to sample handling records, we maintain the following:

- Original raw data for calibrations, samples and quality control measures, including worksheets and data output records (chromatograms, strip charts, and other instrument readout records)
- A written description of or reference to the specific method used, including the computational steps used to translate parameter observations into a reportable analytical value
- Copies of final reports
- Archived standard operating procedures
- Correspondence relating to project-specific laboratory activities
- Corrective action reports, audits and audit responses
- Proficiency test results

### 10.5 ANALYTICAL RECORDS

We document and maintain analytical records, such as strip charts, tabular printouts, computer data files, analytical notebooks, and run logs according to CF-LB-E-008 for Basic Requirements for the Use and Maintenance of Laboratory Notebooks, Logbooks, Forms, and Other Recordkeeping Devices, and CF-LB-E-009 for Run Logs.

The information that is documented in analytical records includes:

- Laboratory sample ID code
- Date and time of analysis
- Instrument ID and operating conditions/parameter (or reference to such data)
- Method of analysis
- All calculations
- Dilutions
- Initials of analyst or operator

- Units of measurement

Our policy is to produce and maintain analytical records that are:

- Accurate
- Reviewed and verified
- Legible and understandable
- Traceable and authentic to their source
- Grouped in a contemporary manner with data entered and information recorded as it is obtained

#### 10.6 ADMINISTRATIVE RECORDS

A number of pertinent records are maintained by the Quality Manager, including:

- Staff qualifications and experience.
- Training records, including initial demonstrations of proficiency. (Refer to procedure CF-HR-E-002 for Employee Training.)
- A log of names, initials and signatures for individuals having responsibility for initialing laboratory records.

We monitor continuing demonstrations of proficiency through AlphaLIMS per CF-HR-E-002 for Employee Training.

**SECTION 11  
LABORATORY REPORT FORMAT AND CONTENTS****11. SECTION 11 - LABORATORY REPORT FORMAT AND CONTENTS**

Accurate data are of little benefit to a client unless they are reported in a format that is easy to interpret and provides all pertinent information relating to the analysis of a sample. At CFA, we have developed certificate of analysis report formats that meet the different needs of our clients, yet provide all of the information necessary to satisfy regulatory requirements while allowing for the interpretation of the data. Each format provides accurate, clear, unambiguous and objective data.

In addition to a certificate of analysis, a client can request and receive an extended data package. This package may include any of the following: certificates of analysis; summaries of quality control; case narratives; instrument data; sample preparation data; measurement traceability and calibration information; and electronic data deliverables. If clients require the reporting of data following the established contract laboratory protocol (CLP), we can provide a CLP-like data package that will meet their needs.

It is important that the certificate of analysis format and data package requirements be discussed with the client prior to our acceptance of the samples. Project Managers are responsible for establishing an agreement with the client concerning data reporting and the potential cost to the client for data packages and/or specialized reporting. Our analytical data are reported to three significant figures unless otherwise required by client contract. The following rounding rules will also be used unless otherwise specified by the client contract:

- If the first non-significant digit is a 5 followed by other non-zero digits, round up the last significant digit (away from zero). For example, 1.2459 as the result of a calculation or measurement that only allows for 3 significant digits should be written 1.25.
- If the first non-significant digit is a 4 followed by other non-zero digits, the last significant digit remains the same. For example, 1.2449 as the result of a calculation or measurement that only allows for 3 significant digits should be written 1.24.

Laboratory reports and data packages are stored and transmitted in a manner that protects client confidentiality and potential matters of national security. No reports or data packages are released to persons or organizations outside CFA without the express consent of the client. If directed by a regulatory agency or subpoenaed to submit documents to a court of law, we will notify the client of the demand and the records being released.

Shipments to the EPA of deliverable packages, including re-submittals, shall be sealed with custody seals in a manner such that opening the packages would break the seals. Custody seals shall be signed and dated.

The following elements of report formats and data packages are described in this section:

- Certificates of analysis (C of A)
- Quality control summary reports (QCSR)
- Analytical case narratives
- Electronic data deliverables (EDDs)
- Types of data packages and reporting formats

- Review of data packages and reports

### 11.1 CERTIFICATES OF ANALYSIS

We have two primary C of A report formats, Level 1 and Level 2. Both contain the following information when applicable:

- Title
- CFA address and phone number
- Name of PM or person serving as the primary client contact
- Barcode identification of the C of A
- Number of page and total number of pages
- Name and address of client, where appropriate
- Project name or code if applicable
- Client-provided sample description
- Unique laboratory ID number for the sample
- Sample matrix
- Characterization and condition of the sample where relevant
- Date of receipt of sample
- Date and time of sample collection, if provided
- Date and time of sample analysis, reanalysis, and/or sample preparation
- Initials of analyst and person responsible for sample prep
- Analytical batch number
- Sample analysis and preparation methods (or unambiguous description of any non-standard method used)
- Reference to sampling procedure
- Additions to or deviations or exclusions from the test method, and other information relevant to a specific test, such as environmental conditions and the use and meaning of data qualifiers
- Nonconformances that affect the data
- Whether data are calculated on a dry weight or wet weight basis
- Identification of the reporting units, such as  $\mu\text{g/L}$  or  $\text{mg/kg}$
- Statement of the estimated uncertainty of the test result, if applicable
- Signature and title of the person(s) accepting responsibility for the content of the C of A
- Date C of A was issued
- Clear identification of data provided by outside sources, such as air temperature or ambient water temperature
- Identification of the reporting limit (RL) or practical quantitation limit (PQL) for each analyte, if applicable.
- If a portion of the sample analysis is subcontracted, the C of A will identify the subcontractor or applicable accreditation number, and the data that was determined by the subcontracting laboratory.

Level 2 Certificates of Analysis contain the following additional information:

- Dilution factors
- Method detection limits
- Surrogate recoveries and the acceptance criteria for all organic analyses
- Estimated concentrations determined for nondetects and appropriate "U" and "J" qualifiers for nondetects and concentrations that fall between the MDL and PQL respectively.

Once issued, a C of A is not altered unless a subsequent C of A is identified as a revised report.

### 11.2 QUALITY CONTROL SUMMARY REPORT (QCSR)

The quality control data that demonstrate the sample preparation and/or analytical efficiency of the batch are summarized on a QCSR. The data reported on the QCSR may be limited to a sample delivery group contained in the batch or may include all quality control for the batch.

Information reported on QCSR includes:

- Quality control sample ID number
- Type of quality control sample
- Concentrations determined, where applicable, for method blanks, matrix spikes, matrix spike duplicates, matrix duplicates, laboratory control samples, serial dilutions, and laboratory control sample duplicates
- Acceptance criteria for matrix spikes, matrix spike duplicates, matrix duplicates, laboratory control samples, and laboratory control sample duplicates
- Nominal concentrations of matrix spikes, matrix spike duplicates, LCSs, and LCS duplicates
- Concentration of parent sample for the matrix spikes, matrix spike duplicates, or sample duplicates
- Percent recoveries for LCS and matrix spikes
- Relative percent differences for the matrix spike duplicates, matrix duplicates, and LCS duplicates
- Analytical batch number with which the quality control data is associated
- Parent sample numbers for matrix spikes, matrix duplicates, and matrix spike duplicates
- Sample or sample delivery group ID
- Project code
- Date issued, page numbers/total number of pages
- Identification of recoveries or relative percent differences that do not meet the acceptance criteria

### 11.3 ANALYTICAL CASE NARRATIVES

Analytical case narratives are written by an analyst or data validator to describe the overall conditions affecting the analysis of a batch or a specific sample in the batch. Case narratives usually include:

- Sample delivery group ID number
- Analytical batch number
- Methods of preparation and analysis
- Sample matrix
- Initial of person preparing and/or reviewing the narrative
- Specific sample ID numbers
- Identification and description of batch quality control samples including parent sample identification
- Affirmation that all sample preparation conditions specified by the method or regulatory agencies were met or identification of specific deviations
- Affirmation that all analysis criteria specified by the method or regulatory agencies were met or identification of specific deviations
- Instrumentation employed if applicable and verification of its calibration
- Summary of batch quality control as compared to acceptance criteria
- Identification of nonconformances
- Pertinent comments and observations of factors that affect sample data quality

**11.4 ELECTRONIC DATA DELIVERABLES (EDDS)**

Electronic data deliverables are generated according to client specifications. EDDs use programs supplied by the client or created internally by our EDD team. Internally generated EDDs are usually written in Perl and/or PL/SQL.

**11.5 TYPES OF DATA PACKAGES AND REPORTS**

We offer seven levels of data reports and the ability to design packages to meet the needs of our clients. The levels of data reports are summarized in Table 1.

**TABLE 1: DATA REPORT FORMATS**

Level	Contents
1	Certificate of Analysis
2	Level 1 plus QC data
3	Level 2 plus case narrative
4	Level 3 plus instrument QC
5	Level 4 plus raw data
6	Level 5 plus standards traceability
7	CLP format

If a client so requests, the above reports can be accompanied by EDDs, case narratives, copies of associated nonconformance reports, and other support documentation. The client’s specific requirements are communicated to the laboratory and data reviewers through AlphaLIMS.

CFA’s SOP CF-CS-E-002 for The Internal Review of Contractually Required Quality Criteria for Client Package Delivery defines preparation and review of the package.

**11.6 REVIEW OF DATA REPORTS, EDDS, AND DATA PACKAGES**

All data reports are reviewed for accuracy and completeness by the PM . All data packages are reviewed in the laboratory by a data reviewer, who is responsible for reviewing specific fractions of the data package for accuracy, consistency, and completeness in accordance with the SOP for that lab area.

**11.7 ELECTRONIC SIGNATURE**

CFA utilizes a system administrator that has the appropriate education and training for development and maintenance of electronic signature systems. Electronic signatures are maintained in the LIMS database and require up to date usernames and passwords in order to be utilized on any electronically generated document. All electronic signatures executed by our employees, agents, or representatives, located anywhere in the world are the legally binding equivalent of traditional handwritten signatures. When an open system is used (e.g., transmission of data over the internet), electronic signatures are used to ensure authenticity and integrity of the electronic records from the point of their creation to the point of receipt.

**SECTION 12**  
**SUBCONTRACTING ANALYTICAL SAMPLES AND OUTSIDE SUPPORT SERVICES**

**12. SECTION 12 - SUBCONTRACTING ANALYTICAL SAMPLES AND OUTSIDE SUPPORT SERVICES**

The subcontracting of samples to other facilities may occur when:

- The client has requested analytical services for which we are not certified or do not offer as a routine product.
- The regulatory or method holding times and/or client due dates are in danger of not being met as the result of instrument malfunction or the unexpected influx of a large group of samples.

No samples are subcontracted without the client's consent. The laboratories selected to receive subcontracted samples are expected to meet the following criteria:

- Demonstrated technical capability to provide data that meet and conform to our quality standards.
- Established certification, if available, for the requested analyses.
- Successful proficiency evaluation results, if available.
- Commitment to meet time requirements for delivery of results to the client.
- Agreement to provide all documentation requested in conjunction with the analysis.
- TNI or ISO/IEC 17025 accreditation for the analysis if required by the client.

We audit potential subcontractors for technical and administrative compliance as directed in CF-QS-E-001 for Conduct of Quality Audits. An audit may be in the form of a book/desk audit or an on-site review.

If there is evidence of a technical, administrative, or quality deterioration, the laboratory is removed from our list of approved subcontractor laboratories pending further evaluation, which may include an on-site audit. Once the laboratory again demonstrates compliance with CFA's standards, it can be reclassified as an approved subcontractor laboratory.

At CFA, we have a multi-faceted and trained staff. There are occasions, however, when it may be necessary to obtain the services of professionals outside of CFA. This may be due to such things as sample workload, introduction of a new instrument or method requiring special knowledge, or employee leave of absence.

Any outside support services or service personnel are subject to the same scrutiny as a subcontract laboratory. If a service fails to meet our standards for excellence, the appropriate parties are promptly notified. If immediate corrections are not implemented and services are not of adequate quality to maintain confidence, the contract is cancelled.

**SECTION 13  
CLIENT SATISFACTION****13. SECTION 13 - CLIENT SATISFACTION**

Meeting the needs and expectations of our clients is essential to meeting our commitment to be the environmental laboratory of first choice. An important part of meeting this commitment involves receiving and resolving client concerns and complaints.

Client complaints that question the quality of laboratory data or data deliverables are directed to Quality Systems. These concerns are responded to with input from the laboratory, or support group as may be needed.

The types of complaints, area(s) affected, and any impacts on quality are trended on a quarterly basis. This information is available to management at any time.

We use AlphaLIMS to monitor client complaints, nonconformances and corrective actions. Every complaint is entered into the system upon receipt and assigned an internal and external due date. The external due date is often established by client contract. The internal due date allows time for the Quality Manager to review the response and transmit it to the client on or before the due date.

If we notice a trend that significantly affects the quality of our data, a corrective action is initiated following CF-QS-E-002 for Conducting Corrective/Preventive Action and Identifying Opportunities for Improvement. The implementation and verification of the corrective action affirms an effective and permanent solution. Corrective Action investigations are verified for effective implementation during subsequent internal audits of the laboratory area where changes were made.

**SECTION 14  
REVISION HISTORY****14. SECTION 14 – REVISION HISTORY**

Revision 1: Added SOP references

Revision 2: Updated DOD requirements.

Revision 3: Assignment of start/stop work order authority

Revision 4: Several changes for audit responses

Revision 5: Various updates from internal audit

Revision 6: Update organizational chart; Removed that a preparation batch could be extended over 24 hours.; Remove Verbiage about spiking LCS and MS/MSD with representative compounds.; Remove Verbiage about spiking LCS and MS/MSD with representative compounds.; Removed MAPEP PT option; Revise sentence related to logs posted near each temperature control device.; Added rounding rules.

Revision 7: Method revisions updated; TNI 2009 Update; Removed reference to obsolete IT SOPs; Updated Org chart and evacuation routes; Added RSO to org chart; Added reference to DOE Order 414.1D

Revision 8: VP of Operation to COO; Quality position in org chart corrected; Evacuation routes include Rad Room; Document reformatted to facilitate consistent headers

Revision 9: Quarterly Progress Report responsibility assigned to the Quality Manager.; Add revision history; Added login fume hood to equipment list; Change in start work policy.

Revision 10: Added computer system security comments. Added signature definitions and exceptions.

Revision 11: Additions for compliance with Kentucky Certification Manual.

Revision 12: Electronic signature policy; Added reference to TO-9a; Updated equipment list to include HRMS4; Updated SOP appendix for TO-9a and new SOPs.

Revision 13: Added ISO Guide 034 clarification and information to section 7's introduction. Added statements regarding confidential reporting of integrity issues.

Revision 14: Added appointment of deputies for key managerial positions.

Revision 15: Added AB notification responsibility to Quality Manager, such as owner change.

Revision 16: Reassigned deputies for key managerial positions. Added new equipment. Added Impartiality section in accordance to ISO/IEC 17025:2017. Added SW846 3546 to test methods. Updated references.

Revision 17: Update TNI 2016. Update HR5 information. Update Evacuation Route.

Revision 18: Update references in Appendix A.

Revision 19: Update Appendix I and Appendix J.

Revision 20: Added DoD MB acceptance limits.

Revision 21: Added EPA SOW HRSM02.0 and associated SOPs.

**APPENDIX A: REFERENCES**

- National Environmental Laboratory Accreditation Program, (NELAP), 3002 NELAC Standard
- The NELAC Institute, (TNI) 2016 Standard, EL-V1M1-2016-Rev.2.1
- 40 CFR Part 136, October 1984, Part VII, EPA 600 Series Methodologies for the Analysis of Organic Contaminants.
- EPA Requirements for Quality Assurance Project Plans (QAPPs), US EPA QA/R5.
- US Department of Energy Quality Systems for Analytical Services (DOE QSAS), Rev 2.6
- US Department of Defense Quality Systems Manual for Environmental Laboratories, Version 5.3, May 2019.
- ANSI/ISO/IEC 17025-2017
- DOE G414/1 – 3, 11/3/04 Suspect and Counterfeit Items
- DOE Order 414.1D Subject: Quality Assurance Approved: 4-25-2011
- 21 CFR Part 11 Subpart C Electronic Signatures
- Commonwealth of Kentucky Wastewater Laboratory Certification Manual June 2013

**APPENDIX B: DEFINITIONS**

The following definitions are used throughout the text of our Quality Systems Plan. These definitions were reprinted from “Definitions for Quality Systems,” NELAC, July 1, 1999. The original source of each definition is provided.

AlphaLIMS: CFA’s Laboratory Information Management System.

Acceptance Criteria: Specified limits placed on characteristics of an item, process, or service defined in the requirement documents. (ASQC)

Accreditation: The process by which an agency or organization evaluates and recognizes a program of study or an institution as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. In the context of the National Environmental Laboratory Accreditation Program (NELAP), this process is a voluntary one. (NELAC)

Accuracy: The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Aliquot: A discrete, measured, representative portion of sample taken for analysis. (DoD, EPA QAD Glossary)

Analyst: The designated individual who performs the “hands-on” analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality. (NELAC)

Analyte: The specific chemicals or components for which a sample is analyzed; may be a group of chemicals that belong to the same chemical family, and are analyzed together. (EPA Risk Assessment Guide for Superfund, OSHA Glossary)

Analytical Detection Limit: The smallest amount of an analyte that can be distinguished in a sample by a given measurement procedure throughout a given confidence interval. (NELAC Quality Systems Committee)

Analytical Reagent (AR) Grade: Designation for the high purity of certain chemical reagents and solvents given by the American Chemical Society. (NELAC Quality Systems Committee)

ANSI: American National Standards Institute--this consensus standards body approves standards as a guide to aid the manufacturer, the consumer and the general public who may be concerned with its scope and provisions.

Audit: A systematic evaluation to determine the conformance to quantitative and qualitative specifications of some operational function or activity. (EPA-QAD)

Batch: Environmental samples prepared and/or analyzed together with the same process and personnel using the same lot(s) of reagents. A preparation batch is composed of one to 20 environmental samples of the same NELAC-defined matrix and meeting the above mentioned criteria. An analytical batch is composed of prepared environmental samples (extracts, leachates or concentrates) that are analyzed together as a group using the same calibration curve or factor. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples. (NELAC Quality Systems Committee)

Blank: A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subject to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. NOTE: Blank correction is not performed on organic analytes. (ASQC)

Blind Sample: A subsample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst’s or laboratory’s proficiency in the execution of the measurement process. (NELAC)

Calibrate: To determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter or other device, or the correct value for each setting of a control knob. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements. (NELAC)

**Calibration:** The set of operations that establish, under specified conditions, the relationship between values indicated by a measuring device, or the correct value of each setting of a control knob. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements. (NELAC)

**Calibration Curve:** The graphical relationship between the known values, such as concentrations, of a series of calibration standards and their analytical response. (NELAC)

**Calibration Standard:** A substance or reference material used to calibrate an instrument. (QAMS)

**Certified Reference Material (CRM):** A reference material, one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation that is issued by a certifying body. (ISO Guide 30 - 2.2)

**Chain of Custody:** A record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number of and types of containers; the mode of collection; collector; time of collection; preservation; and requested analyses. (NELAC Quality Systems Committee)

**Confirmation:** Verification of the presence of a component through the use of an analytical technique that differs from the original test method. These may include: Second column confirmation, Alternate wavelength, Derivatization, Mass spectral interpretation, Alternative detectors or Additional cleanup procedures (NELAC)

**Corrective Action:** Action taken to eliminate the causes of an existing nonconformity, defect, or other undesirable situation in order to prevent recurrence. (ISO 8402)

**Data Audit:** A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality (i.e., that they meet specified acceptance criteria). (NELAC)

**Data Reduction:** The process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useful form. (EPA-QAD)

**Detection Limit:** The lowest concentration or amount of the target analyte that can be determined to be different from zero by a single measurement at a stated degree of confidence. Refer to Method Detection Limit. (NELAC)

**Document Control:** The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly, and controlled to ensure use of the correct version at the location where the prescribed activity is performed. (ASQC)

**Duplicate Analyses:** The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. (EPA-QAD)

**Holding Time (Maximum Allowable Holding Time):** The maximum time that samples may be held prior to analysis and still be considered valid. (40 CFR Part 136)

**Initial and Continuing Demonstrations of Capability:** Procedures to establish the ability of the laboratory to generate acceptable accuracy and precision which is included in many of the EPA's analytical test methods. In general, the procedure includes the addition of a specified concentration of each analyte in each of four separate aliquots of laboratory pure water or authentic samples. These are carried through the analytical procedure and the percent recovery and the standard deviation are compared to specified limits. (40 CFR Part 136, 2003 NELAC)

**Internal Standard:** A known amount of standard added to a test portion of a sample and carried through the entire measurement process as a reference for evaluating and controlling the precision and bias of the applied analytical test method. (NELAC)

**ISO/IEC 17025:** The International Organization for Standardization and International Electrotechnical Commission form this specialized system for worldwide standardization. Members of ISO or IEC participate in the development of International Standards through technical committees established by their organization to deal with particular fields of activity. Other international organizations, government and non-government, also take part in development of these standards. The ANSI/ISO/IEC 17025-2017 is approved as an American National Standard and covers general requirements for the competence of testing and calibration laboratories.

Laboratory: A body that calibrates and/or tests. 1. In cases where a laboratory forms part of an organization that carries out other activities besides calibration and testing, the term “laboratory” refers only to those parts of that organization that are involved in the calibration and testing process. 2. As used herein, the term “laboratory” refers to a body that carries out calibration or testing at or from a permanent location, from a temporary facility, or a mobile facility. (ISO 25)

Laboratory Control Sample (LCS): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes from a source independent of the calibration standards or a material containing known and verified amounts of analytes. It is generally used to establish intra-laboratory or analyst specific precision and bias to assess the performance of all or a portion of the measurement system. (NELAC)

Laboratory Duplicate: Aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently. (NELAC Quality Systems)

Limit of Detection (LOD): An analyte, method and matrix specific estimate of the minimum amount of a substance that can be reliably detected. CFA has established  $LOD = 2 \times MDL$ .

Limit of Quantitation (LOQ): An analyte, method and matrix specific estimate of the minimum amount of a substance that can be reported with a specific level of confidence. The LOQ is set at or above the concentration of the lowest initial calibration standard. The laboratory must empirically demonstrate precision and bias at the LOQ. The LOQ and associated precision and bias must meet client requirements and must be reported.

CFA uses the following guidance:

( $LOD < LOQ$ ): When  $LOD < PQL$ ,  $PQL = LOQ$ . When  $LOD > PQL$ , LOQ is raised to next lowest calibration standard or verifiable level.

Matrix: The component or substrate that contains the analyte of interest. For purposes of batch determination, the following matrix types shall be used:

- Aqueous: Any aqueous sample excluded from the definition of a drinking water matrix or saline/estuarine source. Includes surface water, groundwater, and effluents.
- Drinking Water: Any aqueous sample that has been designated a potable or potential potable water source.
- Saline/Estuarine: Any aqueous sample from an ocean or estuary, or other salt-water source.
- Non-aqueous liquid: Any organic liquid with <15% settleable solids.
- Biological Tissue: Any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.
- Solids: Includes soils, sediments, sludges and other matrices with >15% settleable solids.
- Chemical Waste: A product or by-product of an industrial process.
- Air Samples: Media used to retain the analyte of interest from an air sample such as sorbent tubes, summa canisters, XAD resin or PUFs. Each medium shall be considered as a distinct matrix. (Quality Systems)

Matrix Spike (MS): Prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Matrix Spike Duplicate (spiked sample/fortified sample duplicate): A second replicate matrix spike is prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

May: Denotes permitted action, but not required action. (NELAC)

Method Blank (MB): A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples containing an analyte of interest through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses. (NELAC)

Method Detection Limit (MDL): The minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136 Appendix B)

Minimum Reporting Level (MRL): The lowest concentration of an analyte that can be reliably quantified that is greater than the method detection limit, of sufficient accuracy and precision to meet the intended purpose, and acceptable quality control criteria for the analyte at this concentration are met. This defined concentration can be no lower than the concentration of the lowest calibration standard for that analyte. (Kentucky Wastewater Manual, June 2013)

Must: Denotes an item that is required to be met. (Random House College Dictionary)

Negative Control: Measures taken to ensure that a test, its components, or the environment does not cause undesired effects, or produce incorrect test results. (NELAC)

NELAC: National Environmental Laboratory Accreditation Conference. A voluntary organization of state and federal environmental officials and interest groups purposed primarily to establish mutually acceptable standards for accrediting environmental laboratories. A subset of National Environmental Laboratory Accreditation Program (NELAP). Also known as The NELAC Institute (TNI).

Performance Audit: The routine comparison of independently obtained quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory. (NELAC)

Performance Based Measurement System (PBMS): A set of processes wherein the data quality needs, mandates, or limitations of a program or project are specified and serve as criteria for selecting appropriate test methods to meet those needs in a cost-effective manner. (NELAC)

Positive Control: Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects. (NELAC)

Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance, or range, in either absolute or relative terms. (NELAC)

Preservation: Refrigeration and or reagents added at the time of sample collection to maintain the chemical and/or biological integrity of the sample. (NELAC)

Proficiency Test Sample (PT): A sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Proficiency Testing: A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (NELAC, Section 2.1)

Proficiency Testing Program: The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results in comparison to peer laboratories and the collective demographics and results summary of all participating laboratories. (NELAC)

Protocol: A detailed written procedure for field and/or laboratory operation (e.g., sampling, analysis) that must be strictly followed. (EPA-QAD)

Pure Reagent Water: Shall be water in which no target analytes or interferences are present at a concentration that would impact the results when using a particular analytical test method. (NELAC)

Quality Assurance: An integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality within a stated level of confidence. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Quality Control: The overall system of technical activities whose purpose is to measure and control the quality of a product or service so that it meets the need of users. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

**Quality Manual:** A document stating the quality policy, quality system and quality practices of an organization. This may also be called a Quality Assurance Plan or a Quality Plan. NOTE: The quality manual may call up other documentation relating to the laboratory's quality arrangements. (CFA)

**Quality System:** A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC. (ANSI/ASQC E-41994)

**Quantitation Limits:** The value at which an instrument can accurately measure an analyte at a specific concentration that includes the maximum or minimum levels, concentrations, or quantities of a target that can be quantified with the accuracy required by the data user. These values establish the upper and lower limits of the calibration range. (NELAC with DoD clarification)

**Range:** The difference between the minimum and the maximum set of values. (EPA-QAD)

**Raw Data:** Any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g., tapes that have been transcribed verbatim, dated and verified accurate by signature), the exact copy or exact transcript may be submitted. (EPA-QAD)

**Reagent Blank** (method reagent blank): A sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

**Reference Material:** A material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (ISO Guide 30 -2.1)

**Reference Standard:** A standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived. (VIM - 6.08)

**Reporting Limit Standard (RLS):** A procedural standard that is analyzed to evaluate instrument performance at or below the minimum reporting limit. (Kentucky Wastewater Manual, June 2013)

**Required Reporting Limit (RRL):** The minimum limit that can be reported and meet the limits established within the KPDES Permit. (Kentucky Wastewater Manual, June 2013)

**Requirement:** Denotes mandatory specification; often designated by the term "shall." (NELAC)

**Sample:** Portion of material collected for chemical analysis, identified by a single, unique term. A sample may consist of portions in multiple containers, if a single sample is submitted for multiple or repetitive analysis. (DoD)

**Selectivity:** The capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. (NELAC Quality Systems)

**Sensitivity:** The capability of a test method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (NELAC Quality Systems)

**Shall:** Denotes a requirement that is mandatory whenever the criterion for conformance with the specification requires that there will be no deviation. This does not prohibit the use of alternative approaches or methods for implementing the specification so long as the requirement is fulfilled. (ANSI)

**Should:** Denotes a guideline or recommendation whenever noncompliance with the specification is permissible. (ANSI)

**Signature, Digital:** means an electronic signature based upon cryptographic methods of originator authentication, computed by using a set of rules and a set of parameters such that the identity of the signer and the integrity of

the data can be verified. (21CFR11.3(b)(5)) Note that CFA may use a digital signature that is not fully compliant with the requirements in 21CFR11 subpart C for electronic signatures.

Signature, Electronic: means a computer data compilation of any symbol or series of symbols executed, adopted, or authorized by an individual to be the legally binding equivalent of the individual's handwritten signature. (21CFR11.3(b)(7)) Note that CFA may use an electronic signature that is not fully compliant with the requirements in 21CFR11 subpart C for electronic signatures.

Signature, Handwritten: means the scripted name or legal mark of an individual handwritten by that individual and executed or adopted with the present intention to authenticate a writing in a permanent form. The act of signing with a writing or marking instrument such as a pen or stylus is preserved. The scripted name or legal mark, while conventionally applied to paper, may also be applied to other devices that capture the name or mark. (21CFR11.3(b)(8))

Spike: A known mass of target analyte added to a blank sample or subsample; used to determine recovery efficiency or for other quality control purposes.

Standard Operating Procedure (SOP): A written document that details the method of an operation, analysis or action whose techniques and procedures are thoroughly prescribed and is accepted as the method for performing certain routine or repetitive tasks. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Standard Reference Material (SRM): A certified reference material produced by the U.S. National Institute of Standards and Technology and characterized for absolute content, independent of analytical test method. (NELAC)

Surrogate: A substance with properties that mimic the analyte of interest. It is unlikely to be found in environmental samples and is added to them for quality control purposes. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Test: A technical operation that consists of the determination of one or more characteristics or performance of a given product, material equipment, organism, physical phenomenon, process or service according to a specified procedure. The result of a test is normally recorded in a document sometimes called a test report or a test certificate. (ISO/IEC Guide 2 - 12.4)

Test Method: The adoption of a scientific technique for a specific measurement problem, as documented in a laboratory SOP. (NELAC)

Traceability: The property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons. (VIM-6.12)

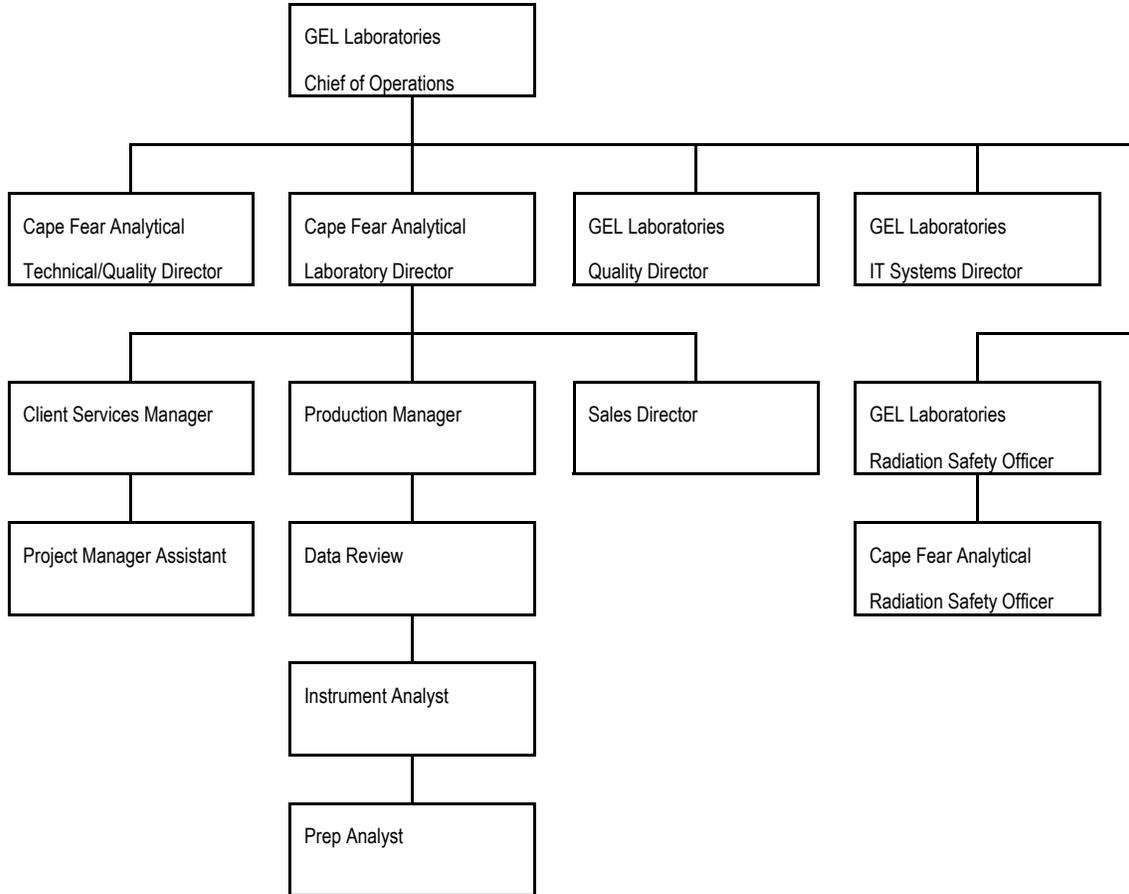
Validation: The process of substantiating specified performance criteria.

Verification: Confirmation by examination and provision of evidence that specified requirements have been met. (NELAC)

NOTE: Verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation, or specification peculiar to the management of the measuring equipment.

The result of verification leads to a decision either to restore in service, to perform adjustments, to repair, to downgrade, or to declare obsolete. In all cases it is required that a written trace of the verification performed shall be kept on the measuring instrument's individual record.

APPENDIX C: CORPORATE ORGANIZATION CHART



**APPENDIX D: CERTIFICATIONS**

Cape Fear Analytical, LLC maintains primary environmental laboratory certification from TNI in Utah. We expand our list of certification as needed.

Original Scope of Accreditations is maintained in the Quality Assurance work area. Electronic copies are available in .pdf form on the CFA intranet. Please call to confirm the status of any certification of interest to you.

The NELAC Institute - Primary issued through the State of Utah, Department of Health, Bureau of Laboratory Improvement;

Secondary TNI accreditation issued through:

California

Florida

Illinois

Louisiana

New Jersey

New York

Mississippi

Pennsylvania

Texas

Washington

North Carolina Department of Health and Human Services, North Carolina State Laboratory Public Health Environmental Sciences, Safe Drinking Water.

Pennsylvania Department of Environmental Protection, Registered to perform analysis on Air samples

Delaware River Basin Commission

DoD QSM

A2LA ANSI/ISO/IEC 17025-2017

## APPENDIX E: ESSENTIAL QUALITY CONTROL REQUIREMENTS

At CFA, we enforce strict adherence to quality control measures. Quality control measures for each type of analysis are delineated in the associated standard operating procedure and include those specified in the identified analytical method. Client requests for additional quality control agreed to by us will be communicated to the laboratory by the Project Manager and performed accordingly.

All quality control measures are assessed and evaluated on an ongoing basis. We use these measures to establish statistically derived quality control acceptance criteria. The acceptance criteria are used to evaluate whether the analytical process is in control and to assist us in establishing the validity of the data. Our procedures for handling out- of-control situations are written in the analytical standard operating procedure.

Method-specific quality measures are described in the appropriate standard operating procedure. Essential but general quality control requirements are summarized in the sections below for chemical testing, including organic analyses.

### E1 CHEMICAL TESTING

This section includes our quality control requirements for organic analyses, and discusses:

- Negative controls
- Positive controls
- Analytical variability and reproducibility
- Method evaluation
- Method detection limits
- Data reduction
- Quality of standards and reagents
- Selectivity
- Constant and consistent test condition

#### E1.1 NEGATIVE CONTROLS

We implement a negative control at least once per analytical batch of samples having the same matrix, and where, if applicable, the same extraction or preparation method is employed. The negative control is a method blank that we use to determine the presence of contamination. If discovered, we must investigate the source of contamination and take measures to correct, minimize, or eliminate the source if:

1. The concentration of target analyte exceeds the established practical quantitation limit and exceeds a concentration greater than 1/10 of the measured concentration of any sample in the analytical batch;
2. The concentration of a target analyte in the method blank exceeds that present in the samples and is greater than 1/10 of the specified regulatory limit.
3. For DOD work, an acceptable blank must have no analytes detected  $> \frac{1}{2}$  the laboratory's LOQ or  $> 1/10^{\text{th}}$  the amount measured in any sample or  $1/10^{\text{th}}$  the regulatory limit, whichever is greater. (see QSM v5.3 table B-6)

If a method blank is indicative of contamination, we must assess each sample in that batch against the above criteria to determine if the data are acceptable. Any sample associated with a contaminated method blank shall be reprocessed for analysis, as needed, or the results will be reported with appropriate data qualifiers.

## **E1.2 POSITIVE CONTROL - METHOD PERFORMANCE**

### **E1.2.1 LABORATORY CONTROL SAMPLE (LCS)**

**Purpose:** The LCS is used to evaluate the performance of the total analytical system, including all preparation and analysis steps. Results of the LCS are compared to established criteria and, if found to be outside of these criteria, indicate that the analytical system is “out of control.” Any affected samples associated with an out-of-control LCS shall be reprocessed for re-analysis or the results reported with appropriate data qualifying codes, as necessary.

**Frequency:** The LCS is analyzed at a minimum of 1 per preparation batch.

**Composition:** The LCS is a controlled matrix, known to be free of analytes of interest, spiked with known and verified concentrations of analytes. NOTE: The matrix spike may be used in place of this control as long as the acceptance criteria are as stringent as for the LCS. Alternatively the LCS may consist of a medium containing known and verified concentrations of analytes such as Certified Reference Material (CRM). All analyte concentrations shall be within the calibration range of the method. The following shall be used in choosing components for the spike mixtures:

The components to be spiked shall be as specified by the mandated test method or other regulatory requirement or as requested by the client.

NOTE: Unless otherwise noted in project quality assurance plans or if components interfere with an accurate assessment, all Department of Defense projects will have LCS, MS, and MSD that contain all target analytes.

**Evaluation Criteria and Corrective Action:** The results of the individual batch LCS are calculated in percent recovery. The laboratory shall document the calculation for percent recovery. The individual LCS is compared to the acceptance criteria as published in the mandated test method. Where there are no established criteria, the laboratory determines internal criteria or utilizes client specified assessment criteria.

An LCS that is determined to be within the criteria effectively establishes that the analytical system is in control and validates system performance for the samples in the associated batch. Samples analyzed along with a LCS determined to be “out of control” should be considered suspect and the samples reprocessed and re-analyzed or the data reported with appropriate data qualifying codes as necessary.

### **E1.2.2 Sample Specific Controls**

The laboratory must document procedures for determining the effect of the sample matrix on method performance. These procedures relate to the analyses of matrix specific Quality Control (QC) samples and are designed as data quality indicators for a specific sample using the designated test method. These controls alone are not used to judge laboratory performance. Examples of matrix specific QC include: Matrix Spike (MS); Matrix Spike Duplicate (MSD); Post Spike (PS) and Post Spike Duplicate (PSD) sample duplicates; and surrogate spikes.

### **E1.2.3 Matrix Spike; Matrix Spike Duplicates, Post Spike ; Post Spike Duplicates:**

**Purpose:** Matrix specific QC samples indicate the effect of the sample matrix on the precision and accuracy of the results generated using the selected method. The information from these controls is sample/matrix specific and would not normally be used to determine the validity of the entire batch.

**Frequency:** The frequency of the analysis of matrix specific samples shall be determined as part of a systematic planning process (e. g. Data Quality Objectives) or as specified by the required mandated test method.

**Composition:** The components to be spiked shall be as specified by the mandated test method or other regulatory requirement or as requested by the client. Any permit specified analytes, as specified by regulation or client requested analytes shall also be included.

**Evaluation Criteria and Corrective Action:** The results from matrix spike/matrix spike duplicate and post spike/post spike duplicate are primarily designed to assess the precision and accuracy of analytical results in a given matrix and are expressed as percent recovery (%R) and relative percent difference (RPD).

Results are compared to the acceptance criteria as published in the mandated test method. Where there are no established criteria, the laboratory should determine internal criteria and document the method used to establish the limits. For matrix spike or post spike results outside established criteria, corrective action shall be documented or the data reported with appropriate data qualifying codes.

#### **E1.2.4 Matrix Duplicates:**

**Purpose:** Matrix duplicates are defined as replicate aliquots of the same sample taken through the entire analytical procedure. The results from this analysis indicate the precision of the results for the specific sample using the selected method. The matrix duplicate provides a usable measure of precision only when target analytes are found in the sample chosen for duplication.

**Frequency:** The frequency of the analysis of matrix duplicates may be determined as part of a systematic planning process (e. g. Data Quality Objectives) or as specified by the mandated test method.

**Composition:** Matrix duplicates are performed on replicate aliquots of actual samples. The composition is usually not known.

**Evaluation Criteria and Corrective Action** The results from matrix duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD) or another statistical treatment (e. g., absolute differences). The laboratory shall document the calculation for relative percent difference or other statistical treatments.

Results are compared to the acceptance criteria as published in the mandated test method. Where there are no established criteria, the laboratory shall determine internal criteria and document the method used to establish the limits. For matrix duplicates results outside established criteria corrective action shall be documented or the data reported with appropriate data qualifying codes.

#### **E1.2.5 Surrogate Spikes:**

**Purpose** Surrogates are used most often in organic chromatography test methods and are chosen to reflect the chemistries of the targeted components of the method. Added prior to sample preparation/extraction, they provide a measure of recovery for every sample matrix.

**Frequency** Except where the matrix precludes its use or when not available, or is not a method requirement, surrogate compounds are added to all samples, standards, and blanks for all appropriate test methods.

**Composition:** Surrogate compounds are chosen to represent the various chemistries of the target analytes in the method. They are often specified by the mandated method and are deliberately chosen

for their being unlikely to occur as an environmental contaminant. Often this is accomplished by using deuterated analogs of select compounds.

**Evaluation Criteria and Corrective Action:** The results are compared to the acceptance criteria as published in the mandated test method or determined using statistical process controls (SPC). Where there are no established criteria, the laboratory determines internal criteria and documents the method used to establish the limits.

Surrogates outside the acceptance criteria must be evaluated for the effect indicated for the individual sample results. The appropriate corrective action may be guided by the data quality objectives or other site specific requirements. Results reported from analyses with surrogate recoveries outside the acceptance criteria include appropriate data qualifiers.

### **E1.3 Method Evaluation**

The following procedures, as described in the other sections of the QAP, are in place in order to ensure the accuracy of the reported result:

- Procedure for initial demonstration of analytical capability performed initially (prior to the analysis of any samples) and if there is a significant change in instrument type, personnel, matrix or test method. Refer to Section 8.
- Procedures for initial and continuing calibration protocols as specified in Section 7.
- Procedures for utilizing proficiency test samples to evaluate the ability of a procedure and/or analyst laboratory to produce accurate data as specified in Section 3.

### **E1.4 Method Detection Limits**

Method detection limits (MDLs) are determined as described in CF-LB-E-001 for The Determination of Method Detection Limits. This procedure is based on that established in 40 CFR Part 136, Appendix B. The laboratory processes for determining Practical Quantitation Limit (PQL), Limit of Detection (LOD) and Limit of Quantitation (LOQ) is also discussed in the SOP CF-LB-E-001.

Where possible, MDL studies are conducted for aqueous, solid and tissue matrices using a clean matrix appropriate to the test method (such as laboratory pure reagent water, Ottawa sand, glass beads or corn oil). MDL studies for the majority of routine parameters are conducted by:

- analyzing a minimum of seven replicates of the lowest calibration standard.
- determining the standard deviation of the seven replicates
- multiplying the standard deviation by 3.143 (based on six degrees of freedom and representing a 99% confidence level) to obtain the calculated MDL.

If the MDL study is being conducted for a new method or target analyte, the following steps are taken:

- the MDL is estimated based on information provided in the method or analytical experience
- a standard with a concentration three to five times the estimated MDL is prepared and analyzed a minimum of seven times
- the MDL is calculated as above based on the standard deviation and degrees of freedom
- the MDL is evaluated for reasonableness by verification through analysis of a prepared standard solution one to three times the calculated MDL.

Additionally, when the MDL is required for use with the Kentucky Certification Manual:

- The replicates shall be analyzed over 2 – 3 non consecutive days.

- The spiked concentration shall be less than 10 times the calculated MDL.
- The calculated MDL shall be less than the RRL.

MDL studies are not performed for any target analyte for which spiking solutions are not available.

Practical quantitation limits (PQLs) are determined by either multiplying the MDL by approximately 2 to 10 or are equal to that of the lowest calibration standard. Concentrations of a target analyte determined to be greater than its PQL are defined as quantitative results. All quantitative reported results are preceded by or bracketed by calibration or calibration verification standards.

The LOD is calculated using  $MDL \times 2 = LOD$ . CFA Laboratories performs quarterly verifications of LODs by spiking a quality system matrix at approximately two to three times the detection limit (for a single-analyte standard) or one to four times the detection limit (for a multi-analyte standard). LOD Verifications are performed on all instruments used to report samples requiring LOD reporting.

The LOD is compared to the PQL and if  $LOD < PQL$ , then  $LOQ = PQL$ . If  $LOD > PQL$ , then LOQ is established at the next lowest level of the calibration curve. CFA Laboratories performs quarterly verifications of LOQs by spiking a quality system matrix at approximately one to two times the claimed LOQ.

The laboratory demonstrates precision and bias at the LOQ by calculating Statistical Process Control (SPC) limits using LOQ measurements, as discussed in SOP CF-QS-E-14, Quality Assurance Measurement Calculations and Processes.

All MDL studies conducted by the laboratory are submitted to the Quality Group for an independent review. Upon acceptance of the MDL study, the MDLs reported to clients via our computer system are updated unless otherwise specified by contract. PQLs are also updated as directed by the new MDLs or changes to procedures.

All data pertaining to the study and the calculation of MDLs is maintained as quality records by the Quality Manager.

**Reporting Limit Standard (RLS - Kentucky Certification Manual)** In order to demonstrate the laboratory's capability to report down to the required reporting limit, the laboratory shall analyze a known standard at or below the required reporting limit. The reporting limit standard (RLS) shall be analyzed as a stand-alone verification standard. The verification will be performed quarterly. The acceptance criteria for a successful RLS verification is the measurement of the analyte spiked at or below the minimum reporting limit that passes all qualification criteria. The concentration of this spike is typically one-half level of the MRL and is not taken through the labs entire sample process, this is an instrument performance verification only.

**Minimum Reporting Level (MRL - Kentucky Certification Manual)** CFA will analyze an MDL on each instrument. If this is not possible in all circumstances, CFA shall demonstrate that the Minimum Reporting Level (MRL) is achievable on all instruments that the MDL study is applied by the extraction, cleanup, and analysis of a verification standard at the MRL. The verification will be performed quarterly. The acceptance limits for this verification is that the analyte recovery is within 50-150%.

### **E1.5 Data Reduction**

The procedures for data reduction, such as use of linear regression, are documented in the individual analytical standard operating procedures. CFA's policy governing the manual integration of chromatographic data is detailed in CF-LB-E-017, Procedure and Policy for Manual Integration.

Manual integrations of chromatographic peaks can only be performed in accordance with CF-LB-E-017. This ensures that the integrations are done in a consistent and technically justifiable manner while meeting the requirements set forth under the Good Automated Laboratory Practices.

SOP CF-QS-E-014, Quality Assurance Measurement Calculations and Processes, discusses the use of laboratory data in statistical determinations and includes discussion of Estimation of Total Analytical Uncertainty, Statistical Process Control (SPC) Limits, and Calibration of Instrumentation.

Understanding of the procedures used for data generation and reduction is an important part of an analyst demonstrating proficiency in an analytical procedure. All analysts and technicians responsible for generating curves and using curve-generated data are trained to this SOP per CFA annual and interim training requirements.

### **E1.6 Quality of Standards and Reagents**

The quality of standards used in instrument calibration or quality control samples and reagents used in sample preparation and/or analysis must meet the criteria described in Section 7. In methods where the purity is not specified, analytical grade reagents are used. Reagents of lesser purity than those specified by the test method are never used. Upon receipt and prior to use, the labels on the container are checked to verify that the purity of the reagents meets the documented requirements of the particular test method.

The quality of water sources is monitored and documented as described in Section 4. The quality of water used in sample preparation or analysis meets the method-specified requirements. The type of water available in the laboratory is described in Section 4.

### **E1.7 Selectivity**

Absolute and relative retention times aid in the identification of components in chromatographic analyses and in evaluation of the effectiveness of a column in separating constituents. The procedures governing retention time windows are documented in the applicable analytical SOP and meet all regulatory and method requirements.

In addition to retention time windows, the acceptance criteria for mass spectral tuning are also documented in the appropriate analytical SOP. In all cases, the acceptance criteria meet or exceed those specified in the analytical methods.

Unless stipulated in writing by the client, confirmations may be performed to verify the compound identification of positive results detected on a sample. Such confirmations are performed on a second analytical column for organic tests. All confirmation is documented.

### **E1.8 Constant and Consistent Test Conditions**

CFA's implementation of standard operating procedures that specify quality criteria including initial and continuing calibrations assures that our test instruments consistently operate within the specifications required of the application for which the equipment is used.

In addition to the specifications applied to instrumentation, glassware used for sample preparation or analysis is cleaned in a manner that reduces the potential for positive or negative interferences.

Glassware is prepared in accordance with CF-LB-E-003 for Glassware Preparation.

This SOP details the procedures used to clean the following groups of glassware:

- Reusable bottles and plasticware
- Glassware used for determination of dioxins/furans or PCB congeners
- Glassware used in the determination of other organic compounds

- Generic glassware used in all other analyses

If the method specifies that the glassware be stored in a particular manner, this requirement is documented in the appropriate analytical SOP.

**APPENDIX F: ETHICS AND DATA INTEGRITY AGREEMENT**

**CAPE FEAR ANALYTICAL, LLC**

**ETHICS AND DATA INTEGRITY AGREEMENT**

- I. I, \_\_\_\_\_, state that I understand the high standards of integrity required of me with regard to the duties I perform and the data I report in connection with my employment at Cape Fear Analytical, LLC.
- II. I agree that in the performance of my duties at Cape Fear Analytical, LLC:
- A. I shall not intentionally report data values that are not the actual values obtained;
  - B. I shall not intentionally report data that does not meet method or procedural specifications unless that data is properly qualified through comments or other notations in the analytical report.
  - C. I shall not intentionally report dates and times of data analyses that are not the actual dates and times of data analyses; and,
  - D. I shall not intentionally represent another individual's work as my own.
- III. I agree to inform Cape Fear Analytical, LLC of any accidental or intentional reporting of non-authentic data by myself or by other employees in a timely manner.
- IV. I will not knowingly participate in any questionable activities or violations of the Procurement Integrity Act during purchasing or sales activities. I will report any questionable activities to Cape Fear Analytical management. This includes discussions on analytical services, pricing and contracts, vendor pricing or other essential business information to anyone outside of The GEL Group, Inc. family.

This Ethics and Data Integrity Agreement has been explained to me by the Quality Manager and I have been provided the opportunity to ask questions on any part of this agreement that I did not understand. It has also been explained to me that any violation of this agreement conducted during work performed under a subcontract or direct contract to a government agency could subject me to potential prosecution.

I understand that violation of this policy subjects me to disciplinary action, up to and including termination of my employment with The GEL Group, Inc and/or Cape Fear Analytical, LLC.

Employee Signature \_\_\_\_\_

Date: \_\_\_\_\_

Trainer Signature \_\_\_\_\_

Date: \_\_\_\_\_

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**APPENDIX G: EQUIPMENT LIST**

<b># of Units</b>	<b>Equipment</b>	<b>Model #</b>	<b>Purchase Date</b>	<b>ID/Serial #</b>
5	Waters Autospec Premier High Resolution Mass Spectrometer w/Agilent 7890 Gas Chromatograph w/Leap GC PAL Autosampler	Premier; GC PAL	Jan-09 Jun-09 Oct-10 May-15 Mar-19	P750; 161809 P763; 161815 P791; 162051 P875; 247503 P757; 160368
3	Zymark Turbovap	LV	Jan-09 Jun-10 Aug-12	TV1-TV9940N9139 TV2-TV9434N4218 TV3-04491
1	Horizon Tech Evaporator	Xcelvap	May-16	TV4 / 16-5305
1	Powerware Uninterrupted Power Source (UPS)	9390	Feb-09	FX451DAAD1; EX422CAA05
1	Baxter Tempu-Con drying oven	H6620-5A	Mar-09	1089-0265
1	Fisher drying oven	OV600G	Apr-09	2034090421812
1	Ohaus Balance - 400 g	Scout Pro SP402	Mar-09	7129320329
1	Ohaus Balance - 4000 g	Scout Pro SP4001	Mar-09	7129370194
1	Denver Instrument Analytical Balance	2009 TP-214	Apr-09	23950038
4	Kewaunee Fume Hood	H05	Feb-09	Not Listed
1	Labconco Fume Hood	728040010814	Sep-10	050638785H
3	Chromalox extractions heater/pump/controller	NA	Jan-09	NA
1	Cooling Technology extractions chiller	MPCA-03X	Mar-09	29005-02
1	Cooling Technology HRMS chiller	ICA-12	Apr-09	Not available
78	Heating mantles and controllers	Glas-Col PowerTrol	Feb-09 May-12	Various
1	Air compressor (Backup)	4B233E	Mar-09	L4/7/2008-00469
1	Air compressor (Primary)	35WC82	Nov-15	40151601

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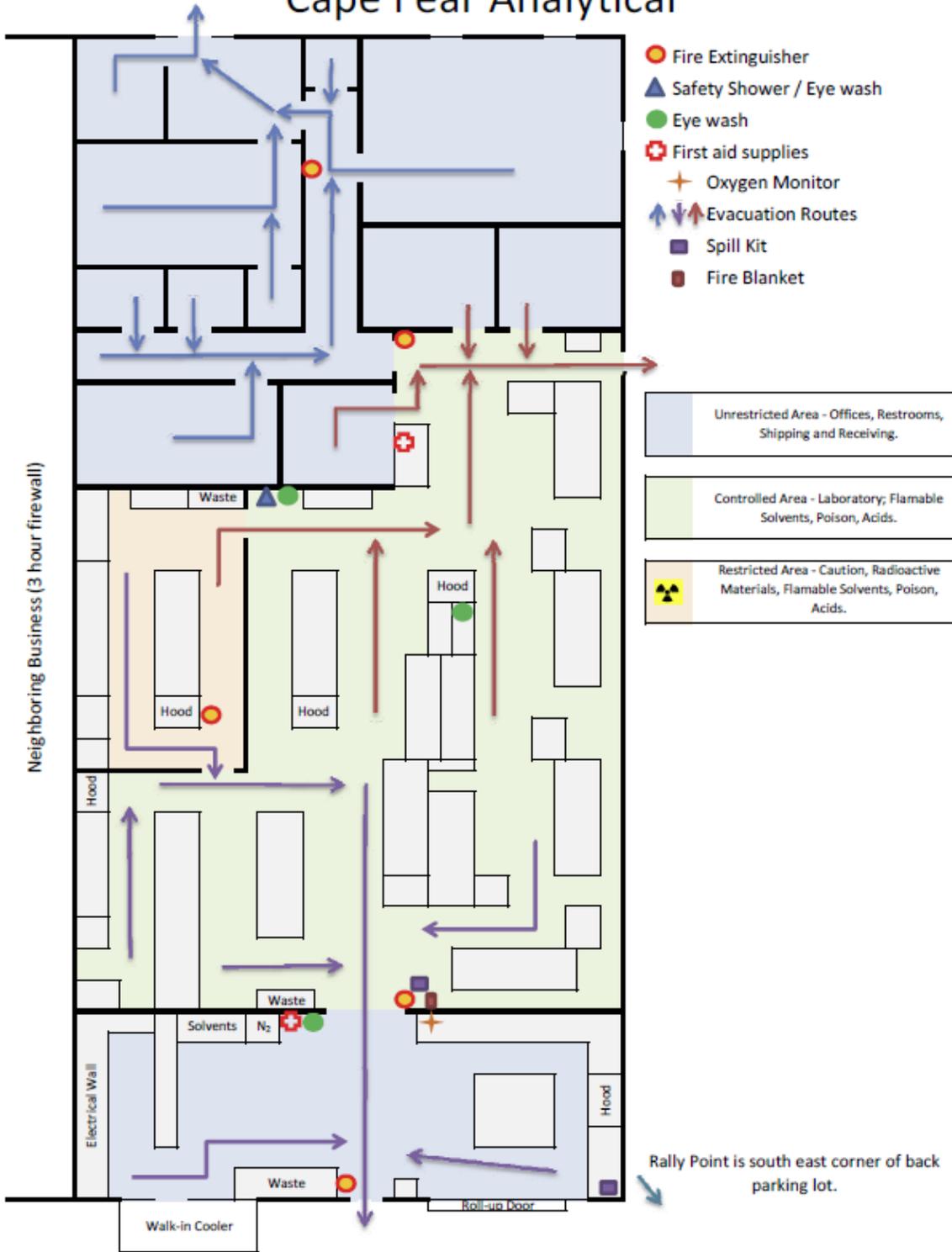
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1	VWR Sonicator	B1500A-DTH	Mar-09	CB0808DUA01271
1	Thermolyne 1400 Furnace	FB1415M	NA	1049990324796
1	Milestone Ethos X Advanced Microwave Extraction System	MA198	Oct-17	1706 3439

APPENDIX H: FACILITIES WITH EVACUATION ROUTES

Cape Fear Analytical



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**APPENDIX I: STANDARD OPERATING PROCEDURES AND ANALYTICAL METHODS**

<b>Standard Operating Procedures and Analytical Methods</b>			
<b>SOP #</b>	<b>Effective Date</b>	<b>SOP Title</b>	<b>Methods</b>
CF-ADM-E-001	21-May-09	Preparation, Authorization, Change, Revision, and Release of SOPs	N/A
CF-CO-E-002	30-Apr-09	Delegated Authority to Commit the Company	N/A
CF-CO-E-003	21-May-09	Contract Review	N/A
CF-CS-E-002	30-Apr-09	Internal Review of Contractually Required Quality Criteria for Client Package Delivery	N/A
CF-CS-E-008	03-Aug-16	Prelogin, Login and Login Review	N/A
CF-CS-M-001	30-Apr-09	Project Management AlphaLIMS Manual	N/A
CF-DC-E-001	30-Apr-09	Document Control	N/A
CF-FC-E-002	21-May-09	Testing Emergency Eyewash and Shower Equipment	N/A
CF-FC-E-003	30-Apr-09	Fume Hood Face Velocity Performance Checks	N/A
CF-FC-E-004	27-Apr-09	Inspection of Fire Extinguishers	N/A
CF-HR-E-002	30-Apr-09	Employee Training	N/A
CF-LB-E-001	21-May-09	The Determination of Method Detection Limits	N/A
CF-LB-E-002	30-Apr-09	Balances	N/A
CF-LB-E-003	30-Apr-09	Glassware Preparation	N/A
CF-LB-E-004	30-Apr-09	Temperature Monitoring and Documentation Requirements for Refrigerators, Ovens, Incubators, and Other Similar Devices	N/A
CF-LB-E-005	21-May-09	Data Review and Validation	N/A
CF-LB-E-007	30-Apr-09	Laboratory Standards Documentation	N/A
CF-LB-E-008	30-Apr-09	Basic Requirements for the Use and Maintenance of Laboratory Notebooks, Logbooks, Forms and Other Recordkeeping Devices	N/A
CF-LB-E-009	30-Apr-09	Run Logs	N/A
CF-LB-E-010	30-Apr-09	Maintenance and Use of Air Displacement Pipets	N/A
CF-LB-E-012	30-Apr-09	Verifying the Maintenance of Sample Integrity	N/A
CF-LB-E-013	03-Mar-17	Data Package Assembly and EDD Generation	N/A
CF-LB-E-015	30-Apr-09	Control of Laboratory Standards	N/A
CF-LB-E-017	30-Apr-09	Procedure and Policy for Manual Integration	N/A
CF-LB-E-028	30-Apr-09	Creation and Maintenance of Case Narratives	N/A
CF-LB-E-031	22-May-09	Subsampling and Compositing of Samples	N/A
CF-LB-E-033	05-Nov-12	Handling of Biological Materials	N/A
CF-LB-E-034	13-Aug-13	Dekaport Splitter	N/A
CF-LB-G-001	22-May-09	Laboratory Waste Management Plan	N/A

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<b>Standard Operating Procedures and Analytical Methods</b>			
<b>SOP #</b>	<b>Effective Date</b>	<b>SOP Title</b>	<b>Methods</b>
CF-LB-N-001	22-May-09	Safety, Health and Chemical Hygiene Plan	N/A
CF-OA-E-001	01-May-09	Dioxin/Furan/PCB Congener Sample Processing	SW846 8290A, EPA 1613B, EPA 1668A, EPA 1668C, EPA TO-9a
CF-OA-E-002	21-May-09	Dioxin/Furan Analysis by HRGC/HRMS	SW846 8290A, EPA 1613B, EPA TO-9a
CF-OA-E-003	21-May-09	PCB Congener Analysis by HRGC/HRMS	EPA 1668A, EPA 1668C
CF-OA-E-007	11Jan119	SC Dioxin Sample Preparation	SW846 8290A, EPA 1613B
CF-OA-E-008	11-Jan-11	SC Dioxin Sample Analysis	SW846 8290A, EPA 1613B
CF-OA-E-010	19-Dec-14	Dioxins-Furans by HRSM	HRSM01.2
CF-OA-E-011	19-Dec-14	PCB Congeners by HRSM	HRSM01.2
CF-OA-E-013	10-Nov-20	Dioxins-Furans by HRSM	HRSM02.0
CF-OA-E-014	10-Nov-20	PCB Congeners by HRSM	HRSM02.0
CF-OA-E-020	21-May-09	Percent Moisture	N/A
CF-OA-E-021	01-Jun-12	Percent Lipid Determination	N/A
CF-OA-E-065	02-Jun-09	Reagent and Solvent Screening	N/A
CF-QS-B-001	06-May-09	Quality Assurance Plan	N/A
CF-QS-B-002	11-Jul-16	QAPP for EPA HRSM Contract	N/A
CF-QS-E-001	22-May-09	Conduct of Quality Audits	N/A
CF-QS-E-002	01-May-09	Conducting Corrective/Preventive Action	N/A
CF-QS-E-003	22-Oct-09	Conflict of Interest Plan	N/A
CF-QS-E-004	22-May-09	Documentation of Nonconformance Reporting and Dispositioning and Control of Nonconforming Items	N/A
CF-QS-E-005	01-May-09	Review of Monitoring Device Logs	N/A
CF-QS-E-007	01-May-09	Thermometer Verification	N/A
CF-QS-E-008	01-May-09	Quality Records Management and Disposition	N/A
CF-QS-E-011	01-May-09	Method Validation and Initial and Continuing Demonstrations of Capability	N/A
CF-QS-E-012	01-May-09	NCR Database Operation	N/A
CF-QS-E-013	01-May-09	Handling of Proficiency Evaluation Samples	N/A
CF-QS-E-014	22-May-09	Quality Assurance Measurement Calculations and Processes	N/A
CF-QS-E-015	01-Dec-09	The Use of Logos and Describing Accreditation Status	N/A
CF-QS-E-017	01-May-09	Maintaining Technical Training Records	N/A
CF-RC-E-001	22-May-09	Receipt and Inspection of Materials	N/A
CF-RC-E-002	22-Aug-17	Material Requisition	N/A
CF-RD-S-000	17-Jun-13	Radiation Safety Plan	N/A
CF-RD-S-001	17-Jun-13	Radiation Surveys	N/A

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<b>Standard Operating Procedures and Analytical Methods</b>			
<b>SOP #</b>	<b>Effective Date</b>	<b>SOP Title</b>	<b>Methods</b>
CF-RD-S-002	17-Jun-13	Radiation Emergencies	N/A
CF-RD-S-003	17-Jun-13	Radiation Inventory Management	N/A
CF-RD-S-004	17-Jun-13	Radioactive Material Handling	N/A
CF-RD-S-007	17-Jun-13	Receiving Radioactive Packages	N/A
CF-RD-S-009	17-Jun-13	Personnel Dosimetry	N/A
CF-RD-S-013	17-Jun-13	Radiation Air Sampling for Radioactivity	N/A
CF-RD-S-014	17-Jun-13	Release of Lab Coats	N/A
CF-RD-S-015	17-Jun-13	Acceptance and Classification of Radioactive Material	N/A
CF-RD-S-016	17-Jun-13	Radiation Work Permits	N/A
CF-SR-E-001	22-May-09	Sample Receipt, Login, and Storage	N/A
CF-SR-E-002	01-May-09	Transportation and Shipping of Samples and Pre-Preserved Sample Containers	N/A
CF-SR-E-003	01-Dec-12	Inspection, Cleaning, and Screening of Sample Packages	N/A
CF-SR-E-004	21-Feb-11	Control of Foreign Soils	N/A

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**APPENDIX J: SAMPLE STORAGE AND PRESERVATION REQUIREMENTS**

<b>Parameter</b>	<b>Container<sup>1</sup></b>	<b>Preservation</b>	<b>Holding Time<sup>2</sup></b>	<b>Min. Volume</b>
<u>Organics</u> PCB Congeners	Amber G, teflon-lined cap	0 ≤ 6° C; <-10°C for tissues; waters: 80 mg thiosulfate <sup>3</sup>	1 year for extraction; 1 year after extraction for analysis (1668, CBC)	1000 mL / 50 g
Dioxin/Furan	Amber G, teflon-lined cap	0 ≤ 6° C; <-10°C for tissues; waters: 80 mg thiosulfate <sup>3</sup>	None (8290) or 1 year (1613, CBC) for extraction; None (8290) or 1 year (1613, CBC) after extraction for analysis	1000 mL / 50 g
Dioxin/Furan on PUF <sup>4</sup>	PUF in Glass	≤ 4° C	30 days from cleaning for sampling container; 7 days from sampling to extraction; 40 days from extraction to analysis.	Varies (approx. 325-400m <sup>3</sup> )

<sup>1</sup> P = Polyethylene; G = Glass

<sup>2</sup> Samples should be analyzed as soon as possible after collection. The holding times listed are maximum times that samples may be held before analysis and be considered valid.

<sup>3</sup> Used only in the presence of residual chlorine.

<sup>4</sup> TO-9A Jan 1999.

**VERIFY THE VALIDITY OF THIS SOP EACH DAY IN USE**

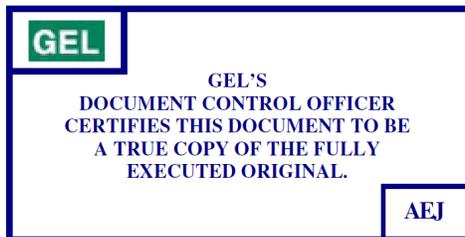
**STANDARD OPERATING PROCEDURE  
FOR  
MODIFIED ELUTRIATE TEST**

**(GL-GC-E-127 REVISION 7)**

APPLICABLE METHOD:  
Modified Elutriate Test

**PROPRIETARY INFORMATION**

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**1.0 STANDARD OPERATING PROCEDURE FOR THE MODIFIED ELUTRIATE TEST****2.0 PURPOSE**

This standard operating procedure describes the manner in which a modified elutriate test is conducted.

**3.0 METHOD DISCUSSION**

3.1 The modified elutriate test should be conducted, and the appropriate chemical analyses should be performed as soon as possible after sample collection. The volume of elutriate sample needed for analysis depends on the number and types of analyses to be conducted (Plumb 1981). Both dissolved and total concentrations of contaminants may be determined from this procedure.

3.2 The volume required for each analysis, the number of parameters measured, and the desired analytical replications influence the total elutriate sample volume required. A glass jar capable of holding at least 8 liters of sample or 55 gallon stainless steel drums are normally used to conduct the testing. The supernatant volume available for sample extraction will vary, depending on the sediment properties, settling times, and the initial concentration of the slurry. It may be necessary to composite several extracted samples to obtain the total required volume.

**4.0 APPLICABLE MATRICES**

4.1 Soils

4.2 Sludges

4.3 Sediments

**5.0 HOLD TIME**

Holding time is 14 days from the time and date of collection until the start of elutriate extraction unless otherwise specified by contract.

**6.0 SAMPLE CONTAINER/PRESERVATION/COLLECTION/STORAGE REQUIREMENTS**

Solid samples are not preserved but must be stored at  $0^{\circ} \leq 6^{\circ} \text{ C}$ .

**7.0 INTERFERENCES**

There are rarely any interferences with this prep. If any are encountered, consult the group leader or quality officer before continuing.

**8.0 DEFINITIONS**

8.1 AlphaLIMS: The Laboratory Information Management System used at GEL.

8.2 Quiescent settling: Undisturbed settling of particles.

**9.0 ANALYST VERIFICATION**

Before a technician/analyst is allowed to analyze samples without supervision, he or she is trained by qualified personnel and is required to successfully analyze a

proficiency sample. Training records are maintained as quality records (Refer to GL-QS-E-008).

#### **10.0 DOCUMENTATION OF DATA**

Sample preparation data are recorded in AlphaLIMS.

#### **11.0 SAFETY, HEALTH, AND ENVIRONMENTAL HAZARDS**

Always wear eye protection with side shields, gloves and laboratory coats while performing this work in the laboratory. For detailed information on chemical safety refer to the Safety, Health, and Chemical Hygiene Plan, GL-LB-N-001.

#### **12.0 SAMPLE RECEIPT FOR ANALYSIS**

12.1 The analyst/technician submits the list of samples needed to the sample custodian group. The sample custodian removes the appropriate sample from the cooler and scans it using the barcode scanner to the appropriate area of the lab. The analyst then takes custody of the samples and scans them to the sample batch. The samples are now ready to be prepared or analyzed.

12.2 Analysts/technicians are responsible for retrieving their own samples when the sample custodian is unavailable.

#### **13.0 APPARATUS**

13.1 Laboratory mixer, preferably with Teflon shaft and blades

13.2 Glass jars of at least 8 L total volume

13.3 Assorted glassware for sample extraction and handling

13.4 Vacuum or pressure filtration equipment, including vacuum pump, peristaltic pump, or compressed air source and appropriate filter holder capable of accommodating 47, 105, or 155 mm filters

13.5 0.45 µm pore-size diameter in-line filters

13.6 Plastic sample bottles, 500 mL capacity for storage of water and liquid phase samples for metal and nutrient analyses

13.7 1 liter capacity glass jars should also be used as sample containers when samples are to be analyzed for semi-volatile constituents

13.8 250 mL centrifuge tubes

13.9 Assorted sizes Tygon tubing

13.10 55 gallon stainless steel open-ended drums

13.11 Laboratory centrifuge capable of handling 250 ml centrifuge tubes

13.12 Laboratory balance or drum scale

#### **14.0 MODIFIED ELUTRIATE TEST PROCEDURE**

14.1 Slurry Preparation: The sediment and dredging site water should be mixed to approximately equal the expected average field inflow concentration. If estimates of the average field inflow concentration cannot be made based

on past data, a slurry concentration of 150 g (dry weight basis) / 1 L of dredge water should be used.

14.1.1 Refer to GL-LB-E-029 for specific directions on sub-sampling. To determine the percent solids of the sediment, obtain a well-mixed aliquot of the sediment (about 100 g) and place in an appropriate sized tin. Dry the sample for approximately 12 hours at 104° C (± 2° C) or until the sample is completely dry. Allow the sample to cool in a desiccator for at least one hour. Record the weight and place the sample in the drying oven for another 30 minutes. Cool the sample again for one hour in a desiccator and take a second weight. If the final weights are within 0.5 g of each other, calculate the % solids using the following equation:

$$\% \text{ solids} = 100 \times \frac{\text{Final Weight}}{\text{Initial Weight}}$$

If the final weights are not within 0.5 g of each other, repeat the drying and cooling process until they are consistent.

14.1.2 Once the % solids value is obtained, use the following equation to determine the amount of well-mixed sample to use for the elutriate test:

$$\text{Total Sample Amount (g)} = \frac{150\text{g}}{(\% \text{ solids}/100)}$$

14.1.3 Weigh out the total sample amount required in a glass jar and add the appropriate amount of dredge water to the sample. The sample is now ready for mixing.

14.2 Mix the slurry for 5 minutes using a laboratory mixer. The slurry should be mixed to a uniform consistency with no unmixed agglomerations of sediment.

14.3 Remove the laboratory mixer and allow the slurry to undergo quiescent settling for 24 hours. The settling time can be altered if requested by a client.

- 14.4 After the settling period, an interface will usually be evident between the supernatant water with low concentration of suspended solids and the more concentrated settled material. Aliquots of the supernatant water should be extracted from the glass jar at a point midway between the water surface and the interface using siphoning techniques. Care should be taken not to re-suspend the settled material.
- 14.5 Aliquoting for analyses should be performed according to the methods for each analysis required. Volume, preservation, and holding time requirements should be followed for each analysis according to their relevant methods and SOPs.
- 14.6 If dissolved fractions are required, filtration or centrifugation will need to be performed on those elutriate samples.
- 14.6.1 Samples to be analyzed for dissolved pesticides and/or PCBs must be free of particles but should not be filtered due to the tendency for these materials to absorb to the filter. Particulate matter can be removed before analysis by high-speed centrifugation.
- 14.6.2 Samples to be analyzed for all other dissolved analyses should be filtered through a 0.45  $\mu\text{m}$  pore-size diameter filter using a filtration assembly. The filtration assembly should be thoroughly rinsed with DI water in between samples.
- 14.7 Subsamples for analyses of total and dissolved fractions should undergo appropriate digestion and/or prep procedures prior to analysis. All digestion and chemical analyses should be performed using accepted procedures.

## 15.0 PREPARATION OF STANDARDS

Documentation of standards and their preparation is maintained in AlphaLIMS in accordance with GL-LB-E-007 for Laboratory Standards Documentation.

## 16.0 INSTRUMENT/EQUIPMENT START-UP PROCEDURE

There are no start up procedures for this prep.

## 17.0 QUALITY CONTROL (QC) REQUIREMENTS

- 17.1 There are no QC requirements for this extraction. QC should be applied to samples as per the prep method being performed after the extraction is complete.
- 17.2 Handling Out-Of-Control Situations:  
If sample does not exhibit settling after 24 hours, contact team leader or group leader.

## 18.0 RUN SEQUENCE

Not applicable

**19.0 INSTRUMENT/EQUIPMENT SHUT-DOWN PROCEDURE**

Not applicable

**20.0 METHOD VARIATION**

Not applicable

**21.0 DATA REVIEW, VALIDATION, AND APPROVAL PROCEDURE**

21.1 Upon completion of batch preparation, digestion data shall be entered into the AlphaLIMS Prep Logbook (refer to Appendix 1) following the guidelines in GL-LB-E-008 for Basic Requirements for the Use and Maintenance of Laboratory Notebooks, Logbooks, Forms, and Other Recordkeeping Devices.

21.2 Data to be entered into the electronic logbook include analyst name, prep data and time, initial weight with units, and final volume with units.

**22.0 RECORDS MANAGEMENT**

Records pertaining to the activity described in this procedure are maintained as quality documents in accordance with GL-QS-E-008 for Quality Records Management and Disposition.

**23.0 LABORATORY WASTE**

For the proper disposal of sample and reagent wastes from this procedure, refer to the Laboratory Waste Management Plan, GL-LB-G-001.

**24.0 REFERENCES**

24.1 "Environmental Effects of Dredging (Technical Notes)," US Army Engineer Waterways Experiment Station, June 1985.

24.2 American Public Health Association, 1985, EPA 1980a, and EPA 1979.

**25.0 HISTORY**

Revision 4: Corrected settling time to reflect proper unit of time.

Revision 5: Added containers to equipment list.

Revision 6: Reformatted SOP to conform to technical procedure format.

Revision 7: Added balance or scale to Apparatus list

## **APPENDIX A.4**

### **Northwest Testing, Inc. Laboratory Information**

The Northwest Testing SOPs listed in Worksheet #23 and the laboratory QA Manual are confidential business information and have not been included in this appendix. The documents are available on request from the Northwest Testing point of contact listed in Worksheet #3/5. The cover and signature pages for Northwest Testing's laboratory QA Manual are included in this appendix for reference. Northwest Testing's SOPs are included in the QA Manual and are not independent documents; therefore, do not have covers or signature pages.



## Accredited Laboratory

A2LA has accredited

### **NORTHWEST GEOTECH, INC. D/B/A NORTHWEST TESTING, INC.**

*Wilsonville, OR*

for technical competence in the field of

## Construction Materials Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).



Presented this 10<sup>th</sup> day of March 2021.

A blue ink signature of the Vice President of Accreditation Services.

Vice President, Accreditation Services  
For the Accreditation Council  
Certificate Number 3087.01  
Valid to December 31, 2022

*For the tests to which this accreditation applies, please refer to the laboratory's Construction Materials Testing Scope of Accreditation.*



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

NORTHWEST GEOTECH, INC.  
d/b/a NORTHWEST TESTING, INC.  
9120 SW Pioneer Court, Suite B  
Wilsonville, OR 97070  
Thomas Ginsbach, P.E. Phone: 503 682 1880

Valid To: December 31, 2022

Certificate Number: 3087.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory for:

CONSTRUCTION MATERIALS ENGINEERING

ASTM: C1077 (Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation);  
C1093 (Standard Practice for Accreditation of Testing Agencies for Masonry);  
D3666 (Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials);  
D3740 (Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction);  
E329 (Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection)

CONSTRUCTION MATERIALS TESTING

<u>Test Method:</u>	<u>Test Description:</u>
<b>Aggregates:</b>	
ASTM C29	Bulk Density (“Unit Weight”) and Voids in Aggregate
ASTM C88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C117	Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C123	Lightweight Particles in Aggregate
ASTM C127	Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C128	Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C131	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Sieve Analysis of Fine and Coarse Aggregates
ASTM C142	Clay Lumps and Friable Particles in Aggregates
ASTM C535	Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C566	Total Evaporable Moisture Content of Aggregate by Drying
ASTM C702	Reducing Samples of Aggregate to Testing Size

<b><u>Test Method:</u></b>	<b><u>Test Description:</u></b>
ASTM D75 <sup>1</sup>	Sampling Aggregates
ASTM D4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D5821	Determining the Percentage of Fractured Particles in Coarse Aggregate
AASHTO T2	Sampling of Aggregates
AASHTO T11	Test for Materials Finer Than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing
AASHTO T19	Bulk Density ("Unit Weight") and Voids in Aggregate
AASHTO T27	Sieve Analysis of Fine and Coarse Aggregates
AASHTO T84	Specific Gravity and Absorption of Fine Aggregate
AASHTO T85	Specific Gravity and Absorption of Coarse Aggregate
AASHTO T96	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
AASHTO T104	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
AASHTO T112	Clay Lumps and Friable Particles in Aggregate
AASHTO T113	Lightweight Pieces of Aggregate
AASHTO T248	Reducing Samples of Aggregate to Testing Size
AASHTO T255	Total Evaporable Moisture Content of Aggregate by Drying
<b><u>Bituminous:</u></b>	
ASTM D75	Sampling Aggregates
ASTM D979 <sup>1</sup>	Sampling Bituminous Paving Mixtures
ASTM D1188	Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
ASTM D2041	Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D2726	Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
ASTM D2950 <sup>1</sup>	Density of Bituminous Concrete in Place by Nuclear Methods
ASTM D3203	Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
ASTM D3549	Thickness or Height of Compacted Bituminous Paving Mixture Specimens
ASTM D5444	Mechanical Size Analysis of Extracted Aggregate
ASTM D6307	Asphalt Content of Hot-Mix Asphalt by Ignition Method
ASTM D6925	Preparation and Determination of the Relative Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyrotory Compactor
ASTM D6926	Preparation of Bituminous Specimens Using Marshall Apparatus
ASTM D6927	Marshall Stability and Flow of Bituminous Mixtures
AASHTO T30	Mechanical Analysis of Extracted Aggregate
AASHTO T166	Bulk Specific Gravity of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface-Dry Specimens
AASHTO T168	Sampling Bituminous Paving Mixtures
AASHTO T209	Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt (HMA)
AASHTO T269	Percent Air Voids in Compacted Dense and Open Asphalt Mixtures

<b><u>Test Method:</u></b>	<b><u>Test Description:</u></b>
AASHTO T312	Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyrotory Compactor
<b><u>Concrete:</u></b>	
ASTM C31/C31M <sup>1</sup>	Making and Curing Concrete Test Specimens in the Field
ASTM C39/C39M	Compressive Strength of Cylindrical Concrete Specimens
ASTM C42/C42M	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C78/C78M	Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C138/C138M <sup>1</sup>	Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C143/C143M <sup>1</sup>	Slump of Hydraulic-Cement Concrete
ASTM C172/C172M <sup>1</sup>	Sampling Freshly Mixed Concrete
ASTM C173 <sup>1</sup>	Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C192/C192M	Making and Curing Concrete Test Specimens in the Laboratory
ASTM C231/C231M <sup>1</sup>	Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C496/C496M	Splitting Tensile Strength of Cylindrical Concrete Specimens
ASTM C617	Standard Practice for Capping Cylindrical Concrete Specimens
ASTM C642	Density, Absorption, and Voids in Hardened Concrete
ASTM C805/C805M <sup>1</sup>	Rebound Number of Hardened Concrete
ASTM C1064/C1064M <sup>1</sup>	Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C1140	Preparing and Testing Specimens from Shotcrete Test Panels
ASTM C1231/C1231M	Unbonded Caps in Determination of Compressive Strength of Hardened Concrete Cylinders
AASHTO T22	Compressive Strength of Cylindrical Concrete Specimens,
AASHTO T23	Making and Curing Concrete Test Specimens in the Field
AASHTO T24	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
AASHTO T97	Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
AASHTO T119	Slump of Hydraulic Cement Concrete,
AASHTO T121	Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
AASHTO T141	Sampling Freshly Mixed Concrete
AASHTO T152	Air Content of Freshly Mixed Concrete by the Pressure Method
AASHTO T196	Air Content of Freshly Mixed Concrete by the Volumetric Method
AASHTO T198	Splitting Tensile Strength of Cylindrical Concrete Specimens
AASHTO T231	Capping Cylindrical Concrete Specimens
AASHTO T309	Temperature of Freshly Mixed Hydraulic Cement Concrete
<b><u>Fireproofing:</u></b>	
ASTM E605 (excluding section 8.3)	Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members
ASTM E736 <sup>1</sup> (field only) (excluding section 7.1)	Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members
AWCI Technical Manual 12-A	Field Applied Sprayed Fire-Resistive Materials
ASTM E2174	On-site Inspection of Installed Firestops
ASTM E2393	On-site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers

<b><u>Test Method:</u></b>	<b><u>Test Description:</u></b>
<b><u>Masonry:</u></b>	
ASTM C140	Sampling and Testing Concrete Masonry Units and Related Units
ASTM C1019 <sup>1</sup>	Sampling and Testing Grout
ASTM C1314	Compressive Strength of Masonry Prisms
ASTM C1552	Capping Concrete Masonry Units, Related Units and Masonry Prisms for Compression Testing
C780 Annex A.6	Standard test method for Preconstruction and Construction Evaluation of Mortar for Plain and Reinforced Unit Masonry
<b><u>Soils:</u></b>	
ASTM D422-2007	Particle-Size Analysis of Soils
ASTM D698	Laboratory Compaction Characteristics of Soil Using Standard Effort
ASTM D854	Specific Gravity of Soil Solids by Water Pycnometer
ASTM D1140	Determining the Amount of Material Finer than 75- $\mu$ m (No. 200) Sieve in Soils by Washing
ASTM D1557	Laboratory Compaction Characteristics of Soil Using Modified Effort
ASTM D1883	CBR (California Bearing Ratio) of Laboratory-Compacted Soils
ASTM D2166	Unconfined Compressive Strength of Cohesive Soil
ASTM D2216	Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D2419	Sand Equivalent Value of Soils and Fine Aggregate
ASTM D2435	One-Dimensional Consolidation Properties of Soils Using Incremental Loading
ASTM D2487	Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2488 <sup>1</sup>	Description and Identification of Soils (Visual-Manual Procedure)
ASTM D2850	Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils
ASTM D2937 <sup>1</sup>	Density of Soil in Place by the Drive-Cylinder Method
ASTM D3080	Direct Shear Test of Soils Under Consolidated Drained Conditions
ASTM D3282	Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
ASTM D4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4718	Unit Weight and Water Content for Soils Containing Oversize Particles
ASTM D4767	Consolidated Undrained Triaxial Compression Test for Cohesive Soils
ASTM D4829	Expansion Index of Soils
ASTM D5084	Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
ASTM D6913	Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
ASTM D6938 <sup>1</sup>	In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
AASHTO T099	Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
AASHTO T100	Specific Gravity of Soils
AASHTO T180	Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
AASHTO T208	Unconfined Compressive Strength of Cohesive Soil
AASHTO T216	One-Dimensional Consolidation Properties of Soils
AASHTO T236	Direct Shear Test of Soils under Consolidated Drained Conditions
AASHTO T297	Consolidated, Undrained Triaxial Compression Test on Cohesive Soils

<b><u>Test Method:</u></b>	<b><u>Test Description:</u></b>
<b><u>Steel (Shop &amp; Field)<sup>1</sup>:</u></b>	
AWS D1.1 Structural Welding Code (Clause 6, Inspection)	Structural Welding Code- Steel
AWS D1.3 Structural Welding Code (Clause 6, Inspection)	Structural Welding Code - Sheet Steel
AWS D1.4 Structural Welding Code (Clause 6, Inspection)	Structural Welding Code - Reinforcing Steel
AWS D1.5 Bridge Welding Code (Clause 6, Inspection)	Bridge Welding Code
AWS D1.8 Structural Welding Code (Clause 7, Inspection)	Seismic Supplement
AISC 360 (Chapter N, QA/QC Fabrication & Erection)	Specification for Structural Steel Buildings
RCSC (Section 9, Inspection)	Specification for Structural Joints Using High-Strength Bolts
<b><u>Nondestructive:</u></b>	
ASTM E709 <sup>1</sup> (Yoke - Dry)	Magnetic Particle Testing
AWS D1.1 (Clause 6 Part C)	Magnetic Particle Testing
AWS D1.8 (Annex G)	Magnetic Particle Testing
ASTM E797, E164, E587 (Contact Straight Beam, Contact Angled Beam)	Ultrasonic Testing
AWS D1.1 (Clause 6 Part C)	Ultrasonic Testing
AWS D1.8 (Annex G)	Ultrasonic Testing
<b><u>Rock:</u></b>	
ASTM D4543 Methods S1, FP2, P2	Preparing Rock Core as Cylindrical Test Specimens and Verifying Conformance to Dimensional and Shape Tolerances
ASTM D7012 (Method C only)	Unconfined Compressive Strength of Intact Rock Core Specimens

<sup>1</sup> This laboratory performs field testing activities for these tests.

<sup>2</sup> This laboratory's scope contains withdrawn or superseded methods. As a clarifier, this indicates that the applicable method itself has been withdrawn or is now considered "historical" and not that the laboratory's accreditation for the method has been withdrawn.

*The laboratory is only accredited for the test methods listed above. The accredited test methods are used in determining compliance with the specifications listed below or, in some cases, the specification is used to show that the required environment for testing has been established. The inclusion of these specifications on this Scope does not confer laboratory accreditation to the specifications nor does it confer accreditation for any method(s) embedded within the specifications.*

<b><u>Specification</u></b>	<b><u>Description</u></b>
ASTM C511	Specification for Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes
ACI 301	Specifications for Structural Concrete of Buildings
ACI 318	Building Code Requirements for Structural Concrete
ACI 530	Building Code Requirements & Specifications for Masonry Structures

## Policy Statements

NGI/NTI's quality system's policies and objectives are defined in this quality manual. The quality policy statement issued under the authority of the Quality Manager includes the following:

- a) The agency shall have managerial and technical personnel who, irrespective of other responsibilities, have the authority and resources needed to carry out their duties, and to identify the occurrence of departures from the quality system or from the procedures for performing tests and/or calibrations, and to initiate actions to prevent or minimize such departures. See Section 4.2.4 for personnel descriptions.
- b) The agency shall have arrangements to ensure that its management and personnel are free from any undue internal and external commercial, financial and other pressures and influences that may adversely affect the quality of their work; these arrangements include ongoing review of staff performance, prohibiting outside employment, or internal or external financial interests in related activities.

All personnel shall understand the policies contained in the QSM and through reviewing and signing the "Quality System Manual Review Documentation" at the front of the QSM, acknowledge they understand and will comply with the statements of confidentiality business ethics, conflicts of interest, and prohibiting of outside employment that adversely affect the quality of their work.

- c) The agency will ensure the protection of its client's confidential information and proprietary rights by maintaining controlled access for client files including electronic files. Procedures will include protecting electronic storage using passwords and other protocol to limit access. The transmission of test results and inspection reports will be controlled by selected administrative staff with oversight by management. Facsimile and electronic transmissions will include a transmittal confidentiality note in the event that information is miss-sent.
- d) The agency will have policies and procedures to avoid involvement in any activities that would diminish confidence in its competence, impartiality, judgment, or operational integrity. The Quality Manager will ensure that only projects within the agency areas of expertise are contracted and that any apparent conflicts of interest are a completely avoided.
- e) Any actual potential or perceived conflict of interest shall be immediately disclosed, confidentially, to NGI's quality manager for resolution. The quality manager shall determine whether any conflict of interest exists and determine an appropriate resolution. Resolutions shall be documented by the Quality Manager.
- f) The agency shall specify the responsibility, authority and interrelationships of all personnel who manage, perform, or verify work affecting the quality of the inspections and tests. See Section 4.2 for descriptions.
- g) The agency shall provide adequate supervision of inspection and testing, including trainees, by persons familiar with methods and procedures, purpose of each inspection and test, and with the assessment of the test results. See Section 4.2.2 for descriptions.
- h) The agency shall have technical management which has overall responsibility for the technical operations and the provisions of the resources needed to ensure the required quality of agency operations. The quality of agency operations is ensured by the Quality Manager, Technical Director, Field Supervisor, and Laboratory Supervisor. See Section 4.2.4 for appointees.

- i) The agency shall appoint members of the agency staff as quality managers who, irrespective of other duties and responsibilities, shall have defined responsibility and authority for ensuring that the quality system is implemented and followed at all times; the Quality Manager shall have direct access to the highest level of management at which decisions are made on agency policy or resources. See Section 4.2.4 for Quality Manager description.
- j) The agency shall appoint deputies for key managerial personnel. See Section 4.2.4 for appointees.
- k) The agency shall ensure that its personnel are aware of the relevance and importance of their activities and how they contribute to the achievement of the objectives of the management system.
- l) The agency management shall ensure that appropriate communication processes are established within the laboratory and that communication takes place regarding the effectiveness of the management system. Note: Examples of forms of communication can include emails, memos, text, or verbal.
- m) The agency management is committed to good professional practice and to the quality of its testing in servicing its clients. The standard of service will be the highest possible within reasonable economic, technical, and time constraints. The objectives of the quality system are to implement and maintain the agency standard of service.
- n) All personnel concerned with field and agency testing activities are required to familiarize themselves with quality documentation and implement the policies and procedures in their work.
- o) The agency is committed to compliance with ASTM E329 and International Standards ISO/IEC 17020 and 17025 and to continually improve the effectiveness of the management system. Inspections and tests shall always be carried out in accordance with stated methods and clients' requirements.
- p) The agency management shall provide evidence of commitment to the development and implementation of the management system and to continually improving its effectiveness.
- q) The agency management shall communicate to the organization the importance of meeting customer requirements as well as statutory and regulatory requirements.
- r) The agency shall ensure that the integrity of the management system is maintained when changes to the management system are planned and implemented.
- s) The agency shall seek feedback, both positive and negative, from its customers. The feedback shall be used and analyzed to improve the management system, testing and calibration activities and customer service. *Note: Examples of the type of feedback include customer satisfaction surveys and a review of test or calibration reports with customers.*
- t) The agency shall continually improve the effectiveness of its management system through the use of the quality policy, quality objectives, audit results, analysis of data, corrective and preventive actions and management review.

The quality policies contained in this section are issued under the authority of the following personnel:



Thomas S. Ginsbach, P.E. President

Date: 10/15/20



Michael A. Ginsbach, Quality Manager, Field Supervisor,  
Laboratory Supervisor (Interim)

Date: 10/15/20



Desmond Weber, Laboratory Supervisor (Incoming)

Date: 10/15/20



Geoff Gagner, Deputy Quality Manager, Senior Technician

Date: 10/15/20

# FIELD AND LABORATORY QUALITY SYSTEM MANUAL<sup>©</sup>



**Northwest Geotech, Inc.**

**Northwest Testing, Inc.**



We support and encourage NICET certification



**US Army Corps  
of Engineers**

## **APPENDIX A.5**

### **SGS North America, Inc. Laboratory Information**

The SGS North America, Inc. SOPs listed in Worksheet #23 and the laboratory QA Manual contain proprietary and/or confidential business information and have not been included in this appendix. These documents are available on request from the SGS North America, Inc. point of contact listed in Worksheet #3/5. The SOP and QA Manual covers are included in this appendix for reference.



State of Florida  
Department of Health, Bureau of Public Health Laboratories  
This is to certify that



E87634

SGS ENVIRONMENT, HEALTH & SAFETY  
5500 BUSINESS DRIVE  
WILMINGTON, NC 28405

has complied with Florida Administrative Code 64E-1,  
for the examination of environmental samples in the following categories

DRINKING WATER - GROUP III UNREGULATED CONTAMINANTS, NON-POTABLE WATER - EXTRACTABLE ORGANICS, NON-POTABLE WATER - PESTICIDES-HERBICIDES-PCB'S, SOLID AND CHEMICAL MATERIALS - EXTRACTABLE ORGANICS, SOLID AND CHEMICAL MATERIALS - PESTICIDES-HERBICIDES-PCB'S, BIOLOGICAL TISSUE - EXTRACTABLE ORGANICS, BIOLOGICAL TISSUE - PESTICIDES-HERBICIDES-PCB'S, AIR AND EMISSIONS - EXTRACTABLE ORGANICS

Continued certification is contingent upon successful on-going compliance with the NELAC Standards and FAC Rule 64E-1 regulations. Specific methods and analytes certified are cited on the Laboratory Scope of Accreditation for this laboratory and are on file at the Bureau of Public Health Laboratories, P. O. Box 210, Jacksonville, Florida 32231. Clients and customers are urged to verify with this agency the laboratory's certification status in Florida for particular methods and analytes.

Date Issued: July 01, 2021      Expiration Date: June 30, 2022



A blue ink signature of Patty A. Lewandowski.

Patty A. Lewandowski, MBA, MT(ASCP)  
Chief Bureau of Public Health Laboratories  
DH Form 1697, 7/04

NON-TRANSFERABLE E87634-47-07/01/2021  
Supersedes all previously issued certificates



**Laboratory Scope of Accreditation**

**Attachment to Certificate #: E87634-47, expiration date June 30, 2022. This listing of accredited analytes should be used only when associated with a valid certificate.**

State Laboratory ID: **E87634**

EPA Lab Code: **NC00919**

**(910) 350-1903**

**E87634**  
**SGS Environment, Health & Safety**  
**5500 Business Drive**  
**Wilmington, NC 28405**

Matrix: **Drinking Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic Acid (11-CIPF3OUdS)	EPA 533	Group III Unregulated Contaminants	NELAP	12/1/2020
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic Acid (11-CIPF3OUdS)	EPA 537.1	Group III Unregulated Contaminants	NELAP	5/26/2020
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2 Fluorotelomersulfonate, 8:2 FTS)	EPA 533	Group III Unregulated Contaminants	NELAP	12/1/2020
1H,1H,2H,2H-Perfluorohexanesulfonic acid (4:2 Fluorotelomersulfonate, 4:2 FTS)	EPA 533	Group III Unregulated Contaminants	NELAP	12/1/2020
1H,1H,2H,2H-Perfluoro-octanesulfonic Acid (6:2 Fluorotelomersulfonate, 6:2 FTS)	EPA 533	Group III Unregulated Contaminants	NELAP	12/1/2020
2-(N-Ethyl-perfluorooctane sulfonamido) acetic acid	EPA 537	Group III Unregulated Contaminants	NELAP	4/25/2017
2-(N-Ethyl-perfluorooctane sulfonamido) acetic acid	EPA 537.1	Group III Unregulated Contaminants	NELAP	5/26/2020
2-(N-Methyl-perfluorooctane sulfonamido) acetic acid	EPA 537	Group III Unregulated Contaminants	NELAP	4/25/2017
2-(N-Methyl-perfluorooctane sulfonamido) acetic acid	EPA 537.1	Group III Unregulated Contaminants	NELAP	5/26/2020
4,8-Dioxa-3H-perfluorononanoic Acid (ADONA)	EPA 533	Group III Unregulated Contaminants	NELAP	12/1/2020
4,8-Dioxa-3H-perfluorononanoic Acid (ADONA)	EPA 537.1	Group III Unregulated Contaminants	NELAP	5/26/2020
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic Acid (9-CIPF3ONS)	EPA 533	Group III Unregulated Contaminants	NELAP	12/1/2020
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic Acid (9-CIPF3ONS)	EPA 537.1	Group III Unregulated Contaminants	NELAP	5/26/2020
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA, GenX)	EPA 533	Group III Unregulated Contaminants	NELAP	12/1/2020
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA, GenX)	EPA 537.1	Group III Unregulated Contaminants	NELAP	5/26/2020
Nonafluoro-3,6-dioxaheptanoic Acid (NFDHA)	EPA 533	Group III Unregulated Contaminants	NELAP	12/1/2020
Perfluoro(2-ethoxyethane) Sulfonic Acid (PFEEESA)	EPA 533	Group III Unregulated Contaminants	NELAP	12/1/2020
Perfluoro-3-methoxypropanoic Acid (PFMPA)	EPA 533	Group III Unregulated Contaminants	NELAP	12/1/2020
Perfluoro-4-methoxybutanoic Acid (PFMBA)	EPA 533	Group III Unregulated Contaminants	NELAP	12/1/2020
Perfluorobutane Sulfonate (PFBS, Perfluorobutane Sulfonic Acid)	EPA 533	Group III Unregulated Contaminants	NELAP	12/1/2020
Perfluorobutane Sulfonate (PFBS, Perfluorobutane Sulfonic Acid)	EPA 537	Group III Unregulated Contaminants	NELAP	4/25/2017
Perfluorobutane Sulfonate (PFBS, Perfluorobutane Sulfonic Acid)	EPA 537.1	Group III Unregulated Contaminants	NELAP	5/26/2020
Perfluorobutanoate (PFBA, Perfluorobutanoic Acid)	EPA 533	Group III Unregulated Contaminants	NELAP	12/1/2020
Perfluorodecanoate (PFDA, Perfluorodecanoic Acid)	EPA 533	Group III Unregulated Contaminants	NELAP	12/1/2020
Perfluorodecanoate (PFDA, Perfluorodecanoic Acid)	EPA 537	Group III Unregulated Contaminants	NELAP	4/25/2017
Perfluorodecanoate (PFDA, Perfluorodecanoic Acid)	EPA 537.1	Group III Unregulated Contaminants	NELAP	5/26/2020

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**Issue Date: 7/1/2021**

**Expiration Date: 6/30/2022**



**Laboratory Scope of Accreditation**

**Attachment to Certificate #: E87634-47, expiration date June 30, 2022. This listing of accredited analytes should be used only when associated with a valid certificate.**

State Laboratory ID: **E87634**

EPA Lab Code: **NC00919**

**(910) 350-1903**

**E87634**  
**SGS Environment, Health & Safety**  
**5500 Business Drive**  
**Wilmington, NC 28405**

Matrix: **Drinking Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Perfluorododecanoate (PFDoA, Pefluorododecanoic Acid)	EPA 533	Group III Unregulated Contaminants	NELAP	12/1/2020
Perfluorododecanoate (PFDoA, Pefluorododecanoic Acid)	EPA 537	Group III Unregulated Contaminants	NELAP	4/25/2017
Perfluorododecanoate (PFDoA, Pefluorododecanoic Acid)	EPA 537.1	Group III Unregulated Contaminants	NELAP	5/26/2020
Perfluoroheptane Sulfonate (PFHpS, Perfluoroheptane Sulfonic Acid)	EPA 533	Group III Unregulated Contaminants	NELAP	12/1/2020
Perfluoroheptanoate (PFHpA, Perfluoroheptanoic Acid)	EPA 533	Group III Unregulated Contaminants	NELAP	12/1/2020
Perfluoroheptanoate (PFHpA, Perfluoroheptanoic Acid)	EPA 537	Group III Unregulated Contaminants	NELAP	4/25/2017
Perfluoroheptanoate (PFHpA, Perfluoroheptanoic Acid)	EPA 537.1	Group III Unregulated Contaminants	NELAP	5/26/2020
Perfluorohexane Sulfonic Acid (PFHxS, Perfluorohexane Sulfonate)	EPA 533	Group III Unregulated Contaminants	NELAP	12/1/2020
Perfluorohexane Sulfonic Acid (PFHxS, Perfluorohexane Sulfonate)	EPA 537	Group III Unregulated Contaminants	NELAP	4/25/2017
Perfluorohexane Sulfonic Acid (PFHxS, Perfluorohexane Sulfonate)	EPA 537.1	Group III Unregulated Contaminants	NELAP	5/26/2020
Perfluorohexanoate (PFHxA, Perfluorohexanoic Acid)	EPA 533	Group III Unregulated Contaminants	NELAP	12/1/2020
Perfluorohexanoate (PFHxA, Perfluorohexanoic Acid)	EPA 537	Group III Unregulated Contaminants	NELAP	4/25/2017
Perfluorohexanoate (PFHxA, Perfluorohexanoic Acid)	EPA 537.1	Group III Unregulated Contaminants	NELAP	5/26/2020
Perfluorononanoate (PFNA, Perfluorononanoic Acid)	EPA 533	Group III Unregulated Contaminants	NELAP	12/1/2020
Perfluorononanoate (PFNA, Perfluorononanoic Acid)	EPA 537	Group III Unregulated Contaminants	NELAP	4/25/2017
Perfluorononanoate (PFNA, Perfluorononanoic Acid)	EPA 537.1	Group III Unregulated Contaminants	NELAP	5/26/2020
Perfluorooctane sulfonate (PFOS, Perfluoro-octane Sulfonic Acid)	EPA 537	Group III Unregulated Contaminants	NELAP	4/25/2017
Perfluorooctane Sulfonic Acid (PFOS, Perfluoro-octane Sulfonate)	EPA 533	Group III Unregulated Contaminants	NELAP	12/1/2020
Perfluorooctane Sulfonic Acid (PFOS, Perfluoro-octane Sulfonate)	EPA 537.1	Group III Unregulated Contaminants	NELAP	5/26/2020
Perfluoro-octanoate (PFOA, Perfluoro-octanoic Acid)	EPA 533	Group III Unregulated Contaminants	NELAP	12/1/2020
Perfluoro-octanoate (PFOA, Perfluoro-octanoic Acid)	EPA 537	Group III Unregulated Contaminants	NELAP	4/25/2017
Perfluoro-octanoate (PFOA, Perfluoro-octanoic Acid)	EPA 537.1	Group III Unregulated Contaminants	NELAP	5/26/2020
Perfluoropentane Sulfonic Acid (PFPeS, Perfluoropentane Sulfonate)	EPA 533	Group III Unregulated Contaminants	NELAP	12/1/2020
Perfluoropentanoate (PFPeA, Perfluoropentanoic Acid)	EPA 533	Group III Unregulated Contaminants	NELAP	12/1/2020
Perfluorotetradecanoate (PFTeDA, perfluorotetradecanoic acid)	EPA 537	Group III Unregulated Contaminants	NELAP	4/25/2017

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**Issue Date: 7/1/2021**

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**Laboratory Scope of Accreditation**

**Attachment to Certificate #: E87634-47, expiration date June 30, 2022. This listing of accredited analytes should be used only when associated with a valid certificate.**

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EPA Lab Code: **NC00919**

**(910) 350-1903**

**E87634**  
**SGS Environment, Health & Safety**  
**5500 Business Drive**  
**Wilmington, NC 28405**

Matrix: **Drinking Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Perfluorotetradecanoate (PFTeDA, perfluorotetradecanoic acid)	EPA 537.1	Group III Unregulated Contaminants	NELAP	5/26/2020
Perfluorotridecanoate (PFTriA, perfluorotridecanoic acid)	EPA 537	Group III Unregulated Contaminants	NELAP	4/25/2017
Perfluorotridecanoate (PFTriA, perfluorotridecanoic acid)	EPA 537.1	Group III Unregulated Contaminants	NELAP	5/26/2020
Perfluoroundecanoate (PFUnA, Perfluoroundecanoic Acid)	EPA 533	Group III Unregulated Contaminants	NELAP	12/1/2020
Perfluoroundecanoate (PFUnA, Perfluoroundecanoic Acid)	EPA 537	Group III Unregulated Contaminants	NELAP	4/25/2017
Perfluoroundecanoate (PFUnA, Perfluoroundecanoic Acid)	EPA 537.1	Group III Unregulated Contaminants	NELAP	5/26/2020



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**E87634**

**SGS Environment, Health & Safety  
5500 Business Drive  
Wilmington, NC 28405**

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 1613	Extractable Organics	NELAP	1/24/2001
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 8290	Extractable Organics	NELAP	7/1/2003
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 1613	Extractable Organics	NELAP	1/24/2001
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 8290	Extractable Organics	NELAP	7/1/2003
1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA 1613	Extractable Organics	NELAP	1/24/2001
1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA 8290	Extractable Organics	NELAP	7/1/2003
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	EPA 1613	Extractable Organics	NELAP	1/24/2001
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	EPA 8290	Extractable Organics	NELAP	7/1/2003
1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA 1613	Extractable Organics	NELAP	1/24/2001
1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA 8290	Extractable Organics	NELAP	7/1/2003
1,2,3,4,7,8-Hxcdd	EPA 1613	Extractable Organics	NELAP	1/24/2001
1,2,3,4,7,8-Hxcdd	EPA 8290	Extractable Organics	NELAP	7/1/2003
1,2,3,4,7,8-Hxcdf	EPA 1613	Extractable Organics	NELAP	1/24/2001
1,2,3,4,7,8-Hxcdf	EPA 8290	Extractable Organics	NELAP	7/1/2003
1,2,3,6,7,8-Hxcdd	EPA 1613	Extractable Organics	NELAP	1/24/2001
1,2,3,6,7,8-Hxcdd	EPA 8290	Extractable Organics	NELAP	7/1/2003
1,2,3,6,7,8-Hxcdf	EPA 1613	Extractable Organics	NELAP	1/24/2001
1,2,3,6,7,8-Hxcdf	EPA 8290	Extractable Organics	NELAP	7/1/2003
1,2,3,7,8,9-Hxcdd	EPA 1613	Extractable Organics	NELAP	1/24/2001
1,2,3,7,8,9-Hxcdd	EPA 8290	Extractable Organics	NELAP	7/1/2003
1,2,3,7,8,9-Hxcdf	EPA 1613	Extractable Organics	NELAP	1/24/2001
1,2,3,7,8,9-Hxcdf	EPA 8290	Extractable Organics	NELAP	7/1/2003
1,2,3,7,8-Pecdd	EPA 1613	Extractable Organics	NELAP	1/24/2001
1,2,3,7,8-Pecdd	EPA 8290	Extractable Organics	NELAP	7/1/2003
1,2,3,7,8-Pecdf	EPA 1613	Extractable Organics	NELAP	1/24/2001
1,2,3,7,8-Pecdf	EPA 8290	Extractable Organics	NELAP	7/1/2003
2,2',3,3',4,4',5,5',6'-Nonachlorobiphenyl (BZ 206)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',4,4',5,5',6'-Octachlorobiphenyl (BZ 194)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (BZ 207)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ 195)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',4,4',5,6'-Octachlorobiphenyl (BZ 196)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ 170)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl (BZ 208)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004

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**Issue Date: 7/1/2021**

**Expiration Date: 6/30/2022**



**Laboratory Scope of Accreditation**

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EPA Lab Code: **NC00919**

**(910) 350-1903**

**E87634**  
**SGS Environment, Health & Safety**  
**5500 Business Drive**  
**Wilmington, NC 28405**

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
2,2',3,3',4,5,5'-Heptachlorobiphenyl (BZ 172)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ 201)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ 174)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',4,5',6-Heptachlorobiphenyl (BZ 175)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ 177)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',4,5'-Hexachlorobiphenyl (BZ 130)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',4,6,6'-Heptachlorobiphenyl (BZ 176)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',4,6-Hexachlorobiphenyl (BZ 131)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',4,6'-Hexachlorobiphenyl (BZ 132)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',4-Pentachlorobiphenyl (BZ 82)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',5,5',6,6'-Octachlorobiphenyl (BZ 202)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',5,5',6-Heptachlorobiphenyl (BZ 178)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',5,5'-Hexachlorobiphenyl (BZ 133)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',5,6,6'-Heptachlorobiphenyl (BZ 179)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',5,6-Hexachlorobiphenyl (BZ 134)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',5-Pentachlorobiphenyl (BZ 83)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',6,6'-Hexachlorobiphenyl (BZ 136)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',6-Pentachlorobiphenyl (BZ 84)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ 203)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,4,4',5,6,6'-Octachlorobiphenyl (BZ 204)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,4,4',5,6-Heptachlorobiphenyl (BZ 181)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,4,4',5,6'-Heptachlorobiphenyl (BZ 182)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,4,4',5-Hexachlorobiphenyl (BZ 137)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ 184)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ 187)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,4,5,5'-Hexachlorobiphenyl (BZ 141)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,4',5,5'-Hexachlorobiphenyl (BZ 146)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,4,5,6,6'-Heptachlorobiphenyl (BZ 186)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,4',5,6,6'-Heptachlorobiphenyl (BZ 188)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,4,5,6-Hexachlorobiphenyl (BZ 142)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,4,5,6'-Hexachlorobiphenyl (BZ 143)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,4,5',6-Hexachlorobiphenyl (BZ 144)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,4',5,6'-Hexachlorobiphenyl (BZ 148)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,4,6,6'-Hexachlorobiphenyl (BZ 145)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,4',6,6'-Hexachlorobiphenyl (BZ 150)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,4,6'-Pentachlorobiphenyl (BZ 89)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004

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**Issue Date: 7/1/2021**

**Expiration Date: 6/30/2022**



**Laboratory Scope of Accreditation**

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State Laboratory ID: **E87634**

EPA Lab Code: **NC00919**

**(910) 350-1903**

**E87634**

**SGS Environment, Health & Safety  
5500 Business Drive  
Wilmington, NC 28405**

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
2,2',3,4-Tetrachlorobiphenyl (BZ 41)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,4'-Tetrachlorobiphenyl (BZ 42)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,5,5'-Pentachlorobiphenyl (BZ 92)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,5,6,6'-Hexachlorobiphenyl (BZ 152)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,5,6'-Pentachlorobiphenyl (BZ 94)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,5',6-Pentachlorobiphenyl (BZ 95)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,5-Tetrachlorobiphenyl (BZ 43)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,6,6'-Pentachlorobiphenyl (BZ 96)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,6'-Tetrachlorobiphenyl (BZ 46)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3-Trichlorobiphenyl (BZ 16)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',4,4',5,6'-Hexachlorobiphenyl (BZ 154)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',4,4',5-Pentachlorobiphenyl (BZ 99)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',4,4',6,6'-Hexachlorobiphenyl (BZ 155)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',4,5',6-Pentachlorobiphenyl (BZ 103)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',4,5-Tetrachlorobiphenyl (BZ 48)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',4,6,6'-Pentachlorobiphenyl (BZ 104)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',4-Trichlorobiphenyl (BZ 17)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',5,5'-Tetrachlorobiphenyl (BZ 52)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',6,6'-Tetrachlorobiphenyl (BZ 54)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',6-Trichlorobiphenyl (BZ 19)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2'-Dichlorobiphenyl (BZ 4)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,3',4,4',5,5',6-Octachlorobiphenyl (BZ 205)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ 189)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	10/17/2003
2,3,3',4,4',5,6-Heptachlorobiphenyl (BZ 190)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,3',4,4',5',6-Heptachlorobiphenyl (BZ 191)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,3',4,4',6-Hexachlorobiphenyl (BZ 158)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,3',4,4'-Pentachlorobiphenyl (BZ 105)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	10/17/2003
2,3,3',4,5,5',6-Heptachlorobiphenyl (BZ 192)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,3',4,5,5'-Hexachlorobiphenyl (BZ 159)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,3',4',5,5'-Hexachlorobiphenyl (BZ 162)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,3',4,5,6-Hexachlorobiphenyl (BZ 160)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,3',4,5',6-Hexachlorobiphenyl (BZ 161)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,3',4',5',6-Hexachlorobiphenyl (BZ 164)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,3',4,5-Pentachlorobiphenyl (BZ 106)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,3',4',5'-Pentachlorobiphenyl (BZ 122)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,3',4,6-Pentachlorobiphenyl (BZ 109)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004

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**E87634**  
**SGS Environment, Health & Safety**  
**5500 Business Drive**  
**Wilmington, NC 28405**

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
2,3,3',4'-Tetrachlorobiphenyl (BZ 55)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,3',4'-Tetrachlorobiphenyl (BZ 56)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,3',5,5',6-Hexachlorobiphenyl (BZ 165)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,3',5,5'-Pentachlorobiphenyl (BZ 111)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,3',5,6-Pentachlorobiphenyl (BZ 112)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,3',5-Tetrachlorobiphenyl (BZ 57)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,3',5'-Tetrachlorobiphenyl (BZ 58)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3',4,4',5,5'-Hexachlorobiphenyl (BZ 167)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	10/17/2003
2,3,4,4',5-Pentachlorobiphenyl (BZ 114)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3',4,4',5-Pentachlorobiphenyl (BZ 118)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,3',4,4',5'-Pentachlorobiphenyl (BZ 123)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	10/17/2003
2,3,4,4'-Tetrachlorobiphenyl (BZ 60)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3',4,4'-Tetrachlorobiphenyl (BZ 66)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3',4,5,5'-Pentachlorobiphenyl (BZ 120)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3',4,5',6-Pentachlorobiphenyl (BZ 121)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,4',5-Tetrachlorobiphenyl (BZ 63)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3',4,5-Tetrachlorobiphenyl (BZ 67)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3',4,5'-Tetrachlorobiphenyl (BZ 68)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,4,6,7,8-Hxcdf	EPA 1613	Extractable Organics	NELAP	1/24/2001
2,3,4,6,7,8-Hxcdf	EPA 8290	Extractable Organics	NELAP	7/1/2003
2,3,4',6-Tetrachlorobiphenyl (BZ 64)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,4,7,8-Pecdf	EPA 1613	Extractable Organics	NELAP	1/24/2001
2,3,4,7,8-Pecdf	EPA 8290	Extractable Organics	NELAP	7/1/2003
2,3',4-Trichlorobiphenyl (BZ 25)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,4'-Trichlorobiphenyl (BZ 22)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3',5,5'-Tetrachlorobiphenyl (BZ 72)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3',5',6-Tetrachlorobiphenyl (BZ 73)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,5-Trichlorobiphenyl (BZ 23)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3',5'-Trichlorobiphenyl (BZ 34)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3',6-Trichlorobiphenyl (BZ 27)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,6-Trichlorobiphenyl (BZ 24)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,7,8-TCDD (Dioxin, 2,3,7,8-Tetrachlorodibenzo-p-dioxin)	EPA 1613	Extractable Organics	NELAP	1/24/2001
2,3,7,8-TCDD (Dioxin, 2,3,7,8-Tetrachlorodibenzo-p-dioxin)	EPA 8290	Extractable Organics	NELAP	7/1/2003
2,3,7,8-TCDF	EPA 1613	Extractable Organics	NELAP	1/24/2001
2,3,7,8-TCDF	EPA 8290	Extractable Organics	NELAP	7/1/2003

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**Issue Date: 7/1/2021**

**Expiration Date: 6/30/2022**



**Laboratory Scope of Accreditation**

**Attachment to Certificate #: E87634-47, expiration date June 30, 2022. This listing of accredited analytes should be used only when associated with a valid certificate.**

State Laboratory ID: **E87634**

EPA Lab Code: **NC00919**

**(910) 350-1903**

**E87634**

**SGS Environment, Health & Safety**

**5500 Business Drive**

**Wilmington, NC 28405**

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
2,3-Dichlorobiphenyl (BZ 5)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3'-Dichlorobiphenyl (BZ 6)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,4',5'-Trichlorobiphenyl (BZ 31)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,4',6'-Trichlorobiphenyl (BZ 32)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,4-Dichlorobiphenyl (BZ 7)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,4'-Dichlorobiphenyl (BZ 8)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,5-Dichlorobiphenyl (BZ 9)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,6-Dichlorobiphenyl (BZ 10)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2-Chlorobiphenyl (BZ 1)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
3,3',4,4',5,5'-Hexachlorobiphenyl (BZ 169)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	10/17/2003
3,3',4,4',5-Pentachlorobiphenyl (BZ 126)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
3,3',4,4'-Tetrachlorobiphenyl (BZ 77)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	10/17/2003
3,3',4,5,5'-Pentachlorobiphenyl (BZ 127)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
3,3',4,5-Tetrachlorobiphenyl (BZ 78)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
3,3',4,5'-Tetrachlorobiphenyl (BZ 79)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
3,3',4-Trichlorobiphenyl (BZ 35)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
3,3',5,5'-Tetrachlorobiphenyl (BZ 80)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
3,3',5-Trichlorobiphenyl (BZ 36)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
3,3'-Dichlorobiphenyl (BZ 11)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
3,4,4',5-Tetrachlorobiphenyl (BZ 81)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
3,4,4'-Trichlorobiphenyl (BZ 37)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
3,4,5-Trichlorobiphenyl (BZ 38)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
3,4',5-Trichlorobiphenyl (BZ 39)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
3,5-Dichlorobiphenyl (BZ 14)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
3-Chlorobiphenyl (BZ 2)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
4,4'-Dichlorobiphenyl (BZ 15)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
4-Chlorobiphenyl (BZ 3)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
BZ 107 + 124	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 110 + 115	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 12 + 13	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 128 + 166	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 129 + 138 + 163	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 135 + 151	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 139 + 140	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 147 + 149	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 153 + 168	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004

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State Laboratory ID: **E87634**

EPA Lab Code: **NC00919**

**(910) 350-1903**

**E87634**  
**SGS Environment, Health & Safety**  
**5500 Business Drive**  
**Wilmington, NC 28405**

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
BZ 156 + 157	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 171 + 173	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 18 + 30	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 180 + 193	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 183 + 185	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 197 + 200	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 198 + 199	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 20 + 28	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 21 + 33	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 26 + 29	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 40 + 71	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 44 + 47 + 65	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 45 + 51	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 49 + 69	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 50 + 53	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 59 + 62 + 75	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 61 + 70 + 74 + 76	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 85 + 116 + 117	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 86 + 87 + 97 + 108 + 119 + 125	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 88 + 91	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 90 + 101 + 113	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 93 + 100	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 98 + 102	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
Decachlorobiphenyl (BZ 209)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
Hpcdd, total	EPA 1613	Extractable Organics	NELAP	12/23/2005
Hpcdd, total	EPA 8290	Extractable Organics	NELAP	5/11/2011
Hpcdf, total	EPA 1613	Extractable Organics	NELAP	12/23/2005
Hpcdf, total	EPA 8290	Extractable Organics	NELAP	5/11/2011
Hxcdd, total	EPA 1613	Extractable Organics	NELAP	12/23/2005
Hxcdd, total	EPA 8290	Extractable Organics	NELAP	5/11/2011
Hxcdf, total	EPA 1613	Extractable Organics	NELAP	12/23/2005
Hxcdf, total	EPA 8290	Extractable Organics	NELAP	5/11/2011
Pecdd, total	EPA 1613	Extractable Organics	NELAP	12/23/2005
Pecdd, total	EPA 8290	Extractable Organics	NELAP	5/11/2011
Pecdf, total	EPA 1613	Extractable Organics	NELAP	12/23/2005
Pecdf, total	EPA 8290	Extractable Organics	NELAP	5/11/2011

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**Laboratory Scope of Accreditation**

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State Laboratory ID: **E87634**

EPA Lab Code: **NC00919**

**(910) 350-1903**

**E87634**  
**SGS Environment, Health & Safety**  
**5500 Business Drive**  
**Wilmington, NC 28405**

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
TCDD, total	EPA 1613	Extractable Organics	NELAP	12/23/2005
TCDD, total	EPA 8290	Extractable Organics	NELAP	5/11/2011
TCDF, total	EPA 1613	Extractable Organics	NELAP	12/23/2005
TCDF, total	EPA 8290	Extractable Organics	NELAP	5/11/2011



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5500 Business Drive  
Wilmington, NC 28405**

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 1613	Extractable Organics	NELAP	7/1/2003
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 8290	Extractable Organics	NELAP	1/24/2001
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 1613	Extractable Organics	NELAP	7/1/2003
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 8290	Extractable Organics	NELAP	1/24/2001
1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA 1613	Extractable Organics	NELAP	7/1/2003
1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA 8290	Extractable Organics	NELAP	1/24/2001
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	EPA 1613	Extractable Organics	NELAP	7/1/2003
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	EPA 8290	Extractable Organics	NELAP	1/24/2001
1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA 1613	Extractable Organics	NELAP	7/1/2003
1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA 8290	Extractable Organics	NELAP	1/24/2001
1,2,3,4,7,8-Hxcdd	EPA 1613	Extractable Organics	NELAP	7/1/2003
1,2,3,4,7,8-Hxcdd	EPA 8290	Extractable Organics	NELAP	1/24/2001
1,2,3,4,7,8-Hxcdf	EPA 1613	Extractable Organics	NELAP	7/1/2003
1,2,3,4,7,8-Hxcdf	EPA 8290	Extractable Organics	NELAP	1/24/2001
1,2,3,6,7,8-Hxcdd	EPA 1613	Extractable Organics	NELAP	7/1/2003
1,2,3,6,7,8-Hxcdd	EPA 8290	Extractable Organics	NELAP	1/24/2001
1,2,3,6,7,8-Hxcdf	EPA 1613	Extractable Organics	NELAP	7/1/2003
1,2,3,6,7,8-Hxcdf	EPA 8290	Extractable Organics	NELAP	1/24/2001
1,2,3,7,8,9-Hxcdd	EPA 1613	Extractable Organics	NELAP	7/1/2003
1,2,3,7,8,9-Hxcdd	EPA 8290	Extractable Organics	NELAP	1/24/2001
1,2,3,7,8,9-Hxcdf	EPA 1613	Extractable Organics	NELAP	7/1/2003
1,2,3,7,8,9-Hxcdf	EPA 8290	Extractable Organics	NELAP	1/24/2001
1,2,3,7,8-Pecdd	EPA 1613	Extractable Organics	NELAP	7/1/2003
1,2,3,7,8-Pecdd	EPA 8290	Extractable Organics	NELAP	1/24/2001
1,2,3,7,8-Pecdf	EPA 1613	Extractable Organics	NELAP	7/1/2003
1,2,3,7,8-Pecdf	EPA 8290	Extractable Organics	NELAP	1/24/2001
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ 206)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',4,4',5,5',6-Octachlorobiphenyl (BZ 194)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	5/11/2011
2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (BZ 207)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ 195)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',4,4',5,6'-Octachlorobiphenyl (BZ 196)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ 170)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl (BZ 208)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004

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EPA Lab Code: **NC00919**

**(910) 350-1903**

**E87634**

**SGS Environment, Health & Safety  
5500 Business Drive  
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Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
2,2',3,3',4,5,5'-Heptachlorobiphenyl (BZ 172)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ 201)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ 174)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',4,5',6-Heptachlorobiphenyl (BZ 175)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ 177)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',4,5'-Hexachlorobiphenyl (BZ 130)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',4,6,6'-Heptachlorobiphenyl (BZ 176)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',4,6-Hexachlorobiphenyl (BZ 131)	EPA 1668	Extractable Organics	NELAP	12/23/2005
2,2',3,3',4,6'-Hexachlorobiphenyl (BZ 132)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',4-Pentachlorobiphenyl (BZ 82)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',5,5',6,6'-Octachlorobiphenyl (BZ 202)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',5,5',6-Heptachlorobiphenyl (BZ 178)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',5,5'-Hexachlorobiphenyl (BZ 133)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',5,6,6'-Heptachlorobiphenyl (BZ 179)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',5,6-Hexachlorobiphenyl (BZ 134)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',5-Pentachlorobiphenyl (BZ 83)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',6,6'-Hexachlorobiphenyl (BZ 136)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',6-Pentachlorobiphenyl (BZ 84)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ 203)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4,4',5,6,6'-Octachlorobiphenyl (BZ 204)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4,4',5,6-Heptachlorobiphenyl (BZ 181)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4,4',5,6'-Heptachlorobiphenyl (BZ 182)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4,4',5-Hexachlorobiphenyl (BZ 137)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ 184)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ 187)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4,5,5'-Hexachlorobiphenyl (BZ 141)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4',5,5'-Hexachlorobiphenyl (BZ 146)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4,5,6,6'-Heptachlorobiphenyl (BZ 186)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4',5,6,6'-Heptachlorobiphenyl (BZ 188)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,4,5,6-Hexachlorobiphenyl (BZ 142)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4,5,6'-Hexachlorobiphenyl (BZ 143)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4,5',6-Hexachlorobiphenyl (BZ 144)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4',5,6'-Hexachlorobiphenyl (BZ 148)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4,6,6'-Hexachlorobiphenyl (BZ 145)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4',6,6'-Hexachlorobiphenyl (BZ 150)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4,6'-Pentachlorobiphenyl (BZ 89)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005

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**Issue Date: 7/1/2021**

**Expiration Date: 6/30/2022**



**Laboratory Scope of Accreditation**

**Attachment to Certificate #: E87634-47, expiration date June 30, 2022. This listing of accredited analytes should be used only when associated with a valid certificate.**

State Laboratory ID: **E87634**

EPA Lab Code: **NC00919**

**(910) 350-1903**

**E87634**

**SGS Environment, Health & Safety  
5500 Business Drive  
Wilmington, NC 28405**

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
2,2',3,4-Tetrachlorobiphenyl (BZ 41)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4'-Tetrachlorobiphenyl (BZ 42)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,5,5'-Pentachlorobiphenyl (BZ 92)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,5,6,6'-Hexachlorobiphenyl (BZ 152)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,5,6'-Pentachlorobiphenyl (BZ 94)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,5',6-Pentachlorobiphenyl (BZ 95)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,5-Tetrachlorobiphenyl (BZ 43)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,6,6'-Pentachlorobiphenyl (BZ 96)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,6'-Tetrachlorobiphenyl (BZ 46)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3-Trichlorobiphenyl (BZ 16)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',4,4',5,6'-Hexachlorobiphenyl (BZ 154)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',4,4',5-Pentachlorobiphenyl (BZ 99)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',4,4',6,6'-Hexachlorobiphenyl (BZ 155)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',4,5',6-Pentachlorobiphenyl (BZ 103)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',4,5-Tetrachlorobiphenyl (BZ 48)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',4,6,6'-Pentachlorobiphenyl (BZ 104)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',4-Trichlorobiphenyl (BZ 17)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',5,5'-Tetrachlorobiphenyl (BZ 52)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	5/11/2011
2,2',6,6'-Tetrachlorobiphenyl (BZ 54)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',6-Trichlorobiphenyl (BZ 19)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2'-Dichlorobiphenyl (BZ 4)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,3',4,4',5,5',6-Octachlorobiphenyl (BZ 205)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ 189)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	10/17/2003
2,3,3',4,4',5,6-Heptachlorobiphenyl (BZ 190)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',4,4',5',6-Heptachlorobiphenyl (BZ 191)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',4,4',6-Hexachlorobiphenyl (BZ 158)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',4,4'-Pentachlorobiphenyl (BZ 105)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	10/17/2003
2,3,3',4,5,5',6-Heptachlorobiphenyl (BZ 192)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',4,5,5'-Hexachlorobiphenyl (BZ 159)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',4',5,5'-Hexachlorobiphenyl (BZ 162)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',4,5,6-Hexachlorobiphenyl (BZ 160)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',4,5',6-Hexachlorobiphenyl (BZ 161)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',4',5',6-Hexachlorobiphenyl (BZ 164)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',4,5-Pentachlorobiphenyl (BZ 106)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',4',5'-Pentachlorobiphenyl (BZ 122)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',4,6-Pentachlorobiphenyl (BZ 109)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005

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State Laboratory ID: **E87634**

EPA Lab Code: **NC00919**

**(910) 350-1903**

**E87634**

**SGS Environment, Health & Safety**

**5500 Business Drive**

**Wilmington, NC 28405**

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
2,3,3',4'-Tetrachlorobiphenyl (BZ 55)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',4'-Tetrachlorobiphenyl (BZ 56)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',5',6-Hexachlorobiphenyl (BZ 165)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',5'-Pentachlorobiphenyl (BZ 111)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',5,6-Pentachlorobiphenyl (BZ 112)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',5-Tetrachlorobiphenyl (BZ 57)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',5'-Tetrachlorobiphenyl (BZ 58)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3',4,4',5,5'-Hexachlorobiphenyl (BZ 167)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	10/17/2003
2,3,4,4',5-Pentachlorobiphenyl (BZ 114)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3',4,4',5-Pentachlorobiphenyl (BZ 118)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	1/24/2001
2,3',4,4',5'-Pentachlorobiphenyl (BZ 123)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	10/17/2003
2,3,4,4'-Tetrachlorobiphenyl (BZ 60)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3',4,4'-Tetrachlorobiphenyl (BZ 66)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3',4,5,5'-Pentachlorobiphenyl (BZ 120)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3',4,5',6-Pentachlorobiphenyl (BZ 121)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,4',5-Tetrachlorobiphenyl (BZ 63)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3',4,5-Tetrachlorobiphenyl (BZ 67)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3',4,5'-Tetrachlorobiphenyl (BZ 68)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,4,6,7,8-Hxcdf	EPA 1613	Extractable Organics	NELAP	7/1/2003
2,3,4,6,7,8-Hxcdf	EPA 8290	Extractable Organics	NELAP	1/24/2001
2,3,4',6-Tetrachlorobiphenyl (BZ 64)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,4,7,8-Pecdf	EPA 1613	Extractable Organics	NELAP	7/1/2003
2,3,4,7,8-Pecdf	EPA 8290	Extractable Organics	NELAP	1/24/2001
2,3',4-Trichlorobiphenyl (BZ 25)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,4'-Trichlorobiphenyl (BZ 22)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3',5,5'-Tetrachlorobiphenyl (BZ 72)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3',5',6-Tetrachlorobiphenyl (BZ 73)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,5-Trichlorobiphenyl (BZ 23)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3',5'-Trichlorobiphenyl (BZ 34)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3',6-Trichlorobiphenyl (BZ 27)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,6-Trichlorobiphenyl (BZ 24)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,7,8-TCDD (Dioxin, 2,3,7,8-Tetrachlorodibenzo-p-dioxin)	EPA 1613	Extractable Organics	NELAP	7/1/2003
2,3,7,8-TCDD (Dioxin, 2,3,7,8-Tetrachlorodibenzo-p-dioxin)	EPA 8290	Extractable Organics	NELAP	1/24/2001
2,3,7,8-TCDF	EPA 1613	Extractable Organics	NELAP	7/1/2003
2,3,7,8-TCDF	EPA 8290	Extractable Organics	NELAP	1/24/2001

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**Issue Date: 7/1/2021**

**Expiration Date: 6/30/2022**



**Laboratory Scope of Accreditation**

**Attachment to Certificate #: E87634-47, expiration date June 30, 2022. This listing of accredited analytes should be used only when associated with a valid certificate.**

State Laboratory ID: **E87634**

EPA Lab Code: **NC00919**

**(910) 350-1903**

**E87634**  
**SGS Environment, Health & Safety**  
**5500 Business Drive**  
**Wilmington, NC 28405**

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
2,3-Dichlorobiphenyl (BZ 5)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3'-Dichlorobiphenyl (BZ 6)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,4',5'-Trichlorobiphenyl (BZ 31)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	5/11/2011
2,4',6'-Trichlorobiphenyl (BZ 32)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,4-Dichlorobiphenyl (BZ 7)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,4'-Dichlorobiphenyl (BZ 8)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,5-Dichlorobiphenyl (BZ 9)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,6-Dichlorobiphenyl (BZ 10)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2-Chlorobiphenyl (BZ 1)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
3,3',4,4',5,5'-Hexachlorobiphenyl (BZ 169)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	10/17/2003
3,3',4,4',5-Pentachlorobiphenyl (BZ 126)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
3,3',4,4'-Tetrachlorobiphenyl (BZ 77)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	10/17/2003
3,3',4,5,5'-Pentachlorobiphenyl (BZ 127)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
3,3',4,5-Tetrachlorobiphenyl (BZ 78)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
3,3',4,5'-Tetrachlorobiphenyl (BZ 79)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
3,3',4-Trichlorobiphenyl (BZ 35)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
3,3',5,5'-Tetrachlorobiphenyl (BZ 80)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
3,3',5-Trichlorobiphenyl (BZ 36)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
3,3'-Dichlorobiphenyl (BZ 11)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
3,4,4',5-Tetrachlorobiphenyl (BZ 81)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	10/17/2003
3,4,4'-Trichlorobiphenyl (BZ 37)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
3,4,5-Trichlorobiphenyl (BZ 38)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
3,4',5-Trichlorobiphenyl (BZ 39)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
3,5-Dichlorobiphenyl (BZ 14)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
3-Chlorobiphenyl (BZ 2)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
4,4'-Dichlorobiphenyl (BZ 15)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
4-Chlorobiphenyl (BZ 3)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
BZ 107 + 124	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 110 + 115	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 12 + 13	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 128 + 166	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 129 + 138 + 163	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 135 + 151	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 139 + 140	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 147 + 149	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 153 + 168	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005

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**Expiration Date: 6/30/2022**



**Laboratory Scope of Accreditation**

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State Laboratory ID: **E87634**

EPA Lab Code: **NC00919**

**(910) 350-1903**

**E87634**  
**SGS Environment, Health & Safety**  
**5500 Business Drive**  
**Wilmington, NC 28405**

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
BZ 156 + 157	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 171 + 173	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 18 + 30	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 180 + 193	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 183 + 185	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 197 + 200	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 198 + 199	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 20 + 28	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 21 + 33	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 26 + 29	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 40 + 71	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 44 + 47 + 65	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 45 + 51	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 49 + 69	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 50 + 53	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 59 + 62 + 75	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 61 + 70 + 74 + 76	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 85 + 116 + 117	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 86 + 87 + 97 + 108 + 119 + 125	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 88 + 91	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 90 + 101 + 113	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 93 + 100	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 98 + 102	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
Decachlorobiphenyl (BZ 209)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
Hpcdd, total	EPA 1613	Extractable Organics	NELAP	12/23/2005
Hpcdd, total	EPA 8290	Extractable Organics	NELAP	12/23/2005
Hpcdf, total	EPA 1613	Extractable Organics	NELAP	12/23/2005
Hpcdf, total	EPA 8290	Extractable Organics	NELAP	12/23/2005
Hxcdd, total	EPA 1613	Extractable Organics	NELAP	12/23/2005
Hxcdd, total	EPA 8290	Extractable Organics	NELAP	12/23/2005
Hxcdf, total	EPA 1613	Extractable Organics	NELAP	12/23/2005
Hxcdf, total	EPA 8290	Extractable Organics	NELAP	12/23/2005
Pecdd, total	EPA 1613	Extractable Organics	NELAP	12/23/2005
Pecdd, total	EPA 8290	Extractable Organics	NELAP	12/23/2005
Pecdf, total	EPA 1613	Extractable Organics	NELAP	12/23/2005
Pecdf, total	EPA 8290	Extractable Organics	NELAP	12/23/2005

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**E87634**

**SGS Environment, Health & Safety  
5500 Business Drive  
Wilmington, NC 28405**

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
TCDD, total	EPA 1613	Extractable Organics	NELAP	12/23/2005
TCDD, total	EPA 8290	Extractable Organics	NELAP	12/23/2005
TCDF, total	EPA 1613	Extractable Organics	NELAP	12/23/2005
TCDF, total	EPA 8290	Extractable Organics	NELAP	12/23/2005



**Laboratory Scope of Accreditation**

**Attachment to Certificate #: E87634-47, expiration date June 30, 2022. This listing of accredited analytes should be used only when associated with a valid certificate.**

State Laboratory ID: **E87634**

EPA Lab Code: **NC00919**

**(910) 350-1903**

**E87634**

**SGS Environment, Health & Safety  
5500 Business Drive  
Wilmington, NC 28405**

Matrix: **Biological Tissue**

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 1613	Extractable Organics	NELAP	12/23/2005
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 8290	Extractable Organics	NELAP	7/1/2003
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 1613	Extractable Organics	NELAP	12/23/2005
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 8290	Extractable Organics	NELAP	7/1/2003
1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA 1613	Extractable Organics	NELAP	12/23/2005
1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA 8290	Extractable Organics	NELAP	7/1/2003
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	EPA 1613	Extractable Organics	NELAP	12/23/2005
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	EPA 8290	Extractable Organics	NELAP	7/1/2003
1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA 1613	Extractable Organics	NELAP	12/23/2005
1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA 8290	Extractable Organics	NELAP	7/1/2003
1,2,3,4,7,8-Hxcdd	EPA 1613	Extractable Organics	NELAP	12/23/2005
1,2,3,4,7,8-Hxcdd	EPA 8290	Extractable Organics	NELAP	7/1/2003
1,2,3,4,7,8-Hxcdf	EPA 1613	Extractable Organics	NELAP	12/23/2005
1,2,3,4,7,8-Hxcdf	EPA 8290	Extractable Organics	NELAP	7/1/2003
1,2,3,6,7,8-Hxcdd	EPA 1613	Extractable Organics	NELAP	12/23/2005
1,2,3,6,7,8-Hxcdd	EPA 8290	Extractable Organics	NELAP	7/1/2003
1,2,3,6,7,8-Hxcdf	EPA 1613	Extractable Organics	NELAP	12/23/2005
1,2,3,6,7,8-Hxcdf	EPA 8290	Extractable Organics	NELAP	7/1/2003
1,2,3,7,8,9-Hxcdd	EPA 1613	Extractable Organics	NELAP	12/23/2005
1,2,3,7,8,9-Hxcdd	EPA 8290	Extractable Organics	NELAP	7/1/2003
1,2,3,7,8,9-Hxcdf	EPA 1613	Extractable Organics	NELAP	12/23/2005
1,2,3,7,8,9-Hxcdf	EPA 8290	Extractable Organics	NELAP	7/1/2003
1,2,3,7,8-Pecdd	EPA 1613	Extractable Organics	NELAP	12/23/2005
1,2,3,7,8-Pecdd	EPA 8290	Extractable Organics	NELAP	7/1/2003
1,2,3,7,8-Pecdf	EPA 1613	Extractable Organics	NELAP	12/23/2005
1,2,3,7,8-Pecdf	EPA 8290	Extractable Organics	NELAP	7/1/2003
2,2',3,3',4,4',5,5',6'-Nonachlorobiphenyl (BZ 206)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',4,4',5,5',6'-Octachlorobiphenyl (BZ 194)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (BZ 207)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ 195)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',4,4',5,6'-Octachlorobiphenyl (BZ 196)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ 170)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl (BZ 208)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004

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**Issue Date: 7/1/2021**

**Expiration Date: 6/30/2022**



**Laboratory Scope of Accreditation**

**Attachment to Certificate #: E87634-47, expiration date June 30, 2022. This listing of accredited analytes should be used only when associated with a valid certificate.**

State Laboratory ID: **E87634**

EPA Lab Code: **NC00919**

**(910) 350-1903**

**E87634**  
**SGS Environment, Health & Safety**  
**5500 Business Drive**  
**Wilmington, NC 28405**

Matrix: **Biological Tissue**

Analyte	Method/Tech	Category	Certification Type	Effective Date
2,2',3,3',4,5,5'-Heptachlorobiphenyl (BZ 172)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ 201)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ 174)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',4,5',6-Heptachlorobiphenyl (BZ 175)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ 177)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',4,5'-Hexachlorobiphenyl (BZ 130)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',4,6,6'-Heptachlorobiphenyl (BZ 176)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',4,6-Hexachlorobiphenyl (BZ 131)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',4,6'-Hexachlorobiphenyl (BZ 132)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',4-Pentachlorobiphenyl (BZ 82)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',5,5',6,6'-Octachlorobiphenyl (BZ 202)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,3',5,5',6-Heptachlorobiphenyl (BZ 178)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',5,5'-Hexachlorobiphenyl (BZ 133)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',5,6,6'-Heptachlorobiphenyl (BZ 179)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',5,6-Hexachlorobiphenyl (BZ 134)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',5-Pentachlorobiphenyl (BZ 83)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',6,6'-Hexachlorobiphenyl (BZ 136)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,3',6-Pentachlorobiphenyl (BZ 84)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ 203)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4,4',5,6,6'-Octachlorobiphenyl (BZ 204)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4,4',5,6-Heptachlorobiphenyl (BZ 181)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4,4',5,6'-Heptachlorobiphenyl (BZ 182)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4,4',5-Hexachlorobiphenyl (BZ 137)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ 184)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ 187)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4,5,5'-Hexachlorobiphenyl (BZ 141)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4',5,5'-Hexachlorobiphenyl (BZ 146)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4,5,6,6'-Heptachlorobiphenyl (BZ 186)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4',5,6,6'-Heptachlorobiphenyl (BZ 188)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',3,4,5,6-Hexachlorobiphenyl (BZ 142)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4,5,6'-Hexachlorobiphenyl (BZ 143)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4,5',6-Hexachlorobiphenyl (BZ 144)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4',5,6'-Hexachlorobiphenyl (BZ 148)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4,6,6'-Hexachlorobiphenyl (BZ 145)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4',6,6'-Hexachlorobiphenyl (BZ 150)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4,6'-Pentachlorobiphenyl (BZ 89)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005

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**Issue Date: 7/1/2021**

**Expiration Date: 6/30/2022**



**Laboratory Scope of Accreditation**

**Attachment to Certificate #: E87634-47, expiration date June 30, 2022. This listing of accredited analytes should be used only when associated with a valid certificate.**

State Laboratory ID: **E87634**

EPA Lab Code: **NC00919**

**(910) 350-1903**

**E87634**

**SGS Environment, Health & Safety  
5500 Business Drive  
Wilmington, NC 28405**

Matrix: **Biological Tissue**

Analyte	Method/Tech	Category	Certification Type	Effective Date
2,2',3,4-Tetrachlorobiphenyl (BZ 41)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,4'-Tetrachlorobiphenyl (BZ 42)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,5,5'-Pentachlorobiphenyl (BZ 92)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,5,6,6'-Hexachlorobiphenyl (BZ 152)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,5,6'-Pentachlorobiphenyl (BZ 94)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,5',6-Pentachlorobiphenyl (BZ 95)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,5-Tetrachlorobiphenyl (BZ 43)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,6,6'-Pentachlorobiphenyl (BZ 96)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3,6'-Tetrachlorobiphenyl (BZ 46)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',3-Trichlorobiphenyl (BZ 16)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',4,4',5,6'-Hexachlorobiphenyl (BZ 154)	EPA 1668	Extractable Organics	NELAP	12/23/2005
2,2',4,4',5-Pentachlorobiphenyl (BZ 99)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',4,4',6,6'-Hexachlorobiphenyl (BZ 155)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',4,5',6-Pentachlorobiphenyl (BZ 103)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',4,5-Tetrachlorobiphenyl (BZ 48)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',4,6,6'-Pentachlorobiphenyl (BZ 104)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',4-Trichlorobiphenyl (BZ 17)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',5,5'-Tetrachlorobiphenyl (BZ 52)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,2',6,6'-Tetrachlorobiphenyl (BZ 54)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2',6-Trichlorobiphenyl (BZ 19)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,2'-Dichlorobiphenyl (BZ 4)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,3',4,4',5,5',6-Octachlorobiphenyl (BZ 205)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ 189)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	10/17/2003
2,3,3',4,4',5,6-Heptachlorobiphenyl (BZ 190)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',4,4',5',6-Heptachlorobiphenyl (BZ 191)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',4,4',6-Hexachlorobiphenyl (BZ 158)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',4,4'-Pentachlorobiphenyl (BZ 105)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	10/17/2003
2,3,3',4,5,5',6-Heptachlorobiphenyl (BZ 192)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',4,5,5'-Hexachlorobiphenyl (BZ 159)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',4',5,5'-Hexachlorobiphenyl (BZ 162)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',4,5,6-Hexachlorobiphenyl (BZ 160)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',4,5',6-Hexachlorobiphenyl (BZ 161)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',4',5',6-Hexachlorobiphenyl (BZ 164)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',4,5-Pentachlorobiphenyl (BZ 106)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',4',5'-Pentachlorobiphenyl (BZ 122)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',4,6-Pentachlorobiphenyl (BZ 109)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005

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**Issue Date: 7/1/2021**

**Expiration Date: 6/30/2022**



**Laboratory Scope of Accreditation**

**Attachment to Certificate #: E87634-47, expiration date June 30, 2022. This listing of accredited analytes should be used only when associated with a valid certificate.**

State Laboratory ID: **E87634**

EPA Lab Code: **NC00919**

**(910) 350-1903**

**E87634**  
**SGS Environment, Health & Safety**  
**5500 Business Drive**  
**Wilmington, NC 28405**

Matrix: **Biological Tissue**

Analyte	Method/Tech	Category	Certification Type	Effective Date
2,3,3',4-Tetrachlorobiphenyl (BZ 55)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',4'-Tetrachlorobiphenyl (BZ 56)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',5,5',6-Hexachlorobiphenyl (BZ 165)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',5,5'-Pentachlorobiphenyl (BZ 111)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',5,6-Pentachlorobiphenyl (BZ 112)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',5-Tetrachlorobiphenyl (BZ 57)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,3',5'-Tetrachlorobiphenyl (BZ 58)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3',4,4',5,5'-Hexachlorobiphenyl (BZ 167)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	10/17/2003
2,3,4,4',5-Pentachlorobiphenyl (BZ 114)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
2,3',4,4',5-Pentachlorobiphenyl (BZ 118)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,3',4,4',5'-Pentachlorobiphenyl (BZ 123)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	10/17/2003
2,3,4,4'-Tetrachlorobiphenyl (BZ 60)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3',4,4'-Tetrachlorobiphenyl (BZ 66)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3',4,5,5'-Pentachlorobiphenyl (BZ 120)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3',4,5',6-Pentachlorobiphenyl (BZ 121)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,4',5-Tetrachlorobiphenyl (BZ 63)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3',4,5-Tetrachlorobiphenyl (BZ 67)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3',4,5'-Tetrachlorobiphenyl (BZ 68)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,4,6,7,8-Hxcdf	EPA 1613	Extractable Organics	NELAP	12/23/2005
2,3,4,6,7,8-Hxcdf	EPA 8290	Extractable Organics	NELAP	7/1/2003
2,3,4',6-Tetrachlorobiphenyl (BZ 64)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,4,7,8-Pecdf	EPA 1613	Extractable Organics	NELAP	12/23/2005
2,3,4,7,8-Pecdf	EPA 8290	Extractable Organics	NELAP	7/1/2003
2,3',4-Trichlorobiphenyl (BZ 25)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,4'-Trichlorobiphenyl (BZ 22)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3',5,5'-Tetrachlorobiphenyl (BZ 72)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3',5',6-Tetrachlorobiphenyl (BZ 73)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,5-Trichlorobiphenyl (BZ 23)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3',5'-Trichlorobiphenyl (BZ 34)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3',6-Trichlorobiphenyl (BZ 27)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,6-Trichlorobiphenyl (BZ 24)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3,7,8-TCDD (Dioxin, 2,3,7,8-Tetrachlorodibenzo-p-dioxin)	EPA 1613	Extractable Organics	NELAP	12/23/2005
2,3,7,8-TCDD (Dioxin, 2,3,7,8-Tetrachlorodibenzo-p-dioxin)	EPA 8290	Extractable Organics	NELAP	7/1/2003
2,3,7,8-TCDF	EPA 1613	Extractable Organics	NELAP	12/23/2005
2,3,7,8-TCDF	EPA 8290	Extractable Organics	NELAP	7/1/2003

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**Issue Date: 7/1/2021**

**Expiration Date: 6/30/2022**



**Laboratory Scope of Accreditation**

**Attachment to Certificate #: E87634-47, expiration date June 30, 2022. This listing of accredited analytes should be used only when associated with a valid certificate.**

State Laboratory ID: **E87634**

EPA Lab Code: **NC00919**

**(910) 350-1903**

**E87634**  
**SGS Environment, Health & Safety**  
**5500 Business Drive**  
**Wilmington, NC 28405**

Matrix: **Biological Tissue**

Analyte	Method/Tech	Category	Certification Type	Effective Date
2,3-Dichlorobiphenyl (BZ 5)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,3'-Dichlorobiphenyl (BZ 6)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,4',5'-Trichlorobiphenyl (BZ 31)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,4',6'-Trichlorobiphenyl (BZ 32)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,4-Dichlorobiphenyl (BZ 7)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,4'-Dichlorobiphenyl (BZ 8)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,5-Dichlorobiphenyl (BZ 9)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2,6-Dichlorobiphenyl (BZ 10)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
2-Chlorobiphenyl (BZ 1)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
3,3',4,4',5,5'-Hexachlorobiphenyl (BZ 169)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	10/17/2003
3,3',4,4',5-Pentachlorobiphenyl (BZ 126)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
3,3',4,4'-Tetrachlorobiphenyl (BZ 77)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	10/17/2003
3,3',4,5,5'-Pentachlorobiphenyl (BZ 127)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
3,3',4,5-Tetrachlorobiphenyl (BZ 78)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
3,3',4,5'-Tetrachlorobiphenyl (BZ 79)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
3,3',4-Trichlorobiphenyl (BZ 35)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
3,3',5,5'-Tetrachlorobiphenyl (BZ 80)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
3,3',5-Trichlorobiphenyl (BZ 36)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
3,3'-Dichlorobiphenyl (BZ 11)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
3,4,4',5-Tetrachlorobiphenyl (BZ 81)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	10/17/2003
3,4,4'-Trichlorobiphenyl (BZ 37)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
3,4,5-Trichlorobiphenyl (BZ 38)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
3,4',5-Trichlorobiphenyl (BZ 39)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
3,5-Dichlorobiphenyl (BZ 14)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
3-Chlorobiphenyl (BZ 2)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
4,4'-Dichlorobiphenyl (BZ 15)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
4-Chlorobiphenyl (BZ 3)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
BZ 107 + 124	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 110 + 115	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	5/11/2011
BZ 12 + 13	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 128 + 166	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 129 + 138 + 163	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 135 + 151	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 139 + 140	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 147 + 149	EPA 1668	Extractable Organics	NELAP	12/23/2005
BZ 153 + 168	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005

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**Issue Date: 7/1/2021**

**Expiration Date: 6/30/2022**



**Laboratory Scope of Accreditation**

**Attachment to Certificate #: E87634-47, expiration date June 30, 2022. This listing of accredited analytes should be used only when associated with a valid certificate.**

State Laboratory ID: **E87634**

EPA Lab Code: **NC00919**

**(910) 350-1903**

**E87634**  
**SGS Environment, Health & Safety**  
**5500 Business Drive**  
**Wilmington, NC 28405**

Matrix: **Biological Tissue**

Analyte	Method/Tech	Category	Certification Type	Effective Date
BZ 156 + 157	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/20/2004
BZ 171 + 173	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 18 + 30	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 180 + 193	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 183 + 185	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 197 + 200	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 198 + 199	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 20 + 28	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 21 + 33	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 26 + 29	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 40 + 71	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 44 + 47 + 65	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 45 + 51	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 49 + 69	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 50 + 53	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 59 + 62 + 75	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 61 + 70 + 74 + 76	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 85 + 116 + 117	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	5/11/2011
BZ 86 + 87 + 97 + 108 + 119 + 125	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 88 + 91	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 90 + 101 + 113	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 93 + 100	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
BZ 98 + 102	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
Decachlorobiphenyl (BZ 209)	EPA 1668	Pesticides-Herbicides-PCB's	NELAP	7/9/2004
Hpcdd, total	EPA 1613	Extractable Organics	NELAP	12/23/2005
Hpcdd, total	EPA 8290	Extractable Organics	NELAP	12/23/2005
Hpcdf, total	EPA 1613	Extractable Organics	NELAP	12/23/2005
Hpcdf, total	EPA 8290	Extractable Organics	NELAP	12/23/2005
Hxcdd, total	EPA 1613	Extractable Organics	NELAP	12/23/2005
Hxcdd, total	EPA 8290	Extractable Organics	NELAP	12/23/2005
Hxcdf, total	EPA 1613	Extractable Organics	NELAP	12/23/2005
Hxcdf, total	EPA 8290	Extractable Organics	NELAP	12/23/2005
Pecdd, total	EPA 1613	Extractable Organics	NELAP	12/23/2005
Pecdd, total	EPA 8290	Extractable Organics	NELAP	12/23/2005
Pecdf, total	EPA 1613	Extractable Organics	NELAP	12/23/2005
Pecdf, total	EPA 8290	Extractable Organics	NELAP	12/23/2005

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State Laboratory ID: **E87634**

EPA Lab Code: **NC00919**

**(910) 350-1903**

**E87634**  
**SGS Environment, Health & Safety**  
**5500 Business Drive**  
**Wilmington, NC 28405**

Matrix: **Biological Tissue**

Analyte	Method/Tech	Category	Certification Type	Effective Date
TCDD, total	EPA 1613	Extractable Organics	NELAP	12/23/2005
TCDD, total	EPA 8290	Extractable Organics	NELAP	12/23/2005
TCDF, total	EPA 1613	Extractable Organics	NELAP	12/23/2005
TCDF, total	EPA 8290	Extractable Organics	NELAP	12/23/2005



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**E87634**  
**SGS Environment, Health & Safety**  
**5500 Business Drive**  
**Wilmington, NC 28405**

Matrix: **Air and Emissions**

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA TO-9A	Extractable Organics	NELAP	5/2/2014
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA TO-9A	Extractable Organics	NELAP	5/2/2014
1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA TO-9A	Extractable Organics	NELAP	5/2/2014
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	EPA TO-9A	Extractable Organics	NELAP	5/2/2014
1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA TO-9A	Extractable Organics	NELAP	5/2/2014
1,2,3,4,7,8-Hxcdd	EPA TO-9A	Extractable Organics	NELAP	5/2/2014
1,2,3,4,7,8-Hxcdf	EPA TO-9A	Extractable Organics	NELAP	5/2/2014
1,2,3,6,7,8-Hxcdd	EPA TO-9A	Extractable Organics	NELAP	5/2/2014
1,2,3,6,7,8-Hxcdf	EPA TO-9A	Extractable Organics	NELAP	5/2/2014
1,2,3,7,8,9-Hxcdd	EPA TO-9A	Extractable Organics	NELAP	5/2/2014
1,2,3,7,8,9-Hxcdf	EPA TO-9A	Extractable Organics	NELAP	5/2/2014
1,2,3,7,8-Pecdd	EPA TO-9A	Extractable Organics	NELAP	5/2/2014
1,2,3,7,8-Pecdf	EPA TO-9A	Extractable Organics	NELAP	5/2/2014
2,3,4,6,7,8-Hxcdf	EPA TO-9A	Extractable Organics	NELAP	5/2/2014
2,3,4,7,8-Pecdf	EPA TO-9A	Extractable Organics	NELAP	5/2/2014
2,3,7,8-TCDD (Dioxin, 2,3,7,8-Tetrachlorodibenzo-p-dioxin)	EPA TO-9A	Extractable Organics	NELAP	5/2/2014
2,3,7,8-TCDF	EPA TO-9A	Extractable Organics	NELAP	5/2/2014
2-Methylnaphthalene	SOP AP-CM 4 / GC-HRMS	Extractable Organics	NELAP	5/2/2014
Acenaphthene	SOP AP-CM 4 / GC-HRMS	Extractable Organics	NELAP	5/2/2014
Acenaphthylene	SOP AP-CM 4 / GC-HRMS	Extractable Organics	NELAP	5/2/2014
Anthracene	SOP AP-CM 4 / GC-HRMS	Extractable Organics	NELAP	5/2/2014
Benzo(a)anthracene	SOP AP-CM 4 / GC-HRMS	Extractable Organics	NELAP	5/2/2014
Benzo(a)pyrene	SOP AP-CM 4 / GC-HRMS	Extractable Organics	NELAP	5/2/2014
Benzo(b)fluoranthene	SOP AP-CM 4 / GC-HRMS	Extractable Organics	NELAP	5/2/2014
Benzo(e)pyrene	SOP AP-CM 4 / GC-HRMS	Extractable Organics	NELAP	5/2/2014
Benzo(g,h,i)perylene	SOP AP-CM 4 / GC-HRMS	Extractable Organics	NELAP	5/2/2014
Benzo(k)fluoranthene	SOP AP-CM 4 / GC-HRMS	Extractable Organics	NELAP	5/2/2014
Chrysene	SOP AP-CM 4 / GC-HRMS	Extractable Organics	NELAP	5/2/2014
Dibenz(a,h)anthracene	SOP AP-CM 4 / GC-HRMS	Extractable Organics	NELAP	5/2/2014
Fluoranthene	SOP AP-CM 4 / GC-HRMS	Extractable Organics	NELAP	5/2/2014
Fluorene	SOP AP-CM 4 / GC-HRMS	Extractable Organics	NELAP	5/2/2014
Indeno(1,2,3-cd)pyrene	SOP AP-CM 4 / GC-HRMS	Extractable Organics	NELAP	5/2/2014
Naphthalene	SOP AP-CM 4 / GC-HRMS	Extractable Organics	NELAP	5/2/2014
Perylene	SOP AP-CM 4 / GC-HRMS	Extractable Organics	NELAP	5/2/2014

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**Issue Date: 7/1/2021**

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**Laboratory Scope of Accreditation**

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EPA Lab Code: **NC00919**

**(910) 350-1903**

**E87634**

**SGS Environment, Health & Safety  
5500 Business Drive  
Wilmington, NC 28405**

Matrix: **Air and Emissions**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Phenanthrene	SOP AP-CM 4 / GC-HRMS	Extractable Organics	NELAP	5/2/2014
Pyrene	SOP AP-CM 4 / GC-HRMS	Extractable Organics	NELAP	5/2/2014



SGS North America Inc.  
EHS  
5500 Business Dr.  
Wilmington, NC 28405  
(910) 350-1903

## SGS QUALITY MANUAL

*Written in accordance with the requirements of C205 – Combined ISO/IEC 17025: and National Environmental Testing Laboratory Accreditation Program Requirements*

**REVISION:** 30

**ISSUED BY:**

*Jeannie Milholland* Jeannie  
2021-01-20 11:32:  
00

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*Ms. Jeannie Milholland, Quality Assurance Director*

**AUTHORIZED BY:**

*Brian Schoenwiesner*

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*Brian Schoenwiesner, Operations Manager*

*Greg Dickinson*

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*Greg Dickinson, Technical Director*

**DATE:** January 20, 2021

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Uncontrolled Copy when Printed

SGS North America Inc.  
Standard Operating Procedure

**Standard Operating Procedure for the  
Analysis of Polychlorinated Dibenzop-Dioxins and  
Polychlorinated Dibenzofurans (PCDD/Fs)**

Issue date: 01/08/2021  
Revision: 14

SGS North America Inc.  
5500 Business Drive  
Wilmington, North Carolina 28405

Approved by:

*Tamara Burkamper*

\_\_\_\_\_  
Tamara Burkamper, Last Revised by

01-08-2021

\_\_\_\_\_  
Date

*Greg Dickinson*

\_\_\_\_\_  
Greg Dickinson, Technical Director

01-08-2021

\_\_\_\_\_  
Date

*Jeannie Milholland*

\_\_\_\_\_  
Jeannie Milholland, Quality Assurance Director

**Jeannie**

**2021-01-08 10:51:10**

\_\_\_\_\_  
Date

(Official copies of final documents will contain all three signatures.)

SGS North America Inc.  
Standard Operating Procedure

**Standard Operating Procedure for the  
Analysis of Pesticides by HRGC/HRMS**

Issue date: 02/12/2020  
Revision: 11

SGS North America Inc.  
5500 Business Drive  
Wilmington, North Carolina 28405

Approved by:

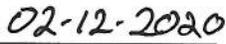
  
\_\_\_\_\_  
D. Tyler Fritz, Last Revised by

  
\_\_\_\_\_  
Date

  
\_\_\_\_\_  
Greg Dickinson, Technical Director

  
\_\_\_\_\_  
Date

  
\_\_\_\_\_  
Jeannie Milholland, Quality Assurance Director

  
\_\_\_\_\_  
Date

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## Standard Operating Procedure for the Analysis of Polychlorinated Biphenyls (PCBs)

Issue date: 02/13/2020  
Revision: 17

SGS North America Inc.  
5500 Business Drive  
Wilmington, North Carolina 28405

Approved by:

  
\_\_\_\_\_  
Megan Shannahan, Last Revised By

2/13/20  
Date

  
\_\_\_\_\_  
Greg Dickinson, Technical Director

2-13-2020  
Date

  
\_\_\_\_\_  
Jeannie Milholland, Quality Assurance Director

02-13-2020  
Date

(Official copies of final documents will contain all three signatures.)

SGS North America Inc.  
Standard Operating Procedure

Standard Operating Procedure for Extraction of Various  
Matrices

Issue date: 06/02/2020  
Revision: 6

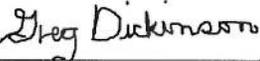
SGS North America Inc.  
5500 Business Drive  
Wilmington, North Carolina 28405

Approved by:

  
\_\_\_\_\_  
Jeffrey H. Land, Last Revised by

06-02-20

\_\_\_\_\_  
Date

  
\_\_\_\_\_  
Greg Dickinson, Technical Director

06-02-2020

\_\_\_\_\_  
Date

  
\_\_\_\_\_  
Jeannie Milholland, Quality Assurance Director

jeannie.milholland@sgs.com  
2020-06-02 10:58:50

\_\_\_\_\_  
Date

(Official copies of final documents will contain all three signatures.)

## **APPENDIX B**

### **Data Validation Checklists**

**B.1 Example Ecochem Checklists**

**B.2 Example LDC Checklists**

## **APPENDIX B.1**

### **Example Ecochem Checklists**

Project No.: _____	1° Rev: _____	Date: _____
Project Name: _____	2° Rev: _____	Date: _____
Lab & SDG: _____		
Analysis: _____		

## ORGANICS/HRMS TECHNICAL EVALUATION CHECKLIST FOR STAGE 2A DV

(Covers summaries of blanks; accuracy; precision; and sample results)

DV Criteria Table:  Default  Client/Program Specific - Control Limits:  Lab  QAPP/SAP  Other:

Qualifiers Issued:  No  Yes      Qualifiers added to:  EDD/Database  Form 1s

### 1.0 Chain-of-Custody/Holding Time/Preservation

Y    N    N/A

1.1 Are COCs included, properly signed, and dated?			
1.2 Are all cooler temperatures within the control limits? <input type="checkbox"/> 0-6°C <input type="checkbox"/> Frozen <-20°C±10°C <input type="checkbox"/> see attached Holding Time worksheet or spreadsheet <input type="checkbox"/> see below			
1.3 Were all samples preserved properly? Indicate method(s) of preservation: <input type="checkbox"/> Cool <input type="checkbox"/> Frozen <input type="checkbox"/> HCl to pH <2 <input type="checkbox"/> MeOH <input type="checkbox"/> NaHSO <sub>3</sub> <input type="checkbox"/> Other:			
1.4 Samples analyzed within holding time? <input type="checkbox"/> see HT eval spreadsheet <input type="checkbox"/> see below			
<i>Secondary:</i> Technical Agreement with HT evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
<b>Comments:</b> <input type="checkbox"/> Data judged as not significantly affected by outliers; no qualifiers assigned.			

### 2.0 Method/Field Blanks

Y    N    N/A

2.1 Are Method Blanks free from contamination? <input type="checkbox"/> see attached Blank Summary Form or data package page <input type="checkbox"/> see below			
2.2 Are there any <input type="checkbox"/> trip and/or <input type="checkbox"/> equipment/field blanks included in the data package? (list below)			
2.3 Are trip and/or equipment/field blanks free from contamination? <input type="checkbox"/> see attached Blank Summary Form or data package page <input type="checkbox"/> see below			
<i>Secondary:</i> Technical Agreement with MB/FB evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
<b>Comments:</b> <input type="checkbox"/> No positive results in associated samples; no action required for method / trip / equip. / other. <input type="checkbox"/> 10X action level established for common lab cont.; 5X action level for others.			

### 3.0 Laboratory Control Sample (Blank Spike/OPR Sample) LCS or OPR LCS/LCSD

Y    N    N/A

3.1 Are all %R-values within the control limits? <b>Limits:</b> <input type="checkbox"/> Lab <input type="checkbox"/> Method <input type="checkbox"/> Project <input type="checkbox"/> see attached Summary Form or data package page <input type="checkbox"/> see below			
3.2 Are all RPD values within control limits (if duplicate analyzed)? <input type="checkbox"/> see attached Summary Form or data package page <input type="checkbox"/> see below			
<i>Secondary:</i> Technical Agreement with LCS/LCSD/OPR evaluation and qualification? <input type="checkbox"/> no qualifiers <input type="checkbox"/> evaluation and DV report agree <input type="checkbox"/> see below			
<b>Comments:</b> <input type="checkbox"/> No positive results in associated samples; no qualifiers as all outliers were > UCL (high bias) <input type="checkbox"/> No qualifiers assigned; one outlier per fraction/column acceptable if > 10%.			

#### 4.0 Surrogate/Labeled Compounds

Y    N    N/A

<b>4.1</b> Are all recovery values within the control limits? <b>Limits:</b> <input type="checkbox"/> Lab <input type="checkbox"/> Method <input type="checkbox"/> Project <input type="checkbox"/> see attached Surrogate Summary Form or data package page <input type="checkbox"/> see below			
<i>Secondary:</i> Technical Agreement with labeled compound evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
<b>Comments:</b> <input type="checkbox"/> No positive results; no qualifiers as all outliers were > UCL (high bias). <input type="checkbox"/> No qualifiers assigned; one outlier per fraction/column acceptable (if > 10%). <input type="checkbox"/> No qualifiers assigned; sample diluted to a conc < low std preventing accurate recovery.			

#### 5.0 Matrix Spike/Matrix Spike Duplicate or Sample and Lab Duplicate (*List Parent Sample ID below*)

Y    N    N/A

<b>5.1</b> Are all %R-values within the control limits? <b>Limits:</b> <input type="checkbox"/> Lab <input type="checkbox"/> Method <input type="checkbox"/> Project <input type="checkbox"/> see attached MS/MSD Summary Form or data package page <input type="checkbox"/> see below			
<b>5.2</b> Are all RPD values within control limits? <input type="checkbox"/> see attached MS/MSD Summary Form or data package page <input type="checkbox"/> see below			
<i>Secondary:</i> Technical Agreement with matrix spike and/or lab duplicate evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
<b>Comments:</b> <input type="checkbox"/> No positive results in parent sample; no qualifiers as all outliers were > UCL (high bias) or RPD only outlier & parent ND. <input type="checkbox"/> Not required by method. <input type="checkbox"/> No qualifiers assigned; sample diluted to a conc < low std preventing accurate recovery. <input type="checkbox"/> The following analyte parent concentrations > 4X spike level; no action.			

#### 6.0 Field Duplicate (FD) (*List Field Duplicate Sample IDs below*)

Y    N    N/A

<b>6.1</b> Were field duplicates collected and analyzed? <input type="checkbox"/> RPD/Difference Calculation Attached			
<b>6.2</b> For results >5X the RL, are RPD values within the control limit? <b>Limits:</b> <input type="checkbox"/> EC Default <input type="checkbox"/> Project <input type="checkbox"/> see attached Calculation Sheet <input type="checkbox"/> see below			
<b>6.3</b> For results less than 5X the RL, are the differences less than the RL (2X the RL for solid matrices)? <input type="checkbox"/> see attached Calculation Sheet <input type="checkbox"/> see below			
<i>Secondary:</i> Technical Agreement with FD evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
<b>Comments:</b> <input type="checkbox"/> No qualifiers assigned based on FD outliers <input type="checkbox"/> Qualify FD samples			

**7.0 Standard Reference Material (SRM) or Certified Reference Material (CRM)**

Y N N/A

7.1 Was an SRM sample(s) analyzed? SRM/CRM Sample ID(s): _____			
7.2 Are all values within control limits? <b>Limits:</b> <input type="checkbox"/> EC Default <input type="checkbox"/> Project <input type="checkbox"/> no outliers <input type="checkbox"/> see below <input type="checkbox"/> see attached			
<i>Secondary:</i> Technical Agreement with SRM/CRM evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
<b>Comments:</b> <input type="checkbox"/> No qualifiers assigned based on SRM/CRM outliers			

**8.0 Sample Results/Completeness Check**

Y N N/A

8.1 Are there results for all analytes on the client required target compound list(s)? <b>see SAP/QAPP for lists</b>			
8.2 Are reporting limits and sample results adjusted for sample size, final volume, dilutions, etc.?			
8.3 Are concentrations reported on the appropriate basis? <input type="checkbox"/> Dry weight <input type="checkbox"/> Wet weight <input type="checkbox"/> Both			
8.4 Do detection limits meet project-specific or method-specific limits?			
8.5 Results were DNR-11 flagged to indicate most appropriate result from multiple reported results.			
8.6 Results qualified J-20 to indicate concentration is greater than calibration range.			
8.7 DLs/RLs elevated due to <input type="checkbox"/> Dil <input type="checkbox"/> %M <input type="checkbox"/> Sample Vol <input type="checkbox"/> Final volume <input type="checkbox"/> Interference (UJ-22) <input type="checkbox"/> Other:			
8.8 Results qualified J-23H due to <input type="checkbox"/> diphenyl ether <input type="checkbox"/> chromatographic interference.			
8.8 Are GC/HPLC second column results within RPD limits? <input type="checkbox"/> All ND <input type="checkbox"/> J-3 for 40%<RPD<60% <input type="checkbox"/> NJ-3 for >60% <input type="checkbox"/> see below <input type="checkbox"/> see attached			
8.9 Were TICS requested for this project and, if so, are they reported as required?			
8.10 TICs qualified NJ-4 to indicate tentatively identified compound.			
8.11 Are all COCs/sections/forms/raw data present and accurate?			
8.12 In the EDD or database, has the Result Reportable field been verified?			
8.13 Data reporting units: <input type="checkbox"/> ug/l <input type="checkbox"/> mg/l <input type="checkbox"/> ng/l <input type="checkbox"/> ug/kg <input type="checkbox"/> mg/kg <input type="checkbox"/> ug/kg <input type="checkbox"/> %			
<i>Secondary:</i> Technical Agreement with sample results evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
<b>Comments:</b> <input type="checkbox"/> Dilutions (see HT Table). <input type="checkbox"/> Results estimated J-14 – see details below.			

**9.0 Secondary Report Narrative Review**

Y N N/A

9.1 Does the narrative report meet all client specifications for content and format?			
9.2 Does the narrative report note any deviations from project validation guidance documents and if so, is rationale provided?			
9.3 Does the report adequately document and discuss <input type="checkbox"/> data anomalies and/or resubmitted data?			
9.4 Were client/field sample IDs used in the report narrative (verify transcription against COC)?			
9.5 Does the Overall Assessment include all required elements? (Adherence to methods; discussion of precision and accuracy; summary of assigned qualifiers, and usability statement)			
9.6 Does the usability statement properly reflect the assigned qualifiers and/or rejected data?			
<b>Comments:</b>			

Project No.:	_____	1° Rev: _____	Date: _____
Project Name:	_____	2° Rev: _____	Date: _____
Lab & SDG:	_____		
Analysis:	_____		

## HRMS TECHNICAL EVALUATION CHECKLIST FOR STAGE 4 DV

(Covers summaries of blanks, accuracy, precision, sample results, calibration, instrument performance, compound ID & recalculations)

DV Criteria Table:  Default  Client/Program Specific - Control Limits:  Lab  QAPP/SAP  Other:

Qualifiers Issued:  No  Yes      Qualifiers added to:  EDD/Database  Form 1s

### 1.0 Chain-of-Custody/Holding Time/Preservation

Y    N    N/A

1.1 Are COCs included, properly signed, and dated?			
1.2 Are all cooler temperatures within the control limits? <input type="checkbox"/> 0-6°C <input type="checkbox"/> Frozen <-20°C±10°C <input type="checkbox"/> see attached Holding Time worksheet or spreadsheet <input type="checkbox"/> see below			
1.3 Were all samples preserved properly? Indicate method(s) of preservation <input type="checkbox"/> Cool <input type="checkbox"/> Frozen <input type="checkbox"/> Other:			
1.4 Samples analyzed within holding time? <input type="checkbox"/> see HT eval spreadsheet <input type="checkbox"/> see below			
<i>Secondary:</i> Technical Agreement with HT evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
<b>Comments:</b> <input type="checkbox"/> Data judged as not significantly affected by outliers; no qualifiers assigned.			

### 2.0 Method/Field Blanks

Y    N    N/A

2.1 Are Method Blanks free from contamination? <input type="checkbox"/> see attached Blank Summary Form or data package page <input type="checkbox"/> see below			
2.2 Are there any equipment/field blanks included in the data package? (list below)			
2.3 Are equipment/field blanks free from contamination? <input type="checkbox"/> see attached Blank Summary Form or data package page <input type="checkbox"/> see below			
<i>Secondary:</i> Technical Agreement with MB/FB evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
<b>Comments:</b> <input type="checkbox"/> No positive results in associated samples; no action required for method / equip. / other.			

### 3.0 Laboratory Control Sample (OPR Sample) LCS or OPR LCS/LCSD

Y    N    N/A

3.1 Are all %R-values within the control limits? <b>Limits:</b> <input type="checkbox"/> Lab <input type="checkbox"/> Method <input type="checkbox"/> Project <input type="checkbox"/> see attached Summary Form or data package page <input type="checkbox"/> see below			
3.2 Are all RPD values within control limits (if duplicate analyzed)? <input type="checkbox"/> see attached Summary Form or data package page <input type="checkbox"/> see below			
<i>Secondary:</i> Technical Agreement with LCS/LCSD/OPR evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
<b>Comments:</b> <input type="checkbox"/> No positive results in associated samples; no qualifiers as all outliers were > UCL (high bias) <input type="checkbox"/> No qualifiers assigned; one outlier per fraction/column acceptable if > 10%.			

#### 4.0 Labeled Compounds

Y N N/A

4.1 Are all recovery values within the control limits? <b>Limits:</b> <input type="checkbox"/> Lab <input type="checkbox"/> Method <input type="checkbox"/> Project <input type="checkbox"/> see attached Labeled Compound Summary Form or data package page <input type="checkbox"/> see below			
<b>Secondary:</b> Technical Agreement with labeled compound evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
<b>Comments:</b> <input type="checkbox"/> No positive results; no qualifiers as all outliers were > UCL (high bias). <input type="checkbox"/> No qualifiers assigned; one outlier per fraction/column acceptable (if > 10%). <input type="checkbox"/> No qualifiers assigned; sample diluted to a conc < low std preventing accurate recovery.			

#### 5.0 Matrix Spike/Matrix Spike Duplicate or Sample and Lab Duplicate (List Parent Sample ID below)

Y N N/A

5.1 Are all %R-values within the control limits? <b>Limits:</b> <input type="checkbox"/> Lab <input type="checkbox"/> Method <input type="checkbox"/> Project <input type="checkbox"/> see attached MS/MSD Summary Form or data package page <input type="checkbox"/> see below			
5.2 Are all RPD values within control limits? <input type="checkbox"/> see attached MS/MSD Summary Form or data package page <input type="checkbox"/> see below			
<b>Secondary:</b> Technical Agreement with matrix spike and/or lab duplicate evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
<b>Comments:</b> <input type="checkbox"/> No positive results in parent sample; no qualifiers as all outliers were > UCL (high bias) or RPD only outlier & parent ND. <input type="checkbox"/> Not required by method. <input type="checkbox"/> No qualifiers assigned; sample diluted to a conc < low std preventing accurate recovery. <input type="checkbox"/> The following analyte parent concentrations > 4X spike level; no action.			

#### 6.0 Field Duplicate (FD) (List Field Duplicate Sample IDs below)

Y N N/A

6.1 Were field duplicates collected and analyzed? <input type="checkbox"/> RPD/Difference Calculation Attached			
6.2 For results >5X the RL, are RPD values within the control limit? <b>Limits:</b> <input type="checkbox"/> EC Default <input type="checkbox"/> Project <input type="checkbox"/> see attached Calculation Sheet <input type="checkbox"/> see below			
6.3 For results less than 5X the RL, are the differences less than the RL (2X the RL for solid matrices)? <input type="checkbox"/> see attached Calculation Sheet <input type="checkbox"/> see below			
<b>Secondary:</b> Technical Agreement with FD evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
<b>Comments:</b> <input type="checkbox"/> No qualifiers assigned based on FD outliers <input type="checkbox"/> Qualify FD samples			

**7.0 Standard Reference Material (SRM) or Certified Reference Material (CRM)** Y   N   N/A

7.1 Was an SRM sample(s) analyzed? <b>SRM/CRM Sample ID(s):</b>			
7.2 Are all values within control limits? <b>Limits:</b> <input type="checkbox"/> EC Default <input type="checkbox"/> Project <input type="checkbox"/> see below <input type="checkbox"/> see attached			
<i>Secondary:</i> Technical Agreement with SRM/CRM evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
<b>Comments:</b> <input type="checkbox"/> No qualifiers assigned based on SRM/CRM outliers			

**8.0 Instrument Performance** Y   N   N/A

8.1 Are PFK static resolving power checks performed at the required frequency?			
8.2 Was PFK resolving power at least 10,000 (10% valley definition) for an appropriate mass?			
8.3 Was the resolving power zeroed correctly (i.e. were the bases of peak displays within the lower grid intersections)?			
8.4 Was the exact mass within 5 ppm of the theoretical mass? (see method for specific mass and criteria) <input type="checkbox"/> see below			
8.5 Was the GC windows-defining mixture analyzed at the required frequency?			
8.6 Are any/all chromatographic separation (valley/peak) criteria met? <input type="checkbox"/> see below			
8.7 Are retention time windows established for all homologue groups?			
<i>Secondary:</i> Technical Agreement with instrument performance evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
<b>Comments:</b>			

**9.0 Initial Calibration** Y   N   N/A

9.1 Are ICALs analyzed on all instruments on which samples are analyzed?			
9.2 Are the correct number and concentration of standards used?			
9.3 Are all ion abundance ratios for unlabeled and labeled compounds within method QC limits? <input type="checkbox"/> see attached ICAL Summary Form or data package page <input type="checkbox"/> see below			
9.4 Is the method-specified signal to noise (S/N) criteria met? <input type="checkbox"/> see attached ICAL Summary Form or data package page <input type="checkbox"/> see below			
9.5 Are the %RSD values for the native compounds within QC limits? <input type="checkbox"/> ±20%RSD <input type="checkbox"/> Other: <input type="checkbox"/> see attached ICAL Summary Form or data package page <input type="checkbox"/> see below			
9.6 Are the %RSD values for the labeled compounds within QC limits? <input type="checkbox"/> ±30%RSD <input type="checkbox"/> ±35%RSD <input type="checkbox"/> Other: <input type="checkbox"/> see attached ICAL Summary Form or data package page <input type="checkbox"/> see below			
9.7 Are any/all absolute retention time criteria met? <input type="checkbox"/> see attached ICAL Summary Form or data package page <input type="checkbox"/> see below			
<i>Secondary:</i> Technical Agreement with initial calibration evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
<b>Comments:</b> <input type="checkbox"/> No positive results assoc. w/ outliers; RL judged as not affected – no qualifiers assigned.			

### 10.0 Continuing Calibration

	Y	N	N/A
10.1 Are continuing calibration/calibration verification standards analyzed at the proper frequency?			
10.2 Are all ion abundance ratios for unlabeled and labeled compounds within method QC limits? <input type="checkbox"/> see attached CCAL Summary Form or data package page <input type="checkbox"/> see below			
10.3 Is the method-specified signal to noise (S/N) criteria met? <input type="checkbox"/> see attached CCAL Summary Form or data package page <input type="checkbox"/> see below			
10.4 Are any/all absolute retention time criteria met? <input type="checkbox"/> see attached CCAL Summary Form or data package page <input type="checkbox"/> see below			
10.5 Are CCALs acceptable <input type="checkbox"/> %D <input type="checkbox"/> %R 70%-130% natives/50-150% labeled <input type="checkbox"/> Conc Values <input type="checkbox"/> other? <input type="checkbox"/> see attached CCAL Summary Form or data package page <input type="checkbox"/> see below			
<b>Secondary:</b> Technical Agreement with continuing calibration evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
<b>Comments:</b> <input type="checkbox"/> No positive results assoc. w/ outliers; RL judged as not affected – no qualifiers assigned. <input type="checkbox"/> RF historically low; no qualifiers assigned since response is stable			

### 11.0 Compound Identification

	Y	N	N/A
11.1 Were all retention time criteria met? <input type="checkbox"/> see below			
11.2 Were the retention times of all the native compound ions within ±2 seconds of the labeled compound ions? <input type="checkbox"/> see below			
11.3 Were the ion abundance ratios within the method QC limits? <input type="checkbox"/> see below			
11.4 Were all S/N ratio criteria met? <input type="checkbox"/> see below			
11.5 Lab used column: _____. Adequate TCDF separation achieved; confirmation not required. <input type="checkbox"/> When checked, lab does not confirm results <RL.			
11.6 If a DB-5 (or equivalent) was used, was confirmation performed for 2378-TCDF hits?			
11.7 Were there any false positives or negatives?			
<b>Secondary:</b> Technical Agreement with compound identification calibration evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
<b>Comments:</b> EMPC flagged values indicate ion abundance ratio criterion for positive ID not met. Results have been Qualified as: <input type="checkbox"/> U-25 for native compounds & <input type="checkbox"/> J-25 for homolog groups <input type="checkbox"/> Lab does not EMPC homolog groups OR <input type="checkbox"/> Lab reported these results as ND (not detected)			

### 12.0 Sample Results/Completeness Check

Y N N/A

12.1 Are there results for all analytes on the client required target compound list(s)? <b>see SAP/QAPP for lists</b>			
12.2 Are reporting limits and sample results adjusted for sample size, final volume, dilutions, etc.?			
12.3 Are concentrations reported on the appropriate basis? <input type="checkbox"/> Dry weight <input type="checkbox"/> Wet weight <input type="checkbox"/> Both			
12.4 Do detection limits meet project-specific or method-specific limits?			
12.5 Results were DNR-11 flagged to indicate most appropriate result from multiple reported results.			
12.6 Results qualified J-20 to indicate concentration is greater than calibration range.			
12.7 DLs/RLs elevated due to <input type="checkbox"/> Diln <input type="checkbox"/> %M <input type="checkbox"/> Samp Vol <input type="checkbox"/> Final volume <input type="checkbox"/> Interference (UJ-22) <input type="checkbox"/> Other:			
12.8 Results qualified J-23H due to diphenyl ether interference.			
12.9 Are all COCs/sections/forms/raw data present and accurate?			
12.10 In the EDD or database, has the Result Reportable field been verified?			
12.11 Data reporting units: <input type="checkbox"/> ug/l <input type="checkbox"/> mg/l <input type="checkbox"/> ng/l <input type="checkbox"/> ug/kg <input type="checkbox"/> mg/kg <input type="checkbox"/> ug/kg <input type="checkbox"/> %			
<b>Secondary:</b> Technical Agreement with sample results evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
<b>Comments:</b> <input type="checkbox"/> Dilutions (see HT Table). <input type="checkbox"/> Results estimated J-14 – see details below.			

### 13.0 Recalculation Checks

Y N N/A

13.1 Recalculation completed for: <input type="checkbox"/> Initial & <input type="checkbox"/> Continuing Calibration(s) # <b>points for curve:</b>			
13.2 Recalculation completed for: <input type="checkbox"/> LCS <input type="checkbox"/> LCS/LCSD <input type="checkbox"/> MS <input type="checkbox"/> MS/MSD			
13.3 Recalculation completed for field sample(s)?			
13.4 Transcription checks completed for: <input type="checkbox"/> Tune <input type="checkbox"/> Interference Check Std <input type="checkbox"/> RL Std <input type="checkbox"/> Serial Dilution			
13.5 Transcription checks completed for blanks? <input type="checkbox"/> Laboratory <input type="checkbox"/> Instrument <input type="checkbox"/> Field			
<b>Secondary:</b> Technical Agreement with recalculations? <input type="checkbox"/> evaluation and DV report agree <input type="checkbox"/> see below			
<b>Comments:</b> <input type="checkbox"/> Dilutions (see HT Table)			

### 14.0 Secondary Report Narrative Review

Y N N/A

14.1 Does the narrative report meet all client specifications for content and format?			
14.2 Does the narrative report note any deviations from project validation guidance documents and if so, is rationale provided?			
14.3 Does the report adequately document and discuss <input type="checkbox"/> data anomalies and/or resubmitted data?			
14.4 Were client/field sample IDs used in the report narrative (verify transcription against COC)?			
14.5 Does the Overall Assessment include all required elements? (Adherence to methods; discussion of precision and accuracy; summary of assigned qualifiers, and usability statement.)			
14.6 Does the usability statement properly reflect the assigned qualifiers and/or rejected data?			
<b>Comments:</b>			



Project No.: _____	1° Rev: _____ Date: _____
Project Name: _____	2° Rev: _____ Date: _____
Lab & SDG: _____	
Analysis: _____	

## INORGANICS TECHNICAL EVALUATION CHECKLIST FOR STAGE 2A DV

(Covers summaries of blanks; accuracy; precision; and sample results)

DV Criteria Table:  Default  Client/Program Specific - Control Limits:  Lab  QAPP/SAP  Other:

Qualifiers Issued:  **No**  **Yes**      Qualifiers added to:  EDD/Database  Form 1s

### 1.0 Chain-of-Custody / Holding Time / Preservation

Y      N      N/A

1.1 Are COCs included, properly signed, and dated?			
1.2 Are all cooler temperatures within the control limits? <input type="checkbox"/> 0-6°C <input type="checkbox"/> Frozen <-20°C±10°C <input type="checkbox"/> see attached Holding Time worksheet or spreadsheet <input type="checkbox"/> see below			
1.3 Were all samples chemically preserved properly? Indicate method(s) of preservation <input type="checkbox"/> Cool <input type="checkbox"/> Frozen <input type="checkbox"/> HCl to pH <2 <input type="checkbox"/> HNO <sub>3</sub> to pH <2 <input type="checkbox"/> H <sub>2</sub> SO <sub>4</sub> <input type="checkbox"/> NaOH to pH>12 <input type="checkbox"/> Other:			
1.4 Samples analyzed within holding time? <input type="checkbox"/> see HT eval spreadsheet <input type="checkbox"/> see below			
Secondary: Technical Agreement with HT evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments: <input type="checkbox"/> Data judged as not significantly affected by outliers; no qualifiers assigned.			

### 2.0 Method Blank(s)

Y      N      N/A

2.1 Are method blanks free from contamination? <input type="checkbox"/> see attached Blank Summary Forms <input type="checkbox"/> see blank eval spreadsheet <input type="checkbox"/> see below			
Secondary: Technical Agreement with MB evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments: <input type="checkbox"/> Analyzed at proper frequency			

### 3.0 Field Blank(s)

Y      N      N/A

3.1 Are there any field blanks associated with the field samples? (list below)			
3.2 Are equipment/field blanks free from contamination? <input type="checkbox"/> see attached Blank Summary Forms <input type="checkbox"/> see blank eval spreadsheet <input type="checkbox"/> see below			
Secondary: Technical Agreement with EB/FB evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments:			

Project No.:	SDG:
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#### 4.0 Laboratory Control Sample and/or Standard Reference Material (SRM/CRM)

Y N N/A

4.1 Are all LCS %R values within the control limits? <b>Limits:</b> <input type="checkbox"/> Lab <input type="checkbox"/> Method <input type="checkbox"/> Project <input type="checkbox"/> see attached LCS Summary Forms <input type="checkbox"/> see below			
4.2 If an LCSD was analyzed, are all RPD values within control limits? <input type="checkbox"/> see attached LCS Summary Forms <input type="checkbox"/> see below			
4.3 Are all SRM recoveries within the acceptance limits? <b>Limits:</b> <input type="checkbox"/> EC Default <input type="checkbox"/> Project <input type="checkbox"/> Other: <input type="checkbox"/> see attached SRM Summary Forms <input type="checkbox"/> see below			
<i>Secondary:</i> Technical Agreement with LCS and/or SRM evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments: <input type="checkbox"/> Analyzed at proper frequency			

#### 5.0 Matrix Spike (and Matrix Spike Duplicate - if analyzed)

Y N N/A

5.1 Are all %R values within the control limits? <b>Limits:</b> <input type="checkbox"/> Lab <input type="checkbox"/> Method <input type="checkbox"/> Project <input type="checkbox"/> see attached MS/MSD Summary Forms or data package pages <input type="checkbox"/> see below			
5.2 If an MSD was analyzed, are all RPD values within control limits? <input type="checkbox"/> see attached MS/MSD Summary Forms or data package pages <input type="checkbox"/> see below			
<i>Secondary:</i> Technical Agreement with MS or MS/MSD evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments: <input type="checkbox"/> Analyzed at proper frequency <input type="checkbox"/> Outliers: Post Digestion Spike Required for %R<30%. <i>List all QC samples associated with each prep batch.</i>			

#### 6.0 Laboratory Duplicate

Y N N/A

6.1 For results >5X the RL, are RPD values within the control limit? <b>Limits:</b> <input type="checkbox"/> EC Default <input type="checkbox"/> Project <input type="checkbox"/> see attached summary forms or spreadsheet <input type="checkbox"/> see below			
6.2 For results less than 5X the RL, are the differences less than the RL (2X the RL for solid matrices)? <input type="checkbox"/> see attached summary forms <input type="checkbox"/> see below			
<i>Secondary:</i> Technical Agreement with LD evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments: <input type="checkbox"/> Analyzed at proper frequency. <i>List all QC samples associated with each prep batch.</i>			

Project No.:	SDG:
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7.0 Field Duplicates (List Field Duplicate Sample IDs below)

Y N N/A

7.1 Were field duplicates collected and analyzed? <input type="checkbox"/> RPD/Difference Calculation Attached			
7.2 For results >5X the RL, are RPD values within the control limit? <b>Limits:</b> <input type="checkbox"/> EC Default <input type="checkbox"/> Project <input type="checkbox"/> see attached Calculation Sheet <input type="checkbox"/> see below			
7.3 For results less than 5X the RL, are the differences less than the RL (2X the RL for solid matrices)? <input type="checkbox"/> see attached Calculation Sheet <input type="checkbox"/> see below			
Secondary: Technical Agreement with FD evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments: <input type="checkbox"/> No qualifiers assigned based on field duplicate outliers. <input type="checkbox"/> Qualify field duplicate samples.			

8.0 Serial Dilutions

Y N N/A

8.1 Are serial dilution %D values within the control limits? Limits: <input type="checkbox"/> 6010D: 20% >25xRL <input type="checkbox"/> 6010C: 10% >10xRL <input type="checkbox"/> 6010B: 10% >50x MDL <input type="checkbox"/> Other: <input type="checkbox"/> see attached summary forms or spreadsheet <input type="checkbox"/> see below			
Secondary: Technical Agreement with serial dilution evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments: <input type="checkbox"/> Not required for 200.8.			

9.0 Sample Results/Completeness Check

Y N N/A

9.1 Are there results for all analytes on the client required target compound list(s)? see SAP/QAPP for lists			
9.2 Are reporting limits and sample results adjusted for sample size, final volume, dilutions, etc.?			
9.3 Are concentrations reported on the appropriate basis? <input type="checkbox"/> Dry weight <input type="checkbox"/> Wet weight <input type="checkbox"/> Both			
9.4 Do detection limits meet project-specific or method-specific limits?			
9.5 Results were DNR-11 flagged to indicate most appropriate result from multiple reported results.			
9.6 Results qualified J-20 to indicate concentration is greater than calibration range.			
9.7 DLs/RLs elevated due to <input type="checkbox"/> Dilution <input type="checkbox"/> Moisture <input type="checkbox"/> Sample volume <input type="checkbox"/> Final volume <input type="checkbox"/> Other: _____			
9.8 Are related results appropriately qualified i.e., speciated chromium?			
9.9 Are total results greater than corresponding dissolved results? <input type="checkbox"/> within lab precision criteria			
9.10 Are all COCs/sections/forms/raw data present and accurate?			
9.11 In the EDD or database, has the Result Reportable field been verified?			
9.12 Data reporting units: <input type="checkbox"/> ug/l <input type="checkbox"/> mg/l <input type="checkbox"/> ng/l <input type="checkbox"/> ug/kg <input type="checkbox"/> mg/kg <input type="checkbox"/> ug/kg <input type="checkbox"/> %			
Secondary: Technical Agreement with sample results evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments: <input type="checkbox"/> Dilutions (see HT Table.)			

Project No.:	SDG:
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10.0 *Secondary* Report Narrative Review

Y N N/A

10.1 Does the narrative report meet all client specifications for content and format?			
10.2 Does the narrative report note any deviations from project validation guidance documents and if so, is rationale provided?			
10.3 Does the report adequately document and discuss data anomalies and/or resubmitted data?			
10.4 Were client/field sample IDs used in the report narrative (verify transcription against COC)?			
10.5 Does the Overall Assessment include all required elements? (Adherence to methods; discussion of precision and accuracy; summary of assigned qualifiers, and usability statement)			
10.6 Does the usability statement properly reflect the assigned qualifiers and/or rejected data?			

Comments:



Project No.: _____	1° Rev: _____ Date: _____
Project Name: _____	2° Rev: _____ Date: _____
Lab & SDG: _____	
Analysis: _____	

## INORGANICS TECHNICAL EVALUATION CHECKLIST FOR STAGE 3 DV

(Covers summaries of blanks, accuracy, precision, sample results, calibration, instrument performance, compound ID & recalculations)

DV Criteria Table:  Default  Client/Program Specific - Control Limits:  Lab  QAPP/SAP  Other:

Qualifiers Issued:  No  Yes      Qualifiers added to:  EDD/Database  Form 1s

### 1.0 Chain-of-Custody / Holding Time / Preservation

Y      N      N/A

1.1 Are COCs included, properly signed, and dated?			
1.2 Are all cooler temperatures within the control limits? <input type="checkbox"/> 0-6°C <input type="checkbox"/> Frozen <-20°C±10°C <input type="checkbox"/> see attached Holding Time worksheet or spreadsheet <input type="checkbox"/> see below			
1.3 Were all samples chemically preserved properly? Indicate method(s) of preservation <input type="checkbox"/> Cool <input type="checkbox"/> Frozen <input type="checkbox"/> HCl to pH <2 <input type="checkbox"/> HNO <sub>3</sub> to pH <2 <input type="checkbox"/> H <sub>2</sub> SO <sub>4</sub> <input type="checkbox"/> NaOH to pH>12 <input type="checkbox"/> Other:			
1.4 Samples analyzed within holding time? <input type="checkbox"/> see HT eval spreadsheet <input type="checkbox"/> see below			
Secondary: Technical Agreement with HT evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments: <input type="checkbox"/> Data judged as not significantly affected by outliers; no qualifiers assigned.			

### 2.0 Method Blank(s)

Y      N      N/A

2.1 Are method blanks free from contamination? <input type="checkbox"/> see attached Blank Summary Forms <input type="checkbox"/> see blank eval spreadsheet <input type="checkbox"/> see below			
Secondary: Technical Agreement with MB evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments: <input type="checkbox"/> Analyzed at proper frequency.			

### 3.0 Field Blank(s)

Y      N      N/A

3.1 Are there any field blanks associated with the field samples? (list below)			
3.2 Are equipment/field blanks free from contamination? <input type="checkbox"/> see attached Blank Summary Forms <input type="checkbox"/> see blank eval spreadsheet <input type="checkbox"/> see below			
Secondary: Technical Agreement with EB/FB evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments:			



### 8.0 Serial Dilutions

Y    N    N/A

8.1 Are serial dilution %D values within the control limits? Limits: <input type="checkbox"/> 6010D: 20% >25xRL <input type="checkbox"/> 6010C: 10% >10xRL <input type="checkbox"/> 6010B: 10% >50x MDL <input type="checkbox"/> Other: <input type="checkbox"/> see attached summary forms or spreadsheet <input type="checkbox"/> see below			
<i>Secondary:</i> Technical Agreement with serial dilution evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments: <input type="checkbox"/> Not required for 200.8.			

### 9.0 Internal Standards (IS) -- ICP-MS only

Y    N    N/A

9.1 Were IS recoveries within the control limits? Limits: <input type="checkbox"/> 6020B >30% <input type="checkbox"/> 6020A > 70% <input type="checkbox"/> NFG 65-125% <input type="checkbox"/> Other: <input type="checkbox"/> see attached IS Summary Forms <input type="checkbox"/> see below			
<i>Secondary:</i> Technical Agreement with internal standard evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments:			

### 10.0 ICP-MS Tune

Y    N    N/A

10.1 Are the mass calibration values less than +/- 0.1amu from the true value? <input type="checkbox"/> see attached Tune <input type="checkbox"/> see below			
10.2 Are the peak resolution values less than 0.9 amu at 10% peak height? (or <0.75 amu at 5% pk ht) <input type="checkbox"/> see attached Tune <input type="checkbox"/> see below			
10.3 Are the %RSD values for mass range monitoring ions less than 5%? ( <i>Not applicable to 6020B.</i> ) <input type="checkbox"/> see attached Tune <input type="checkbox"/> see below			
<i>Secondary:</i> Technical Agreement with ICP-MS Tuner evaluation and qualification? <input type="checkbox"/> no qualifiers <input type="checkbox"/> evaluation and DV report agree <input type="checkbox"/> see below			
Comments:			

### 11.0 Instrument Calibration

Y    N    N/A

11.1 Were ICALs analyzed on all instruments on which samples are analyzed?			
11.2 Were a sufficient number of standards analyzed for the ICAL?			
11.3 Are ICAL calibration factors acceptable? Limits: <input type="checkbox"/> 6010D/6020B: $r > 0.995$ or $r^2 > 0.990$ <input type="checkbox"/> 6010C/6020A: $r > 0.998$ <input type="checkbox"/> Other: <input type="checkbox"/> see attached ICAL <input type="checkbox"/> see below			
11.4 Were ICVs and CCVs analyzed at the proper frequency?			
11.5 Are ICVs and CCVs acceptable (ICP& ICP-MS 90-110%, Hg & CN 85-115%)? <input type="checkbox"/> see attached ICV/CCV Summary Forms <input type="checkbox"/> see below			
<i>Secondary:</i> Technical Agreement with instrument calibration evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments: <input type="checkbox"/> ICP and/or ICP-MS calibrated with one blank and one standard; no linearity check available.			

### 12.0 Calibration/Instrument Blanks

Y    N    N/A

12.1 Are instrument blanks free from contamination? <input type="checkbox"/> see attached Blank Summary Forms <input type="checkbox"/> see below			
<i>Secondary:</i> Technical Agreement with calibration/instrument blank evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments: <input type="checkbox"/> Analyzed at proper frequency.			

### 13.0 Reporting Limit (CRQL) Standards

Y    N    N/A

13.1 Are reporting limit standard %R values within the control limits? <input type="checkbox"/> see attached RL Standard Summary Forms <input type="checkbox"/> see below			
<i>Secondary:</i> Technical Agreement with Reporting Limit Standard evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments: 6010D, 6020B – ICVLL, CCVLL			

### 14.0 Interference Check Samples (ICSA/ICSAB/SIC)

Y    N    N/A

14.1 For the ICSAB, are results within $\pm 20\%$ of the true value? ( <i>ICSAB not required for 6010D &amp; 6020B</i> ) <input type="checkbox"/> see attached ICS Summary Forms <input type="checkbox"/> see below			
14.2 a. For the ICSA/SIC, are results for non-spiked elements within $\pm 2x$ the RL (CRQL, LLOQ)? <input type="checkbox"/> see attached ICS Summary Forms <input type="checkbox"/> see below			
14.3 b. For elements that are greater than $\pm 2x$ the RL, are the concentrations of the associated interfering elements in the field samples less than the ICS/SIC levels? <input type="checkbox"/> see below (if "yes" – no action required, if no, evaluate using TM-09/TM-14)			
<i>Secondary:</i> Technical Agreement with Interference Check Sample evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments: Methods 6010D, 6020B – SIC is unspiked, no spiked interference check sample required.			

### 15.0 Recalculation Checks

Y    N    N/A

15.1 Recalculation completed for: <input type="checkbox"/> Initial & <input type="checkbox"/> Continuing Calibration(s) # points for curve:			
15.2 Recalculation completed for: <input type="checkbox"/> LCS <input type="checkbox"/> LCS/LCSD <input type="checkbox"/> MS <input type="checkbox"/> MS/MSD			
15.3 Recalculation completed for field sample(s)?			
15.3 Transcription checks completed for: <input type="checkbox"/> Tune <input type="checkbox"/> Interference Check Std <input type="checkbox"/> RL Std <input type="checkbox"/> Serial Dil			
15.4 Transcription checks completed for blanks? <input type="checkbox"/> Laboratory <input type="checkbox"/> Instrument <input type="checkbox"/> Field			
<i>Secondary:</i> Technical Agreement with recalculation evaluation and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments: <input type="checkbox"/> Dilutions (see HT Table.)			

Project No.:	SDG:
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16.0 Sample Results & Completeness Check

Y N N/A

16.1 Are there results for all analytes on the client required target compound list(s)? see SAP/QAPP for lists			
16.2 Are reporting limits and sample results adjusted for sample size, final volume, dilutions, etc.?			
16.3 Are concentrations reported on the appropriate basis? <input type="checkbox"/> Dry weight <input type="checkbox"/> Wet weight <input type="checkbox"/> Both			
16.4 Do detection limits meet project-specific or method-specific limits?			
16.5 Results were DNR-11 flagged to indicate most appropriate result from multiple reported results.			
16.6 Results qualified J-20 to indicate concentration is greater than calibration range.			
16.7 DLs/RLs elevated due to <input type="checkbox"/> Dilution <input type="checkbox"/> Moisture <input type="checkbox"/> Sample volume <input type="checkbox"/> Final volume <input type="checkbox"/> Other: _____			
16.8 Are related results appropriately qualified i.e., speciated chromium?			
16.9 Are total results greater than corresponding dissolved results? <input type="checkbox"/> within lab precision criteria			
16.10 Are all COCs/sections/forms/raw data present in the data package and accurate?			
16.11 In the EDD or database, has the Result Reportable field been verified?			
16.12 Data reporting units: <input type="checkbox"/> ug/l <input type="checkbox"/> mg/l <input type="checkbox"/> ng/l <input type="checkbox"/> ug/kg <input type="checkbox"/> mg/kg <input type="checkbox"/> ug/kg <input type="checkbox"/> %			
Secondary: Technical Agreement with sample results evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments: <input type="checkbox"/> Dilutions (see HT Table.)			

17.0 Secondary Report Narrative Review

Y N N/A

17.1 Does the narrative report meet all client specifications for content and format?			
17.2 Does the narrative report note any deviations from project validation guidance documents and if so, is rationale provided?			
17.3 Does the report adequately document and discuss data anomalies and/or resubmitted data?			
17.4 Were client/field sample IDs used in the report narrative (verify transcription against COC)?			
17.5 Does the Overall Assessment include all required elements? (Adherence to methods; discussion of precision and accuracy; summary of assigned qualifiers, and usability statement)			
17.6 Does the usability statement properly reflect the assigned qualifiers and/or rejected data?			
Comments:			



Project No.: _____	1° Rev: _____ Date: _____
Project Name: _____	2° Rev: _____ Date: _____
Lab & SDG: _____	
Analysis: _____	

## ORGANICS/HRMS TECHNICAL EVALUATION CHECKLIST FOR STAGE 2A DV

(Covers summaries of blanks; accuracy; precision; and sample results)

DV Criteria Table:  Default  Client/Program Specific - Control Limits:  Lab  QAPP/SAP  Other:

Qualifiers Issued:  **No**  **Yes**      Qualifiers added to:  EDD/Database  Form 1s

### 1.0 Chain-of-Custody/Holding Time/Preservation

Y    N    N/A

1.1 Are COCs included, properly signed, and dated?			
1.2 Are all cooler temperatures within the control limits? <input type="checkbox"/> 0-6°C <input type="checkbox"/> Frozen <-20°C±10°C <input type="checkbox"/> see attached Holding Time worksheet or spreadsheet <input type="checkbox"/> see below			
1.3 Were all samples chemically preserved properly? Indicate method(s) of preservation <input type="checkbox"/> Cool <input type="checkbox"/> Frozen <input type="checkbox"/> HCl to pH <2 <input type="checkbox"/> MeOH <input type="checkbox"/> NaHSO <sub>3</sub> <input type="checkbox"/> Other:			
1.4 Samples analyzed within holding time? <input type="checkbox"/> see HT eval spreadsheet <input type="checkbox"/> see below			
Secondary: Technical Agreement with HT evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments: <input type="checkbox"/> Data judged as not significantly affected by outliers; no qualifiers assigned.			

### 2.0 Method/Field/Trip Blanks

Y    N    N/A

2.1 Are Method Blanks free from contamination? <input type="checkbox"/> see attached Blank Summary Form or data package page <input type="checkbox"/> see below			
2.2 Are there any <input type="checkbox"/> trip and/or <input type="checkbox"/> equipment/field blanks included in the data package? (list below)			
2.3 Are trip and/or equipment/field blanks free from contamination? <input type="checkbox"/> see attached Blank Summary Form or data package page <input type="checkbox"/> see below			
Secondary: Technical Agreement with MB/FB/TB evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments: <input type="checkbox"/> No positive results in associated samples; no action required for method / trip / equip. / other. <input type="checkbox"/> 10X action level established for common lab cont.; 5X action level for others.			

### 3.0 Laboratory Control Sample (Blank Spike/OPR Sample) LCS or OPR LCS/LCSD

Y    N    N/A

3.1 Are all %R-values within the control limits? <b>Limits:</b> <input type="checkbox"/> Lab <input type="checkbox"/> Method <input type="checkbox"/> Project <input type="checkbox"/> see attached Summary Form or data package page <input type="checkbox"/> see below			
3.2 Are all RPD values within control limits (if duplicate analyzed)? <input type="checkbox"/> see attached Summary Form or data package page <input type="checkbox"/> see below			
Secondary: Technical Agreement with LCS/LCSD/OPR evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
<b>Comments:</b> <input type="checkbox"/> No positive results in associated samples; no qualifiers as all outliers were > UCL (high bias) <input type="checkbox"/> No qualifiers assigned; one outlier per fraction/column acceptable if > 10%.			

Project No.:	SDG:
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#### 4.0 Surrogate/Labeled Compounds

Y N N/A

4.1 Are all recovery values within the control limits? <b>Limits:</b> <input type="checkbox"/> Lab <input type="checkbox"/> Method <input type="checkbox"/> Project <input type="checkbox"/> see attached Surrogate Summary Form or data package page <input type="checkbox"/> see below			
<i>Secondary:</i> Technical Agreement with surrogate/labeled compound evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
<b>Comments:</b> <input type="checkbox"/> No positive results; no qualifiers as all outliers were > UCL (high bias). <input type="checkbox"/> No qualifiers assigned; one outlier per fraction/column acceptable (if > 10%). <input type="checkbox"/> No qualifiers assigned; sample diluted to a conc < low std preventing accurate recovery.			

#### 5.0 Matrix Spike/Matrix Spike Duplicate or Sample and Lab Duplicate (*List Parent Sample ID below*)

Y N N/A

5.1 Are all %R-values within the control limits? <b>Limits:</b> <input type="checkbox"/> Lab <input type="checkbox"/> Method <input type="checkbox"/> Project <input type="checkbox"/> see attached MS/MSD Summary Form or data package page <input type="checkbox"/> see below			
5.2 Are all RPD values within control limits? <input type="checkbox"/> see attached MS/MSD Summary Form or data package page <input type="checkbox"/> see below			
<i>Secondary:</i> Technical Agreement with matrix spike and/or lab duplicate evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
<b>Comments:</b> <input type="checkbox"/> No positive results in parent sample; no qualifiers as all outliers were > UCL (high bias) or RPD only outlier & parent ND. <input type="checkbox"/> Not required by method. <input type="checkbox"/> No qualifiers assigned; sample diluted to a conc < low std preventing accurate recovery. <input type="checkbox"/> The following analyte parent concentrations > 4X spike level; no action.			

#### 6.0 Field Duplicate (FD) (*List Field Duplicate Sample IDs below*)

Y N N/A

6.1 Were field duplicates collected and analyzed? <input type="checkbox"/> RPD/Difference Calculation Attached			
6.2 For results >5X the RL, are RPD values within the control limit? <b>Limits:</b> <input type="checkbox"/> EC Default <input type="checkbox"/> Project <input type="checkbox"/> see attached Calculation Sheet <input type="checkbox"/> see below			
6.3 For results less than 5X the RL, are the differences less than the RL (2X the RL for solid matrices)? <input type="checkbox"/> see attached Calculation Sheet <input type="checkbox"/> see below			
<i>Secondary:</i> Technical Agreement with FD evaluation and qualification? <input type="checkbox"/> no qualifiers <input type="checkbox"/> evaluation and DV report agree <input type="checkbox"/> see below			
<b>Comments:</b> <input type="checkbox"/> No qualifiers assigned based on FD outliers <input type="checkbox"/> Qualify FD samples			

7.0 Standard Reference Material (SRM) or Certified Reference Material (CRM) Y    N    N/A

7.1 Was an SRM sample(s) analyzed? SRM/CRM Sample ID(s): _____			
7.2 Are all values within control limits? <b>Limits:</b> <input type="checkbox"/> EC Default <input type="checkbox"/> Project <input type="checkbox"/> no outliers <input type="checkbox"/> see below <input type="checkbox"/> see attached			
<i>Secondary:</i> Technical Agreement with SRM/CRM evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
<b>Comments:</b> <input type="checkbox"/> No qualifiers assigned based on SRM/CRM outliers			

8.0 Sample Results/Completeness Check Y    N    N/A

8.1 Are there results for all analytes on the client required target compound list(s)? see SAP/QAPP for lists			
8.2 Are reporting limits and sample results adjusted for sample size, final volume, dilutions, etc.?			
8.3 Are concentrations reported on the appropriate basis? <input type="checkbox"/> Dry weight <input type="checkbox"/> Wet weight <input type="checkbox"/> Both			
8.4 Do detection limits meet project-specific or method-specific limits?			
8.5 Results were DNR-11 flagged to indicate most appropriate result from multiple reported results.			
8.6 Results qualified J-20 to indicate concentration is greater than calibration range.			
8.7 DLs/RLs elevated due to <input type="checkbox"/> Dil <input type="checkbox"/> %M <input type="checkbox"/> Sample Vol <input type="checkbox"/> Final volume <input type="checkbox"/> Interference (UJ-22) <input type="checkbox"/> Other:			
8.8 Results qualified J-23H due to <input type="checkbox"/> diphenyl ether <input type="checkbox"/> chromatographic interference.			
8.8 Are GC/HPLC second column results within RPD limits? <input type="checkbox"/> All ND <input type="checkbox"/> J-3 for 40%<RPD<60% <input type="checkbox"/> NJ-3 for >60% <input type="checkbox"/> see below <input type="checkbox"/> see attached			
8.9 Were TICS requested for this project and, if so, are they reported as required?			
8.10 TICs qualified NJ-4 to indicate tentatively identified compound.			
8.11 Are all COCs/sections/forms/raw data present and accurate?			
8.12 In the EDD or database, has the Result Reportable field been verified?			
8.13 Data reporting units: <input type="checkbox"/> ug/l <input type="checkbox"/> mg/l <input type="checkbox"/> ng/l <input type="checkbox"/> ug/kg <input type="checkbox"/> mg/kg <input type="checkbox"/> ug/kg <input type="checkbox"/> %			
<i>Secondary:</i> Technical Agreement with sample results evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
<b>Comments:</b> <input type="checkbox"/> Dilutions (see HT Table). <input type="checkbox"/> Results estimated J-14 – see details below.			

9.0 Secondary Report Narrative Review Y    N    N/A

9.1 Does the narrative report meet all client specifications for content and format?			
9.2 Does the narrative report note any deviations from project validation guidance documents and if so, is rationale provided?			
9.3 Does the report adequately document and discuss <input type="checkbox"/> data anomalies and/or resubmitted data?			
9.4 Were client/field sample IDs used in the report narrative (verify transcription against COC)?			
9.5 Does the Overall Assessment include all required elements? (Adherence to methods; discussion of precision and accuracy; summary of assigned qualifiers, and usability statement)			
9.6 Does the usability statement properly reflect the assigned qualifiers and/or rejected data?			
<b>Comments:</b>			

Project No.: _____	1° Rev: _____ Date: _____
Project Name: _____	2° Rev: _____ Date: _____
Lab & SDG: _____	
Analysis: _____	

## ORGANICS TECHNICAL EVALUATION CHECKLIST FOR STAGE 4 DV

(Covers summaries of blanks, accuracy, precision, sample results, calibration, instrument performance, compound ID & recalculations)

DV Criteria Table:  Default  Client/Program Specific - Control Limits:  Lab  QAPP/SAP  Other:

Qualifiers Issued:  **No**  **Yes**      Qualifiers added to:  EDD/Database  Form 1s

### 1.0 Chain-of-Custody/Holding Time/Preservation

Y    N    N/A

1.1 Are COCs included, properly signed, and dated?			
1.2 Are all cooler temperatures within the control limits? <input type="checkbox"/> 0-6°C <input type="checkbox"/> Frozen <-20°C±10°C <input type="checkbox"/> see attached Holding Time worksheet or spreadsheet <input type="checkbox"/> see below			
1.3 Were all samples chemically preserved properly? Indicate method(s) of preservation <input type="checkbox"/> Cool <input type="checkbox"/> Frozen <input type="checkbox"/> HCl to pH <2 <input type="checkbox"/> MeOH <input type="checkbox"/> NaHSO <sub>3</sub> <input type="checkbox"/> Other _____			
1.4 Samples analyzed within holding time? <input type="checkbox"/> see HT eval spreadsheet <input type="checkbox"/> see below			
Secondary: Technical Agreement with HT evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments: <input type="checkbox"/> Data judged as not significantly affected by outliers; no qualifiers assigned.			

### 2.0 Method/Field/Trip Blanks

Y    N    N/A

2.1 Are Method Blanks free from contamination? <input type="checkbox"/> see attached Blank Summary Form or data package page <input type="checkbox"/> see below			
2.2 Are there any <input type="checkbox"/> trip and/or <input type="checkbox"/> equipment/field blanks included in the data package? (list below)			
2.3 Are trip and/or equipment/field blanks free from contamination? <input type="checkbox"/> see attached Blank Summary Form or data package page <input type="checkbox"/> see below			
Secondary: Technical Agreement with MB/FB/TB evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments: <input type="checkbox"/> No positive results in associated samples; no action required for method / trip / equip. / other. <input type="checkbox"/> 10X action level established for common lab cont.; 5X action level for others.			

### 3.0 Laboratory Control Sample (Blank Spike/OPR Sample) LCS or OPR LCS/LCSD

Y    N    N/A

3.1 Are all %R-values within the control limits? <b>Limits:</b> <input type="checkbox"/> Lab <input type="checkbox"/> Method <input type="checkbox"/> Project <input type="checkbox"/> see attached Summary Form or data package page <input type="checkbox"/> see below			
3.2 Are all RPD values within control limits (if duplicate analyzed)? <input type="checkbox"/> see attached Summary Form or data package page <input type="checkbox"/> see below			
Secondary: Technical Agreement with LCS/LCSD/OPR evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		

**Comments:**  No positive results in associated samples; no qualifiers as all outliers were > UCL (high bias)  
 No qualifiers assigned; one outlier per fraction/column acceptable if > 10%.

4.0 Surrogate/Labeled Compounds Y N N/A

4.1 Are all recovery values within the control limits? **Limits:**  Lab  Method  Project  
 see attached Surrogate Summary Form or data package page  see below

*Secondary:* Technical Agreement with surrogate/labeled compound evaluation and qualification and the evaluation and DV report agree?  see below

Quals			
<input type="checkbox"/>			

**Comments:**  No positive results; no qualifiers as all outliers were > UCL (high bias).  
 No qualifiers assigned; one outlier per fraction/column acceptable (if > 10%).  
 No qualifiers assigned; sample diluted to a conc < low std preventing accurate recovery.

5.0 Matrix Spike/Matrix Spike Duplicate or Sample and Lab Duplicate (*List Parent Sample ID below*) Y N N/A

5.1 Are all %R-values within the control limits? **Limits:**  Lab  Method  Project  
 see attached MS/MSD Summary Form or data package page  see below

5.2 Are all RPD values within control limits?  
 see attached MS/MSD Summary Form or data package page  see below

*Secondary:* Technical Agreement with matrix spike and/or lab duplicate evaluation and qualification and the evaluation and DV report agree?  see below

Quals			
<input type="checkbox"/>			

**Comments:**  No positive results in parent sample; no qualifiers as all outliers were > UCL (high bias) or RPD only outlier & parent ND.  Not required by method.  
 No qualifiers assigned; sample diluted to a conc < low std preventing accurate recovery.  
 The following analyte parent concentrations > 4X spike level; no action.

6.0 Field Duplicate (FD) (*List Field Duplicate Sample IDs below*) Y N N/A

6.1 Were field duplicates collected and analyzed?  RPD/Difference Calculation Attached

6.2 For results >5X the RL, are RPD values within the control limit? **Limits:**  EC Default  Project  
 see attached Calculation Sheet  see below

6.3 For results less than 5X the RL, are the differences less than the RL (2X the RL for solid matrices)?  
 see attached Calculation Sheet  see below

*Secondary:* Technical Agreement with FD evaluation and qualification and the evaluation and DV report agree?  see below

Quals			
<input type="checkbox"/>			

Comments:  No qualifiers assigned based on FD outliers     Qualify FD samples

7.0 Standard Reference Material (SRM) or Certified Reference Material (CRM) Y    N    N/A

7.1 Was an SRM sample(s) analyzed? SRM/CRM Sample ID(s): _____			
7.2 Are all values within control limits? <b>Limits:</b> <input type="checkbox"/> EC Default <input type="checkbox"/> Project <input type="checkbox"/> no outliers <input type="checkbox"/> see below <input type="checkbox"/> see attached			
<i>Secondary:</i> Technical Agreement with SRM/CRM evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
<b>Comments:</b> <input type="checkbox"/> No qualifiers assigned based on SRM/CRM outliers.			

9.0 Internal Standards Y    N    N/A

9.1 Are all internal standard areas within the control limits? <b>List limits:</b> <input type="checkbox"/> 50-200% Other: _____ <input type="checkbox"/> no outliers <input type="checkbox"/> see attached Int. Std. Summary Form or data package page <input type="checkbox"/> see below			
9.1 Are all internal standard RRT within the control limits? <input type="checkbox"/> no outliers <input type="checkbox"/> see attached Int. Std. Summary Form or data package page <input type="checkbox"/> see below			
<i>Secondary:</i> Technical Agreement with internal standard evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments:			

10.0 Instrument Tune Y    N    N/A

10.1 Were instruments tuned at the required frequency? <b>List frequency:</b> <input type="checkbox"/> 12-Hours <input type="checkbox"/> With ICAL <input type="checkbox"/> Other:			
10.2 Are all instrument tune criteria within the required control limits? <input type="checkbox"/> see attached data package page <input type="checkbox"/> see below			
<i>Secondary:</i> Technical Agreement with tune evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments:			

11.0 Breakdown (Pesticides only) Y    N    N/A

11.1 Are breakdown products less than 15%? <input type="checkbox"/> see attached Breakdown Summary Form or data package page <input type="checkbox"/> see below			
11.2 Are breakdown check standards analyzed prior to initial calibration and/or each 12-hour shift?			
<i>Secondary:</i> Technical Agreement with breakdown evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		

Comments:  No positive results assoc. w/ outliers; RL judged as not affected – no qualifiers assigned.  
 Not required for target analytes.  
Date:                      Time:                      Endrin:                      DDT:

12.0 Initial Calibration

Y      N      N/A

12.1 Are ICALs analyzed on all instruments on which samples are analyzed?			
12.2 Are response factors/calibration factors stable? Limits: <input type="checkbox"/> 20% RSD <input type="checkbox"/> $r^2 \geq 0.990$ <input type="checkbox"/> $r \geq 0.995$ <input type="checkbox"/> Other: <input type="checkbox"/> see attached ICAL Summary Form or data package page <input type="checkbox"/> see below			
12.3 Are GC/MS response factors greater than the required minimum control limit?			
12.3 Are GC retention times within required retention time windows (RTW)?			
<i>Secondary:</i> Technical Agreement with initial calibration evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments: <input type="checkbox"/> No positive results assoc. w/ outliers; RL judged as not affected – no qualifiers assigned. <input type="checkbox"/> RF historically low; no qualifiers assigned because response is stable.			

13.0 Continuing Calibration

Y      N      N/A

13.1 Are CCALs analyzed at the proper frequency? <b>List freq:</b> <input type="checkbox"/> 12-Hr Shift <input type="checkbox"/> Every 10 Samples <input type="checkbox"/> Other: <input type="checkbox"/> see attached CCAL Summary Form or data package page <input type="checkbox"/> see below			
13.2 Are CCALs acceptable? Limits: <input type="checkbox"/> $\pm 20\%D$ <input type="checkbox"/> $\pm 25\%D$ <input type="checkbox"/> Other <input type="checkbox"/> see attached CCAL Summary Form or data package page <input type="checkbox"/> see below			
13.3 Are response factors greater than the required minimum control limit? <input type="checkbox"/> see attached CCAL Summary Form or data package page <input type="checkbox"/> see below			
13.3 Are retention times within required retention time windows (RTW) (GC)?			
<i>Secondary:</i> Technical Agreement with continuing calibration evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments: <input type="checkbox"/> No positive results assoc. w/ outliers; RL judged as not affected – no qualifiers assigned. <input type="checkbox"/> RF historically low; no qualifiers assigned since response is stable.			

14.0 Sample Results/Completeness Check

Y      N      N/A

14.1 Are there results for all analytes on the client required target compound list(s)? see SAP/QAPP for lists			
14.2 Are reporting limits and sample results adjusted for sample size, final volume, dilutions, etc.?			
14.3 Are concentrations reported on the appropriate basis? <input type="checkbox"/> Dry weight <input type="checkbox"/> Wet weight <input type="checkbox"/> Both			
14.4 Do detection limits meet project-specific or method-specific limits?			
14.5 Results were DNR-11 flagged to indicate most appropriate result from multiple reported results.			
14.6 Results qualified J-20 to indicate concentration is greater than calibration range.			
14.7 DLs/RLs elevated due to <input type="checkbox"/> Diln <input type="checkbox"/> %M <input type="checkbox"/> Samp Vol <input type="checkbox"/> Final volume <input type="checkbox"/> Interference (UJ-22) <input type="checkbox"/> Other:			
14.8 Are GC/HPLC second column results within RPD limits? <input type="checkbox"/> All ND <input type="checkbox"/> J-3 for 40%<RPD<60% <input type="checkbox"/> NJ-3 for >60% <input type="checkbox"/> see below <input type="checkbox"/> see attached			

Project No.:	SDG:
--------------	------

14.9 Results qualified J-23H due to chromatographic interference.			
14.10 Were TICS requested for this project and, if so, are they reported as required?			
14.11 TICs qualified NJ-4 to indicate tentatively identified compound.			
14.12 Are all COCs/sections/forms/raw data present and accurate?			
14.13 In the EDD or database, has the Result Reportable field been verified?			
14.14 Data reporting units: <input type="checkbox"/> ug/l <input type="checkbox"/> mg/l <input type="checkbox"/> ng/l <input type="checkbox"/> ug/kg <input type="checkbox"/> mg/kg <input type="checkbox"/> ug/kg <input type="checkbox"/> %			
Secondary: Technical Agreement with sample results evaluation and qualification and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments: <input type="checkbox"/> Dilutions (see HT Table). <input type="checkbox"/> Results estimated J-14 – see details below.			

### 15.0 Recalculation Checks

Y N N/A

15.1 Recalculation completed for: <input type="checkbox"/> Initial & <input type="checkbox"/> Continuing Calibration(s) # points for curve:			
15.2 Recalculation completed for: <input type="checkbox"/> LCS <input type="checkbox"/> LCS/LCSD <input type="checkbox"/> MS <input type="checkbox"/> MS/MSD			
15.3 Recalculation completed for field sample(s)?			
15.4 Transcription checks completed for: <input type="checkbox"/> Tune <input type="checkbox"/> Interference Check Std <input type="checkbox"/> RL Std <input type="checkbox"/> Serial Dilution			
15.5 Transcription checks completed for blanks? <input type="checkbox"/> Laboratory <input type="checkbox"/> Instrument <input type="checkbox"/> Field			
Secondary: Technical Agreement with recalculations and the evaluation and DV report agree? <input type="checkbox"/> see below	Quals <input type="checkbox"/>		
Comments: <input type="checkbox"/> Dilutions (see HT Table)			

### 16.0 Secondary Report Narrative Review

Y N N/A

16.1 Does the narrative report meet all client specifications for content and format?			
16.2 Does the narrative report note any deviations from project validation guidance documents and if so, is rationale provided?			
16.3 Does the report adequately document and discuss <input type="checkbox"/> data anomalies and/or resubmitted data?			
16.4 Were client/field sample IDs used in the report narrative (verify transcription against COC)?			
16.5 Does the Overall Assessment include all required elements? (Adherence to methods; discussion of precision and accuracy; summary of assigned qualifiers, and usability statement.)			
16.6 Does the usability statement properly reflect the assigned qualifiers and/or rejected data?			
Comments:			

## **APPENDIX B.2**

### **Example LDC Checklists**

## **APPENDIX B.2**

### **Example LDC Checklists**

LDC #: \_\_\_\_\_

# VALIDATION COMPLETENESS WORKSHEET

Date: \_\_\_\_\_

SDG #: \_\_\_\_\_

## Stage 2A/4

Page: \_\_\_ of \_\_\_

Laboratory: \_\_\_\_\_

Reviewer: \_\_\_\_\_

2nd Reviewer: \_\_\_\_\_

**METHOD:** Metals (EPA SW 846 Method 6010B/6020A/7470A/7471A)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	/	
II.	ICP/MS Tune		Not reviewed for Stage 2A validation.
III.	Instrument Calibration		Not reviewed for Stage 2A validation.
IV.	ICP Interference Check Sample (ICS) Analysis		Not reviewed for Stage 2A validation.
V.	Laboratory Blanks		
VI.	Field Blanks		
VII.	Matrix Spike/Matrix Spike Duplicates		
VIII.	Duplicate sample analysis		
IX.	ICP Serial Dilution		Not reviewed for Stage 2A validation.
X.	Laboratory control samples		
XI.	Field Duplicates		
XII.	Internal Standard (ICP-MS)		Not reviewed for Stage 2A validation.
XIII.	Sample Result Verification		Not reviewed for Stage 2A validation.
XIV.	Overall Assessment of Data		

Note: A = Acceptable  
N = Not provided/applicable  
SW = See worksheet

ND = No compounds detected  
R = Rinsate  
FB = Field blank

D = Duplicate  
TB = Trip blank  
EB = Equipment blank

SB=Source blank  
OTHER:

\*\* Indicates sample underwent Stage 4 validation

	Client ID	Lab ID	Matrix	Date
1				
2				
3				
4				
5				
6				
7				
8				

Notes: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



## **APPENDIX C**

### **HEALTH AND SAFETY PLAN**

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# HEALTH AND SAFETY PLAN REVISION 3

REMEDIAL DESIGN SERVICES  
SWAN ISLAND BASIN PROJECT AREA  
CERCLA DOCKET No. 10-2021-001

PORTLAND HARBOR SUPERFUND SITE  
PORTLAND, MULTNOMAH COUNTY, OREGON

Contract Number: DT2002

*Prepared for:*

Swan Island Basin Remedial Design Group

*Prepared by:*



11107 Sunset Hills Road, Suite 400  
Reston, Virginia 20190

*With assistance from:*

**M**

**M**

PACIFIC groundwater GROUP

MOTT  
MACDONALD

BRIDGEWATER GROUP

May 2022



**DRAFT  
HEALTH AND SAFETY PLAN  
REVISION 3**

**REMEDIAL DESIGN SERVICES  
SWAN ISLAND BASIN PROJECT AREA  
CERCLA DOCKET No. 10-2021-001**

**PORTLAND HARBOR SUPERFUND SITE  
PORTLAND, MULTNOMAH COUNTY, OREGON**

**Contract Number: DT2002**

*Prepared for:*  
**Swan Island Basin Remedial Design Group**

*Prepared by:*  
**HydroGeoLogic, Inc.  
11107 Sunset Hills Road, Suite 400  
Reston, Virginia 20190**

*With assistance from:*  
**Mott MacDonald  
Pacific Groundwater Group  
Bridgewater Group**

**May 2022**

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**Health and Safety Plan  
Swan Island Basin Project Area  
Portland Harbor Superfund Site**

**Record of Changes / Summary of Revisions**

<b>Revision No.</b>	<b>Revision Date</b>	<b>Document Name (If other than entire document, list revised sections or pages)</b>
0	June 29, 2021	Draft Health and Safety Plan for EPA review
1	December 10, 2021	Revisions per EPA comments received August 13, 2021
2	March 16, 2022	Revisions per EPA comments received February 1, 2022
3	May 10, 2022	Revision per EPA comments received April 7, 2022

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**Section 1 General Site Information**

**Land (Off Vigor LLC [Vigor] Property) - Emergencies:** Dial 911

**Land (On Vigor Property) - Emergencies:** Radio Vigor on Channel 1 or Call (503) 247-1799 ext. #1799

**On Water - Emergencies:** Radio the Coast Guard on Channel 16

**Additional Emergency Contact Information:** See Page 19 and Attachment A (Vigor Emergency Response Immediate Notification Summary Sheet)

**Hospital Information:** Pages 19 to 22

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**Job Site Address:** 5555 N Channel Ave.; Portland, Oregon

Swan Island Basin (SIB) Project Area portion of the Portland Harbor Superfund Site, approximately 4 miles Northwest of downtown Portland, Oregon

**Task:** Remedial Design (RD) Services

**Site Contact:** Alan Sprott, Vigor Industrial LLC

**Telephone:** (503) 247-1777

**Email:** [alan.sprott@vigor.net](mailto:alan.sprott@vigor.net)

**Client Contact:** Jennifer Sanscrainte, Ogden Murphy Wallace

**Telephone:** (206) 714-3595

**Email:** [jsanscrainte@omwlaw.com](mailto:jsanscrainte@omwlaw.com)

**Fieldwork Objectives, Tasks, and Equipment:**

The goal of the fieldwork is to achieve the objectives of the Pre-Design Investigation (PDI) Work Plan (WP). To facilitate and allow for the adaptive collection of data to support the RD, the PDI is anticipated to require two phases. This Health and Safety Plan (HASP) covers work to be completed under Phase 1.

Phase 1 Sampling includes:

- Surface Sediment – collected from a boat using a power-grab sampler or manual-grab sampler in shallow water areas.
- Subsurface Sediment – collected from a boat using a vibracore sampler or direct-push probe rig for shallow areas. If necessary, a hand auger may be used.
- Riverbank Soil – collected via upland access using a hand auger.
- Sediment Erodibility – collected using a core barrel.
- Geotechnical Exploratory Borings – collected using a drill rig. For in-water samples, the rig will be placed on a barge.
- Stormwater and Stormwater Solids – collected by grab sampling from public manhole sumps and using in-line sediment traps.
- Willamette River Surface Water – water levels will be monitored using information from U.S. Geological Survey gauge stations.

**Phase 1 Engineering Analysis includes:**

- Bathymetric survey from a boat using multibeam hydrographic survey equipment.
- Detection of buried utilities and debris using the following:
  - Watercraft,
  - Light detection and ranging survey equipment,
  - Multibeam hydrographic survey equipment,
  - Sub-bottom profiler system, and
  - Marine magnetometer.
- Structures evaluation via the following:
  - Visual site walk,
  - Visual observations by boat,
  - Dive inspection, and
  - Laser scan.
- Hydro- and sediment dynamics
  - Water levels and current velocities,
  - Wind-wave and boat wakes, and
  - Suspended sediments.

**Type: Check as many as applicable**

- |  |  |   |
|--|--|---|
| <input checked="" type="checkbox"/> Active               | <input type="checkbox"/> Landfill                | <input type="checkbox"/> Unknown        |
| <input type="checkbox"/> Inactive                        | <input checked="" type="checkbox"/> Uncontrolled | <input type="checkbox"/> Military       |
| <input type="checkbox"/> Secure                          | <input checked="" type="checkbox"/> Industrial   | <input type="checkbox"/> Enclosed Space |
| <input checked="" type="checkbox"/> Unsecure             | <input type="checkbox"/> Recovery                | <input type="checkbox"/> Well Field     |
| <input checked="" type="checkbox"/> Other Specify: River |  |   |

**Description and Features:**

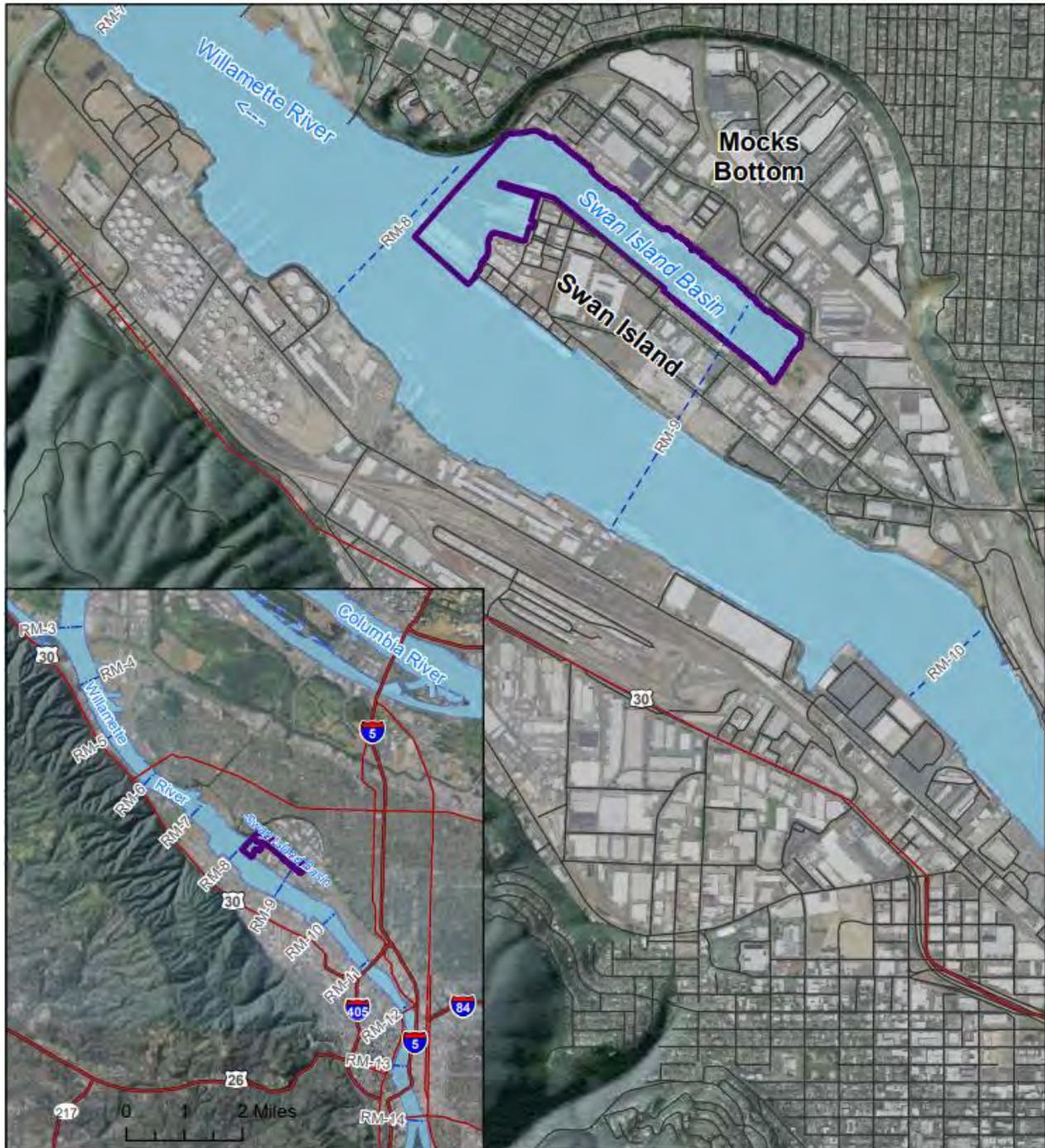
The Portland Harbor Superfund Site is comprised of a 10-mile stretch of the Lower Willamette River where approximately 370 acres of contaminated sediments are designated for remediation to reduce health risks to people and the environment. Field activities are planned to support the RD for the SIB Project Area portion of the Portland Harbor Superfund Site, which is located approximately 4 miles northwest of downtown Portland, Oregon. The site is located north of the main channel of the Willamette River between river mile (RM) markers 8.1 and RM 9.2. The four chemical groups of interest that are primarily related to historical releases from nearby industrial sources include: polychlorinated biphenyls (PCBs), dioxin/furans, the pesticide DDT, and polynuclear aromatic hydrocarbons (PAHs) associated with petroleum products. Of these, PCBs are the most significant and widespread compounds posing potential risks to people and the environment.

The Field Sampling Plan (FSP), which is Appendix A of the SIB PDI WP, describes the sampling objectives and activities for completing RD data collection. The FSP includes guidance for fieldwork by defining in detail the sampling and data-gathering methods to be used during sampling activities. The FSP supports the PDI sampling within the SIB Project Area and the SIB Upland Area. It also provides details for proposed field sampling locations along with procedures for the planned PDI project tasks.

Surrounding Population:  Residential  Industrial  Rural  Urban  Other:

**Figure 1 Site Location**

The site is located approximately 4 miles north of Portland, Oregon, near RM-8 and RM-9 of the Willamette River. For more detailed site maps, see the figures in the FSP.



**Site History:** Detailed information for the site is presented in the FSP.

The Willamette River is the 19th largest river in the U.S. During its 309-mile course, which ends at its confluence with the Columbia River, it drains 11.7% of the area in Oregon. Since the late 1800s, the Portland Harbor section of the lower Willamette River has been extensively modified to accommodate a vigorous shipping industry. Historically, contaminants from many facilities entered the river system from different activities including, but not limited to ship building and repair; ship dismantling; wood treatment and lumber milling; bulk fuels storage; manufactured gas production; chemical manufacturing and storage; metal recycling, production, and fabrication; steel mills, smelters, and foundries; and electrical production and distribution. These activities have resulted in direct discharges from upland areas through stormwater and wastewater outfalls, releases and spills from commercial operations occurring over the water, municipal combined sewer overflows, and indirect discharges through overland flow, bank erosion, groundwater, and other nonpoint sources. In addition, contaminants from off-site sources have reached the site through surface water and sediment transport from upstream and through atmospheric deposition. Operations that continue today along the riverbanks include bulk fuel storage; barge building; ship repair; automobile scrapping; recycling; steel manufacturing; cement manufacturing; operation and repair of electrical transformers (including electrical substations); and many smaller industrial operations.

**Waste Types:**  Liquid  Solid  Sludge  Gas  Unknown  Other Specify: Sediment

**Waste Characteristics:** Check as many as applicable.

Corrosive  Flammable  Radioactive  Toxic  Volatile  
 Reactive  Inert Gas  Unknown  Carcinogenic  
 Other Specify: Wastes are not anticipated to be hazardous.

**Hazards of Concern:**

Exhaust

Inorganic Chemicals

*(Activity Hazard Analysis [AHAs]: Hand Auger Sampling, Water Level Gauging, and Decontamination)*

Organic Chemicals

*(AHAs: Hand Auger Sampling, Water Level Gauging, and Decontamination)*

Slips, Trips, and Falls

*(AHAs: General Site Work, Drilling, Direct-Push Drilling (DPT) -- Sediment Sampling on Land and Over Water, and Sampling from Watercraft)*

Biological: stinging insects, venomous reptiles

*(AHA: General Site Work)*

Infectious Disease Hazards: Coronavirus (Follow current CDC guidelines on social distancing, masking, etc.)

*(AHA: Coronavirus Practices to Prevent Exposure)*

Explosive/Flammable

Motorized Traffic (Attachment B: Traffic Control Plans)

*(AHAs: General Site Work [vehicle inspection checklist is included as Attachment C] & Equipment Decontamination)*

Noise

*(AHAs: General Site Work, Drilling (Land Based and Barge Mounted), Direct-Push Drilling (DPT) – Sediment Sampling on Land and Over Water, Equipment Decontamination)*

Radiological

Heavy Machinery

(AHA: *General Site Work*)

Heat/Cold Stress

(AHA: *General Site Work*)

High Traffic Area

Other Specify:

- Coronavirus (wear mask and/or social distance in accordance with current CDC guidelines. See AHA Coronavirus Practices to Prevent Exposure ),
- Hazards associated with working on a marine vessel, and
- Hazards associated with diving in a river (to be addressed by subcontractor Dive Operations Plan. The subcontractor's plan will be submitted to EPA at a minimum 45 days before dive operations begin.)

**Work Zones (exclusion, contamination reduction, and support):**

To be determined in fieldwork plans prior to mobilization; however, due to the nature of the planned field activities and low potential for exposure; exclusion, contamination reduction, and support zones are not anticipated to be required for the field efforts. Analytical results from contaminant characterization will be used to adjust the need for Work Zones. Initial health and safety briefings will be completed prior to the start of each workday to address potential hazards within the work zones, such as heavy equipment, chemicals brought to the site, and site-related environmental contaminants.

**Principle Disposal Methods and Practices for Investigative-Derived Waste:**

***Containment and Disposal Method***

Not Needed     Needed, summarize below:

Soil, sediment and liquid investigation-derived waste (IDW) will be characterized to determine if it is Resource Conservation and Recovery Act (RCRA) or Toxic Substances Control Act (TSCA) hazardous waste and consequently, its appropriate disposal endpoint. The waste may be characterized through knowledge of the process generating the waste, analytical results of samples collected during the investigation, or laboratory analytical results from waste characterization sampling. Hazardous waste will be shipped and transported only by properly licensed haulers in accordance with applicable state, local, and federal regulations.

If solid IDW (including drilling mud and associated fluids) is characterized as nonhazardous waste, it will be placed in steel drums on pallets, staged, transported, and disposed of at an approved off-site landfill. Nonhazardous soil cuttings will require off-site disposal at a Subtitle D facility. If the IDW is characterized as hazardous waste, it will be disposed of at a permitted RCRA Subtitle C treatment, storage, and disposal facility. Expendable equipment and used personal protective equipment (PPE) will be double bagged and disposed of as municipal waste. See the Waste Management Plan in the FSP (Appendix B of PDI WP).

**Section 2 Project-Specific Hazardous Material Summary:** Indicate waste type and media in which the material is contained, estimate quantity if material exists in bulk quantities.

Chemicals Amounts/Units:	Solids Amounts/Units:	Sludges Amounts/Units:	Solvents Amounts/Units:	Oils Amounts/ Units:	Other Amounts/Units:
<input type="checkbox"/> Acids <input type="checkbox"/> Pickling Liquors <input type="checkbox"/> Caustics <input checked="" type="checkbox"/> Pesticides <input type="checkbox"/> Dyes/Inks <input type="checkbox"/> Cyanides <input type="checkbox"/> Phenols <input type="checkbox"/> Halogens <input checked="" type="checkbox"/> Dioxins <input checked="" type="checkbox"/> Other <b>Specify:</b> Herbicides, PCDD/PCDFs	<input type="checkbox"/> Fly ash <input type="checkbox"/> Asbestos <input type="checkbox"/> Milling/Mine Tailings <input type="checkbox"/> Ferrous Smelter <input type="checkbox"/> Non-ferrous Smelter <input checked="" type="checkbox"/> Metals <input type="checkbox"/> Other <b>Specify:</b>	<input type="checkbox"/> Paint <input type="checkbox"/> Pigments <input type="checkbox"/> Metal Sludges <input type="checkbox"/> POTW Sludge <input type="checkbox"/> Aluminum <input type="checkbox"/> Distillation Bottoms <input type="checkbox"/> Other <b>Specify:</b>	<input type="checkbox"/> Halogenated (chloro, bromo) <input checked="" type="checkbox"/> Solvents <input checked="" type="checkbox"/> Hydrocarbons <input type="checkbox"/> Alcohols <input type="checkbox"/> Ketones <input type="checkbox"/> Esters <input type="checkbox"/> Ethers <input type="checkbox"/> Other <b>Specify:</b>	<input checked="" type="checkbox"/> Oily Wastes <input type="checkbox"/> Gasoline <input checked="" type="checkbox"/> Diesel Oil <input type="checkbox"/> Lubricants <input checked="" type="checkbox"/> PCBs <input checked="" type="checkbox"/> Polycyclic Aromatics <input type="checkbox"/> Other <b>Specify:</b>	<input type="checkbox"/> Laboratory <input type="checkbox"/> Pharmaceutical <input type="checkbox"/> Hospital <input type="checkbox"/> Radiological <input type="checkbox"/> Municipal <input type="checkbox"/> Construction <input type="checkbox"/> Munitions <input type="checkbox"/> Other <b>Specify:</b>

**Overall Hazard Evaluation:**  High  Medium  Low  Unknown  
 Task hazard evaluation is included within the specific AHA

**Justification:** Exposure routes are through ingestion and inhalation of contaminated soil, sediment, and water. Dermal contact and/or inhalation of particulates entrained in air is low. Proper personal hygiene (i.e., laundering, showering, and washing hands) after field activities and the use of proper PPE (gloves) during soil screening will minimize skin contact with contaminants. Screening will take place outdoors. Dust masks will be worn if dust is generated during field activities.

**Fire/Explosion Potential:**  High  Medium  Low  Unknown

**Background Review:**  Complete  Incomplete  
 Additional information to be collected in this and future investigations.

**Section 3 Contaminants of Interest**

Known Contaminants	Highest Observed Concentration (specify units and media)	ACGIH TLV TWA ppm or mg/m <sup>3</sup> (specify)/ OSHA PEL	STEL/ Ceiling Limit	IDLH ppm or mg/m <sup>3</sup> (specify)	IP (eV)	Symptoms/Effects of Acute Exposure
<b>VOCs and SVOCs</b>						
Benzene (71-43-2)	PW-8,200 µg/L	0.5 ppm/1ppm (See 1910.1028) Skin A1 Carcinogen	2.5 ppm	500 ppm Carcinogen	9.24	Irritation of eyes, skin, nose, respiratory system; dizziness; headache, nausea, staggered gait; lassitude.
bis(2-ethylhexyl)phthalate	Soil-27.1 mg/kg Sed-440 mg/kg SW-64 µg/L	ND	ND	ND	ND	ND
Chlorobenzene (106-90-7)	PW-30,000 µg/L	10 ppm/75 ppm A3 Carcinogen	-	1,000 ppm	9.07	Liver damage; irritation of eyes, skin, nose; drowsiness.
PCBs (54% chlorine) Aroclor 1254, Polychlorinated biphenyl (11097-69-1) (Chlorodiphenyl)	Soil-1.02 mg/kg Sed-37 mg/kg SW-0.02 µg/L	0.5 mg/m <sup>3</sup> Skin A3 Carcinogen	-	5 mg/m <sup>3</sup>	NA	Irritation to eyes; chloracne; liver damage and reproductive effects; tumors of pituitary gland and liver; leukemia.
Vinylidene chloride/ 1,1-Dichloroethene (75-35-4)	PW-283 µg/L	5 ppm A4 carcinogen	-	ND	10.0	Liver and kidney damage.
cis-1,2-dichloroethene (540-59-0)	PW-574,000 µg/L	200 ppm	-	1,000 ppm	9.65	Irritation of eyes and skin; central nervous system depression.
Ethyl benzene (100-41-4)	SW-11.4 µg/L PW-905 µg/L	20/100 ppm	125 ppm	800 ppm	8.76	Irritation of eyes, skin, and mucous membrane; headache; dermatitis; narcosis; coma.
Naphthalene	SW-605 µg/L PW-19,700 µg/L	10 ppm Skin	STEL removed in Notice of Intended Changes 2013	250 ppm	8.12	Irritation of eyes, optic neuritis, and corneal damage; headache; confusion; excitement.

Known Contaminants	Highest Observed Concentration (specify units and media)	ACGIH TLV TWA ppm or mg/m <sup>3</sup> (specify)/ OSHA PEL	STEL/ Ceiling Limit	IDLH ppm or mg/m <sup>3</sup> (specify)	IP (eV)	Symptoms/Effects of Acute Exposure
<b>VOCs and SVOCs (continued)</b>						
PAHs Benzo[k]fluoranthene (207-08-9) No U.S. standards or published TLV limits by ACGIH Indeno(1,2,3-cd)pyrene (193-39-5) No U.S. standards or published TLV limits by ACGIH	Soil-600 mg/kg Sed-53,000 mg/kg SW-7.4 µg/L PW-21,000 µg/L					Benzo[k]fluoranthene: Although there is no human data that specifically links exposure to benzo[k]fluoranthene to human cancers, benzo[k]fluoranthene is a component of mixtures that have been associated with human cancer. These include coal tar, soots, coke oven emissions and cigarette smoke. Inhalation hazard, possible skin absorption, irritant to eyes and skin. Indeno(1,2,3-cd)pyrene: Dermal exposure to coal tar and shale oils containing PAHs have been associated with increased incidences of skin tumors in human emissions. PAHs have been linked to increased incidence of lung and genitourinary cancer mortality in coke oven workers. Sufficient data of carcinogenicity in animals.
Tetrachloroethene (127-18-4) Perchloroethylene (PCE)	PW-12,000 µg/L	25/100 ppm	100 ppm A3 carcinogen	150 ppm	9.32	Irritation to eyes, nose, throat; flushed face and neck; dizziness and vertigo.
Trichloroethene (79-01-6) Trichloroethylene (TCE)	PW-585,000 µg/L	10/100 ppm Skin A2 Carcinogen	25 ppm	150 ppm Carcinogen	9.45	Irritation to eyes and skin; vertigo, headache, fatigue, giddiness, tremors, nausea.
Toluene (108-88-3)	PW-821 µg/L	20/200 ppm A4 Carcinogen	300 C ppm	500 ppm	8.82	Irritation of eyes and nose; lassitude; confusion; euphoria; dizziness.
Vinyl chloride (75-01-4)	PW-28,900 µg/L	1 ppm A1 Carcinogen	-	None established Carcinogen	10.0	Lassitude; abdominal pain and gastrointestinal bleeding; liver cancer.
Xylene (1330-20-7) Mixed isomers	PW-1,430 µg/L	100 ppm	150 ppm STEL	900 ppm	8.44-8.56	Irritation of eyes, skin, nose, and throat; dizziness.
<b>METALS</b>						
Arsenic and inorganic compounds as Arsenic (7440-38-2)	Soil-143 mg/kg Sed-132 mg/kg SW-0.075 µg/L PW-77 µg/L	0.01mg/m <sup>3</sup> A1 carcinogen	-	5 mg/m <sup>3</sup>	NA	Damage to kidneys, lungs, nervous system, and mucous membranes.
Cadmium (7440-43-9)	Soil-26 mg/kg Sed-44 mg/kg PW-36 µg/L	0.01 mg/m <sup>3</sup> total 0.002 mg/m <sup>3</sup> Respirable/ A2 Carcinogen	-	9 mg/m <sup>3</sup>	NA	Kidney damage.

Known Contaminants	Highest Observed Concentration (specify units and media)	ACGIH TLV TWA ppm or mg/m <sup>3</sup> (specify)/ OSHA PEL	STEL/ Ceiling Limit	IDLH ppm or mg/m <sup>3</sup> (specify)	IP (eV)	Symptoms/Effects of Acute Exposure
<b>METALS (continued)</b>						
Chromium and inorganic compounds (7440-47-3) Metallic chromium, as Cr(0)	SW-1.92 µg/L PW-147 µg/L	0.5 mg/m <sup>3</sup>	-	250 mg/m <sup>3</sup>	NA	Irritation of eyes; sensitization dermatitis.
Copper (7440-50-8) dust	Soil-13,300 mg/kg Sed-3,290 mg/kg SW-3.68 µg/L PW-182 µg/L	1 mg/m <sup>3</sup>	-	100 mg/m <sup>3</sup>	NA	Irritation of eyes and nose; nasal septum perforation; metallic taste; dermatitis.
Cyanide as CN varies by compound	PW-23 µg/L	5 mg/m <sup>3</sup> salts	-	25 mg/m <sup>3</sup>	NA	Rapidly absorbed through inhalation, oral and dermal routes; vomiting, nausea, weakness, confusion, central nervous system depression, cardio collapse
Lead and inorganic compounds as Lead (7439-92-1)	Soil-4,160 mg/kg Sed-13,400 mg/kg PW-116 µg/L	0.05 mg/m <sup>3</sup> Action level 0.03 mg/m <sup>3</sup>	None	100 mg/m <sup>3</sup>	NA	Central nervous system impairment; lower respiratory tract impairment; hematological effects
Manganese (7439-96-5)	PW-66,200 µg/L 0.1 mg/m <sup>3</sup> inhalable	0.02 mg/m <sup>3</sup> respirable fraction	5 mg/m <sup>3</sup> C	500 mg/m <sup>3</sup>	NA	Parkinson's; insomnia; metal fume fever; chest tightness.
Mercury (7439-97-6) Elemental and inorganic forms	Soil-19 mg/kg Sed-65 mg/kg	0.025/ 0.1 mg/m <sup>3</sup> Skin A4 Carcinogen	-	10 mg/m <sup>3</sup>	NA	Irritation of eyes; tremor; emotional disturbances; indecision.
Vanadium pentoxide as Vanadium (1214-62-3)	PW-379 µg/L	0.05mg/m <sup>3</sup> inhalable, as vanadium pentoxide	-	35 mg/m <sup>3</sup>	NA	Irritation of eyes, skin, and throat; green tongue; metallic taste in mouth; eczema; cough.
Zinc (1314-13-2)	Soil-9,470 mg/kg Sed-9,000 mg/kg SW-58 µg/L PW-983 µg/L	2 mg/m <sup>3</sup> respirable, as zinc oxide/ 5 mg/m <sup>3</sup> A4	10 mg/m <sup>3</sup>	500 mg/m <sup>3</sup>	NA	Metal fume fever; chills; muscle aches; metallic taste in mouth.

Known Contaminants	Highest Observed Concentration (specify units and media)	ACGIH TLV TWA ppm or mg/m <sup>3</sup> (specify)/ OSHA PEL	STEL/ Ceiling Limit	IDLH ppm or mg/m <sup>3</sup> (specify)	IP (eV)	Symptoms/Effects of Acute Exposure
<b>PESTICIDES AND HERBICIDES</b>						
Aldrin (309-00-2)	Sed-1.34 mg/kg SW-0.005 µg/L	0.TLV 0.05 mg/m <sup>3</sup> Skin / OSHA PEL25 mg/m <sup>3</sup> Skin A3 carcinogen	-	25 mg/m <sup>3</sup>	-	Head dizziness, nausea, vomiting, malaise, myoclonic jerks of limbs, convulsions, hematuria, coma, azotemia.
Chlordane (57-74-9)	Sed-2.3 mg/kg SW-0.002 µg/L	0.5 mg/m <sup>3</sup> Skin A3 carcinogen	-	100 mg/m <sup>3</sup>	NA	Blurred vision; confusion; ataxia, delirium; cough; abdominal pain, nausea, vomiting, diarrhea; irritability, tremor, convulsions; anuria In animals: lung, liver, kidney damage Potential occupational carcinogen.
2-(4-chloro-2-methylphenoxy) propanoic acid (MCPP) (93-65-2)	SW-34 µg/L	ND	ND	ND	ND	ND
2,4-Dichlorophenoxy acetic acid (94-75-7)	PW-0.97 µg/L	10 mg/m <sup>3</sup> Skin A4	-	ND	NA	Thyroid and kidney tubular damage.
4,4,'-dichlorodiphenyl dichloroethane (DDD) (72-54-8)	Soil-0.15 mg/kg Sed-690 mg/kg SW-0.003 µg/L PW-2.5 µg/L	None established		ND	NA	Nerve impulse impairment; liver, lung, and lymphatic tumors.
DDE (72-55-9 ('p'-DDE) (3424-82-6 ('p'-DDE)	Sed-24 mg/kg SW-0.001 µg/L PW-0.24 µg/L	None established		ND	NA	Nerve impulse impairment; liver, lung, and lymphatic tumors.
DDT (50-29-3)	Soil-0.016 mg/kg Sed-3,500 mg/kg SW-0.02 µg/L PW-3.2 µg/L	1 mg/m <sup>3</sup> Skin A 3 Carcinogen		500 mg/m <sup>3</sup> Carcinogen	NA	Nerve impulse impairment; liver, lung, and lymphatic tumors.
Dieldrin (60-57-1)	Sed-0.356 mg/kg	0.1/ 0.25 mg/m <sup>3</sup> Skin A3 Carcinogen		50 mg/m <sup>3</sup> Carcinogen	NA	Tumors, muscle twitching, seizures, coma.
Hexachlorobenzene (118-74-1)	Soil-0.022 mg/kg Sed-14 mg/kg SW-0.007 µg/L	0.002 mg/m <sup>3</sup> Skin A3	-	-	NA	Headache; nausea; vomiting; loss of sensory perception; numbness of hands and arms; partial paralysis of arms and legs; loss of muscle control; apprehension; excitement; convulsions, coma, tremors; mutation Confirmed carcinogen.
Lindane (58-89-9) (gamma-benzene hexachloride [BHC])	Sed-0.430 mg/kg	0.5 mg/m <sup>3</sup> Skin A3 carcinogen	-	50 mg/m <sup>3</sup>	NA	Irritation of the skin, eyes, nose, and throat; headache, nausea, nervousness, convulsions, respiratory difficulties, cyanosis, aplastic anemia, muscle spasms.
Silvex	PW-22 µg/L	ND	ND	ND	ND	ND

Known Contaminants	Highest Observed Concentration (specify units and media)	ACGIH TLV TWA ppm or mg/m <sup>3</sup> (specify)/ OSHA PEL	STEL/ Ceiling Limit	IDLH ppm or mg/m <sup>3</sup> (specify)	IP (eV)	Symptoms/Effects of Acute Exposure
<b>ORGANOTIN COUMPOUNDS</b>						
Tributyltin	Soil-0.240 mg/kg Sed-90 mg/kg SW-0.004 µg/L	ND	ND	ND	ND	ND
<b>DIOXINS/FURANS</b>						
1,2,3,7,8,9-hexachlorodibenzo furan (HxCDF)	Sed-0.066 mg/kg	ND	ND	ND	ND	ND
2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) (1746-01-06)	Soil-2.2x10 <sup>-6</sup> mg/kg Sed-1.11x10 <sup>-4</sup> mg/kg SW-3 x 10 <sup>-10</sup> µg/L	None established		Cancer		Irritation of eyes; allergic dermatitis; chloracne; gastrointestinal tract disturbances; kidney disease.
Pentachlorodibenzo furan (PeCDF)	Sed-0.011 mg/kg SW-3 x 10 <sup>-10</sup> µg/L PW-1.3 x 10 <sup>-9</sup> µg/L	ND	ND	ND	ND	ND
PeCDD	Sed-5.8 x 10 <sup>-5</sup> mg/kg SW-5 x 10 <sup>-10</sup> µg/L	ND	ND	ND	ND	ND
Tetrachlorodibenzo furans (TCDF)	Sed-0.015 mg/kg	ND	ND	ND	ND	ND
<b>OTHER</b>						
Perchlorate	PW-210,000 µg/L	ND	ND	ND	ND	ND
Diesel fuel as total hydrocarbons	PW-28,800 µg/L	100 mg/m <sup>3</sup>			NA	Irritation to eyes, skin, mucous membranes; allergic dermatitis; headache; lassitude, blurred vision.

**Notes:**

- = none  
 µg/L = micrograms per liter

ACGIH = American Conference of Governmental Industrial Hygienists  
 Ceiling = limit not to be exceeded  
 eV = electron volt  
 IDLH = Immediately Dangerous to Life and Health (NIOSH)  
 IP = ionization potential  
 mg/kg = milligrams per kilogram  
 mg/m<sup>3</sup> = milligrams per cubic meter  
 NA = not applicable  
 ND = not determined  
 NIOSH = National Institute for Occupational Safety and Health  
 OSHA = Occupational Safety and Health Administration Permissible Exposure Limit (PEL). Standard enforced by law.

PID = photoionization detector  
 ppm = parts per million  
 PW = porewater  
 Sed = sediment  
 Skin = absorbed through the skin  
 STEL = Short Term Exposure Limit (15 minute)  
 SVOC = semi-volatile organic compound  
 SW = surface water  
 TLV = Threshold Limit Value (recommended by ACGIH)  
 TWA = time-weighted average (average concentration for a normal 8-hour working day and 40-hour working week)  
 VOC = volatile organic compound

American Conference of Governmental Industrial Hygienists (ACGIH) Carcinogens

A1 = confirmed human carcinogen  
 A2 = suspected human carcinogen, confirmed animal carcinogen

A3 = confirmed animal carcinogen with unknown relevance to humans  
 A4 = Not classifiable as a human carcinogen

**Section 4 General Site Rules**

- Conduct an initial briefing and address this HASP; site and task hazards; equipment hazards; chemicals brought to the site (hazards, hazard controls, location of safety data sheets [SDSs]); potential emergencies and responses; site control requirements; and PPE. A quick reference for emergencies is contained as Attachment D.
- Confirm that site personnel have required training and qualifications.
- Conduct follow-up briefings, at least weekly, to address changes in scope or hazards.
- Conduct regular inspections to verify implementation and effectiveness of hazard controls (see form, Attachment C).
- Do not consume food, beverages, or tobacco products while working with hazardous chemicals or hazardous waste.
- Decontaminate personnel and equipment after contact with hazardous waste or hazardous chemicals.
- Use a buddy system (visual or by cell phone) to track personnel and render aid, if needed.
- Report incidents and significant near misses in accordance with HGL's Health and Safety Procedure 09, Incident Reporting and Investigation.
- Report or correct unsafe and potentially unsafe conditions or practices.
- Wear required PPE.
- Remove jewelry that may become entangled in equipment.
- Biologicals: Eliminate contact with poisonous and thorny plants, allergens, insects, and animal hazards (e.g., spiders, hornets, reptiles, snakes, deer ticks (Lyme disease), mosquitoes, bird and rodent droppings, biting and stinging insects etc.). Field staff with severe allergic reactions to stinging insects shall alert the SSHO and other field staff during the daily Tailgate Safety Meeting and carry an Epi-pen (if prescribed by a physician) with them while on site.
- Prohibit running and horseplay.
- Personnel, while on duty, shall not operate motor vehicles after being in a duty status (regardless of their role or function) for more than 12 hours during any 24-hour period without at least 8 consecutive hours of rest. Personnel may work an additional 2 hours at the motel or their home (for a total 14-hour day), though still subject to reduction by the other requirements and factors described below. A minimum of 8 consecutive hours shall be provided for rest in each 24-hour period.
- No employee may drive continuously for more than 10 hours in any single on-duty period (continuous period of more than 10 hours in any 24-hour period without at least 8 consecutive hours of rest).
- An automated external defibrillator (AED) is required to be on site and on vessels whenever work is being conducted. At least 2 personnel on site at any one time will have CPR/AED certification.
- There is the potential for sudden, heavy rains at the site and field personnel should keep abreast of weather conditions, carry adequate raingear, and be aware of potential shelter locations if conditions should require suspension of activities.

### Section 5 Activity Hazard Analysis

AHAs will be reviewed with field team members before starting work and will be revised, as necessary, to incorporate additional task-specific considerations. AHAs are to be reviewed periodically to confirm that the work processes have not changed and that the hazards are addressed and controlled. Employees will be briefed on changes made to AHAs. Additional AHAs will be prepared, as appropriate, for new tasks. The AHAs needed for this task are listed below and are included with this HASP:

- Coronavirus Practices to Prevent Exposure
- DPT – Sediment Sampling on Land and Over Water
- Drilling (Land Based and Barge Mounted)
- Drilling/DPT – Sample Processing
- Equipment Decontamination
- General Site Work (including mobilization and demobilization activities)
- Hand Auger Sampling
- Mobilization and Demobilization
- Inspections, Surveys, and Sampling from a Watercraft
- Water Level Gauging
- Working Over and Near Water
- Dive Operations (*pending subcontract*)
- Vessel Operations (*pending subcontract*)

### PPE

PPE Level for this task =  D     D modified     C

Definitions of PPE levels are available in the Corporate Health and Safety Procedures Manual.

Level D = Safety glasses, hard hat, safety toe boots, high visibility vest.

Level D modified = personal flotation device while on watercraft or working near shoreline.

Does the project require air monitoring?

Yes     No

Exposure Monitoring instrument(s) =  PID  PDR (dust monitor) CGI  O<sub>2</sub> meter  Other specify:

***Does the project have permit-required confined spaces that will need to be entered to accomplish the identified project tasks?***

Yes     No

If yes, attach HGL's Health and Safety Procedure 26, Confined Space Entry (Attachment E), which complies with the OSHA General Industry Confined Space Standard, 29 CFR 1910.146 and the OSHA regulation that addresses confined spaces in the construction industry, 29 CFR 1926 Subpart AA. Confined space entry locations will be determined in the field.

***Does the project have work that will require a Hot Work Permit (e.g., welding, metal cutting)?***

Yes     No

If yes, attach Hot Work Permit

***Does the project require specialized training or competent persons for excavations, fall protection, equipment operators, etc.?***

Yes     No

If yes, state specialized training and competent person(s)

Specialized training will be required for confined space entry, boating, barge, and diving activities. However, HydroGeoLogic, Inc. (HGL) personnel will not be operating marine vessels or conducting diving activities. Trained subcontractors will conduct these activities and prepare their own HASPs/AHAs as appropriate for each task.

**Section 6 Additional Personal Protective Equipment Requirements:**  
**This is to assist in the packing preparation and should closely match lists in the Uniform Federal Policy-Quality Assurance Project Plan (or other planning document) and in the Readiness Review forms.**

**Protective Clothing:**  Not Needed

- Splash Suit
- Apron
- High Visibility Vests
- Tyvek® coverall
- Coverall – Specify:
- Encapsulated suit

**Gloves:**  Not Needed

- Undergloves
- Overgloves
- Gloves – Specify: Leather for handling tools and equipment; nitrile for handling samples

**Head & Eye:**  Not Needed

- Face Shield
- Goggles
- Hearing Protection
- Other – Specify:

**Safety glasses** are needed whenever there is a splash potential.

**Face masks** are not considered PPE unless they are N95s or KN95s. Face masks are more source control, and they are to be worn in accordance with current CDC guidelines. See the AHA Coronavirus Practices to Prevent Exposure.

**Respiratory:**  Not Needed

- APR Full face:
- Cartridge/Filter type:
- Escape Mask:
- SCUBA, Airline  Other:

**Note:** Use of respirators requires a respiratory protection plan and assessment to verify that planned respirator use will be effective.

**Boots:**  Not Needed

- Boots: Leather steel-toe or composite toe.
- Disposable covers are to be worn over the boots by visitors and infrequent staff when working/walking on contaminated sediment.
- Overboots: for waders if slippery conditions
- Rubber: on sediment sampling vessels, shallow water (if waders not required), and whenever working on contaminated sediment. Rubber boots are required for primary field staff in these situations.

**Other PPE – specify below:**

Type I (off shore) and V (on shore) personal flotation devices and Waders. To be worn whenever working on or near water.

**Section 7 Personnel and Responsibilities (include subcontractors)**

<b>Name</b>	<b>Firm/Region</b>	<b>Medical Monitoring Clearance* (yes/no)</b>	<b>First Aid &amp; CPR/ AED (yes/no)</b>	<b>Responsibilities</b>	<b>On-Site Involvement</b>
Philip Spadaro	The Intelligence Group			Project Coordinator	Yes
Jeff Hodge	HGL			Senior Project Manager (PM)	Yes
Jennifer Norman	HGL			Deputy PM	Yes
Shane Cherry	HGL			Technical Director	Yes
Scott Fenical	Mott MacDonald			Technical Leader	Yes
Janet Knox	Pacific Groundwater Group			Technical Leader	Yes
Jeff Parker	Pacific Groundwater Group			Field Team Leader/Site Safety and Health Officer	Yes
To be Determined (TBD)	TBD			Sampler(s)	Yes
Shawn Hinz	Gravity			Vessel Operator	Yes
TBD	Gravity			Vibracore Operator	Yes
TBD	Gravity			Power Grab Sampler	Yes
TBD	TBD			DPT Driller	Yes
TBD	TBD			Driller (on land)	Yes
TBD	TBD			Multibeam Bathymetric Survey	Yes
TBD	TBD			Utility/Debris Locate	Yes
TBD	TBD			Dive Inspection	Yes
TBD	TBD			Laser Scan	Yes
TBD	TBD			Driller (on water)	Yes
TBD	TBD			Barge Operator	Yes

\*Health clearance meets the medical surveillance requirements of 29 CFR 1910.120. Medical surveillance certification for on-site personnel is presented in HGL Health and Safety Procedure Manual, Procedure 8.0. HGL personnel are in a medical surveillance program per 29 CFR 1910.120 regardless of their accumulated exposure days or their frequency of respirator use. If they involved in hazard waste field-work, noise louder than 85 decibels, respirator use and potential over exposure to other materials as required by OSHA (lead, asbestos, etc.) they are in the annual/biennial medical surveillance program. Subcontractors are required to meet the medical requirements of 29 CFR 1910.120, if applicable.

Subcontractors shall be solely responsible for the health and safety of their employees and shall comply with applicable laws and regulations. In accordance with 1910.120(b)(1)(iv) and (v), HGL will inform subcontractors of the site emergency response procedures, and potential fire, explosion, health, safety, or other hazards by conducting a site kick-off meeting/training, conducting regular tailgate safety meetings (see form in Attachment C), and making this HASP and site information obtained by others available during regular business hours. Contractors and subcontractors are responsible for: (1) developing their specific AHAs, having a written Hazard Communication Program, and other written hazard specific programs required by federal, state, and local laws and regulations; (2) providing their own PPE; (3) providing documentation that their employees have been health and safety trained in accordance with applicable federal, state and local laws and regulations; (4) providing evidence of medical surveillance and medical approvals for their employees; and (5) designating their own competent persons such as: site safety officer, equipment operators, excavation competent persons, etc. and for ensuring that their employees comply with their own health and safety requirements and taking other additional measures required by their site activities.

**Section 8 Health and Safety Monitoring Equipment and Action Levels**

<b>Instrument</b>	<b>Task</b>	<b>Action Level Guidelines</b>	<b>Response</b>
Photoionization Detector Type: Multi-Rae <input type="checkbox"/> <b>Not Needed</b> Lamp: <input checked="" type="checkbox"/> 10.6 <input type="checkbox"/> 11.7 <input type="checkbox"/> Other	Active HAZWOPER work areas	Total organic vapor(benzene, ethylbenzene, toluene, xylenes) >10 ppm above background in breathing zone  Rationale for >10ppm action level is as follow: Eight of the 11 VOCs of concern have STELS and/or TLVs above 10 ppm. 1,2-dichoroethane has a TLV of 200 ppm an makes up 60% of the total vapor in air concentration.	Suspend the task, withdraw from the area of elevated readings, and evaluate the situation to determine cause(s) of elevated readings. Correct cause(s) if possible. Options include natural ventilation, powered ventilation, changing work schedules, working upwind, altering the task/method, changing schedule, and if none of the preceding options are effective, notify the SSHO. Re-test the area and if concentration is below action level, resume work. If elevated concentrations continue to occur, notify the PM and corporate health and safety personnel before upgrading to respiratory protection. Collect sufficient breathing zone readings to characterize exposure.
Combustible Gas Indicator LEL/O <sub>2</sub> Meter <input type="checkbox"/> <b>Not Needed</b>	Confined Space entry	>5% of LEL <19.5% >23.5 %	Monitoring with a Combustible Gas Indicator is required during any confined space entry. In accordance with HGLs Health and Safety Procedure 26, Confined Space Entry (Attachment E).
Sound level meter or smart phone app <input type="checkbox"/> <b>Not Needed</b>	Active Work areas	>85 dBA (Whenever it is difficult to carry on a conversation with a person when they are standing at an arm’s length away).	Require use of hearing protective devices at >85 dBA.
Dust Monitor (Digital) Type: <input type="checkbox"/> <b>Not Needed</b>	Active HAZWOPER work areas	2 – 2.5 mg/m <sup>3</sup> for visible dust	Visible dust will be controlled in active HAZWOPER work areas. Sources of PM-2.5 (fine grained particle) would not typically be found at construction and remediation sites, as excavation and soil moving activities tend to stir up larger sized dust particles. It should be noted that airborne dust is visible at approximately 2 to 2.5 mg/m <sup>3</sup> . If deemed necessary, particulates will be monitored by a DataRAM 4 or equivalent instrument.
OSHA heat stress app for temperature extremes-heat and cold stress	Active work areas	Variable depending on the individual and work activity. OSHA heat stress app to be used or ACGIH TLVs	Take breaks in the shade, drink chilled fluids. Provide for ample shelter and breaks for hot/cold weather exposure. Personnel to be trained in the recognition of symptoms and treatment of heat and cold stress.

- Notes:**
- ACGIH = American Conference of Governmental Industrial Hygienists
  - dBA = decibel
  - HAZWOPER = Hazardous Waste Operations and Emergency Response
  - LEL = lower explosive limit
  - mg/m<sup>3</sup> = milligrams per cubic meter
  - OSHA = Occupational Safety and Health Administration Permissible Exposure Limit (PEL). Standard enforced by law.
  - PM = Project Manager
  - ppm = parts per million
  - SSHO = Site Safety and Health Office
  - STEL = Short Term Exposure Limit
  - TLV = Threshold Limit Value (recommended by ACGIH)
  - VOC = volatile organic compound

**Section 9 Decontamination Procedures**

**Personalized Decontamination**

Wash well with soap and water before hand to mouth contact is made. A shower will be taken as soon as possible after leaving the field.

Wet or dry decontamination procedures will be selected per project.

**Dry Decon Procedure**

**Not Needed**

Place disposable PPE in a garbage bag as removed in the following order:

- (1) Brush off work boots, remove disposable over boots, or booties
- (2) Remove gloves
- (3) Remove safety glasses
- (4) Remove Tyvek or cloth coverall, if used
- (5) Remove respirator, if used
- (6) Remove inner gloves
- (7) Wash hands/face before eating/drinking

**Wet Decon Procedure**

**Not Needed**

- (1) Wash overboots in soapy water and rinse
- (2) Remove overboots or booties
- (3) Remove gloves
- (4) Remove safety glasses
- (5) Remove Tyvek or cloth coverall, if used
- (6) Remove respirator, if used
- (7) Remove inner gloves
- (8) Wash hands/face before eating/drinking

**Sampling Equipment Decontamination**

**Not Needed**

Sampling equipment will be thoroughly decontaminated as follows:

- (1) Wash and scrub with low phosphate detergent
- (2) Potable tap water rinse 1
- (3) Potable tap water rinse 2
- (4) Thoroughly rinse with deionized water, if specified by the FSP
- (5) Air dry
- (6) Wrap in aluminum foil for transport, if specified by the FSP

**Heavy Equipment Decontamination**

**Not Needed**

Heavy equipment and tool parts that contact subsurface soil are constructed of heavy gauge steel and have no natural or synthetic components that could absorb and retain most soil-borne organic contaminants.

Prior to removal from the work site, potential contaminated soil/sediment/groundwater will be scraped or brushed from the exterior surfaces.

The drill/DPT probe rig, augers, rods, and other large equipment in the exclusion zone will be taken to a decon pad and steam cleaned. Rain suits to protect from overspray and runoff of decontamination fluids will be used if necessary.

**Section 10 Hazardous Materials Inventory (Safety Data Sheets) for Investigation-Associated Substances**

If SDS are accessible online from the site, hard copies are not needed.

**Preservatives**

- Hydrochloric Acid (HCl)
- Ascorbic Acid
- Nitric Acid (HNO<sub>3</sub>)
- Sulfuric Acid (H<sub>2</sub>SO<sub>4</sub>)  Other:
- Sodium Hydroxide (NaOH)
- Zinc Acetate (ZnOAc)

**Decontamination**

- Alconox™  Hexane
- Liquinox™  Isopropanol
- Acetone  Nitric Acid
- Methanol  Other:
- Mineral Spirits

**Calibration Gases and Fluids**

- Isobutylene  pH Standard
- Methane  Propane
- Pentane  Zobell Solution
- Hydrogen  Other:
- Conductivity Standard

**Spill Response: The following materials will be kept on site for spill response (check all appropriate materials)**

- Absorbent Pads  Granular absorbent material(non-flammable)  Polyethylene Sheeting
- Waste Container  Shovels or assorted hand tools  Other: materials specified in the SPCC.

If a hazardous waste spill or material release to the air, soil, or water at the site is observed, the U.S. Environmental Protection Agency (EPA) site representative and the local fire department will be immediately notified. An assessment will be made of the magnitude and potential impact of the release. If it is safe to do so, site personnel will attempt to locate the source of the release, prevent further release, and contain the spilled and/or affected materials. Additional details are presented in the sitewide Emergency Response Plan and its Appendix A, Spill Prevention, Control, and Countermeasures Plan.

**Section 11 Emergency Contacts**

	<b>Phone</b>	<b>Emergency Contacts</b>	<b>Name</b>	<b>Phone</b>
Emergency/Fire/Police	On land (Off Vigor Property): 911 On land (On Vigor Property): Channel 1-VHS radio -or- call (503) 247-1799 ext. #1799 On Water: Channel 16-VHS radio	Senior PM	Jeff Hodge, PMP	913-378-2302
Dig/Utility Clearance	811 800-522-2404	Deputy Project Manager	Jennifer Norman, AICP	425-610-7840
Health Department	Multnomah County 503-988-3674	SSHO	Jeff Parker, LG, RG	206-734-0937
Sheriff's Department	Multnomah County 503-988-4300	Health and Safety Manager (HSM)	Edie Scala-Hampson, CIH, CHMM	847-409-6384
Highway Patrol/State Police	Northern Command Center 800-442-0776	CHSD	Steve Davis, CSP, CIH	865-659-0499
U.S. Coast Guard – Marine Safety Unit Portland	VHS Radio Channel 16 503-240-9310	Occupational Physician	WorkCare - 24/7	888-449-7787
National Response Center (spills)	800-424-8802	<b>HGL 24 Hour Emergency Number</b>		<b>800-341-3647</b>
Oregon Emergency Response System	800-452-0311			

**Notes:**

- AICP = American Institute of Certified Planners
- CHMM = Certified Hazardous Materials Manager
- CHSD = Corporate Health and Safety Director
- CIH = Certified Industrial Hygienist
- CSP = Certified Safety Professional
- LG = Licensed Geologist
- PM = Project Manager
- PMP = Project Management Professional
- RG = Registered Geologist
- SSHO = Site Safety and Health Office

**Section 12 Medical Emergency**

<b>Hospital Name, Address, and Phone:</b> Legacy Emanuel Medical Center 2801 N. Gantenbein Avenue, Portland, Oregon 97227 503-413-2200	<b>Name of Contact at Hospital if needed:</b>
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<b>Name of 24-Hour Ambulance:</b>	<b>Distance to Hospital:</b> 2.7 miles
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**Route to Hospital with approximate time and distance to the site. (See Figure 2a):**

Life threatening emergencies:

- On land (off Vigor property): Dial 911
- On land (on Vigor property): Radio Vigor staff on Channel 1-VHS radio -or- call (503) 247-1799 ext. #1799
- On the water: Radio the Coast Guard on Channel 16 on the VHS radio.

Time-critical emergencies: Proceed to the Legacy Emanuel Medical Center. The center is 2.7 miles southeast of the site. The estimated drive time is 10 minutes.

Note: On-water emergencies that require landing the vessel at the Swan Island Boat Ramp before heading to the hospital. Driving directions to the hospital listed below are from the boat ramp.

1. Start out going southeast on N. Basin Ave. toward N. Emerson Ct. (0.27 miles)
2. Stay straight to go onto N. Anchor St. (0.30 miles)
3. Turn slight left onto N. Channel Ave.
4. N. Channel Ave. becomes N. Going St. (0.95 miles)
5. Turn right onto N. Interstate Ave. (0.10 miles)
6. Turn left onto N. Skidmore St. (0.70 miles)
7. Turn right onto N. Vancouver Ave. (0.75 miles)
8. Turn right onto N. Stanton St. (0.06 miles)
9. Turn right onto N. Gantenbein Ave. (0.02 miles)
10. Destination is on the right.
11. Emergency Room is on the west side of the hospital, off N. Kerby Ave. and N. Morris St.

For nonlife-threatening emergencies: Field staff are recommended to use Urgent Care (Figure2b).

**Section 13 Contingency Plans Summarized below:**

If the field team members observe hazards which require response from public-level emergency services, they will withdraw from the area and contact public emergency services to handle the situation. They will subsequently call HGL CHSD Steve Davis or the HSM Edie Scala-Hampson.

**Wildfire smoke safety protocol**

Smoke from wildfires contains chemicals, gases and fine particles that can harm health. The greatest hazard comes from breathing fine particles in the air, which can reduce lung function, worsen asthma and other existing heart and lung conditions, and cause coughing, wheezing and difficulty breathing.

Protection from Wildfire Smoke will apply when the current Air Quality Index (AQI) for PM2.5 particulate is 101 or greater ("unhealthy") and when it is reasonably anticipated that employees may be exposed to wildfire smoke.

- At the start of each shift and periodically thereafter, as needed, AQI forecasts and current AQI for PM<sub>2.5</sub> will be checked at the following websites or using another effective method (telephone, email, text, etc.) from the agencies listed below:
  - o The EPA AirNow
  - o The U.S. Forest Service
  - o The Interagency Wildland Fire Air Quality Response Program
  - o The local air pollution control district
  - o The local air quality management district
- The SSHO will notify field personnel when the ambient air concentration at the work location is at or above the following levels and when it drops below levels requiring protection:
  - o 35.5 µg/m<sup>3</sup> (AQI 101);
  - o 150.5 µg/m<sup>3</sup> (AQI 201);
  - o 500.4 µg/m<sup>3</sup> (AQI 501); and
- The following exposure controls will be implemented:
  - o AQI ≥ 101. Control by use of NIOSH-approved respirators that protect from PM<sub>2.5</sub> particulates.
  - o AQI ≥ 201.
    - Implement engineering controls, where feasible, to reduce employee exposure. Examples include providing enclosed structures or vehicles for employees to work in where the air is filtered.
    - Whenever engineering controls are not feasible or do not reduce employee exposures changes will be made to work procedures or schedules (delay) when practicable. Examples include changing the location where employees work or their work schedules.
    - When engineering and administrative controls cannot reduce hazardous levels, KN-95 or NIOSH approved respirators will be used.
  - o AQI ≥ 501. Stop work until conditions approve.

In the event of medical emergency, see contact instructions in Sections 12 and 13.

If breathing zone contaminant levels are above the action level, additional ventilation or engineering controls will be implemented. If these controls do not eliminate the exposure, personnel protection will be reevaluated.

The weather will be monitored routinely. If lightning is seen or thunder heard, the “30-30 Rule” will be used where visibility is good and there is nothing obstructing the view of the thunderstorm. When lightning is seen, the time until thunder is heard, is counted. If that time is 30 seconds or less, then the thunderstorm is within 6 miles and is dangerous. Activities with exposure will cease at that time and will not resume until at least 30 minutes after the last clap of thunder. If immediate shelter is required, personnel will go to the nearest available shelter and wait until hazardous conditions pass.

A temporary field office is planned inside Building #10 of the Vigor Industrial LLC facility, which covers the western half of Swan Island. Staff will follow Vigor Industrial LLC evacuation plans while at the temporary field office or anywhere on the Vigor property. The routes are illustrated in Attachment F. The proposed muster point for the field activities is the Swan Island Boat Ramp located approximately 0.50 miles southeast of the temporary facility. Evacuation from the boat ramp will proceed according to the City of Portland plan (<https://www.portlandoregon.gov/pbem/article/668061>). Additional rally points and evacuation methods for severe weather will be identified on site as needed. If no shelter is available, move into field vehicles and travel to hotel if necessary.

When a medical facility or physician is not accessible within 5 minutes of the work site, a minimum of two personnel on each shift will be qualified to administer first aid and CPR/AED.

#### Emergency Equipment

- A minimum of one ANSI Z308.1, Type III first aid kit for portable outdoor settings;
- A minimum of one approved fire extinguisher (10-B:C).
- An AED.

Subcontractors operating watercraft will prepare a Capsize/Water Rescue Plan to be included with their HASP.

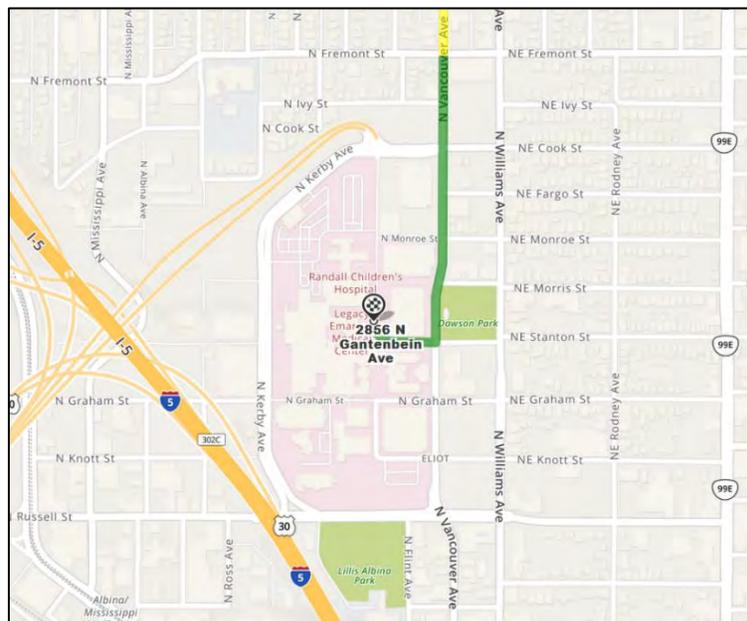
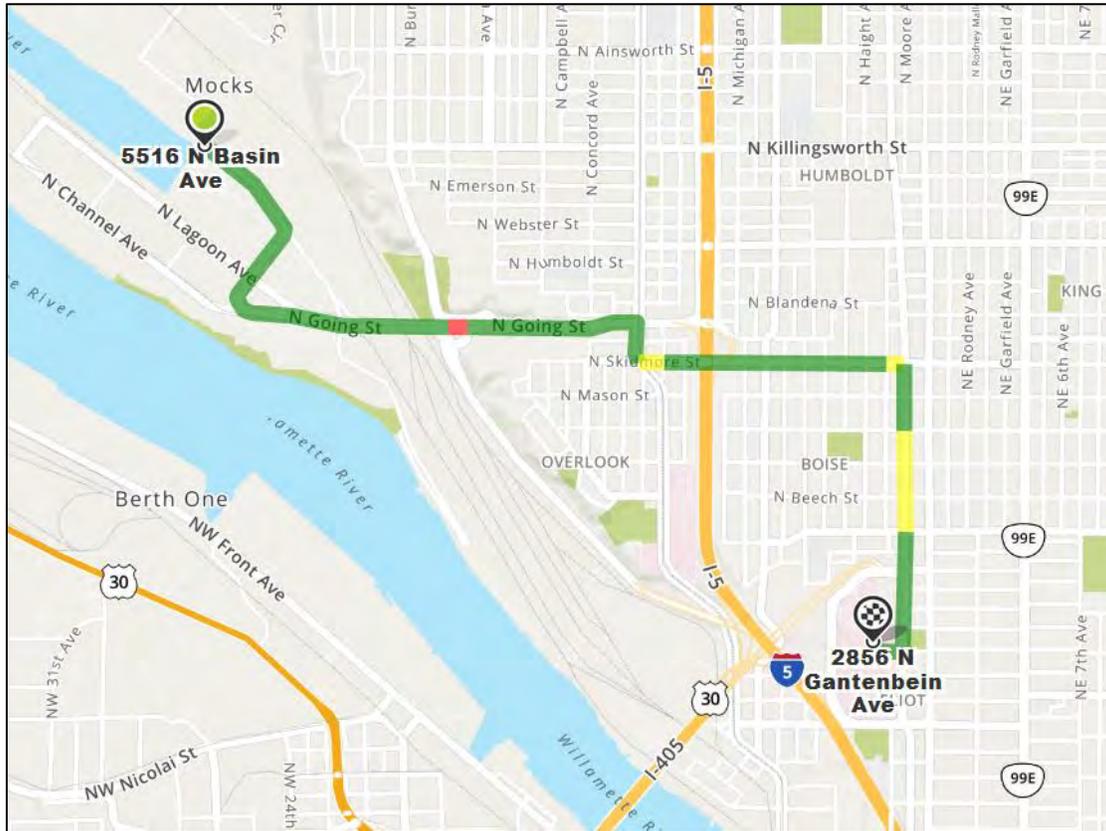
**Health and Safety Plan**

**HydroGeoLogic, Inc.**  
**Swan Island Basin Remedial Design Group**  
**Project Name: Swan Island Basin Project Area,**  
**Portland Harbor Superfund Site**  
**Contract/Task Order: DT2002**

**Section 14 Health and Safety Plan Approvals**

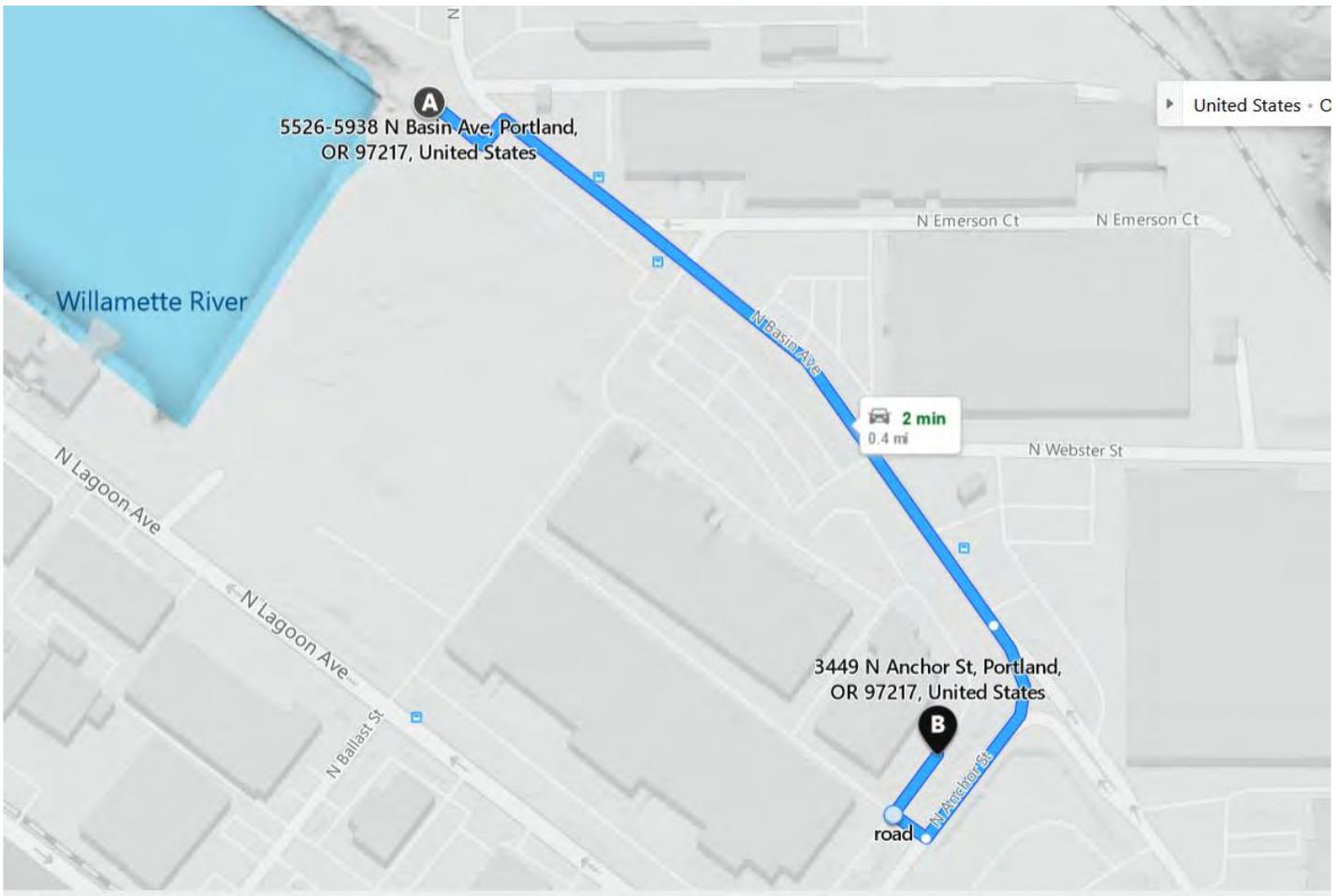
Prepared by:	Date:
SSHO Signature:	Date:
HGL HSM Signature:	Date:

Figure 2a Hospital Route Map from Swan Island Boat Ramp



**Legacy Emanuel Medical Center, 2801 N. Gantenbein Ave.,  
Portland, OR 97227, 503-413-2200**

Figure 2b Route Map from Swan Island Boat Ramp to Concentra Urgent Care



**Concentra Urgent Care**  
**3449 N. Anchor Street, Ste. 300A,**  
**Portland, OR 97217**  
**503-283-0013**

Note: The SSHO in consultation with the injured personnel will make a decision whether to go the urgent care or hospital emergency room based on site circumstances and the severity of the injury. In addition, WorkCare may be contacted by phone at 888-449-7787 to provide guidance on which medical facility would be appropriate to treat the injury or illness.



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**ACTIVITY HAZARD ANALYSIS FORMS**

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ACTIVITY HAZARD ANALYSIS (AHA)						
<b>Activity/Work Task:</b> Coronavirus Practices to Prevent Exposure <b>Project Location:</b> Swan Island Basin, Portland Harbor Superfund Site, Multnomah County, Oregon <b>Contract number:</b> DT2002 <b>Date Prepared:</b> May 2021 <b>Prepared by:</b> Steve Davis CIH, CSP <b>Corporate Health and Safety Reviewer:</b> Edie Scala-Hampson <b>Notes:</b> (Field Notes, Review Comments, etc.)	<b>Overall Risk Assessment Code (RAC) (Use highest code)</b>				<b>L</b>	
	<b>Risk Assessment Code (RAC) Matrix</b>					
	<b>Severity</b>	<b>Probability</b>				
		Frequent	Likely	Occasional	Seldom	Unlikely
	Catastrophic	<b>E</b>	<b>E</b>	<b>H</b>	<b>H</b>	<b>M</b>
	Critical	<b>E</b>	<b>H</b>	<b>H</b>	<b>M</b>	<b>L</b>
	Marginal	<b>H</b>	<b>M</b>	<b>M</b>	<b>L</b>	<b>L</b>
	Negligible	<b>M</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>
	Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above)					
	<b>Probability</b> the likelihood the activity will cause a Mishap (near miss, incident, or accident). Identify as: Frequent, Likely, Occasional, Seldom, or Unlikely.				<b>RAC Chart</b>	
<b>Severity</b> the outcome/degree if a mishap occurred. Identify as: Catastrophic, Critical, Marginal, or Negligible				<b>E = Extremely High Risk</b>		
Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.				<b>H = High Risk</b>		
				<b>M = Moderate Risk</b>		
				<b>L = Low Risk</b>		
Job Steps	Hazards	Controls			RAC	
Mobilization to site	Failure to plan/warn/train Infection	<p>Conduct readiness review with field team members prior to fieldwork. Site Safety and Health Officer (SSHO) to identify potential infection sources due to the task, location, and surrounding areas. Include discussion of same in site-specific training.</p> <p>SSHO to identify and implement any applicable local or state requirements for infection control measures.</p> <p>SSHO to discuss Coronavirus hazards and controls in the readiness review and initial tailgate safety meeting and address the topics listed below. The meetings should be held remotely, outdoors, or in a space large enough to allow space between participants. SSHO to verify that the necessary equipment and supplies are available and in good condition: face coverings, disinfectant, gloves, and safety glasses.</p> <ol style="list-style-type: none"> <li>The virus is highly contagious and is spread primarily by airborne droplets ejected when infected people cough, sneeze, or possibly just breathe. Most of these droplets settle out of the air within about 6 feet.</li> </ol>			<b>L</b>	

Job Steps	Hazards	Controls	RAC
Mobilization to site (continued)	Failure to plan/warn/train Infection (continued)	<ol style="list-style-type: none"> <li>2. The most frequent symptoms are fever, coughing, and shortness of breath.</li> <li>3. Maintain 6-foot separation unless the job task requires working closely. If unable to maintain 6-foot distance when working with other personnel inside buildings or in a group outside, wear tight-fitting filtering face mask over nose and mouth (unless NIOSH-approved respirator is required due to other airborne hazards). Face masks must have at least two filtering layers and must not have exhalation valves.</li> <li>4. Do not share tools, pens, or anything else without disinfecting between uses. Use your own pen.</li> <li>5. Site personnel are required to report travel to high-risk areas, potential exposure to infected people, and symptoms of illness. Site personnel should consider bringing personal thermometers to monitor their temperatures.</li> <li>6. Limit vehicle occupancy to two people and adjust vehicle's air handling system to maximize outside air. Both occupants must wear face coverings.</li> <li>7. Discuss and follow any state and local restrictions on gatherings (number of people that can congregate) and closings. Be aware that stores, restaurants, and coffee locations that you may have frequented may be closed. Bring your own food and drinks.</li> </ol> <p>See Center for Disease Control document <i>How It Spreads</i>:  <a href="https://www.cdc.gov/coronavirus/2019-ncov/prepare/transmission.html">https://www.cdc.gov/coronavirus/2019-ncov/prepare/transmission.html</a></p>	L
Travel to site	Infection	<p>Avoid air travel if possible. If air travel is necessary, wear face covering over mouth and nose in airports, planes, and any other situation where 6-foot spacing is not possible. Disinfect high contact surfaces in and around plane seats with disinfectant wipes. Adjust seat air ventilation to high flow.</p> <p>If renting a vehicle, request a rental vehicle that has been idle. Three days is best because all or nearly all virus particles on surfaces are inactivated by 72 hours of exposure to air. At least 75% of virus particles are inactivated by 24 hours of exposure to air. See the following link for additional information:  <a href="https://www.nejm.org/doi/full/10.1056/NEJMc2004973">https://www.nejm.org/doi/full/10.1056/NEJMc2004973</a>.</p>	L

Job Steps	Hazards	Controls	RAC
Travel to site (continued)	Infection (continued)	<p>Wipe the steering wheel and other high-contact surfaces of rental vehicles with disinfectant. Use any cloth or tissue saturated with disinfectant such as &gt;60% isopropyl alcohol, &gt;120 proof clear liquor (keep sealed or in trunk when in transit), or commercial disinfectant. Concentrated alcohol is flammable so use in well-ventilated area away from ignition sources. Any disinfectant product from a reputable supplier should inactivate the virus.</p> <p>Use gloves or wash or disinfect hands after touching commonly handled items such as gas dispenser handles.</p> <p>Use disinfectants in area with good ventilation and away from ignition sources.</p>	L
Hotel stays	Infection	<p>Request a room that has been idle. Three days is best because all or nearly all virus particles on surfaces are inactivated by 72 hours of exposure to air. At least 75% of virus particles are inactivated by 24 hours of exposure to air. See the following link for additional information:  <a href="https://www.nejm.org/doi/full/10.1056/NEJMc2004973">https://www.nejm.org/doi/full/10.1056/NEJMc2004973</a>.</p> <p>Request no maid service for short stays.</p> <p>Minimize time spent in common areas like the hotel lobby, exercise facility, or restaurant. Practice social distancing with hotel staff and other guests.</p> <p>Wipe high-contact areas like doorknobs and countertops with disinfectant. Use any cloth or tissue saturated with disinfectant such as &gt;60% isopropyl alcohol, &gt;120 proof clear liquor, or commercial disinfectant spray. Concentrated alcohol is flammable so use in well-ventilated area away from ignition sources. Note that any disinfectant from a reputable supplier (Lysol, Clorox) is likely to be effective on Coronavirus.</p> <p>Use disinfectants in area with good ventilation and away from ignition sources.</p>	L

Job Steps	Hazards	Controls	RAC
Transportation or shipment of disinfectants	Violation of U.S. Department of Transportation hazardous materials shipping regulations Spills, leaks, and fires	<p>Comply with airline requirements for transporting disinfectants in carry-on or checked luggage.</p> <p>Transport disinfectants in vehicles in compliance with U.S. Department of Transportation Materials of Trade exception:</p> <ul style="list-style-type: none"> <li>• Materials in labeled and leak-tight containers.</li> <li>• Containers secured so that they do not move while in transit, driver aware of hazardous materials in vehicle.</li> <li>• No more than 5 gallons of flammable liquid in any single container.</li> </ul> <p>If disinfectants must be shipped (for example by FedEx) use ground shipment.</p>	L
Tasks that involve large crews and travel to distant locations	Logistical issues related to managing infected personnel far from home	<p>SSHO to acquire a limited supply (5 to 10) of N95 or KN95 masks or half face elastomeric respirators with particulate filters, if possible, to be maintained on site and used for infection control if necessitated by potential exposure to field team members who are known or suspected to be infected.</p> <p>HGL's Project Manager (PM), in concert with senior management, will provide coordination and support to facilitate quarantine. If suspected infected personnel must be within 6 feet of other personnel (in a car, for instance) the suspected infected individual and any personnel within a 6-foot radius must wear a N95 or KN95 mask (without exhalation valve) or double layer surgical mask with cloth mask on top.</p>	L
Site tasks	Infection or spread of infection	<ul style="list-style-type: none"> <li>• Stay at least 6 feet from other personnel unless closer spacing is necessary for the work (and maintain this spacing during breaks and lunch). If unable to maintain 6-foot distance, wear a face mask over mouth and nose. Face masks must have at least two layers of filtering material.</li> <li>• Hold tailgate safety meetings outdoors or in a space large enough to allow separation.</li> <li>• Do not share pens or tools.</li> <li>• Do not pass or exchange items like paperwork or clipboards.</li> <li>• Limit vehicle occupancy to two, if possible, and set the vehicle's air handling system to maximize intake of outside air. The driver and passenger should both wear face coverings.</li> </ul>	L

Job Steps	Hazards	Controls	RAC
Site tasks (continued)	Infection or spread of infection (continued)	<ul style="list-style-type: none"> <li>• Avoid touching high-contact surfaces like shared pens, toilet valve handles, doorknobs, etc. with your bare skin and if you cannot avoid that, wash, or disinfect your hands afterward.</li> <li>• Avoid handshakes and hugs.</li> <li>• Provide handwashing station or hand sanitizer and use often.</li> <li>• Disinfect high-contact surfaces (i.e., door handles, copy machine keypad, coffee pot, refrigerator door handle, etc.) frequently.</li> <li>• Personnel must perform a self-assessment each morning and if symptoms like fever, cough, or shortness of breath that might indicate infection are present, must self-quarantine and notify the SSHO and their supervisor by phone call or email. SSHO is to notify PM and Human Resources (HR). SSHO may not release the name of quarantined personnel to others without authorization from HR.</li> <li>• Surfaces that have been touched by personnel who are ill should be thoroughly disinfected (door handles, vehicles) or disposed (pens, pencils, hard hat liners) to minimize potential for disease transmission. Enclosed areas such as vehicles or equipment cabs will be placed under lockout/tag out procedures for 24 hours to remove airborne virus particles, then thoroughly disinfected prior to return to service. Alternatively, if feasible, such surfaces and areas can be allowed to self-disinfect by leaving them unused for 7 days, which will allow virus particles to become inactivated.</li> </ul>	L
Use of sanitizers and cleaning sprays	Skin irritations-dermatitis, increased risk of eczema	Wear gloves when cleaning high-contact surfaces. When sanitizing hands, if soap and water cleaning is not available, wait for the sanitizer to dry completely before donning gloves. Sanitizer can breakdown the skin making an individual more prone to chemical and biological exposures. Sanitizers in close contact with the skin may also cause dermatitis. Use hand sanitizers from reputable manufacturers. Conduct hazard communication training on disinfectants that are being used.	L

Job Steps	Hazards	Controls	RAC
<b>Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.</b>			

Equipment	Training	Inspection
<p><u>Personal Protective Equipment Level D:</u></p> <ul style="list-style-type: none"> <li>• Hard hat (if there are overhead hazards)</li> <li>• Safety glasses</li> <li>• Safety-toed boots</li> <li>• Work gloves/chemical resistant gloves</li> </ul> <p><u>Other Equipment:</u></p> <ul style="list-style-type: none"> <li>• Face coverings</li> <li>• Hand sanitizer</li> <li>• Disinfectant wipes</li> <li>• Gloves</li> </ul>	<p><u>Competent Person (CP) / Qualified Person (QP):</u></p> <p>CP/SSHO _____</p> <p><u>Training Requirements (as determined by the SSHO):</u></p> <ul style="list-style-type: none"> <li>• Tailgate meetings</li> <li>• Emergency procedures</li> <li>• Hazard communication</li> </ul>	<ul style="list-style-type: none"> <li>• Daily inspection (SSHO)</li> <li>• Housekeeping (daily)</li> <li>• Hand washing station or hand sanitizer solution available and used.</li> <li>• Distancing being practiced.</li> </ul> <p>Do any personnel show signs of infection?</p> <p>SSHO (Parker) to notify PM and HR of any reports or signs of infection immediately. SSHO is not to provide names of involved personnel to others without authorization from HR.</p>

ACTIVITY HAZARD ANALYSIS (AHA)						
<b>Activity/Work Task:</b> Direct-Push Technology (DPT) – Sediment Sampling on Land and Over Water  <b>Project Location:</b> Swan Island Basin, Portland Harbor Superfund Site, Multnomah County, Oregon  <b>Contract number:</b> DT2002  <b>Date Prepared:</b> May 2021  <b>Prepared by:</b> Steve Davis CIH, CSP  <b>Corporate H&amp;S Reviewer:</b> Edie Scala-Hampson  <b>Notes:</b> (Field notes, review comments, etc.)	Overall Risk Assessment Code (RAC) (Use highest code)				L	
	<b>Risk Assessment Code (RAC) Matrix</b>					
	<b>Severity</b>	<b>Probability</b>				
		Frequent	Likely	Occasional	Seldom	Unlikely
	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L
	Step 1: Review each “ <b>Hazard</b> ” with identified safety “ <b>Controls</b> ” and determine RAC (See above)					
	“ <b>Probability</b> ” the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom, or Unlikely.				<b>RAC Chart</b>	
“ <b>Severity</b> ” the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible				E = Extremely High Risk		
				H = High Risk		
Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each “Hazard” on AHA. Annotate the overall highest RAC at the top of AHA.				M = Moderate Risk		
				L = Low Risk		
Job Steps	Hazards	Controls	RAC			
Mobilization/demobilization	Driving hazards	See Mobilization and Demobilization AHA	L			
Loading/unloading DPT rig on barge (To be conducted by subcontractor)	Falling, tripping, slipping into water, and drowning  Undercut banks and sloughing ground	See Working Over and Near Water AHA	L			
Borehole setup	Struck by vehicle traffic	Position drill rig and support vehicles to shield work zone.  Wear highly visible clothing, set up work zone suitable to site conditions (i.e., traffic cones, caution tape, vehicle placement). Do not assume equipment and vehicle operators have seen you unless operator has made eye contact with you and signaled to you.  These requirements apply to any work that exposes HydroGeoLogic, Inc. (HGL) employees, HGL temporary employees, and HGL subcontractors to traffic hazards. Examples of such work include the following: <ul style="list-style-type: none"> <li>• Work in a travel lane of a public road.</li> <li>• Work on the shoulder of a public road.</li> </ul>	L			

Job Steps	Hazards	Controls	RAC
Borehole setup (continued)	Struck by vehicle traffic (continued)	<ul style="list-style-type: none"> <li>• Work beyond the shoulder of a public road but within the road’s right of way that potentially exposes personnel to being struck by traffic.</li> <li>• Work at any location where there is extensive vehicle movement and a risk of personnel being struck by moving vehicles.</li> </ul> <p><b>CONTROLS</b></p> <ul style="list-style-type: none"> <li>• Ensure that substantial physical barriers such as concrete traffic barriers or stationary vehicles are placed between personnel and oncoming traffic when working in or near a public road, publicly accessible parking areas, or any other situation where vehicles operated by third parties may endanger personnel.</li> <li>• Ensure that site- or project-specific plans and controls are in place to protect personnel whenever traffic hazards are present.</li> <li>• Ensure that all work on or near roadways complies with federal, state, local, and facility laws and requirements.</li> <li>• Notify the applicable road authority (municipality, state Department of Transportation [DOT], etc.) prior to performing work that will or may disrupt traffic.</li> <li>• Ensure that a traffic control plan and permit in compliance with the requirements of the local jurisdiction, or DOT Manual of Uniform Traffic Control Devices (MUTCD) is prepared and implemented for work in or on the right of way of a public or facility road.</li> <li>• Ensure that a qualified traffic control subcontractor or a law enforcement officer is used to control traffic for any work in a public road or on the shoulder of a public road with a speed limit greater than 35 miles per hour (mph), or as required by applicable traffic authority requirements.</li> <li>• Ensure that personnel working on or near public roads wear at least Class 2 high visibility garments if speeds exceed 25 mph and Class 3 if speeds exceed 50 mph.</li> <li>• Ensure that personnel working in off-road locations where moving vehicles pose a hazard wear high visibility garments.</li> </ul> <p>See HGL Procedure 25 for MUTCD Requirements:  <a href="https://hydrogeologic.sharepoint.com/:b:/r/sites/CorporateDocumentLibrary/Shared%20Documents/200%20-%20Health%20and%20Safety/201%20-%20Personnel%20Safety/HGL%20HS%20Procedure%2025%20Traffic%20Control%20Program.pdf?csf=1&amp;web=1&amp;e=0cBL4Z">https://hydrogeologic.sharepoint.com/:b:/r/sites/CorporateDocumentLibrary/Shared%20Documents/200%20-%20Health%20and%20Safety/201%20-%20Personnel%20Safety/HGL%20HS%20Procedure%2025%20Traffic%20Control%20Program.pdf?csf=1&amp;web=1&amp;e=0cBL4Z</a> </p>	<b>L</b>

Job Steps	Hazards	Controls	RAC
Borehole setup (continued)	Vehicle damage	Use a spotter standing to side of rig (not behind) when backing drill rig. Confirm proper operation of backup alarm.	L
	Uneven terrain	Use jacks and proper blocking to level rig. Choose level, open areas to drill. If client requires plastic sheeting under the rig, keep it away from the mechanical portions of the rig that contact the ground (i.e., tracks, wheels, jacks).	L
	Overhead utilities	<p>Maintain distance of at least 20 feet from overhead power lines. Avoid borehole locations near overhead lines. Do not move drill rig with tower/mast in the upward position.</p> <p>Complete a Site Layout Plan prior to mobilizing the equipment. The plan should identify all overhead hazards.</p> <p>Survey the travel route for overhead and terrain hazards before equipment is moved. The minimum distances from electrical lines must be observed.</p> <p>Maintain clearance distances stated above when operating beneath a power line that has not been verified as de-energized and grounded. Power lines should be assumed to be energized unless verified to be de-energized and visibly grounded. Erect a high-visibility elevated warning line or barricades at the minimum approach distance.</p> <p>Train each field team member in the electrocution hazards and emergency procedures associated with energized power lines.</p> <p>See Procedure 11 <a href="#">Electrical Safety</a></p>	L
	Underground utilities	<p>Follow the procedure for intrusive activities in the Field Sampling Plan (FSP). Additional details are included in the Subsurface Utility Avoidance Standard Operating Procedure (411.03) included in the FSP.</p> <p>Complete the Pre-Boring/Checklist for each boring.</p> <p>Complete a Site Layout Plan prior to mobilizing the equipment. The plan should identify all underground hazards.</p> <p>Locate and mark utilities prior to commencing intrusive activities. Retain a copy of mark-out ticket for documentation purposes and quality control purposes.</p> <p>Document utility mark-out using the Utility Mark-out Documentation form. No boring work is to be performed until all utility mark-outs are verified.</p>	L

Job Steps	Hazards	Controls	RAC
Borehole setup (continued)	Underground utilities (continued)	<p>Ensure that buried utilities are daylighted and visible when drilling must be conducted within 5 feet of the utility.</p> <p>DO NOT proceed with intrusive activities until the construction manager/field superintendent and site safety and health officer (SSHO) have issued an Intrusive Activities Permit.</p> <p>Advance by hand digging, probing, and/or air knife to 5 feet below ground surface if markings are unclear or utilities known to be present are not marked.</p> <p>Contact Digger's Hotline if an underground facility is damaged, dislocated, or disturbed.</p>	<b>L</b>
	Slips, trips, and falls	<p>Understand the hazard of slips, trips, and falls – consider the consequences.</p> <p>Do not jump from equipment or elevated surfaces.</p> <p>Clean up work areas throughout the day and at the end of each workday. Use three-point contact rule for entering/exiting vehicles, trucks, and equipment.</p> <p>Use handrails and other stationary objects (door frames, doorknobs, steering wheels, walls, etc.) to increase stability.</p> <p>Use extra caution when walking on wet, muddy, frosty, icy, or snow-covered surfaces.</p> <p>Increase your awareness, keep alert, stay focused, and know your environment.</p> <p>Provide warning signs or cordon off areas where necessary.</p> <p>Consider postponing work as necessary and feasible.</p> <p>Avoid slippery areas when possible.</p> <p>Stay away from slopes, hills, and grades. Be cautious when using stairs.</p> <p>Remove snow and ice when possible (shoveling, chipping, and salt application).</p> <p>Apply traction aids, such as sand, gravels, and straw. Choose footwear wisely.</p> <p>Slow down - take smaller steps.</p> <p>Lower your center of gravity when necessary.</p>	<b>L</b>

Job Steps	Hazards	Controls	RAC
Borehole setup (continued)	Slips, trips, and falls (continued)	Maintain proper illumination in work areas.  Provide fall protection when personnel are exposed to fall hazards greater than 4 feet.	L
	Strains and sprains from improper lifting of loads	Lift with legs, a straight back, and do not twist while lifting heavy loads.  Use multiple employees or mechanical lifting devices for lifting objects over the 50-pound limit.	L
Watercraft operation (To be conducted by subcontractor)	Hazards of boat operation Falling overboard and/or stranded	See Working Over and Near Water AHA. AHA will be provided by subcontractor.	L
Connecting drill tools to drive head or other tools (To be conducted by subcontractor)	Pinch points between rig and tooling	Keep hands clear of joints when connecting drill tools. Wear PVC gloves when connecting tools. If joining tools requires operation of winch or feed controls, have two workers present: one to operate controls and one to align tools. One person should not operate controls and join tools simultaneously.  Be aware of pinch-point hazards and work in a manner to prevent injuries.  Keep hands out of areas that may present pinching hazards and personnel should not position themselves between equipment.	L
Advancing percussion tools (driving sampler, driving casing, direct-push hammering) (To be conducted by subcontractor)	Struck by broken drill tooling from drill tooling improperly lined up	Maintain percussion force in line with hammer and tool string (minimize bending of tool string or driving at an angle). If conditions become difficult, use stop work authority and re-evaluate.  Maintain a safe distance from operations.	L
	Noise	Wear ANSI NRR 30 or higher hearing protection when direct push activities exceed 85 dBA while advancing tools.	L
	Cuts from cutting plastic tubing	Prevent lacerations by cutting away from hands and body. Watch the line of fire with the cutter. Wear cut resistant gloves.	L
Collecting sediment samples	Slip, trip, and fall hazards  Contact/struck by drilling equipment  Strains, sprains, awkward bending/lifts, and ergonomic hazards  Noise  Inhalation and skin contact hazards	Refer to Drilling/DPT – Sampling Processing AHA	L

Job Steps	Hazards	Controls	RAC
Down-hole tool removal (To be conducted by subcontractor)	Struck by cable from cable recoil from strained winch	<p>Use rod clamp, vice or slide ring to support loads.</p> <p>Minimize time that objects are suspended above ground or secure supporting surface.</p> <p>Minimize slippage by using proper tools for material being lifted.</p> <p>Lift straight up using safety hook or hoisting plug whenever possible.</p> <p>Remove drill tools in 6-foot sections, or less.</p> <p>Stay clear of strained winch cables or drive shafts. Never place body between pulling force and load.</p>	L
Decontamination of equipment	<p>High pressure water</p> <p>Skin contact</p> <p>Inhalation</p>	<p>Wear modified Level D protection, including a face shield and safety goggles.</p> <p>Ensure that other personnel are out of the area prior to decontamination when pressure washing equipment is used. Secure the area around the decon pad with cones, caution tape, or barricades.</p> <p>Ensure that safe work practices and precautions are taken to minimize the potential for physical injury.</p> <p>Avoid skin and eye contact with isopropyl alcohol, Alconox, or other cleaning materials.</p> <p>Stand upwind to minimize any potential inhalation exposure.</p> <p>Dispose of spent cleaning solutions and rinses accordingly.</p> <p>Ensure that area is clean after equipment is decontaminated.</p>	L
General site work	<p>General site hazards: insect bites and stings</p> <p>Contact dermatitis from poisonous and irritating plants (poison ivy, poison oak, and poison sumac)</p> <p>Severe weather</p> <p>Heat stress</p> <p>Cold stress</p> <p>Noise</p> <p>Lifting</p> <p>UV hazards, etc.</p>	See General Site Work AHA	L

Equipment to be Used	Training Requirements/Competent or Qualified Personnel Name(s)	Inspection Requirements
<p><u>Personal Protective Equipment</u></p> <ul style="list-style-type: none"> <li>• Hard hat</li> <li>• Safety glasses with side shields</li> <li>• Safety-toed boots</li> <li>• Work gloves</li> <li>• Class 2 high visibility vests</li> <li>• Hearing protection, as necessary</li> <li>• Nitrile gloves to prevent contact with contaminated water</li> <li>• Type I or V U.S. Coast Guard-approved personal flotation devices</li> </ul> <p><u>Other Equipment:</u></p> <ul style="list-style-type: none"> <li>• 2-way radio with Channel 16 for marine emergencies</li> <li>• Photoionization Detector (PID)</li> <li>• Multi-gas meter</li> <li>• Fire extinguishers</li> <li>• First aid kit</li> <li>• Eye wash</li> <li>• GFCI</li> <li>• Heavy duty extension cords (S, ST, SO, STO, SJ, SJO, SJT, SJOT)</li> <li>• Drinking water</li> <li>• Insect repellent with DEET (Deep Woods Off™ or equivalent) Repel Permanone™</li> <li>• Smart phone apps for weather, noise, temperature stress, etc.</li> </ul>	<p><u>Competent Person (CP) / Qualified Person (QP):</u></p> <p>CP/SSHO _____</p> <p>Alternate CP/SSHO _____</p> <p>QP/First Aid and CPR _____</p> <p>QP/First Aid and CPR _____</p> <p>QP/Driller _____</p> <p>CP/Rigger _____</p> <p>CP/Excavation _____</p> <p><u>Training Requirements (as determined by the SSHO):</u></p> <ul style="list-style-type: none"> <li>• HAZWOPER 40-hour site safety orientation</li> <li>• Emergency procedures hazard communication</li> <li>• Hearing conservation applicable AHAs</li> <li>• Qualified equipment operators</li> <li>• Lifting/back safety</li> <li>• Fire extinguisher use</li> <li>• Biological hazard identification and control</li> <li>• Earthquake response</li> <li>• Tsunami evacuation</li> <li>• Tornado shelter location</li> <li>• Lightning safety procedures</li> <li>• Heat stress prevention and heat stroke treatment</li> <li>• Cold stress prevention</li> </ul> <p>HGL Health and Safety Procedures:  <a href="https://hydrogeologic.sharepoint.com/sites/CorporateDocumentLibrary/Shared%20Documents/Forms/All%20Documents/%20%20By%20Category.aspx?FolderCTID=0x01200090A45A7427CF96489B6671350D555226&amp;FilterField1=Document%5F0020%5FCategory&amp;FilterValue1=200%20%2D%20H%20">https://hydrogeologic.sharepoint.com/sites/CorporateDocumentLibrary/Shared%20Documents/Forms/All%20Documents/%20%20By%20Category.aspx?FolderCTID=0x01200090A45A7427CF96489B6671350D555226&amp;FilterField1=Document%5F0020%5FCategory&amp;FilterValue1=200%20%2D%20H%20</a></p>	<ul style="list-style-type: none"> <li>• Daily site safety inspection (SSHO)</li> <li>• Daily site safety inspection (Quality Control Officer)</li> <li>• Mechanized equipment (daily)</li> <li>• Overhead utilities (prior to operating equipment in area)</li> <li>• Underground utilities (prior to intrusive activities)</li> <li>• Drilling Equipment Operations Inspection Checklist - Pre-Mobilization and Mobilization: to be completed by the drilling subcontractor prior to/upon mobilization to the project site.</li> <li>• Drilling Equipment Operations Inspection Checklist - Weekly and Location Specific: to be completed by the drilling subcontractor a minimum of once per week and/or each time the drill rig is moved to a new boring location.</li> <li>• Drilling Equipment Operations Inspection Checklist – Daily: to be completed daily by the drilling subcontractor.</li> <li>• Rigging (before each use) Housekeeping (daily)</li> <li>• Fire extinguisher (monthly) Vehicle inspection (daily)</li> <li>• Equipment and tools inspection (daily and before use)</li> <li>• Survey areas for poisonous plants, insects, and animals (each work area)</li> <li>• Check body for ticks (each evening during tick season)</li> </ul> <p>For each work area: Identify closest usable tornado shelter that is available and route to the hospital.</p>

ACTIVITY HAZARD ANALYSIS (AHA)						
<b>Activity/Work Task:</b> Drilling (Land Based and Barge Mounted)  <b>Project Location:</b> Swan Island Basin, Portland Harbor Superfund Site, Multnomah County, Oregon  <b>Contract number:</b> DT2002  <b>Date Prepared:</b> May 2021  <b>Prepared by:</b> Steve Davis CIH, CSP  <b>Corporate H&amp;S Reviewer:</b> Edie Scala-Hampson  <b>Notes:</b> (Field Notes, Review Comments, etc.)	<b>Overall Risk Assessment Code (RAC) (Use highest code)</b>				<b>L</b>	
	<b>Risk Assessment Code (RAC) Matrix</b>					
	<b>Severity</b>	<b>Probability</b>				
		Frequent	Likely	Occasional	Seldom	Unlikely
	Catastrophic	<b>E</b>	<b>E</b>	<b>H</b>	<b>H</b>	<b>M</b>
	Critical	<b>E</b>	<b>H</b>	<b>H</b>	<b>M</b>	<b>L</b>
	Marginal	<b>H</b>	<b>M</b>	<b>M</b>	<b>L</b>	<b>L</b>
	Negligible	<b>M</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>
	Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above)					
	"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom, or Unlikely.				<b>RAC Chart</b>	
"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible				<b>E = Extremely High Risk</b>		
Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.				<b>H = High Risk</b>		
				<b>M = Moderate Risk</b>		
				<b>L = Low Risk</b>		

Job Steps	Hazards	Controls	RAC																		
Site preparatory communication phase and inspection	Overhead utilities: arc flash and electrocution  Underground utilities: electrocution, arc flash, fire, property damage	Identify overhead lines and complete a site layout plan prior to mobilizing the equipment.  Assume power lines to be energized unless verified to be de-energized and visibly grounded.  Keep equipment at least 20 feet from uninsulated transmission lines unless voltage is known so closer approach distances can be calculated. Keep equipment at least 10 feet from insulated electrical lines.	<b>L</b>																		
<table border="1"> <thead> <tr> <th colspan="2">Minimum Clearance from Energized Overhead Electric Lines</th> </tr> <tr> <th>Nominal System Voltage (kilovolts)</th> <th>Minimum Rated Clearance (feet)</th> </tr> </thead> <tbody> <tr> <td>0-50</td> <td>10</td> </tr> <tr> <td>51-200</td> <td>15</td> </tr> <tr> <td>201-300</td> <td>20</td> </tr> <tr> <td>301-500</td> <td>25</td> </tr> <tr> <td>501-750</td> <td>35</td> </tr> <tr> <td>751-1,000</td> <td>45</td> </tr> <tr> <td>Over 1,000</td> <td>As established by the utility owner/operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution).</td> </tr> </tbody> </table>			Minimum Clearance from Energized Overhead Electric Lines		Nominal System Voltage (kilovolts)	Minimum Rated Clearance (feet)	0-50	10	51-200	15	201-300	20	301-500	25	501-750	35	751-1,000	45	Over 1,000	As established by the utility owner/operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution).	
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Job Steps	Hazards	Controls	RAC
Site preparatory communication phase and inspection (continued)	Overhead utilities: arc flash and electrocution  Underground utilities: electrocution, arc flash, fire, property damage  (continued)	Complete a dig permit prior to mobilizing equipment. Use subcontractor utility locator and/or ground penetrating radar if there is uncertainty regarding the presence or location of high-hazard (gas, high voltage) or high-value utilities. Have high-hazard utilities turned off and locked out if possible.  Walk the excavation area to visually verify that the identified utility locations are consistent with visible clues like power poles, depressions over old trenches, etc.  Expose (daylight) high-hazard or high-value utilities that are within the excavation footprint or within 5 feet of the edge of planned excavation, using low impact techniques such as shovel or hand auger. Expose such utilities, using low-impact techniques, at least every 5 feet to confirm location and depth. Do not use drilling equipment within 6 inches of high-hazard utilities.	L
Bore hole setup Determine location for setup/staging equipment	Traffic-struck by hazards  Vehicle damage  Driving over soft ground  Uneven terrain  Slip, trip, fall, and flying debris	Position drill rig and support vehicles to shield work zone.  Place barricades for work site protection, if necessary (i.e., traffic cones, caution tape, vehicle placement).  Wear high-visibility vest.  Do not assume equipment and vehicle operators have seen you unless operator has made eye contact with you and signaled to you.  Use a spotter standing to side of rig (not behind) when backing drill rig.  Confirm proper operation of backup alarm.  Choose location with level and firm soils.  Use jacks and proper blocking to level rig. Choose level, open areas to drill. If client requires plastic sheeting under the rig, keep it away from the mechanical means of the rig that contact the ground (i.e., tracks, wheels, jacks).  Keep work area picked up and as clean as feasible and free of tripping and fall hazards. Apply traction aids, such as sand, gravels, and straw.  Wear safety glasses when near rig or where there is a potential for flying debris.  Wear slip-resistant footwear.  Maintain proper illumination in work areas.	L
Boarding, disembarking, and working on barge	Falling, tripping, slipping into water and drowning	See Working Over and Near Water AHA	L
Drilling (To be conducted by subcontracted driller)	Rolling, spreading, or sliding of tools and supplies	Conduct/document weekly drilling inspection in a logbook or checklist.  Maintain adequate clearance for the movement of vehicles and operation of drilling equipment.  Use spotters when vision is impaired.  Determine safe tool placement to prevent struck by injuries.	L
			L

Job Steps	Hazards	Controls	RAC
Drilling (To be conducted by subcontracted driller) (continued)	Caught by rotating machinery Fire Hand injuries Rolling, spreading, or sliding of tools and supplies Caught by rotating machinery Fire Hand injuries	Inspect all drilling equipment in presence of site safety and health officer (SSHO). Verify (lead driller) that all safety interlock and engine kill switches on the equipment operate correctly. Wear leather gloves when handling materials with potential for sharp edges, splinters, burrs, rough surfaces, etc. Be aware of and avoid pinch point hazards. Conduct repairs that require HOT WORK under a HOT WORK PERMIT. Inform SSHO of HOT WORK and provide fire watch and suitable fire extinguisher. Use screens to control sparks and UV (welding flash burns to eyes) exposure as necessary. Advance by hand digging, probing, post hole digging, and/or air knifed to 5 feet below ground surface if markings are unclear, or utilities known to be present are not marked. Contact Digger's Hotline if an underground facility is damaged, dislocated, or disturbed.	L
Connecting drill tools to drive head or other tools (To be conducted by subcontracted driller)	Pinch points between rig and tooling Struck by or caught between moving machinery	Keep hands clear of joints when connecting drill tools. Wear PVC gloves when connecting tools. If joining tools requires operation of winch or feed controls, have two workers present: one to operate controls and one to align tools. One person should not operate controls and join tools simultaneously. Be aware of pinch-point hazards and work in a manner to prevent injuries. Keep hands out of areas that may present a pinching hazard and personnel will not position themselves between equipment. Do not wear loose coveralls, clothing, or jewelry that may entangle in moving equipment. Confirm that the operator verbally alerts employees and visually ensures employees are clear from dangerous parts of equipment prior to starting or engaging equipment.	L
Advancing percussion tools (driving sampler, driving casing, direct push hammering).	Struck by broken drill tooling from drill tooling improperly lined up	Maintain percussion force in-line with hammer and tool string (minimize bending of tool string or driving at an angle). If conditions become difficult, use stop work authority and re-evaluate. Maintain a safe distance from operations.	L
Down-hole tool removal (To be conducted by subcontracted driller)	Struck by cable from cable recoil from strained winch	Use rod clamp, vice or slide ring to support loads. Minimize time that objects are suspended above ground or secure supporting surface. Minimize slippage by using proper tools for material being lifted. Lift straight up using safety hook or hoisting plug whenever possible. Remove drill tools in 6-foot sections, or less. Stay clear of strained winch cables or drive shafts. Never place body between pulling force and load.	L

Job Steps	Hazards	Controls	RAC
Decon of equipment	High pressure water Skin contact Inhalation	<p>Wear modified Level D protection, including a face shield and safety goggles.</p> <p>Ensure that other personnel are out of the area prior to decontamination when pressure washing equipment is used. Secure the area around the decon pad with cones, caution tape, or barricades.</p> <p>Ensure that safe work practices and precautions are taken to minimize the potential for physical injury.</p> <p>Avoid skin and eye contact with isopropyl alcohol, Alconox, or other cleaning materials.</p> <p>Stand upwind to minimize any potential inhalation exposure.</p> <p>Dispose of spent cleaning solutions and rinses accordingly.</p> <p>Ensure that area is clean after equipment is decontaminated.</p>	L
Wrap up	Take home toxics	<p>Decon with soap and water or wipes.</p> <p>Remove all contaminated clothing and materials and leave on site. Use plastic as a barrier for soil, truck bed, or foot well contact.</p>	L
General site work	<p>General site hazards:</p> <p>Insect bites and stings</p> <p>Contact dermatitis from poisonous and irritating plants (poison ivy, poison oak, and poison sumac)</p> <p>Vehicle traffic</p> <p>Severe weather</p> <p>Heat stress</p> <p>Cold stress</p> <p>Noise</p> <p>Lifting</p> <p>Slips, trips, and falls</p> <p>UV hazards, etc.</p>	Refer to General Site Work AHA.	L

Equipment	Training	Inspection
<p><u>Personal Protective Equipment Level D:</u></p> <ul style="list-style-type: none"> <li>• Hard hat (if there are overhead hazards)</li> <li>• Safety glasses</li> <li>• Safety-toed boots</li> <li>• Work gloves/chemical-resistant gloves</li> <li>• ANSI Class 2 reflective warning vests</li> <li>• Hearing protection</li> <li>• Type I or V U.S. Coast Guard-approved personal flotation device (when working near or over open water)</li> </ul> <p><u>Other Equipment:</u></p> <ul style="list-style-type: none"> <li>• VHS radio</li> <li>• Generator</li> <li>• Fire extinguishers</li> <li>• Emergency eyewash</li> <li>• First aid kit</li> <li>• Insect repellent–DEET</li> <li>• Hand tools</li> <li>• Spill containment supplies, if needed</li> <li>• Containers as needed</li> <li>• Tarps</li> <li>• GFCI</li> <li>• Heavy duty extension cords</li> <li>• Drinking water</li> <li>• Smart phone apps (temperature stress, noise, weather)</li> </ul>	<p><u>Competent Person (CP) / Qualified Person (QP):</u></p> <p>CP/SSHO _____</p> <p>Alternate CP/SSHO _____</p> <p>QP/First Aid and CPR _____</p> <p>QP/First Aid and CPR _____</p> <p><u>Training Requirements (as determined by the SSHO):</u></p> <ul style="list-style-type: none"> <li>• HAZWOPER 40 hour/annual refresher</li> <li>• Site safety orientation</li> <li>• Tailgate meetings</li> <li>• Emergency procedures</li> <li>• Hazard communication</li> <li>• Hearing conservation</li> <li>• Applicable AHAs</li> <li>• Fire extinguisher use</li> <li>• Biological hazard identification and control</li> <li>• Severe weather shelter location</li> <li>• Lightning safety procedures</li> <li>• Temperature stress prevention, controls, and treatment</li> </ul>	<p>Drilling Equipment Safety Inspection Checklist: to be completed daily by the drilling contractor.</p> <ul style="list-style-type: none"> <li>• Daily inspection (SSHO)</li> <li>• Housekeeping (daily)</li> <li>• Fire extinguisher (monthly)</li> <li>• Vehicle inspection (daily)</li> <li>• Eyewash (each work area)</li> <li>• Equipment and tools inspection (daily and before use)</li> <li>• Survey areas for poisonous plants, insects, and animals (each work area)</li> <li>• Check body for ticks (each evening during tick season)</li> </ul> <p>For each work area: Identify closest usable tornado shelter that is available and route to the hospital.</p>

**ACTIVITY HAZARD ANALYSIS (AHA)**

<b>Activity/Work Task:</b> Drilling/DPT – Sample Processing <b>Project Location:</b> Swan Island Basin, Portland Harbor Superfund Site, Multnomah County, Oregon <b>Contract Number:</b> DT2002 <b>Date Prepared:</b> May 2021 <b>Prepared By:</b> Steve Davis CIH, CSP <b>Corporate H&amp;S Reviewer:</b> Edie Scala-Hampson <b>Notes:</b> (Field Notes, review comments, etc.)	<b>Overall Risk Assessment Code (RAC) (Use highest code)</b>				<b>L</b>	
	<b>Risk Assessment Code (RAC) Matrix</b>					
	<b>Severity</b>	<b>Probability</b>				
		Frequent	Likely	Occasional	Seldom	Unlikely
	Catastrophic	<b>E</b>	<b>E</b>	<b>H</b>	<b>H</b>	<b>M</b>
	Critical	<b>E</b>	<b>H</b>	<b>H</b>	<b>M</b>	<b>L</b>
	Marginal	<b>H</b>	<b>M</b>	<b>M</b>	<b>L</b>	<b>L</b>
	Negligible	<b>M</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>
	Step 1: Review each “Hazard” with identified safety “Controls” and determine RAC (See above)					
	“Probability” is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom, or Unlikely.				<b>RAC Chart</b>	
“Severity” is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible				<b>E = Extremely High Risk</b>		
				<b>H = High Risk</b>		
Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each “Hazard” on AHA. Annotate the overall highest RAC at the top of AHA.				<b>M = Moderate Risk</b>		
				<b>L = Low Risk</b>		

Job Steps	Hazards	Controls	RAC
Determine location for setup/staging equipment	Traffic-struck by hazards Driving over soft ground Uneven terrain	See Mobilization/Demobilization AHA and Drilling (Land Based and Barge Based) AHA	<b>L</b>
Accept precut tube from driller	Slip, trip, and fall hazards	Wear slip-resistant footwear.  Keep work area picked up and as clean as feasible and free of tripping and fall hazards.	<b>L</b>
	Hand injuries	Items to be handled shall be inspected for sharp edges, splinters, burrs, rough surfaces, etc. prior to being handled.  Personnel shall wear leather gloves when handling materials with sharp edges, splinters, burrs, rough surfaces, etc.  Personnel should be aware of and avoid pinch point hazards.	<b>L</b>
	Flying debris	Wear safety glasses when near rig or where there is a potential for flying debris.  Ensure eyewash is available.	<b>L</b>

Job Steps	Hazards		RAC
Accept precut tube from driller (continued)	Strains, sprains, awkward bending/lifts and ergonomic hazards	Lift with straight back and legs. Avoid twisting. Ensure walking pathway is clear. Do not lift greater than 50 pounds. Use mechanical assistance or two-person lift whenever possible. Limit repetitive awkward motions.	L
	Noise	Wear hearing protection if noise levels from neighboring equipment exceeds 85 dBA (if you cannot be heard speaking in a normal voice at arms distance).	L
Accept precut tube from driller	Contact with/struck by drilling equipment	Maintain eye contact with driller when entering zone of operation. Don't stand too close to rig; honor the exclusion zone. Use qualified drillers to operate drilling equipment. Conduct real-time monitoring with photoionization detector (PID) when drillers are aware of your presence.	L
Measure with PID for volatile organic compound	Inhalation of contaminants	Follow personal protective equipment (PPE) dictates of Health and Safety Plan (HASP) based on airborne measurements and action levels.	L
Sample collection	Inhalation and skin contact hazards	Wear chemical-resistant gloves based on the identified chemicals. Use boot covers and splash suit protection if necessary. Follow respirator action level dictates of HASP. Perform decontamination as specified in the HASP. The restricted areas/exclusion zones and contamination reduction zones should be set up and appropriately marked with signage, as necessary, and indicated in HASP. Avoid contact with contaminated materials. Wear PPE, as specified in the HASP. The site safety and health officer (SSHO) will perform chemical air monitoring, as specified in the HASP. Verify emergency eyewash stations have been inspected, cleaned, filled, and in service. Notify all personnel of the emergency eyewash station locations. Notify the SSHO if odors are detected.	L

Job Steps	Hazards	Controls	RAC
Put sample in preserved jar	Inhalation and skin contact with sample preservatives: NaOH, HNO <sub>3</sub> , HCl	<p>Read and follow safety data sheets for each chemical used.</p> <p>Provide emergency eyewash station for all areas where acid (sample preservative) and methanol are being used.</p> <p>Do not use any chemical that you have not been trained to safely use. Provide ventilation as necessary.</p> <p>Wear appropriate PPE (gloves, safety glasses).</p> <p>Use in well-ventilated area.</p> <p>Properly label all containers.</p>	L
	Spills	Use absorbents and containers for spills.	
Log/label and put sample in cooler	Cut hazards	Set up stable work area for labeling samples, logging, and doing paperwork.	L
Observation of drillers: DPT, rotary, mud, etc.	Exposure to site contaminants	Instruct drillers of potential or known contaminants on site.	L
	Hazards associated with drilling: electrical such as overhead or underground utilities, rolling, spreading or sliding of tools and supplies, caught by rotating machinery, and Fire	<p><b><u>Actions to be taken by drillers:</u></b></p> <ul style="list-style-type: none"> <li>• Conduct/document weekly drilling inspection in a logbook or checklist.</li> <li>• Require dig permit (utility clearance) before invasive work begins.</li> <li>• Mark/locate underground utilities. No drilling within 5 feet of marked underground utilities or within a minimum of 20 feet of overhead lines.</li> <li>• Maintain adequate clearance for the movement of vehicles and operation of drilling equipment.</li> <li>• Use spotters when vision is impaired.</li> <li>• Determine safe tool placement to prevent struck by injuries.</li> <li>• Inspect all drilling equipment in presence of SSHO.</li> <li>• Verify (lead driller) that all safety interlock and engine kill switches on the drilling equipment operate correctly.</li> <li>• Conduct repairs that require HOT WORK under a HOT WORK PERMIT. Inform SSHO of HOT WORK and provide fire watch and suitable fire extinguisher. Use screens to control sparks and UV (welding flash burns to eyes) exposure as necessary.</li> </ul>	L

Job Steps	Hazards	Controls	RAC
Decon of equipment	Skin contact Inhalation	Wear modified Level D protection, including a face shield and safety goggles. Avoid skin and eye contact with isopropyl alcohol, Alconox, or other cleaning materials. Stand upwind to minimize any potential inhalation exposure. Dispose of spent cleaning solutions and rinses accordingly. Ensure that area is clean after equipment is decontaminated.	L
Wrap up	Take home toxics	Decon with soap and water or wipes. Remove all contaminated clothing and materials and leave on site. Use plastic as a barrier for soil, truck bed, or foot well contact.	L
General site work	General site hazards: insect bites and stings; contact dermatitis from poisonous and irritating plants (poison ivy, poison oak, and poison sumac); vehicle traffic; severe weather; heat stress; cold stress; noise; lifting; slips, trips, falls; and UV hazards	See General Site Work AHA.	L

Job Steps	Hazards	Controls	RAC
<b>Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.</b>			

Equipment	Training	Inspection
<p><u>Personal Protective Equipment - Level D:</u></p> <ul style="list-style-type: none"> <li>• Hard hat</li> <li>• Safety glasses</li> <li>• Safety-toed boots</li> <li>• Work gloves/chemical-resistant gloves</li> <li>• ANSI Class 2 reflective warning vests</li> <li>• Type I or V U.S. Coast Guard-approved personal flotation device (when working near or over water)</li> </ul> <p><u>Other Equipment:</u></p> <ul style="list-style-type: none"> <li>• 2-way VHS radios</li> <li>• Generator</li> <li>• Fire extinguishers</li> <li>• Emergency eyewash</li> <li>• First aid kit</li> <li>• Insect repellent- DEET</li> <li>• Hand tools</li> <li>• Spill containment supplies</li> <li>• Tarps</li> <li>• GFCI</li> <li>• Heavy duty extension cords</li> <li>• Drinking water</li> <li>• Weather radio and/or smart phone apps for temperature and noise</li> <li>• Heat/cold stress monitoring</li> <li>• Sample bottles</li> <li>• Preservatives</li> <li>• Cooler</li> <li>• Hand tools</li> <li>• PID</li> </ul>	<p><u>Competent Person (CP) / Qualified Person (QP):</u></p> <p>CP/SSHO _____</p> <p>QP/First Aid and CPR _____</p> <p>QP/First Aid and CPR _____</p> <p><u>Training Requirements (as determined by the SSHO):</u></p> <ul style="list-style-type: none"> <li>• HAZWOPER 40 hour</li> <li>• Site safety orientation</li> <li>• Tailgate meetings</li> <li>• Emergency procedures</li> <li>• Hazard communication</li> <li>• Hearing conservation</li> <li>• Applicable AHAs</li> <li>• Fire extinguisher use</li> <li>• Biological hazard identification and control</li> <li>• Tornado shelter location</li> <li>• Lightning safety procedures</li> <li>• Heat stress prevention and heat stroke treatment</li> <li>• Cold stress prevention</li> </ul>	<ul style="list-style-type: none"> <li>• Daily site safety inspection (SSHO)</li> <li>• Housekeeping (daily)</li> <li>• Fire extinguisher (monthly)</li> <li>• Vehicle inspection (daily)</li> <li>• Eye wash (each work area)</li> <li>• Equipment and tools inspection (daily and before use)</li> <li>• Survey areas for poisonous plants, insects, and animals (each work area)</li> <li>• Check body for ticks (each evening during tick season)</li> </ul> <p>For each work area: Identify closest usable tornado shelter that is available and route to the hospital.</p> <ul style="list-style-type: none"> <li>• Pre/post maintenance/calibration per manufacturer's recommendation.</li> <li>• Visual prior to use</li> </ul>

ACTIVITY HAZARD ANALYSIS (AHA)						
<b>Activity/Work Task:</b> Equipment Decontamination <b>Project Location:</b> Swan Island Basin, Portland Harbor Superfund Site, Multnomah County, Oregon <b>Contract number:</b> DT2002 <b>Date Prepared:</b> May 2021 <b>Prepared by:</b> Steve Davis CIH, CSP <b>Corporate H&amp;S Reviewer:</b> Edie Scala-Hampson <b>Notes:</b> (Field notes, review comments, etc.)	<b>Overall Risk Assessment Code (RAC) (Use highest code)</b>				<b>L</b>	
	<b>Risk Assessment Code (RAC) Matrix</b>					
	<b>Severity</b>	<b>Probability</b>				
		Frequent	Likely	Occasional	Seldom	Unlikely
	Catastrophic	<b>E</b>	<b>E</b>	<b>H</b>	<b>H</b>	<b>M</b>
	Critical	<b>E</b>	<b>H</b>	<b>H</b>	<b>M</b>	<b>L</b>
	Marginal	<b>H</b>	<b>M</b>	<b>M</b>	<b>L</b>	<b>L</b>
	Negligible	<b>M</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>
	Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above)					
	"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom, or Unlikely.				<b>RAC Chart</b>	
"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible				<b>E = Extremely High Risk</b>		
				<b>H = High Risk</b>		
Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.				<b>M = Moderate Risk</b>		
				<b>L = Low Risk</b>		
Job Steps	Hazards	Controls			RAC	
Determine location for setup	Traffic-struck by hazards	<ul style="list-style-type: none"> <li>Select location away from traffic</li> <li>Place barricades for work site protection, if necessary</li> <li>Keep all unnecessary personnel out of the work area and in an upwind location</li> <li>Wear high-visibility vest</li> </ul>			<b>L</b>	
	Driving over soft ground Uneven terrain	Choose location with level and firm soils			<b>L</b>	

Job Steps	Hazards	Controls	RAC
<p>Movement to and in the decontamination area</p>	<p>Contact with/struck by heavy equipment hazards</p> <p>Vehicular and pedestrian traffic</p>	<ul style="list-style-type: none"> <li>• Shut down all machinery or equipment by positive means to prevent its operation during decontamination.</li> <li>• Lower and block bulldozer and scraper blades, end-loader bucket, and similar equipment (if applicable).</li> <li>• Prohibit unattended machinery or equipment that has not been turned off.</li> <li>• Prohibit getting off or on equipment while it is in motion.</li> <li>• Require all mobile equipment be equipped with backup alarm. Confirm operation.</li> <li>• Use signs, barricades, and other traffic control devices as necessary.</li> <li>• Determine if supplemental lighting will be needed in low light conditions.</li> <li>• Wear high-visibility vests when performing work within the decontamination area.</li> <li>• Use long-handled brushes, brooms or other appropriate device to remove loose materials at dry decontamination; hand brushing will not be permitted.</li> <li>• Require the driver or operator to set brakes and keep the dry decontamination personnel in view.</li> <li>• Require equipment operators and truck drivers to not move a stopped vehicle that is subject to a ground personnel decontamination activity except by the signal of the individual who directed the vehicle to stop.</li> <li>• Require trucks to pull out of dry decontamination at a moderate speed with attention to other traffic areas and ground personnel in the support area.</li> </ul>	<p>L</p>

Job Steps	Hazards	Controls	RAC
Movement to and in the decontamination area (continued)	Heat stress: exposure to high ambient temperatures See also General Site Work AHA	<ul style="list-style-type: none"> <li>• Acclimatize to work in hot weather by gradually working in heat and taking more frequent breaks, systematically building up tolerance to heat.</li> <li>• Conduct field activities in the early morning, if possible, to avoid heat or inclement weather.</li> <li>• Have enough drinking water on site so that each worker can consume at a minimum, one quart per hour per shift.</li> <li>• Review with personnel, by frequent reminders, to take water breaks so that each person can consume enough water.</li> <li>• Provide access to shade (i.e., blockage from direct sunlight), that is reasonably close to the work area. Keep in mind that a vehicle or other enclosed area with no air conditioning is NOT considered shade. The area must be a well-ventilated area or have air conditioning.</li> <li>• Conduct training on risk factors, signs, and symptoms of heat illness, importance of hydration and acclimatization, importance of reporting symptoms, what to do in case of heat illness emergency and contacting emergency medical services.</li> <li>• Follow the requirements for physiological monitoring (e.g., during work in temperatures above 90°F adjusted temperature, perform physiological monitoring—see safety plan if wearing Tyvek for when to start monitoring) and document on the Heat Stress Physiological Monitoring form.</li> <li>• Be conscious of your individual tolerance to work in hot weather.</li> <li>• Monitor yourself and co-workers for signs and symptoms of heat stress.</li> <li>• Take breaks as necessary in shady or cool areas and drink plenty of liquids.</li> </ul>	<b>L</b>

Job Steps	Hazards	Controls	RAC
Decontamination	<p>Exposure/inhalation and contact with hazardous substances</p> <p>Exposure/high noise levels</p> <p>Struck by flying debris</p> <p>Slip, trip, and fall hazards</p>	<ul style="list-style-type: none"> <li>• Perform dry decontamination in the exclusion zone (EZ).</li> <li>• Remain out of the line of fire of dust or contaminated soils while using hand tools.</li> <li>• Stage equipment, to the maximum extent possible, to avoid contamination (i.e., running on clean or overburden soils).</li> <li>• Position decontamination area to minimize potential for cross-contamination or release of any contamination outside the EZ areas.</li> <li>• Decontaminate from greater contaminated area to a lesser-contaminated area.</li> <li>• Lay down Poly or a composite mat to minimize the potential of re-contaminating the equipment while moving it out of the EZ.</li> <li>• Decontaminate a grossly contaminated piece of equipment, (dry) before it is moved from the EZ to the decontamination pad.</li> <li>• Provide hearing protection on site and require employees to be in a hearing conservation program if exposed to noise above 85 dBA time weighted average.</li> <li>• Use engineering controls (i.e., guards, mufflers, distance) to reduce worker exposure to noise.</li> <li>• Conduct noise surveys on activities in question.</li> <li>• Place signs to notify employees of high noise areas (85 dBA) where hearing protection is required.</li> <li>• Reinforce that dry decontamination will not sweep materials at any time. Keep dust to a minimum.</li> <li>• Use a face shield when performing wet decontamination procedures using pressure washers.</li> <li>• Use wet methods to sweep out cabs.</li> <li>• Use a face shield when using a sledgehammer to remove gross contamination.</li> <li>• Cover the importance of housekeeping in safety briefings.</li> <li>• Wear slip-resistant footwear.</li> <li>• Keep work area picked up and as clean as feasible and free of tripping and fall hazards.</li> </ul>	L

Job Steps	Hazards	Controls	RAC
<p>Handle equipment and materials</p> <p>Wrapping and securing contaminated equipment for transport</p>	<p>Slip, trip, and fall hazards</p>	<ul style="list-style-type: none"> <li>• Cover the importance of housekeeping in safety briefings.</li> <li>• Wear slip-resistant footwear.</li> <li>• Keep work area picked up and as clean as feasible and free of tripping and fall hazards.</li> </ul>	L
<p>Wiping, scraping, and brushing of contaminated equipment</p>	<p>Flying debris-eye hazards</p>	<ul style="list-style-type: none"> <li>• Wear safety glasses or goggles and a face shield.</li> <li>• Ensure eyewash is available.</li> </ul>	L
<p>Pressure-washing equipment</p> <p>Collection and handling of decontamination fluids</p>	<p>Burns-heat/chemical associated with pressure washing</p>	<ul style="list-style-type: none"> <li>• Wear rain suits or suits of chemical-resistant material to prevent direct contact with hot water or chemicals of concern.</li> <li>• Prohibit decontamination or washing of personal protective equipment (PPE) with hot water, while on a person. The pressure/steam washer shall be inspected before each use. The manufacturer's instruction manual shall be used to guide the inspection process.</li> <li>• Train personnel in the use of the washing equipment and emergency shut-off procedures for the equipment being used.</li> <li>• Use the minimum amount of steam/pressure that will complete the job. Pressure washers exceeding 3,000 psi should not be used without health and safety manager approval.</li> <li>• Direct the spray from such equipment at surfaces to be cleaned and never at body parts or other personnel.</li> <li>• Use face shields (those in the immediate area of spraying).</li> <li>• Keep a firm grip on wand and do not point it at anything that is not being washed.</li> <li>• Be aware of slipping and be conscious of good footing.</li> <li>• Never wire/fix open the trigger on the wand.</li> <li>• Take adequate breaks to avoid fatigue. Avoid hot surfaces.</li> <li>• Shut off units and allow to cool prior to re-fueling (if gas powered).</li> <li>• Monitor carbon monoxide if gas-powered pressure washers are used. Carbon monoxide concentrations should not typically exceed 5 parts per million (ppm) within any indoor areas. The threshold limit value for carbon monoxide is 25 ppm, for 8 hours.</li> </ul>	L

Job Steps	Hazards	Controls	RAC
Handle equipment and materials Wrapping and securing contaminated equipment for transport Wiping, scraping, and brushing of contaminated equipment Pressure-washing equipment Collection and handling of decontamination fluids	Contact with potentially contaminated materials: inhalation and skin contact hazards	<ul style="list-style-type: none"> <li>Conduct real-time monitoring with photoionization detector (PID).</li> <li>Wear required PPE as indicated in HASP such as: chemical-resistant gloves based on the identified chemicals, boot covers, and splash suit protection. Follow respirator action level dictates of HASP.</li> <li>Maintain good housekeeping to safeguard against cross-contamination of surrounding areas and eliminate safety hazards.</li> <li>Practice good personal hygiene.</li> <li>Refer to HASP for chemical hazard discussion.</li> <li>Require only essential personnel be in the decontamination area. All others should be in an upwind location.</li> </ul>	L
Measure with PID for volatile organic compound	Inhalation of contaminants	Follow PPE dictates of HASP based on airborne measurements and action levels.	L
Personal decon	Take home toxics	<ul style="list-style-type: none"> <li>Decontaminate per HASP.</li> <li>Remove all contaminated clothing and materials and leave on site.</li> <li>Shower as soon as possible.</li> </ul>	L
Containerize water	Spills-environmental damage	Use absorbents and containers for rinse water.	L
General site work	General site hazards – Environmental Biologicals (plants, insects, wildlife) Adverse weather Temperature stresses UV hazards, noise, lifting, etc.	Refer to General Site Work AHA	L

Job Steps	Hazards	Controls	RAC
<i>Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.</i>			

Equipment	Training	Inspection
<p><u>Personal Protective Equipment:</u></p> <ul style="list-style-type: none"> <li>• Hard hat</li> <li>• Safety glasses</li> <li>• Safety-toed boots</li> <li>• Work gloves/chemical-resistant gloves</li> <li>• ANSI Class 2 reflective warning vests</li> <li>• Type I or V U.S. Coast Guard-approved personal flotation devices (when working over or near water)</li> </ul> <p>Or</p> <ul style="list-style-type: none"> <li>• One PPE grade lower than the work in exclusion zone</li> </ul> <p><u>Other Equipment:</u></p> <ul style="list-style-type: none"> <li>• Generator</li> <li>• Fire extinguishers</li> <li>• Emergency eyewash</li> <li>• First aid kit</li> <li>• Insect repellent- DEET</li> <li>• Hand tools</li> <li>• Spill containment supplies</li> <li>• Containers as needed</li> <li>• Tarps</li> <li>• Drums</li> <li>• GFCI</li> <li>• Heavy duty extension cords</li> <li>• Drinking water</li> <li>• Weather radio and/or smart phone apps for temperature and noise</li> <li>• Heat stress/cold monitoring</li> <li>• Steam cleaner</li> <li>• Alconox/cleaning brushes/buckets, as needed</li> </ul>	<p><u>Competent Person (CP) / Qualified Person (QP):</u></p> <p>CP/SSHO _____</p> <p>_____</p> <p>QP/First Aid and CPR _____</p> <p>QP/First Aid and CPR _____</p> <p><u>Training Requirements (as determined by the SSHO):</u></p> <ul style="list-style-type: none"> <li>• HAZWOPER 40 hour</li> <li>• Site safety orientation</li> <li>• Tailgate meetings</li> <li>• Emergency procedures</li> <li>• Hazard communication</li> <li>• Hearing conservation</li> <li>• Applicable AHAs</li> <li>• Fire extinguisher use</li> <li>• Biological hazard identification and control</li> <li>• Tornado shelter location</li> <li>• Lightning safety procedures</li> <li>• Heat stress prevention and heat stroke treatment</li> <li>• Cold stress prevention</li> </ul>	<ul style="list-style-type: none"> <li>• Daily inspection (SSHO)</li> <li>• Housekeeping (daily)</li> <li>• Fire extinguisher (monthly)</li> <li>• Vehicle inspection (daily)</li> <li>• Eyewash (daily)</li> <li>• Equipment and tools inspection (daily and before use)</li> <li>• Survey areas for poisonous plants, insects, and animals (each work area)</li> <li>• Check body for ticks (each evening during tick season)</li> </ul> <p>For each work area: Identify route to the hospital.</p>

ACTIVITY HAZARD ANALYSIS (AHA)						
<b>Activity/Work Task:</b> General Site Work <b>Project Location:</b> Swan Island Basin, Portland Harbor Superfund Site, Multnomah County, Oregon <b>Contract number:</b> DT2002 <b>Date Prepared:</b> May 2021 <b>Prepared by:</b> Steve Davis CIH, CSP <b>Corporate H&amp;S Reviewer:</b> Edi Scala-Hampson <b>Notes:</b> (Field Notes, Review Comments, etc.)	<b>Overall Risk Assessment Code (RAC) (Use highest code)</b>				<b>L</b>	
	<b>Risk Assessment Code (RAC) Matrix</b>					
	<b>Severity</b>	<b>Probability</b>				
		Frequent	Likely	Occasional	Seldom	Unlikely
	Catastrophic	<b>E</b>	<b>E</b>	<b>H</b>	<b>H</b>	<b>M</b>
	Critical	<b>E</b>	<b>H</b>	<b>H</b>	<b>M</b>	<b>L</b>
	Marginal	<b>H</b>	<b>M</b>	<b>M</b>	<b>L</b>	<b>L</b>
	Negligible	<b>M</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>
	Step 1: Review each “ <b>Hazard</b> ” with identified safety “ <b>Controls</b> ” and determine RAC (See above)					
	<b>Probability</b> the likelihood the activity will cause a Mishap (near miss, incident or accident). Identify as: Frequent, Likely, Occasional, Seldom, or Unlikely.				<b>RAC Chart</b>	
<b>Severity</b> the outcome/degree if a mishap occurred. Identify as: Catastrophic, Critical, Marginal, or Negligible				<b>E = Extremely High Risk</b>		
Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each “Hazard” on AHA. Annotate the overall highest RAC at the top of AHA.				<b>H = High Risk</b>		
				<b>M = Moderate Risk</b>		
				<b>L = Low Risk</b>		
<b>Job Steps</b>	<b>Hazards</b>	<b>Controls</b>	<b>RAC</b>			
Review–health and safety (H&S) needs, communication, and preparatory instructions	Behavioral: human error - failure to plan/warn/train  Inadequate preparation can lead to personal injuries, property damage and project delays  Employees not trained in the safe execution of their assigned task may harm themselves or others	Readiness review with field team members prior to fieldwork.  Site safety and health officer (SSHO) to identify applicable portions of Health and Safety Plan (HASP) and include those AHAs in site-specific job training for workers.  SSHO to perform on-site verification that HASP and AHAs capture all important site hazards and controls.  SSHO to verify that access to the necessary equipment to evaluate and control site hazards is available and complete and in good condition (i.e., equipment, tools, personal protective equipment (PPE), materials, etc. required to perform the tasks. For example: PID with correct lamp for evaluating chemical hazards in breathing zone.	<b>L</b>			
	Unfamiliarity with site, general site hazards, project safety rules, chain of command, and emergency procedures  Adding new personnel to work team, visitors	Conduct training and coordination with team.  New employees will be trained and proficient before they are assigned to their jobs.  Visitors will receive a site safety briefing and PPE.	<b>L</b>			

Job Steps	Hazards	Controls	RAC
Review–H&S needs, communication, and preparatory instructions (continued)	Emergency response unfamiliarity Delay in response and treatment	<p>SSHO to verify that emergency safety supplies and first aid supplies are available and complete.</p> <p>SSHO to review emergency procedures, contact numbers, evacuation plans, severe weather shelters, and rally points.</p> <p>The SSHO will monitor weather conditions each day to plan and prepare for hazardous conditions. Work activities, especially those conducted on the water, will be suspended prior to weather conditions becoming hazardous so that workers have ample time to seek shelter. Upon seeing lightning or hearing thunder, outdoor activities should be suspended and personnel should be evacuated to safe areas.</p> <p>SSHO to confirm that all personnel know what to do in the event of an accident (personal or property damage).</p>	L
Transportation to site and site vehicle maneuvering	Struck by vehicle accidents/traffic	<p>Prohibit cell phone use by driver while vehicle is in motion.</p> <p>Practice defensive driving and wear safety restraints when vehicle is in motion. (See <a href="#">Safe Driving H&amp;S Procedure 16</a>)</p> <p>Adjust vehicle per personal specifications and confirm that it is in good working order and all cargo is secured and distractions are minimized.</p> <p>Familiarize yourself with the route and directions.</p> <p>Keep vehicle speed appropriate to road conditions.</p> <p>Be aware of the onset of driving fatigue and take breaks as needed.</p> <p>Perform a walk-around vehicle inspection at least daily (See Appendix A of this HASP).</p>	L
	Weather: poor road conditions, ruts, snow, ice mud puddles, and poor traction	<p>Monitor weather conditions and consider postponing travel or decreasing speed in poor travel conditions.</p> <p>Match driving speed to the conditions.</p>	L
	Struck by or against: maneuvering in tight areas/potential vehicle or personnel damage	<p>Use a spotter to help maneuver in tight areas.</p> <p>Avoid backing if possible.</p> <p>Check all blind spots before you attempt to move vehicle.</p> <p>Sound horn before backing and move slowly.</p>	L
Secure site	Unwanted entry: security/site access control	Establish positive site access control prior to on-site operations using barricades, signs, or fencing.	L

Job Steps	Hazards	Controls	RAC
Material handling and setup	Strains, sprains, awkward bending/lifting positions and ergonomic hazards	<p>Know your own limitations and ask for help if you need it. Size up the load before the lift.</p> <p>Use mechanical assistance or two-person lift for loads greater than 50 pounds and for large awkward loads.</p> <p>Lift with the legs and keep back straight.</p> <p>DO NOT lift and twist torso at the same time.</p> <p>Confirm that the walking pathway is clear of depressions or debris.</p> <p>Limit repetitive awkward motions and unbalanced lifting as much as possible.</p>	L
Working around vehicles, drill/direct-push technology (DPT) rigs, and vessels/on-water platforms	Struck-by hazards, crushing hazards, caught-between, noise-hearing loss	<p>Select work location away from traffic.</p> <p>Discuss active work areas in daily briefings.</p> <p>Place barricades or stationary vehicles for work site protection, if necessary.</p> <p>Wear high-visibility vest.</p> <p>STAY CLEAR of traffic on land and on the water.</p> <p>Make eye contact with operators of equipment to make sure they know your intentions.</p> <p>Prohibit machinery or equipment, requiring an operator, to run unattended.</p> <p>Confirm all heavy equipment has functional backup alarms.</p> <p>Minimize the number of ground personnel working around heavy equipment.</p> <p>Never position yourself between moving and fixed objects.</p> <p>Wear hearing protection if noise levels are &gt;85 dBA.</p>	L

Job Steps	Hazards	Controls	RAC
Working around/near other trades or contractors	Hazards caused by other trades-failure to communicate hazards (various hazards: toxic dusts, chemicals, physical hazards, biological hazards)	<p>Coordinate with subcontractors and other personnel daily.</p> <p>Notify others of potential hazards posed by HydroGeoLogic, Inc. (HG)L work and ask them to do the same for us. Stop work or implement controls if the work of others poses a hazard for HGL or subcontractor personnel.</p> <p>Inform subcontractors of locations of warning signs, hazards, and precautions they should take. Provide specific hazard communication training tailored to the project workplace.</p> <p>Inspect the work of subcontractors to verify safe operation and compliance with applicable requirements and require correction of deficiencies.</p> <p>Ask the “creating” employers (subcontractors) to correct hazards. NEVER tell the “creating” employer how to do their job but tell subcontractors to get the hazard corrected and hold them accountable. If HGL detects a safety violation, it has an obligation to see that it gets corrected by the subcontractor that created the hazard.</p> <p>Ensure that all site workers have the required Occupational Safety and Health Administration (OSHA) training.</p> <p>Require that each subcontractor be responsible for conducting inspections of their specific operations and equipment, conducting exposure monitoring for their workers, and providing site data sheets (SDSs), PPE, medical surveillance, and specialized worker training (e.g., forklift, excavation and trenching, fall protection, etc.).</p>	L
	Fire	<p>Maintain at least one dry chemical fire extinguisher having a minimum UL rating of 1A5BC on site.</p> <p>10B:C should be in cab of bulldozer, crane, front-end-loader, etc.</p> <p>4A:60B:C in immediate area of hot work</p> <p>40-B:C in immediate re-fueling area</p> <p>3A:40B:C (within 30 feet) near generator</p> <p>Limit smoking to designated areas</p>	L
Working in remote areas and on steep slopes while collecting river bank samples.	Criminal activity, wild animals, falls leading to inability to self-evacuate Getting lost	<p>Use the buddy system, if possible; however, if it cannot be used, follow the lone worker procedure by contacting the project manager or alternate point of contact at work start, mid-day, and when leaving work site at end of day. Let others on site (non-HGL staff) know where you are working and establish a check in procedure.</p> <p>Bring a smart phone, topographic and/or site map, compass, GPS.</p>	L

Job Steps	Hazards	Controls	RAC
Working in remote areas and on steep slopes while collecting river bank samples (continued)	Injuries and accidents from driving/walking over soft ground, uneven and rough terrain, and steep slopes.	Choose location with level and firm soils, when possible. Have gravel added to site roads to improve traction, if needed. Maintain vehicle speed corresponding to road conditions. Watch footing when walking in mud or wet soils.	L
	Unhygienic conditions	Confirm that restroom facilities, if installed on site, are adequately provided and maintained. Maintain hand disinfectant, wipes, and wash stations.	L
	Slip, trip, and fall hazards	Wear slip-resistant footwear. Inspect the work area for slip, trip, and fall hazards. Use sand, salt, or slip-on traction aids to control ice slip hazards, as needed, during winter months. Keep work area picked up and as clean as feasible. Keep egress routes as clear and unobstructed as possible.	L
Working outdoors Walking on site	Biologicals—contact with poisonous and thorny plants, allergens, insects, and animal hazards (for example: spiders, hornets, reptiles, snakes, deer ticks (Lyme disease), mosquitoes, bird and rodent droppings, biting and stinging insects etc.). Specify below any site-specific details and or review HASP for specific biological hazards.	Note: All personnel have the option to complete the Voluntary Allergy/Sensitivity/Medical Questionnaire. Conduct visual inspection before work begins and note (mark) areas of poisonous vegetation, insect (hornet wasp) nests, and snake habitats. Use mosquito repellent with DEET and tick repellent with permethrin, as required. <a href="#">DEET SDS</a> Treat clothing with permethrin-based products if ticks are prevalent. Know the local fauna and review emergency preparedness measures. Review potential animal dangers specific to the site and precautions (actions to take if run-in with wild animal occurs) and treatments. Inspect your body and clothing for ticks during outdoor activity and at the end of the day. Wear light-colored clothing so ticks can be more easily seen. Remove ticks right away to prevent infections. Tuck pants into socks when in areas with tick potential. Wear long-sleeved shirts that should be tucked in. Review information for poison ivy/oak recognition and treatment if plants are present. Use existing footpaths when possible.	L

Job Steps	Hazards	Controls	RAC
Working outdoors Walking on site (continued)	Biologicals—contact with poisonous and thorny plants, allergens, insects, and animal hazards (for example: spiders, hornets, reptiles, snakes, deer ticks (Lyme disease), mosquitoes, bird and rodent droppings, biting and stinging insects etc.). Specify below any site-specific details and or review HASP for specific biological hazards. (continued)	Avoid walking in un-cleared areas with poison ivy or biological hazard potential. Use barrier cream and cleaning products such as Zanfel, Ivy Block, Tecnu, IvyX if poison ivy or poison oak is prevalent. <ul style="list-style-type: none"> <li>• Wash hands using Ivy cleanser, prior to eating, using restroom, operating motor vehicle, and after leaving the field.</li> <li>• Do not touch face with hands or clothing while in the field.</li> <li>• Remove contaminated work clothing with gloves. Store, bag and wash separately.</li> </ul> Use poison ivy cleansers (not lotion soap) to clean affected skin. Lotion soaps will spread the irritant oil on larger areas of the skin. Shower immediately upon leaving work. Wear snake chaps if poisonous snakes are present.	L
Working in heat and sun	UV exposure—sunburn  Temperature stress: heat exhaustion, stroke	Wear UVA/UVB SPF sunscreen (minimum 30 SPF) and reapply frequently. Wear hats and clothing that shield skin from direct sun. Implement heat stress controls when the heat index is greater than 75 degrees Fahrenheit (°F), when the temperature is 75°F or more with relative humidity of 55% or more: Acclimatize by gradually working in heat, systematically building up tolerance. Conduct field activities in the early morning, if possible, to avoid heat. Have enough water on site so that each worker can consume, at a minimum, one quart per hour per shift. Have frequent reminders to personnel, to take water breaks so that each person can consume enough water. Provide access to shade that is reasonably close to the work area. Take breaks as necessary in shady or cool areas and hydrate. Conduct training on risk factors, signs and symptoms of heat illness, importance of hydration and acclimatization, and importance of reporting symptoms and what to do in case of heat illness emergency and contacting emergency medical services (see HASP).	L

Job Steps	Hazards	Controls	RAC
Working in heat and sun (continued)	UV exposure—sunburn  Temperature stress: heat exhaustion, stroke  (continued)	Follow the requirements for physiological monitoring as stated in the HASP. (e.g., during work in temperatures above 90 adjusted temperature, perform physiological monitoring—see safety plan if wearing Tyvek for when to start monitoring.)  Be conscious of individual tolerances to work in hot weather and medication contraindication for heat exposure.  Monitor yourself and co-workers for signs and symptoms of heat stress. (See <a href="#">Procedure 14.1 Heat Stress</a> )	L
Working in cold temperatures	Temperature stress: cold, hypothermia	Institute cold stress controls when air temperature or wind chill is or may drop below 40° F, when parts of the body are or may become immersed in cold water, and when working in snow or ice.  Train employees on the dangers and symptoms of cold-related illnesses and the applicable hazard controls. (See <a href="#">Procedure 14 Cold Stress</a> )  Train workers on the personal factors that may increase risk such as advanced age and circulatory problems and medications.  Establish a buddy system and ensure that personnel watch each other for signs of cold-related illnesses.  Provide a warm break area and establish a schedule for warm-up breaks and increase the frequency of warm-up breaks with decreasing temperatures. Take warm-up breaks if personnel exhibit shivering or report pain in the extremities that might be due to incipient frostbite.  Prevent or minimize exposure of bare skin if temperature or wind chill is less than minus (-) 25°F.  Schedule tasks to avoid long periods during which workers must sit or stand still.  Adjust work schedules or tasks for new employees to permit acclimatization to the cold conditions.  Encourage personnel to drink adequate quantities of water, soup, or other fluids to ensure adequate hydration.  Establish emergency plans to include immediately available dry clothing if there is a potential for personnel to be splashed or immersed in liquid.	L

Job Steps	Hazards	Controls	RAC
On-water activities	Hazards associated with working near open water	See Working Over and Near Water AHA	L
Repetition of work tasks for periods longer than 8 hours	Behavioral: human error - fatigue associated with extended work shifts including general drowsiness and also associated driving fatigue	<p>Operators of heavy equipment must not exceed 12 hours of duty time in any 24-hour period.</p> <p>Motor vehicle operators must not exceed 10 hours of driving in any 24-hour period.</p> <p>Do not operate motor vehicles after working for more than 12 hours during any 24-hour period.</p> <p>Know personal physical and psychological limitations.</p> <p>Stop working/driving, when necessary, to take breaks and hydrate.</p> <p>Stop work all together if fatigue endangers your safety or the safety of others. If appropriate, find a replacement for your job tasks.</p> <p>Schedule more demanding tasks for when endurance and alertness is best.</p> <p>Postpone more demanding and hazardous jobs if you are fatigued.</p> <p>Follow guidelines of HASP for work-rest regimens under adverse conditions of heat or cold stress.</p>	L
Completion of work shift and cleanup	<p>Clothing contact with potentially irritant materials/insects</p> <p>Take home toxics</p>	<p>Decontaminate yourself and gear, as appropriate, for contaminants and dust.</p> <p>If appropriate, wear Tyvek and washable or disposable over-boots to keep personal clothing and boots clean and free of any contaminated soils.</p> <p>Use liners to prevent contamination of truck.</p> <p>Shower immediately at end of workday.</p> <p>Check body for ticks, bites, and signs of irritation or cuts.</p>	L

Job Steps	Hazards	Controls	RAC
<b><i>Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.</i></b>			

Equipment	Training	Inspection																																																																																																														
<p><u>PPE Level D:</u></p> <ul style="list-style-type: none"> <li>• Hard hat (if there are overhead hazards)</li> <li>• Safety glasses</li> <li>• Safety-toed boots</li> <li>• Work gloves/chemical-resistant gloves</li> <li>• ANSI Class 2 reflective warning vests</li> <li>• Hearing protection, as necessary</li> <li>• Type I or V U.S. Coast Guard-approved personal flotation devices (when working near open water)</li> <li>• Face coverings (if social distance cannot be maintained)</li> </ul> <p><u>Other Equipment:</u></p> <ul style="list-style-type: none"> <li>• VHS radios</li> <li>• Generator, if needed</li> <li>• Fire extinguishers</li> <li>• Emergency eyewash bottle</li> <li>• First aid kit</li> <li>• Insect repellent–DEET and permethrin</li> <li>• Hand tools</li> <li>• Spill containment supplies, if needed</li> <li>• Containers, as needed</li> <li>• Tarps</li> <li>• GFCI</li> <li>• Heavy duty extension cords</li> <li>• Drinking water</li> <li>• Weather radio/or</li> <li>• Smart phone apps (temperature stress, noise, weather)</li> <li>• Hand sanitizer</li> <li>• Sun screen</li> <li>• Disinfectant wipes</li> </ul>	<p><u>Competent Person (CP) / Qualified Person (QP):</u></p> <p>CP/SSHO _____</p> <p>QP/First Aid and CPR _____</p> <p>QP/First Aid and CPR _____</p> <p><u>Training Requirements (as determined by the SSHO):</u></p> <ul style="list-style-type: none"> <li>• HAZWOPER 40 hour and current refresher</li> <li>• Supervisor training (SSHO)</li> <li>• OSHA 30 hour (SSHO)</li> <li>• Site safety orientation</li> <li>• Tailgate meetings</li> <li>• Emergency procedures</li> <li>• Hazard communication</li> <li>• Hearing conservation</li> <li>• Bloodborne pathogen</li> <li>• Applicable AHAs</li> <li>• Fire extinguisher use</li> <li>• Biological hazard identification and control</li> <li>• Severe weather shelter location</li> <li>• Lightning safety procedures</li> <li>• Temperature stress prevention, controls, and treatment</li> </ul>	<ul style="list-style-type: none"> <li>• Daily inspection (SSHO)</li> <li>• Housekeeping (daily)</li> <li>• Fire extinguisher (monthly)</li> <li>• Vehicle inspection (daily)</li> <li>• Equipment and tools inspection (daily and before use)</li> <li>• Portable flexible cords or cables (daily)</li> <li>• Eyewashes (monthly)</li> <li>• Survey areas for poisonous plants, insects, and animals (each work area)</li> </ul> <p>For each work area: Identify closest usable tornado shelter that is available and route to the hospital.</p> <ul style="list-style-type: none"> <li>• First aid kit inspection every 3 months, if unopened they do not have to be opened for inspection.</li> </ul> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p style="text-align: center;">Requirements for Basic First Aid Unit Package</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Unit first aid item</th> <th style="text-align: center;">Minimum Size or Volume (metric)</th> <th style="text-align: center;">Minimum Size or Volume (US)</th> <th style="text-align: center;">Item quantity per unit package</th> <th style="text-align: center;">Unit package size</th> </tr> </thead> <tbody> <tr> <td>Absorbent Compress</td> <td>206 cm<sup>2</sup></td> <td>32 in<sup>2</sup></td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> </tr> <tr> <td>Adhesive Bandage</td> <td>2.5 x 7.5 cm</td> <td>1 x 3 in</td> <td style="text-align: center;">16</td> <td style="text-align: center;">1</td> </tr> <tr> <td>Adhesive Tape</td> <td>2.3 m</td> <td>2.5 yd (total)</td> <td style="text-align: center;">1 or 2</td> <td style="text-align: center;">1 or 2</td> </tr> <tr> <td>Antiseptic Wipe</td> <td>2.5 x 2.5 cm</td> <td>1 x 1 in.</td> <td style="text-align: center;">10</td> <td style="text-align: center;">1</td> </tr> <tr> <td>Aspirin, Individually Wrapped</td> <td>325 mg</td> <td></td> <td style="text-align: center;">2</td> <td style="text-align: center;">2</td> </tr> <tr> <td>Bandage Compress (2 in-4 in)</td> <td>5 x 91 cm</td> <td>2 x 36 in.</td> <td style="text-align: center;">4</td> <td style="text-align: center;">1</td> </tr> <tr> <td>Burn Dressing</td> <td>10 x 10 cm</td> <td>4 x 4 in</td> <td style="text-align: center;">1</td> <td style="text-align: center;">1-2</td> </tr> <tr> <td>Burn Treatment</td> <td>0.9</td> <td>1/32 fl. Oz.</td> <td style="text-align: center;">6</td> <td style="text-align: center;">1</td> </tr> <tr> <td>Cold Pack</td> <td>10 x 12.5 cm</td> <td>4 x 5 in</td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> </tr> <tr> <td>*Combat style Tourniquet with Windlass</td> <td>96.3 x 3.8</td> <td>37.5 x 1.5 in. width</td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> </tr> <tr> <td>CPR Breathing Barrier</td> <td></td> <td></td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> </tr> <tr> <td>Eye Covering, with means of attachment</td> <td>19 cm<sup>2</sup></td> <td>2.9 in<sup>2</sup></td> <td style="text-align: center;">2</td> <td style="text-align: center;">1</td> </tr> <tr> <td>Eye/Skin Wash</td> <td>118 ml (total)</td> <td>4 fl. oz total</td> <td style="text-align: center;">1</td> <td style="text-align: center;">2</td> </tr> <tr> <td>First Aid Guide</td> <td></td> <td></td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> </tr> <tr> <td>Gloves, latex free</td> <td>XL</td> <td>XL</td> <td style="text-align: center;">2 pair</td> <td style="text-align: center;">1</td> </tr> <tr> <td>Hand Sanitizer</td> <td>0.9 g</td> <td>1/32 oz.</td> <td style="text-align: center;">6</td> <td style="text-align: center;">1</td> </tr> <tr> <td>Occlusive Dressing</td> <td>10.2 x 10.2</td> <td>4 x 4</td> <td style="text-align: center;">1</td> <td style="text-align: center;">2</td> </tr> <tr> <td>Roller Bandage (2 in.)</td> <td>5 x 366 cm</td> <td>2 in. x 4 yd.</td> <td style="text-align: center;">2</td> <td style="text-align: center;">1</td> </tr> <tr> <td>Roller Bandage (4 in.)</td> <td>10 x 366 cm</td> <td>4 in. x 4 yd.</td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> </tr> <tr> <td>Sterile pad</td> <td>7.5 x 7.5 cm</td> <td>3 x 3 in.</td> <td style="text-align: center;">4</td> <td style="text-align: center;">1</td> </tr> <tr> <td>Triangular Bandage</td> <td>101 x 101 x 14cm</td> <td>40 x 40 x 30 in.</td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> </tr> </tbody> </table> <p style="text-align: center; font-size: small;">* Required when power tools in use.</p> </div>	Unit first aid item	Minimum Size or Volume (metric)	Minimum Size or Volume (US)	Item quantity per unit package	Unit package size	Absorbent Compress	206 cm <sup>2</sup>	32 in <sup>2</sup>	1	1	Adhesive Bandage	2.5 x 7.5 cm	1 x 3 in	16	1	Adhesive Tape	2.3 m	2.5 yd (total)	1 or 2	1 or 2	Antiseptic Wipe	2.5 x 2.5 cm	1 x 1 in.	10	1	Aspirin, Individually Wrapped	325 mg		2	2	Bandage Compress (2 in-4 in)	5 x 91 cm	2 x 36 in.	4	1	Burn Dressing	10 x 10 cm	4 x 4 in	1	1-2	Burn Treatment	0.9	1/32 fl. 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**ACTIVITY HAZARD ANALYSIS (AHA)**

<p><b>Activity/Work Task:</b> Hand Auger Sampling</p> <p><b>Project Location:</b> Swan Island Basin, Portland Harbor Superfund Site, Multnomah County, Oregon</p> <p><b>Contract number:</b> DT2002</p> <p><b>Date Prepared:</b> May 2021</p> <p><b>Prepared By:</b> Steve Davis CIH, CSP</p> <p><b>Corporate H&amp;S Reviewer:</b> Edi Scala-Hampson</p> <p><b>Notes:</b> (Field notes, review comments, etc.)</p>	<p><b>Overall Risk Assessment Code (RAC) (Use highest code)</b> <span style="background-color: green; color: white; padding: 2px 10px;">L</span></p> <p><b>Risk Assessment Code (RAC) Matrix</b></p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th rowspan="2">Severity</th> <th colspan="5">Probability</th> </tr> <tr> <th>Frequent</th> <th>Likely</th> <th>Occasional</th> <th>Seldom</th> <th>Unlikely</th> </tr> </thead> <tbody> <tr> <td>Catastrophic</td> <td style="background-color: red; color: white;">E</td> <td style="background-color: red; color: white;">E</td> <td style="background-color: orange;">H</td> <td style="background-color: orange;">H</td> <td style="background-color: yellow;">M</td> </tr> <tr> <td>Critical</td> <td style="background-color: red; color: white;">E</td> <td style="background-color: orange;">H</td> <td style="background-color: orange;">H</td> <td style="background-color: yellow;">M</td> <td style="background-color: green;">L</td> </tr> <tr> <td>Marginal</td> <td style="background-color: orange;">H</td> <td style="background-color: yellow;">M</td> <td style="background-color: yellow;">M</td> <td style="background-color: green;">L</td> <td style="background-color: green;">L</td> </tr> <tr> <td>Negligible</td> <td style="background-color: yellow;">M</td> <td style="background-color: green;">L</td> <td style="background-color: green;">L</td> <td style="background-color: green;">L</td> <td style="background-color: green;">L</td> </tr> </tbody> </table> <p>Step 1: Review each <b>“Hazard”</b> with identified safety <b>“Controls”</b> and determine RAC (See above)</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 70%;"> <b>“Probability”</b> is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom, or Unlikely.                 </td> <td style="text-align: center;"><b>RAC Chart</b></td> </tr> <tr> <td style="width: 70%;"> <b>“Severity”</b> is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible                 </td> <td style="background-color: red; color: white; text-align: center;">E = Extremely High Risk</td> </tr> <tr> <td></td> <td style="background-color: orange; text-align: center;">H = High Risk</td> </tr> <tr> <td></td> <td style="background-color: yellow; text-align: center;">M = Moderate Risk</td> </tr> <tr> <td></td> <td style="background-color: green; text-align: center;">L = Low Risk</td> </tr> </table> <p>Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each “Hazard” on AHA. Annotate the overall highest RAC at the top of AHA.</p>	Severity	Probability					Frequent	Likely	Occasional	Seldom	Unlikely	Catastrophic	E	E	H	H	M	Critical	E	H	H	M	L	Marginal	H	M	M	L	L	Negligible	M	L	L	L	L	<b>“Probability”</b> is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom, or Unlikely.	<b>RAC Chart</b>	<b>“Severity”</b> is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible	E = Extremely High Risk		H = High Risk		M = Moderate Risk		L = Low Risk
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Job Steps	Hazards	Controls	RAC
Determine location for setup/load and unload/stage equipment	Traffic-struck by hazards	Determine best access route before transporting equipment. Select location away from traffic. Place barricades for work site protection, if necessary. Wear high-visibility vest.	L
	Driving over soft ground Uneven terrain	Choose location with level and firm soils.	L
Collect soil/sediment samples	Ergonomic	Use good body mechanics. Do not twist at waist when pulling. Avoid awkward hand and body positions. Maintain good fitness routine.	L
	Slip, trip, and fall hazards	Wear slip-resistant footwear. Look before you step to ensure secure footing. Watch for rocks and animal burrows. Keep work area picked up and as clean as feasible and free of tripping and fall hazards.	L
	Flying debris, dirt, dust, and rocks	Wear safety glasses when there is a potential for flying debris. Ensure eyewash bottle or stations are available and first aid supplies are adequate.	L

Job Steps	Hazards	Controls	RAC
Collect soil samples (continued)	Strains, sprains, awkward bending/lifts, and ergonomic hazards	Size up the lift. Use proper lifting techniques. Ensure walking pathway is clear. Do not lift greater than 50 pounds. Use mechanical assistance or two-person lift for loads heavier than 50 pounds. Limit repetitive awkward motions. Never twist or turn when lifting. Use your legs to lift and keep a straight back.	L
	Noise	Wear hearing protection if noise levels from neighboring equipment exceeds 85 dBA (if you cannot be heard speaking in a normal voice at arms distances).	L
	Struck by hazards/pinch points	Maintain eye contact with machine operators and acknowledge they see you before moving into the work zone. Honor exclusion zone. Conduct real-time monitoring with photoionization detector (PID), if needed, when all operators are aware of your presence. Keep hands, fingers, and feet clear of moving equipment and pinch points.	L
Measure with PID for volatile organic compound	Inhalation of contaminants/chemical exposure	Follow personal protective equipment (PPE) dictates of HASP based on airborne measurements and action levels. Communicate air monitoring results to all those affected. Assure all chemicals brought to site are labeled as to contents (for example, methanol, hexane, acids) and hazards, and then disposed of properly. Obtain safety data sheets (SDSs) for all chemicals brought to the site	L
Collect soil samples	Inhalation and skin contact hazards	Wear chemical-resistant gloves based on the identified chemicals. Use boot covers and splash suit protection if necessary. Follow respirator action level dictates of HASP.	L
	Take home toxics	Decontaminate with soap and water. Remove all contaminated clothing and materials and leave on site. Use plastic as a barrier for soil, truck bed, or foot well contact. Practice good hygiene. Not eating or smoking until decontaminated. Shower as soon as possible.	L
	Unattended worker	Use "Buddy system."	L

Job Steps	Hazards	Controls	RAC
Put sample in preserved jar	Inhalation and skin contact with preservatives: NaOH, HNO <sub>3</sub> , HCl	Use in well ventilated area. Wear appropriate PPE (cuffed gloves, safety glasses). Review SDS.	L
	Spills	Use absorbents and containers for spills.	L
Label and put sample in cooler	Cut hazards	Set up stable work area for labeling samples. Wear adequate hand protection. Use care when handling glassware.	L
General site work (if not covered specifically in this AHA, refer to the General Site Work AHA)	General site hazards: insect bites and stings. Contact dermatitis from poisonous and irritating plants (poison ivy, poison oak, and poison sumac). Vehicle traffic Severe weather Heat stress Cold stress Noise Lifting Slips, trips, and falls UV hazards, etc.	See General Site Work AHA.	L

Job Steps	Hazards	Controls	RAC
<b>Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.</b>			

Equipment	Training	Inspection
<p><u>Personal Protective Equipment:</u></p> <ul style="list-style-type: none"> <li>• Hard hat</li> <li>• Safety glasses</li> <li>• Safety-toed boots</li> <li>• Work gloves/chemical-resistant gloves</li> <li>• ANSI Class 2 reflective warning vests</li> <li>• Hearing protection, as needed</li> </ul> <p><u>Other Equipment:</u></p> <ul style="list-style-type: none"> <li>• Generator</li> <li>• Fire extinguishers</li> <li>• Emergency eyewash</li> <li>• First aid kit</li> <li>• Insect repellent with DEET</li> <li>• Repel Permanone™</li> <li>• Drinking water</li> <li>• Smart phone apps for temperature, weather, noise, as needed</li> </ul>	<p><u>Competent Person (CP) / Qualified Person (QP):</u></p> <p>CP/SSHO _____</p> <p>QP/First Aid and CPR _____</p> <p>QP/First Aid and CPR _____</p> <p><u>Training Requirements (as determined by the SSHO):</u></p> <ul style="list-style-type: none"> <li>• Site safety orientation</li> <li>• Tailgate meetings</li> <li>• Emergency procedures</li> <li>• Hazard communication</li> <li>• Hearing conservation</li> </ul>	<ul style="list-style-type: none"> <li>• Daily site safety inspection (SSHO)</li> <li>• Housekeeping (daily)</li> <li>• Eyewash equipment (weekly)</li> <li>• Fire extinguisher (monthly)</li> <li>• Vehicle inspection (daily)</li> <li>• Equipment and tools inspection (daily and before use)</li> <li>• Survey areas for poisonous plants, insects, and animals (each work area)</li> <li>• Check body for ticks (each evening during tick season)</li> </ul> <p>For each work area: Identify closest usable tornado shelter that is available and route to the hospital.</p>

ACTIVITY HAZARD ANALYSIS (AHA)						
<b>Activity/Work Task:</b> Mobilization and Demobilization (includes setup, take down, and staging of equipment) <b>Project Location:</b> Swan Island Basin, Portland Harbor Superfund Site, Multnomah County, Oregon <b>Contract number:</b> DT2002 <b>Date Prepared:</b> May 2021 <b>Prepared By:</b> Steve Davis CIH, CSP <b>Corporate H&amp;S Reviewer:</b> Edie Scala-Hampson <b>Notes:</b> (Field notes, review comments, etc.)	<b>Overall Risk Assessment Code (RAC) (Use highest code)</b>				<b>L</b>	
	<b>Risk Assessment Code (RAC) Matrix</b>					
	<b>Severity</b>	<b>Probability</b>				
		Frequent	Likely	Occasional	Seldom	Unlikely
	Catastrophic	<b>E</b>	<b>E</b>	<b>H</b>	<b>H</b>	<b>M</b>
	Critical	<b>E</b>	<b>H</b>	<b>H</b>	<b>M</b>	<b>L</b>
	Marginal	<b>H</b>	<b>M</b>	<b>M</b>	<b>L</b>	<b>L</b>
	Negligible	<b>M</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>
	Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above)					
	"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom, or Unlikely.				<b>RAC Chart</b>	
"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible				<b>E = Extremely High Risk</b>		
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Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.				<b>M = Moderate Risk</b>		
				<b>L = Low Risk</b>		
Job Steps	Hazards	Controls			RAC	
Review-health and safety needs	Inadequate planning, preparation, and training that can lead to the pain and suffering of an accident or personal injury	Readiness review to confirm all field personnel understand the project hazards and hazard controls and are trained in the procedures corresponding to work assignments.  Conduct pre-entry health and safety briefing.  Confirm all site hazards are recognized.  Confirm all necessary equipment to evaluate and control site hazards is available, calibrated, and in good working condition.  Confirm applicable engineering, administrative, and personal protective equipment (PPE) controls are ready to be implemented as needed.  Confirm emergency safety and first aid supplies are available.  Review emergency procedures and evacuation plans.			<b>L</b>	

Job Steps	Hazards	Controls	RAC
Mobilize equipment, tools and safety gear/demobilization same	Strains, sprains, awkward bending/lifts, and ergonomic hazards	<p>Move the load inside the truck as close to the edge of the bed as possible to be ready for unloading/ loading.</p> <p>Test the load first by nudging the item or container to estimate its weight and to determine if it can be moved alone. Know your limitations.</p> <p>Seek assistance in moving the object or load if it is heavier than 50 pounds.</p> <p>Do not lift greater than 50 pounds without mechanical assistance or two-person lift.</p> <p>Slide the load across the truck bed, do not lift and move.</p> <p>Move obstructions inside the truck to allow the load to slide across the truck bed.</p> <p>Use a step stool or step ladder to gain access to bed.</p> <p>Use proper lifting techniques. Lift with legs and a straight back. Do not twist while carrying a load. Move feet to avoid twisting.</p> <p>Ensure walking pathway is clear.</p> <p>Limit repetitive awkward motions.</p> <p>See General Site Work AHA.</p>	L
Travel to site	Traffic (road and site traffic) Infection	<p>Adjust seat and mirrors to ensure that you can reach controls and see behind you. Inspect vehicle to confirm it is in good working order and all cargo is secured and distractions are minimized. Familiarize yourself with the route and directions. (See <a href="#">HGL H&amp;S Procedure 16 Driving Safety</a>)</p> <p>See Coronavirus Practices to Prevent Exposure AHA</p>	L
<p>On-site mobilization/ demobilization</p> <ul style="list-style-type: none"> <li>Determine location for setup/staging equipment. Determine strategy for demobilization.</li> <li>Develop capability at the site, to include installation of office/equipment storage trailers, etc., as needed</li> <li>Set up/ take down trailers and other support services, as needed</li> <li>Load and unload equipment from barge/boat</li> </ul>	Traffic-struck by hazards	<p>Select location away from traffic.</p> <p>Place barricades for work site protection, if necessary.</p> <p>Wear high-visibility vest.</p> <p>Stay clear of traffic and equipment. Have all necessary PPE (hardhat, safety glasses, hearing protection, vest, etc.)</p>	L
	Driving over soft ground Uneven and rough terrain	Choose location with level and firm soils	L
	Site access control-unwanted entry	Use barricades or caution tape to mark the work area limits if there is potential for intrusion by unauthorized personnel	L
	Electric shock	Require that all electrical power hook up, installations, and disconnections be made or certified by a qualified electrician who will provide written certification of installation and grounding.	L
	Falling, tripping, slipping into water and drowning	See Working Over and Near Water AHA.	L



Job Steps	Hazards	Controls	RAC
Removal and transport of equipment and supplies from the site	Take home toxics	Decontaminate equipment and clothing as needed to minimize transfer of contaminants. Do not bring contaminated PPE or boots into truck. Use liners to prevent contamination of truck.	L
	Same hazards as in step above	See action to eliminate or minimize hazards in step above.	L
General site work	General site hazards: Insect bites and stings. Contact dermatitis from poisonous and irritating plants (poison ivy, poison oak, and poison sumac). Vehicle traffic Severe weather Heat stress Cold stress Noise. Lifting Slips, trips, and falls UV hazards, etc.	Refer to General Site Work AHA.	L

Job Steps	Hazards	Controls	RAC
<b>Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.</b>			

Equipment	Training	Inspection
<p><u>Personal Protective Equipment:</u></p> <ul style="list-style-type: none"> <li>• Hard hat</li> <li>• Safety glasses</li> <li>• Safety-toed boots</li> <li>• Work gloves/Chemical-resistant gloves</li> <li>• ANSI Class 2 reflective warning vests</li> <li>• TYPE I or V U.S. Coast Guard-approved personal flotation devices (PFDs) when working on or near water</li> </ul> <p><u>Other Equipment:</u></p> <ul style="list-style-type: none"> <li>• Generator</li> <li>• Fire extinguishers</li> <li>• Emergency eyewash</li> <li>• First aid kit</li> <li>• Insect repellent with DEET such as Repel or Permanone™</li> <li>• Hand tools</li> <li>• Spill containment supplies</li> <li>• Containers as needed</li> <li>• Tarps</li> <li>• GFCI</li> <li>• Heavy duty extension cords</li> <li>• Drinking water</li> <li>• Weather radio</li> <li>• Heat/cold stress monitoring</li> <li>• Sampling equipment including pumps, pump controllers, PID, water level probe, misc. hand tools</li> </ul>	<p><u>Competent Person (CP) / Qualified Person (QP):</u></p> <p>CP/SSHO _____</p> <p>QP/First Aid and CPR _____</p> <p>QP/First Aid and CPR _____</p> <p><u>Training Requirements (as determined by the SSHO):</u></p> <ul style="list-style-type: none"> <li>• HAZWOPER 40 hour</li> <li>• Site safety orientation</li> <li>• Tailgate meetings</li> <li>• Emergency procedures</li> <li>• Hazard communication</li> <li>• Hearing conservation</li> <li>• Applicable AHAs</li> <li>• Fire extinguisher use</li> <li>• Biological hazard identification and control</li> <li>• Tornado shelter location</li> <li>• Lightning safety procedures</li> <li>• Heat stress prevention and heat stroke treatment</li> <li>• Cold stress prevention</li> </ul>	<ul style="list-style-type: none"> <li>• Daily site safety inspection (SSHO)</li> <li>• Housekeeping (daily)</li> <li>• Eye wash equipment (weekly)</li> <li>• Fire extinguisher (monthly)</li> <li>• Vehicle inspection daily</li> <li>• Equipment and tools inspection daily and before use</li> <li>• Survey areas for poisonous plants, insects, and animals (each work area)</li> <li>• Check body for ticks (each evening during tick season)</li> </ul> <p>For each work area: Identify route to the hospital.</p>



Note: This AHA will be revised and modified daily during the daily Tailgate Safety Meeting to include specific daily weather and river conditions for the portion of the Willamette River where activities will occur.

ACTIVITY HAZARD ANALYSIS (AHA)						
<b>Activity/Work Task:</b> Inspections, Surveys, and Sampling from a Watercraft <b>Project Location:</b> Swan Island Basin, Portland Harbor Superfund Site, Multnomah County, Oregon <b>Contract Number:</b> DT2002 <b>Date Prepared:</b> May 2021 <b>Prepared By:</b> Steve Davis CIH, CSP <b>Corporate H&amp;S Reviewer:</b> Edie Scala-Hampson <b>Notes:</b> (Field Notes, review comments, etc.)	<b>Overall Risk Assessment Code (RAC) (Use highest code)</b>				L	
	<b>Risk Assessment Code (RAC) Matrix</b>					
	<b>Severity</b>	<b>Probability</b>				
		Frequent	Likely	Occasional	Seldom	Unlikely
	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L
	Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above)					
	"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom, or Unlikely.				<b>RAC Chart</b>	
"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible				E = Extremely High Risk		
Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.				H = High Risk		
				M = Moderate Risk		
				L = Low Risk		

Job Steps	Hazards	Controls	RAC
Determine location for setup/staging equipment-load and unload	Struck by hazards	Select location away from traffic. Place barricades for work site protection, if necessary. Wear high-visibility vest.	L
	Driving over soft ground Uneven terrain	Choose location with level and firm soils. Add gravel or use mud ramps on soft ground.	L
	Slip, trip, and fall hazards	Determine best access route before transporting equipment. Wear slip-resistant footwear. Look before you step to ensure safe and secure footing. Use Type I or V U.S. Coast Guard-approved personal floatation devices (PFDs) when working within 10 feet of water and/or entering shallow waters. Do not enter waters greater than waist depth. Keep work area clean and free of trip and fall hazards.	L

Note: This AHA will be revised and modified daily during the daily Tailgate Safety Meeting to include specific daily weather and river conditions for the portion of the Willamette River where activities will occur.

Job Steps	Hazards	Controls	RAC
Determine location for setup/staging equipment-load and unload (continued)	Heavy lifting- strains, sprains, awkward bending/lifts, and ergonomic hazards	Ensure walking pathway is clear. Do not lift greater than 50 pounds. Use mechanical assistance or two-person lift whenever possible. Limit repetitive awkward motions and twisting.	L
	Eye hazards-flying debris/splash and UV hazards	Wear safety glasses or a face shield when there is a potential for flying debris or splash hazards. Wear glasses with UV protection. Ensure eyewash station is available.	L
Weather evaluation	Severe weather and cold and/or heat stresses and water temperature hazards	Monitor weather forecasts for predicted inclement weather. Review heat and cold stress recognition and prevention instructions. Monitor heat stress index, air temperature, humidity and wind. Follow American Conference of Governmental Industrial Hygienists guidelines for work-rest regimens, as necessary. (Download the free smart phone Occupational Safety and Health Administration app for monitoring heat index on smartphone) <a href="http://www.osha.gov/SLTC/heatillness/heatindex/heatapp.html">www.osha.gov/SLTC/heatillness/heatindex/heatapp.html</a> Drink small amounts (4 oz.) of liquids for rehydration during breaks, per the work/rest regimen required based on temperature, workload, and acclimatization. Conduct work during the warmer/cooler part of the day if feasible. Wear sunscreen. Refer to Working Over and Near Water AHA. Refer to General Site Work AHA for actions not listed here.	L
Watercraft operation (To be conducted by subcontractor)	Hazards of boat operation	Refer to Working Over and Near Water AHA and watercraft subcontractor Health and Safety Plan (HASP).	L
Sample collection	Water hazards-falling overboard and/or stranded	Refer to Working Over and Near Water AHA.	L

Note: This AHA will be revised and modified daily during the daily Tailgate Safety Meeting to include specific daily weather and river conditions for the portion of the Willamette River where activities will occur.

Job Steps	Hazards	Controls	RAC	
Sample collection (continued)	Inhalation, ingestion, and skin contact hazards of chemicals of concern	<p>Conduct real-time monitoring before and during sampling activities if contaminant of concern concentrations in media warrant sampling.</p> <p>Follow personal protective equipment (PPE) dictates of HASP based on airborne measurements and action levels.</p> <p>Wear chemical-resistant gloves based on the identified chemicals. Use boot covers and splash suit protection, if necessary. Follow respirator action level dictates of HASP.</p> <p>Follow good hygiene practices.</p> <p>Move exposed person away from source of contamination and rinse mouth if contaminant has been ingested.</p> <p>If exposure to skin occurs, promptly wash contaminated skin using soap or mild detergent and water.</p>	L	
	Hand and power tool use	<p>Ensure all tools are working properly.</p> <p>Beware of sharp edges.</p> <p>Beware of electrical connections and water hazards when working with electric powered tools especially on vessels or on-water platforms.</p>		L
	Pinch points	<p>Secure objects on deck.</p> <p>Keep hands clear of closing mechanisms and moving parts.</p> <p>Avoid placing body parts between vessels and other objects.</p>		L
	Take home toxics	<p>Decontaminate with soap and water.</p> <p>Remove all contaminated clothing and materials and leave on site. Use plastic as a barrier for soil, truck bed, or foot well contact.</p> <p>Shower as soon as possible.</p>		L
	Environmental hazards <ul style="list-style-type: none"> <li>• Biologicals - Plants, insects, wildlife</li> <li>• Adverse weather</li> <li>• Temperature stresses</li> <li>• UV hazards</li> </ul>	See General Site Work AHA.		L
	Unattended worker	<p>Use the "buddy system."</p> <p>Maintain visual contact with the sampling technician during sampling activities.</p>		L



Note: This AHA will be revised and modified daily during the daily Tailgate Safety Meeting to include specific daily weather and river conditions for the portion of the Willamette River where activities will occur.

Job Steps	Hazards	Controls	RAC
Put sample in preserved jar	Inhalation, ingestion, and skin contact with preservatives such as: acids, methanol and hexane	Use in well-ventilated area. Wear appropriate PPE (gloves, safety glasses). Obtain safety data sheets for preservatives being used. Follow safe handling procedures. Follow good hygiene practices. Move exposed person away from source of contamination and rinse mouth if contaminant has been ingested. If exposure to skin occurs, promptly wash contaminated skin using soap or mild detergent and water.	L
	Spills	Use absorbents and containers for spills.	L
Label and put sample in cooler	Cut hazards	Set up stable work area for labeling samples. Label all containers as to contents. Wear adequate hand protection. Use care when handling glassware.	L
	Heavy lifting - strains, sprains, awkward bending/lifts, and ergonomic hazards	Use proper lifting techniques. Ensure walking pathway is clear. Do not lift greater than 50 pounds. Use mechanical assistance or two-person lift whenever possible. Limit repetitive awkward and twisting motions.	L

Job Steps	Hazards	Controls	RAC
<b>Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.</b>			



Note: This AHA will be revised and modified daily during the daily Tailgate Safety Meeting to include specific daily weather and river conditions for the portion of the Willamette River where activities will occur.

Equipment	Training	Inspection
<p><u>Personal Protective Equipment - Level D:</u></p> <ul style="list-style-type: none"> <li>• Hard hat</li> <li>• Safety glasses</li> <li>• Safety-toed boots</li> <li>• Work gloves/chemical-resistant gloves</li> <li>• ANSI Class 2 reflective warning vests</li> <li>• Type I or V U.S. Coast Guard-approved PFDs will be worn at all times whenever working on or near water.</li> </ul> <p><u>Other Equipment:</u></p> <ul style="list-style-type: none"> <li>• Fire extinguishers</li> <li>• Emergency eyewash</li> <li>• First aid kit</li> <li>• Insect repellent with DEET such as Repel or Permanone™</li> <li>• Hand tools</li> <li>• Spill containment supplies</li> <li>• Containers as needed</li> <li>• Tarps</li> <li>• Heavy duty extension cords</li> <li>• Drinking water</li> <li>• Weather radio and/or smart phone apps for weather, temperature and noise</li> <li>• Two-way marine radio</li> <li>• Heat/cold stress monitoring</li> <li>• Sampling equipment</li> </ul>	<p><u>Competent Person (CP) / Qualified Person (QP):</u></p> <p>CP/SSHO _____</p> <p>QP/First Aid and CPR _____</p> <p>QP/First Aid and CPR _____</p> <p><u>Training Requirements (as determined by the SSHO):</u></p> <ul style="list-style-type: none"> <li>• HAZWOPER 40-Hour</li> <li>• Site safety orientation</li> <li>• Tailgate safety meetings</li> <li>• Emergency procedures</li> <li>• Hazard communication</li> <li>• Hearing conservation</li> <li>• Applicable AHAs</li> <li>• Fire extinguisher use</li> <li>• Biological hazard identification and control</li> <li>• Lightning safety procedures</li> <li>• Heat stress prevention and heat stroke treatment</li> <li>• Cold stress prevention</li> <li>• Boat safety and licensing training (to be provided by watercraft subcontractor)</li> </ul>	<ul style="list-style-type: none"> <li>• Daily site safety inspection (SSHO)</li> <li>• Housekeeping (daily)</li> <li>• Eyewash equipment (weekly)</li> <li>• Fire extinguisher (monthly)</li> <li>• Vehicle inspection (daily)</li> <li>• Equipment and tools inspection (daily and before use)</li> <li>• Survey areas for poisonous plants, insects, and animals (each work area)</li> <li>• Check body for ticks (each evening during tick season)</li> </ul> <p>For each work area: Identify route to the hospital.</p>

**ACTIVITY HAZARD ANALYSIS**

<b>Activity/Work Task:</b> Water Level Gauging <b>Project Location:</b> Swan Island Basin, Portland Harbor Superfund Site, Multnomah County, Oregon <b>Contract Number:</b> DT2002 <b>Date Prepared:</b> May 2021 <b>Prepared By:</b> Steve Davis CIH, CSP <b>Corporate H&amp;S Reviewer:</b> Edie Scala-Hampson <b>Notes:</b> (Field notes, review comments, etc.)	<b>Overall Risk Assessment Code (RAC) (Use highest code)</b>					<b>L</b>
	<b>Risk Assessment Code (RAC) Matrix</b>					
	<b>Severity</b>	<b>Probability</b>				
		Frequent	Likely	Occasional	Seldom	Unlikely
	Catastrophic	<b>E</b>	<b>E</b>	<b>H</b>	<b>H</b>	<b>M</b>
	Critical	<b>E</b>	<b>H</b>	<b>H</b>	<b>M</b>	<b>L</b>
	Marginal	<b>H</b>	<b>M</b>	<b>M</b>	<b>L</b>	<b>L</b>
	Negligible	<b>M</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>
	Step 1: Review each “Hazard” with identified safety “Controls” and determine RAC (See above)					
	“Probability” is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom, or Unlikely.				<b>RAC Chart</b>	
“Severity” is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible				<b>E = Extremely High Risk</b>		
Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each “Hazard” on AHA. Annotate the overall highest RAC at the top of AHA.				<b>H = High Risk</b>		
				<b>M = Moderate Risk</b>		
				<b>L = Low Risk</b>		

Job Steps	Hazards	Controls	RAC
Mobilization to water level sites	Traffic Road hazards	See Mobilization and Demobilization AHA	<b>L</b>
Taking water levels	General site hazards: Insect bites and stings. Contact dermatitis from poisonous and irritating plants (poison ivy, poison oak, and poison sumac). Severe weather Heat stress Cold stress Noise Lifting Slips, trips, falls UV hazards, etc.	See General Site Work AHA	<b>L</b>
	Falling, tripping, and slipping into water and drowning	See Working Over and Near Water AHA	<b>L</b>
	Contamination exposure	Wear nitrile gloves.  Decontaminate water level meter between wells.	<b>L</b>

Job Steps	Hazards	Controls	RAC
Taking water levels (continued)	Inhalation of contaminants.	Measure with photoionization (PID) for volatile organic compounds if previous monitoring results are not available or if they indicate the presence of vapors. Monitor for methane at landfill monitoring wells. Follow personal protective equipment (PPE) dictates of the Health and Safety Plan (HASP) based on airborne measurements and action levels. Conduct real-time air monitoring as required by HASP. Obtain or review chemical information on hazardous materials and review their safety data sheets. Open each well for a brief period before work is conducted to allow any vapors to clear. Follow respirator action level dictates of HASP.	L

Job Steps	Hazards	Controls	RAC
<b><i>Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.</i></b>			

Equipment	Training	Inspection
<p><u>Personal Protective Equipment:</u></p> <ul style="list-style-type: none"> <li>• Hard hat</li> <li>• Safety glasses</li> <li>• Safety-toed boots</li> <li>• Work gloves/chemical-resistant gloves</li> <li>• ANSI Class 2 reflective warning vests</li> </ul> <p><u>Other Equipment:</u></p> <ul style="list-style-type: none"> <li>• Fire extinguishers</li> <li>• Emergency eyewash</li> <li>• First aid kit</li> <li>• Insect repellent with DEET such as Repel or Permanone™</li> <li>• Hand tools</li> <li>• Drinking water</li> <li>• Weather radio and/or smart phone apps for weather and temperature</li> <li>• Heat/cold stress monitoring</li> <li>• Water level meters</li> <li>• PID</li> <li>• Four gas meter (for landfill water level gauging only)</li> </ul>	<p><u>Competent Person (CP) / Qualified Person (QP):</u></p> <p>CP/SSHO _____</p> <p>QP/First Aid and CPR _____</p> <p>QP/First Aid and CPR _____</p> <p><u>Training Requirements (as determined by the SSHO):</u></p> <ul style="list-style-type: none"> <li>• HAZWOPER 40-Hour</li> <li>• Site safety orientation</li> <li>• Tailgate safety meetings</li> <li>• Emergency procedures</li> <li>• Hazard communication</li> <li>• Applicable AHAs</li> <li>• Fall protection</li> <li>• Fire extinguisher use</li> <li>• Biological hazard identification and control</li> <li>• Lightning safety procedures</li> <li>• Heat stress prevention and heat stroke treatment</li> <li>• Cold stress prevention</li> </ul>	<ul style="list-style-type: none"> <li>• Daily site safety inspection (SSHO)</li> <li>• Housekeeping (daily)</li> <li>• Fire extinguisher (monthly)</li> <li>• Vehicle inspection (daily)</li> <li>• Equipment and tools (inspection daily and before use)</li> <li>• Survey areas for poisonous plants, insects, and animals (each work area)</li> <li>• Check body for ticks</li> </ul> <p style="text-align: center;">For each work area: Identify route to the hospital.</p>

**ACTIVITY HAZARD ANALYSIS**

<b>Activity/Work Task:</b> Working Over or Near Water <b>Project Location:</b> Swan Island Basin, Portland Harbor Superfund Site, Multnomah County, Oregon <b>Contract Number:</b> DT2002 <b>Date Prepared:</b> May 2021 <b>Prepared By:</b> Steve Davis CIH, CSP <b>Corporate H&amp;S Reviewer:</b> Edie Scala-Hampson <b>Notes:</b> (Field Notes, review comments, etc.)	<b>Overall Risk Assessment Code (RAC) (Use highest code)</b>					<b>L</b>
	<b>Risk Assessment Code (RAC) Matrix</b>					
	<b>Severity</b>	<b>Probability</b>				
		Frequent	Likely	Occasional	Seldom	Unlikely
	Catastrophic	<b>E</b>	<b>E</b>	<b>H</b>	<b>H</b>	<b>M</b>
	Critical	<b>E</b>	<b>H</b>	<b>H</b>	<b>M</b>	<b>L</b>
	Marginal	<b>H</b>	<b>M</b>	<b>M</b>	<b>L</b>	<b>L</b>
	Negligible	<b>M</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>
	Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above)					
	"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom, or Unlikely.				<b>RAC Chart</b>	
"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible				<b>E = Extremely High Risk</b>		
Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.				<b>H = High Risk</b>		
				<b>M = Moderate Risk</b>		
				<b>L = Low Risk</b>		

Job Steps	Hazards	Controls	RAC
Weather evaluation	Severe weather and cold and/or heat stresses Water temperature hazards	<p>Monitor weather forecasts for predicted inclement weather. Check weather prior to departure and reschedule if severe weather is forecasted. Personnel will depart the location near the open water if lightning is within 10 miles.</p> <p>Review heat and cold stress recognition and prevention instructions.</p> <p>Monitor heat stress index, air temperature, humidity and wind. Follow American Conference of Governmental Industrial Hygienists guidelines for work-rest regimens, as necessary. (Download the free smart phone Occupational Safety and Health Administration app for monitoring heat index: <a href="http://www.osha.gov/SLTC/heatillness/heatindex/heatapp.html">www.osha.gov/SLTC/heatillness/heatindex/heatapp.html</a>.)</p> <p>Drink small amounts (4 oz.) of liquids for rehydration during breaks, per the work-rest regimen required based on temperature, workload, and acclimatization.</p> <p>Conduct work during the warmer/cooler part of the day if feasible.</p> <p>Wear 30+ SPF sunscreen.</p> <p>Suspend work at winds above 25 miles per hour, rough water, freezing rain, lightning/thunder, or during extreme temperatures.</p> <p>Check that communication device's function. For overwater work, communication devices will be provided by vessel operators. HydroGeoLogic, Inc., will use VHS radios for all near water work.</p> <p>Refer to General Site Work AHA and the sitewide Emergency Response Plan for additional detail and actions not listed here.</p>	<b>L</b>

Job Steps	Hazards	Controls	RAC
General site work	Falling, tripping, slipping into water, and drowning	<p>Where the hazard of drowning exists, always wear a U.S. Coast Guard-approved Type I or Type V personal flotation device (PFD) when working around water, even when inside mobile equipment. Auto-inflatable models are preferred, if available. Ring buoys with at least 90 feet of line should be provided and readily available for emergency rescue operations. Distance between staged/stored ring buoys shall not exceed 200 feet.</p> <p>Use the “buddy system” while working on or near water.</p> <p>Keep water rescue equipment easily accessible and know where they are stored.</p> <p>Ensure there are markings or barricades at the edge of vessels.</p> <p>Use lifeline, harness, and appropriate anchorage if deemed necessary.</p> <p>Practice good housekeeping and keep all travel ways clear around water hazards.</p> <p>Prevent placement of non-secured loads at the edge of vessels that workers may lean against or sit on.</p> <p>Means of access and egress and their approaches should be free from obstruction and, as far as practicable, kept clear of any substance likely to cause a slip, trip, or fall hazards.</p> <p>Add slip-resistant tape or surfacing where possible.</p> <p>Use handrails where available.</p> <p>Wear non-slip footwear.</p> <p>Maintain visual contact with staff during all activities.</p> <p>Maintain communication with staff working near water.</p> <p>Formulate relevant emergency preparedness procedures, e.g., contingency plans, rescue/evacuation arrangements, and drills. A rescue vessel may also be required.</p> <p>Conduct daily workplace examinations.</p>	L
	Pinching Entrapment	<p>Secure objects on deck.</p> <p>Maintain safe distance from moving mechanical parts.</p> <p>Barricade, mark with high-visibility taping or signage, or point out pinch point hazards.</p> <p>Keep hand clear of closing mechanisms and moving parts.</p> <p>DO NOT place body parts over the side of the vessel when another object is in close proximity.</p>	L
	Tension hazards	<p>Recognize cables, ropes, and straps may be under tension or force. Stand sufficiently back to prevent whiplash hazards from snapped cables or hydraulic lines.</p> <p>Communicate with the field team members whenever an object is being moved, hoisted, or tension is placed on a cable or hydraulic line.</p>	L

Job Steps	Hazards	Controls	RAC
General site work (continued)	Exceeding capacity	Do not exceed the weight limit of the vessel and be mindful to changes in its center of gravity when stowing equipment or heavy loads.  Do not exceed the posted number of passengers and weight limits	L
	Fire, smoke inhalation, injury from blast shrapnel, or burns	Ensure that a functioning fire extinguisher is available and personnel know where it is located.  Call 911.  Be prepared to abandon vessel in case of major fire. <ul style="list-style-type: none"> <li>• Review abandon ship procedures (to be provided by the boating subcontractor) with field team members prior to work.</li> <li>• Only the vessel captain or platform lead can order abandon ship.</li> <li>• Communicate the intent to abandon ship to all personnel onboard.</li> <li>• Notify the U.S. Coast Guard (USCG) and nearby vessels of intent to abandon ship.</li> <li>• Be aware of the propeller position and any floating spills of petroleum fluids before abandoning ship.</li> </ul>	L
	Slips and falls due to undercut banks and sloughing ground	Suitable footwear is required to reduce the risk of slipping.  Use caution: Look before you step to ensure safe and secure footing. Slopes are extremely dangerous.  Watch out for burrowing animals.  Use slow cautious steps in descending and ascending slopes. Tall weeds make visibility difficult.	L
	Noise	Wear hearing protection in high noise environments (greater than 85 dBA for a time weighted 8-hour average). At noise levels above 85 dBA you will not be able to carry on a conversation at arms-length without yelling.  Ensure hearing protection is available.	L
	Contact with contaminated water	Use nitrile gloves.  Rinse skin with clean potable water immediately and thoroughly after coming into contact with possible contaminated water.  Cover any broken skin areas with disinfectant and bandages.	L
	Electrical hazards contact with energized line (shock; electrocution)	All electrical installations and equipment should be constructed, installed, operated, protected, and maintained to prevent the risk of danger from electric shock or burns.  NEVER string or hang temporary power cords, wires, etc., on metal or near water.	L

Job Steps	Hazards	Controls	RAC
General site work (continued)	Person overboard, drowning	<p>PFD must be worn within 10 feet of water's edge on overwater vessels or platforms.</p> <p>Ensure a throw ring and throw rope are readily accessible.</p> <p>Be able to identify and address hypothermia.</p> <p>If you witness someone fall overboard:</p> <ul style="list-style-type: none"> <li>• Yell "Person Overboard!"</li> <li>• Throw a flotation device immediately.</li> <li>• If the vessel engine is running, take it out of gear and swing the stern clear to keep from hitting the person</li> <li>• Call 911 or USCG via marine radio (channel 16)</li> <li>• Assign a spotter to keep the person overboard in sight at all times.</li> <li>• Contact nearby vessels for assistance.</li> <li>• Recover the person from the water.</li> <li>• Lift from the shoulders of the life vest during retrieval, not the person's body, unless there is no other option.</li> </ul> <p>If you fall overboard:</p> <ul style="list-style-type: none"> <li>• Hold your mouth and nose closed and protect your head.</li> <li>• At the surface, look for movement, listen for sounds, and call for help.</li> <li>• Use the whistle attached to your PFD and activate the beacon light.</li> <li>• It is only sensible to swim if there is reason to believe you have a chance of reaching your destination. Too much movement in cold water can speed risk of hypothermia.</li> </ul>	L
Watercraft operation/navigation (To be conducted by subcontractor)	Hazards of boat operation	<p>Boat operator(s) must meet all education and licensing requirements of the State of Oregon, which includes the Oregon Marine Safety Board Boater Education Course.</p> <p>Observe all boating regulations.</p> <p>Familiarize yourself with any movement of boat traffic on the stream or river.</p> <p>Maintain a safe operating distance from shoreline and other vessels.</p> <p>Obtain information about water temperature and depths, and be familiar with locations of rocks, ledges, and manmade surface obstructions noted within the study area.</p> <p>Tie down equipment when necessary if there are issues of boat instability.</p> <p>Acquire USCG-approved lighting and signaling devices as required.</p> <p>Acquire marine emergency and rescue equipment.</p>	L

Job Steps	Hazards	Controls	RAC
Sample collection from watercraft	Water hazards - Falling overboard and/or stranded	<p>Remain seated except when working.</p> <p>Wear USCG-approved PFDs while on watercraft.</p> <p>Wear non-slip work shoes.</p> <p>Properly secure, guard, and maintain the boat access and walking areas free of tripping and slipping hazards.</p> <p>Maintain an adequate number of USCG throw rings.</p> <p>Do not exceed maximum weight capacity for watercraft.</p> <p>Do not use watercraft without shore support personnel.</p> <p>Maintain radio/cell phone contact with shore personnel.</p> <p>Review float plan with shore personnel so they can track whereabouts.</p> <p>Review training for person overboard emergencies and conduct drills to verify personnel are aware of their responsibilities.</p> <p>Follow water safety rules.</p> <p>Refer to USCG regulations. For more extensive information on working on or around water, refer to the Marine Operations Requirements.</p> <p>Review the prepared plan for marine emergencies such as fire, sinking, flooding, severe weather, person overboard, etc.</p>	L
Sample collection from shore/wading	Slipping into water and drowning	<p>Wear waders and USCG-approved PFDs. Check for leaks in waders prior to entering water.</p> <p>Work in pairs, using the “buddy system” to complete all tasks.</p> <p>Work during low tide. Check depths and flows.</p> <p>Use pole to probe depth of water ahead of where steps are taken to avoid drop-offs and boulders/rocks with gaps that could trap a foot.</p> <p>Do not enter water deeper than waist height.</p> <p>Be aware of potentially slippery surfaces and tripping hazards.</p> <p>Do not enter areas of high flow or when large floating debris is present.</p>	L
Boat refueling, if required (To be conducted by subcontractor)	Fire and fuel spills	<p>Store fuel in an area free of vegetation and debris with proper signage.</p> <p>Transport all flammable liquids in approved containers.</p> <p>Prohibit smoking while refueling.</p> <p>Turn motor off before refueling.</p> <p>Maintain a fully charged fire extinguisher that is readily accessible.</p> <p>Verify spill kit is on board all vessels or platforms that use petroleum fuel or hydraulics.</p>	L

Job Steps	Hazards	Controls	RAC
<b><i>Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.</i></b>			
		Refer to the sitewide Emergency Response Plan for additional details and responses to boating related incidents.	

Equipment	Training	Inspection
<p><u>Personal Protective Equipment:</u></p> <ul style="list-style-type: none"> <li>• Hard hat</li> <li>• Safety glasses</li> <li>• Safety-toed boots</li> <li>• Work gloves/chemical-resistant gloves</li> <li>• ANSI Class 2 reflective warning vests</li> <li>• Type I or V USCG-approved PFDs</li> </ul> <p><u>Other Equipment:</u></p> <ul style="list-style-type: none"> <li>• Sunscreen</li> <li>• Generator</li> <li>• Fire extinguishers</li> <li>• Emergency eyewash</li> <li>• First aid kit</li> <li>• Insect repellent with DEET</li> <li>• Repel Permanone™</li> <li>• Hand tools</li> <li>• Spill containment supplies</li> <li>• First aid supplies</li> <li>• Containers as needed</li> <li>• Tarps</li> <li>• GFCI</li> <li>• Heavy duty extension cords</li> <li>• Drinking water</li> <li>• Weather radio</li> <li>• Heat stress monitoring</li> <li>• Smart phone apps for: Weather, noise, heat, river water level</li> </ul>	<p><u>Competent Person (CP) / Qualified Person (QP):</u></p> <p>CP/SSHO _____</p> <p>Alternate CP/SSHO _____</p> <p>QP/First Aid and CPR _____</p> <p>QP/First Aid and CPR _____</p> <p><u>Training Requirements (as determined by the SSHO):</u></p> <ul style="list-style-type: none"> <li>• HAZWOPER 40</li> <li>• Site safety orientation</li> <li>• Tailgate meetings</li> <li>• Emergency procedures</li> <li>• Hazard communication</li> <li>• Hearing conservation</li> <li>• Applicable AHAs</li> <li>• Fire extinguisher use</li> <li>• Biological hazard identification and control</li> <li>• Lightning safety procedures</li> <li>• Heat stress prevention and heat stroke treatment</li> <li>• Cold stress prevention</li> <li>• Boat safety and licensing training for the vessel operator</li> </ul>	<ul style="list-style-type: none"> <li>• Daily site safety inspection (SSHO)</li> <li>• Housekeeping (daily)</li> <li>• Eye wash equipment (weekly)</li> <li>• Fire extinguisher (monthly)</li> <li>• Vehicle inspection (daily)</li> <li>• Equipment and tools inspection (daily and before use)</li> <li>• Survey areas for poisonous plants, insects, and animals (each work area)</li> <li>• Check body for ticks (each evening during tick season)</li> </ul>

**ACTIVITY HAZARD ANALYSIS (AHA) CERTIFICATION**

<b>Activity/Work Task:</b> Encountering Houseless Community Members <b>Project Location:</b> Swan Island Basin, Portland Harbor Superfund Site, Multnomah County, Oregon <b>Contract number:</b> DT2002 <b>Date Prepared:</b> January 2021, revised May 2022 <b>Prepared by:</b> Jeff Gadt <b>Corporate Health and Safety Approval:</b> Edie Scala-Hampson CIH, CHMM <b>Notes:</b> (Field Notes, Review Comments, etc.)	<b>Overall Risk Assessment Code (RAC) (Use highest code)</b>					<b>L</b>
	<b>Risk Assessment Code (RAC) Matrix</b>					
	<b>Severity</b>	<b>Probability</b>				
		Frequent	Likely	Occasional	Seldom	Unlikely
	Catastrophic	<b>E</b>	<b>E</b>	<b>H</b>	<b>H</b>	<b>M</b>
	Critical	<b>E</b>	<b>H</b>	<b>H</b>	<b>M</b>	<b>L</b>
	Marginal	<b>H</b>	<b>M</b>	<b>M</b>	<b>L</b>	<b>L</b>
	Negligible	<b>M</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>
	Step 1: Review each <b>"Hazard"</b> with identified safety <b>"Controls"</b> and determine RAC (See above)					
	<b>Probability</b> the likelihood the activity will cause a Mishap (near miss, incident, or accident). Identify as: Frequent, Likely, Occasional, Seldom, or Unlikely.					<b>RAC Chart</b> <b>E = Extremely High Risk</b> <b>H = High Risk</b> <b>M = Moderate Risk</b> <b>L = Low Risk</b>
<b>Severity</b> the outcome/degree if a mishap occurred. Identify as: Catastrophic, Critical, Marginal, or Negligible						
Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.						

Job Steps	Hazards	Controls	RAC
Mobilization to site	Failure to plan/warn/train about the houseless community and potential hazards	<p>Conduct readiness review with field team members prior to fieldwork. Site Safety and Health Officer (SSHO) to identify properties with houseless communities or individuals in relation to the task, work locations, and surrounding areas.</p> <p>SSHO to confirm Houseless Outreach Flyers notifying the houseless community of field activities at the properties they occupy are available for distribution. This flyer, which is to be updated quarterly, will be distributed to each houseless community member encountered during field activities. When applicable per direction from EPA, SSHO to confirm Houseless Outreach Flyers have been distributed in the work area 3-5 days ahead of the start of field activities.</p> <p>SSHO to facilitate/confirm field personnel have received the <i>Intro to Trauma Informed Care Training</i>, as recommended by EPA. Review the <a href="#">HGL Bloodborne Pathogens Program (H&amp;S Procedure 19)</a>.</p> <p>SSHO to discuss interactions with houseless community members and lessons learned in the readiness review and initial tailgate safety meeting and address the topics listed below. SSHO to verify that the necessary equipment and supplies are available and in good condition: nitrile gloves,</p>	<b>L</b>

Job Steps	Hazards	Controls	RAC
		Kevlar® or equivalent gloves resistant to cut/puncture wounds, steel-toed boots, and safety glasses.	
Site Tasks	Sharp objects (e.g., broken glass, needles)	<ol style="list-style-type: none"> <li>1. Wear proper PPE as described above.</li> <li>2. Be aware of your surroundings with regard to the presence of the houseless community members and debris that could contain needles (<u>bloodborne pathogens</u>), broken glass or metal. Avoid the handling of these objects unless wearing proper protective puncture resistant gear.</li> <li>3. If clearing debris from an area of ground, use a shovel or broom to move the debris and limit hand contact with surfaces/material that cannot be visually inspected.  Use traffic cones to delineate areas of hazardous debris.</li> <li>4. If a sharp object breaks the skin of an individual:               <ol style="list-style-type: none"> <li>a. Get first aid to treat the wound.</li> <li>b. If it's suspected that the individual may have been exposed to blood or other potentially infectious body fluids, follow the notification requirements in Section 5.3 <i>Post Exposure Actions of the Bloodborne Pathogens Program</i>.</li> </ol> </li> </ol>	<b>L</b>
	Other potentially infectious material (OPIM)	<ol style="list-style-type: none"> <li>1. Implement the controls for sharp objects. In particular, use of nitrile gloves.</li> <li>2. Be aware that bodily fluids (e.g., saliva, semen, any bodily fluid that is visibly contaminated with blood) and feces may be present in or near areas where houseless individuals camp. HBV, HCV, and HIV can be spread through contact with OPIM.</li> </ol>	

Job Steps	Hazards	Controls	RAC
Site Tasks (continued)	Person-to-person encounters with aggressive houseless individuals	<ol style="list-style-type: none"> <li>1. Maintain the buddy system at all times during work activities in areas the houseless community occupy.</li> <li>2. During the tailgate meeting each morning, discuss notable houseless individuals other field personnel have encountered.</li> <li>3. Procedures for encounters with houseless community members:               <ol style="list-style-type: none"> <li>a. If houseless individuals occupy a property to be sampled, make eye contact and treat them with dignity/respect and apply principles from the <i>Intro to Trauma Informed Care Training</i>. Distribute Houseless Outreach flyers to each individual encountered. When applicable per direction from EPA, SSHO to confirm Houseless Outreach Flyers have been distributed in the work area 3-5 days ahead of the start of field activities.</li> <li>b. If an individual becomes aggressive, back away to a safe location. When you are in a safe location, away from the aggressor and out of ear shot, call a community social work organization and/or police.                   <ol style="list-style-type: none"> <li>i. Portland Police Bureau 911 AND ask for PORTLAND STREET RESPONSE (this program dispatches unarmed and trauma-informed staff)</li> <li>ii. Multnomah County's 24/7 mental health crisis line: 503-988-4888</li> </ol> </li> </ol> </li> </ol> <p>If the houseless community member is a panhandler: make eye contact as you speak with them; apologize first to the panhandler to keep them calm, but use a firm tone; say sorry, and that you are working and need to continue with your tasks; if they become aggressive back away and follow steps above.</p>	

Job Steps	Hazards	Controls	RAC
<b>Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.</b>			

Equipment	Training	Inspection
<p><u>Personal Protective Equipment Level D:</u></p> <ul style="list-style-type: none"> <li>• Safety glasses</li> <li>• Safety-toed boots</li> <li>• ANSI Class 2 reflective warning vests</li> <li>• Cut/puncture resistant gloves</li> <li>• Chemical resistant gloves</li> </ul> <p><u>Other Equipment:</u></p> <ul style="list-style-type: none"> <li>• Disinfectant wipes</li> <li>• First aid kit</li> </ul>	<p><u>Competent Person (CP) / Qualified Person (QP):</u></p> <p>CP/SSHO _____</p> <p><u>Training Requirements (as determined by the SSHO):</u></p> <ul style="list-style-type: none"> <li>• Tailgate meetings</li> <li>• Intro to Trauma Informed Care Training</li> <li>• Emergency procedures</li> <li>• Hazard communication</li> </ul>	<ul style="list-style-type: none"> <li>• Daily inspection (SSHO)</li> <li>• Housekeeping (daily)</li> <li>• First aid kit readily available</li> <li>• Buddy system being practiced.</li> </ul> <p>SSHO (Parker) to notify PM and HR of any reports or signs of infection immediately. SSHO is not to provide names of involved personnel to others without authorization from HR.</p>

ACTIVITY HAZARD ANALYSIS (AHA) CERTIFICATION						
<b>Activity/Work Task:</b> Work at Properties with Combative Property Owners <b>Project Location:</b> Swan Island Basin, Portland Harbor Superfund Site, Multnomah County, Oregon <b>Contract number:</b> DT2002 <b>Date Prepared:</b> March 2022 <b>Prepared by:</b> Phyllis Chase <b>Corporate Health and Safety Approval:</b> Edie Scala-Hampson CIH, CHMM <b>Notes:</b> (Field Notes, Review Comments, etc.)	<b>Overall Risk Assessment Code (RAC) (Use highest code)</b>				<b>L</b>	
	<b>Risk Assessment Code (RAC) Matrix</b>					
	<b>Severity</b>	<b>Probability</b>				
		Frequent	Likely	Occasional	Seldom	Unlikely
	Catastrophic	<b>E</b>	<b>E</b>	<b>H</b>	<b>H</b>	<b>M</b>
	Critical	<b>E</b>	<b>H</b>	<b>H</b>	<b>M</b>	<b>L</b>
	Marginal	<b>H</b>	<b>M</b>	<b>M</b>	<b>L</b>	<b>L</b>
	Negligible	<b>M</b>	<b>L</b>	<b>L</b>	<b>L</b>	<b>L</b>
	Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above)					
	<b>Probability</b> the likelihood the activity will cause a Mishap (near miss, incident, or accident). Identify as: Frequent, Likely, Occasional, Seldom, or Unlikely.				<b>RAC Chart</b>	
<b>Severity</b> the outcome/degree if a mishap occurred. Identify as: Catastrophic, Critical, Marginal, or Negligible				<b>E = Extremely High Risk</b>		
Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.				<b>H = High Risk</b>		
				<b>M = Moderate Risk</b>		
				<b>L = Low Risk</b>		
Job Steps	Hazards	Controls			RAC	
Mobilization to site	Failure to plan/warn/train about work on properties with combative owners before entering property.	<ol style="list-style-type: none"> <li>1. Conduct readiness review with field team members prior to fieldwork. Site Safety and Health Officer (SSHO) to identify properties with potentially combative owners. SSHO will reinforce that if a situation escalates to a violent confrontation or physical altercation, call the Portland Police at 911.</li> <li>2. During the daily tailgate safety meeting, the SSHO will discuss potential combative property owners for the day's work and review hazards and controls listed on this AHA.</li> <li>3. Notify property point of contact of the schedule for working on their property in accordance with notification requirements on the access agreement or at least 7 days before the work is to begin if there is no specification in the access agreement. In addition, the field team leader will speak with property point of contact before work begins each day to describe the day's activities.</li> <li>4. The field team leader will wear a distinguishable vest to be clearly identifiable by target property personnel.</li> </ol>			<b>L</b>	

Job Steps	Hazards	Controls	RAC
Mobilization to site (continued)	Failure to plan/warn/train about work on properties with combative owners before entering property. (continued)	5. To the extent possible, coordinate with an independent third to be a part of the field team. The third party will provide an unbiased report on interactions with site staff.	L
Documentation	Uncooperative target property personnel	Details to include in the daily logbook entry: <ul style="list-style-type: none"> <li>• How the property was accessed (e.g. boat, overland from where).</li> <li>• HGL Team members accessing the property.</li> <li>• Times for arrival and departure.</li> <li>• Nearby activities or employees if you observe any.</li> <li>• Property staff interactions.</li> </ul>	L
Site Tasks	Uncooperative target property personnel Physical and verbal threats	<ol style="list-style-type: none"> <li>1. If target property personnel become verbally aggressive, remain calm and avoid escalation. Exit the property immediately. When you are in a safe location, away from the aggressor, contact Jeff Gadt or Jeff Hodge.</li> <li>2. If situation escalates to a violent confrontation or physical altercation call the Portland Police at 911.</li> <li>3. All communications with combative staff will be conducted by the field team leader.</li> <li>4. The field team leader will pause work efforts every 0.5 hours to observe site</li> <li>5. Maintain the buddy system at all times during work activities.</li> <li>6. If target property personnel are blocking a sample location, remain calm, make eye contact and treat them with dignity and respect. Apologize, but use a firm tone; say sorry, and that you are working and need to access the area for sampling. Politely ask them to move away from the sample area. If they refuse to give you access, don't argue. Exit the property and contact Jeff Gadt or Jeff Hodge. Have their contact #'s in your phone.</li> <li>7. Keep extra space between you and property staff whenever possible.</li> <li>8. Reflect respect and dignity toward all property staff. Don't argue or try to convince them of anything.</li> <li>9. Respect the property. Keep work site neat and clean. After work is completed, leave the work area clean and, to the extent possible, restored to original site conditions</li> </ol>	L

Job Steps	Hazards	Controls	RAC
<b>Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.</b>			

Equipment	Training	Inspection
<p><u>Personal Protective Equipment Level D:</u></p> <ul style="list-style-type: none"> <li>• Safety glasses</li> <li>• Safety-toed boots</li> <li>• Cut/puncture resistant gloves</li> <li>• Chemical resistant gloves</li> </ul> <p><u>Other Equipment:</u></p> <ul style="list-style-type: none"> <li>• First aid kit</li> <li>• Supervisor vest for Field Team Lead</li> </ul>	<p><u>Competent Person (CP) / Qualified Person (QP):</u></p> <p>CP/SSHO _____</p> <p><u>Training Requirements (as determined by the SSHO):</u></p> <ul style="list-style-type: none"> <li>• Tailgate meetings</li> <li>• Emergency procedures</li> <li>• Hazard communication</li> </ul>	<ul style="list-style-type: none"> <li>• Daily inspection (SSHO)</li> <li>• Housekeeping (daily)</li> <li>• First aid kit readily available</li> <li>• Buddy system being practiced.</li> </ul>

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**ATTACHMENT A**

**VIGOR EMERGENCY RESPONSE IMMEDIATE NOTIFICATION SUMMARY SHEET**

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## EMERGENCY RESPONSE IMMEDIATE NOTIFICATION

**SECURITY**  
**MEDICAL**

**=**

**CHANNEL 1** or **Ext. # 1799**

**503-247-1799**

Call Security to notify them of the emergency (type of emergency, location, number of injured, etc.) For emergency on vessels, notify Security *and* the Ship's Superintendent. Security personnel will contact on-site First Aid and any outside Emergency response agencies as needed. (see VI Emergency Response Plan)

*Notify first available Supervisor of the emergency.*

**OILS SPILLS AND CHEMICAL RELEASE NOTIFICATION PROCEDURE**

IF THERE IS A SPILL OF OIL OR CHEMICALS, IMMEDIATELY CONTACT THE ON SITE SHIP SUPERINTENDENT AND VIGOR'S ENVIRONMENTAL DEPARTMENT. STOP THE RELEASE OF MATERIAL, ATTEMPT TO CONTAIN SPILLED MATERIAL – ONLY IF YOU CAN DO SO SAFELY AND HAVE THE PROPER EQUIPMENT AND TRAINING.

(see VI Emergency Response Plan)

<b>Information Telephone List for Ship's Master, Subcontractor, and Tenant</b>				
 <b>Contacts</b>	 <b>Radio</b>	<b>#</b> <b>Ext.</b>	 <b>Telephone</b>	 <b>Cellular</b>
SECURITY – MAIN GATE	Channel 1	1799	503-247-1799	503-240-8226
First Aid – Sphere MD	Channel 1	1795	503-247-1795	
Incident Commander / FSO Security Director- Jeremiah Keenan	Channel 1			971-204-1135
Deputy Incident Commander	Channel 1			
Swing Shift Yard Superintendent – Brandon Walker	Channel 1			503-804-8765
Dock Master – Ken Swingle	Channel 1	1638	503-247-1638	503-702-2292
Safety Department Director – Gina Facca Safety Manager – Meagan Lunday	Channel 1	1639 1553	503-208-0732 503-329-8063	503-208-0732 503-329-8063
Environmental Department VP – Alan Sprott Manager – Bob Coates	Channel 11	1672 1806	503-247-1672 503-247-1806	503-703-0875 503-703-9271

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**ATTACHMENT B**  
**TRAFFIC CONTROL PLANS**

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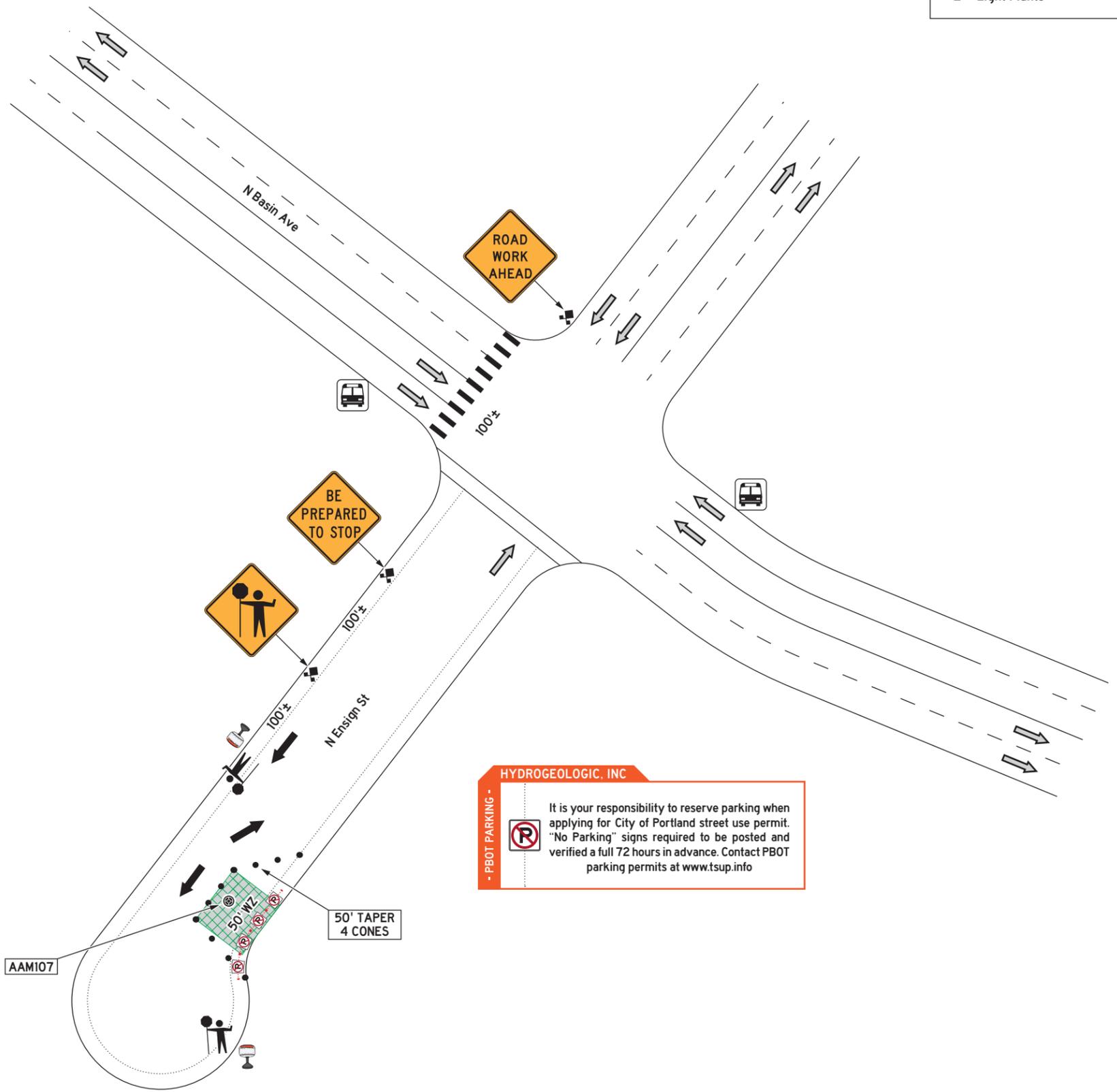
**Notes**

1. Flaggers shall have light plants during non-daylight hours and maintain high levels of visibility at all times
2. Maintain 10' minimum lane width for auto traffic at all times
3. Cone spacing at 20 MPH | Taper = 20' | Tangent = 20' | Corner/Access/Bike/Ped = 10'
4. Adjust devices so that business entrances/exits are not affected
5. All traffic control shall adhere to current MUTCD & PBOT Manual guidelines
6. Adjust to field conditions



**Equipment List**

- 1 Road Work Ahead
- 1 Be Prepared to Stop
- 1 Flagger Ahead
  
- 15 28" Cones
  
- 2 Flaggers with Radios
- 2 Light Plants



**Legend**

- 36" x 36" Signs w/ Flags
- 28" Cones
- Flagger
- Light Plant
- Work Zone
- 20' Reserved Parking
- Parking Lane
- Manhole Location

**D&H FLAGGING**  
- WOMEN OWNED BUSINESS -

**D&H PLAN #9904-1**  
November 5, 2021

Prepared By: Jesse Dickens  
 Office: (503) 232-2488  
 Email: plans@d-hflagging.com

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Contractor: HydroGeoLogic, Inc  
 Contact Person: Anna St. John  
 Phone: 503-312-4676  
 Email: astjohn@bridgeh20.com  
 Job Location: N Basin Ave & N Ensign St  
 City, State: Portland, OR  
 Type of Work: Manhole Access  
 Job Duration: 1 Night

### Equipment List

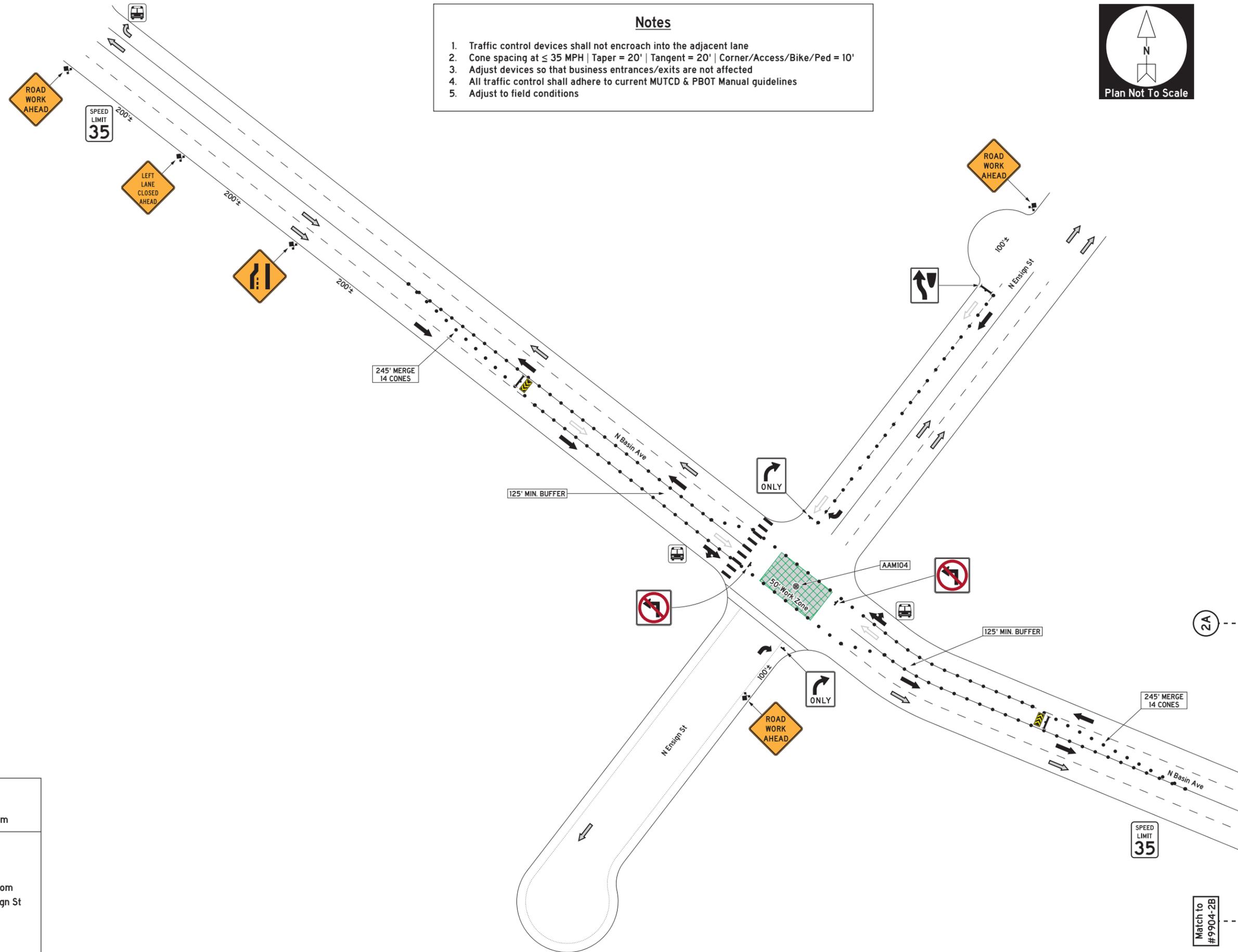
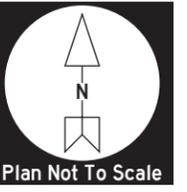
- 4 Road Work Ahead
- 2 Left Lane Closed Ahead
- 2 Transition
- 2 Type II - Right Turn Only
- 2 Type II - No Left Turn
- 1 Type III - Median Shift (L)
- 2 Arrow Boards with Type III Barricades
- 135 28" Cones

### Legend

-  36" x 36" Signs w/ Flags
-  Type II Barricade
-  Type III Barricade
-  Arrow Board
-  28" Cones
-  Work Zone
-  Parking Lane

### Notes

1. Traffic control devices shall not encroach into the adjacent lane
2. Cone spacing at  $\leq 35$  MPH | Taper = 20' | Tangent = 20' | Corner/Access/Bike/Ped = 10'
3. Adjust devices so that business entrances/exits are not affected
4. All traffic control shall adhere to current MUTCD & PBOT Manual guidelines
5. Adjust to field conditions



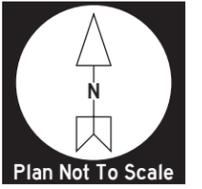
**D&H FLAGGING**  
- WOMEN OWNED BUSINESS -

**D&H PLAN #9904-2A**  
November 5, 2021

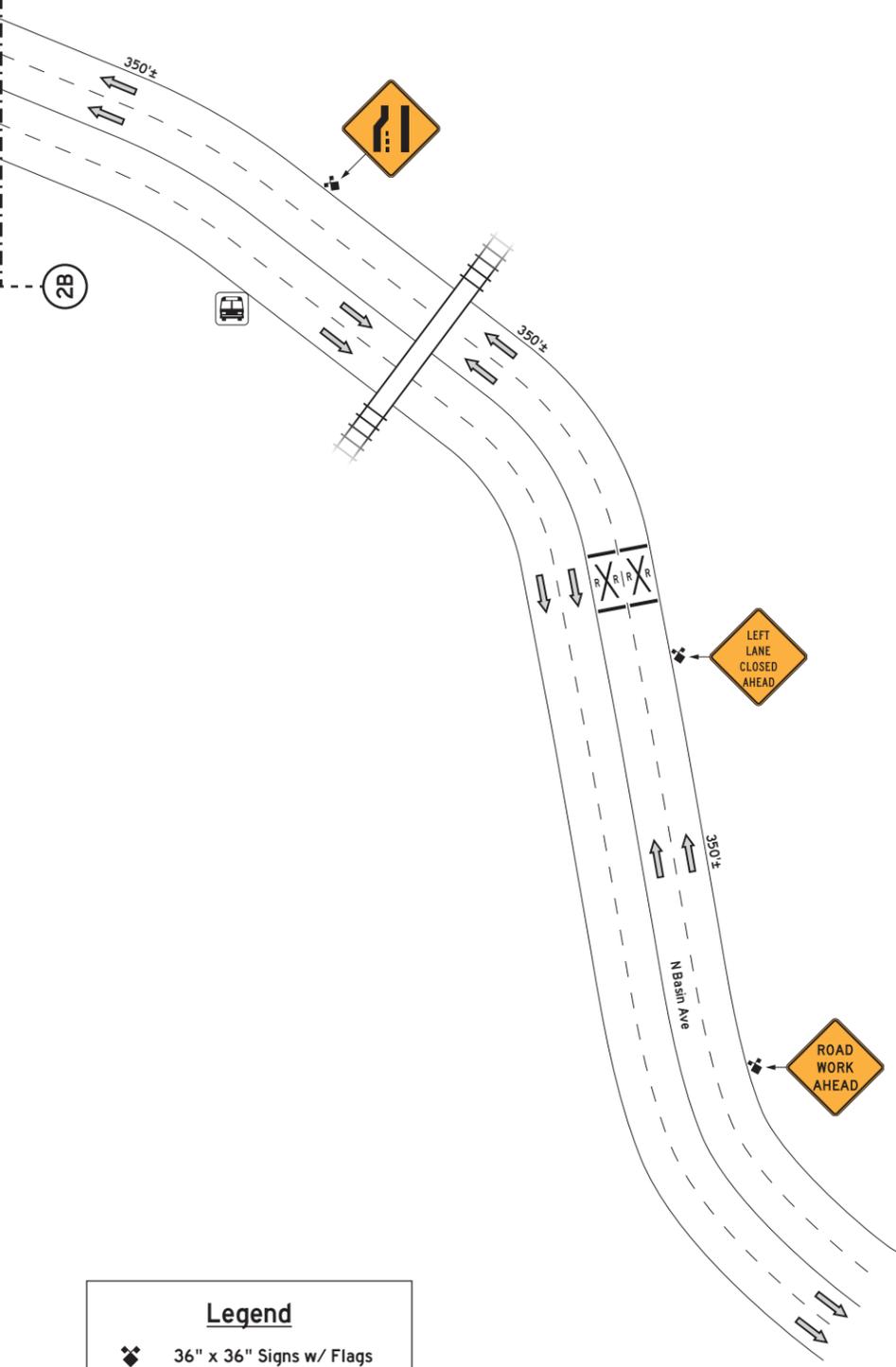
Prepared By: Jesse Dickens  
Office: (503) 232-2488  
Email: plans@d-hflagging.com

Contractor: HydroGeoLogic, Inc  
Contact Person: Anna St. John  
Phone: 503-312-4676  
Email: astjohn@bridgeh20.com  
Job Location: N Basin Ave & N Ensign St  
City, State: Portland, OR  
Type of Work: Manhole Access  
Job Duration: 1 Night

Match to #9904-2B



Match to  
#9904-2A



**Legend**

-  36" x 36" Signs w/ Flags
-  Type II Barricade
-  Type III Barricade
-  Arrow Board
-  28" Cones
-  Work Zone
-  Parking Lane



**D&H  
FLAGGING**  
- WOMEN OWNED BUSINESS -

**D&H PLAN #9904-2B**  
November 5, 2021

Prepared By: Jesse Dickens  
Office: (503) 232-2488  
Email: plans@d-hflagging.com

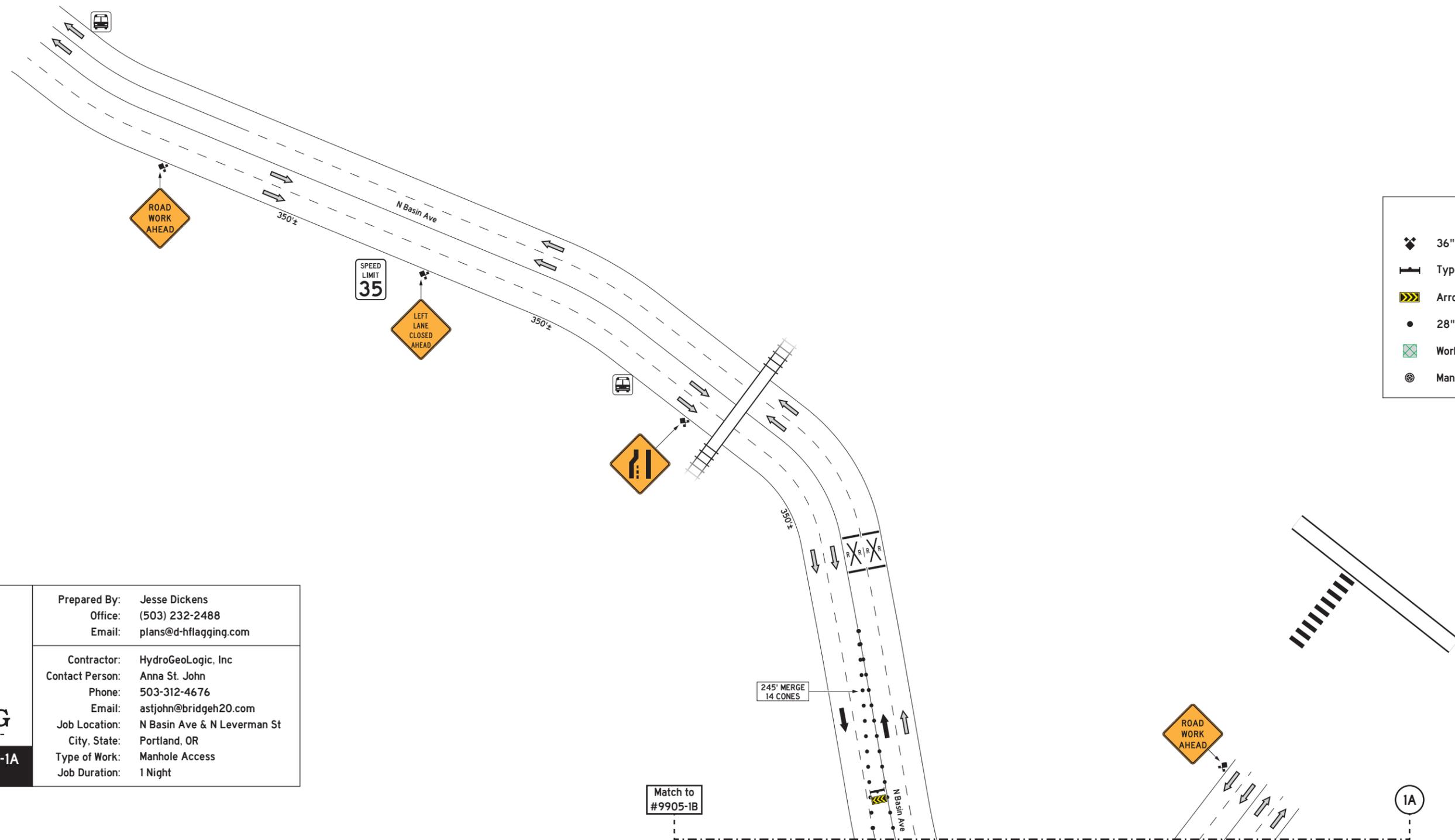
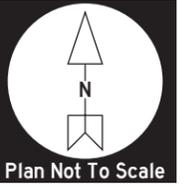
Contractor: HydroGeoLogic, Inc  
Contact Person: Anna St. John  
Phone: 503-312-4676  
Email: astjohn@bridgeh20.com  
Job Location: N Basin Ave & N Ensign St  
City, State: Portland, OR  
Type of Work: Manhole Access  
Job Duration: 1 Night

**Notes**

1. Traffic control devices shall not encroach into the adjacent lane
2. Cone spacing at 35 MPH | Taper = 20' | Tangent = 20' | Corner/Access/Bike/Ped = 10'
3. All traffic control shall adhere to current MUTCD & PBOT Manual guidelines
4. Adjust to field conditions

**Equipment List**

- 3 Road Work Ahead
- 2 Left Lane Closed Ahead
- 2 Transition
- 1 Type III - Median Shift (R)
- 2 Arrow Boards with Type III Barricades
- 60 28" Cones



**Legend**

- ◆ 36" x 36" Signs w/ Flags
- ▬ Type III Barricade
- ▬ Arrow Board
- 28" Cones
- ⊠ Work Zone
- ⊙ Manhole Location

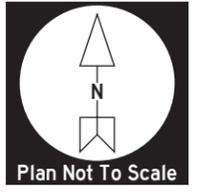
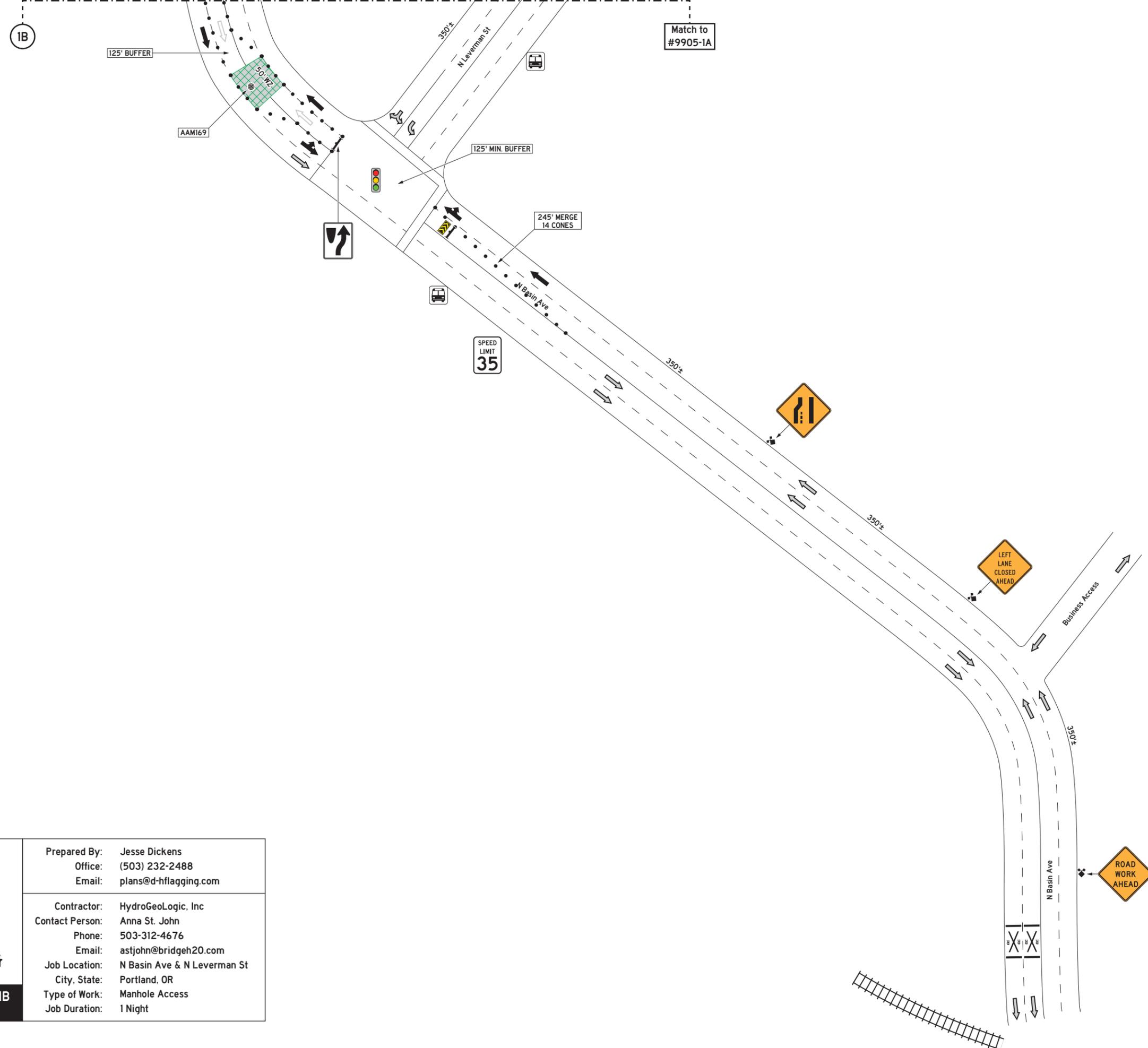


**D&H  
FLAGGING**  
- WOMEN OWNED BUSINESS -

**D&H PLAN #9905-1A**  
November 5, 2021

Prepared By: Jesse Dickens  
Office: (503) 232-2488  
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Contractor: HydroGeoLogic, Inc  
Contact Person: Anna St. John  
Phone: 503-312-4676  
Email: astjohn@bridgeh20.com  
Job Location: N Basin Ave & N Leverman St  
City, State: Portland, OR  
Type of Work: Manhole Access  
Job Duration: 1 Night



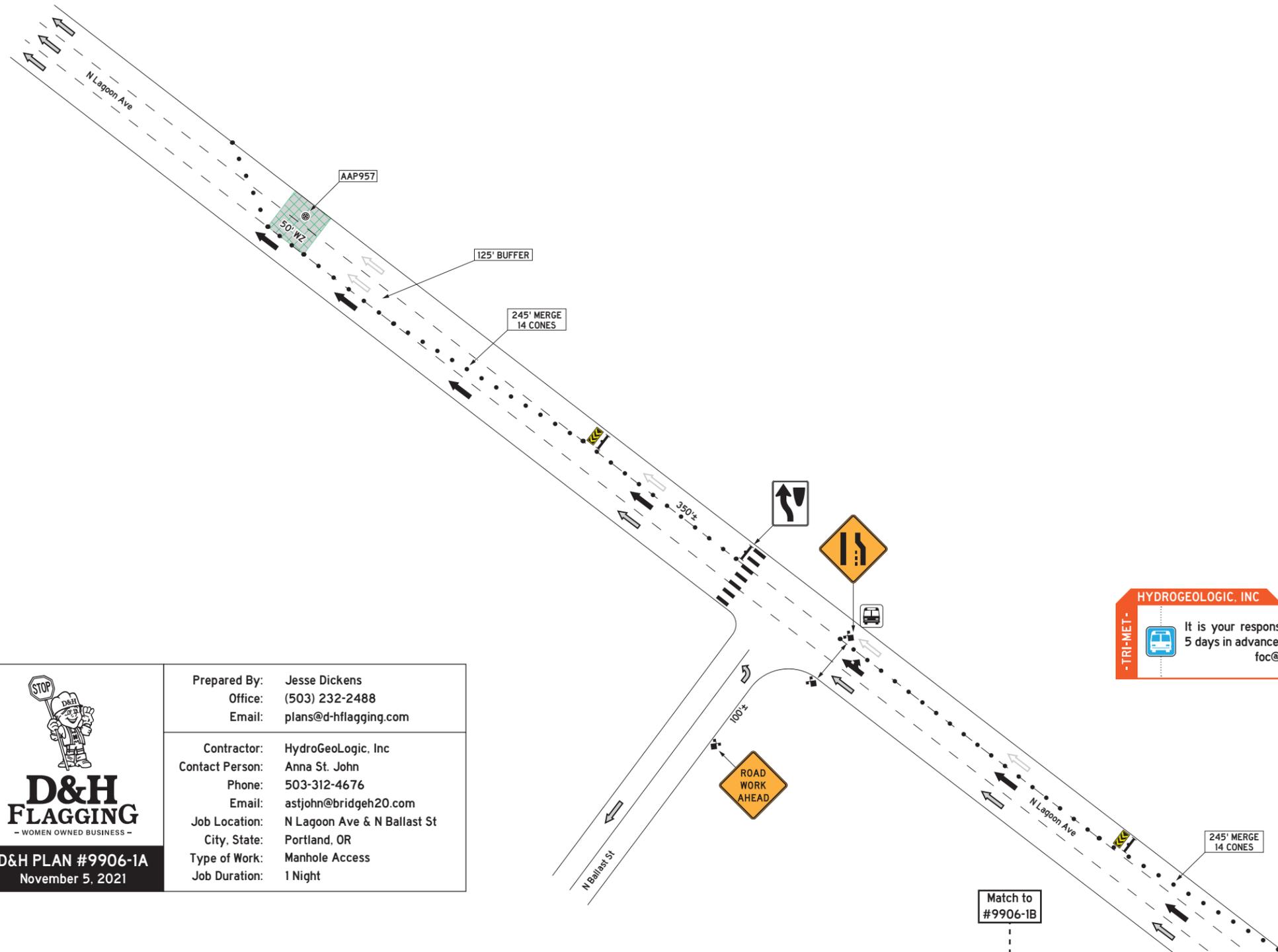
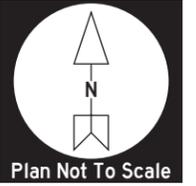
<p><b>D&amp;H FLAGGING</b> - WOMEN OWNED BUSINESS -</p> <p><b>D&amp;H PLAN #9905-1B</b> November 5, 2021</p>	<p>Prepared By: Jesse Dickens Office: (503) 232-2488 Email: plans@d-hflagging.com</p>
	<p>Contractor: HydroGeoLogic, Inc Contact Person: Anna St. John Phone: 503-312-4676 Email: astjohn@bridgeh20.com Job Location: N Basin Ave &amp; N Leverman St City, State: Portland, OR Type of Work: Manhole Access Job Duration: 1 Night</p>

**Legend**

- 36" x 36" Signs w/ Flags
- Type III Barricade
- Arrow Board
- 28" Cones
- Work Zone
- Manhole Location

**Notes**

1. Traffic control devices shall not encroach into the adjacent lane
2. Cone spacing at  $\leq 35$  MPH | Taper = 20' | Tangent = 20' | Corner/Access/Bike/Ped = 10'
3. Adjust devices so that business entrances/exits are not affected
4. All traffic control shall adhere to current MUTCD & PBOT Manual guidelines
5. Adjust to field conditions



**Equipment List**

- 3 Road Work Ahead
- 2 Right Two Lanes Closed Ahead
- 4 Transition
  
- 1 Type III - Median Shift (L)
  
- 2 Arrow Boards with Type III Barricades
  
- 70 28" Cones

**Legend**

- 36" x 36" Signs w/ Flags
- Type III Barricade
- Arrow Board
- 28" Cones
- Work Zone
- Manhole Location

**HYDROGEOLOGIC, INC**  
 It is your responsibility to notify Tri-Met 5 days in advance of affecting bus stops at [foc@trimet.org](mailto:foc@trimet.org)



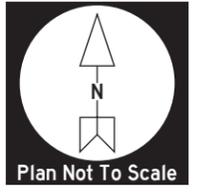
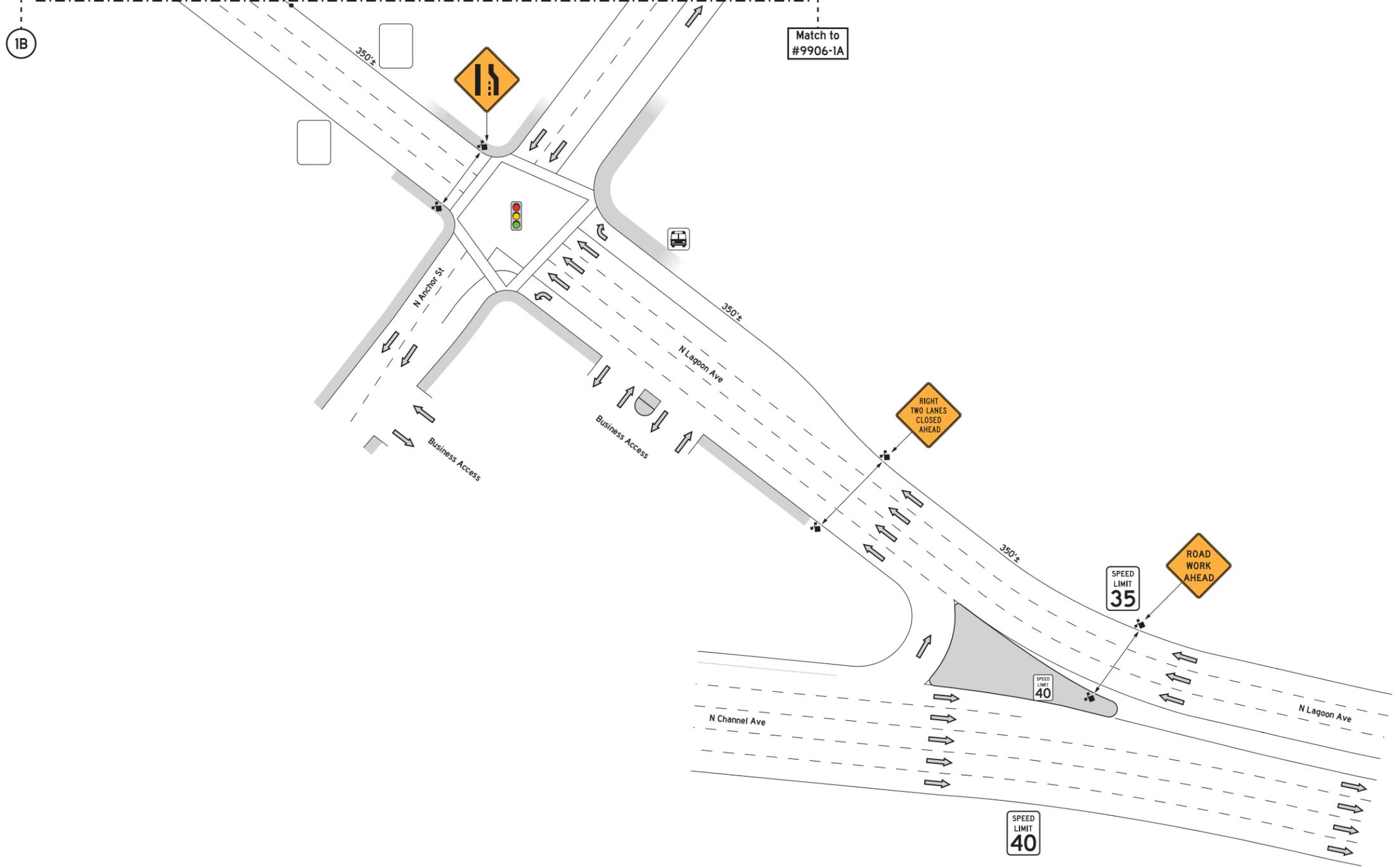
**D&H FLAGGING**  
- WOMEN OWNED BUSINESS -

**D&H PLAN #9906-1A**  
November 5, 2021

Prepared By: Jesse Dickens  
 Office: (503) 232-2488  
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---

Contractor: HydroGeoLogic, Inc  
 Contact Person: Anna St. John  
 Phone: 503-312-4676  
 Email: [astjohn@bridgeh20.com](mailto:astjohn@bridgeh20.com)  
 Job Location: N Lagoon Ave & N Ballast St  
 City, State: Portland, OR  
 Type of Work: Manhole Access  
 Job Duration: 1 Night



**D&H  
FLAGGING**  
- WOMEN OWNED BUSINESS -

**D&H PLAN #9906-1B**  
November 5, 2021

Prepared By: Jesse Dickens  
 Office: (503) 232-2488  
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Contractor: HydroGeoLogic, Inc  
 Contact Person: Anna St. John  
 Phone: 503-312-4676  
 Email: astjohn@bridgeh20.com

Job Location: N Lagoon Ave & N Ballast St  
 City, State: Portland, OR  
 Type of Work: Manhole Access  
 Job Duration: 1 Night

**Legend**

- 36" x 36" Signs w/ Flags
- Type III Barricade
- Arrow Board
- 28" Cones
- Work Zone
- Manhole Location

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**ATTACHMENT C**  
**HEALTH AND SAFETY FORMS**

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# DAILY PROJECT SAFETY INSPECTION REPORT

Project: \_\_\_\_\_ Date: \_\_\_\_\_

Inspector Name: \_\_\_\_\_

Work Area Description: \_\_\_\_\_

Site Activities at Time of Inspection \_\_\_\_\_

	YES	NO	NA
<u>FIRST AID</u>			
1. Are first aid kit locations identified and accessible?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Are emergency eye wash/safety showers available and inspected monthly?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Are first aid kits inspected weekly?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Is a qualified first aid/CPR provider on site?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>PERSONAL PROTECTIVE EQUIPMENT</u>			
1. Have levels of personnel protection been established?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Are respirators decontaminated, inspected, changed and stored according to standard procedures?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Have employees been fit-tested?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Is defective personal protective equipment tagged and taken out of service?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Does compressed breathing air meet CGA Grade "D" minimum?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Are there sufficient sizes and quantities of protective equipment? Coveralls, gloves, reflective vests?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. At a minimum, are employees utilizing safety glasses, hearing protection, hard hats, and safety toe boots, chemical protective gloves (if applicable) and following SSHP requirements?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Is there protection against insects, sunburn, heat stress, cold stress, vibration and other environmental hazards? Shade, warming shelters, drinking water, work-rest regimen enforced?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>FIRE PREVENTION</u>			
1. Are employees smoking only in designated outdoor areas?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Are fire lanes established and maintained?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Are flammable liquid dispensing systems bonded?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Are approved safety cans available for storage of flammable liquids?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Has the local fire department been contacted?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Are flammables and combustibles properly stored?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Are flammable storage cabinets available and used when needed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>AIR MONITORING</u>			
1. Is required air monitoring being conducted?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Are air monitoring instruments calibrated daily?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Are air monitoring logs up to date?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Are instrument user manuals available?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Are instruments being maintained?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Are employees notified of personal sampling results within 5 days of receipt?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Is dust being controlled?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

# DAILY PROJECT SAFETY INSPECTION REPORT (continued)

Project: \_\_\_\_\_

Date: \_\_\_\_\_

	YES	NO	NA
<u>WELDING AND CUTTING</u>			
1. Are fire extinguishers present at welding and cutting operations? Is a fire watch assigned?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Are confined spaces evaluated prior to and during cutting and welding operations?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Have Hot Work Permits been completed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Are proper helmets, goggles, aprons, and gloves available for welding and cutting operations?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Are welding machines properly grounded?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Are oxygen and fuel gas cylinders stored a minimum of 20 feet apart?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Are only trained personnel permitted to operate welding and cutting equipment?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Are gas cylinders transported in a secured vertical position with caps in place?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Is there adequate ventilation to prevent inhalation of metal fume (manganese)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>HAND AND POWER TOOLS</u>			
1. Are defective hand and power tools tagged and taken out of service?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Is eye protection available and used when operating power tools?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Are guards and safety devices in place on power tools?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Are power tools inspected before each use?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Are non-sparking tools available when necessary?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Is the correct tool being used for the job?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>MOTOR VEHICLES</u>			
1. Are vehicles clean and regularly inspected?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Are personnel licensed for the vehicles they operate?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Are unsafe vehicles tagged and reported to supervision?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Is vehicles safety equipment operating properly?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Are loads secure?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Are vehicle occupants using safety belts?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Are current insurance cards and blank accident report forms located in vehicles?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>EMERGENCY PLANS</u>			
1. Are emergency numbers posted?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Have emergency escape routes been designated?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Are employees familiar with the emergency signal?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Has the emergency route to the hospital been established and posted?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Is a vehicle on site that can transport injured employees to the hospital?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Is there emergency support documentation (written agreements, telephone conversation log)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>MATERIALS HANDLING/ MANLIFTS/OPERATOR EQUIPMENT QUALIFICATIONS</u>			
1. Are materials stacked and stored to prevent sliding or collapsing?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Are tripping hazards identified?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Are semi-trailers chocked?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Are fixed jacks used under semi-trailers?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Are riders prohibited on materials handling equipment?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Are approved manlifts provided for the lifting of personnel?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Are personnel in manlifts wearing approved fall protection devices?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Are only qualified operators utilized i.e., forklift trained, heavy equipment, crane operator? Documentation of qualification?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

# DAILY PROJECT SAFETY INSPECTION REPORT (continued)

Project: \_\_\_\_\_

Date: \_\_\_\_\_

	YES	NO	NA
<u>FIRE PROTECTION</u>			
1. Has a fire alarm system been established?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Do employees know the location and use of all fire extinguishers?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Are fire extinguisher locations posted?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Are combustible materials segregated from open flames?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Have fire extinguishers been professionally inspected during the last year?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Are fire extinguishers visually inspected monthly?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Has a fire drill occurred within the last 12 months?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>ELECTRICAL/CONTROL OF HAZARDOUS ENERGY</u>			
1. Is electrical equipment and wiring properly guarded and maintained in good condition?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Are extension cords kept out of wet areas?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Is damaged electrical equipment tagged and taken out of service?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Have underground electrical lines been identified by proper authorities?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Has a lockout/tagout system been established?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Are GFCIs being used on all temporary electrical systems and as needed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Are extension cords being inspected daily?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Are warning signs exhibited on high voltage equipment (250V or greater)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Is adequate distance maintained from overhead electrical lines?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Are switches, circuit breakers, and switchboards installed in wet locations enclosed in weatherproof enclosures?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Are restricted or limited approach boundaries identified on electrical panels?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Are authorized electricians trained in NFPA 70?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Are only electrically rated tools being used for electrical work?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>CRANES/RIGGING/CRITICAL LIFTS</u>			
1. Are cranes inspected daily prior to use?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Are crane swing areas barricaded or demarked?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Is all rigging equipment tagged with an identification number and rated capacity?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Is rigging equipment inspection documented?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Are slings, chains, and rigging inspected before each use?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Are damaged slings, chains, and rigging tagged and taken out of service?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Are slings padded or protected from sharp corners?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Do employees keep clear of suspended loads?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Are rated load capacities and special hazard warnings posted on crane?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Are the records of annual crane inspection available?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Has accessible areas within the swing radius of the rear of the crane been barricaded?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Do crane operators have required training/certification?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

# DAILY PROJECT SAFETY INSPECTION REPORT (continued)

Project: \_\_\_\_\_

Date: \_\_\_\_\_

	YES	NO	NA
<u>COMPRESSED GAS CYLINDERS/PRESSURIZED SYSTEMS</u>			
1. Are breathing air cylinders charged only to prescribed pressures?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Are like cylinders segregated and stored in well ventilated areas?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Is smoking prohibited in cylinder storage areas?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Are cylinders stored secure and upright?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Are cylinders protected from snow, rain, etc.?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Are cylinder caps in place before cylinders are moved?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Are fuel gas and oxygen cylinders stored a minimum of 20 feet apart?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Are propane cylinders stored and used only outside of buildings?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>SCAFFOLDING/ AERIAL WORK PLATFORMS</u>			
1. Is scaffolding placed on a flat, firm surface?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Are scaffold planks free of mud, ice, grease, etc.?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Is scaffolding inspected before each use?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Are defective scaffold parts taken out of service?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Have employees completed scaffold user training?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. On scaffolds where platforms are overlapped, is planking overlapped a minimum of 12 inches?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Does scaffold planking extend over end supports between 6 to 18 inches (dependent upon platform length)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Are employees restricted from working on scaffolds during storms and high winds?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Are all pins in place and wheels locked?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Is required perimeter guarding (top rail, mid rail, and toe board) present?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Has a competent person been designated to oversee scaffold construction?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Are employees prohibited from moving mobile scaffold horizontally while employees are on them?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Are all scaffold components manufactured by the same company?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>WALKING AND WORKING SURFACES AND GENERAL SITE HOUSEKEEPING</u>			
1. Are ladders regularly inspected?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Are access ways, stairways, ramps, and ladders clean of ice, mud, snow, or debris?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Are ladders being used in a safe manner?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Are ladders kept out of passageways, doors, or driveways?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Are broken or damaged ladders tagged and taken out of service?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Are metal ladders prohibited in electrical service?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Are stairways and floor openings guarded?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Are safety feet installed on straight and extension ladders?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Is general housekeeping being maintained?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Are ladders tied off?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Are handrails and side rails installed along the unprotected sides of stairways having 4 or more risers or rising more than 30 inches?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>SITE SAFETY PLAN</u>			
1. Is a site safety plan available on site or accessible to all employees?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Does the safety plan accurately reflect site conditions and tasks?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Have potential hazards been described to employees on site?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Is there a designated safety official on site?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Have all employees signed the safety plan acknowledgment form?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

# DAILY PROJECT SAFETY INSPECTION REPORT (continued)

Project: \_\_\_\_\_

Date: \_\_\_\_\_

	YES	NO	NA
<u>SITE POSTERS</u>			
1. Are the following posters displayed in a prominent and accessible area?			
A. Minimum Wage	<input type="checkbox"/>	<input type="checkbox"/>	
B. OSHA Job Protection	<input type="checkbox"/>	<input type="checkbox"/>	
2. Are all required state-specific posters displayed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>SITE CONTROL</u>			
1. Are work zones clearly marked?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Are support trailers located to minimize exposure from a potential release?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Are support trailers accessible for approach by emergency vehicles?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Is the site properly secured during and after work hours?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Is an exclusion zone sign-in/sign-out log maintained?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Are only personnel with current training and physicals permitted in exclusion or contamination reduction zone?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>HEAVY EQUIPMENT</u>			
1. Is heavy equipment inspected as prescribed by the manufacturer? Records available?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Is defective heavy equipment tagged and taken out of service?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Are project roads and structures inspected for load capacities and proper clearances?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Is heavy equipment shut down for fueling and maintenance?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Are backup alarms installed and working on mobile equipment?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Have qualified equipment operators been designated? Licenses and training verified?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Are riders prohibited on heavy equipment?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Are guards and safety appliances in place and used?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Are operators using the "three point" system when mounting/dismounting equipment?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>EXCAVATION</u>			
1. Has a "competent person" been designated to oversee excavation activities?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Prior to opening excavations, are utilities located and marked?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Has a professional engineer evaluated all excavations greater than 20 feet deep?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Is there rescue equipment on site and accessible to the excavation area?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Is excavated material placed a minimum of 24 inches from the excavation?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Are the sides of excavations sloped or shored to prevent cave ins?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Have excavations greater than 4 ft deep been monitored for hazardous atmospheres (i.e., LEL/O <sub>2</sub> deficiency, toxics)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Are ladders or ramps used in excavations over 4 feet deep?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Are means of egress available so as to require no more than 25 feet of lateral travel?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Are barriers, i.e., guardrails or fences, placed around excavations near pedestrian or vehicle thoroughfares?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Is excavation inspected daily by competent persons and documented?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>CONFINED SPACES</u>			
1. Have employees been trained in the hazards of confined spaces?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Are all confined spaces identified and labeled to prevent entry?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Is a copy of the confined space entry procedure available?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Has a rescue plan been established?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Is an entry supervisor present at each permit-required entry?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Are required extraction/fall protection devices being used?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## DAILY PROJECT SAFETY INSPECTION REPORT (continued)

Project: \_\_\_\_\_

Date: \_\_\_\_\_

	YES	NO	NA
<u>DECONTAMINATION</u>			
1. Are decontamination stations set up on site?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Is decontamination water properly contained and disposed of?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Are all pieces of equipment inspected for proper decontamination before leaving the site?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Are shin/metatarsal guards being used during power washing activities?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>HAZARD COMMUNICATION</u>			
1. Is there a copy of the HAZCOM procedure on site?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Are there SDSs for required materials/chemicals present on site?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Are all containers properly labeled, as to content, hazard?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Have employees been trained in accordance with the HAZCOM procedure?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Do employees (including subcontractors) know and understand the effects of exposure from the chemicals on site?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Have all personnel signed the HAZCOM acknowledgment form?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Is there an updated list of chemicals maintained on site?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>TRAINING</u>			
1. Are tailgate safety meetings being conducted daily or before each shift?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Are current training/medical records maintained on site?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. 40 hour and 8 hour refresher training certificates available, if applicable?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. 30 hour OSHA construction certificate available for SSHO?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>DOCUMENTATION</u>			
1. Is an OSHA 300 Log maintained and the 300A posted during February 1 to April 30?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Are accident report forms available?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Is a copy of health and safety policy and procedures available on site?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>RADIOACTIVE MATERIALS/X-RAY GENERATING EQUIPMENT</u>			
1. Is there a license or registration? (examples: Troxler gauge or XRF device)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Is radioactive material stored on site?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Is the radioactive material storage area posted with a sign stating "Caution Radioactive Materials"?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>





Unit # \_\_\_\_\_ Start Date \_\_\_\_\_  
 Mileage \_\_\_\_\_ Project # \_\_\_\_\_  
 Vehicle Type \_\_\_\_\_ License # \_\_\_\_\_  
 Inspected By \_\_\_\_\_ Fuel Front \_\_\_\_\_  
 Employee # \_\_\_\_\_ Fuel Rear \_\_\_\_\_

## DAILY VEHICLE INSPECTION (Weekly Log)

N/A = Not Applicable    C = Comments    O = Okay    N = Needs Attention	SAT	SUN	MON	TUE	WED	THU	FRI
Exterior/Interior Clean							
Lights: Head-Tail-Turn-Stop-Emergency-Back Up							
Operating Controls/ Gauges							
Battery/ Starter/ Horn							
Air Conditioner/ Heater/ Defroster							
Back-up Alarm ( Trucks )							
Windshield, Other Glass, Wipers/Washer							
Mirrors: Inside-Outside ( Convex-Trucks )							
Insurance Card & Accident Report Kit							
Emergency Phone Number List							
Map to Urgent Care Facility & Hospital							
Current Registration, Plates							
Service Brakes, Emergency/Parking Brake							
Trailer Aux. Brake Controller/Electrical Connection							
Coupling Devices/Safety Chain Anchor Point							
Wheel Chocks ( When Equipped with Trailer )							
Engine Oil, Oil Pressure							
Transmission Oil & Drive Line							
Radiator/Cooling System							
Exhaust/ Muffler							
Front Axle/Steering/Suspension System							
First Aid Kit							
Fire Extinguisher ( mounted/accessible/charged )							
Emergency Flares or Reflective Markers							
Tires/Wheels/Rims							
Spare Tire, Jack, Lug Wrench							
Frame/Bumpers							
Seat Belts ( One for Each Passenger )							
Visible Damage to Body							
Driver Safety Notification Sticker							
Other, Please Enter Comments Below							
Was Unit Serviced? Yes/ No	Date Serviced	Miles					

Comments:

---

I have been authorized and I am licensed to operate this vehicle.

**INSPECTORS SIGNATURE:** \_\_\_\_\_

**DATE:** \_\_\_\_\_

**PLEASE REPORT ALL DEFICIENCIES TO YOUR SUPERVISOR**  
 RETAIN THIS INSPECTION DOCUMENT IN PROJECT FILES



## H&S Procedure 26

Approved by: Health and Safety Director

Steve Davis CIH, CSP Digitally signed by Steve Davis CIH, CSP  
Date: 2020.10.08 13:08:55 -04'00'

### 26.1 Confined Space Pre-Entry Inspection Checklist

Publication Date: March 2011

Revision No.: 07

Revision Date: October 2020

Review Date: October 2021

## APPENDIX A

### CONFINED SPACE PRE-ENTRY INSPECTION CHECKLIST

DATE: \_\_\_\_\_ CLIENT: \_\_\_\_\_

SPACE LOCATION AND DESCRIPTION: \_\_\_\_\_

\_\_\_\_\_

SPACE NUMBER \_\_\_\_\_

(IF APPLICABLE)

PURPOSE OF ENTRY: \_\_\_\_\_

JOB NUMBER: \_\_\_\_\_

CLIENT CLASSIFICATION: \_\_\_ NON-PERMIT \_\_\_ PERMIT REQUIRED \_\_\_ HAZARD ELIMINATED  
\_\_\_ ALTERNATE PROCEDURES – HAZARDS CONTROLLED BY CONTINUOUS VENTILATION

#### ATMOSPHERIC

Oxygen Deficient (<19.5%)       Oxygen Enriched (>23.5%)

LEL (>10%)

Flammable Dusts

Toxics

IDLH

#### Technical Notes:

#### ENGULFMENT HAZARDS

Water/Liquids

Solid Materials

#### INTERNAL CONFIGURATION

Converging Walls

Maze Construction

Obstacle(s) in Space

#### OTHER RECOGIZED HAZARDS

Energy/Mechanical/Electrical

Hot Work

Use of Chemicals/Compressed Gases in Space

Other Serious Hazard(s)

List \_\_\_\_\_

## 26.1 Confined Space Pre-Entry Inspection Checklist

H&S Procedure No.: 26
Publication Date: March 2011
Revision No.: 07
Revision Date: October 2020
Review Date: October 2021

### AIR MONITORING MEASUREMENTS

TESTS MADE	PERMISSIBLE ENTRY LEVEL	MONITORING LOCATION	BEFORE VENTILATION	AFTER VENTILATION
Oxygen	19.5% to 23.5%			
Flammable atmosphere	<10% of lower explosive limit			
Toxic Materials				
Other				

Note: If it is not possible to conduct air monitoring in advance, so note.

### INSTRUMENTS

MAKE	MODEL	SERIAL NO.	CALIBRATION DATE

### EQUIPMENT NECESSARY FOR ENTRY - CHECKLIST

EQUIPMENT	YES	NO
Confined Space Entry Permit Needed (Corporate Health & Safety Notified)		
Authorized Entrants, Authorized Attendants, Entry Supervisor		
Lockout/Tagout Materials		
Ventilation Fan, Hoses and Saddle Vent		
Barriers, Danger Signs, Flags, Traffic Cones (devices)		
Direct Reading Gas Monitor(s) with Current Bench Calibration		
Safety Harness and Lifelines for Entrant and Standby Persons		
Hoisting Equipment e.g., Tripod <input type="checkbox"/> with Fall Protection		
Fire Extinguisher (ABC) 10 lb.		
First Aid and Infection Control Kit		
Powered Communications <input type="checkbox"/> Intrinsically Safe		
Electric Equipment and Lighting <input type="checkbox"/> Explosion Proof		
Hardhat, Goggles, Boots, Gloves, Disposable Outerwear		
Chemical Protective Clothing		
Escape Bottles - 5 Minute/10 Minute (ESCBA)		
Air Purifying Respirators		
Supplied Air Respirators (Level B) <input type="checkbox"/> Airline with ESCBA <input type="checkbox"/> SCBA		

## 26.1 Confined Space Pre-Entry Inspection Checklist

H&S Procedure No.: 26
Publication Date: March 2011
Revision No.: 07
Revision Date: October 2020
Review Date: October 2021

CONFINED SPACE RESCUE TEAM

ONSITE

OFFSITE

Name: \_\_\_\_\_

Phone Number: \_\_\_\_\_

Contact Person: \_\_\_\_\_

Estimated Response Time: \_\_\_\_\_

- |   |   |
|---|---|
| <input type="checkbox"/> Rescue team not required because space meets requirements for Hazard Eliminated or Alternate Procedures. | <input type="checkbox"/> Rescue team notified and <u>staged</u> at entry site when: |
| <input type="checkbox"/> Rescue Team notified and available to <u>respond</u> to entry site when:                                 | - Entrants are wearing supplied air respirators; OR/AND                             |
| - Entrants are not wearing supplied air respirators: AND  | - Entrants are exposed to IDLH or potential IDLH conditions; OR/AND                 |
| - Entrants are not exposed to IDLH or potential IDLH conditions; AND  | - Entrants would be expected to have difficulty in “self-rescue.”                   |
| - Entrants can be expected to “self-rescue” under normal circumstances; AND   |   |
| - No other need for a standby rescue team.  |   |

Sketch of confined space showing access for mechanical ventilation and monitoring.

**A copy of this document must be reviewed by the Confined Space Entry Team Prior to Entry.**

Inspector Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Project Manager: \_\_\_\_\_

Date: \_\_\_\_\_



## H&S Procedure 26

Approved by: Health and Safety Director

Steve Davis CIH, CSP Digitally signed by Steve Davis CIH, CSP  
Date: 2020.10.08 13:18:17 -04'00'

### 26.3 Confined Space Entry Permit

Publication Date: March 2011

Revision No.: 07

Revision Date: October 2020

Review Date: October 2021

## APPENDIX C CONFINED SPACE ENTRY PERMIT



# CONFINED SPACE ENTRY PERMIT

PERMIT NO. \_\_\_\_\_  
 DATE: \_\_\_\_\_  
 JOB NO. \_\_\_\_\_

Please refer to Pre-Entry Inspection Checklist.  
 Permit valid for duration of entry only. All copies of permit will remain at job site until job is completed.

Client: \_\_\_\_\_

Site location and description: \_\_\_\_\_

Purpose of Entry: \_\_\_\_\_

Supervisor: \_\_\_\_\_ Employee No.: \_\_\_\_\_

### SELECT MINIMUM REQUIREMENTS TO BE COMPLETED AND REVIEWED PRIOR TO ENTRY

Check and Initial Appropriate Response	Yes	No	N/A	Supv Init	Check and Initial Appropriate Response	Yes	No	N/A	Supv Init
<b>ENGINEERING CONTROLS</b>					<b>PERSONAL PROTECTIVE EQUIPMENT</b>				
Lock Out/De-energize/Test					Safety Glasses				
Line(s) Broken-Capped-Blanked					Face Shield				
Ventilation					Chemical Goggles				
Secure Area (Barriers/Danger Signs/Flags)					Hard Hat				
Inert-Purge-Flush and Ventilate					Gloves				
<b>SAFETY EQUIPMENT</b>					Boots				
Air Monitoring Equipment					Chemical Protective Clothing				
Full Body Harness with "D" Ring					<b>RESPIRATORY PROTECTION</b>				
Emergency Escape Retrieval Equip					ESCBA Only				
Lifelines					APR				
Fall Protection					Airline w/ESCBA				
Fire Extinguishers/First Aid Kit					SCBA				
Lighting (Explosion Proof)					<b>RESCUE SERVICES</b>				
Spark Resistant Tools					Emergency Response Team Notified				
Powered Communication (Intrinsically Safe)					Standby Rescue Personnel w/SCBA				

### RECORD AIR MONITORING RESULTS PRIOR TO ENTRY. CONTINUOUSLY MONITOR THE ATMOSPHERE. RECORD READINGS AT LEAST EVERY TWO HOURS.

Air Monitoring	Permissible Entry Level (w/o Respiratory Protect)	Time: _____				
		Concentration	Concentration	Concentration	Concentration	Concentration
Percent Oxygen	19.5 to 23.5%					
Lower Flammable Limit	Under 10%					
Toxic Materials						
Other specific exposures						

Air Monitor Model: _____	Serial No.: _____	Calibration Date: _____
Air Monitor Model: _____	Serial No.: _____	Calibration Date: _____
Air Monitor Model: _____	Serial No.: _____	Calibration Date: _____

Attendants: Name/Signature _____	Employee Number _____	Attendant Training Date _____
_____	_____	_____

Entrants: Name Signature _____	Employee Number _____	Entrant Training Date _____
_____	_____	_____

**ALL THE ABOVE CONDITIONS ARE SATISFIED AND ALL PERSONNEL NOTIFIED**

 SUPERVISOR SIGNATURE: \_\_\_\_\_  
 DATE: \_\_\_\_\_ TIME: \_\_\_\_\_

<b>PERMIT CANCELLED</b>	SUPERVISOR SIGNATURE _____ DATE: _____ TIME: _____
-------------------------	---





SAFETY MEETING/TRAINING LOG

- Tailgate (daily)
- Activity Hazard Analysis
- Pre-Task Hazard Analysis (prior to new task or operation)
- Site Safety Orientation (new personnel)
- Supervisor's (monthly)
- Supervisor's (weekly)
- UXO Awareness
- Asbestos Awareness
- Health and Safety Plan Addendum: \_\_\_\_\_
- Other: \_\_\_\_\_

Date/Time: \_\_\_\_\_

Client: \_\_\_\_\_

Location: \_\_\_\_\_

Job No.: \_\_\_\_\_

Meeting/training conducted by: \_\_\_\_\_

Work Activities: \_\_\_\_\_

Safety / Training Topics Presented

Chemical Hazards: \_\_\_\_\_

Physical Hazards: \_\_\_\_\_

Specific Safety Topic(s): \_\_\_\_\_

\_\_\_\_\_

Specific Training Covered: \_\_\_\_\_

\_\_\_\_\_

Attendees

Name Printed and Employee Number:

Signature:

\_\_\_\_\_  
\_\_\_\_\_  
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**ATTACHMENT D**  
**EMERGENCIES QUICK REFERENCE**

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# EMERGENCIES QUICK REFERENCE

## PORTLAND HARBOR SUPERFUND SITE

### 1. VESSEL COLLISIONS

- Stop the vessel.
- Complete roll call for all passengers.
- Alert vessel master that there a person overboard.
- If person is missing, scan the water for passenger.
- Stop the vessel immediately.
- If possible, position the overboard person between the boat and the wind by approaching the swimmer from downwind.
- Use lifeslings™, a roped buoy, swim platforms, ladders, and even brute strength to bring the person on board.
- Never have anyone go into the water as this will add another person to be rescued.
- Provide assistance to passenger overboard.
- If passenger cannot be retrieved immediately, maintain visual contact with the passenger overboard and have another passenger or the vessel master radio for help on VHS Channel 16 or call 911.
- Evacuate boat at nearest muster point, vessel master inspects the boat.

### 2. FIRE ABOARD

- Stop the vessel immediately.
- Position the boat so that the fire is downwind of the field team members.
- Shut off the fuel supply if the fire is close to an engine and it is safe to do so.
- Use a fire extinguisher to battle small flames, aiming at the base and moving it in a sweeping motion.
- Call for help using a VHS Channel 16 or 911 on a cellular phone and follow the instructions provided by public emergency services personnel.
- Abandoned the vessel as a last resort.

### 3. CARBON MONOXIDE POISONING

- Keep fresh air circulating regardless of the ambient weather conditions.
- Ventilate the work area thoroughly if exhaust fumes are noticed.

## **EMERGENCIES QUICK REFERENCE**

### **PORTLAND HARBOR SUPERFUND SITE (CONTINUED)**

#### **4. FALLING OVERBOARD**

- Alert vessel master that there a person overboard without losing site of the person overboard.
- If possible, position the overboard person between the boat and the wind by approaching the swimmer from downwind.
- Use lifeslings™, a roped buoy, swim platforms, ladders, and even brute strength to bring the person on board.
- Never have anyone go into the water as this will add another person to be rescued.
- Provide assistance to passenger overboard.
- If passenger cannot be retrieved immediately, maintain visual contact with the passenger overboard and have another passenger or the vessel master radio for help on VHS Channel 16 or call 911.

#### **5. DISCOVERING UNEXPLODED ORDINANCE (UXO)**

- Do not handle or move UXO once discovered.
- Isolate the UXO with a barrier (for example caution tape) to ensure that it is not jostled by another site staff member.
- Return to muster point and evacuate the vessel.
- Call for help using a VHS Channel 16 or 911 on a cellular phone and follow the instructions provided by public emergency services personnel.

#### **6. CONTACT WITH PRESERVATIVE WITH ACID OR BASE**

- Immediately flush area exposed area with deionized water in first aid kit.
- Return to muster point if on water.

#### **7. CRUSHING INJURY**

- Immobilize area by implementing 1<sup>st</sup> aid training.
- Contacting help:
  - On water: Call for help using a VHS Channel 16 or 911
  - On land (off Vigor property): On a cellular phone call 911.
  - On land (on Vigor property): Radio Vigor on Channel 1 or Call (503) 247-1799 ext. #1799.
- Return to muster point if on water.

**EMERGENCIES QUICK REFERENCE**  
**PORTLAND HARBOR SUPERFUND SITE (CONTINUED)**

**8. LARGE/DEEP LACERATION THAT IS LIFE THREATENING**

- Stop bleeding by implementing 1st aid training.
- Contacting help:
  - On water: Call for help using a VHS Channel 16 or 911
  - On land (off Vigor property): On a cellular phone call 911.
  - On land (on Vigor property): Radio Vigor on Channel 1 or Call (503) 247-1799 ext. #1799.
- Return to muster point if on water.

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**ATTACHMENT E**

**HGL CONFINED SPACE PROCEDURE**

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	<b>H&amp;S Procedure 26</b>	
	Approved by:	Health and Safety Director
<b>Confined Space Entry</b>	Steve Davis CIH, CSP	Digitally signed by Steve Davis CIH, CSP Date: 2020.10.08 13:04:17 -04'00'
	Publication Date: March 2011	
	Revision No.: 07	
	Revision Date: October 2020	
		Review Date: October 2021

## 1.0 PURPOSE

The purpose of this procedure is to ensure work in confined spaces is executed safely. Confined spaces often present physical and atmospheric hazards that can be avoided if they are recognized and addressed prior to entering these spaces to perform work. HGL's processes are also intended to comply with the OSHA General Industry Confined Space Standard, 29 CFR 1910.146 and the OSHA regulation that addresses confined spaces in the construction industry, 29 CFR 1926 Subpart AA. If HGL employees or subcontractors are engaged in both construction and industrial confined space entry, the work must comply with the construction safety standard because the standard is the more protective of the two.

## 2.0 SCOPE AND APPLICATION

This procedure applies to any work which exposes HGL employees, HGL temporary employees or subcontractors to confined space hazards. It also applies to situations where personnel or subcontractors may work around confined spaces, e.g., there are posting and signage requirements for confined spaces even if no one will enter identified confined spaces.

This procedure applies to entering, attending entries, and supervising entry into confined spaces. Examples of such work may include sampling or inspections in vaults, sewers, pits, tanks, crawl spaces, attics, and boilers. HGL subcontractors that perform this work must have their own processes that meet or exceed these requirements and the applicable regulations.

## 3.0 GENERAL REQUIREMENTS

- Evaluate confined spaces that HGL personnel or subcontractors will enter and determine which of the following classifications is applicable and ensure that the appropriate hazard controls are implemented.
  - Non-permit required,
  - Permit-required,
  - Hazards eliminated, or
  - Alternate procedures.
- Document confined space evaluations. The Confined Space Pre-Entry Inspection Checklist can be used to document the evaluation. Non-permit-required spaces pose little hazard and can be entered with minimal hazard controls. Permit-required spaces may pose significant hazards and entry will require full compliance with OSHA's permit-required confined space standards. Hazards-eliminated spaces pose no atmospheric hazard and

## Confined Space Entry

H&S Procedure No.: 26

Publication Date: March 2011

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Review Date: October 2021

physical hazards have been controlled using engineering controls. Entry into hazards-eliminated spaces can be conducted as for a non-permit-required space. Alternate procedures spaces pose no physical hazard and the atmosphere can be maintained in a safe status using forced air ventilation. Entry requires continuous forced air ventilation and air monitoring but does not require many of the controls specified for fully regulated permit-required spaces.

- Identify confined spaces that are under HGL control with signage. For permit required confined spaces the signs should read, “DANGER – PERMIT REQUIRED CONFINED SPACE, DO NOT ENTER.” For non-permit required spaces the sign should read, “CAUTION - NON-PERMIT REQUIRED CONFINED SPACE, KEEP OUT UNLESS AUTHORIZED.”
- Have this document available at the jobsite for review by all employees that will be entering confined spaces.
- Train staff that will participate in confined space entry in the applicable hazards and hazard controls. The training should include the kinds of spaces workers may be in, what the hazards could be, how those hazards will be made safe or monitored, potential emergencies, and emergency plans including how workers will be rescued if necessary. Training is required for all confined space entry, including entry into non-permit spaces, and must include available information regarding classification of the confined space(s) to be entered and air monitoring results.
- Take effective measures to prevent unauthorized personnel from entering confined spaces.
- Include a discussion of any confined spaces at a jobsite (including the known hazards) in the site safety briefing and daily tail gate briefings when work is scheduled to be performed in or around the confined spaces. This discussion must include subcontractor personnel who will work in or near the confined spaces.
- Assess and control any hazards caused by tasks to be conducted in or near confined spaces such as welding, grinding, painting, etc. These hazards may include noise, airborne exposures to toxic vapors or particulates, oxygen deficiency, and others.
- Complete a confined space entry permit and receive all approvals prior to entering permit-required spaces.
- Limit all entry into permit-required confined spaces to those situations when it is the only feasible means of completing the tasks.
- Conduct continuous atmospheric monitoring during entries in permit-required spaces and during entries using alternate procedures to verify absence of a hazardous atmosphere.
- Conduct continuous monitoring and have an early warning alarm system for engulfment hazards, in confined spaces such as storm sewers.

<b>Confined Space Entry</b>	H&S Procedure No.: 26
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- Ensure that an effective communication process is established to allow the attendant to notify entrants in a permit-required space to evacuate or entrants to notify the attendant of problems. This process must be effective in the presence of interferences such as noise created by work inside the space or obstructions to line-of-sight.
- Before entry, prepare and discuss the plan for emergency self-rescue from permit-required confined spaces and/or for emergency rescue procedures with equipment and trained personnel, if required. If relying on local emergency services for emergency rescue, arrangements with the responders must be coordinated in advance so that they know to give HGL notice if they will be unable to respond (because they are responding to another emergency, attending department-wide training, etc.). Note: Outside emergency services must have the capability to reach the victim(s) within a time frame that is appropriate for the permit space hazard(s) identified.

#### 4.0 DEFINITIONS

**Acceptable Entry Conditions** – The conditions that must exist in a permit space to allow entry and to ensure that HGL or subcontractor employees involved with a permit-required confined space entry can safely enter and work within the space.

**Alternate Procedures**- Procedures that can be used if the only hazard posed by the permit space is an actual or potential hazardous atmosphere.

**Attendant** – Is the employee authorized and assigned to observe the Entrant during entry into a permit-required confined space. All Attendants must receive an appropriate level of confined space entry training and show competence in carrying out an Attendant’s responsibilities. No confined space entry will be undertaken without the presence of an Attendant. The Attendant can also serve as the entry supervisor.

**Authorized Entrant** – Means an employee who is authorized by the entry supervisor to enter a permit space. The Entrant must alert the attendant if a dangerous situation develops.

**Blanking or Blinding** – Means the absolute closure of a pipe, line, or duct by the fastening of a solid plate (such as a blind flange, spectacle blind, or a skillet blind) that completely covers the bore and that can withstand the maximum pressure of the pipe, line, or duct with no leakage beyond the plate.

**Competent Person** – A trained individual who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has the authorization to take prompt corrective measures to eliminate them. Each employer at a worksite must ensure that a competent person identifies all confined spaces in which one or more of the employees it directs may work, and identifies each space that is a permit space, through consideration and evaluation of the elements of that space, including testing as

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necessary. The competent person may also serve as entry supervisor, during confined space entries, if appropriately qualified.

**Confined Space** – A space that is large enough and so configured that an employee can bodily enter (entire body or a portion of the body, e.g. head, arms and upper torso) and do assigned work, has limited or restricted means for entry or exit, and is not designed for continuous employee occupancy.

Examples of confined spaces include, but are not limited to, the following:

- boilers
- storm drains
- tunnels
- sewers
- bunkers
- pipelines
- sumps
- utility/transformer vaults
- wells
- pumping stations
- sewage digesters
- smokestacks
- vats
- ductwork
- tanks
- reaction or process vessels

**Types of Confined Spaces**

**Non-Permit-Required Confined Space** – A confined space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard that can cause death or serious physical harm.

**Permit-Required Confined Space (or “Permit Space”)** – A confined space that has any one of the following characteristics:

- Contains or has the potential to contain a hazardous atmosphere,
- Contains a material with the potential for engulfment of an Entrant,
- Has an internal shape such that an Entrant could be trapped or asphyxiated by inwardly converging walls, or a floor that slopes downward and tapers to a smaller cross section or Contains any other recognized serious safety and health hazard (such as moving machinery or the potential for the release of thermal energy).

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Entry into a permit-required confined space requires use of trained personnel, following written practices and procedures, use of an entry permit system, and arrangement of rescue services described in this written program.

***Permit Space, hazard eliminated-*** A permit required confined space can be temporarily reclassified as a non-permit confined space if the space poses no actual or potential hazardous atmosphere, and all other hazards within the space are eliminated without entry into the space. Note that there is a difference in the meanings of controlled and eliminated. Control of atmospheric hazards through forced air ventilation does not constitute elimination of the hazards.

Entry into a permit space, hazard eliminated, does not require use of barriers, permit system, or rescue and emergency service measures (example, no tripod and full body harness). Self-rescue from the confined space is the means of exit. For purposes of this written program, only the host employer/owner of the confined space can classify and document these spaces as such.

Hazard eliminated means that all serious safety and health hazards have been controlled using physical controls not including personal protective equipment (PPE) or respiratory protection. Note: This classification is typically a temporary designation as the engineering controls that eliminated the hazards may be removed after the work in the space has been completed.

***Permit Space, alternate procedures-*** Alternate procedures can be used to enter a permit required confined space if there are no physical hazards or the physical hazards in the space are eliminated or isolated through engineering controls and the atmosphere can be kept safe through continuous forced air ventilation. Entry under these conditions requires continuous air monitoring with a monitor that will alarm if unsafe atmospheric conditions develop but does not require entry permits, provisions for emergency rescue, or most of the formal requirements for permit-required confined space entry. The evaluation and air monitoring must be documented. HGL’s confined space entry permit form can be used for documentation.

***Controlling Contractor*** – The employer that has overall responsibility for construction at the worksite. **Note:** If the controlling contractor owns or manages the property, then it is both a controlling employer and a host employer. Controlling contractors and host employers must discuss spaces on the site and the hazards with entry employers and each other before and after entry.

***Double Block and Bleed*** – The closure of a line, duct, or pipe by closing and locking or tagging two in-line valves and by opening and locking or tagging a drain or vent valve in the line between the two closed valves.

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**Early-Warning System** – The monitoring method used to alert authorized entrants and attendants that an engulfment hazard may be developing. Examples of early-warning systems include but are not limited to: alarms activated by remote sensors, and lookouts with equipment for immediately communicating with the authorized entrants and attendants.

**Emergency** – Means any occurrence (including any failure of power, hazard control or monitoring equipment) or event, internal or external, to the permit space that could endanger entrants.

**Engulfment** – Means the surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, crushing, or suffocation.

**Entry** – The act by which a person intentionally passes through an opening into a permit required confined space. Entry includes ensuing work activities in that space and occurs when any part of the entrant’s body breaks the plane of an opening into the space, regardless of whether there is an intent to fully enter the space.

**Entry employer** – The employer who directs workers to enter a space.

**Entry Permit (Permit)** – The written or printed document that is provided by the employer (see Appendix C for HGL form) to allow and control entry into a permit space and that contains the following information:

- The permit space to be entered,
- The purpose of the entry,
- Authorized entrants, attendants, and entry supervisors,
- Hazards of the permit space to be entered and measures used to isolate the permit space and to eliminate or control permit space hazards,
- Acceptable entry conditions, and results of initial and periodic tests, and
- Equipment, such as personal protective equipment, monitoring equipment, communications equipment, alarm systems, and rescue equipment.

**Entry Rescue** – Entry rescue requires entry by a fully trained and equipped confined space emergency responder. The attendant should not perform entry rescue unless there is a replacement attendant immediately available.

**Entry Supervisor** – The person responsible for determining whether acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating entry as required by this section. The entry supervisor must remain

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at the jobsite throughout the entire entry operation. **Note:** An entry supervisor also may serve as an attendant or as an authorized entrant, if that person is trained and equipped as required by this standard for each role he or she fills. Also, the duties of entry supervisor may be passed from one individual to another during an entry operation.

**Fall Hazards** – Any conditions creating a potential fall of 6 feet or more.

**Hazardous Atmosphere** – An atmosphere that may expose workers to the risk of death, incapacitation, and impairment to self-rescue, injury, or acute illness from one or more of the following causes:

- The atmospheric oxygen concentration is below 19.5 percent (“oxygen deficient atmosphere”) or above 23.5 percent (“oxygen enriched atmosphere”). Any atmosphere with less than 19.5 percent oxygen will not be entered without the use of an approved supplied air system.

**Note:** The oxygen level in a confined space can decrease because of work in progress, such as welding, cutting, or brazing. It can also be decreased by certain chemical reactions (rusting) or through bacterial action (fermentation). The oxygen level also may be low if another gas, such as carbon dioxide or nitrogen, displaces the oxygen in the space. An oxygen-rich atmosphere (above 23.5 percent) will cause combustible materials to burn violently when ignited and should be avoided.

- Flammable gas or vapor is more than 10 percent of its lower explosive limit (LEL)/lower flammable limit (LFL).
- Airborne combustible dust is at a concentration that meets or exceeds the LEL.

**Note:** This concentration may be approximated as a condition in which the dust obscures vision at a distance of 5 feet (1.52 meters) or less.

- Toxic substances at atmospheric concentrations that could result in employee exposures greater than 1/2 a published exposure limit. Those substances that can cause death, incapacitation, impairment of the ability to self-rescue, injury, or acute illness due to their health effects must be given higher priority than substances that pose chronic hazards. Other OSHA standards and protective requirements may also apply to airborne exposures. Some sources of toxic substances are as follows:
  - Material previously stored in the space: Contents can be absorbed into the walls and gradually vaporize after the contents have been removed. Removing contents and residue may release gases, vapors, or dusts into the space.
  - Work tasks in a confined space: Examples include welding, cutting, brazing, painting, scraping, sanding, degreasing, etc. Various processes generate toxic substances that may accumulate in the confined space.

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- Areas next to the confined space: Toxics produced by work outside of a confined space, such as a nearby welding operation, can enter and accumulate in the confined space.

**Host Employer** – The employer that owns or manages the property where the work is taking place. The host employer must identify and provide any information regarding permit space hazards and entry operations. Controlling contractors and host employers must discuss spaces on the site and their hazards with entry employers and each other before and after entry. The host employer should identify the designated rescue method and/or service during the pre-entry inspection.

**Hot Work** – Is defined as operations such as riveting, welding, cutting, burning, and heating that can provide a source of ignition and/or cause or have the potential to cause a hazardous atmosphere. If hot work is required in a confined space, a hot work permit must be completed.

**Isolation** – The process by which a permit space is removed from service and completely protected against the release of energy and material into the space. Techniques include blanking or blinding; misaligning or removing sections of lines, pipes, or ducts; a double block and bleed system; lockout or tagout of all sources of energy; or blocking or disconnecting all mechanical linkages. Simply locking or tagging out a piping system, is not appropriate for fluid isolation purposes and would not qualify a space as non-permit, since it does not eliminate the hazard.

**Limited or Restricted Means for Entry or Exit** – Means a condition that has a potential to impede an employee’s movement into or out of a confined space. Such conditions include, but are not limited to, trip hazards, poor illumination, slippery floors, inclining surfaces and ladders. Examples of where restricted exist may occur are: tanks, vessels, silos, storage bins, vaults and pits.

**Lockout** – Means the placement of a lockout device on an energy isolating device, in accordance with an established procedure, ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

**Lower Flammable Limit or Lower Explosive Limit** – Means the minimum concentration of a substance in air needed for an ignition source to cause a flame or explosion.

**Monitor or Monitoring** – Means the process used to identify and evaluate the hazards after an authorized entrant enters the space. This is a process of checking for changes that are performed in a continuous manner after the completion of the initial testing or evaluation of that space.

**Non-entry Rescue** – Occurs when a rescue service, usually the attendant, retrieves employees in a permit space without entering the permit space using a retrieval system (see below).

**Prohibited Condition** – Any condition in a permit space that is not allowed by the permit during the period when entry is authorized.

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**Reduced Visibility** – Is defined as conditions where direct communications with others is not possible or visibility is limited to less than 5 feet due to darkness or other causes.

**Rescue Service** – The personnel designated to rescue HGL or subcontractor employees from permit spaces.

**Retrieval System** – The equipment, including a retrieval line, chest or full-body harness, wristlets, if appropriate, and a lifting device or anchor, used for non-entry rescue of persons from permit spaces.

**Self-Rescue** – Means that entrants into a confined space can easily exit the space by walking out or climbing a readily accessible ladder. This method of rescue may be appropriate for non-permit confined spaces and Alternate Procedures spaces as the hazards posed by these spaces are minimal or are controlled by ventilation.

**Test or testing** – Means the process by which the hazards that may confront entrants of a permit space are identified and evaluated. Testing includes specifying the tests that are to be performed in the permit space.

**Ventilation** – Means controlling a hazardous atmosphere using continuous forced-air mechanical systems that meet the requirements of §1926.57—Ventilation. As noted in the standard, using ventilation to preclude the possibility of a hazardous atmosphere is considered control of the atmospheric hazard and is not considered elimination, therefore the ventilated space would still be considered a Permit Confined Space, however alternate entry procedures may be used if conditions as defined in Alternate Procedures are met.

## 5.0 PROCEDURE

A confined space is a space that is large enough and so configured that an employee can bodily enter (entire body or a portion of the body), has limited or restricted means for entry or exit, and is not designed for continuous employee occupancy. Examples of confined spaces include tanks, boilers, etc. Because confined spaces can pose physical and atmospheric hazards, confined space entry is regulated by OSHA, and in some cases, requires completion of a confined space entry permit, and implementation of multiple hazard controls. A permit-required confined space is one that: contains or has a potential to contain a hazardous atmosphere, contains a material that may engulf an entrant, has an internal configuration that might trap or asphyxiate an entrant, or contains any other recognized serious safety or health hazard. There are three categories of permit-required spaces and corresponding processes for hazard control defined by OSHA: fully regulated – all of the requirements for permit-required entry apply; “hazard eliminated” – temporarily reclassified as a non-permit confined space if the space poses no actual or potential hazardous atmosphere; and all other hazards within the space are eliminated by engineering controls; and “alternate procedures” – no physical hazards are present and atmospheric hazards can be controlled by continuous forced air ventilation.

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A “hazard-eliminated” space can be treated as a non-permit space if the requisite requirements continue to be met. The decision process, monitoring results, and steps taken to eliminate hazards must all be documented, and the documentation must be retained. HGL must still ensure that entries are made safely and that entries are terminated if uncontrolled hazards are encountered.

“Alternate procedures” for permit required spaces does not require a permit system, or provisions for emergency rescue. Self-rescue from the confined space is allowed, but provisions such as harnesses and lanyards are recommended. Forced air ventilation and air monitoring must begin before entry and continue during entries. Air monitoring must be conducted continuously during entry and instruments must be equipped with alarm(s) that will alert entrants to unsafe conditions or the air monitoring instrument must be continuously monitored by an entrant or supervisor. The determination that a space meets the required criteria and the air monitoring results must be documented, and this documentation must be retained. This documentation must contain the date, the location of the space, and the signature of the person compiling the documentation. HGL’s pre-entry checklist can be used to document the initial evaluation and HGL’s confined space entry permit form can be used to document air monitoring results during the entry. Note: much of the information called out on the permit form will not be relevant to this type of entry.

**5.1 NOTIFICATION**

The Project Manager must contact Corporate Health and Safety before initiating any project with new confined space entry tasks, whether it be by HGL or subcontractors.

Notification may be email or by telephone. This notification will include the following:

- Project name, location, and Project Manager
- Anticipated confined space entry tasks
- Names of the proposed members of the confined space entry team(s), and, in the case of HGL serving as “host employer,” the name of the subcontractor making entry.

**5.2 PRE-ENTRY INSPECTION**

The Project Manager, Site Safety and Health Officer and/or Entry Supervisor must conduct a pre-entry site inspection. The inspection must be documented (see Pre-Entry Inspection Checklist in Appendix A), and should identify at least the following:

- Entryway or utility accessibility and condition.
- Photographs.
- Current or past contents of pipes, sumps, or tanks.
- Air testing results.

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- Any structural modifications or additions required to make a safe entry.
- Any fall hazards or ladder use that may be present during entry.
- The possible effect of adverse weather.
- The locations of entry, exit, and ports for mechanical venting.
- Lockout/tagout; blanking, blocking, and bleeding; or isolation requirements.
- The types of safety and environmental monitoring equipment required to make a safe entry.
- The location and path to a secondary means of egress if available.

During the pre-entry inspection, the atmosphere of a confined space should be tested, if possible, using equipment of sufficient sensitivity and specificity to identify and evaluate any hazardous atmospheres that may exist or arise, so that appropriate entry procedures can be developed, and acceptable entry conditions identified

### **5.3 POST-INSPECTION**

Once the pre-entry inspection checklist is completed (see Appendix A), the Project Manager, Site Safety and Health Officer and/or the Entry Supervisor and Corporate Health and Safety Director will review this data and determine acceptable entry conditions. The Corporate Health and Safety Director will review the information and will guide an evaluation of the space (if not already classified). The entry will be planned as permit-required, hazard-eliminated, or alternate procedures. If the entry will be a permit-required entry performed or supervised by HGL employees, a confined space entry permit must be completed using the form in Appendix C. The entry permit will be used to authorize entry into a permit-required confined space and must be posted outside the permit space prior to entry.

### **5.4 VERIFICATION TESTING**

The atmosphere of a permit space that may contain a hazardous atmosphere must be tested, by the Entry Supervisor before entry, for the contaminants identified during the pre-entry inspection using equipment specified in the permit. Initial measurement of values for each atmospheric parameter must be made for at least the minimum response time of the test instrument specified by the manufacturer, including procedures to identify stratified atmospheres.

Evaluation and interpretation of this data (i.e., are atmospheric contaminant concentrations within the range of acceptable entry conditions) will be done by the Entry Supervisor. For all HGL or contractor permit-required confined space entries, there will be continuous atmospheric monitoring for the duration of the entry, if there is a potential for a hazardous atmosphere to develop.

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Results of testing (i.e., actual concentration, etc.) must be recorded on the permit in the space provided next to the stipulated acceptable entry condition and, if applicable, in the project field manual.

## 5.5 PERMIT COMPLETION

The HGL Confined Space Entry Permit (permit) consists of a list of engineering controls, safety equipment, personal protective equipment, respiratory protection, and rescue service arrangements that may be appropriate for any given confined space. Based on information obtained from the pre-entry inspection and documented on the Pre-Entry Inspection Checklist, each individually listed permit condition will be identified as necessary for the entry or not. The following permit conditions are required for all HGL or subcontractor permit-required entries:

- Effective communication between the attendant and entrants,
- Lockout/tagout, unless not applicable (i.e., no hazardous energy or any potentially moving equipment is present),
- Lines broken or capped, unless not applicable (i.e., no lines discharge into the space),
- Ventilation, unless mechanical ventilation is not necessary or would not be effective,
- Secured area,
- Air monitoring,
- Full body harness,
- Emergency retrieval and/or lifeline and/or fall protection,
- Fire extinguisher/first aid kit,
- Safety glasses and/or goggles,
- Hard hat (unless hard hats will increase hazards), and
- Emergency procedures.

Any member of the HGL confined space entry team may fill out the HGL permit. The Entry Supervisor is responsible for verifying that the information on the permit is complete and correct, all permit conditions have been met, and all equipment, including personal protective equipment, is in working order and being properly used. If all conditions are met, the Entry Supervisor reviews the permit with the authorized Entrant(s) and Attendant, signs it, and posts it at the entrance to the confined space.

## 5.6 ENTRY

Whenever possible, permit required confined space entry should be horizontal with the Entrant wearing a full body harness attached to a retrieval line. For vertical openings, entry may be made by a ladder inserted into the confined space or by lowering the Entrant into the space using a man-

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rated winch. During any vertical entry, fall protection shall be provided for the Entrant and Attendant and must consist of a full body harness, a shock-absorbing fall lanyard, or an American National Standards Institute (ANSI) certified retractable lifeline/emergency retrieval winch combination, or equivalent.

*A mechanical retrieval system must be available to retrieve employees from vertical entry confined spaces more than 5 feet deep.*

If the Entrant will be stopping at several different heights for more than a few minutes (e.g., to do an inspection of the walls), a boatswain’s chair will be used when the opening to the space has a diameter larger than 24 inches. Use of a boatswain’s chair will be in accordance with OSHA 29 CFR 1910.28 (k), 1926.104, and 1926.451 (l).

**5.7 ENTRY TERMINATION**

The Entry Supervisor will cancel the entry permit when the following conditions are met:

- The entry operations covered by the permit have been completed.
- A prohibited condition that is not allowed under the entry permit arises in or near the permit space.

If the Entry Supervisor cancels the permit due to a prohibited condition, all personnel must evacuate the confined space. Prior to reentering the confined space, a new Permit must be completed.

**5.8 EMERGENCY RESPONSE AND RESCUE**

Prior to entering a permit required confined space, arrangements must be made to respond to credible emergencies. HGL will implement procedures for facilitating self-rescue or ensure the capability for rescue from outside confined spaces, for providing necessary emergency services to rescued employees, and for preventing unauthorized personnel from attempting a rescue.

HGL has not trained or authorized a standing HGL “in-house” rescue team in lieu of notifying and/or staging an “external” trained and equipped rescue team at confined space entry projects. *Permit-required entries will not be allowed into confined spaces with atmospheres exceeding concentrations known or suspected to be IDLH unless a trained and equipped and authorized rescue entrant or rescue team, approved by Corporate Health and Safety, is staged on site prior to entry.*

For the purposes of this written program and the above policies, one of the following rescue arrangements must be made by the Site Safety and Health Officer or Entry Supervisor, prior to permit-required confined space entry:

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- Self-rescue is appropriate as the primary rescue provision under the following conditions:
  - The only hazard posed by the space is an actual or potential hazardous atmosphere,
  - The atmosphere in the space can be made safe by forced air ventilation (alternative procedures),
  - The atmosphere in the space is tested prior to entry and monitored continuously during entry,
  - There is a safe and unimpeded pathway to exit. If there is any doubt about the ability to self-rescue full-body harnesses and lanyards should be used, and
  - There is a system in place to monitor entrants.
- A rescue team can be notified at the time of entry and be available to respond if called if:
  - Entrants will not be wearing supplied air respirators,
  - Entrants are not expected to be exposed to IDLH or other imminently hazardous conditions, and Entrants can be expected to “self-rescue” or be “non-entry rescued” under normal circumstances,
  - The entry is a straight horizontal or vertical,
  - A trained and authorized Rescue Entrant, in addition to the Attendant, is staged at the entry,
  - No other need for a standby rescue team exists.
- A fully equipped and trained rescue team must be notified and staged on-site at the time of entry if:
  - Entrants will be wearing supplied air respirators,
  - Entrants are expected to be exposed to IDLH conditions, and/or
  - Entrants would be expected to have difficulty in being “non-entry rescued” under normal circumstances,
  - There are other OSHA standards for specific tasks, such as welding, with specific requirements for rescue, and/or
  - Any other need for an on-site rescue team exists.

If off-site third-party rescue personnel are to be used, arrangements must be completed with rescue and emergency services prior to the confined space entry. The “host employer”/confined space owner should identify the designated rescue service during the pre-entry inspection. The service should be contacted by the Entry Supervisor, and determination of interest to serve as the rescue team, availability, response time, equipment, familiarity with the site, and responder training must

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be documented. NOT ALL BASE AND LOCAL FIRE DEPARTMENTS ARE QUALIFIED TO SERVE AS CONFINED SPACE RESCUE TEAMS.

For each permit required confined space entry, an Emergency Response Form (see Appendix B) shall be completed and approved by the Entry Supervisor. The approved Emergency Response Form must be posted with the entry permit near the opening of the confined space. Emergency escape routes and directions to the nearest hospital (attach maps) shall be developed and attached to the Emergency Response Form (see Appendix B).

### **5.9 SUBCONTRACTOR AND MULTI-EMPLOYER WORKSITES**

The client, representatives of the client, or a subcontractor may be required to enter a confined space with HGL employees. OSHA requires the coordination of entry operations when employees of more than one employer are working simultaneously as authorized entrants in a confined space. Planning the task and making these arrangements in advance could prevent the purchase or rental of redundant equipment and the assignment of extra employees to the project.

OSHA identifies the employer who controls the confined space as the “host employer,” and all other employers who could enter the space as a contractor or “guest employer.” HGL is usually a “guest employer” in relation to its clients. HGL is always a “host employer” to HGL-hired subcontractors.

As a “guest employer,” HGL will:

- Provide a copy of this written confined space entry program to the “host employer” to allow for coordination of efforts,
- Provide documentation of HGL or subcontractor employees’ confined space entry training,
- Obtain any available information regarding permit space hazards and entry operations from the “host employer,”
- Independently assess the classification of a confined space using observation, instrumentation, and direct communication with the client and document such information on a Pre-Entry Inspection Checklist (see Appendix A), and
- Communicate to the “host employer” any hazards confronted or created during the entry.

Should a “host employer” require HGL and subcontractor employees to follow the host employer’s written confined space entry program the HGL Entry Supervisor will notify HGL’s Corporate Health and Safety Director before coordinating operations with the “host employer.”

As a “controlling contractor,” HGL will:

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- Discuss spaces on the site and their hazards with entry employers and each other before and after entry.
- Make sure employers outside a space know not to create hazards in the space, and that entry employers working in a space at the same time do not create hazards for one another's workers.

As a “host employer,” HGL will:

- Obtain a copy of the subcontractor’s written confined space entry program,
- Discuss any barriers, precautions or procedures that have been set up for protection in or near permit spaces,
- Obtain documentation of subcontractor employees’ confined space entry training,
- Provide to the subcontractor any available information regarding permit space hazards and entry operations from the client/owner of the confined space,
- Independently assess the classification of a confined space using observation, instrumentation, and direct communication with the client/owner and document such information on a Pre-Entry Inspection Checklist (see Appendix A), and
- Debrief the subcontractor and communicate to the “host employer” any hazards confronted or created during the entry.

#### **5.10 TRAINING REQUIREMENTS**

- All employees who participate or support confined space entry must receive training in their specific roles in confined space entry, the rules and regulations, kinds of spaces workers may be in, what the hazards could be, how those hazards will be made safe or monitored, how workers will self-rescue or be rescued if anything goes wrong, company policy, recognizing warnings and identification signs, procedures that address employees of other companies who may enter and work in permit-required confined spaces, and this procedure. This basic training requirement applies regardless of the type of confined space (non-permit, permit-required, hazard eliminated, or alternative process) to be entered. Retraining must also be provided for authorized and affected employees when there is a change that presents a new hazard.
- Entrants, Supervisors, and Attendants will be trained in:
  - Their roles and responsibilities.
  - The hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure.
  - The communication method to alert entrants of the need to evacuate the space.

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- The monitoring methods that will be used to evaluate activities inside and outside the space to determine if it is safe for entrants to remain in the space.
- The need to verify that appropriate entries have been made on the entry permit, all tests conducted, and that all procedures and equipment specified by the permit are in place before endorsing the permit and allowing entry to begin.
- The method of performing non-entry rescue or summoning rescue services.

## **6.0 RESPONSIBILITIES**

Corporate officers, managers, and project-level staff should all be role models for safety. Other responsibilities are summarized below.

### **6.1 PRESIDENT, CHIEF OPERATING OFFICER, DIVISIONAL VICE PRESIDENTS**

- Provide adequate resources to enable safe work. Maintain a general awareness of procedural requirements.

### **6.2 CORPORATE HEALTH AND SAFETY DIRECTOR**

The Corporate Health & Safety Director will be consulted before initiating any new task with confined space entry exposures. The Corporate Health & Safety Director will assist the supervisors in meeting their responsibilities under this section. This assistance will include providing technical guidance in identifying confined spaces, reviewing project confined space entry and procedures, and assisting in developing and facilitating training.

- Approve this program and subsequent revisions.
- Provide support and assistance in the implementation of this program.
- Review the confined space entry task(s) and provide constructive input on confined space hazard recognition and control.
- Review Pre-Entry Inspection Checklists and provide guidance regarding hazards and completion of confined space entry permits.
- Confirm and document certification in the HGL Training and certification database that the employees have completed the necessary confined space training for their roles.

### **6.3 OFFICE MANAGERS**

- Maintain a general awareness of the applicable portions of these requirements.
- Maintain an awareness of the confined spaces on supervised work and ensure that adequate controls are in place.

<b>Confined Space Entry</b>	H&S Procedure No.: 26
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	Revision No.: 07
	Revision Date: October 2020
	Review Date: October 2021

#### **6.4 OFFICE HEALTH AND SAFETY COORDINATORS**

- Maintain a general awareness of the applicable portions of these requirements.
- Maintain an awareness of confined spaces on work managed by the office.
- Verify that confined space hazards are controlled.

#### **6.5 SUPERVISORS AND PROJECT MANAGERS**

- Ensure that confined spaces are identified and everyone working onsite is aware of locations and hazards. Coordinate entry operations with subcontractors and ensure that entry is performed in compliance with OSHA’s Confined Space Standards and this procedure.
- Contact Corporate Health and Safety to discuss plans for entry.
- Ensure that personnel authorized to be involved in confined space entry work are properly trained and collect certifications.
- Ensure that there is a trained competent and responsible entry supervisor/attendant for each confined space entry project or task.
- Procure appropriate equipment for confined space entry project tasks.
- Coordinate the confined space entry with those of the owner or contractor and make the subcontractor aware of the elements that make the space in question a permit space. Also, apprise subcontractors of any procedures that HGL and/or the host employer/owner of the space have implemented for the protection of employees of HGL or its subcontractor.
- Ensure that all involved adhere to approved procedures.
- Keep records of pre-entry check lists and permits.
- Debrief the subcontractor after the entry

#### **6.6 ENTRY SUPERVISOR/ SITE SAFETY OFFICER/COMPETENT PERSON**

- Ensure that conditions in permit-required confined spaces have been tested to determine if acceptable entry conditions exist before entry begins,
- Verify that the information on the Pre-Entry Inspection Checklist (see Appendix A) accurately reflects the conditions and hazards of the confined space,
- Verify that the completed entry permits (see Appendix C) reflects the availability and proper working condition of the equipment to be used for atmospheric monitoring, entry, and remote emergency retrieval before authorizing or allowing entry,

## Confined Space Entry

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- Verify that the necessary procedures, practices, and equipment for safe entry are present and in effect before allowing entry.
- Verify that qualified rescue services are available and that the means for summoning them are operable.
- Oversee the initial air monitoring to determine if an acceptable entry condition is present.
- Verify that all Entrants and Attendants have received appropriate training, and medical and respiratory protection clearances (if respirators will be worn) before initiating an entry.
- Verify, at least once each hour, that the entry operations remain consistent with the terms of the entry permit and that acceptable entry conditions are present.
- Cancel the entry authorization and end the entry when acceptable entry conditions are not present.
- Take the necessary measures for concluding an entry operation including canceling the permit and replacing the cover or otherwise restricting access to the confined space. Take the appropriate measures to prevent individuals who the company has not authorized for entry from lingering in or near an active confined space entry.
- Arrange for all required field and safety equipment before initiating entry.
- Inspect all equipment before entry and ensure that the environmental monitors have been properly calibrated, passed a function check, and operate correctly.
- Ensure that the permit-required confined space is tested or monitored continuously to determine if acceptable entry conditions are being maintained during entry operations.
- Reevaluate the space in the presence of any Entrant, or his/her representative, who requests that the space be reevaluated if they have reason to believe the evaluation may not have been adequate.
- Provide each Entrant with monitoring results immediately.
- Ensure that at least one Entry Supervisor/Attendant is outside the confined space for the duration of the entry and that there is effective communication between the entrants and attendant.
- Identify all HGL or subcontractor staff that have roles in the confined space entry and discuss their roles with them.
- Prevent unauthorized personnel from attempting a rescue.
- Prepare, use, and cancel entry permits.
- Conclude the entry and close the entry permit after operations have been completed.

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- Have a discussion with entry employer, controlling employer and host employer after the entry to review how the entry proceeded and provide any information regarding permit space hazards or lessons learned during the entry operation.
- Ensure that confined space entry permits are retained as required by this procedure.

## 6.7 ATTENDANT

The Attendant continuously maintains an accurate count of persons in the permit-required confined space. The Attendant is only assigned to one confined space entrance at a time, even if there is an emergency.

The Attendant shall:

- Recognize potential hazardous energy, chemical, physical, electrical, or mechanical confined space hazards, as well as the signs, symptoms, and consequences of exposure to these hazards, and report any unusual circumstance to the Entry Supervisor,
- Monitor activities inside and outside the confined space and judge if it is safe for the Entrants to remain in the space, and
- Monitor the air quality inside the confined space.
- Communicate – The Attendant shall:
  - Keep in contact with Entrants during entry, and
  - Order Entrants to evacuate the permit space immediately when:
    - The Attendant observes an activity or condition outside the acceptable entry conditions for that confined space,
    - The Attendant detects a situation outside the confined space that could endanger the Entrants,
    - The Attendant detects an uncontrolled hazard within the confined space, or
    - An emergency in a nearby confined space may distract the Attendant from his/her responsibilities.
- Rescue – The Attendant shall:
  - Call 911 or contact the appropriate emergency response team,
  - Never enter the confined space to attempt a rescue of Entrants unless replaced by a standby attendant,
  - Properly use any remote rescue equipment provided and perform any other assigned rescue and emergency duties, and
  - Warn or stop unauthorized Entrants.

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## 6.8 EMPLOYEES

- Participate in confined space training, as needed.
- Follow the confined space entry procedures.
- Alert supervisor if proper equipment is not available or there are uncontrolled hazards.

## 7.0 RECORDS

Collect and maintain documentation generated as a result of this program in accordance with Document Control requirements of the HGL Corporate Quality Assurance Manual.

Entry permits, records of monitoring results, determinations regarding confined space classification, and related documents will be retained in project records. Records of task or site-specific training will be retained in project documentation. Records of formal training such as classroom training for confined space entrants, attendants, and supervisors will also be kept in HGL's corporate training data base.

The training records will include the following information:

- The dates of the training sessions.
- The contents or a summary of the training sessions.
- The names and qualifications of persons conducting the training.
- The names of persons attending the training sessions.

## 8.0 REFERENCES

- OSHA's 29 CFR 1910.146, Permit-required Confined Spaces.
- OSHA's 29 CFR 1926 Subpart AA Confined Spaces in Construction.



# H&S Procedure 26

Approved by: Health and Safety Director

Steve Davis CIH, CSP Digitally signed by Steve Davis CIH, CSP  
Date: 2020.10.08 13:08:55 -04'00'

## 26.1 Confined Space Pre-Entry Inspection Checklist

Publication Date: March 2011

Revision No.: 07

Revision Date: October 2020

Review Date: October 2021

### APPENDIX A

## CONFINED SPACE PRE-ENTRY INSPECTION CHECKLIST

DATE: \_\_\_\_\_ CLIENT: \_\_\_\_\_

SPACE LOCATION AND DESCRIPTION: \_\_\_\_\_

\_\_\_\_\_

SPACE NUMBER \_\_\_\_\_  
(IF APPLICABLE)

PURPOSE OF ENTRY: \_\_\_\_\_

JOB NUMBER: \_\_\_\_\_

CLIENT CLASSIFICATION: \_\_\_ NON-PERMIT \_\_\_ PERMIT REQUIRED \_\_\_ HAZARD ELIMINATED  
\_\_\_ ALTERNATE PROCEDURES – HAZARDS CONTROLLED BY CONTINUOUS VENTILATION

#### ATMOSPHERIC

Oxygen Deficient (<19.5%)       Oxygen Enriched (>23.5%)

LEL (>10%)

Flammable Dusts

Toxics

IDLH

#### Technical Notes:

#### ENGULFMENT HAZARDS

Water/Liquids

Solid Materials

#### INTERNAL CONFIGURATION

Converging Walls

Maze Construction

Obstacle(s) in Space

#### OTHER RECOGIZED HAZARDS

Energy/Mechanical/Electrical

Hot Work

Use of Chemicals/Compressed Gases in Space

Other Serious Hazard(s)

List \_\_\_\_\_

## 26.1 Confined Space Pre-Entry Inspection Checklist

H&S Procedure No.: 26
Publication Date: March 2011
Revision No.: 07
Revision Date: October 2020
Review Date: October 2021

### AIR MONITORING MEASUREMENTS

TESTS MADE	PERMISSIBLE ENTRY LEVEL	MONITORING LOCATION	BEFORE VENTILATION	AFTER VENTILATION
Oxygen	19.5% to 23.5%			
Flammable atmosphere	<10% of lower explosive limit			
Toxic Materials				
Other				

Note: If it is not possible to conduct air monitoring in advance, so note.

### INSTRUMENTS

MAKE	MODEL	SERIAL NO.	CALIBRATION DATE

### EQUIPMENT NECESSARY FOR ENTRY - CHECKLIST

EQUIPMENT	YES	NO
Confined Space Entry Permit Needed (Corporate Health & Safety Notified)		
Authorized Entrants, Authorized Attendants, Entry Supervisor		
Lockout/Tagout Materials		
Ventilation Fan, Hoses and Saddle Vent		
Barriers, Danger Signs, Flags, Traffic Cones (devices)		
Direct Reading Gas Monitor(s) with Current Bench Calibration		
Safety Harness and Lifelines for Entrant and Standby Persons		
Hoisting Equipment e.g., Tripod <input type="checkbox"/> with Fall Protection		
Fire Extinguisher (ABC) 10 lb.		
First Aid and Infection Control Kit		
Powered Communications <input type="checkbox"/> Intrinsically Safe		
Electric Equipment and Lighting <input type="checkbox"/> Explosion Proof		
Hardhat, Goggles, Boots, Gloves, Disposable Outerwear		
Chemical Protective Clothing		
Escape Bottles - 5 Minute/10 Minute (ESCBA)		
Air Purifying Respirators		
Supplied Air Respirators (Level B) <input type="checkbox"/> Airline with ESCBA <input type="checkbox"/> SCBA		

## 26.1 Confined Space Pre-Entry Inspection Checklist

H&S Procedure No.: 26
Publication Date: March 2011
Revision No.: 07
Revision Date: October 2020
Review Date: October 2021

CONFINED SPACE RESCUE TEAM

ONSITE

OFFSITE

Name: \_\_\_\_\_

Phone Number: \_\_\_\_\_

Contact Person: \_\_\_\_\_

Estimated Response Time: \_\_\_\_\_

- |   |   |
|---|---|
| <input type="checkbox"/> Rescue team not required because space meets requirements for Hazard Eliminated or Alternate Procedures. | <input type="checkbox"/> Rescue team notified and <u>staged</u> at entry site when: |
| <input type="checkbox"/> Rescue Team notified and available to <u>respond</u> to entry site when:                                 | - Entrants are wearing supplied air respirators; OR/AND                             |
| - Entrants are not wearing supplied air respirators; AND  | - Entrants are exposed to IDLH or potential IDLH conditions; OR/AND                 |
| - Entrants are not exposed to IDLH or potential IDLH conditions; AND  | - Entrants would be expected to have difficulty in “self-rescue.”                   |
| - Entrants can be expected to “self-rescue” under normal circumstances; AND   |   |
| - No other need for a standby rescue team.  |   |

Sketch of confined space showing access for mechanical ventilation and monitoring.

**A copy of this document must be reviewed by the Confined Space Entry Team Prior to Entry.**

Inspector Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Project Manager: \_\_\_\_\_

Date: \_\_\_\_\_



## H&S Procedure 26

Approved by: Health and Safety Director

Steve Davis CIH, CSP Digitally signed by Steve Davis CIH, CSP  
Date: 2020.10.08 13:18:17 -04'00'

### 26.3 Confined Space Entry Permit

Publication Date: March 2011

Revision No.: 07

Revision Date: October 2020

Review Date: October 2021

## APPENDIX C CONFINED SPACE ENTRY PERMIT



# CONFINED SPACE ENTRY PERMIT

PERMIT NO. \_\_\_\_\_  
DATE: \_\_\_\_\_  
JOB NO. \_\_\_\_\_

Please refer to Pre-Entry Inspection Checklist.  
Permit valid for duration of entry only. All copies of permit will remain at job site until job is completed.

Client: \_\_\_\_\_

Site location and description: \_\_\_\_\_

Purpose of Entry: \_\_\_\_\_

Supervisor: \_\_\_\_\_ Employee No.: \_\_\_\_\_

### SELECT MINIMUM REQUIREMENTS TO BE COMPLETED AND REVIEWED PRIOR TO ENTRY

Check and Initial Appropriate Response	Yes	No	N/A	Supv Init	Check and Initial Appropriate Response	Yes	No	N/A	Supv Init
<b>ENGINEERING CONTROLS</b>					<b>PERSONAL PROTECTIVE EQUIPMENT</b>				
Lock Out/De-energize/Test					Safety Glasses				
Line(s) Broken-Capped-Blanked					Face Shield				
Ventilation					Chemical Goggles				
Secure Area (Barriers/Danger Signs/Flags)					Hard Hat				
Inert-Purge-Flush and Ventilate					Gloves				
<b>SAFETY EQUIPMENT</b>					Boots				
Air Monitoring Equipment					Chemical Protective Clothing				
Full Body Harness with "D" Ring					<b>RESPIRATORY PROTECTION</b>				
Emergency Escape Retrieval Equip					ESCBA Only				
Lifelines					APR				
Fall Protection					Airline w/ESCBA				
Fire Extinguishers/First Aid Kit					SCBA				
Lighting (Explosion Proof)					<b>RESCUE SERVICES</b>				
Spark Resistant Tools					Emergency Response Team Notified				
Powered Communication (Intrinsically Safe)					Standby Rescue Personnel w/SCBA				

**RECORD AIR MONITORING RESULTS PRIOR TO ENTRY. CONTINUOUSLY MONITOR THE ATMOSPHERE.  
RECORD READINGS AT LEAST EVERY TWO HOURS.**

Air Monitoring	Permissible Entry Level (w/o Respiratory Protect)	Time: _____				
		Concentration	Concentration	Concentration	Concentration	Concentration
Percent Oxygen	19.5 to 23.5%					
Lower Flammable Limit	Under 10%					
Toxic Materials						
Other specific exposures						

Air Monitor Model: _____	Serial No.: _____	Calibration Date: _____
Air Monitor Model: _____	Serial No.: _____	Calibration Date: _____
Air Monitor Model: _____	Serial No.: _____	Calibration Date: _____

Attendants: Name/Signature \_\_\_\_\_ Employee Number \_\_\_\_\_ Attendant Training Date \_\_\_\_\_

Entrants: Name Signature \_\_\_\_\_ Employee Number \_\_\_\_\_ Entrant Training Date \_\_\_\_\_

**ALL THE ABOVE CONDITIONS ARE SATISFIED AND ALL PERSONNEL NOTIFIED**  
SUPERVISOR SIGNATURE: \_\_\_\_\_ DATE: \_\_\_\_\_ TIME: \_\_\_\_\_

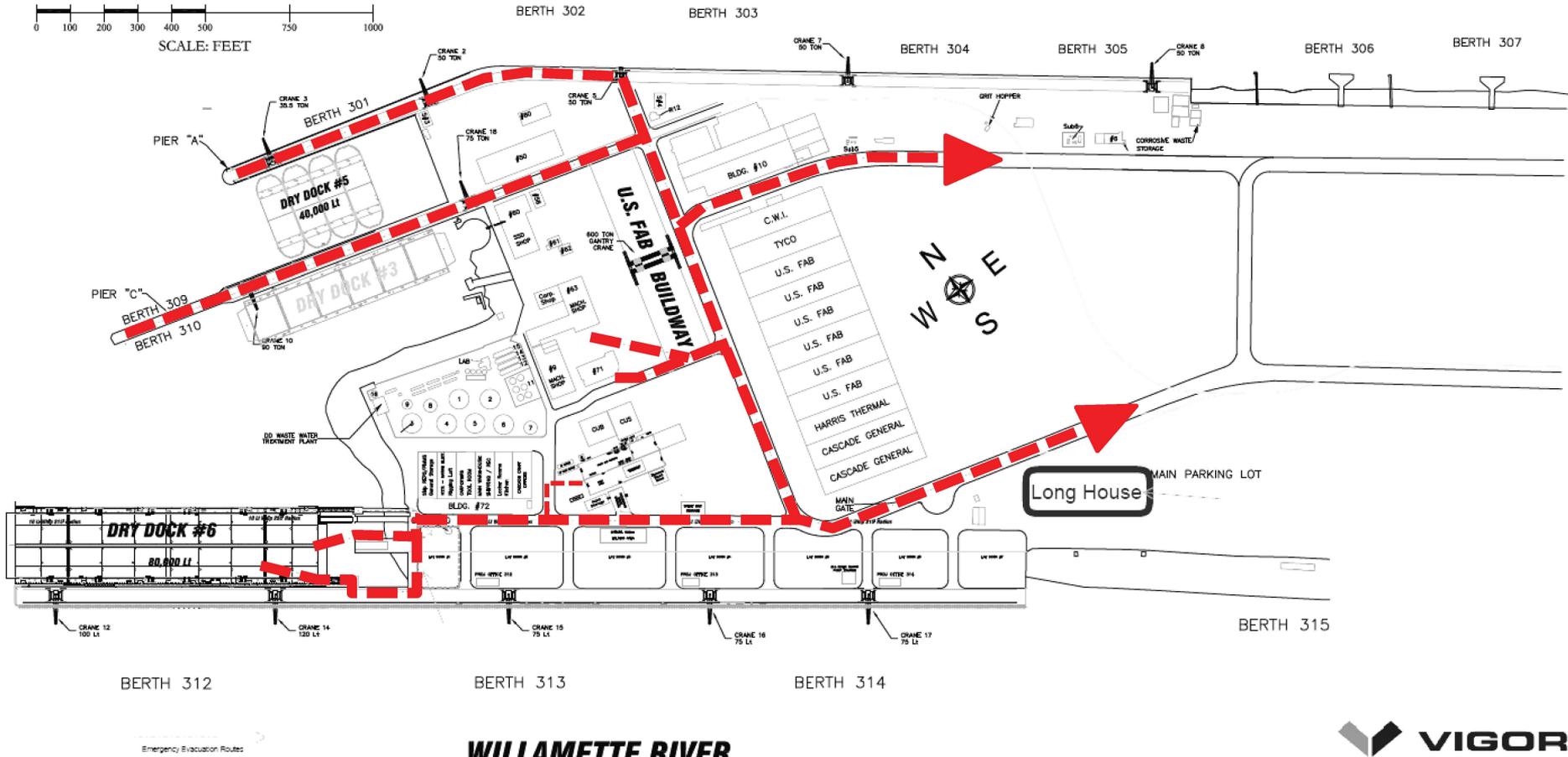
<b>PERMIT CANCELLED</b>	SUPERVISOR SIGNATURE _____
	DATE: _____ TIME: _____

**ATTACHMENT F**

**VIGOR LLC ON PROPERTY EVACUATION ROUTES**

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# SWAN ISLAND BASIN (LAGOON)



**WILLAMETTE RIVER**



DEPARTMENT <b>SHIPYARD CC</b>	CREATED BY <b>SCC</b>	DRAWING NO. <b>080514</b>	JOB <b>LI</b>	ITEM
DESCRIPTION <b>PORTLAND SHIPYARD LAYOUT</b>	<i>RW</i>	DRAWN BY <b>SWINGLE</b>	DATE ORDERED <b>August 2014</b>	FILE NO. <b>YARD DWGS</b>

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## **APPENDIX D**

### **EMERGENCY RESPONSE PLAN**

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**EMERGENCY RESPONSE PLAN  
REVISION 3**

**REMEDIAL DESIGN SERVICES  
SWAN ISLAND BASIN PROJECT AREA  
CERCLA DOCKET NO. 10-2021-001**

**PORTLAND HARBOR SUPERFUND SITE  
PORTLAND, MULTNOMAH COUNTY, OREGON**

**Contract Number: DT2002**

*Prepared for:*

**Swan Island Basin Remedial Design Group**

*Prepared by:*



**11107 Sunset Hills Road, Suite 400  
Reston, Virginia 20190**

*With assistance from:*

**M**  
**M**  
PACIFIC groundwater GROUP MOTT MACDONALD BRIDGEWATER GROUP

**May 2022**



**EMERGENCY RESPONSE PLAN  
REVISION 3**

**REMEDIAL DESIGN SERVICES  
SWAN ISLAND BASIN PROJECT AREA  
CERCLA DOCKET NO. 10-2021-001**

**PORTLAND HARBOR SUPERFUND SITE  
PORTLAND, MULTNOMAH COUNTY, OREGON**

**Contract Number: DT2002**

*Prepared for:*

**Swan Island Basin Remedial Design Group**

*Prepared by:*

**HydroGeoLogic, Inc.  
11107 Sunset Hills Road, Suite 400  
Reston, Virginia 20190**

*With assistance from:*

**Mott MacDonald  
Pacific Groundwater Group  
Bridgewater Group**

**May 2022**

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**Emergency Response Plan  
Swan Island Basin Project Area  
Portland Harbor Superfund Site**

**Record of Changes / Summary of Revisions**

Revision No.	Revision Date	Document Name (If other than entire document, list revised sections or pages)
0	June 29, 2021	Draft Emergency Response Plan for EPA review
1	December 10, 2021	Revisions per EPA comments received August 13, 2021
2	March 16, 2022	Revisions per EPA comments received February 1, 2022
3	May 10, 2022	Revisions per EPA comments received April 5, 2022

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Figure 1-1 SIB Project Area

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Attachment 1 Spill Plan Inspection Form  
Attachment 2 Spill Log

## **LIST OF APPENDICES**

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Appendix A Spill Prevention, Control, and Countermeasures Plan

## LIST OF ACRONYMS AND ABBREVIATIONS

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BEECN	Basic Earthquake Emergency Communications Node
EPA	U.S. Environmental Protection Agency
ERP	Emergency Response Plan
FTL	field team leader
HASP	Health and Safety Plan
HGL	HydroGeoLogic, Inc.
NOAA	National Oceanic and Atmospheric Administration
PFD	personal flotation device
PM	project manager
POC	point of contact
RD	Remedial Design
RPM	Remedial Project Manager
SIB	Swan Island Basin
SPCCP	Spill Prevention, Control, and Countermeasures Plan
SSHO	site safety and health officer

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**EMERGENCY RESPONSE PLAN  
SWAN ISLAND BASIN PROJECT AREA  
PORTLAND HARBOR SUPERFUND SITE  
PORTLAND, MULTNOMAH COUNTY, OREGON**

## **1.0 INTRODUCTION**

This Emergency Response Plan (ERP) describes the specific measures to be carried out in the event of an injury to personnel, damage to property, or spills of materials during work activities at the Swan Island Basin (SIB) Project Area located at the Portland Harbor Superfund Site in Portland, Multnomah County, Oregon. The overall site location is shown on Figure 1-1. The SIB Project Area is between approximately River Mile 8.1 and River Mile 9.2 on the northeast side of the Willamette River and includes all riverbanks from top of the bank to the river. For a detailed site description and history of the site, refer to the Field Sampling Plan (HydroGeoLogic, Inc. [HGL], 2021a).

### **1.1 PURPOSE AND SCOPE**

This ERP provides a description of the site-specific actions necessary in the event of personnel injury, property damage, or spills of materials during the performance of the Remedial Design (RD) work which constitutes an emergency or may present an immediate threat to public health or welfare or the environment. This plan is to be used in conjunction with HGL's Health and Safety Plan (HASP) for work at the SIB Project Area. Procedures for emergency medical treatment and first aid are specified in the HASP. This plan:

- Identifies the types of emergencies that may be encountered during the project work and typical responses,
- Lists important points of contact (POCs) along with their notification and reporting procedures, and
- Describes the approach to inspections and data recording.

### **1.2 PLAN REVISION AND AMENDMENT**

This ERP will be maintained and reviewed annually and will be updated and/or amended as described herein. The emergency POC telephone numbers will be reviewed and updated semiannually and/or when a change in operations or management occurs. The plan will be reviewed and amended immediately if the following occur:

- The list of emergency equipment, supplies, and/or materials required to stop and/or control a spill or release are altered or updated;
- The emergency POCs change;
- The plan fails to contain, control, or clean up a spill or release of hazardous materials; or
- The plan fails to address personnel injuries or property damage.

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## **2.0 FORMS OF EMERGENCIES EVALUATED**

The various types of emergencies covered in this plan generally fall into two broad categories: those associated with human activities and those related to natural events.

### **2.1 HUMAN-INDUCED EMERGENCIES**

#### **2.1.1 Spills**

Spills, leaks, and releases associated with the RD field investigation are described in Section 4 of this ERP and discussed in Section 3 of the Spill Prevention, Control, and Countermeasures Plan (SPCCP) included as Appendix A. The potential sources of contaminants anticipated to be encountered during the RD field investigation include petroleum products (e.g., fuel, oil, and grease) associated with sample collection equipment and vehicles, sample preservatives, and investigation derived wastes such as drilling mud and detergent/water from decontamination activities. The multistep process for controlling and reporting on spills is presented in Section 5 of the SPCCP.

#### **2.1.2 Fires and Explosions**

Except for small fires that can be managed with handheld equipment such as fire extinguishers, the priority during emergencies is to evacuate project personnel, followed by notifying trained emergency responders to contain the fire. Fire extinguishers will be maintained on site as described in the activity hazard analysis General Site Work located in the sitewide HASP (HGL, 2021b). The field team leader (FTL)/site safety and health officer (SSHO) will follow the incident reporting requirements outlined in this document and the SPCCP if field team members, including subcontractors, are injured or property damage to field equipment occurs.

Potential fires and explosions may occur during the project activities on land at the temporary field office (Building #10 of the Vigor facility), the riverbank/upland area, a vessel, or an on-water platform. For emergencies occurring on land, field team members and subcontractors should muster at the upland position (Swan Island Boat Ramp) specified in the HASP if fire or explosions threatens work activities being conducted inside the field office or within the riverbank/upland area. If a staff member observes a hazard that public emergency services should handle, they will withdraw from the area and contact public emergency services immediately.

Field team members working on vessels or on-water platforms will wear U.S. Coast Guard-approved personal flotation devices (PFDs) as described in the sitewide HASP (HGL, 2021b). Field team members should evacuate to an adjacent vessel or platform in the event of fire, or explosion if it is safe to do so, and the fire is too large to fight using handheld equipment. Personnel will maintain as much distance as possible from the emergency site to avoid open flames and impacts from shrapnel from explosions, and then evacuate to the nearest safe shoreline area or back to the Swan Island Boat Ramp until personnel numbers and condition have been assessed.

If additional vessels or on-water platforms are not present in the work area, or if the escape path to them includes encountering additional hazards, then the field team members should abandon the vessel as a last resort and swim to the nearest shore. The areas around running engines/

propellers and any visible floating petroleum that has the potential to catch fire shall be avoided. Upon reaching the shore, personnel should assist coworkers out of the water and assemble to evaluate the situation, especially with respect to burns or injuries. The group should mobilize back to the primary muster location (Swan Island Boat Ramp) and then contact public emergency services if they have not already been notified of the event.

### **2.1.3 Boating-Related Incidents**

Five types of general boating-related incidents that could happen during on-water work of the RD field investigation are presented below.

#### **Collisions**

Shipping traffic, industrial transportation, and recreational usage occur on the Willamette River. In addition, upstream flooding events may wash wood/vegetation and other floating debris into the river. This traffic, along with floating debris, can create collision hazards with vessels. The potential for collisions on the water can be reduced by:

- Following the accepted rules of navigation and general boating safety.
- Using a spotter to assist with identifying other vessels and floating debris.
- Maintaining a safe speed, especially when traffic is heavy, or visibility is reduced due to fog or early/late day low light conditions.
- Not operating the vessel when fatigued or under conditions that may impair reaction times.
- Paying special attention to navigational aids.

#### **Running Aground**

This type of hazard includes grounding the vessel on the river bottom or other underwater structure when operating on the river. The following will reduce the chances of running aground:

- Know your environment and the waterways you travel in.
- Use a spotter when the boat is in motion and/or operating in shallow waters or areas with known underwater snags.
- Be aware that the location of shallow submerged objects will change as water levels change.
- Bring appropriate charts and onboard electronic equipment such as sonar to determine the exact position and water depth.
- If the boat is not grounded too severely, the operator may simply be able to reverse off from where it is grounded by putting the engine into reverse, tilting the engine slightly upward (for an outboard or an inboard/outboard), and then shifting some weight away from where the boat is grounded. Otherwise, the field team members may attempt to physically push the vessel off the obstruction using poles or similar equipment or by contacting another vessel for assistance.

### **Fire Aboard**

Proper fueling techniques and materials storage, as well as following standard boating safety guidelines, will help prevent the likelihood of fires aboard a vessel. The following approach will be used for small fires that do not require abandoning the vessel:

- Stop the vessel immediately if in transit.
- Position the boat so that the fire is downwind of the field team members.
- Shut off the fuel supply if the fire is close to an engine and it is safe to do so.
- Use a fire extinguisher to battle small flames, aiming at the base and moving it in a sweeping motion.
- Call for help using a marine radio (VHF channel 16, the distress, safety, and calling frequency) or cellular phone and follow the instructions provided by public emergency services personnel.

### **Capsizing and Falling Overboard**

Collisions with other vessels or floating debris, heavy wave action, sharp turns, swinging heavy equipment, and misplaced steps on wet and slick decks can contribute to capsizing and overboard events. Overboard victims face several dangers, including panic, injury during the fall, and hypothermia. For those aboard the boat, quick thinking and coordinated action are essential to an effective rescue.

- Alert vessel master that there is a person overboard without losing sight of the person overboard.
- Persons onboard must always wear PFDs when performing on-water work, as specified in the sitewide HASP.
- Do not exceed the weight limit of the vessel and be mindful of changes in its center of gravity when stowing equipment or heavy loads.
- Do not allow passengers to sit anywhere not designed for seating when the vessel is in transit.
- Avoid boating in rough weather or adverse conditions.
- Reduce speed appropriately when making turns.

In an overboard situation:

- Alert vessel master that there is a person overboard without losing sight of the person overboard.
- Stop the vessel immediately if in transit.
- Position the overboard person between the boat and the wind by approaching the overboard person from downwind.

- Use a roped buoy, swim platforms, ladders, and even brute strength to bring the person on board.
- Never have anyone go into the water as this will add another person to be rescued.

Additional details regarding the overboard scenario are presented in the activity hazard analysis Working Near Open Water located in the sitewide HASP (HGL, 2021b), and will be presented by the subcontractors responsible for providing boating services.

### **Carbon Monoxide Poisoning**

Carbon monoxide is produced anytime a fuel source is burned, including on a boat in the form of engines, heaters, and generators. Here are a few tips to keep carbon monoxide safely away from boat passengers:

- Keep fresh air circulating regardless of the ambient weather conditions.
- Ventilate the work area thoroughly if exhaust fumes are noticed.
- Be aware of the location of engine and/or generator exhaust outlets.
- Avoid working in the vicinity of idling engines and generators.

See the sitewide HASP and its related subcontractor-specific boating safety plans for detailed information on treatment and evacuation of personnel in the event of an injury or person-in-the-water (overboard) situation (HGL, 2021b).

## **2.2 NATURALLY-CAUSED EMERGENCIES**

### **2.2.1 Flooding and Swift Water Events**

Floods are the most frequent and widespread of natural disasters caused by weather. They may occur following heavy rains, when ocean waves (tsunami) crash on the shore, snow melts rapidly, or in conjunction with dams or levees failing. Floods can happen in a matter of minutes or over a long period of time, lasting days, weeks, or even months. Their effect on Willamette River conditions can impact the RD field investigation.

The FTL and/or SSHO will check and be aware of the following each day prior to commencing on-water or on-bank activities associated with the Willamette River:

- Physical river conditions including elevation/stage,
- Water temperature,
- Regional (upstream) rainfall amounts within the past 48 hours,
- Anticipated rainfall intensity and amount, and
- Upstream dam release schedule and flow values.

These conditions and data can be obtained from the following sources:

Observation	Source	Website
River Conditions	U.S. Geological Survey Gage #14211720, Willamette River, Portland, OR	<a href="https://waterdata.usgs.gov/usa/nwis/uv?site_no=14211720">https://waterdata.usgs.gov/usa/nwis/uv?site_no=14211720</a>
Previous Rainfall Amount and Intensity	National Oceanic and Atmospheric Administration (NOAA)/National Weather Service data at Portland International Airport	<a href="https://w1.weather.gov/data/obhistory/KPDX.html">https://w1.weather.gov/data/obhistory/KPDX.html</a>
Forecasted Weather/Precipitation	<ul style="list-style-type: none"> <li>• NOAA/National Weather Service Data for Portland</li> <li>• Other publicly available online source</li> </ul>	<a href="https://forecast.weather.gov/MapClick.php?textField1=45.59&amp;textField2=-122.59">https://forecast.weather.gov/MapClick.php?textField1=45.59&amp;textField2=-122.59</a>
Upstream Dam Releases	U.S. Army Corps of Engineers, Portland District Water Management	<a href="https://www.nwd-wc.usace.army.mil/nwp/wm/teacups.html">https://www.nwd-wc.usace.army.mil/nwp/wm/teacups.html</a>

Being aware of and avoiding non-normal river conditions will be the primary means of preventing water-related emergencies. On-water work and possibly on-bank activities (such as riverbank slope inspections) will be rescheduled when recent storm events cause water currents to increase, contribute significant amounts of floating debris to the river, or similar extreme river conditions are present or anticipated to occur during the work period. The riverbank and associated slopes will be visually inspected by the FTL and/or SSHO after the river returns to normal water elevation and flow patterns. These conditions will be discussed with the project team and a decision will be made whether to continue or delay on-bank work activities.

### 2.2.2 Seismic Events

Portland, Oregon, is in the Cascadia Fault subduction zone, an area of low to moderate seismic and volcanic activity. Hazards within the project area related to seismic events would be related primarily to falling and collapsing items that lead to covering or crushing personnel or equipment. These may include buildings, trees, riverbank riprap/soil, or retaining walls/piers in the industrialized section of the project area. Bank collapse, liquefaction of soil/sediments, or waves in the river because of the seismic event are possible secondary hazards.

#### **On-Water Response**

On-water and dive work should be stopped immediately in the event of a seismic event, and the work platforms or vessels shall navigate away from the shore or land-connected structures and toward the center of the river channel to avoid falling trees, structures, and destabilized riverbank soils. It is preferred that vessels return to the Swan Island Boat Ramp rather than disembarking at the nearest shore as soils may be unstable and because the boat ramp infrastructure is better equipped for responding to emergencies. To avoid dangerous and damaging waves associated with the seismic events, personnel should relocate from the boat ramp to higher ground and then follow the muster protocol described in the “Off-Water Response” section below.

### **Off-Water Response**

If a seismic event occurs during RD investigation work along the riverbank or upland area, the field team members should move away from the riverbank edge, buildings, trees, and steep slopes as much as possible. Personnel should follow the safest and shortest route to the muster spot after ground shaking has stopped. Roll call of the RD field personnel will be taken once everyone has relocated to the muster location (Swan Island Boat Ramp Parking Area). Damaged or collapsed transportation and communication networks may create areas of isolation throughout Portland. In this case, field team members may be required to walk to the nearest police/fire station or Basic Earthquake Emergency Communications Node (BEECN) to receive assistance. The nearest fire station (Portland Fire and Rescue Station 22 – Overlook/Swan Island) is located at 4515 North Maryland Avenue, approximately 1.6 miles East of the Swan Island Boat Ramp. The nearest BEECNs are located at:

- University of Portland Public Safety Office located in Haggerty Hall at 5415 N. Warren Street near the intersection of N. Portsmouth Avenue and N. Warren Street approximately 1.5 miles northwest of the Swan Island Boat Ramp.
- Arbor Lodge Park at the northeast corner of N. Dekum Street and N. Greely Avenue approximately 1.0 mile northeast of the Swan Island Boat Ramp.

A visual assessment of the project area will be made following a seismic event to determine the impact to completion of the RD field activities, including the potential for aftershocks or future impacts such as delayed collapse of weakened structures. The U.S. Environmental Protection Agency (EPA), HGL with its subcontractors, and the SIB RD Group will each assign representatives to conduct the visual assessment together.

### **2.2.3 Riverbank/Slope Structural Failure**

The project manager (PM), SSHO, or on-site staff, along with the project geotechnical engineer, will follow the process outlined below if a significant failure of the riverbank occurs within the project work limits:

- Examine the SIB to document current conditions.
- Photograph observed bank failure, estimate the volume of material dislodged during the failure, and evaluate stability.
- Identify and contact the property owner to coordinate response actions.
- With permission of property owner, barricade the failure area from access while the failure is under evaluation.
- Develop a plan to address the failure area and provide it to EPA.
- With permission of property owner, stabilize and monitor the area, as necessary.

### 3.0 EMERGENCY POINTS OF CONTACT AND PROCEDURES FOR NOTIFICATION AND REPORTING

#### 3.1 ON-SITE RESPONSE TEAM

Field team members initially responding to an emergency should immediately contact the RD field investigation FTL following a spill or safety incident, if the FTL was not already present in the immediate vicinity. The FTL will act as the primary POC during emergencies and coordinate the appropriate response. The SSHO will assume this role if the FTL is not present on site at the time of the event. In the case of on-water accidents the vessel captain will initially act as the POC until the vessel returns to the boat ramp and the FTL/SSHO is apprised of the situation. The FTL will assess the emergency, spill, or release and then direct the confinement, containment, and control measures until relieved by local responding emergency personnel, if applicable. Once the emergency has been abated, the FTL will begin the process of communicating details of the event to regulatory agencies and the project team.

#### 3.2 EMERGENCY CONTACTS

A general list of off-site POCs for emergencies is presented in the table below. Further detailed POCs specific to spills and bodily injury are included in the SPCCP and sitewide HASP, respectively.

Contact/Agency	Office Phone Number	Emergency Phone Number
<b>Emergencies</b>		
<i>On Water Emergency:</i> U.S. Coast Guard – Marine Safety Unit Portland	Not Applicable	Call Channel 16 on VHS Radio
<i>Land Emergency (On Vigor LLC Property):</i> Vigor Emergency Staff	503-247-1799 ext. #1799	Call Channel 1 on VHS Radio
<i>Land Emergency (Off Vigor Property):</i> 911 Bureau of Emergency Communications, City of Portland	Not Applicable	911
<b>Swan Island Basin Remedial Design</b>		
Philip Spadaro, SIB RD Group Project Coordinator, The Intelligence Group, LLC	Not Applicable	206-390-2842
Edie Scala-Hampson, Health & Safety Officer, HGL	847-409-6384	847-409-6384
Jeff Hodge, Senior PM, HGL	913-378-2302	913-626-9225
Jennifer Norman, Deputy PM, HGL	425-610-7840	360-202-0033
Shane Cherry, Technical Director	239-313-7495	425-218-9748
Scott Fenical, Technical Leader	415-773-2164	415-341-4669
Janet Knox, Technical Leader	206-375-5432	206-375-5432
Jeff Parker, FTL/SSHO	206-734 0937	206-734 0937
<b>Exterior Agencies</b>		
Elisabeth Novak, Project Coordinator, EPA	503-326-3277	503-351-4445
National Response Center	800-424-8802	800-424 8802
Michael Heffner, State Emergency Response Commission	503-934-8030	Not Applicable
Emergency Response System, Oregon Department of Environmental Quality	Not Applicable	800-452-0311

### **3.3 NOTIFICATION PROCEDURES**

In the event of an emergency, the FTL (or a designated appointee) will conduct an initial evaluation of the scenario. Personnel safety and protection of life and limb take precedence over environmental protection. After initiating first aid, a decision will be made on whether to involve public emergency response services. After the emergency situation has been resolved, the EPA Remedial Project Manager (RPM) will be notified and provided the following information:

1. Reporter's name and contact information;
2. Location, date, time, and duration of incident/release;
3. Description and timeline of the incident/release;
4. Severity of incident (threat to persons, property, or the environment) and potential threat to first responders, if any;
5. Estimated dollar amount of property damage, if known; and
6. Name and telephone number of contact person for further information.

The EPA RPM will be provided with the following additional detail if the emergency involves the release of a hazardous substance:

1. Chemical name or identity of the released substance(s) (Note: chemicals on-site and in the staging area will be restricted to only those required for RD efforts.);
2. Estimate of the quantity of the substance(s) released and description of the media into which the release occurred;
3. Associated health risks and medical attention necessary for exposed individuals; and
4. Actions implemented to date, such as containment and/or evacuation.

### **3.4 REPORTING PROCESS**

The following will be provided to the EPA RPM in association with the occurrence of an emergency event:

- A report will be submitted, within 14 calendar days of the start of the incident, that outlines the event and actions taken or planned by or on behalf of the project team.
- A full report detailing measures taken in relation to the incident will be submitted within 30 days of the event's conclusion.

## **4.0 SPILL RESPONSE**

In the case of a spill or release associated with the RD field investigation, the SPCCP (Appendix A) describes the response procedures to be followed, as well as the notification and reporting processes. Specifically, detailed guidance related to spill prevention, control, and response is presented in Section 5 of the SPCCP. The EPA RPM will act as the primary POC for distributing emergency-related information to the public, with support from HGL and the SIB RD Group, as required.

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## **5.0 INSPECTIONS AND RECORDS**

### **5.1 INSPECTIONS**

Routine inspections will be conducted monthly during field efforts and will include, at a minimum, a visual inspection of the hazardous materials containers at the on-site office and equipment staging area, if present, and the adjacent areas for signs of a spill or leak. The SSHO will conduct and record these inspections in a logbook. See Section 5 of the SPCCP for additional detail regarding equipment inspections.

### **5.2 RECORDS**

Spills will be documented on the Spill Plan Inspection Form (Attachment 1) and must be entered into the Spill Log (Attachment 2). Additional pages may be included with the Spill Plan Inspection Form as needed to describe the event in greater detail. Examples of additional information may include:

- Known or possible causes of the spill or release;
- Areas affected;
- Effectiveness of the cleanup; and
- A review of the cleanup subcontractor, if necessary, and the procedures used.

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## **6.0 REFERENCES**

HydroGeoLogic, Inc. (HGL), 2021a. Field Sampling Plan, Swan Island Basin Project Area/Portland Harbor Superfund Site, Portland, Oregon, Draft. June.

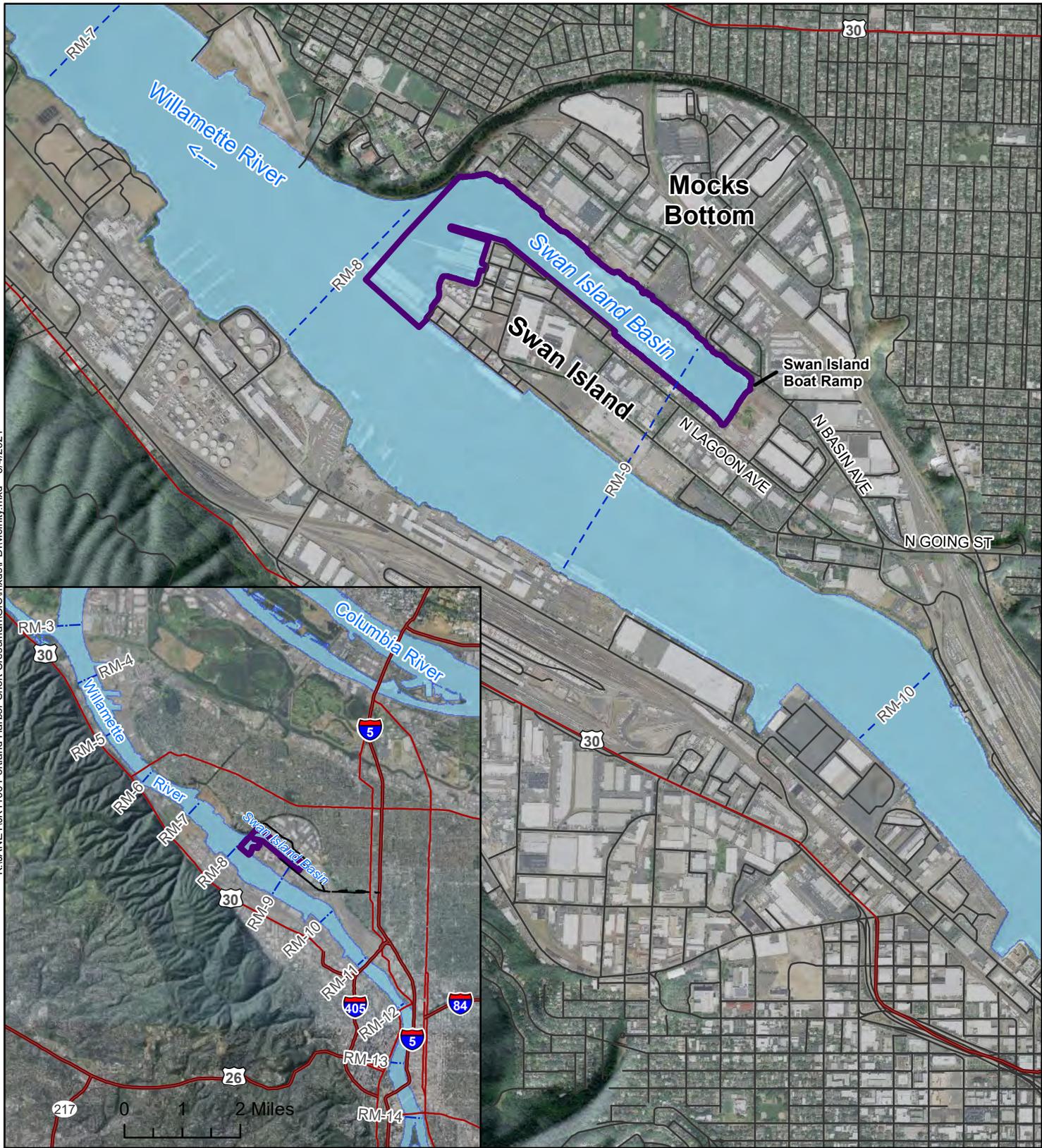
HGL, 2021b. Sitewide Health and Safety Plan, Swan Island Basin Project Area/Portland Harbor Superfund Site, Portland, Oregon, Draft. June.

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## **FIGURES**

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K:\UANET\JK1106 Portland Harbor\_Short\_Crossman\GIS\mxd\SDU\vicinity.mxd 6/4/2021



- Swan Island SDU
- River Mile
- Ordinary High Water

Notes:  
 SDU = Sediment Decision Unit  
 SIB = Swan Island Basin  
 RM = River Mile

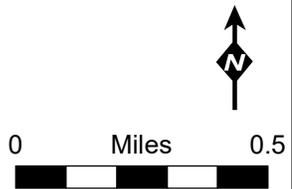


Figure 1-1  
 SIB Project Area

Emergency Response Plan  
 Swan Island Basin



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**ATTACHMENT 1**

**Spill Plan Inspection Form**

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## Spill Plan Inspection Form

### Swan Island Basin Project Area, Portland Harbor Superfund Site

#### **Lids and Labels -**

- Have lids and caps been returned to their proper place? Yes \_\_\_ No \_\_\_
- Are labels present and legible on containers? Yes \_\_\_ No \_\_\_

#### **Evidence of Spills -**

- Is there an indication that a spill might have occurred? Yes \_\_\_ No \_\_\_
- If so, was the spill properly cleaned? Yes \_\_\_ No \_\_\_
- Was the Spill Log completed for that incident? Yes \_\_\_ No \_\_\_
- Were kit materials used, and if so, restocked? Yes \_\_\_ No \_\_\_

#### **New Hazardous Materials -**

- Have new chemical products been purchased? Yes \_\_\_ No \_\_\_
- Is a safety data sheet for the new product available on site? Yes \_\_\_ No \_\_\_
- Is the container properly labeled? Yes \_\_\_ No \_\_\_
- Is the new product stored and handled properly? Yes \_\_\_ No \_\_\_

#### **Spill Kits -**

- Have items been used from the spill kit? Yes \_\_\_ No \_\_\_
- If items are missing, is there an associated entry in the Spill Log? Yes \_\_\_ No \_\_\_
- Are there items missing from the spill kit that are currently on order? Yes \_\_\_ No \_\_\_
- Is the spill kit stored at its designated location? Yes \_\_\_ No \_\_\_
- Is there a sufficient supply of daily cleanup materials? Yes \_\_\_ No \_\_\_

#### **Storm Drains in the On-Site Office and Equipment Staging Area -**

- Is there a buildup of sediment in the drain traps? Yes \_\_\_ No \_\_\_
- Is there evidence of drain clogging? Yes \_\_\_ No \_\_\_
- Are the drain filters intact? Yes \_\_\_ No \_\_\_
- Should the drain filters be replaced? Yes \_\_\_ No \_\_\_
- Have the drain filters been replaced? Yes \_\_\_ No \_\_\_

#### **Items Fixed -**

- Have previously documented deficiencies been fixed or made acceptable? Yes \_\_\_ No \_\_\_

**Spill Plan Inspection Form (continued)**  
**Swan Island Basin Project Area, Portland Harbor Superfund Site**

List issues, deficiencies, or failures in detail:

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Completed by: \_\_\_\_\_

Date: \_\_\_\_\_

**ATTACHMENT 2**

**Spill Log**

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## Spill Log

### Swan Island Basin Project Area, Portland Harbor Superfund Site

Date of Spill	Facility/Location of Spill	Material and Estimated Size of Spill (gallons)	Prevention Measures Taken?	Spill Kit Materials Reordered?	Was the Spill Kit Adequate to Contain and Clean Up the Spill? <sup>1</sup>	Notification <sup>2</sup>	Recorded by

Notes –

<sup>1</sup> List deficiencies associated with the kit such as missing or undersized equipment.

<sup>2</sup> Document the date, time, name of notified individual, and the agency notified.

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## **APPENDIX A**

### **SPILL PREVENTION, CONTROL, AND COUNTERMEASURES PLAN**

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**FINAL  
SPILL PREVENTION, CONTROL, AND  
COUNTERMEASURES PLAN  
REVISION 3**

**REMEDIAL DESIGN SERVICES  
SWAN ISLAND BASIN PROJECT AREA  
PORTLAND HARBOR SUPERFUND SITE  
PORTLAND, MULTNOMAH COUNTY, OREGON  
CERCLA DOCKET NO. 10-2021-001**

**Contract Number: DT2002**

*Prepared for:*  
**Swan Island Basin Remedial Design Group**



**11107 Sunset Hills Road, Suite 400  
Reston, Virginia 20190**

*With assistance from:*



**May 2022**



# SPILL PREVENTION, CONTROL, AND COUNTERMEASURES PLAN

## SWAN ISLAND BASIN PROJECT AREA PORTLAND HARBOR SUPERFUND SITE

**Project Name:** Swan Island Basin Project Area

**Location:** Portland Harbor Superfund Site

Portland, Multnomah County, Oregon

**Contact Name:** Robert Bird

**Phone:** 703-326-7832 x1832

**Email:** rbird@hgl.com

**Professional Engineering Certification:** I hereby certify that I have examined the project site and proposed work areas and being familiar with the provisions of 40 CFR part 112, attest that this SPCCP has been prepared, or updated within 5 years, in accordance with good engineering practices and meets the requirements listed in 40 CFR part 112.

This plan has been certified by:



**Date of certification:**

6/17/22

Engineer's Seal

EXPIRES: 12/31/23

Copies of this plan are to be located at the field site trailer and available to employees.

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## LIST OF ACRONYMS AND ABBREVIATIONS

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CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	contaminant of concern
DDD	dichloro-diphenyl-dichloroethane
DDE	dichloro-diphenyl-dichloroethylene
DDT	dichloro-diphenyl-trichloroethane
EPA	U.S. Environmental Protection Agency
FTL	field team leader
HGL	HydroGeoLogic, Inc.
NRC	National Response Center
ODEQ	Oregon Department of Environmental Quality
OSHA	U.S. Occupational Safety and Health Administration
PDI	Pre-remedial Design Investigation
PHSS	Portland Harbor Superfund Site
PM	project manager
PPE	personal protective equipment
RD	Remedial Design
RM	river mile
SDS	safety data sheet
SERC	State Emergency Response Commission
SIB	Swan Island Basin
SPCCP	Spill Prevention, Control, and Countermeasures Plan
TIG	The Intelligence Group, LLC

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**SPILL PREVENTION, CONTROL, AND COUNTERMEASURES PLAN**  
**SWAN ISLAND BASIN PROJECT AREA**  
**PORTLAND HARBOR SUPERFUND SITE**  
**PORTLAND, MULTNOMAH COUNTY, OREGON**

**1.0 INTRODUCTION**

This Spill Prevention, Control, and Countermeasures Plan (SPCCP) describes the specific measures to be carried out in the event of an accidental spill or release of hazardous materials during Pre-remedial Design Investigation (PDI) work activities at the Swan Island Basin (SIB) Project Area portion of the Portland Harbor Superfund Site (PHSS), located on the Willamette River near Portland, Oregon. For a detailed site description and history of the site, refer to the Field Sampling Plan (HydroGeoLogic, Inc. [HGL], 2021a).

Personnel conducting work activities at the project site will be familiar with this SPCCP and will review the actions that would be required should a spill occur in their respective area.

**1.1 PURPOSE AND SCOPE**

The actions to be taken in the event of a spill or release during SIB field investigation activities are described in this plan, which provides site-specific guidelines regarding responsible leadership for implementing effective countermeasures during a spill or release to help minimize or eliminate damage to property and the environment. This plan (1) identifies potential spill sources and associated work activities; (2) establishes guidelines for the prevention and control of spills associated with the project activities; (3) establishes roles, responsibilities, procedures, and training guidelines for response personnel; and (4) describes notification and reporting requirements with respect to unintentional spills and releases. The plan has been prepared in accordance with 40 CFR Part 110 (requirements for spill reporting) and Part 112 (requirements to prepare and implement an SPCCP).

**1.2 PLAN REVISION AND AMENDMENT**

This SPCCP will be maintained and reviewed annually and will be updated and/or amended in parallel with changes or updates to the Emergency Response Plan.

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## **2.0 PROJECT AREA DESCRIPTION**

### **2.1 LOCATION AND HISTORY**

PHSS is in Portland, Oregon, on the Lower Willamette River immediately downstream of the urban downtown area from river mile (RM) 1.9 upstream to RM 11.8. The study area is located within SIB, which is on the northeastern side of the Lower Willamette River in PHSS between RM 8.1 and RM 9.2. Contamination in river sediments is associated with decades of industrial use along the Willamette River. In December 2000, PHSS was added to the U.S. Environmental Protection Agency's (EPA's) National Priorities List, and a Record of Decision was prepared in 2017 (EPA, 2017).

### **2.2 CONTAMINANTS OF CONCERN**

The contaminants of concern (COC) driving the cleanup in the project area are the following:

- Polychlorinated biphenyls;
- Dioxins and furans;
- Polycyclic aromatic hydrocarbons; and
- Pesticides DDT, DDD, and DDE (EPA, 2017; EPA and WC Group, 2019).

### **2.3 PROPOSED FIELD ACTIVITIES**

The field investigation is targeted for the third quarter of 2021 and is expected to last 2 to 6 weeks. Activities to be conducted in support of the Remedial Design (RD) are described in the FSP (HGL, 2021a) and will include:

- Bathymetric surveys mapping riverbed features that will require boats to be used on the water.
- Sediment and porewater sampling that will require the use of on-water barges, support boats, and possibly drilling equipment.
- Barge-mounted or land-based drilling activities that will require using a drill rig or direct push probe unit along with support vehicles.
- Visual inspections of marine structures using a three-member dive team that will require using a support vessel.
- General project support during site visits, inspections, sampling, and other activities that will require parking vehicles at the support facility/field trailer.

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### 3.0 WORK ACTIVITIES AND POTENTIAL SOURCES OF SPILLS

The potential sources of hazardous materials anticipated to be encountered during the RD field investigation are summarized in the following table.

Activity	Potential Source	Contaminants
<ul style="list-style-type: none"> <li>• Bathymetric Surveys</li> <li>• Dive Inspections</li> <li>• Sediment Sampling</li> </ul>	<ul style="list-style-type: none"> <li>• Boat/On-Water Vessels</li> <li>• Support Vehicles</li> </ul>	Fuel, oil, and grease
<ul style="list-style-type: none"> <li>• Soil, Sediment, and Porewater Sampling</li> </ul>	<ul style="list-style-type: none"> <li>• Drill Rig</li> <li>• Direct Push Probe Unit</li> <li>• Support Vehicles</li> </ul>	<ul style="list-style-type: none"> <li>• Diesel, unleaded fuel, oil, and grease</li> <li>• Investigation-derived Waste from sampling activities (sample preservatives and detergents from decontamination activities)</li> <li>• Drill cuttings/mud slurry</li> </ul>
<ul style="list-style-type: none"> <li>• Site Visits</li> <li>• Riverbank Inspections</li> <li>• General Support</li> </ul>	Support Vehicles	Fuel, oil, and grease

The U.S. Occupational Safety and Health Administration (OSHA) Hazardous Communications Program requires that safety data sheets (SDSs) be available to personnel when work is performed at the site. The SDSs include information such as the properties of each chemical; the physical, health, and environmental health hazards; personal protective equipment (PPE) to use when handling the chemical; and safety precautions for handling, storing, and transporting the chemical. The SDSs for the contaminants hazardous materials that are anticipated to be used or encountered during the RD field activities are included in the sitewide Health and Safety Plan (HGL, 2021b), of which a hard copy will be present on site during the work activities.

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## **4.0 REPORTING SPILLS**

### **4.1 SPILL INFORMATION**

Spills in reportable quantities (see Section 4.2.1) of the hazardous materials listed in Section 3 are unlikely during the RD field investigation. However, RD field personnel will be instructed on the requirements and procedures for spill prevention, control, and reporting as part of the general health and safety orientation for site work. The basic information to have in hand for reporting spills includes:

1. Reporter's name, company, and contact information;
2. Location, date, time, and duration of incident/release;
3. Chemical name or identity of the released substance(s);
4. Estimate of the quantity of the substance(s) released and description of the media into which the release occurred;
5. Description and timeline of the incident/release;
6. Severity of the incident (threat to persons, property, or the environment) and potential threat to first responders, if any;
7. Associated health risks and medical attention necessary for exposed individuals;
8. Actions implemented to date, such as containment and/or evacuation; and
9. Name and telephone number of contact person for further information.

### **4.2 NOTIFICATION AND REPORTING**

#### **4.2.1 State of Oregon Notification**

Certain scenarios require immediate notification to the Oregon Department of Environmental Quality (ODEQ) according to Oregon Administrative Rules Database Chapter 340 Division 142, *Oil and Hazardous Materials Emergency Response Requirements*. Reportable spills as defined by ODEQ include:

- Any amount of oil released to waters of the state;
- Oil spills on land more than one barrel (42 gallons); and/or
- Hazardous materials that are equal to, or greater than, the quantity listed in 40 CFR Part 302 (List of Hazardous Substances and Reportable Quantities), and amendments adopted before July 1, 2002.

Verbal notification of the spill will be provided to the Oregon Emergency Response System at 800-452-0311. Written notification of the release and subsequent cleanup will be provided within 30 calendar days to ODEQ on the Spill/Release Report form located on the ODEQ website at <https://www.oregon.gov/deq/Hazards-and-Cleanup/env-cleanup/Pages/How-To-Report-A-Spill.aspx>.

#### **4.2.2 National Response Center**

The National Response Center (NRC) is the sole federal point of contact when reportable oil and chemical releases occur and must be contacted within 24 hours of the incident. This contact can be made via telephone at 800-424-8802. The NRC duty officer will guide the caller through a detailed series of questions based on the Standard Report Form to gather as much information as possible concerning the spill or release. Alternately, the contact can be made through email at [NRC@uscg.mil](mailto:NRC@uscg.mil).

Contacting NRC fulfills the requirement to report releases of hazardous substances under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and several other federal regulatory programs. If direct reporting to NRC is not possible at the time of or immediately following the incident, reports may be made to the designated EPA on-scene coordinator for the geographic area where the release occurred. However, those reports must subsequently be relayed to NRC as soon as practicable.

#### **4.2.3 State Emergency Response Commission**

As required by the Emergency Planning and Notification regulation, the State Emergency Response Commission (SERC) must be notified when a facility accidentally releases one of the following types of chemicals into the environment in an amount greater than or equal to the reportable quantity:

- List of Extremely Hazardous Substances (40 CFR part 355); and
- CERCLA hazardous substances (40 CFR part 302).

The point of contact for SERC is:

Michael Heffner, SERC Coordinator  
Oregon State Police; Office of the State Fire Marshal  
3565 Trelstad Ave. SE  
Salem, OR 97317-9614  
Phone: 503-934-8030  
Email: [michael.heffner@state.or.us](mailto:michael.heffner@state.or.us)

#### **4.2.4 Project Team Notification and Reporting**

In addition to notifying the appropriate regulatory agencies, the SIB project team will be notified in the following manner:

- Field team members initially responding to the event should immediately contact the field team leader (FTL) following a spill if the FTL was not in the immediate vicinity of the spill. The FTL shall immediately notify the appropriate spill reporting agencies, followed by notification to the EPA project coordinator.
- The FTL shall then notify the HGL corporate health and safety coordinator along with the SIB project manager (PM). The PM shall initiate communication with the SIB RD

Group through Group Project Coordinator Philip Spadaro with The Intelligence Group, LLC (TIG).

<b>Point of Contact/</b>		
Oregon Department of Environmental Quality, Emergency Response System	-	800- 452-0311
National Response Center	-	800 424 8802
Michael Heffner, State Emergency Response Commission	503-934-8030	-
Elisabeth Novak, Project Coordinator, EPA	503-326-3277	503-351-4445
Edie Scala-Hampson, Health & Safety Officer, HGL	847-409-6384	847-409-6384
Jeff Hodge, Senior PM, HGL	913-378-2302 x8302	913-626-9225
Jennifer Norman, Deputy PM, HGL	425-610-7840	360-202-0033
Philip Spadaro, Group Project Coordinator, TIG	206-681-9844	206-390-2842

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## **5.0 SPILL PREVENTION, CONTROL, AND RESPONSE**

### **5.1 SPILL PREVENTION**

#### **5.1.1 Training**

The minimum training requirements for on-site personnel designated to handle oil and/or hazardous materials or respond to spills will include OSHA Hazardous Waste Operations and Emergency Response 40-hour safety and health training, a current 8-hour OSHA Refresher certificate, and documented training in respirator use. Spill awareness, prevention, and response procedures will be discussed as part of the initial site safety orientation to be conducted at the start of the field activities and if/when new personnel join the field team. Concepts of spill prevention, control, and response will be added to the rotation of topics to be discussed as part of the daily safety tailgate meeting to maintain awareness and knowledge. Subcontractors will provide spill response training for their own members in accordance with state and federal regulations.

#### **5.1.2 Inspections**

Incoming vehicles and equipment (including delivery trucks and employee and subcontractor vehicles) will be checked for leaking oil and fluids when they are first mobilized to the project and daily during regular use. Vehicles or equipment that are visibly leaking will not be allowed on site until repairs are made to address the issue. Visual inspections for leaks under and around powered equipment will be part of the FTL's daily site inspection and documented in the Daily Quality Control Report.

#### **5.1.3 Fueling**

Fueling of vehicles and equipment will be performed off site to the extent possible. For instances where fueling occurs at the project site:

- Specific areas, located away from drainage courses and stormwater inlets, will be designated for use when it is impractical to send vehicles or equipment off site for refueling. The areas will be protected from stormwater runoff and runoff.
- “Topping off” fuel tanks will be discouraged.
- A means of secondary containment, such as a drain pan, will be used when fueling to catch spills/leaks.
- A spill kit will be available immediately adjacent to the fueling operation.

#### **5.1.4 Regular Maintenance and Cleaning Equipment**

Regular maintenance and cleaning of powered (fuel-driven) equipment should be performed off site. If emergency maintenance is required to move or prepare a piece of equipment to be relocated off site for extensive service or repair, then drip pans, plastic sheeting, or other means to prevent/contain spills should be taken prior to performing the work.

### **5.1.5 Biodegradable Hydraulic Fluids and Oils**

The use of biodegradable or plant-based petroleum products is encouraged on this project, particularly when used in proximity to water bodies, to lessen the environmental impact of spills or fluid releases. Current fluids and oils in equipment should be converted to biodegradable alternatives wherever possible.

## **5.2 CONTROL**

### **5.2.1 Guidelines for Containers**

- Close and seal containers when not in use.
- Label containers to show the contents and capacity.
- Maintain containers in good condition during normal use. Transfer materials to new containers if containers are leaking or visibly damaged. Immediately clean spills on the exterior of the container.
- Store substances per the manufacturer's directions in containers that are in good condition and compatible with the materials.
- Allow sufficient spacing between containers for ease of access, periodic inspections, and release response.
- Use grounding procedures when storing and dispensing flammable materials from drums or totes to prevent static sparks.
- Keep portable containers (with capacity of less than 5 gallons) for flammable/combustible liquids (such as gasoline cans) in a flammable storage cabinet when not in use.
- Remove markers and labels from clean, empty, hazardous substance containers (drums), and mark the container with the word "empty."
- Provide at least 4 inches of headspace in drums to allow for expansion of the stored material.

### **5.2.2 Spill Kits**

Spill response equipment will be provided and maintained in areas where spills are likely to occur. The equipment will meet the following guidelines:

- Stock spill cleanup kits and response equipment that are compatible with the substances used or stored on site;
- Locate spill kits in areas where spills are likely to occur;
- Stock spill kits to manage the worst-case anticipated release (corresponding to the volume of the largest container or sum of containers); and
- Periodically inspect spill kits and other emergency response equipment to ensure they are complete, and that the equipment is in proper working condition.

Subcontractors will be responsible for supplying appropriately sized spill kits containing materials specific to their operations and instructions for their use. Each on-water vessel will have at least one spill kit on board.

### **5.2.3 Containment Areas**

- Containment areas shall be constructed with leak-resistant materials or provided with a similar liner and have a storage volume equal to or greater than 110 percent of the largest individual container or tank located inside the containment area.
- Containment areas shall be included as part of the FTL's daily inspection of site conditions.
- Rainwater/precipitation shall not be allowed to accumulate in containment areas or secondary containment features.
- Store non-bulk chemicals within appropriate secondary containment if a potential exists for release to the environment.
- Inspect secondary containment periodically and identify, clean, and remove spills from the secondary containment feature.
- Fire extinguisher(s) shall be available near areas in which flammable or combustible materials are stored.

### **5.2.4 Good Housekeeping**

- Use proper signage to identify hazardous substance or waste storage, collection, and disposal areas.
- Close hazardous substance containers when not in use.
- Regularly inspect, clean and repair containers. Do not use damaged containers including lids.
- Use a funnel or spigot when transferring chemicals from larger to smaller containers to prevent spills and use drip pans or other collection devices to contain drips or leaks.
- Immediately clean and properly manage small spills or leaks per the material SDS.
- Inspect equipment and hazardous substance storage areas to ensure that leaks or spills are not occurring.
- Keep work and storage areas clean and in good general condition. Maintain clearance and open walkways around stored materials, containers, and equipment.

## **5.3 SPILL CONTROL AND RESPONSE**

The FTL of the RD field investigation activities shall be primarily responsible for implementation of this SPCCP in the field.

### 5.3.1 General Spill Response Procedures

Response actions associated with spills and releases will vary in relation to the range of materials and variety of activities planned for the RD field investigation, along with the scale and variable severity of the hazards presented in the event of a spill. General procedures for addressing spills are outlined in the following sections. Subcontractors and vessel captains will be responsible for the initial response to on-water spills and emergencies with HGL personnel providing additional support regarding containment and the reporting process.

#### Step One: Communicate the Hazard

- If the nature of a spill is not known, the FTL must radio the Coast Guard on Channel 16 (on water spills) or call 911 (on land spills, off Vigor LLC property) or radio Vigor emergency response staff on Channel 1/call 503-247-1799 and evacuate the area of the spill. The field team members will not attempt to clean up spills that may contain unknown chemicals.
- Immediately notify others working in the area and the FTL of the hazard. Evacuate the area if the situation warrants it.
- Follow the established emergency procedures to call for help and/or radio Channels 1 or 16 or call 911 for large spills, hazardous materials, or in the event of injured personnel. Inform the dispatcher of the type of material that was spilled and the quantity so that first responders will be ready to address the situation. Be prepared to provide SDS information to fire department, emergency medical technician, hospital, or physician.
- Remove injured or contaminated personnel from the immediate area if the situation is immediately dangerous to life and health if they can be reached and withdrawn from the area without endangering additional personnel in the process. First aid and/or decontamination procedures will be implemented, as appropriate.

#### Step Two: Control the Spill

- The sooner a spill is contained, the smaller the area that will need to be cleaned.
- The FTL, SSHO, and/or vessel captain will evaluate the scale of the spill and chemical/physical properties of the spilled material to determine whether it can be managed by on-site personnel or requires addressing from public emergency agencies.
- When a spill is managed by on-site personnel, they should immediately don appropriate PPE for the chemical and the nature of the hazard including respirators, if necessary. The appropriate PPE for this activity will be based upon the guidelines in the SDSs, which will be co-located with the chemicals being stored and/or in the possession of the field team members whenever field activities utilizing these compounds are occurring.
- Implement readily available actions (such as closing a valve or righting a container that has tipped over) to stop the spill or minimize the chances of it becoming worse if this does not introduce risk to that acting person's health.

- Shut down potential sources of heat or ignition if possible and appropriate for the type of spilled material. Increase ventilation to the area if that will safely disperse fumes and aid in drying liquids.

### **Step Three: Contain the Hazard**

- Once the immediate situation has been addressed, take steps to keep the spill from spreading to other areas or contaminating adjacent surfaces. This usually involves confining the spilled material to a small area by using some type of absorbent material or neutralizer.
- Prevent the spill from spreading to floor drains, stormwater inlets, or other places that may allow the material to flow into environmentally sensitive areas.
- Practice and be knowledgeable of a variety of spill confinement techniques and equipment including absorbent mats, booms, dikes, and related materials, as well as possessing a working knowledge of common patch and repair tactics such as pre-measured epoxy sticks, clay-based patches, tourniquets, and pipe wraps.

### **Step Four: Evaluate and Implement Cleanup**

- The FTL will assess the spill/release and then direct the confinement, containment, and control measures until relieved by local responding emergency personnel, if necessary.
- Collect the material used to contain or neutralize the spill and dispose of it in the specified manner.
- Implement personnel and equipment decontamination procedures, if necessary.

### **Step Five: Notification and Reporting**

- Initiate the notification process for regulatory agencies and the project team.
- Begin gathering information and data regarding the spill and cleanup process and start the reporting process.

## **5.3.2 Spill Response for Petroleum and Floating Liquids**

### **5.3.2.1 Responses to Minor Spills**

Minor spills typically involve small quantities of oil, fuel, paint, etc., which can be controlled by the first responder at the discovery of the spill. Minor spills have 1) volume of less than 42 gallons, 2) do not contact stormwater drains or other means of conveyance, 3) do not enter bodies of water, and 4) do not contain hazardous materials or reportable quantities as described in Code of Federal Regulations 40 CFR Part 302. Minor spills of any volume that occur over water must be reported. On-water minor spills will be contained and removed by appropriately trained personnel using spill kits and other tools (i.e., floating oil boom) available aboard the vessel.

The PM will be notified of spills less than 42 gallons on land and will begin the process of communicating details of the event to the SIB RD Group, adjacent property owners/managers, and EPA. Notification to regulatory agencies of minor spills is not required unless the spill enters a

water body. The response procedures presented in Section 5.3.1 will be followed for spills on land with the addition of:

- Containerizing the underlying material in a 55-gallon drum (or similar sized container included as part of the spill kit) along with contaminated cleanup materials for proper disposal.
- Collecting a sample of the drummed materials for characterization and disposal.
- Collecting a sample of the soil, gravel, subgrade, etc. beneath the spill zone to document that the spilled material has been adequately removed.

### **5.3.2.2 Responses to Major Spills**

Major spills are those that are too large in scale or intensity to be addressed by available personnel using materials present on site (i.e., spill kits). In addition, these releases may pose a safety or health hazard or contact and enter a body of water.

The primary approach for responding to major oil/petroleum spills will be mechanical containment, recovery, and cleanup. Typical equipment will include booms, barriers, and skimmers, as well as sorbent materials placed and managed to block the spread of material, concentrated into one area, and removed for disposal. A release of any amount of oil/petroleum into a water body or volume greater than 42 gallons on land will initiate the notification process (regulatory agencies and the project team) described in Section 4.2.

### **5.3.3 Non-Petroleum Substances Response**

Non-petroleum types of materials present during the RD field investigation that might be subject to spills include soil cuttings/drilling mud, sample preservatives, and investigation-derived waste. Except for soil cuttings/drilling mud, these materials are not anticipated to be on site in quantities large enough to create a major spill scenario. The approach to evaluating, responding to, and cleaning up these types of materials is expected to be the same as that described previously for petroleum-based materials. Minor spills will be reported to the FTL and documented in the Daily Quality Control Report.

## **6.0 REFERENCES**

EPA and WC Group, 2019. Administrative Settlement Agreement and Order on Consent for Remedial Design at Willamette Cove Project Area, EPA Region 10. CERCLA Docket No. 10-2019-0142. December.

HGL, 2021b. Sitewide Health and Safety Plan, Swan Island Basin Project Area/Portland Harbor Superfund Site, Portland, Oregon, Draft. June.

HydroGeoLogic, Inc. (HGL), 2021a. Field Sampling Plan, Swan Island Basin Project Area/Portland Harbor Superfund Site, Portland, Oregon, Draft. June.

U.S. Environmental Protection Agency (EPA), 2017. Portland Harbor Superfund Site Record of Decision, Portland, Oregon. EPA Region 10, Seattle, Washington. January.

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## **APPENDIX E**

### **RESPONSE TO EPA COMMENTS**

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APPENDIX E  
 EPA Review of Draft Pre-Design Investigation Work Plan  
 Response to Comments Matrix  
 May 10, 2022

#	Reference No.	Document	EPA Draft PDI Work Plan Comments on August 13, 2021	SIB Response on September 10, 2021	EPA's October 7, 2021 Reply to Suggested Revisions
The following are U.S. Environmental Protection Agency's (EPA's) comments on the Draft Pre-Design Investigation Work Plan Revision 4 (PDI Work Plan), prepared by HydroGeoLogic, Inc. (HGL) on behalf of the Swan Island Basin Remedial Design Group and dated June 2021. The PDI Work Plan is a deliverable prepared for the SIB RD Group under the Administrative					
1a	1001	Sufficiency Assessment Report Data Gaps	The PDI Work Plan does not clearly establish that the data gaps identified in the SIB Project Area Draft Sufficiency Assessment Report Revision 4 (SAR) (HGL 2021) will be filled as part of the PDI. A summary of the data gaps should be provided in the PDI Work Plan along with a plan to fill those data gaps. EPA recommends including a crosswalk table to track data needs.	The PDI Work Plan will be amended to clearly establish the data gaps identified in the SAR will be addressed as part of the PDI. A summary of the data gaps identified together with a plan to address these data gaps will be provided in the PDI Work Plan. A crosswalk table will be created to track data needs.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
1b	1002	Sufficiency Assessment Report Data Gaps	Additionally, clarify if any of the evaluations planned for the PDI are intended to generate inputs for the SEDCAM modeling discussed in the SAR. Additional comments regarding the proposed SEDCAM model will be provided with EPA's comments on the SAR.	The PDI Work Plan will be amended to clarify which PDI data will be used to generate inputs for the SEDCAM model. The specific information and a brief summary of how it will be used will be included as text in appropriate sections, including Sections 4.1 and 4.9.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
2a	1003	SMA Delineation	Sediment management area (SMA) refinement needs to consider both surface and subsurface sediment exceedances of all remedial action levels (RALs) applicable outside of the navigation channel and principal threat waste (PTW) thresholds (see Remedial Design [RD] Principle #1 in Section 1.4 of EPA's Remedial Design Guidelines and Considerations [RDGC]).	The text will be amended to include discussion of subsurface RAL and PTW exceedances that fall outside of the areal extent of the SMA, if any, including justification for how they should impact the SMA refinement.	
2b	1004	SMA Delineation	The intent of the recommendations in the RDGC is to provide a nominal 150-foot grid resulting in a maximum distance of 150 feet between sample locations to delineate an SMA boundary. Note, it is expected that additional samples at higher density may be needed to sufficiently plan for the RD. Adjust the text and proposed sample locations to illustrate that no samples are further than 150 feet apart or provide rationale for why certain proposed sample locations should be spaced farther apart. Note that SMA boundaries will be considered undelineated until they are bounded by samples with no RAL and/or PTW threshold exceedances within a 150-foot grid.	The text in the and applicable supporting documents will be amended to note that sample locations shall not be further than 150' apart. This sample spacing guidance applies specifically to the SMA boundaries with more flexibility for sample spacing within the interior of the SMA. Where proposed sample locations are >150' apart, written rationale will be provided to justify these proposed sample locations.	The response is acceptable pending EPA's review of the revised PDI Work Plan. As indicated in EPA's comments on the Draft SAR, areas under docks and other structures must be characterized as part of remedial design and physical and chemical characterization should be noted as a data gap that should be addressed during the PDI.
3	1005	Sediment Sampling	Upon reviewing planned core depths relative to existing subsurface data and RAL/PTW exceedances EPA believes that the target depth of the proposed subsurface sediment samples should be extended to 15-feet (ft) below mudline (bml) or refusal in most locations. Additionally, 20 feet bml may be required in some locations, particularly those adjacent to historical sample locations with concentrations exceeding RALs at depths greater than 15 feet. EPA recommends collecting additional archive samples from deeper intervals than the depths proposed in this PDI Work Plan to be analyzed pending characterization of the shallower intervals to avoid unnecessary design schedule delay. This will reduce the potential for data gaps related to unbound depth of contamination (DOC) and lateral extent of contamination. If only subsurface contamination exceeds RALs and/or PTW thresholds and the expected remedial technology application is capping, full delineation of DOC may not be necessary (see RD Principle #4 in Section 1.4 of the RDGC [EPA 2021]). However, characterization of subsurface sediment contamination will be required to sufficiently characterize material to be left in place to support cap design evaluations (see RDGC Table 5-2) or to demonstrate the stability of the buried contamination. If DOC is not fully delineated, EPA will require additional sampling to delineate DOC in dredging areas and areas with non-aqueous phase liquid (NAPL) impacts.	The expected remedial technology within the SMA is predominantly dredge and capping or just capping. In light of this likely technology application, EPA further affirmed (8/19/21) that DOC need not be defined in every core, but data should be collected to define DOC for SIB and to support dredge design where dredging is the anticipated remedial technology. The revised PDI Work Plan will clearly show what is known about DOC for PTW and RAL exceedance. Cores will be judgmentally located to fill data gaps in DOC and extended to 15 or 20 ft bml in areas where necessary and appropriate with selected archiving of samples for analysis. Some 150'-spaced core locations that are not needed for SMA refinement may be omitted to support these deeper core sampling locations with justification for the larger spacing.	The response is mostly acceptable; however, note that presumptive capping remedies are highly dependent on future land use in the SIB Project Area but EPA understands that the PDI work will result in additional information regarding future FMD depth requirements. The proposed core locations that exceed 150 foot by 150 foot spacing in the revised PDI Work Plan will be reviewed for potential data gaps. EPA also requests that a proposed analytical schedule for triggering archive samples is provided in the revised . Lastly, if porewater sample collection is not proposed for a supplemental PDI there may be data gaps such that additional sediment core collection is warranted in areas where the 150 foot by 150 foot spacing is exceeded to generate adequate data for cap design.

APPENDIX E (Continued from Previous Page)  
 EPA Review of Draft Pre-Design Investigation Work Plan  
 Response to Comments Matrix  
 May 10, 2022

#	Reference No.	Document	EPA's Draft Final PDI Work Plan Comments on February 1, 2022	SIB Response on February 17, 2022	EPA's Draft Final PDI Work Plan Comments on April 5, 2022	SIB Response on May 10, 2022
Settlement Agreement and Order on Consent (ASAOC), CERCLA Docket No. 10-2021-001, executed between EPA and the SIB RD Grot						
1a	1001	Sufficiency Assessment Report Data Gaps	<p>Additional information summarizing data gaps identified in the SAR was not provided in the text. Additionally, a crosswalk table of data gaps identified in the SAR was not included nor was that information added to existing tables. Revise the PDI Work Plan to include additional information summarizing data gaps identified in the SAR and a crosswalk table of data collection and SAR-identified data gaps or add information about SAR-identified data gaps to Table 4-1.</p> <p>As a specific example, the SAR identified a VOC groundwater plume associated with End of Swan Island Lagoon (ESCI #3901) as "C(u) Sources not sufficiently controlled because RPCs are present in site media &gt;CUL and/or RAL and there is a direct pathway." As indicated in the SAR, this site is not currently in the DEQ source control program. The plume has the potential to discharge into the project area at concentrations above CULs. The lack of porewater data should be identified as a data gap and sampling incorporated into the future porewater sampling program in order to determine (as indicated in the ASAOC SOW) whether cleanup can go forward and, if or how this source should be integrated into the in-water design.</p> <p>Further, neither Section 4.1 nor Section 4.9 include any discussion of how the PDI data will be used in the SEDCAM modeling. Although the PDI sediment core data may not directly be used for the SEDCAM modeling, the hydrodynamic and sediment transport modeling presumably will be used to develop inputs for SEDCAM. Therefore, at a minimum, revise Section 4.9 to discuss how these models will be used to support the SEDCAM model.</p>	<p>PDI WP Table 4-1 was reorganized and modified to include the data gaps identified in the SAR and to note that those are SAR-identified data gaps.</p> <p>Comment reference to Section 4.9 in the PDI Work Plan is incorrect. Section 4.11.7 Recontamination Potential Evaluation describes how hydrodynamic and sediment transport modeling results will be used to develop SEDCAM inputs as follows:</p> <p>"Recontamination potential evaluations in this section include analysis of sediment movements which when combined with contaminant concentrations from areas of sediment origin, provide input of contaminants from different sources for use in the SEDCAM modeling described in SAR Section 8.6." [Note that this text is not shown in RLISO because it was included as written in the December 2021 submittal.]</p> <p>"[Bullet Point] Generate sediment deposition footprint from simulated outfalls and rates of sediment deposition to be used as input to SEDCAM modeling for recontamination potential evaluation."</p> <p>Section 4.11.7 was amended to describe how the hydrodynamic and sediment transport modeling will be used to develop inputs for SEDCAM as follows:</p> <p>"The hydrodynamic and sediment transport modeling results will be used to develop inputs for SEDCAM. SEDCAM will be applied to multiple locations spatially distributed within the SIB Project Area, and the hydrodynamic and sediment transport modeling results will inform key parameter values at each SEDCAM location. Those parameters will include local sediment deposition rates, scour rates, mixing depth, and COC loading."</p>		
1b	1002	Sufficiency Assessment Report Data Gaps				
2a	1003	SMA Delineation				
2b	1004	SMA Delineation	<p>EPA notes the following potential data gaps:</p> <ul style="list-style-type: none"> <li>Figure 3-2a indicates a historical RAL exceedance for surface sediment sample S220 (PCBs and PeCDD) in cell C25 along the SMA boundary however no new surface sample is proposed in cell B25 to delineate the extent of the SMA boundary. A subsurface sample is proposed in cell B25 and a surface sample should be added to this location or a rationale provided for not further characterizing contamination at depth.</li> <li>Cell B8 has 2 surface samples; 1 has a PCB exceedance. A subsurface sample should be added to cell B8 to delineate contamination vertically or a rationale provided for not further characterizing contamination at depth.</li> <li>Cell B10 contains Post ROD sample A1 which has no exceedances. However, the post ROD sample directly adjacent A2 (cell C10) has above RAL surface concentrations not delineated by depth. A subsurface sample should be added in either C10 or B10 between A1 and A2 to delineate the contamination horizontally and vertically.</li> <li>A subsurface sample is planned for B19. Include a surface sample to delineate the SMA horizontally.</li> <li>PDI Sample B303, located on the boundary of the SMA in grid cell C-28, exceeded PCB and dioxin/furan RALs. Sample G411 was collected from grid cell B-28 (the adjacent grid cell to the north) in 2004, and this sample was not analyzed for dioxins/furans. The Revised PDI Work Plan does not identify this data gap, which has the potential to leave the SMA undelineated adjacent to a riverbank.</li> <li>Add step out subsurface sediment samples adjacent to cells BH and BI (IH and II) and archive in the event that samples from cells BH and BI have RAL or PTW threshold exceedances.</li> </ul> <p>Note that areas under docks and other structures may require additional characterization as part of RD and physical and chemical characterization in those areas should be noted as a data gap in the PDI Work Plan.</p>	<ul style="list-style-type: none"> <li>The surface core interval for cell B25 has been changed from archive to part of the Phase I analysis set</li> <li>Added new core location to cell B8</li> <li>Added new core location to cell B10</li> <li>This cell is reasonably well-covered by historical data, and may not constitute a data gap after planned Phase I analyses. A core surface-sediment interval will be archived in cell B19, and we recommend reviewing data gaps after Phase I to determine whether to analyze this sample.</li> <li>The surface core interval for cell C28 has been changed from archive to part of the Phase I analysis set. The core surface-sediment interval in cell B28 will be archived and reviewed for potential further analysis after Phase I results are received.</li> <li>Added new core locations to cells H0 and I0. These cores will be archived and reviewed for potential analysis in the event cells H1 and I1 have RAL or PTW threshold exceedances.</li> <li>Table 4-1 in the PDI was modified to include physical and chemical characterization in areas under docks and other structures as a data gap in the PDI Work Plan.</li> </ul>	<p>EPA notes that surface sediment samples have been added to the Phase I analysis set in cells B24 and C25. However, no surface sediment sample is currently proposed in the Phase I analysis set in cell B25.</p> <p>Also, there is no surface core sample from cell C28 in the Phase I analysis set identified in FSP Figure 4-3 or FSP Table 4-2. Clarify whether the SIB Group intends to include a surface sediment sample from cell B25 and C28 in the Phase I analysis set and revise the PDI WP accordingly.</p> <p>Additionally, EPA notes the following potential data gaps in vertical delineation of PTW exceedances the SIB Group may choose to address:</p> <ul style="list-style-type: none"> <li>At Cell R6 to bound subsurface PTW contamination at core PSY43.</li> <li>Downstream of Cell N1 (similar to the samples at H0 and I0) to bound PTW Exceedances at PSY34. If collected, this should be a 20-foot sediment core because PSY34 has total PCB PTW threshold and RAL exceedances from 4 to 8 and 8 to 10.8 feet bml, respectively.</li> </ul>	<p>Figures, tables, and text will be updated to confirm that cells B25 and C28 will be sampled as part of Phase I activities.</p> <p>A 10-foot core will be added to cell R6, and a 20-foot core will be added to cell N0. The PDI WP will be updated to reflect these additions.</p> <p>Changes to PDI WP include Tables 3-2 and 4-1 and text Sections 3.1.1, 3.1.2, and 4.1. Changes to FSP include Figures 4-3 and 4-4; FSP Tables 2-1, 4-1, and 4-3, and FSP text in Sections 4.2, 4.2.2, 4.2.3, and 4.2.3.1.</p>
3	1005	Sediment Sampling	<p>EPA appreciates that the text indicates SIB Group will consult with EPA regarding archive sample analysis. Revise the PDI Work Plan to include the proposed analytical schedule for archived samples for EPA review relative to the overall schedule for design. Sediment characterization data gaps will be reevaluated once the PDI data is collected and added to the CSM.</p> <p>Additionally, the Revised PDI Work Plan contains inconsistent information regarding the approach to delineating the depth of contamination (DOC) within the SMA. The FSP (Appendix A) identifies 8 locations that will be advanced to 20 feet below the sediment surface, but these eight deep locations are not discussed in Section 4.1 or Table 4-1. Revise the PDI Work Plan to correct discrepancies regarding the plan for delineating DOC in the project area.</p> <p>Figures 3-3a and 3-3b map subsurface sample locations where DOC was not delineated. These locations are generally located at the head of SIB to the east of Outfall S1, or adjacent to the drydocks at the mouth of SIB. The Revised PDI Work Plan only proposes DOC cores at the head of SIB (generally to the east of Outfall S1). EPA recommends that DOC cores also be advanced adjacent to the drydocks at the mouth of SIB or a rationale be provided for why additional cores are not necessary. Revise the rationale to support selecting sample locations to inform DOC.</p>	<p>Added text to Section 3.1.1 describing analytical schedule and timeframe for conferring with EPA regarding analysis of archived material.</p> <p>Added text regarding depth of contamination data gap locations (8 grid cells) to PDI Section 4.1</p>	<p>The text in Section 4.1 has been revised to identify the locations where 20-foot sediment cores will be collected but does not include the rationale. Revise this section to include the rationale for collecting DOC sediment cores from these locations (i.e., existing data show DOC greater than 10 feet bml). Additionally, EPA recommends that the sediment core in cell J8 be changed to a 20-foot vibracore because sample WLCPSK091-Z has a total PCBs PTW threshold exceedance from 6.8 to 10.8 feet bml.</p>	<p>The core collected from cell J8 will be revised to be a 20-foot core. The PDI WP will be updated to reflect this change.</p> <p>The PDI WP will be updated to provide a description of rationale used in selecting 20-foot core locations as follows:</p> <p>"20-foot core locations are selected to target areas with PTW exceedances that are unbounded in depth near or exceeding 10 feet below mudline, and to a lesser extent areas with unbounded RAL exceedances. Locations were further selected to target areas where the expected remedial technologies are most uncertain, starting near Berth 305 and continuing to the Head of SIB. Eight 20-foot cores will be collected in and near this area, from grid cell columns 18 to 35. A ninth 20-foot core will be collected in the Dry Dock Basin near an unbounded PCB PTW exceedance in grid cell J8, and a tenth 20-foot core will be collected in grid cell N0 just outside the Swan Island Sediment Decision Unit near an unbounded PCB PTW exceedance in grid cell N1."</p>

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4a	1006	Riverbanks	The analytical approach provided for evaluating the historical riverbank samples should be consistent with the Portland Harbor Superfund Site (PHSS) Record of Decision (ROD) (EPA 2017) requirements and EPA's RDGC Appendix D (EPA 2021). The lateral extent of contaminant concentrations exceeding the criteria listed in ROD Table 17 (for riverbank soil) and Table 21 for these historical samples should be evaluated. If historical samples were not analyzed consistent with the ROD and RDGC Appendix D requirements, the evaluation should identify the data gaps.	The text in this section will be revised to include the following: "The historical riverbank sample results were evaluated in Section 6 and Appendix E of the SAR. ROD cleanup level (CUL) and remedial action level (RAL) exceedances were identified. Because the lateral extents of the exceedances were not defined and / or all ROD contaminants of concern (COCs) were not analyzed, these conditions were identified as data gaps for the PDI and additional characterization proposed."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
4b	1007	Riverbanks	The riverbank sampling plan should be included in the PDI Work Plan. The text indicates that 150 transects will be, "targeted for visual inspection and possible sample collection." The riverbank sampling plan should include the data quality objectives, planned sampling locations, and sampling methods (including contingency plans).	The riverbank sampling will be conducted in two phases. The first phase of the proposed riverbank characterization will be a visual assessment of the riverbank to evaluate erodibility and bank condition. The first phase is necessary to identify sample locations. After the visual inspection, HGL will evaluate bank stability using the BANCs model and prepare a riverbank sampling plan as an addendum to the PDI Work Plan with the data quality objectives and proposed sampling locations and analyses. The riverbank sampling plan will be provided to EPA for review and approval prior to sampling. Sampling methods are described in Section 4.3 of the Field Sampling Plan. The will be revised to clarify the two phased approach and specify the preparation of the riverbank soil sampling plan for EPA review and approval prior to conducting the second phase sampling.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
5	1008	Data Sources	Data used in remedial design (RD) deliverables should come from the Portland Harbor Environmental Data Portal. Verify that the sediment data included in the PDIWP was from the datasets provided at the following links or currently in review by EPA (See below). The text data not included in the approved or in review data sets should either be removed or be clearly distinguishable on all figures and tables.	Interpolations and statistics will be revised to be based only on EPA-approved data or data currently in review by EPA. Report interpolations, figures, and tables will be revised to remove data that are not approved by EPA. Report text will be updated to list the EPA-approved data sources as the basis of RD deliverables.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
5a	1009	Data Sources	RI/FS data (Remedial Investigation Database and Feasibility Study Database): <a href="http://ph-public-data.com/document/CDMSmith2018/">http://ph-public-data.com/document/CDMSmith2018/</a>	Please see Response to Comment #1008.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
5b	1010	Data Sources	Pre-RD Investigation and Baseline Sampling data: <a href="http://ph-public-data.com/document/PHRD_2019">http://ph-public-data.com/document/PHRD_2019</a>	Please see Response to Comment #1008.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
5c	1011	Data Sources	Pacific Groundwater Group, 2019. Surface and Subsurface Sediment Field Sampling and Data Report, Swan Island Lagoon, Portland Harbor Superfund Site. Prepared for Daimler Trucks North America LLC (DTNA). Data in review by EPA	Please see Response to Comment #1008.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
5d	1012	Data Sources	Pacific Groundwater Group, 2019. Surface and Subsurface Sediment Field Sampling and Data Report, Swan Island Lagoon, Portland Harbor Superfund Site. Prepared for de maximis, inc. Data in review by EPA	Please see Response to Comment #1008.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
6	1013	Habitat Conditions Data Collections	EPA appreciates the initiative to collect these data. EPA recommends habitat data be collected to inform the Habitat Equivalency Analysis (HEA) based approach, which enables quantification of pre- and post-remedial habitat conditions to determine potential mitigation requirements, as described in Specific Comments on Section 3.11.	The data collection to characterize habitat conditions will be utilized to inform a HEA-based approach that will enable quantification of pre- and post-remedial habitat conditions to determine potential mitigation requirements, if any, as described in Section 3.11 The HEA-based approach is commonly utilized to determine and quantify - where possible - unavoidable impacts by the required remediation. This approach will be supplemented as needed based upon through ongoing technical discussions with EPA technical team members.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
7	1014	Seepage and Porewater Data	Empirical methods to measure groundwater seepage should be considered in the current PDI Work Plan or the text should be revised to clarify when such empirical measurements are expected to be completed for cap design (e.g., a subsequent stage of the PDI or the supplemental PDI). Comparative measurements of temperature and specific conductance in sediment porewater and overlying surface water can identify general locations of upwelling but do not provide a quantitative measure of the upwelling rates which can be of the most benefit to this sensitive modeling parameter. Similarly, porewater concentrations for ROD Table 17 contaminants will also be required for cap design so the text should clarify when porewater chemistry data is expected to be collected.	The text will be modified to clarify that the porewater evaluation will be completed in two phases. The first phase, as currently proposed, focuses on mapping the locations where upward migration of porewater is currently occurring in SIB sediments. The text will be amended to describe the second phase of porewater characterization for cap evaluation. The second phase will include empirical methods to measure groundwater seepage and porewater sampling to characterize porewater chemistry. The results of the first phase are needed to determine the locations and quantities of samples and groundwater seepage measurements. The text will be modified to state that HGL will prepare and submit a Phase 2 sampling and field measurement plan to EPA for review and approval prior to advancing the second phase of the study.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
8	1015	Cap Design Data Needs	Data and engineering study needs to support cap design are incomplete. Engineering described in the PDI Work Plan to inform cap design are limited to cap physical stability. Clarify how the sampling proposed in the PDI Work Plan is expected to inform chemical isolation layer design requirements for the cap. The PDI Work Plan should more clearly identify data gaps relevant to inform cap design, a cap treatability study (noted in Worksheets #14 and #16 of the QAPP), and any other engineering evaluations needed to support RD. These data gaps should include sampling for site-specific porewater concentrations and groundwater seepage rates in areas where porewater upwelling is measured and/or caps may be required.	Text revisions to the porewater study will also address this comment (see response to previous comment). Specifically, the second phase of the porewater study will include collecting and analyzing porewater samples and making field measurements of groundwater seepage. The design analyses to support cap design and evaluate cap stability are not part of the PDI, but instead will be conducted either as part of the Basis of Design report or first design submittal. The discussion of the porewater study will be amended to explicitly identify the data needs for the anticipated cap design and evaluation, and show how the proposed data collection addresses those data needs. Regarding the cap treatability study, that study has not yet been designed, and it is not proposed as part of the PDI. The cap treatability study will be designed and implemented on a parallel track with the PDI, and it will go through separate EPA review and approval.	The response is acceptable pending EPA's review of the revised PDI Work Plan.

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4a	1006	Riverbanks				
4b	1007	Riverbanks				
5	1008	Data Sources	Section 3.1 indicates that the RD will not rely on the data set from the 2015 Kleinfelder investigation, which has not been approved by EPA, but may consider it a qualitative reference within the SIB project area. Revise the text to clearly identify when and how unapproved data are used qualitatively.	There are no plans at this time to use non-approved EPA data qualitatively. Removed text from Section 3.1 stating KFR may be used qualitatively. Revised statement, after deletion, reads, "EPA has not accepted the data set from the Kleinfelder investigation in 2015 and the RD will not rely on that data."		
5a	1009	Data Sources				
5b	1010	Data Sources				
5c	1011	Data Sources				
5d	1012	Data Sources				
6	1013	Habitat Conditions Data Collections				
7	1014	Seepage and Porewater Data	The text mentions future groundwater seepage and porewater chemistry sampling but does not clearly state that sampling will be included in Phase 2 as is indicated in several SIB Group responses. Revise the text to include an explicit discussion of the sampling planned for Phase 2.  Additionally, porewater chemistry should be noted as a data gap in Table 4-1 and FSP Table 2-1, and the anticipated time at which that data gap will be filled should be noted (e.g., Phase 2 PDI).	Text was added to clearly state that sampling will be included in Phase 2: "The survey described above is the first phase of a two-phase approach to characterizing porewater chemistry and groundwater upwelling rates. Porewater sampling and analysis will be included in Phase 2 to characterize porewater chemistry. After the results of the Phase 1 porewater upwelling mapping effort are completed, HGL will use those results to prepare a sampling and analysis plan for characterizing porewater chemistry and migration rates in the areas where groundwater seepage occurs. That future porewater sampling and analysis plan will be provided to EPA for review as an addendum to the PDI Work Plan and FSP."  The second to last paragraph of Section 4.2 was revised to read, "The upwelling survey results will be overlaid on proposed cap areas and used to identify future collection stations for quantitative measurements of seepage rates in proposed cap areas for cap modeling. Seepage rate data collection methods and locations will be described in a future porewater sampling and analysis plan that will be provided to EPA for review as an addendum to the PDI Work Plan and FSP."		
8	1015	Cap Design Data Needs	Revise the text related to the cap treatability study to describe the plan indicated in SIB Group's response. Worksheets #14 and #16 of the QAPP have not been revised and still show that the treatability study was supposed to be submitted to EPA on October 27, 2021.	Worksheets #14 and #16 of the QAPP were revised to show that work plan development for the treatability study will be initiated in 2022 and the first draft of the treatability study work plan will be submitted to EPA October 24, 2022 to allow consideration of Phase 1 Porewater Study results in developing that work plan. Subsequent schedule milestone dates for the cap treatability study were also updated. Text in Section 4.2 of the PDI was revised to include a brief description of the vision for the cap treatability study as follows: "A cap treatability study is tentatively planned as a component of the design and evaluation of sediment capping within the SIB Project Area. That cap treatability study is not included as part of the current PDI Work Plan. It will be developed on a parallel track with the PDI and documented in a draft Cap Treatability Study Work Plan that will be submitted to EPA for review tentatively October 2022 to allow consideration of the Phase 1 porewater survey results in developing that work plan. Preliminary concepts for the cap treatability study envision laboratory tests designed to compare alternatives for cap composition, chemical treatment amendments, and thickness."		

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9	1016	Enhanced Natural Recovery	The ROD technology application decision tree identifies ENR as the selected technology for areas within the project area that are outside of the sediment management area (SMA). The PDI Work Plan should acknowledge this requirement more clearly and describe what data collection and evaluations will be used to identify areas where MNR may be an effective remedial technology versus areas where ENR would be necessary to achieve CULs. Data gaps relevant to this evaluation should be identified to ensure that the necessary information will be collected as part of the PDI.	The applicable sections of all documents will be amended to specifically clarify which areas will be potentially subject to MNR and ENR. The revised text will include specific data collection locations and parameters. The text will also include evaluations based upon this data to reflect the selection of the appropriate technology based upon demonstrated compliance with applicable CULs. Specifically, HGL anticipates that there will be few if any areas where MNR would be an effective substitute for ENR. Data collection and analysis efforts relevant to the consideration of MNR include the shoreline reconnaissance for riverbank evaluation, the habitat survey, and the hydrodynamic and sediment dynamic analysis within the project area.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
10	1017	Data Quality Objectives	EPA recommends revising the document to follow EPA's 7 step DQO process for each media (EPA, 240/B-06/001, 2006).	The appropriate documents will be amended to reflect compliance with EPA's 7-step DQO process for each sampled media. While this comment was listed as item#10 in the General Comments of the PDI Work Plan, specific amendments that addresses this comment will be found in the QAPP, the FSP and all other documents where data collection and analyses will be performed.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
11	2001	SRASP			
12	2002	Recontamination Evaluation			
Specific Comments on Preliminary Design Investigation Work Plan					
1	1018	Section 1.3 Conceptual Remedial Design Elements, page 1-4	EPA has the following comments on this section and the text should be revised accordingly:		The response is acceptable pending EPA's review of the revised PDI Work Plan.
1a	1019	Section 1.3 Conceptual Remedial Design Elements, page 1-4	Revise the text in this section and subsequently as appropriate to indicate that confirmation of future land uses is a necessary component of data to be collected for each technology and its application.	Section 1.3 of the PDI Work Plan lists and describes elements that provide the basis for the Conceptual Remedial Design. The text of this section will be amended in the PDI Work Plan and all other appropriate documents as applicable to state "that future land uses are a necessary component when collecting data for the evaluation of the application of each technology."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
1b	1020	Section 1.3 Conceptual Remedial Design Elements, page 1-4	The description of the remediation technology application process in each subsection should be revised for consistency with the remedy selection criteria shown in the ROD technology application decision tree (PDI Work Plan Figure 1-3) and the design requirements described in ROD Section 14.2.9. Application of dredging and capping are based on the locations of RAL and PTW exceedances relative to river regions (i.e., shallow, intermediate, etc.).	Section 1.3 of the PDI Work Plan lists and describes elements that provide the basis for the Conceptual Remedial Design. The text in this section will state "the application of the remediation technology process will demonstrate compliance with the EPA ROD technology application decision tree and the design requirements found in ROD Section 14.2.9. The application of the specific remedial actions of dredging and capping are/will be based on the locations of RAL and PTW exceedances relative to river regions."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
2	1021	Section 1.3.1 Sediment Dredging via Future Maintenance Dredging in the Navigation Channel, page 1-5	This section states that "the entirety of the SIB Project Area is located outside the Federal Navigation Channel and is therefore not subject to the specified future maintenance dredging depths associated with it." This section should be updated to include a discussion of the 50-foot Navigation Channel offset as discussed in Section 5.3.3 of the RDGC, and that the western portion of the site adjacent to the navigation channel is subject to coordination with EPA and USACE to ensure slopes and depths in this area are suitably compatible.	Section 1.3.1 will be amended to include language that addresses the 50' Federal Navigational Channel offset as referenced in Section 5.3.3 of the RDGC. It is acknowledged that the western portion of the SIB site is subject to coordination with USEPA and USACE to ensure that the slopes and depths are suitably compatible. Note that the western portion of the site adjacent to the navigation channel is anticipated to be remediated using ENR, so the remedy is unlikely to result in significant changes in slope or depth in this part of the project area. The text in section 1.3.1 will note the requirement to coordinate with EPA and USACE to ensure slopes and depths in this area are suitably compatible.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
3	1022	Section 1.6 Important Definitions, page 1-9	EPA has the following comments on this section and the text should be revised accordingly:		The response is acceptable pending EPA's review of the revised PDI Work Plan.
3a	1023	Section 1.6 Important Definitions, page 1-9	Cleanup Levels (CULs) – Revise the text to state, "For riverbank soil or sediment, when risk based CULs were less than background concentrations for a given contaminant, background concentrations were selected as the CUL (emphasis added)".	The text will be revised to state, "For riverbank soil or sediment, when risk based CULs were less than background concentrations for a given contaminant, background concentrations were selected as the CUL."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
3b	1024	Section 1.6 Important Definitions, page 1-9	Recontamination Potential Chemicals (RPCs) – The stated approach for identifying RPCs is screening existing surface sediment data against CULs. While the surface sediment screening process/approach may be utilized, it does not remove the need to screen data from all media (e.g., surface sediment, subsurface sediment, groundwater, stormwater, and riverbanks) against ROD criteria to identify sources that may pose a recontamination threat. EPA requests that the identification of RPCs be based on an assessment of all available sediment, riverbank, groundwater, and stormwater data screened against the applicable ROD Table 17 CULs as modified by the 2019 ESD and the 2020 Errata #2 memorandum, and ROD Table 21 RALs and PTW thresholds. The PDI approach should be revised as needed based on review of data from all media.	The stated approach to identifying RPCs will be revised to include the results of the data review from all media from the SAR. The screening of available data for stormwater, groundwater, and riverbank data against applicable ROD Table 17 CULs, as modified by the 2019 ESD and 2020 Errata #2 was performed in Section 6 and Appendix E of the SAR. The following COCs exceeded ROD CULs in riverbank soil: Arsenic, cadmium, copper, lead, mercury, zinc, PCBs, PAHs, and dieldrin. The following COCs exceeded ROD CULs in groundwater: Arsenic, copper, and PAHs. The following COCs exceeded ROD CULs in stormwater: Arsenic, copper, zinc, BEHP, PCBs, cPAHs, and dioxins and furans. All of these COCs were retained as RPCs in surface sediment, except cadmium, copper, lead, zinc, DDX, and total chlordane.	The response is acceptable pending EPA's review of the revised PDI Work Plan. Note that proposing a reduced list of RPCs does not eliminate the requirement that all ROD Tables 17 and 21 contaminants be considered in remedial design. Robust rationale based on analytical results and the CSM must be provided if Table 17 and/or Table 21 contaminants are proposed to be excluded from analysis during remedial design.

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9	1016	Enhanced Natural Recovery	Data gaps related to the ENR evaluation have not been clearly identified in the PDI Work Plan. Furthermore, the text added to Section 1.3.5 should be expanded to clarify what criteria will be considered when evaluating areas for ENR. Revise the text and data gap tables to include this information.	Table 4-1 in the was modified to identify data gaps related to ENR. The following text was added to Section 1.3.5:  "Criteria that will be used to specify locations for ENR are summarized as follows:  • Located outside the SMA but within the project area; • COC concentrations in surface sediments exceed CULs but are less than RALs; and • Sediment deposition occurs at too slow a rate for MNR to be protective. Threshold rate will be determined as part of the sediment transport modeling analysis."		
10	1017	Data Quality Objectives	EPA has the following comments on the DQO-related revisions and the text should be revised accordingly:  a. Revise QAPP Section 11.3.2, page 26 to remove dive crew size. HASP elements of dive crew size will be separately reviewed for any safety deficiencies by EPA. b. Revise each section of 11.3 to include specific standards for each media, e.g. for bathymetry, citing the Hydrographic Surveying Engineering Manual (EM) 1110-2-1003, USACE 2013. c. Revise the DQO to explicitly note where in the WP text details on the number of samples and locations to meet each portion of the objective are found. d. The DQO should more specifically discuss how each piece of collected data will be used as well as error tolerances.	Text was revised as follows:  a. QAPP Section 11.3.2, page 26 was revised to remove dive crew size. b. Section 11.3 was modified to include a table documenting the 7-step DQO process for each of the applicable surveys the table includes reference to specific, applicable standards for each survey. c. The new DQO table in Section 11.3 notes where details are found in the PDI Work Plan text regarding the number of samples and locations to meet each portion of the objective. d. The new DQO table in Section 11.3 describes how each piece of collected data will be used as well as error tolerances.		
11	2001	SRASP	In the event that a discrepancy exists between the Revised PDI Work Plan and the SRASP, note that the SRASP will be used.	Comment noted and agreed.		
12	2002	Recontamination Evaluation	EPA would like to reiterate the following comment, which was also included in EPA's December 17, 2021 comments on the SAR.  All recontamination potential evaluations "should clearly discuss the magnitude of exceedances of screening criteria as the basis for the relative significance of recontamination pathways. EPA recommends further interpreting any CUL exceedances in the context of RDGC, Appendix C Table 3: RAO Monitoring. The table shows how EPA will assess progress toward achieving RAOs using pathway-specific PRGs and spatial scales during long-term monitoring. This information should be used to determine whether ongoing sources that exceed CULs have the potential to impede or delay attainment of RAOs. Note that RAL and PTW threshold exceedances are evaluated on a discrete basis."	Comment noted. No revisions to the PDI Work Plan were made.		
1	1018	Section 1.3 Conceptual Remedial Design Elements, page 1-4				
1a	1019	Section 1.3 Conceptual Remedial Design Elements, page 1-4				
1b	1020	Section 1.3 Conceptual Remedial Design Elements, page 1-4				
2	1021	Section 1.3.1 Sediment Dredging via Future Maintenance Dredging in the Navigation Channel, page 1-5				
3	1022	Section 1.6 Important Definitions, page 1-9				
3a	1023	Section 1.6 Important Definitions, page 1-9				
3b	1024	Section 1.6 Important Definitions, page 1-9	The text was not revised as indicated in SIB Group's response. Update the text to state that RPCs will be based on an assessment of all available sediment, riverbank, groundwater, and stormwater data screened against the applicable ROD Table 17 CULs as modified by the 2019 ESD and the 2020 Errata #2 memorandum, and ROD Table 21 RALs and PTW thresholds.	The text in Section 1.6 pertaining to RPCs was updated to state "RPCs will be based on an assessment of all available sediment, riverbank, groundwater, and stormwater data screened against the applicable ROD Table 17 CULs as modified by the 2019 ESD and the 2020 Errata #2 memorandum, and ROD Table 21 RALs and PTW thresholds."		

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3c	1025	Section 1.6 Important Definitions, page 1-9	Remedial Action Levels (RALs) – Revise text to clarify that the Site-wide RALs in ROD Table 21 apply to the SIB Project Area. Because the Project Area is not in the navigation channel, the Navigation Channel RALs do not apply to SIB SMAs.	The text will be revised to state, "The Site-wide RALs in ROD Table 21 apply to the SIB Project Area."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
4	1026	Section 2 Existing Conditions Overview, page 2-1	EPA has the following comments on this section and the text should be revised accordingly:		The response is acceptable pending EPA's review of the revised PDI Work Plan.
4a	1027	Section 2 Existing Conditions Overview, page 2-1	Per EPA's RDGC Section 4.1, the CSM update should include "contaminant characteristics including the nature and extent of contamination for COCs [contaminants of concern] for all relevant media, sources of contamination, and migration pathways" (EPA 2021). Add a summary of these missing CSM elements or a reference to the SAR.	The Existing Conditions section will be amended to state that for all relevant media, it includes the nature and extent of COC contamination, contamination sources, and migration pathways. A summary of all CSM elements will be included in the applicable documents.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
4b	1028	Section 2 Existing Conditions Overview, page 2-1	EPA recommends adding background information about the Willamette River such as the tribal and ecological history and use. The text should acknowledge that the Willamette River is critical habitat for fish, wildlife, aquatic and terrestrial plants, and birds, and supports several endangered salmon runs as stated in ROD Section 1. Revise the text to refer to the archaeological survey conducted during the RI/FS and highlight any areas of interest in SIB.	The Existing Conditions sections of the PDI Work Plan will be amended to include applicable and relevant background information about the Willamette River including tribal and ecological history and use. The text will state "The Willamette River is critical habitat for fish, wildlife, aquatic and terrestrial plants and birds and supports several endangered salmon runs as stated in the ROD. The archaeological survey conducted during the RI/FS will also be utilized to highlight any areas of interest in the SIB."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
5	1029	Section 2.2 Swan Island Basin Conceptual Site Model, page 2-3	The CSM highlights the quiescent and low energy nature of the lagoon and only discusses vessel traffic in the context of navigational depth requirements. The CSM should also discuss the impacts of vessel traffic on riverbed scour and bank erosion and identify that while the majority of the lagoon is privately owned, there is public access via a beach and boat ramp at the head of the lagoon.	The following two sentences will be added to appropriate locations within the CSM discussion in Section 2.2: "While the lagoon riverbed/banks are typically more stable than those in the main river, vessel traffic in the lagoon may cause mobilization of sediment and potentially erosion in riverbank locations not protected by structure or armoring." and "The majority of the lagoon is privately owned, however there is public access via a beach and boat ramp at the head of the lagoon."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
6	1030	Section 2.2.1 Quiescent Backwater Conditions are Prevalent Withing SIB, page 2-4	EPA has the following comments on this section and the text should be revised accordingly:	Please see responses to Comments #1031 and 1032.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
6a	1031	Section 2.2.1 Quiescent Backwater Conditions are Prevalent Withing SIB, page 2-4	Revise the text to provide a reference for the statement that flow velocities do not exceed 0.1 feet per second and describe the conditions under which the flow velocities exceed 0.1 feet per second and the associated velocities.	Section 2.2.1 will be updated to read "During peak flow conditions in the river, as well as during periods of low flow that result in maximum tidal exchange, current velocities within the SIB interior are typically less than 0.1 feet per second. Current velocities are larger in the mouth of the SIB between the navigation channel and the shipyard, reaching up to roughly 1 foot per second, and can exceed 1 foot per second in the main channel (Coast & Harbor Engineering 2013)."	The response is acceptable pending EPA's review of the revised PDI Work Plan. EPA requests that the cited reference be provided with the revised PDI Work Plan.
6b	1032	Section 2.2.1 Quiescent Backwater Conditions are Prevalent Withing SIB, page 2-4	Provide the technical rationale for the assertion that, "the interior of the SIB remains quiescent and does not convey flood flows in contrast to the main river." Clarify which parts of the Project Area this statement applies to (i.e., inner cove versus the transition zone).	This sentence in Section 2.2.1 will be updated to read "...the SIB does not convey flood flows moving in the main river, because it is a backwater channel. Even during large flood events, the interior of the SIB remains quiescent, with river flow-induced current velocities less than 0.1 feet per second (Coast & Harbor Engineering 2013)."	The response is acceptable pending EPA's review of the revised PDI Work Plan. EPA requests that the cited reference be provided with the revised PDI Work Plan.
7	1033	Section 2.2.2 Sediment Deposition and Scour are Limited by Low Energy Hydrodynamics, page 2-4	Provide a reference or the technical rationale for the statements that deposition is low, and scour is negligible in the Project Area. In addition, discuss deposition and scour due to anthropogenic forces (e.g., propwash from vessel traffic).	Section 2.2.2 will be re-named "Natural River Sediment Deposition and River-Induced Scour are Limited by Low Energy Hydrodynamics in the SIB Interior", and will be updated to read "Quiescent river flow conditions in the SIB interior result in low sediment deposition rates (neutral, between -2.5 to +2.5 centimeters per year), as demonstrated by comparison of hydrographic surveys from both 2002 to 2009 and from 2009 to 2018 (AECOM and Geosyntec 2019). Riverbed scour due to river currents alone is likely negligible, based on observed small current velocities and modeled currents less than 0.1 feet per second (Coast & Harbor Engineering 2013)." The PDI proposes new hydrodynamics analysis to evaluate the anthropogenic effects of vessel traffic on sediment dynamics because that information was identified as a data gap. NOTE: reference to be added is <i>AECOM and Geosyntec, 2019. PDI Evaluation Report, Portland Harbor Pre-Remedial Design Investigation and Baseline Sampling, Portland Harbor Superfund Site, Portland, Oregon.</i>	The response is acceptable pending EPA's review of the revised PDI Work Plan.
8	1034	Section 2.2.4 Stormwater Outfalls are the Primary Connected Pathway from Upland Sources to SIB Sediments, page 2-4	Provide robust rationale for the assertion that stormwater outfalls are the "primary connected pathway" or revise the section name.	Section 2.2.4 of the PDI Work Plan will be amended to add a robust rationale for the statement noted in the comment. The rationale for focusing on the connected stormwater pathway between upland sources and SIB sediments is based on the CSM published in the ROD and the relative magnitude of the transport capacity for each of the potential transport pathways. The analysis of sources and source control included in the SAR included an evaluation of recontamination pathways, and that evaluation concluded that the stormwater pathway was a primary connected pathway for transporting chemicals from upland sources to SIB sediments. The amended text in Section 2.2.4 will draw on the SAR evaluation. Additionally, the revised text will clarify that this statement applies to future recontamination, and that the relative importance of contaminant transport pathways under past conditions was likely different.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
9	1035	Section 2.2.5 Dredging History Informs Interpretation and Application of Sediment Characterization Data, pages 2-4 through 2-5	Clarify whether there was a lack of records for any period in the provided dredging history. Note whether any years where dredging was not noted are due to a lack of data or whether records confirmed no dredging occurred.	This text of this section will be updated to include a discussion of known periods where dredging did not occur versus periods with historical data gaps. The text will be revised to state: "Records for the shipyard from 1981 to present are well researched and documented in LWG work. However, specific dredging information is not available prior to the 1970s for the SIB and may not be complete for non-shipyard facilities."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
10	1036	Section 3 Data Gaps Analysis, pages 3-1 through 3-8	EPA has the following comments on this section and the text should be revised accordingly:		

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3c	1025	Section 1.6 Important Definitions, page 1-9				
4	1026	Section 2 Existing Conditions Overview, page 2-1				
4a	1027	Section 2 Existing Conditions Overview, page 2-1				
4b	1028	Section 2 Existing Conditions Overview, page 2-1				
5	1029	Section 2.2 Swan Island Basin Conceptual Site Model, page 2-3				
6	1030	Section 2.2.1 Quiescent Backwater Conditions are Prevalent Withing SIB, page 2-4				
6a	1031	Section 2.2.1 Quiescent Backwater Conditions are Prevalent Withing SIB, page 2-4	A reference for the statement that flow velocities do not exceed 0.1 feet per second was provided in the SIB response, but the cited reference was not provided with the revised PDI Work Plan. Provide the cited reference with the revised PDI Work Plan for EPA review.	HGL will transmit an electronic copy of the cited reference to EPA as part of the submittal of the revised PDI scheduled for March 16, 2022.		
6b	1032	Section 2.2.1 Quiescent Backwater Conditions are Prevalent Withing SIB, page 2-4				
7	1033	Section 2.2.2 Sediment Deposition and Scour are Limited by Low Energy Hydrodynamics, page 2-4				
8	1034	Section 2.2.4 Stormwater Outfalls are the Primary Connected Pathway from Upland Sources to SIB Sediments, page 2-4				
9	1035	Section 2.2.5 Dredging History Informs Interpretation and Application of Sediment Characterization Data, pages 2-4 through 2-5	The text of this section was not updated to include a discussion of known periods where dredging did not occur versus periods with historical data gaps. Revise the text as indicated in the SIB Group response.	Added text stating: "Records for the shipyard from 1981 to present are well researched and documented in LWG work. However, specific dredging information is not available prior to the 1970s for the SIB and may not be complete for non-shipyard facilities."		
10	1036	Section 3 Data Gaps Analysis, pages 3-1 through 3-8				

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10a	1037	Section 3 Data Gaps Analysis, pages 3-1 through 3-8	Discuss how the identified data gaps and proposed data collection relate to RD. For example, clarify what RD need(s) the flood impact modeling will serve. Additionally, discuss how the PDI sampling will fill all data gaps associated with the assigned remedial technologies or discuss future plans to fill any remaining data gaps. For example, clarify whether the PDI data will satisfy data needs to evaluate monitored natural recovery (MNR) in the SIB Project Area.	The text in this section will be amended to provide a clear, direct connection between data collection and the technical information required to support the evaluation with the appropriate level of remedy that follows the RDGC. Examples of amended text will include a thorough discussion of the applicability and necessity of flood impact modeling will have on a particular evaluated and selected remedial strategy. HGL will include a crosswalk table to clarify the connection between data collection and addressing data gaps.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
10b	1038	Section 3 Data Gaps Analysis, pages 3-1 through 3-8	The data gaps analysis appears to only consider the spatial density of samples and does not discuss whether every sample has results for relevant Table 17 and/or Table 21 contaminants. Include a discussion of any contaminant-specific data gaps in the text.	Section 3 will be revised to include discussion of Table 17 and/or Table 21 COCs and contaminant-specific data gaps. Discussions will be added such as, "TBT is not analyzed in samples near y. TBT will be analyzed in proposed sample x to fill this data gap."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
11	1039	Section 3.1 Surface/Subsurface Sediment Contaminant Concentrations, pages 3-1 through 3-2	EPA has the following comments on this section and the text should be revised accordingly:		
11a	1040	Section 3.1 Surface/Subsurface Sediment Contaminant Concentrations, pages 3-1 through 3-2	The first line of this section states that "Surface sediment RAL exceedances define SMAs in PHSS." This statement is incorrect and must be revised to include both surface and subsurface exceedances. See General Comment regarding SMA Delineation.	The text of this section will be updated to state: "Surface and subsurface sediment RAL and PTW exceedances define SMAs in PHSS." Further discussion on the role of specific subsurface exceedances and their specific impacts will be included.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
11b	1041	Section 3.1 Surface/Subsurface Sediment Contaminant Concentrations, pages 3-1 through 3-2	One of the goals listed in this PDI is to delineate the extent of PTW. Locations with PTW exceedances should be highlighted on PDI Work Plan Figure 3 series and Appendix A Figure 4 series and differentiate RAL from PTW exceedances. The sampling plan should clearly illustrate an approach to delineating these locations vertically and horizontally.	The Figure 3 series and Appendix A Figure 4 series will be updated to highlight PTW exceedances. The sampling plan will be amended to include discussion of how PTW areas will be delineated vertically and horizontally, as described in Response to Comments #1023, 1024, and 1025.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
12	1042	Section 3.1.1 Surface Sediment Contaminant Concentrations, page 3-2	EPA has the following comments on this section and the text should be revised accordingly:		
12a	1043	Section 3.1.1 Surface Sediment Contaminant Concentrations, page 3-2	This section discusses the data density of surface sediment locations and "step out" data referenced to Figure 3-2. This section should be revised after removal or differentiation and qualification of locations on Figure 3-2 that are not part of the approved database. See General Comment regarding Data Sources.	The discussion of step-out sediment locations will be updated by removing or delineating and qualifying non-EPA approved data sources.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
12b	1044	Section 3.1.1 Surface Sediment Contaminant Concentrations, page 3-2	Remove qualitative descriptors like "modest" and "high degree" of coverage and replacing them with a discussion of percentages of areas where samples are not in conformance with the 150-foot sample to sample distance.	The text of this section will be updated with the specific percentage of grid cells that are not currently in conformance with the 150-foot sample to sample distance, and the terms "modest" and "high degree" will be removed.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
12c	1045	Section 3.1.1 Surface Sediment Contaminant Concentrations, page 3-2	Clarify what is meant by "step out" in the context of the sampling plan. There are no surface grabs indicated on the figures that are listed as step out locations.	Figure 3-2 will be updated to highlight the step out locations referenced in this section. "Step out locations" are defined in Section 3.1.1, but the text may be updated for clarity.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
13	1046	Section 3.1.2 Subsurface Sediment Contaminant Concentrations, page 3-3	This section states that "Conceptually, core locations are identified in each grid cell lacking existing subsurface data by randomly generating x, y coordinates for core collection within each cell." SIB RD Group should provide a rationale for why this approach has been selected and how randomly generated locations will achieve the goals of this PDI or RD plans. EPA generally considers targeted, rather than randomized, sample locations the most appropriate for RD-level SMA delineation.	The text of this section will be revised to locate samples with nominal 150-foot spacing using a 150-foot grid with tolerance for existing sample spacing, vessel accuracy, obstructions, and refusal found due to field conditions. Locations will be judgmentally chosen and where adjustments are made, explanations of locations will be provided.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
14	1047	Section 3.3 Stormwater Discharge, page 3-4	EPA has the following comments on this section and the text should be revised accordingly:		
14a	1048	Section 3.3 Stormwater Discharge, page 3-4	Revise the text in PDI Work Plan Section 3.3 to clarify which outfalls are planned to be sampled as part of the PDI. The following text implies that sampling will occur at private outfall basins: "the collection of additional source control data within city of Portland outfall basins M-1, M-2, M-3, S-1, and S-2, and select private outfall basins..." However, Section 4.3 and Figure 4-2 only describe PDI sampling for the City of Portland outfalls. Appendix A  Section 4.5 also indicates that private outfalls will be sampled, and that text should be revised as needed to clarify which private outfalls will be sampled or the process for determining which outfalls will be sampled.	The purpose of Section 3.3 of the PDI Work Plan is to provide an overview of the data gaps related to the stormwater discharge pathway. Pursuant to the August 19 call with EPA, HGL will be preparing a separate PDI Work Plan or FSP addendum for the proposed scope of work for stormwater sampling to include a visual inspection of all active private and public outfalls, with special emphasis on those private outfall discharges with surface water CUL exceedances (10x order of magnitude) and/or are adjacent to RAL or PTW thresholds in the riverbank or adjacent sediment.  Section 4.3 will be updated to identify the private stormwater systems to be sampled including, the USCG MSU, ATT Leasing, Port of Portland Dredge Base, North Basin Watumull LLC outfall, Daimler Trucks North America Corp 5 Wind Tunnel property, and Port of Portland N Lagoon Avenue property. Figure 4-2 of the PDI Work Plan shows the City and private outfalls to be sampled. This initial list of private outfalls to be sampled will be confirmed or modified based on the results of the proposed field reconnaissance and visual inspection of private outfalls.	EPA understands that the proposed scope of work has been refined and provided in the Draft Stormwater and Riverbank Assessment and Sampling Plan based, in part, on the results of the reconnaissance performed on September 22, 2021. EPA appreciates prioritizing sampling stormwater outfalls adjacent to CUL, RAL, or PTW exceedances in sediment. EPA does not recommend a bright line prioritization based on exceedances 10 times the magnitude of the surface water CUL in stormwater; rather, EPA recommends evaluating the frequency and magnitude of CUL exceedances, stormwater discharge volumes, and current and past facility uses when selecting sampling locations. EPA anticipates providing any additional comments on the revised PDI Work Plan or Draft Stormwater and Riverbank Assessment and Sampling Plan as appropriate.

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10a	1037	Section 3 Data Gaps Analysis, pages 3-1 through 3-8	<p>A discussion of applicability and necessity of flood impact modeling on a selected remedial strategy was not included. A crosswalk table of data collection and data gaps was not included nor was information about SAR identified data gaps added to existing tables. Revise the PDI Work Plan to include a discussion of applicability and necessity of flood impact modeling on a selected remedial strategy, a crosswalk table of data collection and data gaps, and/or add information about SAR identified data gaps in existing tables. See also comment reference No. 1001.</p> <p>Additionally, revisions to text in Section 3.1.1 (Surface Sediment Contaminant Concentrations) discuss sediment cores and should be moved to Section 3.1.2 (Subsurface Sediment Contaminant Concentrations).</p>	<p>The first sentence in Section 3.10 was modified to read, "Flood impact evaluation is necessary to confirm that a selected remedial strategy does not result in exacerbated flooding in the surrounding area during heavy rain events." Table 4-1 was modified to attribute SAR-identified data gaps. Flood impact modeling of a selected remedial strategy will be performed as part of the Basis of Design Report and/or RD Work Plan once a remedial strategy has been selected.</p> <p>Revisions to text in Section 3.1.1 (Surface Sediment Contaminant Concentrations) that discuss sediment cores were not moved per the comment. While this discussion refers to cores, the focus of the discussion is that surface sediment information will be obtained by using the top interval of cores for specified locations, and for all cores the top interval will be archived, and if necessary, used to address surface sediment data gaps. This discussion is located in the correct place and was not moved to Section 3.1.2.</p>		
10b	1038	Section 3 Data Gaps Analysis, pages 3-1 through 3-8	Note that data gaps related to Table 17 contaminants must be addressed during RD. It is acceptable to defer that sampling until the remedial technologies have been selected.	Comment noted. Existing discussion in Section 3.1.1 states that the proposed sampling plan and possibly archived samples from the top interval of cores may be used to address COC-specific data gaps. No revisions to the PDI Work Plan were made.		
11	1039	Section 3.1 Surface/Subsurface Sediment Contaminant Concentrations, pages 3-1 through 3-2				
11a	1040	Section 3.1 Surface/Subsurface Sediment Contaminant Concentrations, pages 3-1 through 3-2				
11b	1041	Section 3.1 Surface/Subsurface Sediment Contaminant Concentrations, pages 3-1 through 3-2	Figure 3-3b shows the locations for PTW threshold exceedances, but Appendix A Figure 4 series does not contain similar information. Revise Appendix A Figure 4 series to include the locations for PTW threshold exceedances.	Appendix A Figure 4 series was revised to include the locations for PTW threshold exceedances on FSP Figures 4-2 and 4-4.		
12	1042	Section 3.1.1 Surface Sediment Contaminant Concentrations, page 3-2				
12a	1043	Section 3.1.1 Surface Sediment Contaminant Concentrations, page 3-2				
12b	1044	Section 3.1.1 Surface Sediment Contaminant Concentrations, page 3-2				
12c	1045	Section 3.1.1 Surface Sediment Contaminant Concentrations, page 3-2				
13	1046	Section 3.1.2 Subsurface Sediment Contaminant Concentrations, page 3-3	Sections 3.1.1 and 3.1.2 of the Revised PDI Work Plan state that target coordinates will be randomly generated within each grid cell and then manually adjusted to better meet the 150-foot spacing criteria and that final coordinates will be reported after the fieldwork is complete. However, there is no information about who will be responsible for manually adjusting locations, when the locations will be adjusted (i.e., prior to going into the field, or in the field), and what rationale will be used to inform decision making. As a result of randomization and manual adjustment the distance between proposed samples often exceeds the nominal 150 feet guidance. For example, the subsurface samples in B33 & B34 are approximately 220 feet apart and samples along the SMA boundary C33 and B34 are 250 feet. Additionally, other samples including D25 and E25 are approximately 240 feet apart, D15 & D16 (250 feet), B18 & C18 (200 feet) and various other samples within the design footprint. Revise the PDI Work Plan to provide target sample coordinates and clearly demonstrate that these targeted sampling locations achieve the spatial coverage requirements provided in the RDGC.	Sample locations have been modified to reduce gaps between samples, addressing most gaps greater than 150 ft. All gaps identified by EPA in comment #1046 have been addressed. Remaining gaps larger than 150 feet are not expected to impact remedial design or significantly limit characterization of contamination left in place.		
14	1047	Section 3.3 Stormwater Discharge, page 3-4				
14a	1048	Section 3.3 Stormwater Discharge, page 3-4				

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14b	1049	Section 3.3 Stormwater Discharge, page 3-4	Revise the last sentence in the section to clarify that uplands source control is DEQ's jurisdiction with coordination and input from EPA on upland contamination which may impact the river. Information on upland source control strategy and DEQ and EPA roles in source control is provided in the Portland Harbor Joint Source Control Strategy (JSCS) (DEQ and EPA 2005).	The last sentence of this section will be updated to be consistent with EPA's clarification in this comment: "Uplands source control is ODEQ's jurisdiction with coordination and input from EPA on upland contamination which may impact the river."	The response is mostly acceptable. EPA requests that the text additionally clarify that the EPA is lead for source control at the Navy Reserve and the US Coast Guard sites.
15	1050	Section 3.7 Shoreline and Overwater Structures and Activities, Pages 3-5 through 3-6	SAR Section 7.4 identifies a need for field reconnaissance to assess "coatings/preservatives used on water structures to evaluate the potential significance the piling coatings or treatment processes could have on recontamination potential." Revise the text to discuss this data gap and provide a plan to fill it.	Revise text to state: "Leaching or abrasion of the in-water structures are potential pathways for associated contaminants to reach nearby sediment. There has not been a comprehensive survey of in-water structures or debris in the SIB Project Area, and there is no facility-specific information regarding the presence or absence of contaminants on these structures. A screening level visual inspection of readily accessible in water structures will be conducted as part of shoreline and overwater structures data collection activities. To the extent that wooden and painted steel structures will remain in place as part of the remedy, they may need to be assessed during the RD."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
16	1051	Section 3.11 Habitat Conditions, page 3-7	Revise the third sentence of the first paragraph to replace "RD" with "RA."	This typographical error will be corrected to read RA.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
17	1052	Section 3.11 Habitat Conditions, page 3-7	The definition of shallow water used by the National Marine Fisheries Service (NMFS) is pertinent to the evaluation of potential impacts on ecological resources, specifically impacts on species listed under the Endangered Species Act. NMFS defines shallow water as 0 to -15 feet Columbia River Datum (CRD). Revise the first sentence of the second paragraph to indicate that habitat conditions characterization data collected for shallow water would include the area from 0 to -15 feet CRD.	The first sentence of the of the 2nd paragraph of Section 3.11 will be amended to state "habitat conditions characterization data collected for shallow water will include the area from 0 to -15' CRD which is the NMFS definition of shallow water for the CRD."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
18	1053	Section 3.11 Habitat Conditions, pages 3-7 through 3-8	EPA appreciates the initiative to collect these data. EPA recommends coordination with NMFS as soon as possible to confirm the appropriate habitat conditions data are collected. Habitat conditions characterization data should include evaluation of the active channel margin (ACM), which NMFS defines as the area between ordinary high water and ordinary low water. Revise the text to clarify that the survey will include areas down to -15 feet CRD rather than "e.g., depth down to 2 meters." The characterization should also include the riparian area (above ordinary high water) as well as deep water (below ordinary low water) portions of the project area. In addition to the habitat data described in this section of the PDI Work Plan, EPA recommends habitat data be collected to inform the HEA-based approach, which enables quantification of pre- and post-remedial habitat conditions to determine potential mitigation requirements. Habitat data should be collected along transects at a spacing appropriate to fully describe habitat conditions for input into the HEA. Data should include representative photos at a frequency necessary to capture the habitat conditions along each transect. To inform the HEA, habitat data should include the acreages and conditions of each habitat area where remedial activities will occur, including the following: photos on a transect spacing and photo frequency above and below water that will capture all habitat types and variations in quality for items a-e:	The purpose of the proposed habitat data collection is to provide a preliminary basis for assessing the need, extent, and nature of compensatory mitigation that may be required for impacts to Waters of the United States regulated under Sections 404 and 401 of the Clean Water Act. HEA is commonly used as a basis for evaluating habitat function loss and replacement under the Natural Resources Damages Assessment (NRDA) process. HGL does not anticipate using HEA as part of this analysis because addressing NRDA is not within the scope of work for the RD. The USACE has jurisdiction over Section 404, and EPA has delegated Section 401 authority to Oregon DEQ. HGL requests that EPA broker any coordination with NMFS to discuss habitat characterization requirements necessary to inform a habitat impact assessment under CWA requirements, and HGL requests that such coordination also include USACE and ODEQ regulatory representatives. NMFS would be involved in the impact and mitigation discussion through Endangered Species Act Section 7 consultation initiated by the USACE under Section 404 of the Clean Water Act. HEA may be selected as an analytical tool to inform the impact assessment, but that decision should be made in coordination with the appropriate agencies with regulatory jurisdiction.	Under CERCLA, EPA does not obtain a CWA Section 404 permit from the USACE, but instead has authority to direct the evaluation of habitat impacts to meet the substantive requirements of CWA Section 404. Similarly, USACE does not have a role in consultation with NMFS for implementation of the CERCLA remedy relative to ESA. EPA has initiated programmatic consultation with NMFS for the site-wide cleanup and will direct the project area-specific evaluations under ESA and CWA 404. HEA is the tool that will be used to evaluate habitat pre-and post-remediation for the purposes of complying with CWA Section 404 and, in coordination with NMFS, in compliance with ESA. Therefore, performing parties will need to collect appropriate data to inform the HEA, as described in the EPA comment. EPA, as the decision maker, will ensure implementation of all reasonable NMFS requirements.
18a	1054	Section 3.11 Habitat Conditions, pages 3-7 through 3-8	Riparian habitat conditions (above ordinary high water and less than 400 feet from the ACM): vegetation, substrate, location with respect to historical floodplain, slope, presence of buildings, structures, and riprap	HGL will amend section 3.11 to include photos on a 150 ft transect spacing along the shoreline to inform the characterization of habitat conditions within the target shoreline zone.	The response is acceptable pending EPA's review of the revised PDI Work Plan; however, EPA recommends that conditions between the 150 foot transects that are not represented by the predetermined transect locations be noted to limit potential data gaps. EPA recommends that habitat data adequate to inform the HEA be collected following established procedures for physical habitat characterization. EPA suggests consideration of methods presented in Chapter 8 of the National Rivers and Streams Assessment Field Operations Manual - Non-Wadeable (EPA 2017).

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14b	1049	Section 3.3 Stormwater Discharge, page 3-4	<p>This section states that ROD Table 17 COCs were detected in stormwater and stormwater solids in public and select private outfall basins at concentrations that exceed surface water and/or sediment CULs and/or RALs. This should be qualified with the understanding that source control measures, including removal of stormwater solids with concentrations above RALs, have been implemented since RAL exceedances were detected, and these data are not representative of current conditions.</p> <p>Revise the text to clarify that source control measures have been implemented in some or all cases, and the PDI stormwater sampling will serve to provide updated analytical data representative of current conditions.</p> <p>The last sentence in this section could lead to misinterpretation that the two sites owned by the U.S. Government (U.S. Navy and Marine Reserve Center [Environmental Cleanup Site Information (ECSI) 5109] and adjacent U.S. Coast Guard Marine Safety Unit [ECSI 1338]) are not subject to source control requirements. Revise this sentence to identify EPA as the regulatory authority for source control at the Navy and USCG sites.</p>	<p>The following text has been added to the first paragraph of Section 3.3: ROD Table 17 COCs...before and, in some locations, after best management practices and/or source control measures were implemented, including the removal of solids with ROD Table 17 COCs and/or RALs. As a result, this data may not be representative of current conditions."</p> <p>The text in the second paragraph of Section 3.3 has been updated to indicate that additional stormwater and solids data will provide updated analytical data representative of current conditions. The revised sentence reads, "For the reasons above, the collection of additional stormwater and solids data within city of Portland outfall basins M-1, M-2, M-3, S-1, and S-2, and select private outfall basins, is necessary, to provide updated analytical data representative of current conditions, determine source control sufficiency to complete the SAR and for modeling to assess recontamination potential for SIB (HGL, 2021)."</p> <p>The last sentence of the second paragraph of Section 3.3 has been revised to identify EPA as the regulatory authority for source control at the U.S. Navy and U.S. Coast Guard sites.</p>	<p>EPA appreciates the revisions to Section 3.3 and requests clarification regarding which specific outfalls and/or manholes had RAL exceedances after BMPs were implemented. Revise the text to indicate which locations had RAL exceedances after BMPs were implemented or delete the text.</p>	<p>This sentence will be deleted. While several locations had CUL exceedances after BMPs were implemented (OFM-1, OFM-2, OFS-2 [manhole AAP953], USGG MSU, and SIUF OU3 [Port of Portland N. Lagoon Avenue property] ), the detected post-BMP concentrations, where available, did not exceed the RALs.</p>
15	1050	Section 3.7 Shoreline and Overwater Structures and Activities, Pages 3-5 through 3-6				
16	1051	Section 3.11 Habitat Conditions, page 3-7				
17	1052	Section 3.11 Habitat Conditions, page 3-7				
18	1053	Section 3.11 Habitat Conditions, pages 3-7 through 3-8	<p>Note that under CERCLA, EPA does not obtain a CWA Section 404 permit from the USACE, but instead has authority to direct the evaluation of habitat impacts to meet the substantive requirements of CWA Section 404. Similarly, USACE does not have a role in consultation with NMFS for implementation of the CERCLA remedy relative to ESA. EPA has initiated programmatic consultation with NMFS for the site-wide cleanup and will direct the project area-specific evaluations under ESA and CWA 404. HEA is the tool that will be used to evaluate habitat pre-and post- remediation for the purposes of complying with CWA Section 404 and, in coordination with NMFS, in compliance with ESA. Therefore, performing parties will need to collect appropriate data to inform the HEA, as described in the EPA comment. EPA, as the decision maker, will ensure implementation of all reasonable NMFS requirements. Similarly, EPA has not delegated its authority under CWA Section 401 to DEQ for CERCLA cleanups in which EPA is lead. EPA will seek input from DEQ in its decision making in implementing CWA. Revise the document as appropriate.</p>	<p>The first paragraph of Section 3.11 was revised to read, "EPA has authority to direct the evaluation of habitat impacts to meet the substantive requirements of Clean Water Act (CWA) Section 404. EPA has initiated programmatic consultation with National Marine Fisheries Service (NMFS) for the site-wide cleanup and will direct the project area-specific evaluations under the Endangered Species Act and CWA Section 404. Habitat Equivalency Analysis (HEA) is the tool that EPA will use to evaluate habitat pre-and post-remediation for the purposes of complying with CWA Section 404 and in coordination with NMFS, in compliance with the Endangered Species Act. The purpose of the habitat conditions characterization would be to collect the data needed to inform an HEA-based approach to comparing pre- and post-remediation habitat conditions. EPA, as the decision maker, will ensure implementation of all reasonable NMFS requirements. Similarly, EPA will determine how CWA requirements will be implemented with input from ODEQ."</p> <p>The second paragraph of Section 3.11 was revised to define the habitat data collection study area to include the shoreline within the SIB project area and the vertical extent including the riparian area extending down to -15 ft Columbia River Datum. Additionally, each of the five vertical extent zones were identified, defined, and discussed (e.g., riparian area, active channel margin, shallow water, deep water, and off channel areas).</p> <p>The last paragraph of Section 3.11 was revised to read, "There are no precursors to the habitat characterization work, but it would be most efficient to coordinate the work with any riverbank evaluation survey efforts. The riverbank survey, overwater and shoreline structure surveys, bathymetry surveys, and surface sediment sampling would all be potential sources of data to support completion of the habitat characterization."</p>	<p>EPA is currently in coordination with NMFS to verify the requirements for habitat data collection, including data needs and methods for habitat surveys, that will be used to inform the HEA and for compliance with ESA and CWA. No changes to the habitat data collection are requested.</p>	<p>Noted; HGL will consult with EPA RPM prior to mobilizing for habitat data collection to confirm if additional guidance has been provided at that time.</p>
18a	1054	Section 3.11 Habitat Conditions, pages 3-7 through 3-8				

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18b	1055	Section 3.11 Habitat Conditions, pages 3-7 through 3-8	ACM conditions: slope, vegetation, substrate, presence of riprap, sheetpile/seawall, pilings, suspended structures over channel margins (e.g., docks), and floating structures (e.g., docks)	HGL will amend section 3.11 to include photos on a 150 ft transect spacing along the shoreline to inform the characterization of habitat conditions within the target shoreline zone.	The response is acceptable pending EPA's review of the revised PDI Work Plan; however, EPA recommends that conditions between the 150 foot transects that are not represented by the predetermined transect locations be noted to limit potential data gaps. EPA recommends that habitat data adequate to inform the HEA be collected following established procedures for physical habitat characterization. EPA suggests consideration of methods presented in Chapter 8 of the National Rivers and Streams Assessment Field Operations Manual - Non-Wadeable (EPA 2017).
18c	1056	Section 3.11 Habitat Conditions, pages 3-7 through 3-8	Shallow water conditions: depth, substrate, presence of riprap, sheetpile/seawall, pilings, and suspended and floating structures	HGL will amend section 3.11 to include photos on a 150 ft transect spacing along the shoreline to inform the characterization of habitat conditions within the target shoreline zone.	The response is acceptable pending EPA's review of the revised PDI Work Plan; however, EPA recommends that conditions between the 150 foot transects that are not represented by the predetermined transect locations be noted to limit potential data gaps. EPA recommends that habitat data adequate to inform the HEA be collected following established procedures for physical habitat characterization. EPA suggests consideration of methods presented in Chapter 8 of the National Rivers and Streams Assessment Field Operations Manual - Non-Wadeable (EPA 2017).
18d	1057	Section 3.11 Habitat Conditions, pages 3-7 through 3-8	Deep water conditions: depth, substrate, presence of riprap, sheetpile/seawall, pilings, and suspended and floating structures	HGL will amend section 3.11 to include photos on a 150 ft transect spacing along the shoreline to inform the characterization of habitat conditions within the target shoreline zone.	The response is acceptable pending EPA's review of the revised PDI Work Plan; however, EPA recommends that conditions between the 150 foot transects that are not represented by the predetermined transect locations be noted to limit potential data gaps. EPA recommends that habitat data adequate to inform the HEA be collected following established procedures for physical habitat characterization. EPA suggests consideration of methods presented in Chapter 8 of the National Rivers and Streams Assessment Field Operations Manual - Non-Wadeable (EPA 2017).
18e	1058	Section 3.11 Habitat Conditions, pages 3-7 through 3-8	Off-channel (if present): tributary water temperature and position relative to main channel substrate)	HGL will amend section 3.11 to include photos on a 150 ft transect spacing along the shoreline to inform the characterization of habitat conditions within the target shoreline zone.	The response is acceptable pending EPA's review of the revised PDI Work Plan; however, EPA recommends that conditions between the 150 foot transects that are not represented by the predetermined transect locations be noted to limit potential data gaps. EPA recommends that habitat data adequate to inform the HEA be collected following established procedures for physical habitat characterization. EPA suggests consideration of methods presented in Chapter 8 of the National Rivers and Streams Assessment Field Operations Manual - Non-Wadeable (EPA 2017).
19	1059	Section 4.1 Surface/Subsurface Sediment Contaminant Concentrations, page 4-1	The text states, "COCs may be analyzed using archived material, as needed, to characterize the "leave surface" or fill data gaps identified during the RD." Revise the text to expand the discussion of what conditions would trigger analysis of archived material.	The text will be expanded to discuss what conditions would trigger analysis of archived material, such as a finding of anomalously high concentration.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
20	1060	Section 4.2 Porewater Upwelling Location Survey, page 4-2	EPA has the following comments on this section and the text should be revised accordingly:		
20a	1061	Section 4.2 Porewater Upwelling Location Survey, page 4-2	The text indicates that the transects shown on Figure 4-1 may be deviated from as needed. Revise the text to specify under what conditions these deviations may be warranted and discuss the distance or radius within which a station may be relocated. Any deviations from the PDI Work Plan must be reported to EPA via field change request forms for review and approval prior to implementing the proposed change.	The text will be revised to read: "Measurements may deviate from the proposed transect lines if a strong contrast in surface water and porewater conductivity measurements is recorded in one area along a transect to delineate the extent of that contrast on and around the transect line area and to quantify variability within the potential upwelling zone. The stronger the difference in measurements, the more measurements will be collected in that area to map the extent of the upwelling zone(s). These additional stations will be within 50 feet of the previous station. In addition, deviations from proposed station locations may occur if the substrate is too hard to manually drive the Trident Probe into the sediment or vessels or other over-water features are present during the survey."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
20b	1062	Section 4.2 Porewater Upwelling Location Survey, page 4-2	Add 2 or 3 transects towards the mouth of the Swan Island Basin in the Dry Dock Basin and Berth 312 area or provide a justification for not including any porewater upwelling transects in this area. Revise Figure 4-1 accordingly.	Figure 4-1 has been updated with three transects in the Dry Dock Basin based on accessible locations.	The response is acceptable pending EPA's review of the revised PDI Work Plan.

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18b	1055	Section 3.11 Habitat Conditions, pages 3-7 through 3-8	The PDI Work Plan text was revised to include mention of transects spaced 150 feet apart along the riverbank. There is no description of data collection within the active channel margin (ACM). Revise the text to provide details regarding the collection of HEA-based data for the ACM.	The following text was added to Section 3.11:  " • Active channel margin (ACM) – the area between ordinary high water and ordinary low water."  "Data needs to characterize the ACM are depth, substrate, presence of riprap, sheetpile/seawall, pilings, and suspended and floating structures."		
18c	1056	Section 3.11 Habitat Conditions, pages 3-7 through 3-8	There is no description of data collection within the shallow water areas. Revise the text to provide details regarding the collection of HEA-based data for the shallow water areas.	The following text was added to Section 3.11:  " • Shallow water – the area between 0 and -15 ft Columbia River Datum."  "Data needs to characterize the shallow water area are depth, substrate, presence of riprap, sheetpile/seawall, pilings, and suspended and floating structures."		
18d	1057	Section 3.11 Habitat Conditions, pages 3-7 through 3-8	There is no description of data collection within the deep-water areas. Revise the text to provide details regarding the collection of HEA-based data for the deep-water areas.	The following text was added to Section 3.11:  " • Deep water – the area deeper than -15 ft Columbia River Datum."  "Data needs to characterize the deep water area are depth, substrate, presence of riprap, sheetpile/seawall, pilings, and suspended and floating structures."		
18e	1058	Section 3.11 Habitat Conditions, pages 3-7 through 3-8	There is no description of data collection within the off-channel areas, if present. Revise the text to provide details regarding the collection of HEA-based data for the off-channel areas, if present.	The following text was added to Section 3.11:  " • Off-channel areas - tributaries to the main waterway."  "Data needs to characterize the off-channel areas include are tributary water temperature and position relative to main channel substrate."		
19	1059	Section 4.1 Surface/Subsurface Sediment Contaminant Concentrations, page 4-1				
20	1060	Section 4.2 Porewater Upwelling Location Survey, page 4-2				
20a	1061	Section 4.2 Porewater Upwelling Location Survey, page 4-2				
20b	1062	Section 4.2 Porewater Upwelling Location Survey, page 4-2				

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20c	1063	Section 4.2 Porewater Upwelling Location Survey, page 4-2	The timing of the investigation should be planned during the time of the year when the river surface elevations are dropping, has less tidal fluctuations, and seasonal groundwater levels are elevated. The text indicates that regional groundwater elevations were used to determine the period of greatest potential upwelling. The optimal period of upwelling should be determined based on historical river stage and groundwater data as localized to the project area as possible. This period should be clearly identified in the PDI Work Plan for EPA review and approval before starting the survey.	Section 4.2 will be revised to read: "The timing of the investigation will be planned during the time of the year when the river level is dropping, has less tidal fluctuations, and seasonal groundwater levels are elevated. Based on a review of available data documenting 2002 through 2007 groundwater elevations at former monitoring wells at the Portland Shipyard and Willamette River gage data (Morrison Street Bridge Station), the river drops in February, March, June, and July and groundwater elevations at the Shipyard were highest in February. As a result, the upwelling survey is proposed for February and March 2022 during neap tide windows when there is the least amount of difference between high and low water."	The response is mostly acceptable pending EPA's review of the revised PDI Work Plan. EPA requests that the revised PDI Work Plan also indicate how tidal fluctuations will be accounted for during the porewater upwelling investigation.
20d	1064	Section 4.2 Porewater Upwelling Location Survey, page 4-2	Revise the text to discuss the allowable range of distances between transects and number of stations for each transect shown on Figure 4-1.	The text will be revised to read: "Proposed station distances will vary with distance from the shoreline and have been adjusted for the presence of permanent or semi-permanent structures (Figure 4-1). The proposed survey assumes station distances of 50 feet near the shore and 100 feet away from the shore. Specifically, the proposed survey assumes fifteen 800-foot-wide transects across SIB (with up to 10 stations each where no permanent structures are present) and two 400-foot-wide transects at the head of SIB (8 stations) for a total of up to 158 stations."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
20e	1065	Section 4.2 Porewater Upwelling Location Survey, page 4-2	Revise the text with the expected temperature differentials needed to detect upwelling between surface water and groundwater.	The text will be revised to read: "The detection of upwelling zones between surface water and groundwater will be based primarily on measurements of conductivity with conductivity measurement contrasts with a cutoff of 930 microSiemens per centimeter. The second method will use a combined Z-score of 0.95 for temperature and conductivity contrasts (Coastal Monitoring Associates, 2020). Data Report [for] Trident Probe Transition Zone Water Screening [for] Tube Forgings of America, Inc. / Front Avenue LLCs, 4950, 5034, and 5200 NW Front Avenue, Portland, OR. July."	The response is acceptable pending EPA's review of the revised PDI Work Plan. EPA requests that the cited reference be provided with the revised PDI Work Plan.
20f	1066	Section 4.2 Porewater Upwelling Location Survey, page 4-2	Revise the text to clearly state the uses of the data being collected. EPA's recommendation is that this data is only suitable to locate quantitative seepage rate collection stations for use in cap modeling.	HGL agrees with EPA regarding the data uses. The text will be revised to read: "The upwelling survey results will be overlaid on proposed cap areas and possibly used to identify future collection stations for quantitative measurements of seepage rates and pore water concentrations in proposed cap areas as part of remedial design for cap modeling."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
20g	1067	Section 4.2 Porewater Upwelling Location Survey, page 4-2	EPA recommends revising the text to follow EPA's 7 step DQO process EPA, 2006 EPA/240/B-06/001)	HGL concurs with EPA's recommendation. The text will be revised to apply the following seven steps to the discussion for both the Phase 1 survey (proposed in Draft PDI Work Plan) and the second phase sampling and field measurement effort that will be amended to this discussion in response to other EPA comments. Step 1. State the problem: How will upwelling impact a future remedial cap? Step 2. Identify the Goal of the Study. State how environmental data will be used in meeting objectives and solving the problem, identify study questions, define alternative outcomes. Map upwelling zones for cap design and modeling. Step 3. Identify data inputs needed to answer the question. Define extent of areas, future seepage rates once areas defined. Step 4. Define the boundaries of the study. Step 5. Develop the analytic approach. Step 6. Specify performance or acceptance criteria. Step 7. Develop the plan for developing the data.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
21	1068	Section 4.3 Stormwater Outfall and Conveyance System Sampling, page 4-3	EPA has the following comments on this section and the text should be revised accordingly:		
21a	1069	Section 4.3 Stormwater Outfall and Conveyance System Sampling, page 4-3	Clarify the approach for determining whether private outfalls will be sampled and the process that will be used to sample those outfalls. The text is unclear how the private outfall inventory will be used to determine which private outfalls will be sampled. The specific sampling locations and methods for private outfall sampling should be described in the PDI Work Plan or future supplemental s to allow for EPA review at least 4 weeks before conducting sampling.	Please see response to Comment #1070.	See response to comment #1070.

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20c	1063	Section 4.2 Porewater Upwelling Location Survey, page 4-2	EPA has the following comments, and the text should be revised accordingly:  i. Text in PDI Work Plan Section 4.2 and FSP Section 5.5 states that the upwelling survey will be conducted in February and March 2022 based on an evaluation of groundwater elevation data from former monitoring wells at the Portland Shipyard and Willamette River gauge data (Morrison Street Bridge station). This information needs to be presented as a figure showing changes in river stage and groundwater elevations with time for EPA's review and concurrence of the period of highest upwelling.  ii. EPA notes that the February/March time period is different from the July/August time period identified in the response to this comment. Resolve the inconsistency between the timeframe suggested in SIB Group's response and PDI Work Plan to ensure that the DQO of measurement during the time period of greatest upwelling is demonstrated to EPA and revise the text as appropriate.	i. Figure 4-1b has been generated showing the available groundwater elevation data from the shipyard in the 2000s overlaid on the Willamette River gauge data for the Morrison Street Bridge station. Seasonal groundwater elevation data is available for monitoring wells between 2001 and 2007. Groundwater elevations were higher than river elevations during different seasons, with some plotting consistently close to river elevations, reflecting high connectivity with the river. Some groundwater elevations were relatively static and consistently above river elevations. In addition to the elevation differences between groundwater and river stage, temperature differences between groundwater and surface water enhance the ability of the Trident Probe to detect locations where groundwater upwelling occurs. Temperature differences are stronger earlier in the year versus later in the year in this region according to the professional experience of the consultant operating the Trident probe. Currently, Willamette River discharge and gauge height are very low (below 25th percentile), therefore low river conditions are present. In addition, river temperatures are currently 6-7 degrees Celsius, and will provide a strong contrast with groundwater temperatures (estimated to be between 13 and 15 degrees Celsius). ii. The previous inconsistency in the proposed timeframe for the upwelling survey has been resolved and the text revised.	i. Revise Section 4.2 based on EPA's March 2, 2022 conditional approval of the porewater upwelling survey. As written, Section 4.2 does not discuss the data limitations nor the need for a potential summer upwelling survey. Add text to acknowledge these limitations and the potential summer upwelling survey. Additionally, Section 4.2 states that in late February 2022 groundwater temperatures are "estimated to be between 12 and 15 degrees Celsius." Include a reference or data source for this estimate of groundwater temperature. Revise FSP Section 5.5 to be consistent with PDI WP Section 4.2.  ii. The response and revisions to the PDI WP are acceptable.	i. The following text will be added to Section 4.2: Limitations of the upwelling study are related to the screening-level nature of the measurements, and the limited temporal coverage of the data. While conductivity and temperature provide a good indicator of potential upwelling zones, they can be influenced by processes other than groundwater upwelling and thus need to be considered as a screening level indicator of potential upwelling zones only, and not a quantitative measure of upwelling rates. Quantification of upwelling rates generally requires different methodologies that are most effectively applied after the potential upwelling zones have been identified. The screening survey will be conducted during conditions that are present in February – March 2022 and are thus primarily indicative of that time period. As discussed above, the period is expected to be a favorable time to detect upwelling using conductivity and temperature. However, the actual conditions that are present during the measurement period may vary from what is expected. In addition, seasonal and other temporal variations in river levels and groundwater levels may influence the nature and extent of upwelling zones. To the extent that uncertainty remains in identification of potential upwelling zones following the winter measurement event, some level of verification during the summer period may be considered. The source for estimated groundwater temperatures in late February 2022 was groundwater temperatures measured in groundwater monitoring wells at the Front Avenue Property in the RM9W Project Area (DEQ ECSI 1239) on February 28, 2018 (Bridgewater, 2020 – Interim Report for Source Control Evaluation: Updated Final Groundwater Monitoring Well Installation and Development, 2017 – 2018 Sampling and Analyses, and Proposed Transition Zone Water Sampling and Analyses. Revised August 13). This citation will be added within the parenthetical in Section 4.2: (estimated to be between 12 and 15 degrees Celsius (Bridgewater, 2020)) and to Section 730 References. FSP Section 5.5 will be revised concurrently with revisions in Section 4.2.
20d	1064	Section 4.2 Porewater Upwelling Location Survey, page 4-2				
20e	1065	Section 4.2 Porewater Upwelling Location Survey, page 4-2	The actual added text deviates from what was indicated in the SIB response. Revise the text to be consistent with SIB Group's response. Additionally, EPA requests that the cited reference be provided with the revised PDI Work Plan.	The text has been revised consistent with the SIB Group's September 2021 response, and reads, "The detection of upwelling zones between surface water and groundwater will be based primarily on measurements of conductivity, with conductivity measurement contrasts with a cutoff of 930 microSiemens per centimeter, and; the second method will use a combined Z-score of 0.95 for temperature and conductivity contrasts (Coastal Monitoring Associates, 2020)." The cited reference will be provided as part of the transmittal of the revised PDI Work Plan scheduled for March 16, 2022.		
20f	1066	Section 4.2 Porewater Upwelling Location Survey, page 4-2				
20g	1067	Section 4.2 Porewater Upwelling Location Survey, page 4-2				
21	1068	Section 4.3 Stormwater Outfall and Conveyance System Sampling, page 4-3				
21a	1069	Section 4.3 Stormwater Outfall and Conveyance System Sampling, page 4-3				

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21b	1070	Section 4.3 Stormwater Outfall and Conveyance System Sampling, page 43	The invert elevations at the proposed sampling locations should be identified to support planning and determining whether backflow will be present in stormwater pipes during selected storms. If alternative sampling locations are selected, those locations should be representative of basin discharges.	HGL will remove the entire stormwater SOW from PDI Work Plan and inserting it into an addendum per EPA's suggestion. PDI Work Plan Addendum would include a visual survey of public and private outfalls including upland conveyance systems that discharge to the outfalls. The FSP Addendum would propose sampling all public outfall systems (M1, M2, M3, S1 and S2) since previous stormwater data, CUL level exceedances (10x) are dated, and Sedcam modeling requires more recent data for RPCs. Include a table with manhole locations, pipe sizes and invert elevations, and proposed types of monitoring. Sampling to include grab solids samples prior to sediment trap installation, flow meter installation and modeling, and HVS stormwater sampling. Phase IIb - Propose to sample private systems where stormwater concentrations > 10x CULs or no data available, and discharges are adjacent to CUL, RAL or PTW exceedances in sediment. Instrumentation if private systems will include autosamplers with flow meters. Solids grab samples in system and/or build smaller sediment traps for private pipes to OFs.  The text in this section will be revised as follows: Table X summarizes proposed sample locations in the City's conveyance system and invert elevations to evaluate whether backflow will be present in the conveyance system during selected storms, along with alternative locations in the event that backflow may be anticipated."	See EPA's response in the 9/22/21 EPA Response to Comments Matrix – Early Feedback on Stormwater and Riverbank Responses document.  9/22/21 Comment: Section 3 of the SRASP summarizes proposed sample locations. The five municipal outfall basins are proposed for sampling because of their sizes, age and magnitude of previous concentrations, and large discharge volumes relative to the sizes of private systems that discharge to SIB. In addition, more recent data are needed from the larger city outfall basins for input parameters to the Sedcam recontamination evaluation model. Sampling of seven private outfall basins that directly discharge to SIB are proposed based on historical data, if available, the magnitude and frequency of CUL detections, current and former site operations, and/or presence of CUL or RAL exceedances in the adjacent riverbank or sediment.  EPA appreciates prioritizing sampling stormwater outfalls adjacent to CUL, RAL or PTW exceedances in sediment. EPA does not recommend a bright line prioritization based on a >10X CUL exceedance in stormwater; rather, EPA recommends evaluating the frequency and magnitude of CUL exceedances, stormwater discharge volumes, and current and past facility uses when selecting sampling locations. EPA understands the proposed scope of work will be refined and provided to EPA in a separate PDI Work Plan or FSP addendum based, in part, on the results of the reconnaissance work. EPA anticipates providing additional comments on the PDI Work Plan or FSP addendum, as appropriate.
21c	1071	Section 4.3 Stormwater Outfall and Conveyance System Sampling, page 43	The HVS sampling methodology using the Gravity Marine PR2900 system is a timeweighted sampling method and not flow-weighted sampling. Revise the text accordingly.	Please see response to 21b. The text will be revised as follows: "The HVS sampling methodology using the Gravity Marine PR2900 system is a time-weighted sampling method that targets sampling during the highest flow periods of a sampling event."	EPA understands the proposed scope of work will be refined and provided to EPA in a separate PDI Work Plan or FSP addendum based, in part, on the results of the reconnaissance work. EPA anticipates providing additional comments on the PDI Work Plan or FSP addendum, as appropriate.  The response is mostly acceptable. EPA requests that the text additionally clarify that the method is a time-weighted composite sampling method.
21d	1072	Section 4.3 Stormwater Outfall and Conveyance System Sampling, page 43	The rationale for collecting manual grab solids samples should be clarified in the PDI Work Plan. The data use described in Section 4.3 is to "inform the relative RPC load coming from each major sub-basin." Because sediment traps capture time-integrated sediment that is transported through the conveyance system, sediment trap solids data provide stronger assessment of loading than manual grab samples of deposited sediments.	Include in PDI Work Plan or FSP Addendum for Stormwater Evaluation. The text will be revised in one of these forthcoming documents as follows: "The rationale for collecting manual grab samples from laterals in sub-basins of each City outfall basin, prior to sediment trap deployment, is to collect any materials present in the line in the unlikely event that no solids are collected in the sediment traps. These solids will be archived (frozen) for potential future analyses."	The response is acceptable pending EPA's review of the Draft Stormwater and Riverbank Assessment and Sampling Plan.
21e	1073	Section 4.3 Stormwater Outfall and Conveyance System Sampling, page 43	Provide the rationale for the proposed grab sample at manhole AAQ011. It is unclear what RD data purpose sampling at the upgradient part of the drainage basin serves. See also the Editorial Comment on Section 4.3.	Include in PDI Work Plan of FSP Addendum for Stormwater Evaluation. The text will be revised as follows: "This location is proposed for solids grab sampling in the stormwater system to determine if polychlorinated biphenyls (PCBs) are being tracked from the adjacent property at 3205 N Webster Street and migrating to Swan Island Basin via City outfall M-3 discharges. This site is a former Oregon DEQ cleanup site that formerly dismantled transformers where PCBs were detected in soil. The site was paved and issued a no further action determination in 1992. However, PCBs were detected in solids around this site and along N. Emerson Street to the north in 2013."	The response is acceptable pending EPA's review of the Draft Stormwater and Riverbank Assessment and Sampling Plan.
22	1074	Section 4.4 Riverbank Characterization, page 4-4	EPA has the following comments on this section and the text should be revised accordingly:		

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#	Reference No.	Document	EPA's Draft Final PDI Work Plan Comments on February 1, 2022	SIB Response on February 17, 2022	EPA's Draft Final PDI Work Plan Comments on April 5, 2022	SIB Response on May 10, 2022
21b	1070	Section 4.3 Stormwater Outfall and Conveyance System Sampling, page 4-3				
21c	1071	Section 4.3 Stormwater Outfall and Conveyance System Sampling, page 4-3				
21d	1072	Section 4.3 Stormwater Outfall and Conveyance System Sampling, page 4-3				
21e	1073	Section 4.3 Stormwater Outfall and Conveyance System Sampling, page 4-3				
22	1074	Section 4.4 Riverbank Characterization, page 4-4				

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#	Reference No.	Document	EPA Draft PDI Work Plan Comments on August 13, 2021	SIB Response on September 10, 2021	EPA's October 7, 2021 Reply to Suggested Revisions
22a	1075	Section 4.4 Riverbank Characterization, page 4-4	This section discusses review of historical data. If historical soil data has been collected on the riverbank, these locations should be added to the PDI figures. Additionally, an assessment of the extent of ROD Table 17 (riverbank soil/sediment) and Table 21 contaminants or gaps in the data sets should be included in a series of figures. This data should be included in either this PDI Work Plan or in final PDI data evaluation.	This section will be revised as follows: "The screening of available riverbank data against ROD CULs is summarized in Section 6.1.3 and presented in Section 2 of Appendix E and Tables E.1 through E.4 of the SAR. "	The response is acceptable pending EPA's review of the revised PDI Work Plan.
22b	1076	Section 4.4 Riverbank Characterization, page 4-4	EPA recommends that Incremental Sampling Methodology (ISM) be considered in the forthcoming riverbank sampling work plan for the sandy beach located at the head of the lagoon where public access is provided via a public boat ramp. If ISM is used, the SAP/QAPP development is to follow the Interstate Technology & Regulatory Council's (ITRC) guidance document, Incremental Sampling Methodology. Technical and Regulatory Guidance (ITRC 2012).	HGL agrees that proposed methods should include Incremental Sampling Methodology and will update the PDI Work Plan and FSP text accordingly. The text will be revised as follows: "Incremental Sampling Methodology (ISM) will be followed for sampling the sandy beach at the City's "End of the Swan Island Lagoon" property as follows: Thirty 2-ounce aliquots will be collected from 30 randomly distributed locations and composited into one composite decision unit (DU) sample for ISM processing and analyses in the analytical laboratory."	The response is acceptable pending EPA's review of the revised PDI Work Plan. Note that 30-aliquots per DU may not be enough depending on the size of the DU. Further, EPA would like to clarify that the ITRC guidance was updated in 2020 and should be referred to: <a href="https://ism-2.itrcweb.org/">https://ism-2.itrcweb.org/</a>
23	1077	Section 4.5 Bathymetric and Topographic Surveys, page 4-5	EPA has the following comments on this section and the text should be revised accordingly:	Please see response to Comments #1078, #1079, and #1080.	
23a	1078	Section 4.5 Bathymetric and Topographic Surveys, page 4-5	A topographic/bathymetric survey work and quality control plan needs to be submitted. Contents of the plan should include a general discussion of the work to be performed, target river stage, survey timeframe, information on the specific equipment and software to be used, key personnel involved, and discussions about datums, survey control/frequency of monument checks, lead line, velocity and bar check measurements, data acquisition, and data processing. The FSP must also include details appropriate for the bathymetry equipment being used to show how it is compliant with the minimum standards outlined in the U.S. Army Corps of Engineers (USACE) Engineering Manual (EM) 1110-2-1003, Hydrographic Surveying, dated November 30, 2013 See Appendix A of the Pre-RD Group's Bathymetry Survey Field Sampling Plan for an example (AECOM and Geosyntec 2018), available on the Portland Harbor Environmental Data Portal: <a href="http://ph-publicdata.com/document/AECOM2020/">http://ph-publicdata.com/document/AECOM2020/</a>	A bathymetric survey work plan and quality control plan will be submitted as part of the Final FSP (Appendix A to the Final PDIWP) and will be referenced in Section 4.5 of the Final PDIWP. To clarify, this will not include topographic data collection because no topography data collection is proposed in the PDI (as noted in Section 4.5) due to availability of suitable existing data. Since we are inserting a large work plan after it is developed (significant input from a subcontractor), we cannot quote the text we will insert at this time.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
23b	1079	Section 4.5 Bathymetric and Topographic Surveys, page 4-5	The text states that, "Reasonable approximations will be made in areas where data collection is not feasible (e.g., under vessels)." Revise the text to explicitly state the manner in which such approximations will be made and clarify what efforts will be made around berthing schedules to access areas under vessels.	Section 4.5 will be revised to state "Reasonable bottom elevation approximations will be made in areas where data collection is not feasible (e.g., under permanently moored vessels or large pile-restrained floats), such as filling data gaps using interpolation based on observed slopes, or filling with previous data if analysis shows recent changes are minimal. Side-scan sonar and sub-bottom profiling being performed at different times may also be used to help address bottom elevation data gaps to the extent feasible."	The response is acceptable pending EPA's review of the revised PDI Work Plan. Note that areas characterized with this approach may still present a data gap which would need to be filled later in remedial design.
23c	1080	Section 4.5 Bathymetric and Topographic Surveys, page 4-5	Provide an FSP following EPA's 7 step DQO process for LiDAR and bathymetry data collection as an attachment to the final PDI Work Plan for EPA review.	A bathymetric survey work plan and quality control plan will be submitted as part of the Final FSP (Appendix A to the Final PDIWP), including a summary of the 7 steps for systematic planning using the data quality objectives (DQO) process, and will be referenced in Section 4.5 of the Final PDIWP. No topography data collection is proposed in the PDI (Mobile Terrestrial LiDAR is proposed only to assist in structures/debris detection). Since we are inserting a large work plan after it is developed (significant input from a subcontractor), we cannot quote the text we will insert at this time.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
24	1081	Section 4.6 Geotechnical Sampling, 3rd bullet, page 4-6	EPA has the following comments on this section and the text should be revised accordingly:	Please see response to Comments #1082 and #1083.	
24a	1082	Section 4.6 Geotechnical Sampling, 3rd bullet, page 4-6	Clarify whether the organic content of the soils will be measured as part of the laboratory test program.	The sub-list under the 3rd bullet on page 4-6 will be updated to include: "Organic Content (ASTM, 2020e1)"	The response is acceptable pending EPA's review of the revised PDI Work Plan.

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22a	1075	Section 4.4 Riverbank Characterization, page 4-4	<p>Some description of available riverbank data was added to Section 4.4. The level of detail provided is acceptable at this time; however, EPA expects a comprehensive presentation and evaluation of historical riverbank data to be included with the Phase 2 riverbank FSP.</p> <p>The bullets in Section 4.4, page 4-8 do not include the scenario when ROD Table 21 contaminants exceed the PTW thresholds. The fourth bullet states that remedial technologies to address contaminated riverbank soils with RAL exceedances may include bank stabilization, removal of contaminated soils, and/or capping. Bank stabilization, in and of itself, is not a remedial technology identified in the ROD. EPA understands that riverbanks may be stabilized as a result of removal and/or capping. Revise the first sentence in the fourth bullet to read: "If ROD Table 21 focused COC concentrations exceed the RALs or ROD Table 21 contaminant concentrations exceed the PTW thresholds..." Revise the bullet list summary to address the requirements of EPA's conditional approval of the SRASP and to differentiate actions shown in the second and third bullets.</p> <p>Additionally, revise this section to include the missing footnote 6 and to reference the decision process indicated in RDGC Appendix D Section 4.1.2 in addition to referencing the ROD.</p> <p>Finally, it is not clear why the SIB Group response references Section 6.1.3. There is no Section 6.1.3.</p>	<p>A comprehensive presentation and evaluation of the historical riverbank data will be included in the Phase 2 riverbank FSP.</p> <p>The second and third bullets were edited to highlight the evaluation of erodibility included in the BANCS model.</p> <p>The fourth bullet in Section 4.4, page 4-8 has been revised as follows: "If ROD Table 21 focused COC concentrations exceed the RALs but not the ROD Table 21 COC concentrations PTW thresholds, the vertical and lateral extent of the exceedances will be delineated, a BANCS analysis (or equivalent erodibility evaluation) will be performed to identify erodible and non-erodible conditions, as noted above, and the RD for the riverbank will be designed in accordance with the requirements of the ROD. Remedial technologies to address contaminated riverbank soils may include removal of contaminated soils and/or capping of contaminated soils, supplemented with bank stabilization to resist erosion (e.g., from stormwater runoff, tidal fluctuations, and propeller wash)."</p> <p>A new fifth bullet was added to the list to address the scenario when ROD Table 21 contaminants exceed the PTW thresholds. The new fifth bullet reads, "If ROD Table 21 COC concentrations exceed the PTW thresholds, the vertical and lateral extent of the exceedances will be delineated, a BANCS analysis (or equivalent erodibility evaluation) will be performed to identify erodible and non-erodible conditions, as noted above, and the RD for the riverbank will be designed in accordance with the requirements of the ROD. Remedial technologies to address contaminated riverbank soils may include removal of contaminated soils and/or capping of contaminated soils, supplemented with bank stabilization to resist erosion (e.g., from stormwater runoff, tidal fluctuations, and propeller wash)."</p> <p>Missing footnote 6 was corrected to be footnote 5 and added to the text with the definition of RAO 9 for riverbanks, and a reference to the decision process indicated in RDGC Appendix D Section 4.1.2.</p> <p>The SIB Group comment response reference to Section 6.1.3 (Riverbanks Adjacent to the SIB Project Area), refers to Section 6.1.3 in the Sufficiency Assessment Report.</p>		
22b	1076	Section 4.4 Riverbank Characterization, page 4-4				
23	1077	Section 4.5 Bathymetric and Topographic Surveys, page 4-5				
23a	1078	Section 4.5 Bathymetric and Topographic Surveys, page 4-5				
23b	1079	Section 4.5 Bathymetric and Topographic Surveys, page 4-5				
23c	1080	Section 4.5 Bathymetric and Topographic Surveys, page 4-5				
24	1081	Section 4.6 Geotechnical Sampling, 3rd bullet, page 4-6				
24a	1082	Section 4.6 Geotechnical Sampling, 3rd bullet, page 4-6				

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24b	1083	Section 4.6 Geotechnical Sampling, 3rd bullet, page 4-6	Add Specific Gravity – ASTM D854 to be consistent with Field Sampling Plan (FSP) Table 4-1.	The sub-list under the 3rd bullet on page 4-6 will be updated to include: "Specific Gravity (ASTM, 2014)"	The response is acceptable pending EPA's review of the revised PDI Work Plan.
25	1084	Section 4.6 Geotechnical Sampling, 2nd paragraph, page 4-6	Verify that the example for "other applicable guidance documents" is Ohio Department of Transportation versus Oregon Department of Transportation.	The second paragraph of page 4-6 will be updated to: "...as well as other applicable guidance documents (e.g., Oregon Department of Transportation, Federal Highway Administration)."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
26	1085	Section 4.8 Existing Utilities and Debris Identification Surveys, pages 4-7 through 4-8	The text indicates the use of multi-beam and Table 3-5 describes the use of Mobil Terrestrial LiDAR scans. Clarify whether side-scan sonar is being proposed in areas where multibeam may not work and specify what conditions would call for side-scan sonar. See also General Comment regarding 7 step DQO preparation.	Section 4.8 will be revised to include "Side-scan sonar is being proposed as a supplement to multibeam along the entire shoreline in areas where required due to the presence of higher-elevation marine debris (e.g., broken timber piles) or other obstacles preventing safe vessel access and data capture in the multi-beam survey."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
27	1086	Section 4.9 Hydrodynamics and Sediment Dynamics Measurements, page 4-8	Provide the rationale supporting the proposed locations for the bottom-deployed Acoustic Doppler Current Profilers (ADCPs).	Section 4.9 will be revised to include "The outer bottom-deployed ADCP location was chosen to characterize currents closer to the entrance where river flows enter SIB and recirculate (Coast & Harbor Engineering 2013). The inner bottom-deployed ADCP location was chosen to characterize currents in the more quiescent area within the SIB where velocities are typically less than 0.1 feet per second (Coast & Harbor Engineering 2013). At both locations, consideration was made to avoid potential conflicts with vessel traffic, as well as bottom slope to ensure instrument package stability during the deployment."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
28	1087	Section 4.10 Habitat Conditions Survey, page 4-9	EPA has the following comments on this section and the text should be revised accordingly:		
28a	1088	Section 4.10 Habitat Conditions Survey, page 4-9	Revise this section consistent with EPA comments on Section 3.11 to provide more detail on the habitat conditions data to be collected.	This section will be amended accordingly to provide a clearer and detailed description of habitat conditions to be collected for use in evaluating and selecting the appropriate level of remedy. See response to comment 3.11 and note the need to coordinate with NMFS, USACE, and ODEQ regarding applicability of Clean Water Act Sections 404 and 401 and Endangered Species Act. The purpose of the habitat evaluation is to support the analysis of impacts to Waters of the United States and the determination of whether compensatory mitigation is required under Section 404. The habitat assessment is not related to NRDA.	The response is not acceptable. See EPA response to #1053.
28b	1089	Section 4.10 Habitat Conditions Survey, page 4-9	Provide additional detail for the statement that, "data collection will be conducted in accordance with applicable state and federal guidelines." Discuss which state and federal guidelines are applicable.	Section 4.10 of the PDI Work Plan, Habitat Conditions Survey, will be amended to state "data collection for the survey of habitat conditions will follow all applicable federal and state rules and guidelines. The specific rules and guidelines are typically found within the appropriate federal 404 and 401 permits as well as the applicable Nationwide General Permit for this specific activity. Since this work will be conducted pursuant to CERCLA, it is anticipated that a Permit Equivalent will be issued by the EPA Project Manager that incorporates the regulatory conditions that will guide this work."	The SIB Group will need to collect appropriate data to inform the HEA, as described in the above EPA comment (reference #1053). The PDI Work Plan should describe the methodology for performing the habitat conditions survey
29	1090	Section 4.11.3 Facility Future Use and RA Impact Evaluation, pages 4-10 through 4-11	Revise the text to note that future use evaluations should include an estimate of the structures' remaining design life per ROD Figure 28 Footnote No. 2.	Section 4.11.3 language will be updated to include "Functional structures determination will be performed, including an estimate of the structures' remaining service life."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
30	1091	Section 4.11.5 Dredging Study, page 4-11	Clarify the goals of the geotechnical evaluation bullet on the dredging study. Include any portions of that study (i.e., internal dredge side slopes, slope stability and structural offsets, additional finite element modeling) or any other geotechnical assessments that will be needed to evaluate the dredge design. This section should also identify evaluations for any underground utilities or pipelines that may be in the project area.	The bullet "Geotechnical evaluation;" will be updated to read "Geotechnical evaluation, for the purposes of evaluating potential dredging production rates, slope stability, side slope design, structural offsets, dewatering, and disposal considerations;"	The response is acceptable pending EPA's review of the revised PDI Work Plan.
31	1092	Section 4.11.6 Constructability Assessment, Page 4-12	EPA recommends that the constructability assessment be conducted in coordination with the dredging study and consider all dredging technologies (i.e., mechanical, hydraulic, land-based, and water-based). Additionally, this section should identify any construction monitoring anticipated for seawalls or other structures that may be required as a result of dredging.	Section 4.11.6 will be updated to include "The constructability assessment will be conducted in coordination with the dredging study." and "The constructability assessment will also include a discussion on potential construction monitoring suitable to protect existing functional structures."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
32	1093	Section 4.11.7 Recontamination Potential Evaluation, pages 4-12 through 4-15	EPA has the following comments on this section and the text should be revised accordingly:		

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24b	1083	Section 4.6 Geotechnical Sampling, 3rd bullet, page 4-6				
25	1084	Section 4.6 Geotechnical Sampling, 2nd paragraph, page 4-6				
26	1085	Section 4.8 Existing Utilities and Debris Identification Surveys, pages 4-7 through 4-8				
27	1086	Section 4.9 Hydrodynamics and Sediment Dynamics Measurements, page 4-8				
28	1087	Section 4.10 Habitat Conditions Survey, page 4-9				
28a	1088	Section 4.10 Habitat Conditions Survey, page 4-9	The SIB Group needs to collect appropriate data to inform the HEA, as described in the above EPA comment (reference #1053). The PDI Work Plan should describe the methodology for performing the habitat conditions survey. See also the comment above regarding EPA's authority under CWA 401 during CERCLA cleanup. Also revise Section 10 of the FSP to be consistent with these comments by removing reference to any required permit from USACE for a SLOPES STU variance. EPA decides on the substantive compliance for ARARs listed in Table 25 of the ROD.	See response to comment reference #1053. Section 4.10 of the was amended to include a description of methodology for conducting the habitat conditions survey based on the methods presented in Chapter 8 of the National Rivers and Streams Assessment Field Operations Manual - Non-Wadeable (EPA 2017).Section 10 of the FSP was revised to remove reference to any required permit from USACE for a SLOPES STU variance.		
28b	1089	Section 4.10 Habitat Conditions Survey, page 4-9	The revised PDI Work Plan text indicates a misunderstanding of the purpose, objectives, and use of the habitat conditions data. As described in the EPA comments and responses on Section 3.11, these data are needed to inform the HEA-based approach. The new text referring to federal and state rules and guidelines within the 404 and 401 permits and a nationwide general permit is generally true relative to using nationwide permits as a guide for performing party substantive permit compliance; however, these should not be used to the exclusion of project specific substantive permit compliance examples. Revise the text to note that these federal and state permits do not limit EPA's interpretation of substantive permit requirements and that future deliverables will incorporate Portland Harbor-specific examples as provided in the forthcoming Programmatic Biological Opinion. Reference to a permit equivalent is incorrect and should be deleted. EPA comments on Section 3.11 provide guidance and suggested methodology for the collection of habitat conditions data and should be incorporated into the PDI Work Plan.	Text in Section 4.10 was revised to note that CWA Section 404 and 401 permits do not limit EPA's interpretation of substantive permit requirements and that future deliverables will incorporate Portland Harbor-specific examples as provided in the forthcoming Programmatic Biological Opinion. Reference to a permit equivalent was deleted from Section 4.10. Section 4.10 was amended to describe habitat conditions data collection based on methods described in Chapter 8 of the National Rivers and Streams Assessment Field Operations Manual - Non-Wadeable (EPA 2017).		
29	1090	Section 4.11.3 Facility Future Use and RA Impact Evaluation, pages 4-10 through 4-11				
30	1091	Section 4.11.5 Dredging Study, page 4-11				
31	1092	Section 4.11.6 Constructability Assessment, Page 4-12				
32	1093	Section 4.11.7 Recontamination Potential Evaluation, pages 4-12 through 4-15				

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32a	1094	Section 4.11.7 Recontamination Potential Evaluation, pages 4-12 through 4-15	The text proposes seven recontamination potential analyses. Discuss the RD use these evaluations will serve. For example, clarify whether they are intended to provide a combined contaminant loading estimate for use in the proposed SEDCAM model, i.e., the input of contaminant concentrations in freshly deposited sediment as stated in SAR Section 8.6.	The following will be added to the introduction of Section 4.11.7: "Recontamination potential evaluations in this Section include analysis of sediment movements which, when combined with contaminant concentrations from areas of sediment origin, provide input of contaminants from different sources for use in the SEDCAM modeling described in SAR Section 8.6."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
32b	1095	Section 4.11.7 Recontamination Potential Evaluation, pages 4-12 through 4-15	SAR Section 7.1 states that upstream sediments exceeding CULs could be a source of recontamination; therefore, additional characterization of upstream sediment transport and deposition is needed. The PDI Work Plan proposes sediment sampling in the SIB (Section 4.1) but does not address how sediment data from upstream of the SIB Project Area will be incorporated in the river sediment transport recontamination potential analysis discussed in PDI Work Plan Section 4.11.7. Discuss how upstream sediment data will be incorporated into the modeling analysis (i.e., as a boundary condition or through sediment tracking analysis with sources released from upstream).	The following will be added to the river sediment transport section of Section 4.11.7: "Upstream river sediments will be incorporated into the modeling through sediment tracking analysis with multi-fraction sediment sources within the river upstream of the SIB."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
33	1096	Section 4.11.7 Recontamination Potential Evaluation, Upland Pathways – Direct Discharges (Outfalls) Recontamination Potential, page 4-13	EPA has the following comments on this section and the text should be revised accordingly:		
33a	1097	Section 4.11.7 Recontamination Potential Evaluation, Upland Pathways – Direct Discharges (Outfalls) Recontamination Potential, page 4-13	Discuss the proposed sediment-concentration budget and clarify whether this methodology only applies to direct discharges from outfalls or if it also applies to other potential recontamination pathways.	The term sediment-concentration budget refers to contributing sediment transport inputs from outfalls to the SEDCAM modeling, which also applies to other pathways. The bullet "Evaluation for recontamination potential based on sediment-concentration budget." will be revised to read "Generate sediment deposition footprint from simulated outfalls, and rates of sediment deposition, to be used as input to SEDCAM modeling for recontamination potential evaluation."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
33b	1098	Section 4.11.7 Recontamination Potential Evaluation, Upland Pathways – Direct Discharges (Outfalls) Recontamination Potential, page 4-13	Clarify if outfall discharges will also have a contaminant concentration evaluation similar to overwater sources pathways.	Section 4.11.7 will be updated to include a bullet stating: "Sediment footprints from simulated outfall discharges will be assigned contaminant concentrations based on contaminant concentrations measured during stormwater sampling."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
34	1099	Section 4.11.7 Recontamination Potential Evaluation, Upland Pathways – Overwater Sources (Particulates) Recontamination Potential, page 4-13	Explain what data will be used to characterize over-water discharged particulates and what methodology will be used to simulate their deposition.	Section 4.11.7 will be updated to read: "Data used to characterize over-water contributions will include any available measured concentrations within discharged particulates or estimates based on desktop study, and particulate physical properties relevant to in-water transport (density, diameter, shape). Transport and deposition will be simulated using hydrodynamic modeling combined with particle tracking (Lagrangian) transport simulations."	The response is mostly acceptable pending EPA's review of the revised PDI Work Plan. Include the historical data and/or discuss the desktop studies that that will be used to characterize contaminant concentrations. If insufficient data are available it may be considered a data gap which must be filled to complete the remedial design.
35	1100	Section 4.11.7 Recontamination Potential Evaluation, Resuspension/Scour Pathways – Sediment Releases During Dredging bullet, page 4-15	Resuspension evaluation should compare expected impacts from both hydraulic and mechanical dredging to assist with equipment selection. EPA recommends conducting this in coordination with the dredging study.	A bullet will be added to this section stating "Evaluate releases from both hydraulic and mechanical dredging, in coordination with the Dredging Study."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
36	1101	Section 4.11.8 Cap Stability Evaluations, Cap Stability Evaluation (Erosion) - Anthropogenic Conditions Post-Remedial Action, page 4-16	The text proposes to evaluate impacts on cap stability from anthropogenic conditions and lays out tasks focused on bottom velocities. Revise the text to include wave impacts due to maximum wake generated by expected vessel traffic.	A bullet will be added to this section stating "Evaluate post-remedial action maximum expected vessel-generated waves."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
37	1102	Section 4.11.8 Cap Stability Evaluations, Geotechnical Cap Stability page 4-17	The stability of the cap against the bearing capacity failure mode and filter design should be evaluated in addition to the slope stability failure mode.	Section 4.11.8 will be updated to include "Bearing capacity failure and filter design will be evaluated in general accordance with EPA's <i>Assessment and Remediation of Contaminated Sediments (ARCS) Program Guidance for In-Situ Subaqueous Capping of Contaminated Sediments (EPA 1998)</i> "	The response is acceptable pending EPA's review of the revised PDI Work Plan.
38	1103	Section 4.11.9 Green Remediation Practice Evaluation, page 4-17	EPA has the following comments on this section and the text should be revised accordingly:		

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32a	1094	Section 4.11.7 Recontamination Potential Evaluation, pages 4-12 through 4-15				
32b	1095	Section 4.11.7 Recontamination Potential Evaluation, pages 4-12 through 4-15				
33	1096	Section 4.11.7 Recontamination Potential Evaluation, Upland Pathways – Direct Discharges (Outfalls) Recontamination Potential, page 4-13				
33a	1097	Section 4.11.7 Recontamination Potential Evaluation, Upland Pathways – Direct Discharges (Outfalls) Recontamination Potential, page 4-13				
33b	1098	Section 4.11.7 Recontamination Potential Evaluation, Upland Pathways – Direct Discharges (Outfalls) Recontamination Potential, page 4-13				
34	1099	Section 4.11.7 Recontamination Potential Evaluation, Upland Pathways – Overwater Sources (Particulates) Recontamination Potential, page 4-13	Revise the text to include the historical data and/or discuss the desktop studies that will be used to characterize contaminant concentrations. Revise the text to discuss where collection of under pier cores would be a preferable line of evidence. If insufficient data are available, it will likely be considered a data gap which must be filled to complete the remedial design, such as with under pier core samples which would be a direct measure of recent and historical overwater discharge.	Data sources for analysis of future recontamination potential from overwater sources are under evaluation. The SIB Group requests approval of the PDIWP with the commitment that further coordination with EPA will be performed regarding the appropriate data source(s) prior to commencing the overwater sources portion of the recontamination analysis. The SIB Group does not believe surface sediment samples are a reliable data source for evaluation of overwater sources likely to be present in the future, due to low sedimentation rates in SIB and mixing from multiple pathways. We expect we will need to consider multiple lines of evidence to establish an appropriate range of COC loading values from overwater activities. We anticipate uncertainty in characterizing loading from overwater sources. Sensitivity analysis and intelligent scenario development are key components to how we plan to handle that uncertainty.	Response acceptable based on the SIB Group's commitment that further coordination with EPA will be performed regarding the appropriate data source(s) prior to commencing the overwater sources portion of the recontamination analysis.	Noted; HGL is committed to coordinating with EPA regarding the appropriate data source(s) prior to commencing the overwater sources portion of the recontamination analysis.
35	1100	Section 4.11.7 Recontamination Potential Evaluation, Resuspension/Scour Pathways – Sediment Releases During Dredging bullet, page 4-15				
36	1101	Section 4.11.8 Cap Stability Evaluations, Cap Stability Evaluation (Erosion) - Anthropogenic Conditions Post-Remedial Action, page 4-16				
37	1102	Section 4.11.8 Cap Stability Evaluations, Geotechnical Cap Stability page 4-17				
38	1103	Section 4.11.9 Green Remediation Practice Evaluation, page 4-17				

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38a	1104	Section 4.11.9 Green Remediation Practice Evaluation, page 4-17	This section should make it clear that the intention of the regional and national EPA guidance is to reduce impacts from design investigations as well as construction, e.g., use of alternative fuels in vehicles used for sampling work and construction activities. At a minimum, the following Green Remediation resources should be considered: i. Consideration of Greener Cleanup Activities in the Superfund Cleanup Process ( <a href="https://semspub.epa.gov/work/HQ/100000160.pdf">https://semspub.epa.gov/work/HQ/100000160.pdf</a> ) ii. Green Remediation Best Management Practices: Site Investigation and Environmental Monitoring ( <a href="https://clu.in.org/greenremediation/docs/GR_Fact_Sheet_SI&amp;EM.pdf">https://clu.in.org/greenremediation/docs/GR_Fact_Sheet_SI&amp;EM.pdf</a> ) iii. Green Remediation Best Management Practices: Clean Fuel & Emission Technologies for Site Cleanup ( <a href="https://clu.in.org/greenremediation/docs/Clean_FuelEmis_GR_fact_sheet_8-31-10.pdf">https://clu.in.org/greenremediation/docs/Clean_FuelEmis_GR_fact_sheet_8-31-10.pdf</a> ) iv. Green Remediation Best Management Practices: Integrating Renewable Energy into Site Cleanup ( <a href="https://clu.in.org/greenremediation/docs/integrating_re_into_site_cleanup_factsheet.pdf">https://clu.in.org/greenremediation/docs/integrating_re_into_site_cleanup_factsheet.pdf</a> ) v. Green Remediation Best Management Practices: Materials and Waste Management ( <a href="https://clu.in.org/greenremediation/docs/GR%20BMP%20fact%20sheet_materials&amp;waste.pdf">https://clu.in.org/greenremediation/docs/GR%20BMP%20fact%20sheet_materials&amp;waste.pdf</a> ) vi. Green Remediation Focus ( <a href="https://clu-in.org/greenremediation/dco">https://clu-in.org/greenremediation/dco</a> )	HGL will consider the Green Remediation resources identified in the comment when planning and implementing the PDI. The text has been revised to include the following statement: "Per discussion with EPA on August 19, 2021, the Green Remediation Practice Evaluation will not need to include design investigations, and the Green Remediation Plan will be developed after the Pre-Design Investigation. The design team is committed to using Best Management Practices during the design investigations to minimize their environmental footprint to the extent feasible."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
38b	1105	Section 4.11.9 Green Remediation Practice Evaluation, page 4-17	For the Pre-Design Investigation Report, the Green Remediation Plan should include best management practices that will be implemented during this phase of the project.	See response to Comment #1104.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
38c	1106	Section 4.11.9 Green Remediation Practice Evaluation, page 4-17	Consistent with the Region 10 policy noted above, in either this section or the next iteration of this document (i.e., the Green Remediation Plan) explain how baseline versus reductions in energy and water usage, particulate emissions, waste generation and handling, and other improvements will be tracked and reported during pre-design investigation activities, remedial design, and construction.	Section 4.11.9 will be updated to include "The Green Remediation Plan will include a discussion on how baseline versus reductions in energy and water usage, particulate emissions, waste generation and handling, and other improvements will be tracked and reported during construction."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
38d	1107	Section 4.11.9 Green Remediation Practice Evaluation, page 4-17	While EPA Region 10's Clean and Green Policy is cited, the specific aspects of the regional guidance are not explicitly discussed, e.g., Environmental Management System (EMS) aspects, buying office paper with recycled content, using recycled toner cartridges, etc. Include in the text how this regional guidance was considered.	Section 4.11.9 will be updated to generally describe what regional guidance included in EPA Region 10's Clean and Green Policy will be included in the Green Remediation Practice Evaluation.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
38e	1108	Section 4.11.9 Green Remediation Practice Evaluation, page 4-17	Revise the text to specify when the Green Remediation Plan will be drafted during the design process for EPA review to ensure elements that apply to RD data gathering activities are applied in a timely fashion.	Section 4.11.9 will be updated to include "The Green Remediation Plan will be drafted for EPA review following the pre-design investigation."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
38f	1109	Section 4.11.9 Green Remediation Practice Evaluation, page 4-17	Revise the text to specify when the Green Remediation Plan will be drafted during the design process for EPA review to ensure elements that apply to RD data gathering activities are applied in a timely fashion.	Section 4.11.9 will be updated to include "The Green Remediation Practice Evaluation will address ROD requirements related to construction, such as minimizing transportation of materials and using rail rather than truck transport to the extent practicable."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
39	1110	Section 4.11.10 Flood Impact Evaluation, page 4-18	EPA has the following comments on this section and the text should be revised accordingly:		
39a	1111	Section 4.11.10 Flood Impact Evaluation, page 4-18	The flood impact evaluation does not require 3D modeling. Delete term "3D" from text in parentheses in the first paragraph of section.	"3D" will be removed from the text in parentheses in the first paragraph of Section 4.11.10.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
39b	1112	Section 4.11.10 Flood Impact Evaluation, page 4-18	Revise the text to include a discussion of climate change impacts as another factor to be assessed in the flood impact evaluation. Per the ROD, "uncertainties associated with potential climate change will be incorporated into the flood rise evaluation" (EPA 2017).	A third bullet will be added to Section 4.11.10: "Uncertainties associated with potential climate change effects on future hydrologic conditions affecting the flood rise evaluation will be incorporated into the modeling as a sensitivity analysis."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
40	1113	Section 5.0 PDI Management Plan, page 5-1	The following sentence should be appended to note that field work protocols will conform to state and national COVID-19 guidelines: "At all times, this work will adhere to industry prescribed health and safety practices in the field and in the water."	Section 5.0 will be amended as follows "At all times, this work will adhere to industry prescribed H&S practices in the field and in the water. This also includes any current national, state or local COVID-19 guidelines."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
41	1114	Section 6 Deliverables/Schedule, page 6-1	Include a table that summarizes the proposed schedule for PDI sampling. The table would provide a quick reference to confirm that sampling is planned for the optimum time (e.g., stormwater/outfall sampling and porewater upwelling surveys), as well as confirm that sampling is appropriately staged so as not to interfere with the other sampling efforts (e.g., geotechnical sampling and sediment sampling for chemistry and other parameters). EPA understands that a detailed field schedule is not possible at this time but expects that one will be provided in the final PDI Work Plan prior to mobilization.	Table 6-1, listing the field tasks, will be added to the document. The new table is provided in the Attachments to this RTC document. The following text will be added to Section 6.1: "The proposed schedule for the work is shown in Table 6-1."	The response is acceptable pending EPA's review of the revised PDI Work Plan. The schedule was not appended to the RTC.

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38a	1104	Section 4.11.9 Green Remediation Practice Evaluation, page 4-17				
38b	1105	Section 4.11.9 Green Remediation Practice Evaluation, page 4-17				
38c	1106	Section 4.11.9 Green Remediation Practice Evaluation, page 4-17				
38d	1107	Section 4.11.9 Green Remediation Practice Evaluation, page 4-17				
38e	1108	Section 4.11.9 Green Remediation Practice Evaluation, page 4-17				
38f	1109	Section 4.11.9 Green Remediation Practice Evaluation, page 4-17				
39	1110	Section 4.11.10 Flood Impact Evaluation, page 4-18				
39a	1111	Section 4.11.10 Flood Impact Evaluation, page 4-18				
39b	1112	Section 4.11.10 Flood Impact Evaluation, page 4-18				
40	1113	Section 5.0 PDI Management Plan, page 5-1				
41	1114	Section 6 Deliverables/Schedule, page 6-1	Table 6-1 indicates that the bathymetry and topography surveys were completed from 11/1/2021 to 12/1/2021. Revise the dates to reflect the correct period in 2022 when these survey activities are planned.	Table 6-1 will be updated to reflect the most recent project schedule.		

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42	1115	Section 7.1 Positioning, Horizontal, and Vertical Control, page 7-1	State the frequency at which the onboard fathometer will be checked with physical (i.e., lead line, pole) checks. Describe how any offsets of a certain value or greater will be accounted for with relevant software.	Gravity Marine will provide the frequency of checks and offsets. A bar check will be conducted daily prior to sampling. This will be done by lowering a metal plate at a known distance below the sonar and recording the value. The depth will be analyzed for accuracy based on the draft of the sonar below the waterline. Draft values will be input into the survey navigation software HYPACK. This allows for static offsets to be applied to real time depth data and corrected for accurate depth readings. Any adjustments in the draft value will be measured and input directly in the hardware configuration of the HYPACK survey software prior to sampling.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
43	1116	Section 7.2.1 Positioning at Sediment Sample Stations, page 7-1	Revise the text to note the fixed survey benchmark being selected. The FSP should describe which monuments will be used and when the position check(s) will be performed. The FSP should verify that these monuments are adequate for the survey to be performed. Provide a table showing primary and secondary monuments and include the monument name, coordinates, and elevation. To relate this project to previously collected data, the monuments should consist of the previously established monuments, to the extent possible. If any of the previous monuments will not be used, justification for using different monuments should be provided. A primary monument should be shot at the beginning and end of the survey, at a minimum. If a monument is not easily accessible during surveying, a new monument should be established as close as possible to the original monument and any deviations should be noted in the final report. Provide all monument elevations in NAVD88 and provide a conversion factor value for any monument elevations that are converted from a different reference elevation. The location of the established monuments to be used for position checks should be shown on a figure.	GNSS checks will be performed with the vessel, and will record horizontal but not vertical data. Section 7.3.1 will be updated with a full description of the positioning procedures, provided by Gravity Marine.  Alternatively, HGL could use the same SOP used by Gravity Marine in other Portland Harbor PDI work because it is accepted by EPA at other sites and significantly easier to perform. Gravity Marine can also follow procedures written in-text currently, if requested. Above text assumes change, need updated comment response if the existing procedures are kept.  HGL will work with EPA to determine the preferred SOP.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
44	1117	Table 3-3 Data Gap Analysis – Geotechnical Site Characterization	The list of engineering analyses under the “Site Specific Geotechnical Design Parameters” data requirement item should also include an evaluation of bearing capacity mode of failure for the cap.	Table 3-3 will be updated to include "Evaluation of the cap bearing capacity failure mode."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
45	1118	Table 3-4 Data Gap Analysis – Shoreline and Overwater Structures	Revise the table to include the estimated remaining service life of shoreline and overwater structures as a data requirement.	Table 3-4 will be revised by adding the following: "- Data Requirement: Functional structures evaluation - Existing Data Summary: Some as-built design plans are available for various fixed structures within the shipyard, but no remaining service life information is available. - Data Gap to be Filled: Current condition assessments of shoreline and over-water structures, and structural evaluation to estimate remaining service life."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
46	1119	Table 3-6 Data Gap Analysis – Hydrodynamics and Sediment Dynamics	A 3D hydrodynamic and sediment transport model is proposed to fill a data gap for currents and water levels. However, being a freshwater tidal system (i.e., lacking salinity and/or thermal stratification) a 2D model will be adequate. Review and revise the proposed modeling approach, as needed. EPA recommends collecting data when water levels are low.	The referenced bullet will be revised to state “Numerical modeling results will be generated using a river-wide 2D hydrodynamic model, with local 3D hydrodynamic modeling performed on a limited basis as needed.”	The response is acceptable pending EPA's review of the revised PDI Work Plan.
47	1120	Table 3-6 Data Gap Analysis – Hydrodynamics and Sediment Dynamics	EPA has the following comments on this section and the text should be revised accordingly:		
47a	1121	Table 3-6 Data Gap Analysis – Hydrodynamics and Sediment Dynamics	The table should be expanded to include data on climate change (as relates to anticipate associated with potential climate change will be incorporated into the flood rise evaluation and cap design elements”. See RDGC Section 5.2.12 for additional guidance (EPA 2021).	A row called "Climate change" will be added to the table, with a summary of relevant existing data/literature, and data gaps to be filled by literature review and research during the PDI.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
47b	1122	Table 3-6 Data Gap Analysis – Hydrodynamics and Sediment Dynamics	Conceptual fluid design modeling of propeller wash is proposed. The table should be expanded to include EPA guidance (Palermo et al., 1998, RDGC) on incorporating propeller wash impacts on cap design.	On the Propeller wash row, the <i>Existing Data Summary</i> column will be updated to include a third bullet “EPA guidance (Palermo et al., 1998, RDGC) on incorporating propeller wash impacts on cap design.” NOTE: the cited bullet should have read “Computational Fluid Dynamics (CFD) modeling of propeller wash based on vessel traffic evaluation.”	The response is acceptable pending EPA's review of the revised PDI Work Plan.
48	1123	Figure 1-2 Technology Assignments, Selected Remedy	Section 1.1 indicates that Figure 1-2 shows the Project Area technology assignments as depicted in the ROD. However, Figure 1-2 does not match the technology assignments indicated on Figure 31d of the ROD; namely, Figure 1-2 does not show capping as the assigned technology under Pier A. Revise the figure to address the discrepancy.	Figure 1-2 will be revised to show capping as the assigned technology under Pier A.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
49	1124	Figures 3 Series	EPA has the following comments on this section and the text should be revised accordingly:		
49a	1125	Figures 3 Series	Different symbols should be used to differentiate sampling events.	The Figure 3 series will be updated to use different symbols to differentiate sampling events. Due to the large number of investigations that comprise the EPA RI/FS data in SIB, the RI/FS data will use a single symbol whereas post-ROD events will have unique symbols	The response is acceptable pending EPA's review of the revised PDI Work Plan.

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42	1115	Section 7.1 Positioning, Horizontal, and Vertical Control, page 7-1				
43	1116	Section 7.2.1 Positioning at Sediment Sample Stations, page 7-1				
44	1117	Table 3-3 Data Gap Analysis – Geotechnical Site Characterization				
45	1118	Table 3-4 Data Gap Analysis – Shoreline and Overwater Structures				
46	1119	Table 3-6 Data Gap Analysis – Hydrodynamics and Sediment Dynamics				
47	1120	Table 3-6 Data Gap Analysis – Hydrodynamics and Sediment Dynamics				
47a	1121	Table 3-6 Data Gap Analysis – Hydrodynamics and Sediment Dynamics				
47b	1122	Table 3-6 Data Gap Analysis – Hydrodynamics and Sediment Dynamics				
48	1123	Figure 1-2 Technology Assignments, Selected Remedy				
49	1124	Figures 3 Series				
49a	1125	Figures 3 Series				

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49b	1126	Figures 3 Series	The current scale of the figures is too large and lacks data required for EPA or stakeholders to perform a timely review. EPA recommends having an overview figure and then zooming in to locations such that sample ID's can be added to proposed and historical cores.	The noted figures will be zoomed in and sample IDs added.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
49c	1127	Figures 3 Series	Evaluation of bathymetric data should be included to support sampling decisions. Add contours to the figures and, if needed, the scales should be adjusted.	Bathymetry contours will be added to support sampling decisions.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
49d	1128	Figures 3 Series	Revise the figures to depict the location, name, and contaminant identified. For additional clarity, include the concentration of the contaminant, depth interval, and indication if that location is vertically delineated with two consecutive 1-foot sampling intervals below applicable RAL or PTW thresholds (see Section 5.1.2 of the RDGC).	Figures and tables will support vertical delineation of RAL or PTW discussion, providing location, name, and contaminant identified, including depth and indication if that location is vertically delineated with two consecutive 1-foot sampling intervals below RAL or PTW or justification why that information is not needed.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
49e	1129	Figures 3 Series	Add the demarcation of the shallow zone, intermediate zone, approximate top of bank, and approximate future maintenance dredge areas on all figures.	The Figure 3 series will be updated to delineate shallow zone, intermediate zone, approximate top of bank, and approximate future maintenance dredge areas.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
50	1130	Figures 3-2 and 3-3	As discussed in the Approved Sample Databases general comment, only samples from approved data sets should be provided on the data gaps assessment figures. Remove or differentiate all non-approved surface and subsurface locations.	Figures 3-2 and 3-3 will be revised to differentiate non-approved data.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
51	1131	Figures 4-3 and 4-5	Ensure that the bathymetry FSP, once submitted, indicates the target overlap of bathymetry and LiDAR surveys to meet DQOs along with river elevation ranges necessary to achieve each survey successfully.	A bathymetric survey work plan and quality control plan will be submitted as part of the Final FSP (Appendix A to the Final PDIWP) and will be referenced in Section 4.5 of the Final PDIWP, including a summary of the 7 steps for systematic planning using the data quality objectives (DQO) process. No topography data collection is proposed in the PDI (as noted in Section 4.5) due to availability of suitable existing data. The bathymetric survey work plan will indicate target elevations to ensure adequate overlap with the existing topographic survey data. Since we are inserting a large work plan after it is developed (significant input from a subcontractor), we cannot quote the text we will insert at this time.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
52	2003	Section 6.2 Engineering Study Elements of the PDI, page 6-2			
53	2004	Figure 3-2 and 3-3 Series			
53a	2005				
53b	2006				
53c	2007				
53d	2008				

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49b	1126	Figures 3 Series				
49c	1127	Figures 3 Series				
49d	1128	Figures 3 Series				
49e	1129	Figures 3 Series	Figures 3-1a through 3-1d illustrate revised Portland Harbor Site regions, including a smaller future maintenance dredge area compared to what was presented in the ROD. The Revised PDI Work Plan should discuss these changes, including sources of information, how these changes may affect the application of remedial technologies, and whether these revised areas have been accepted by EPA for use in the RD.	Discussion was added to PDI Work Plan Section 3.1 regarding updates to approximate future maintenance dredge areas compared to what was presented in the ROD. New text reads:  "Note that future maintenance dredge (FMD) areas portrayed on Figures 3-1a to 3-1d differ from what was shown in the ROD, and EPA has not yet accepted these areas for use in the RD. Section 2.2.6 of this PDI Work Plan identifies current and future navigation depth requirements for the SIB Project Area as a data gap. The approximate FMD areas shown in Figures 3-1a to 3-1d are preliminary and based on preliminary information provided by a subset of the shoreline property users. The FMD areas that will be used to inform the RD will be mapped based on the results of the proposed facility owner/operator interviews, which will include a survey of waterway users (see Section 4.11.2 of this PDI Work Plan). Any revisions to the map of FMD areas will be reported to EPA in the PDI Evaluation Report and subject to EPA review and acceptance prior to using them to inform technology applications and RD development."  The bullet list in Section 4.11.2 (Facility Owner/Operator Interviews) was amended to include this new bullet point: "Determine the current and future navigation depth requirements for the SIB Project Area."		
50	1130	Figures 3-2 and 3-3				
51	1131	Figures 4-3 and 4-5				
52	2003	Section 6.2 Engineering Study Elements of the PDI, page 6-2	Revise the text to clarify that this is not a fully inclusive list of all engineering evaluations required for RD or revise the list to include all engineering evaluations in the RDGC (EPA 2021).	Text in Section 6.2 was revised to by adding, "This is not a fully inclusive list of all engineering evaluations required for RD. Additional engineering evaluations will be identified and documented in the Basis of Design Report, the RD Work Plan, and subsequent design submittals."		
53	2004	Figure 3-2 and 3-3 Series	EPA has the following comments on these figures and the figures should be revised accordingly:	Noted.		
53a	2005		The grid cell identification letters and numbers are missing from these figures, making them difficult to cross reference with FSP Tables and Figures that identify proposed sample locations. Revise the figures to include the grid cell identification letters and numbers.	Figures 3-2 and 3-3 series were modified to add the grid cell identification letters and numbers.		
53b	2006		The circles surrounding the sample location symbols make the figure difficult to review. Revise the figures to more clearly identify CUL, RAL, and PTW threshold exceedances by changing the color of the sample location symbol itself.	A new surface-sediment CUL-exceedance figure, now Figure 3-2a, has been added to the PDI. Figure symbols on Figures 3-2 and 3-3 series were revised to more clearly identify CUL, RAL, and PTW threshold exceedances.		
53c	2007		It is unclear why the sample location symbols differentiate "Post-ROD" and "PDI" sample locations. Revise the figures or clarify in the text the difference between "Post-ROD" and "PDI" sample locations.	The legend of the Figures 3-2 and 3-3 series for historical sample points have been renamed to "RI/FS", "PDI", and "Other Studies" to resolve the ambiguity between "PDI" and "Post-ROD" studies.		
53d	2008		Include a figure that shows locations with surface or subsurface RAL and/or PTW threshold exceedances.	We believe these data are already presented fully on the Figures 3-2 and 3-3 series, and with the ROD SMA boundary shown on those figures.		

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54	2009	Table 4-2 Summary of Stormwater System Sampling Activities and Locations			
<b>Editorial Comments on PDI Work Plan</b>					
1	1132	Section 1.6 Important Definitions, Contaminants of Concern (COCs), page 1-9	The second sentence in the subsection appears to contain a typographical error: "DDX.1." Revise as needed.	DDX.1 will be revised to read, "DDx" as listed in Tables 21 and 17.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
2	1133	Section 2.2.5 Dredging History Informs Interpretation and Application of Sediment Characterization Data, page 2-4	This section lists the maintenance dredge events and references figures from the 2004 Programmatic Work Plan. EPA recommends adding boundaries of the historic dredge areas to a figure in the PDI Work Plan or in the data evaluation report to provide additional context for data comparison and relationship to the conceptual site model (CSM).	The boundaries of the five listed maintenance dredge events will be included in a new figure in the data evaluation report, and the report text will reference the figure in discussing data comparison and the CSM.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
3	1134	Section 3.1.2 Subsurface Sediment Contaminant Concentrations, 2nd paragraph, page 3-3	The last sentence of this paragraph is repeated. Remove one of the duplicate sentences.	The duplicate sentence will be removed.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
4	1135	Section 3.3 Stormwater Discharge, page 3-4	The following text appears to have a typographical error: "CLs and/or RALs". Revise to state, "CULs and/or RALs".	The text will be revised to state "CULs and/or RALs."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
5	1136	Section 4.3 Stormwater Outfall and Conveyance System Sampling, page 4, bullet 3	The text in bullet three indicates that a grab solids sample will be collected from AAQ011, whereas Figure 2 indicates the sample will be collected at AAQ012. Revise as needed so that text and figures are consistent.	Additional details on this comment will be included in the new, separate PDI Work Plan addendum for stormwater evaluation. Figure 2 will be revised to indicate that the sample will be collected at AAQ011.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
6	1137	Section 7 References, pages 7-1 through 7-1	Add the following citations to the reference section:		
6a	1138	Section 7 References, pages 7-1 through 7-1	PGG (Pacific Groundwater Group). 2019a. Surface and Subsurface Sediment Field Sampling and Data Report, Swan Island Lagoon, Portland Harbor Superfund Site. Prepared for Daimler Trucks North America LLC.	This citation will be added to the section references and cited within the text.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
6b	1139	Section 7 References, pages 7-1 through 7-1	PGG. 2019b. Surface and Subsurface Sediment Field Sampling and Data Report, Swan Island Lagoon, Portland Harbor Superfund Site. Prepared for de maximis, inc.	This citation will be added to the section references and cited within the text.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
7	1140	Figure 3-3	Revise the legend to clarify which locations represent surface samples, subsurface samples, or both.	This figure will be updated to include only subsurface sample locations, or to clearly delineate whether a sample location is surface, subsurface, or both.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
8	1141	References	DEQ and EPA. 2005. <i>Portland Harbor Joint Source Control Strategy</i> . EPA. 2017. <i>Record of Decision, Portland Harbor Superfund Site, Portland, Oregon</i> . Prepared by EPA Region 10. EPA. 2020. <i>Remedial Design Guidelines and Considerations</i> . Portland Harbor Superfund Site, Portland, Oregon. February 28, 2020. IRTC. 2009. <i>Incremental Sampling Methodology</i> . Washington, DC. Palermo, MR, JE Clausner, MP Rollings, GL Williams, TE Myers, TJ Fredette and RE Randall. 1998. <i>Guidance for subaqueous dredged material capping, Technical Report DOER-1</i> , U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.		
9	2010	Formatting			
10	2011	Formatting			
11	2012	Formatting			

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54	2009	Table 4-2 Summary of Stormwater System Sampling Activities and Locations	Table 4-2 should be updated to be consistent with the text in FSP Section 4.5.1 that states, "The whole water sample will be analyzed for ROD Table 17 COCs, except the PCBs, OCPs, and dioxins and furans. If there is a sufficient volume of stormwater solids available in the carboy after the removal of the whole water sample, those solids will be separated by centrifuge in the laboratory and analyzed for ROD Table 17 COCs, except the PCBs, OCPs, and dioxins and furans".	Table 4-2 was updated to be consistent with FSP Section 4.5.1 text noted in the comment. Specifically, the collection method for stormwater samples was revised to read "HVS (Whole Water Carboy)" where applicable.		
1	1132	Section 1.6 Important Definitions, Contaminants of Concern (COCs), page 1-9	The typographical error remains in the text. Revise as needed.	The typographical error was corrected from DDx.1 to DDx.		
2	1133	Section 2.2.5 Dredging History Informs Interpretation and Application of Sediment Characterization Data, page 2-4				
3	1134	Section 3.1.2 Subsurface Sediment Contaminant Concentrations, 2nd paragraph, page 3-3				
4	1135	Section 3.3 Stormwater Discharge, page 3-4				
5	1136	Section 4.3 Stormwater Outfall and Conveyance System Sampling, page 4-4, bullet 3				
6	1137	Section 7 References, pages 7-1 through 7-1				
6a	1138	Section 7 References, pages 7-1 through 7-1	The citation was not added to the reference section. Revise as needed.	Citation added to the reference section		
6b	1139	Section 7 References, pages 7-1 through 7-1	The citation was not added to the reference section. Revise as needed.	Citation added to the reference section		
7	1140	Figure 3-3				
8	1141	References				
9	2010	Formatting	Revise the document with bookmarks for all section headers, automated 508 tagging and other EPA document formatting expectations.	The document has been formatted to comply with 508 requirements.	The PDI Work Plan Revision 2 did not meet the 508 tagging requirements for accessibility (pursuant to Section 5.4 of the SIB Group's statement of work). Guidance on preparing a 508 compliant document is attached.	The main body of the document and tables will be revised according to the 508 compliance document and guidance received from EPA (4/12/2022). The Excel tables of the document were causing the remaining 508 errors. The Excel tables were converted to Word to eliminate the errors. HGL does not plan to revise the figures and appendices.
10	2011	Formatting	When preparing future response to comments, indicate new section header numbers if the section header number has been changed for ease of EPA review.	Any revised section numbers have been identified within individual comment responses.		
11	2012	Formatting	The subsections under Section 2.2 are numbered as 2.1.1 to 2.1.6. They should be corrected to 2.2.1 to 2.2.6.	Section 2.1 and 2.2 were properly tagged and the 2.1.1 to 2.1.6 were auto-corrected to 2.2.1 to 2.2.6.		

**APPENDIX E**  
**EPA Review of Draft Pre-Design Investigation Work Plan**  
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#	Reference No.	Document	EPA Draft PDI Work Plan Comments on August 13, 2021	SIB Response on September 10, 2021	EPA's October 7, 2021 Reply to Suggested Revisions
12	2013	Table 4-1 Summary of Sample Activities, Numbers, and Analyses			
N/A	2014	QAPP Worksheet 15			
N/A	2015	QAPP Worksheet 20			
<b>General Comments on the Field Sampling Plan</b>					
Following are EPA's comments on the HydroGeoLogic, Inc. Field Sampling Plan (FSP), Appendix A of the Draft Pre-Design Investigation Work Plan, prepared by HydroGeoLogic, Inc. on behalf of the Swan Island Basin Remedial Design Group and dated June 2021.					
1	1142	Phase 2 Analysis of Archived Subsurface and Surface Intervals	Tables 4-2 and 4-3 indicate samples will be archived for Phase 2 and that the FSP will provide more detail. Discussion of Phase 2 analysis is missing from the FSP and must be added. The FSP should include details such as when archived samples will be analyzed and how to analyze those samples. Additionally, EPA recommends review of adjacent historical sample locations to determine subsurface intervals for Phase 1 sample analysis. As noted in PDI Work Plan General Comment on Sediment Sampling, historical locations were found to have concentrations above RALs at depths greater than 15 feet.	Tables and text will be revised for consistency with the PDI Work Plan (as above).	The response is acceptable pending EPA's review of the revised PDI Work Plan.
2	1143	Riverbank Sample Locations	Chemical characterization of riverbank soils should be conducted throughout the bank between mean low water (MLW) and the top of the bank, as described in Section 2.2.1 of RDGC Appendix D. The proposed sampling locations do not provide coverage of the MLW zone of the riverbank and samples should be added to capture that part of the riverbank.	As discussed during the August 19m 2021 call with EPA, HGL will remove the riverbank sampling scope of work from the PDI Work Plan and move it to a separate addendum with phased scope of work to follow EPA's Riverbank Guidance. The PDI Work Plan Addendum / Phase Ia - Visual survey of bank will be to define geomorphic features, material types and collect input parameters for BANCs evaluation of erodibility / stability.  Note that this change will also require an FSP Addendum/Phase II. HGL will proposed sample collections at the top, face, and mean low water (toe) along each transect where BANCs determines bank is unstable. HGL will present a contingency plan if material cannot be sampled at a location. HGL will also include number and type of analyses in this FSP vs QAPP in PDI Work Plan.	The response is partially acceptable pending EPA's review of the Draft Stormwater and Riverbank Assessment and Sampling Plan. EPA notes that riverbank soil sampling needs to be performed to determine whether in-water SMAs are contiguous with contaminated riverbank soil exceeding RALs/PTW, not just in erodible areas. Initial sampling in erodible areas may be acceptable if followed by supplemental riverbank soil sampling in non-erodible areas that are potentially contiguous with in-water SMAs.
3	2014				
<b>Specific Comments on the Field Sampling Plan</b>					
Following are EPA's comments on the HydroGeoLogic, Inc. Field Sampling Plan (FSP), Appendix A of the Draft Pre-Design Investigation Work Plan, prepared by HydroGeoLogic, Inc. on behalf of the Swan Island Basin Remedial Design Group and dated June 2021.					
1a	1144	Section 1.3 Purpose and Objectives, No. 2, page 1-4	Revise to clarify what "three applications" the text is referring to.	The text in Section 1.3 will be revised to remove the phrase "three applications", and instead to simply list the applications as follows "...needs are sufficient to support the ASAOC applications required for Sediment Management Area...".	The response is acceptable pending EPA's review of the revised PDI Work Plan.
1b	1145	Section 1.3 Purpose and Objectives, No. 2, page 1-4	Revise the following text for clarity: "Ensure that the data and analysis needs are sufficient to support..." It is not clear how a data/analysis need would support RD. Data and analysis support RD after data and analysis needs (data gaps) are filled.	The text in Section 1.3 will be revised to remove the words "data and" to indicate that just the analysis needs (data gaps) are necessary to support RD.	The response is acceptable pending EPA's review of the revised PDI Work Plan.

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12	2013	Table 4-1 Summary of Sample Activities, Numbers, and Analyses	Table 4-1 still shows that data collection for subsurface sediment sampling includes 174 cores and total 870 samples, which are from the previous draft PDI Work Plan. They should be updated to 181 cores and 905 samples to be consistent with Section 4.1. Similarly, the stormwater sample numbers in Table 4-1 should be updated from 11 to 12 to be consistent with Section 4.3.	Table 4-1 was updated to include the revised subsurface sediment core and total sample number to be consistent with Section 4.1. Table 4-1 was updated to include revised stormwater sample numbers to be consistent with Section 4.3.	Table 4-1 has been revised to be consistent with PDI WP Section 4.1. However, QAPP Worksheet #20 has not been updated to reflect the correct number of samples and field QC samples. Revise QAPP Worksheet #20 to reflect the final sample counts.	QAPP Worksheet #20 will be updated to be consistent with Table 4-1 (of Appendix A - Field Sampling Plan) to include the correct number of samples and field QC samples for each media. FSP Table 4-1 and QAPP Worksheet #20 will be updated to reflect changes in sediment sample numbers in response to Comment # 2b. Additional changes to FSP Table 4-1 were made to update Analyses column from "SIB RPCs" to "All surface water COCs (ROD Table 17)" and to provide further clarification/delineation between public/private stormwater activities.
N/A	2014	QAPP Worksheet 15				Introductory text: Added text to clarify distinction between focused COCs, RPCs, and ROD Table 17 COCs for all media rather than just aqueous matrix. Worksheet 15.4A: Clarified Focused COC RAL column for aroclors to refer to Total PCBs RAL. Worksheet 15.8A: Added aldrin and lindane - ROD Table 17 COCs, inadvertently omitted in previous submission.
N/A	2015	QAPP Worksheet 20				Surface Sediment Samples: Removed excess EB samples that are accounted for in the subsurface sediment core samples. Added note to Sediment Core Samples row label "(includes surface interval at selected locations)" to clarify change. Surface and Shallow Core Riverbank Samples: Added PAH analysis as it was inadvertently omitted in previous submission. Stormwater: In-Line Solids and Manual Grab Sediment Samples: Reduced excess EBs inadvertently included for locations with dedicated samplers. Added footnote #7 to clarify change.
1	1142	Phase 2 Analysis of Archived Subsurface and Surface Intervals				
2	1143	Riverbank Sample Locations				
3	2014		In cases where sample volume is limited and select COCs must be prioritized for analysis, EPA recommends analyzing for metals if sufficient volume remains after analyzing for focused COCs.	In Section 4.5.7.4, "with metals analysis completed on any remaining solid or liquid" was added to the end of the first sentence.		
1a	1144	Section 1.3 Purpose and Objectives, No. 2, page 1-4				
1b	1145	Section 1.3 Purpose and Objectives, No. 2, page 1-4				

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2	1146	Section 4.2 Sediment Sampling, page 4-2	All ROD Table 21 contaminants should be analyzed, per Section 5.1.2 of EPA's RDGC (EPA 2021) unless a CSM based technical rationale can be provided to limit analysis. EPA acknowledges that the data density and results for chlorobenzene and naphthalene are likely sufficient to support such rationale. Revise the text to provide an explicit explanation that references the data.	This section will be amended to include an explicit technical rationale for any ROD Table 21 COCs not analyzed.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
3	1147	Section 4.2.2.2 Surface Sample Collection and Compositing, page 4-5	The text states that "After sealing the sample containers, the container threads will be thoroughly wiped down before storing on ice in a sampler cooler. This will prevent leakage and potential cross-contamination." The order of operations in the first sentence is incorrect and should be corrected. Also, if potential cross-contamination is to be avoided between sample containers stored in a cooler on ice, each jar should be placed in a sealed plastic bag and wrapped in bubble wrap. Revise the text accordingly.	The text in Section 4.0 will be revised to list the sample containment operations in the correct order and will include wrapping each jar in bubble wrap and sealing in a plastic bag as added precautions.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
4	1148	Section 4.2.4 Sediment Erodibility (SedFlume) Sample Collection, page 4-10	Revise the text to describe the rationale behind the specific locations proposed to be sampled and the number of cores to be characterized for erodibility. Based on experience at other sites, 30 cores over the 117 acre SIB project area is a relatively high density of cores. It is not clear if this density of cores is warranted. Discuss whether there are large variations in sedimentation rates, fines content, energy regimes, consolidation effects, etc. that can affect erodibility in the SIB Project Area.	The following text will be included in Section 4.2.4: "The SedFlume sampling program was designed based on review of previous sampling that was performed in Portland Harbor (Sea Engineering 2006). The previous programs included two samples in the SIB: one sample near the SIB entrance, and one sample in the SIB central interior. Analysis of those testing results indicates significant differences in sediment erodibility properties, including erosion rates and fines content. Therefore, a robust sampling program was determined to be warranted in order to capture these significant differences in sediment erodibility."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
5	1149	Section 4.2.2.1.1 Power-Grab Sampling, page 4-3	EPA has the following comments on this section and the text should be revised accordingly:		
5a	1150	Section 4.2.2.1.1 Power-Grab Sampling, page 4-3	Clarify that power grab samples will be a 3-point composite sample like the manual grab locations. The section does state that a minimum of 3 samples will be collected but does not specify if these locations will be composited.	The text will be revised to clarify: "Power grab samples will consist of a 3-point composite sample like manual grab locations."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
5b	1151	Section 4.2.2.1.1 Power-Grab Sampling, page 4-3	The text indicates that if field conditions preclude the field staff from collecting proposed target samples, then the location will be adjusted or abandoned. Revise the text to clarify that adjustment of sample locations outside of the 25-foot radius or abandonment of a sampling location must be documented in a field change request and approved by EPA.	Revisions will clarify adjustment outside the 25-foot tolerance or abandonment decisions. The following text will be included in Section 4.2.3.1.1: "If an adjusted sample location falls outside of a 25-foot radius of the planned sample location, or if a sample location is abandoned, the location will be documented in a field change request for EPA approval." Also note that FSP text in Section 8.1.1 Field Decisions and Documentation will be amended to clearly describe the process for making and documenting field changes with EPA approval. That process will require (1) verbal communication with EPA to initially discuss the situation and possible solutions, and (2) written documentation of the change.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
6	1152	Section 4.2.3.1.1 Core Acceptance Criteria and Contingency Plans, pages 4-6 through 4-7	EPA has the following comments on this section and the text should be revised accordingly:		
6a	1153	Section 4.2.3.1.1 Core Acceptance Criteria and Contingency Plans, pages 4-6 through 4-7	The target recovery should be 80 percent, which is consistent with other sites in Portland Harbor. Revise the text as needed.	The following text will be revised in Section 4.2.3.1.1: "The target core recovery is 80 percent."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
6b	1154	Section 4.2.3.1.1 Core Acceptance Criteria and Contingency Plans, pages 4-6 through 4-7	Revise the text to note that, if 80 percent recovery is not achieved, SIB RD Group's representative should contact EPA to discuss potential deviations prior to abandoning a location.	The following text will be included in Section 4.2.3.1.1: "If the target 80-percent recovery is not achieved, SIB RD Group's representative will contact EPA to discuss the potential deviations prior to abandoning the location." Also note that FSP text in Section 8.1.1 Field Decisions and Documentation will be amended to clearly describe the process for making and documenting field changes with EPA approval. That process will require (1) verbal communication with EPA to initially discuss the situation and possible solutions, and (2) written documentation of the change. Also note that FSP text in Section 8.1.1 Field Decisions and Documentation will be amended to clearly describe the process for making and documenting field changes with EPA approval. That process will require (1) verbal communication with EPA to initially discuss the situation and possible solutions, and (2) written documentation of the change.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
6c	1155	Section 4.2.3.1.1 Core Acceptance Criteria and Contingency Plans, pages 4-6 through 4-7	Revise the text to state that the sample attempts should be made within a 25-foot radius of the target location and that deviations outside this area will require approval by EPA.	Section 4.2.3.1.1 of the FSP will be updated to include: "Sample attempts will be made within the 25-foot radius tolerance. For deviations outside the 25-foot tolerance, EPA will be notified by a method accessible to the field crew while on site (e.g., mobile phone followed up with an email). If EPA is not available, field sampling will proceed and deviations from the FSP will be documented in the field logbook." This text will also be included in the PDI. Also note that FSP text in Section 8.1.1 Field Decisions and Documentation will be amended to clearly describe the process for making and documenting field changes with EPA approval. That process will require (1) verbal communication with EPA to initially discuss the situation and possible solutions, and (2) written documentation of the change.	The response is acceptable pending EPA's review of the revised PDI Work Plan.

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2	1146	Section 4.2 Sediment Sampling, page 4-2	Similar to the rationale provided for chlorobenzene, revise the text to include a robust technical rationale for omitting naphthalene from the analyte list.	Footnote in FSP Section 4.2 was modified to include the statement, "Naphthalene will be analyzed along with other PAHs." Deleted the statement from the footnote in FSP Section 4.2 that indicated naphthalene will be excluded.		
3	1147	Section 4.2.2.2 Surface Sample Collection and Compositing, page 4-5				
4	1148	Section 4.2.4 Sediment Erodibility (SedFlume) Sample Collection, page 4-10				
5	1149	Section 4.2.2.1.1 Power-Grab Sampling, page 4-3				
5a	1150	Section 4.2.2.1.1 Power-Grab Sampling, page 4-3				
5b	1151	Section 4.2.2.1.1 Power-Grab Sampling, page 4-3	Revise this section to reference FSP Section 8.1.1.	Added text to Section 4.2.2.1.1 (Power Grab Sampling) that refers to FSP Section 8.1.1, "Section 8.1.1 of this FSP describes the procedure for requesting EPA approval."		
6	1152	Section 4.2.3.1.1 Core Acceptance Criteria and Contingency Plans, pages 4-6 through 4-7				
6a	1153	Section 4.2.3.1.1 Core Acceptance Criteria and Contingency Plans, pages 4-6 through 4-7				
6b	1154	Section 4.2.3.1.1 Core Acceptance Criteria and Contingency Plans, pages 4-6 through 4-7				
6c	1155	Section 4.2.3.1.1 Core Acceptance Criteria and Contingency Plans, pages 4-6 through 4-7				

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6d	1156	Section 4.2.3.1.1 Core Acceptance Criteria and Contingency Plans, pages 4-6 through 4-7	Clarify what is meant by "within +/- 2 ft of target" with regards to penetration depth. The text seems to imply that cores with 8 to 12 feet of penetration bml will be accepted, but it is not clear how the first core acceptance criteria (overlying water is present and the surface is intact) would be met if there is an extra 2 feet of sediment in the 10-foot core tube.	Revisions will clarify that the core tube length is 15 ft per Section 4.2.3.3 that describes Vibracore Sampling using a "15-ft long, 4-inch outer diameter" core tube.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
7	1157	Section 4.2.3.2 Direct-Push Sampling, page 4-9	Clarify whether direct-push sampling will achieve the data quality objectives for RD. At least a 5-foot sample is needed to apply the ROD technology application decision tree, and the PDI Work Plan estimates that a 10-foot core would be needed to vertically delineate impacts. Describe what measures will be taken if direct-push samples are unable to vertically delineate the depth of contamination.	Revisions will clarify: "Direct-Push borings reach target depth of 10 ft using <i>successive</i> 4-ft long core tubes and the acceptance criteria listed in Section 4.2.3.1.1." Please also see Response to Comments #1023, 1024, 1025 for DOC and vertical SMA delineation approach for subsurface core sampling.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
8	1158	Section 4.2.5 Dredge Elutriate Testing, pages 4-10 through 4-11	EPA has the following comments on this section and the text should be revised accordingly:		
8a	1159	Section 4.2.5 Dredge Elutriate Testing, pages 4-10 through 4-11	It is unclear why dredge elutriate testing (DRET) samples will be collected in accordance with Standard Operating Procedure (SOP) A-4 Storm Drain Sampling (Appendix A). Using a grab sample pole fitted with a sample cup or stainless beaker may not provide adequate sediment volume for the required testing and also limits DRET sample collection to surface sediment. This is also inconsistent with Section 4.2.5.3 text which states that: "A second Vibracore will be collected at select locations to perform bulk sediment testing including: waste characterization, DRET, and bench tests for stabilization and handling to support RD." The Vibracore samples should be used for bulk sediment waste characterization and DRET samples instead of the sampling methodology described in SOP A-4.	The referenced SOP is incorrect. The correct SOP is SOP 403.08 Sediment Sampling. Text will be revised to correct this.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
8b	1160	Section 4.2.5 Dredge Elutriate Testing, pages 4-10 through 4-11	Revise the text to clarify how and when the sediment samples for disposal characterization and DRET testing will be collected and analyzed, including details on sample depths, proposed locations, compositing, analysis methods, etc. Locations with highest historical COC concentrations should be targeted for the disposal characterization bulk samples.	Additional detail on collection of sediment samples proposed for disposal characterization and DRET testing will be provided. "Investigation Derived Waste (IDW) will be properly characterized and disposed of by NRC-US ecology who has been performing this task for other RD areas under agreement with Gravity Marine." All data regarding highest concentration areas will be provided to NRC-US ecology for waste segregation and proper disposal, as needed. 2018 sampling efforts followed similar protocols in the highest concentration areas of SIB and none of the IDW generated during the 2018 sample effort was characterized as hazardous waste.	EPA appreciates the additional information regarding IDW disposal. EPA clarifies that the original comment was focused on elutriate testing and dredge material characterization for disposal during remedial action and requests additional detail on the approach for collecting and analyzing samples for elutriate testing and dredge material characterization.
8c	1161	Section 4.2.5 Dredge Elutriate Testing, pages 4-10 through 4-11	Discuss the basis for determining compliance with disposal facility acceptance criteria and confirm that the proposed analytical methods will adequately meet data gaps related to dredged material disposal.	See response to Comment #1160. Disposal facility compliance will be fully met with additional screening by NRC-US ecology if a data gap is identified. In 2018 sampling from the highest SIB concentration areas, further analyses were not needed.	See EPA response to #1160.
8d	1162	Section 4.2.5 Dredge Elutriate Testing, pages 4-10 through 4-11	Specify the ambient water quality criteria to be used for evaluating DRET results and the conventional parameters that will be tested in addition to bulk chemistry. Also indicate the proposed location and volume of surface water sample collection for the DRET slurries.	The ambient water quality criteria for evaluating DRET testing will be the EPA's National Recommended Water Quality Criteria, with the standard being the lower of the aquatic life and the human health-consumption of organism criteria for freshwater systems.  Surface water samples for the DRET slurries will be collocated with the DRET sediment sampling locations. The surface water samples will be composited to provide a single bulk water sample for DRET slurry and treatability testing. Target sample volume will be specified in the revised FSP.	EPA appreciates the response. In addition on comparing DRET results to the EPA National Recommended Water Quality Criteria, where those criteria do not have values, use the following criteria:  • Oregon Administrative Rule (OAR) 340-041-8033 Table 30: Aquatic Life Water Quality Criteria for Toxic Pollutants  • Oak Ridge National Laboratory Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996  EPA requests that DRET results be compared to both chronic and acute criteria.
8e	1163	Section 4.2.5 Dredge Elutriate Testing, pages 4-10 through 4-11	Section 4.2.5.2 references Table 2-2 as showing surface water cleanup levels (CULs). Table 2-2 only shows sediment/riverbank soil CULs. DRET samples should be analyzed for all contaminants with surface water and sediment/riverbank soil CULs per ROD Table 17.	Text will be revised to include analysis of contaminants with surface water or sediment/riverbank CULs in ROD Table 17.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
8f	1164	Section 4.2.5 Dredge Elutriate Testing, pages 4-10 through 4-11	In addition to the TCLP chemical analysis, Resource Conservation and Recovery Act (RCRA) waste characteristics of ignitability and corrosivity, and any listed waste, should also be analyzed for the disposal characterization bulk sediment samples. As stated in Remedial Investigation Section 3.2.3.1.1, ship building and repair activities in the area could have led to volatile organic compound (VOC) contamination; generator knowledge should be considered to determine whether F002 waste characterization should be conducted.	These analyses will be added to the analyses proposed for waste characterization and disposal. Text will be revised to state, "Investigation Derived Waste (IDW) will be properly characterized and disposed of by NRC-US ecology who has been performing this task for other RD areas under agreement with Gravity Marine."	EPA appreciates the response and the addition of the analyses. Note, consistent with EPA response to #1160, EPA clarifies that the original comment was focused on dredge material characterization for disposal during remedial action, and not on disposal of IDW.

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6d	1156	Section 4.2.3.1.1 Core Acceptance Criteria and Contingency Plans, pages 4-6 through 4-7	The text was not revised as indicated by SIB Group's response. Revise the text to clarify that a 15-foot core tube will be used.	Section 4.2.3.1.1 (Core Acceptance Criteria and Contingency Plans) does not specify core length but specifies 80% recovery as a criterion for acceptance. Core length is specified in Section 4.2.3.1 (Sediment Core Collection) of the FSP indicating that 15-foot core tubes will be used. We believe this is the appropriate location for this information, rather than 4.2.3.1.1 (Core Acceptance Criteria and Contingency Plans). This response supercedes the previous response on this comment thread by making the requested revision to the appropriate section.		
7	1157	Section 4.2.3.2 Direct-Push Sampling, page 4-9				
8	1158	Section 4.2.5 Dredge Elutriate Testing, pages 4-10 through 4-11				
8a	1159	Section 4.2.5 Dredge Elutriate Testing, pages 4-10 through 4-11				
8b	1160	Section 4.2.5 Dredge Elutriate Testing, pages 4-10 through 4-11	EPA appreciates the additional information regarding IDW disposal. EPA clarifies that the original comment was focused on elutriate testing and dredge material characterization for disposal during remedial action. Revise this section to define the locations for DRET, provide additional detail on the approach for collecting and analyzing samples for elutriate testing and dredge material characterization, and clarify what water quality criteria will be used to evaluate the results.  Revise Section 4.1 of the PDI Work Plan to be consistent with this section of the FSP.	Added locations of DRET samples to FSP and PDI (grid cells F14, D5, and C20). Added text explaining that the DRET COCs will be tested for all ROD Table 17 Surface Water COCs. Approach for collecting and analyzing samples appears well-described in Sections 4.2.5.1 and 4.2.5.2, and the cited SOP 403.08. Updated text of both FSP and PDI to be consistent.		
8c	1161	Section 4.2.5 Dredge Elutriate Testing, pages 4-10 through 4-11				
8d	1162	Section 4.2.5 Dredge Elutriate Testing, pages 4-10 through 4-11		Comment resolved in FSP Section 4.2.5.2		
8e	1163	Section 4.2.5 Dredge Elutriate Testing, pages 4-10 through 4-11				
8f	1164	Section 4.2.5 Dredge Elutriate Testing, pages 4-10 through 4-11	EPA appreciates the response and the addition of the analyses. Note, consistent with EPA response to #1160, EPA clarifies that the original comment was focused on dredge material characterization for disposal during remedial action, and not on disposal of IDW. Revise the text to include RCRA waste characteristics of ignitability and corrosivity, and add that any listed waste, should also be analyzed for the disposal characterization bulk sediment samples.	Requested text added to the second bullet of Section 4.2.5.1. Revised sentence reads, "Samples of the bulk sediment, as collected and after amendment, will be tested as specified in the Resource Conservation and Recovery Act by the toxicity characteristic leaching procedure and for ignitability, corrosivity, and listed waste to characterize dredged sediments for disposal."		

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8g	1165	Section 4.2.5 Dredge Elutriate Testing, pages 4-10 through 4-11	Clarify when and how dewatering and stabilizing amendments will be tested if the applicable disposal suitability and water quality criteria are not met.	If disposal suitability and water quality criteria are not met, then bench-scale testing of amendments will be performed to assess effectiveness at meeting applicable disposal and discharge criteria and support remedial design. Additional detail on bench-scale testing methods and potential amendments will be provided in the revised text.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
8h	1166	Section 4.2.5 Dredge Elutriate Testing, pages 4-10 through 4-11	Provide a description of bench tests for dredged material stabilization and handling of wastes to support remedial design.	Bench-scale testing will include water clarification testing as part of the DRET, paint filter testing to support disposal characterization, slump testing to assess sediment behavior during handling, and testing of different admixtures of sediment and amendments. Additional detail on bench-scale testing methods will be provided in the revised text.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
9	1167	Section 4.3.2 Riverbank Soil Characterization, pages 4-12 through 4-13	EPA has the following comments on this section and the text should be revised accordingly:		
9a	1168	Section 4.3.2 Riverbank Soil Characterization, pages 4-12 through 4-13	A formal plan for riverbank sampling should be provided. This section states that up to 150 samples may be collected (1 from each transect) but does not indicate a planned location. EPA disagrees with a random approach to riverbank characterization to be determined in the field. A plan should be provided that outlines how SIB RD Group riverbank soils throughout the riverbank between the top of bank and MLW will be characterized. See FSP General Comment on Riverbank Sample Locations.	The riverbank characterization will be completed in two phases. The first phase includes a reconnaissance of the entire riverbank within the SIB project area and completion of a bank stability analysis using the BANCS model. The first phase of the proposed riverbank characterization is to visually assess the riverbank for BANCS evaluation and material types. After this visual inspection, HGL will provide a riverbank sampling plan as a Field Sampling Plan Addendum with the data quality objectives and proposed sampling locations. The first phase reconnaissance would be performed at same time as first phase of stormwater evaluation (anticipated for fall 2021). See response to Comment #1146. Sampling methods are described in Section 4.3 of the Field Sampling Plan.	The response is acceptable pending EPA's review of the Draft Stormwater and Riverbank Assessment and Sampling Plan.
9b	1169	Section 4.3.2 Riverbank Soil Characterization, pages 4-12 through 4-13:	EPA expects characterization of riverbank soils for all contaminants listed in RDGC Appendix D Table 1 unless a technical rationale based on the project area CSM can be provided to support the exclusion of certain contaminants listed on Table 1 of the guidance. Revise all applicable sections of the PDI Work Plan and FSP accordingly.	The SAR included a detailed analysis and screening process to identify RPCs. The text will be modified to incorporate the results of that SAR analysis. The RPC screening analysis considered source areas, source control measures, and transport pathways to determine that certain chemicals identified in RDGC Appendix D Table 1 do not pose a risk of recontamination.	See EPA's response in the 9/22/21 EPA Response to Comments Matrix – Early Feedback on Stormwater and Riverbank Responses document.  EPA 9/22/21 comment: The RPC screening analysis of existing surface sediment data is not adequate for determining the analytical suite for sampling of other media such as riverbank soil. EPA expects characterization of riverbank soils for all contaminants listed in the RDGC Appendix D Table 1, unless an evaluation of upland/riverbank sources clearly demonstrates lack of sources of particular contaminants on specific riverbanks that justifies their exclusion from the analytical suite. EPA recommends that during this phase of PDI riverbank characterization all contaminants listed on Table 1 of Appendix D in the RDGC be analyzed.
9c	1170	Section 4.3.2 Riverbank Soil Characterization, pages 4-12 through 4-13:	The text states that, if riprap or other surface obstructions are present at a target riverbank soil sample location, the location will be relocated within 50 feet of the target location. Revise the text to clarify that, if such relocation is not possible, sample abandonment will need approval from EPA through a field change request.	See response to Comment #1168. Completion of the riverbank characterization in two phases should eliminate this situation by ensuring that selected sampling location are all feasible for sample collection. EPA will have the opportunity to review and approve the proposed sample collection locations as part of the PDI addendum that proposes the second phase of the riverbank characterization that will include riverbank soil sample collection.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
10	1171	Section 4.4.2 Exploratory Borings, pages 4-13 through 4-14	EPA has the following comments on this section and the text should be revised accordingly:		
10a	1172	Section 4.4.2 Exploratory Borings, pages 4-13 through 4-14	Explain how mudline elevation at the in-water boring locations will be determined.	Paragraph 1 on page 4-14 will be updated with the following text: "...and in-water borings will be advanced to a termination depth of approximately 50 ft below the mudline. Prior to drilling a weighted line will be used to determine the depth of the mudline relative to the deck of the drill ship. Following drilling the mudline elevation will be estimated based on bathymetric survey data, GPS location data, and the water level at the time of drilling."	EPA appreciates the response and requests use of a lead line and/or fathometer.
10b	1173	Section 4.4.2 Exploratory Borings, pages 4-13 through 4-14	Cite applicable ASTM standard for standard penetration testing.	The following sentence will be added to FSP Section 4.4.2: "Standard penetration tests will be conducted in accordance to ASTM D1586 (ASTM, 2018), with consideration given to ASTM 1587 and 3550."  The following citation will be added to the reference section: <i>ASTM, 2018. D1586, Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils, ASTM International, West Conshohocken, PA, at URL www.astm.org.</i>	The response is acceptable pending EPA's review of the revised PDI Work Plan.
10c	1174	Section 4.4.2 Exploratory Borings, pages 4-13 through 4-14	Standard penetration test blow counts should also be logged by the field engineer or geologist in addition to the parameters listed.	Section 4.4.2 will be updated to include "Standard penetration test (SPT) blow counts will be logged in accordance with ASTM D1586."	The response is acceptable pending EPA's review of the revised PDI Work Plan.

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8g	1165	Section 4.2.5 Dredge Elutriate Testing, pages 4-10 through 4-11	Revise the text to include additional detail on bench-scale testing methods and potential amendments.	Elutriate testing is proposed only to develop information for water quality during dredging. Upland disposal is required by the ROD, so elutriate testing to support in-water disposal is not proposed. No bench scale testing is proposed. This response supercedes previous responses on this comment thread based on the determination that bench scale testing is not needed to support upland disposal.		
8h	1166	Section 4.2.5 Dredge Elutriate Testing, pages 4-10 through 4-11	Revise the text to include additional detail on bench-scale testing methods and potential amendments.	Elutriate testing is proposed only to develop information for water quality during dredging. No bench scale testing is proposed. This response supercedes previous responses on this comment thread based on the determination that bench scale testing is not needed to support upland disposal.		
9	1167	Section 4.3.2 Riverbank Soil Characterization, pages 4-12 through 4-13				
9a	1168	Section 4.3.2 Riverbank Soil Characterization, pages 4-12 through 4-13				
9b	1169	Section 4.3.2 Riverbank Soil Characterization, pages 4-12 through 4-13:	All RDGC Appendix D Table 1 contaminants are included for analysis in the QAPP Tables 19 and 30.1, except chlorobenzene. Chlorobenzene analysis by EPA method 8260 should be added to the riverbank soil analytical schedule unless its omission can be justified with robust technical rationale based on the project area-CSM provided in the forthcoming Phase 2 riverbank field sampling plan.	Chlorobenzene was not detected in surface or subsurface sediment samples from the SIB Project Area. Development of the Phase 2 riverbank field sampling plan will include an evaluation of existing EPA approved soil data for riverbanks, and Chlorobenzene analysis by EPA method 8260 will be evaluated for possible inclusion in the riverbank analytical schedule in the Phase 2 riverbank field sampling plan.		
9c	1170	Section 4.3.2 Riverbank Soil Characterization, pages 4-12 through 4-13:				
10	1171	Section 4.4.2 Exploratory Borings, pages 4-13 through 4-14				
10a	1172	Section 4.4.2 Exploratory Borings, pages 4-13 through 4-14				
10b	1173	Section 4.4.2 Exploratory Borings, pages 4-13 through 4-14				
10c	1174	Section 4.4.2 Exploratory Borings, pages 4-13 through 4-14				

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10d	1175	Section 4.4.2 Exploratory Borings, pages 4-13 through 4-14	Explain how the cone penetration testing results will be used to derive engineering properties for geotechnical analyses.	The following text will be added to Section 4.4.3, immediately after paragraph 1: "Existing semi-empirical correlations will be used to estimate geotechnical parameters from the CPT sampling results (cone tip resistance, qc, and "sleeve friction", fs) including but not limited to over consolidation ratio, undrained shear strength, relative density, 1-D compressibility, and Young's and shear moduli."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
11	1176	Section 4.5 Stormwater and Stormwater Solids Sampling, pages 4-15 through 4-21	EPA has the following comments on this section and the text should be revised accordingly:		
11a	1177	Section 4.5 Stormwater and Stormwater Solids Sampling, pages 4-15 through 4-21	Provide the analytical suite for each of the planned sampling methodologies. If the analytes are tabulated elsewhere, provide a reference to that information in Appendix A Section 4.5. EPA recommends that stormwater outfall samples be analyzed for all ROD Table 17 contaminants with surface water CULs, not just recontamination potential chemicals (RPCs).	The purpose of the stormwater sampling focuses on supporting the evaluation of potential recontamination of SIB sediments after implementation of the remedy. The SAR included a screening process to define the RPCs, and the purpose of that analysis was to determine which chemicals have the potential to recontaminate SIB sediments based on source control anticipated future sources, and the connection of transport pathways between those sources and SIB sediments. HGL believes it is appropriate and compliant with applicable guidance and requirements (specifically, instructions for completing the source control sufficiency assessment) to focus on RPCs for the purpose of this study.	See EPA's response in the 9/22/21 EPA Response to Comments Matrix – Early Feedback on Stormwater and Riverbank Responses document.  9/22/21 comment: EPA recommends that stormwater samples are analyzed for all ROD Table 17 contaminants with surface water CULs, unless an evaluation of existing stormwater data and outfall-specific sediment evaluations demonstrate that a particular contaminant is not a concern in stormwater. Limiting the analysis of stormwater samples to RPCs is not recommended for the following reasons: -The CSM describes localized settling of contaminants near outfalls and some of the COCs were screened out in the RPC analysis based on SWACs of the entire lagoon, which doesn't take localized inputs into account; - The RPC approach does not address evaluation of surface water remedial action objectives (i.e., RAOs 3 and 7)
11b	1178	Section 4.5 Stormwater and Stormwater Solids Sampling, pages 4-15 through 4-21	Discuss the proposed investigation of private outfalls. PDI Work Plan Section 3.3 states that, "The status of discharges from some of the private outfalls is unknown and will need to be evaluated as part of the PDI to provide information necessary to complete the SAR." Note which private outfalls are planned to be inspected and the rationale for selecting those outfalls. Clarify what information will be collected as part of this investigation and provide the proposed schedule.	Please see response to Comment #1070.	See EPA's response in the 9/22/21 EPA Response to Comments Matrix – Early Feedback on Stormwater and Riverbank Responses document.
11c	1179	Section 4.5 Stormwater and Stormwater Solids Sampling, pages 4-15 through 4-21	Clarify the sampling locations, media, and approach for the manual grab sample at the public outfalls discharge point (Item 3 on page 4-15).	Please see response to Comment #1072.	The response is acceptable pending EPA's review of the Draft Stormwater and Riverbank Assessment and Sampling Plan. Note that the response to Comment #1072 does not address Comment #1179.
12	1180	Section 4.5.2.1.3 Particulate Phase Concentration, page 4-19	The final bullet suggests that the RPC concentration is in "picograms to proton masses, which is the same as µg/kg". It is not clear from the equation provided where the proton mass unit comes from or how that is equivalent to micrograms per kilogram (µg/kg). Revise the text to clarify.	The text will be revised as follows: "The proton mass is the total particulate phase mass collected from the high vortex sampling during HVS for stormwater and calculated by the analytical laboratory. The proton mass of particles = 1.67E-12 picograms and 1 kg = 1.0E+15 pg. and 1.0E+9 micrograms, which is the same as microgram per kilogram, a more typical measurement of sediment concentrations."	EPA appreciates the response, but it is still not clear to EPA where the value for proton mass of particles of 1.67E-12 pg. is derived or how it is used for this calculation. EPA requests that the text be revised to clarify.
13	1181	Section 4.5.3 Automatic Stormwater Sampling Methodology for Private Outfall, page 4-19	EPA has the following comments on this section and the text should be revised accordingly:		
13a	1182	Section 4.5.3 Automatic Stormwater Sampling Methodology for Private Outfall, page 4-19	Revise the text to clarify that the sampling storm event criteria are as follows: i. Antecedent dry period of at least 24 hours (as defined by less than 0.1 inches over the previous 24 hours ii. Minimum predicted rainfall volume of greater than 0.2 inches per event iii. Expected duration of storm event of at least 3 hours	The text in Section 4.5.3 will be revised as follows: "Stormwater sampling criteria will be consistent with Appendix D of the 2005 ODEQ and EPA Joint Source Control Strategy Guidance: i. Antecedent dry period of at least 24 hours (as defined by less than 0.1 inch over the previous 24 hours ii. Minimum predicted rainfall volume of greater than 0.2 inch per event iii. Expected duration of storm event of at least 3 hours."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
13b	1183	Section 4.5.3 Automatic Stormwater Sampling Methodology for Private Outfall, page 4-19	Provide additional information on how the autosamplers will be used to collect samples. It is not clear if the samples will be grab samples or composite, whether the samplers will be programmed to automatically collect samples at a given flow volume/time or if they will be manually actuated, and if there are specific SOPs for the use of autosamplers.	The text in Section 4.5.3 will be revised as follows: "Autosamplers (e.g., Teledyne ISCO 6712C portable samplers with flow meters) will be used to collect samples from small private conveyance systems to assess whether COCs in stormwater are controlled prior to RA. The samplers will be automatically programmed to collect samples to evaluate COC concentrations discharging to SIB and the need for source control measures. Proposed private facility locations were selected based on the location of discharges relative to SMAs, ROD CUL/RAL exceedances, and/or lack of data adjacent to SMAs." Follow up and provide SOPs for autosamplers included in FSP or reference to LWG FSP.	See EPA's response in the 9/22/21 EPA Response to Comments Matrix – Early Feedback on Stormwater and Riverbank Responses document.  9/22/21 Comment: The samples will be grab samples collected during precipitation events required in the 2005 ODEQ-EPA JSCS Guidance.
14	1184	Section 4.5.4 Manual Grab Stormwater Solids Sampling Methodology, page 4-19	Provide additional information explaining what Teledyne ISCO portable samples are, what types of samples they are intended to collect, and how these data compare to HVS data.	See the response to Comment #1183.	The response is acceptable pending EPA's review of the Draft Stormwater and Riverbank Assessment and Sampling Plan.

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10d	1175	Section 4.4.2 Exploratory Borings, pages 4-13 through 4-14				
11	1176	Section 4.5 Stormwater and Stormwater Solids Sampling, pages 4-15 through 4-21				
11a	1177	Section 4.5 Stormwater and Stormwater Solids Sampling, pages 4-15 through 4-21				
11b	1178	Section 4.5 Stormwater and Stormwater Solids Sampling, pages 4-15 through 4-21				
11c	1179	Section 4.5 Stormwater and Stormwater Solids Sampling, pages 4-15 through 4-21				
12	1180	Section 4.5.2.1.3 Particulate Phase Concentration, page 4-19				
13	1181	Section 4.5.3 Automatic Stormwater Sampling Methodology for Private Outfall, page 4-19				
13a	1182	Section 4.5.3 Automatic Stormwater Sampling Methodology for Private Outfall, page 4-19				
13b	1183	Section 4.5.3 Automatic Stormwater Sampling Methodology for Private Outfall, page 4-19				
14	1184	Section 4.5.4 Manual Grab Stormwater Solids Sampling Methodology, page 4-19	The text in the first paragraph of section 4.5.3 indicates that time-weighted composite samples will be collected and the text in the third paragraph of section 4.5.3 indicates that flow-weighted composite samples will be collected. Revise the text to clarify whether time-weighted or flow-weighted composites will be collected and how this best services the relevant DQO.	Reference to "flow-weighted" sample was deleted from the third paragraph and replaced with "time-weighted".		

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15	1185	Section 4.5.4 Manual Grab Stormwater Solids Sampling Methodology, page 4-19 and Section 4.5.5 In-Line Sediment Trap Sampling Methodology, page 4-20	Insufficient information is provided to justify sieving the solids and only analyzing the fraction that is less than 2 mm. The size class of solids that is mobile is dependent on site-specific hydraulic conditions, and the assumption that materials greater than 2 millimeters (mm) in diameter are not mobile is not supported by data or site-specific analysis. In-line sediment traps are specifically intended to capture mobile solids, so sieving and only analyzing the fraction that is less than 2 mm is not appropriate. All solids collected should be analyzed.	The last paragraph for each section (Sections 4.5.4 and 4.5.5) will be revised as follows: "The entire sediment trap solids samples will be analyzed."	The response is acceptable pending EPA's review of the Draft Stormwater and Riverbank Assessment and Sampling Plan.
16	1186	Section 4.5.5 In-Line Sediment Trap Sampling Methodology, page 4-20	Clarify the proposed timing for deployment of in-line sediment traps and collection of samples. The timelines described in Section 4.5.5 are not consistent with the timelines proposed in Section 4.3 of the PDI Work Plan.	If access to City conveyance system is granted by the end of September 2021, in-line sediment traps will be deployed in October 2021 before the anticipated first flush event, bottles removed and replaced at the end of January, April and June 2022 for compositing and analyses representing wet season accumulation. The bottles deployed in June 2022 will be deployed until October 2022 before the wet season first flush event and analyses will represent dry weather accumulation. These details will be addressed in the Stormwater addendum.	The response is acceptable pending EPA's review of the Draft Stormwater and Riverbank Assessment and Sampling Plan.
17	1187	Section 4.5.6.3 In-Line Sediment Trap Sampling, page 4-21	Note that all Table 21 contaminants are used to define SMAs (not just focused COCs) and, as such, EPA recommends that analysis of all Table 21 contaminants be prioritized.	The purpose of the stormwater solids sampling focuses on supporting the evaluation of potential recontamination of SIB sediments after implementation of the remedy. The SAR included a screening process to define the RPCs, and the purpose of that analysis was to determine which chemicals have the potential to recontaminate SIB sediments based on source control, anticipated future sources, and the connection of transport pathways between those sources and SIB sediments. HGL believes it is appropriate and compliant with applicable guidance and requirements to focus on RPCs for the purpose of this study.	See EPA's response in the 9/22/21 EPA Response to Comments Matrix – Early Feedback on Stormwater and Riverbank Responses document.  9/22/21 Comment: EPA expects the analyte list for in-line sediment traps to include Table 17 COCs unless an evaluation of upland sources clearly demonstrates lack of sources of particular contaminants to the stormwater conveyance system. EPA understands that sample volume may necessarily limit the analyses that can be conducted and recommends in this circumstance that the Table 21 contaminants are prioritized for analysis.
18	1188	Section 4.9.1 Hand Sampling Tools, page 4-26	EPA recommends that it be noted in the field logbook when field equipment are decontaminated; and subsequent sample locations in which that equipment was used should be noted in the field logbook for tracking purposes.	HGL will revise Section 4.9.2 Hand Sampling Tools, page 4-26 to include the following statement "Field equipment decontamination dates and times will be noted in the logbook."	The response is acceptable pending EPA's review of the revised PDI Work Plan. In addition, EPA notes that if scrubbing and rinsing with Alconox is insufficient to remove visually observable tar/oil-related contamination on sampling equipment, the equipment needs to be scrubbed and rinsed using a solvent rinse until all visual signs of contamination are absent. EPA recommends that if NAPL is encountered and a solvent rinse is conducted, a field equipment wipe blank be collected after decontaminating the equipment and noted in the field logbook for tracking purposes. The wipe blank can be archived frozen for future analysis if cross contamination is suspected.
19	1189	Section 4.9.2 Drilling Equipment, page 4-26	Discuss how drilling equipment will be decontaminated if oily/tar residue is present, similar to the discussion of hand sampling tools. See also Specific Comment on Section 4.9.1 regarding field equipment.	Section 4.9.2 Drilling Equipment will be revised with the addition of a new sub-bullet: "If drilling equipment is contaminated with oily/tar that can not be decontaminated with an Alconox™ detergent rinse, a concentrated Alconox™ rinse will be attempted. If that approach is still unsuccessful, then a fast evaporating distillate of petroleum (such as toluene or xylene) will be used to remove the oily/tar residue. This distillate of petroleum product will not include use of oily paint thinners. Following removal of the oily/tar residue, the equipment will be rinsed with Alconox™ and distilled water to ensure the removal of the petroleum distillate."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
20	1190	Section 5.1 Bathymetry and Topography and Section 5.2 Detection of Existing Buried Utilities and Debris, page 5-1	FSP Sections 5.1 and 5.2 present general guidelines to complete a geophysical survey to identify potential debris as well as coverage, depth, and thickness of sediment types present within the SIB Project Area. However, the text does not provide a work plan for conducting a geophysical survey.  EPA is amenable to the approach to allow the SIB RD Group to work with potential geophysical subcontractors to develop a scope of work to conduct the geophysical survey, as EPA recognizes that preliminary work to determine and resolve several issues related to geophysical surveying prior to designing work such as soil/sediment/water sub-bottom survey, magnetometer survey and side scan sonar, multi-beam bathymetric survey for infrastructure identification, etc. needs to occur. However, EPA expects a geophysical survey work plan that follows EPA's 7 step DQO process to be provided for agency review. EPA requests 45 days of review time for this work plan prior to the scheduled work.	A geophysical survey work plan and quality control plan will be submitted as part of the Final FSP (Appendix A to the Final PDIWP), with the FSP updated to include a summary of the 7 steps for systematic planning using the data quality objectives (DQO) process. Since we are inserting a large work plan after it is developed (significant input from a subcontractor), we cannot quote the text we will insert at this time.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
21	1191	Section 5.3.2 Dive Inspection of In-Water Structures, pages 5-2 through 5-3	Dive inspections should include in-water sheet pile bulkheads and not be limited to over-water structures. Dive inspections should not be limited to a maximum of three over-water or in-water structures if additional inspections can be performed to determine a structure's functional use and its estimated remaining design life.	Section 5.3.2 will be revised to read "Selected in-water and over-water structures will be inspected by a dive team. The structures selected for a dive inspection will be based on the results of the screening-level inspections and preliminary analysis of the impacts of the RA on the structures. An existing structure that exhibits noticeable above-water deterioration that reduces the design capacity and is also negatively impacted by the proposed RA will receive priority for a dive inspection."	EPA recommends top to bottom inspection of structures anticipated to be impacted by remedial action to ensure structure failure is not likely to occur given assumed setbacks (e.g., above water abutment conditions may not necessarily represent underwater conditions).

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15	1185	Section 4.5.4 Manual Grab Stormwater Solids Sampling Methodology, page 4-19 and Section 4.5.5 In-Line Sediment Trap Sampling Methodology, page 4-20				
16	1186	Section 4.5.5 In-Line Sediment Trap Sampling Methodology, page 4-20				
17	1187	Section 4.5.6.3 In-Line Sediment Trap Sampling, page 4-21				
18	1188	Section 4.9.1 Hand Sampling Tools, page 4-26				
19	1189	Section 4.9.2 Drilling Equipment, page 4-26				
20	1190	Section 5.1 Bathymetry and Topography and Section 5.2 Detection of Existing Buried Utilities and Debris, page 5-1				
21	1191	Section 5.3.2 Dive Inspection of In-Water Structures, pages 5-2 through 5-3	Revise the text to include top to bottom inspection of structures anticipated to be impacted by remedial action to ensure structure failure is not likely to occur given assumed setbacks (e.g., above water abutment conditions may not necessarily represent underwater conditions).	The first paragraph of Section 5.3.2 is revised to read, "Selected in-water and overwater structures will be inspected by a dive team. The structures selected for a dive inspection will be based on the results of the screening-level inspections and preliminary analysis of the impacts of the Remedial Action on the structures. For structures anticipated to be impacted by the Remedial Action, a top to bottom inspection will be conducted."		

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22	1192	Section 5.4.1 Current Velocities and Water Levels, page 5-5	The rationale behind the proposed longitudinal and lateral ADCP transects within the SIB project area is not clear. The two longitudinal transects will very likely not show any meaningful trends in currents since the dominant flow direction is oriented in the same direction as the proposed transects. The lateral transects will also not show significant variations in currents due to the relatively small tidal prism of the SIB. Consider eliminating the two longitudinal transects and reduce the number of lateral transects or provide the rationale supporting the selection of transects.	Section 5.4.1 will be updated to include "Lateral transect locations were chosen to measure alongshore currents, and eddying effects, while avoiding active vessel mooring locations. Longitudinal transects were included to capture cross-basin currents which likely occur in some locations due to eddying effects. It is understood that currents are likely quite small within the interior of the basin and demonstrating this is an important element of validating the SIB conceptual site model."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
23	1193	Section 5.4.3 Suspended Sediments, page 5-6	Revise the text to specify how suspended sediment concentrations will be measured. Based on PDI Work Plan Section 4.9, it seems that turbidity will be measured, with presumably a turbidity- total suspended solids (TSS) correlation to be developed and used to convert the continuous turbidity measurements to continuous estimates of TSS. However, turbidity measurements are typically made at a single point in the vertical (in the water column) and therefore cannot be used to characterize the depth-average TSS or the depth integrated suspended sediment flux. Revise the text to clarify the analytical methods proposed (measure turbidity, or acoustic backscatter using the ADCP), the depth intervals proposed to be sampled, and the procedures to be used to estimate TSS time-series.	Section 5.4.3 will be updated to include "A logging Conductivity, Temperature, and Depth (CTD) Sonde equipped with a turbidity sensor will be mounted on the ADCP platforms and oriented such that the sensor portion or the CTD is near the level of the first ADCP data bin or at least near the same distance from the bottom as the ADCP head. The CTD will collect sensor data concurrently with the sampling period of the ADCP. A third CTD will be used to collect water quality profiles that include optical turbidity for at least three (3) ensembles during the current profiling at each bottom mount for through column correlation with backscatter data. CTD profiles will be collected concurrently with water samples. The purpose will be to collect data throughout the water column to provide a vertical variation profile to supplement the near-bottom optical backscatter point sensor (OBS)/turbidity measurements. Note: Due to equipment shortages and availability, an infrared turbidity OBS sensor may be used in place of an optical turbidity CTD.  To assist with data correlation and quality checks, approximately 500 ml to 1,000 ml of water will be collected for laboratory analysis of turbidity and TSS based on the laboratory's requirements. A maximum analysis of up to 10 water samples will be collected following the first deployment of the ADCP platforms, and up to 10 water samples will be collected following the second deployment. A water grab sampler will be used to collect a water sample within the first sample bin (estimated to be approximately 1-meter from bottom) near both ADCP stations during an ensemble recording event. Turbidity from these samples will be recorded on the boat upon recovery using a handheld turbidity meter then processed for transport to a laboratory for testing (turbidity and TSS only). Additional water samples shall be taken at random locations along the proposed ADCP transects following a CTD profile at the close of the transect at an area and depth indicating varying back-scatterance on the ADCP real-time display. Water samples will be analyzed by a contract laboratory for Total Suspended Solids, by EPA Method 160.2. AND SSC analytical method, ASTM D 3977-97, Standard Test Method for Determining Sediment Concentration in Water Samples (ASTM, 1999). Results of laboratory analysis and details of the sample collection will be provided with the report. Laboratory water samples will be collected concurrent to the first deployment and service deployment event only.  Prior to deployment, turbidity sensors will be pre-calibrated using a nominal range concentration turbidity standard for the site. Pre-calibration of the turbidity sensors will be standardized using a 2-point calibration with distilled water and a (TBD) high concentration turbidity standard to set the internal offset and scale of the OBS or alternate turbidity sensor. During the TSS calibration, short-term averages (as provided by logger) will be recorded with the OBS/turbidity sensor in a thoroughly mixed container of site sediment collected within the sediment traps, or those collected using a small grab sampler (back-up) and distilled water. Three to five sediment concentrations, ranging from 1-40g/l will be used to develop a calibration curve. This calibration will likely be represented by a non-linear 2nd or 3rd order polynomial curve with a specific calibration for each sensor. During post processing, the stored data logger values (in NTU, counts or millivolts) will be processed with the developed calibration equations to produce SSC values for each averaged field measurement."	ADCPs typically do not include measurements immediately above the instrument head (the blanking distance for the instrument); therefore, the position of the turbidity sensor should be set such that it is within the first ADCP bin (from bottom) rather than at the level of the ADCP head. Similarly, water samples for TSS/SSC measurements should be collected at the same level as the turbidity measurement and not too far (laterally) from the instrument location.  Additionally, the concentration ranges of 1-40 g/L for the instrument TSS calibration seem too high. Ambient TSS values in the SIB are unlikely to be that high; review and revise the TSS concentration range to be consistent with the ambient TSS range. In addition to the TSS-turbidity curve developed from the laboratory calibration, TSS from the in situ turbidity data can be compared to the TSS measured in water samples as an additional check and validation of the performance of the TSS-turbidity relationship.
24	1194	Section 5.5 Porewater Upwelling Location Survey, page 5-6	EPA has the following comments on this section and the text should be revised accordingly:		
24a	1195	Section 5.5 Porewater Upwelling Location Survey, page 5-6	The period of greatest upwelling identified in this section is July and August which is different from the June and July timeframe identified in PDI Work Plan Section 4.2. Revise the text to address Specific Comment on PDI Work Plan Section 4.2 and resolve the inconsistency between the timeframe suggested in the PDI Work Plan and FSP to ensure that the DQO is met of measurement during the time period of greatest upwelling is met.	The timing of the investigation will be planned during the time of the year when the river surface elevations are dropping, has less tidal fluctuations, and seasonal groundwater levels are elevated. Based on a review of available, historical, 2002 through 2007 groundwater elevations from former monitoring wells at the Portland Shipyard and Willamette River gage data (Morrison Street Bridge station), the river drops in February, March, June and July and groundwater elevations at the Shipyard were highest in February. As a result, the upwelling survey is proposed for February – March 2022.	Please provide response.

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22	1192	Section 5.4.1 Current Velocities and Water Levels, page 5-5				
23	1193	Section 5.4.3 Suspended Sediments, page 5-6				
24	1194	Section 5.5 Porewater Upwelling Location Survey, page 5-6				
24a	1195	Section 5.5 Porewater Upwelling Location Survey, page 5-6	See EPA response to comment on Section 4.2 Porewater Upwelling Location Survey (comment reference no. 1063).	See HGLs' response to comment reference no. 1063. Text in FSP Section 5.5 was revised to provide additional information about Trident probe measurements, including data collection rate of 15 stations per day, timing of survey period coinciding with neap tide conditions to minimize tidal fluctuations, and subsurface probe depth of 18 inches.		

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24b	1196	Section 5.5 Porewater Upwelling Location Survey, page 5-6	The text indicates that a Trident Probe will be used to measure temperature and specific conductance contrast between sediment porewater and overlying surface water. Trident probes can be used to collect porewater samples for chemical analysis and this data is needed for cap design. The PDI Work Plan could be revised to include collection of porewater samples for chemical analysis of ROD Table 17 contaminants. Alternatively, other means of collecting porewater samples should be proposed.	The text will be revised as follows: "The need for porewater analyses will be assessed after the delineation of upwelling zones and may occur as part of remedial design for cap design."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
24c	1197	Section 5.5 Porewater Upwelling Location Survey, page 5-6	Provide a SOP for the Trident Probe sampling with the revised PDI Work Plan for EPA review.	The SOP for the Trident Probe has been added to Appendix A of the FSP.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
24d	1198	Section 5.5 Porewater Upwelling Location Survey, page 5-6	FSP Section 5.5 and Figure 5-5 should be revised consistent with EPA comments on PDI Work Plan Section 4.2.	FSP Section 5.5 and Figure 5-5 will be revised consistent with EPA comments on PDI Work Plan Section 4.2. The text will be revised to read: "Proposed station distances will vary with distance from the shoreline and have been adjusted for the presence of permanent or semi-permanent structures (Figure 5-5). The proposed survey assumes station distances of 50 feet near the shore and 100 feet away from the shore. Specifically, the proposed survey assumes fifteen 800-foot-wide transects across SIB (with up to 10 stations each where no permanent structures are present) and two 400-foot-wide transects at the head of SIB (8 stations) for a total of up to 158 stations."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
25	1199	Section 8.1.1 Field Decisions and Documentation, page 8-1	The following text should be removed: "If the EPA contact or designee cannot be reached in a reasonable time frame, minor modifications to the plan may be made without EPA approval." EPA expects field sampling to be conducted according to an approved WP and FSP. Any deviations from these documents must be reported to EPA via field change requests for review and approval prior to implementing the proposed change. EPA will make every effort to provide prompt communication regarding field deviations.	The following text from Section 8.1.1 Field Decisions and Documentation (page 8-1) has been removed: "If the EPA contact or designee cannot be reached in a reasonable time frame, minor modifications to the plan may be made without EPA approval."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
26	1200	Section 9.5 Laboratory Selection, page 9-3	Add a bullet noting that laboratories with detection limits below Table 17 CULs and/or Table 21 RALs will be selected to the greatest extent practicable.	A bullet has been added to Section 9.5 Laboratory Selection, page 9-3, noting that "laboratories with detection limits below Table 17 CULs and/or Table 21 RALs will be selected to the greatest extent practicable".	The response is acceptable pending EPA's review of the revised PDI Work Plan.
27	1201	Table 2-2 Cleanup Levels for Sediment and Riverbank Soil	Correct the CUL for TCDD to 0.0002 µg/kg.	The CUL for TCDD has been changed to 0.0002 µg/kg on Table 2-2 Cleanup Levels for Sediment and Riverbank Soil.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
28	1202		EPA has the following comments on this section and the text should be revised accordingly:		
28a	1203	Table 4-1 Summary of Sample Activities, Numbers, and Analyses	EPA recommends removing the ASTM reference number in Table 4-1 and instead state ASTM standard number.	Table 4-1 will be updated by removing reference numbers and only stating ASTM standard numbers (e.g. D2216).	The response is acceptable pending EPA's review of the revised PDI Work Plan.
28b	1204	Table 4-1 Summary of Sample Activities, Numbers, and Analyses	ASTM Standards listed for "Sieve and Hydrometer analysis" are incorrect. Verify and cite the applicable ASTM Standards.	The ASTM standard for sieve analysis will be corrected to D6913. The ASTM standard for hydrometer analysis will be corrected to D7928.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
29	1205	Table 4-2	Clarify the significance of the sample nomenclature. It is not clear why all but 2 samples end in "Y".	The "Y" at the end of all but two of the location IDs in Table 4-2 will be removed.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
30	1206	Table 4-2 and Table 4-3	The footnotes states, "The other half and remaining undivided cores will be archived for Phase 2. See FSP for more details." Phase 2 is not mentioned anywhere else in the PDI Work Plan or FSP. Revise this reference and include in the text details regarding Phase 2.	Reference to Phase 2 will be removed from Tables 4-2 and 4-3. The footnote will be revised to state "The other half and remaining undivided cores will be archived for future use."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
31	1207	All FSP Figures	Remove the "Confidential" stamps from the figures.	Figures will be updated to remove 'Confidential' stamps.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
32	1208	Figures 4-3 and 4-4	EPA has the following comments on this section and the text should be revised accordingly:		

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24b	1196	Section 5.5 Porewater Upwelling Location Survey, page 5-6				
24c	1197	Section 5.5 Porewater Upwelling Location Survey, page 5-6	Revise the FSP to provide the frequency at which Trident probe measurements will be recorded and clarify whether that frequency will account for daily tidal fluctuations	<p>The following text has been added to the second paragraph of Section 5.5: "The Trident probe measurements are planned to be collected at a rate of 15 stations per day. The Trident probe records temperature and specific conductance measurements every 5 seconds; the reported measurements are the average over a 30-second interval."</p> <p>The following text has been added to the fourth paragraph of Section 5.5: "The survey period was selected to correspond as closely as possible to neap tide conditions when tidal fluctuations are relatively small (~2 ft). The subsurface probe depth was also selected to be at 18 inches, deep enough to be minimally affected by tidal fluctuations."</p>		
24d	1198	Section 5.5 Porewater Upwelling Location Survey, page 5-6				
25	1199	Section 8.1.1 Field Decisions and Documentation, page 8-1				
26	1200	Section 9.5 Laboratory Selection, page 9-3				
27	1201	Table 2-2 Cleanup Levels for Sediment and Riverbank Soil				
28	1202					
28a	1203	Table 4-1 Summary of Sample Activities, Numbers, and Analyses				
28b	1204	Table 4-1 Summary of Sample Activities, Numbers, and Analyses				
29	1205	Table 4-2				
30	1206	Table 4-2 and Table 4-3				
31	1207	All FSP Figures				
32	1208	Figures 4-3 and 4-4				

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32a	1209	Figures 4-3 and 4-4	As discussed in PDI Work Plan General Comment on Data Sources, only samples from approved data sets should be provided on the data gaps assessment figures. Remove or differentiate all non-approved surface and subsurface locations.	Figures 4-3 and 4-4 will be updated by differentiating non-EPA approved data sources.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
32b	1210	Figures 4-3 and 4-4	The figure legend states that dark green shading means "SMA sample". Define and explain that term in the text.	The legend entry 'SMA Sample' on Figures 4-3 and 4-4 will be changed to "Grid Cell Without Existing Data within SMA". The legend entry "SMA Boundary Sample" will be changed to "Grid Cell Without Existing Data on Border of SMA".	The response is acceptable pending EPA's review of the revised PDI Work Plan.
33	1211	Figure 4-6 Proposed Riverbank Characterization Transects	Add the MLW elevation contour to Figure 4-6 and adjust the sampling transects to include sampling throughout the riverbank between top of bank and MLW.	Figure 4-6 has been updated with the MLW elevation.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
34	1212	Appendix A Standard Operating Procedures, SOP 403.07 Geologic Borehole Logging, Attachment 2, Unified Soil Classification System Table	Verify the correctness of the equation for the Coefficient of Curvature (Cc) and revise if needed.	The existing Attachment 2 of SOP 403.07 will be updated: the equation for Coefficient of Curvature (Cc) will be revised to: " $Cc=(D30)^2 / (D10 \times D60)$ ". A new version of the Standard Operating Procedure (SOP) for Borehole Logging for geotechnical logging, SOP R-4, will be included in the Final FSP for use during logging of geotechnical borings.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
35	1213	Appendix C Waste Management Plan, General Comment:	EPA recommends estimating the quantity of investigation derived waste (IDW) that will be generated because handling/disposal of 55-gallon drums of waste may not be economical. One may consolidate multiple drums into a roll-off bin, then conduct composite sampling. This method proves to be more cost-effective if about 10 or more drums are expected to be generated.	The quantity of generated waste will be estimated and the most cost efficient method for containment will be determined. Appendix C will be updated accordingly. Section 2 of the appendix has been revised as follows: "Additionally, the quantity of general waste will be estimated and the most cost efficient method for containment will be determined."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
36	1214	Appendix C Section 3.0 General Waste Management, 3rd paragraph, page C-7	Plan states that phosphate-free detergent bearing liquid wastes will be sampled/analyzed for site contaminants of concern, then discharged to sanitary sewer system if 'the permit' allows. One would need to coordinate such discharges with the local sewer agency. Revise the text to state who that would be. As a recommendation, one might consider other disposal means or consolidating the liquid waste because the cost of the chemical analysis may be higher than alternative disposal methods. Also, there can be weather-dependent factors for City of Portland publicly owned treatment works discharge limitations that may prevent its use.	Costs for analyses and transport/disposal will be compared to determine the most cost efficient method and the plan will be updated accordingly. The following text update will be made after first sentence: "... will be sampled for site contaminants of concern." New proposed text: "If discharge to a sanitary sewer system is identified as the most cost effective method, the appropriate representative at the sewer system authority will be identified and permission to discharge requested."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
37	1215	Appendix C Section 3.1 Containers and Accumulation, page C-8	EPA has the following comments on this section and the text should be revised accordingly:		
37a	1216	Appendix C Section 3.1 Containers and Accumulation, page C-8	The text states that, "The waste accumulation area is identified as the staging area at the Fred Divine Dock ..." Provide a figure showing this location and determine if accidental waste releases in this area could result in releases to the environment. Also, provide a brief description of the construction of the "secondary containment system" area. Consider, among other factors, if accumulation of rainwater in the containment area could be an issue.	A figure identifying the Fred Divine Dock property lines, drainages, buildings, and secondary containment will be provided. The text will be revised after second sentence: "Figure __ denotes the location of the proposed waste accumulation area." A new sentence will be added to the end of the paragraph as follows: "Also, the waste accumulation area will be constructed with a secondary containment system consisting of a plastic lined area with 2x4s or waddles and/or a pre-constructed system."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
37b	1217	Appendix C Section 3.1 Containers and Accumulation, page C-8	The text states that, "The field crew can use this area to process ..." Revise the text to clarify if this area "will" be used (or not).	The text in Appendix C Section 3.1, 2nd paragraph will be edited as follows "The field crew will use the waste accumulation area to process..... "	The response is acceptable pending EPA's review of the revised PDI Work Plan.
38	1218	Appendix C Section 3.4.5 Nonhazardous Waste Manifest, C-14	It is not typical/required to use a manifest for non-hazardous waste, although records of the quantity and disposal location for the non-hazardous IDW shipments are necessary and required.	The "Nonhazardous Waste Manifest" in Appendix C Section 3.4.5, first sentence and bullets will be revised as follows: "Each load.....be shipped using a Nonhazardous Waste Record. At a minimum, the record will include the required fields, "quantity of waste" and "disposal location".	The response is acceptable pending EPA's review of the revised PDI Work Plan.
39	1219	Appendix C Section 4.0 Documentation, page C-17	EPA has the following comments on this section and the text should be revised accordingly:		
39a	1220	Appendix C Section 4.0 Documentation, page C-17	The text states that "The locations and quantities of soil reused at the site ..." There appears to be no plan to reuse IDW at the site. Clarify whether there is a plan to reuse IDW. If not, remove this sentence.	No IDW will be reused at the site. The sentence beginning with "The locations and quantities of soil reused at the site..." will be removed from Appendix C Section 4.0	The response is acceptable pending EPA's review of the revised PDI Work Plan.
39b	1221	Appendix C Section 4.0 Documentation, page C-17	Provide a copy of all documentation declared in this section to EPA.	The text at the end of Appendix C, Section 4.0 be amended as follows: "Copies of all documentation will be provided to EPA."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
40	2015	Appendix C Section 3.4.1 CERCLA OSR Confirmation, page C-12			

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32a	1209	Figures 4-3 and 4-4	The figures do not differentiate between EPA approved and non-approved data sources. Clarify whether the non-approved data was removed or revise the figures to indicate which data are not approved.	Non-approved data is not included/shown on figures. A note was added to the figure legends to indicate that only EPA-approved data are shown and list the data sources.		
32b	1210	Figures 4-3 and 4-4				
33	1211	Figure 4-6 Proposed Riverbank Characterization Transects				
34	1212	Appendix A Standard Operating Procedures, SOP 403.07 Geologic Borehole Logging, Attachment 2, Unified Soil Classification System Table				
35	1213	Appendix C Waste Management Plan, General Comment:				
36	1214	Appendix C Section 3.0 General Waste Management, 3rd paragraph, page C-7				
37	1215	Appendix C Section 3.1 Containers and Accumulation, page C-8				
37a	1216	Appendix C Section 3.1 Containers and Accumulation, page C-8				
37b	1217	Appendix C Section 3.1 Containers and Accumulation, page C-8				
38	1218	Appendix C Section 3.4.5 Nonhazardous Waste Manifest, C-14				
39	1219	Appendix C Section 4.0 Documentation, page C-17				
39a	1220	Appendix C Section 4.0 Documentation, page C-17				
39b	1221	Appendix C Section 4.0 Documentation, page C-17				
40	2015	Appendix C Section 3.4.1 CERCLA OSR Confirmation, page C-12	Delete "and submit to the RPM for review, approval, and signature as generator of the waste" from the last sentence of this section. EPA is not the waste generator at the SIB Project Area and the EPA RPM does not need to review, approve, or sign the waste manifest or other support documentation. However, the EPA Region 10 Off-Site Contact must provide an acceptability determination of the receiving facility for any waste, including IDW, to be sent off-site. The EPA RPM should be copied on correspondence with the EPA Region 10 Off-Site Contact.	The requested text was removed. Communication requirements noted for EPA Region 10 Off-Site Contact and EPA RPM.		

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<b>Editorial Comments on the Field Sampling Plan</b>					
1	1222	Section 4.5.4 Manual Grab Stormwater Solids Sampling Methodology, page 4-19	The text states that, "Standing water in the manhole sump, if present, may be pumped off to simplify solids sample collection." For clarity, revise the text to state that standing water will be pumped off.	The text has been revised to indicate that standing water will be pumped off. The following statement has replaced the former sentence "If standing water is present in the manhole sump, it will be pumped off to simplify solids sample collection."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
2	1223	Figure 4-1	The outfall symbols are difficult to distinguish from "Surface Sample Locations (Existing)" symbols. EPA recommends using a different symbol/shape/color for outfalls on the figures.	Figure symbology will be updated accordingly.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
3	1224	Figure 4-3	The color scheme on this figure is difficult to read. Suggest reducing opacity of the following grid colors Existing Surface Sample, SMA Sample, and SMA Boundary Sample. The colors used for Proposed Surface Core Sample Location and Surface Sample Location (Existing) are too similar, which is confusing because purple means both "existing" and "proposed". Revise all other figures with similar color schemes.	The color scheme of Figure 4-3, and other figures with similar color scheme, will be modified to provide more clarity.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
<b>General Comments on Appendix B, the Quality Assurance Project Plan</b>					
Following are EPA's comments on the HydroGeoLogic, Inc. Quality Assurance Project Plan (QAPP), Appendix B of the Draft Pre-Design Investigation Work Plan, prepared by HydroGeoLogic, Inc. on behalf of the Swan Island Basin Remedial Design Group and dated June 2021.					
1	1225	General	The QAPP was reviewed versus the requirements in EPA Requirements for Quality Assurance Project Plan: EPA QA/R-5, March 2001, Reissued May 2006; Guidance for Quality Assurance Project Plans: EPA QA/G-5, December 2002, and the Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) manual (EPA 2005) and optimized worksheets (March 2012). Some sections were missing or incomplete, including B10–Data Management [refer to the data management plan in the work plan]; C1–Assessment and Response Actions [missing discussions on the authority and independence of the individual(s) performing the assessments in relation to those being assessed]; and D2–Verification and Validation Methods [missing data validation procedures checklists to be used by the data validator]. Include or expand on these sections in the QAPP, as appropriate. The section on Non-Direct Measurements should identify existing data and data sources, for example, computer databases or literature files, or models that should be accessed and used.	B-10: The following reference to the data management plan has been added to the end of the introductory text for Worksheet #29: "Project documentation, including field data, laboratory data, and electronic files will be maintained in accordance with the project data management plan described in Section 9.0 of the FSP and the Programmatic Data Management Plan (EPA, 2020a)." C-1: The following introductory text has been added to Assessments table of Worksheets #31, #32, and #33: "The planned project assessment activities are described below. In addition to the planned activities listed below, all on-site workers will monitor project activities on an ongoing basis to ensure compliance with project plans, good work practices, and H&S requirements. If a non-conforming or unsafe condition is observed, all site workers have the authority to stop work until the condition is addressed." The following text has been added to the Assessment Response and CA table of Worksheets #31, #32, and #33: "The responsibilities for assessment response and implementing corrective action are described below. In all cases, corrective action will be monitored and assessed by different personnel than those tasked with implementing the corrective action. The project QA Officer, who is independent from the project management and execution team, will have the final authority to determine if corrective action has been satisfactorily implemented, except for H&S corrective action, which is under the final authority of the Corporate H&S Manager." D-2: Example data validation checklists have been provided by the validation subcontractor and have been added to the QAPP as Appendix B. Non-Direct Measurements: References to Section 2.0 of the SAR and Section 2.0 of the PDI Work Plan have been added to Worksheet #13. The referenced sections describe the database and existing site data that were used to develop project data needs and the CSMS.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
2	1226	General	The first references to analysis for total suspended solids (TSS) in the QAPP are in Worksheet #19, Sample Containers, Preservation, and Hold Times and Worksheet #23, Analytical SOP Reference Table. Include TSS in the other analytical worksheets or clarify why TSS analysis is not included on the other worksheets.	TSS is included as a project analysis with the geotechnical parameters listed in Worksheet #12.10; however, the acronym was not defined at this first reference. Worksheet #12.10 has been revised to include "(TSS)" at this first use of total suspended solids.	The response is acceptable pending EPA's review of the revised PDI Work Plan.

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1	1222	Section 4.5.4 Manual Grab Stormwater Solids Sampling Methodology, page 4-19				
2	1223	Figure 4-1				
3	1224	Figure 4-3				

1	1225	General				
2	1226	General				

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<b>Specific Comments on Appendix B, the Quality Assurance Project Plan</b>					
1	1227	QAPP Worksheet #1 and 2, Title and Approval Page, page 3	Revise the worksheet to include Oregon Department of Environmental Quality (ODEQ) and Yakama Nation as stakeholders on.	ODEQ and the Yakama Nation have been added as stakeholders in Item 7 of Worksheets #1 and #2 (p. 3).	The response is acceptable pending EPA's review of the revised PDI Work Plan.
2	1228	QAPP Worksheet #3 and #5 and Worksheet #9, pages 4 and 19	EPA has the following comments on this section and the text should be revised accordingly:		
2a	1229	QAPP Worksheet #3 and #5 and Worksheet #9, pages 4 and 19	DEQ personnel are listed in the distribution list as a settling party entity but should be listed as a Support Regulatory Agency. For clarification, the title for Wesley Thomas should be listed as Project Manager.	The table has been revised to list ODEQ personnel under the sub-heading of "Support Regulatory Agency". Wesley Thomas's title has been revised to "PM".	The response is acceptable pending EPA's review of the revised PDI Work Plan.
2b	1230	QAPP Worksheet #3 and #5 and Worksheet #9, pages 4 and 19	Yakama Nation Fisheries is erroneously listed as part of the Five Tribes; Yakama is spelled incorrectly (Yakama, not Yakima); and Laura Shira's email address is wrong; revise to: shil@yakamafish-nsn.gov.	Laura Shira's title has been revised to "Yakama Nation Representative" and the spelling of "Yakama" has been corrected in the corresponding Organization and Email Address fields of the table.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
3	1231	QAPP Worksheet #4, 7 and 8, Project Organization and QAPP Distribution, under EPA Regulatory Program, page 4	The QAPP approval page is unsigned. A signature is required for all versions of the QAPP submitted to document review and concurrence of the contents. Include the final signed QAPP approval page in the updated document. Include Josie Clark, EPA, as secondary RPM who can be contacted if Madi Novak is unavailable.	The signature blocks in this worksheet does not indicate approval but indicates that the listed personnel have read and agree to implement this QAPP as written. The final version of the QAPP will include a sign-off from all listed project personnel. Obtaining external signatures requires time and coordination with EPA and other parties, and the effects of this requirement must be accounted in the timeline for delivering the final PDI Work Plan. HGL proposes to complete the revised QAPP at least one week in advance of the final PDI submittal date to allow sufficient time to secure external signatures in time for the delivery date of November 12, 2021.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
4	1232	QAPP Worksheet #10, Conceptual Site Model, pages 20 through 24	Revise the worksheet to summarize or reference a description of the SIB Project Area CSM (in the SAR). As written, it focuses on the harbor wide CSM.	The opening paragraph of Worksheet #10 has been revised to include this text: "The comprehensive refined CSM for the SIB Project Area is presented in Section 2.2 of the PDI Workplan." The following text has been added to Section 10.2 of QAPP Worksheet #10: "The following sections provide an overview of the PHSS. The development history of the SIB Project Area is presented in Section 3.1.3 of the SAR. Site investigation activities at the SIB Project Area were generally conducted as a component of the PHSS-wide investigations described below. Field investigation activities specific to the SIB Project Area are discussed in Section 3.4 of the SAR." A reference to the SAR describing the dredging activities specific to the SIB Project Area has been added to Section 10.2.1 of QAPP Worksheet #10.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
5	1233	QAPP Worksheet #11, Project Data Quality Objectives, Develop the Analytical Approach, page 27	Include a reference to Worksheet #15 in Section 11.5 so the reader can find key analytical approach information such as analytical methods, detection limits, and project action limits (PALs).	The following text has been added at the end of the second paragraph of Section 11.5 of Worksheet #11: "The project analytical methods, including target analytes and the associated laboratory sensitivity limits and the project action limits (PALs), are presented in Worksheet #15."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
6	1234	QAPP Worksheet #11, Project Data Quality Objectives, Specify Performance or Acceptance Criteria, page 27	For projects that involve hypothesis testing (e.g., the presence or absence of contamination exceeding some threshold value) for decision-making, the QAPP needs to specify probability limits for decision errors. For estimations and other analytic approaches (e.g., estimating the volume of groundwater or soil potentially requiring remediation), the QAPP needs to state performance criteria (for new data being collected) or acceptance criteria (for existing data being considered for use). Based on the information presented on Worksheet #11, Section 11.6 (Specify Performance and Acceptance Criteria) and 11's reference to the details in analytical Worksheets #12, 15, 28 and 28, it seems that the estimation approach is planned. Specify whether the estimation approach is planned to be used in the updated QAPP.	The following text has been added to the final paragraph of Worksheet #11, Section 11.6: "The project DQOs have been developed to address an estimation problem and determining the probability limits on decision errors is not required."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
7	1235	QAPP Worksheet #12.1 through 12.9, Measurement Performance Criteria, Sensitivity rows, pages 39-60	The column titled "QC Sample or Measurement Performance Activity" shows the project quantitation limit (PQL) and the column titled "Measurement Performance Criteria" is listed as "Established at or above the low point of calibration curve". The associated footnote #4 says, "This method requirement will only be reviewed to complete definitive (Stage 4) data validation." Since achievement of the remedy will be based on evaluating the data against the selected action levels (e.g., cleanup levels [CULs]), the project's measurement performance criteria should be included on these worksheets. A reference can be made to Worksheet #15s for specific sensitivity requirements.	A row has been added to the MDL DQI for each method table in Worksheet #12 indicating that the Measurement Performance Criteria (MPC) includes performance relative to the associated analyte PALs. For example, text has been added to Worksheet 12.1a stating one of the MPCs for MDLs is: "MDL at or below the analyte-specific PALs listed in Worksheets #15.1, #15.2a and b, and #15.3a and b".  The footnote indicating that this is a Stage 4 QC element has been removed from "MDL" in the second column and added to "Conducted and updated at least annually" in the MPC column (column 3) in order to differentiate this analytical requirement from the project-specific MPC for comparison to PALs, which is applicable to all results regardless of validation level.  "Laboratory MDL determination" has been revised to "MDL" in column 2 of the MPC tables.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
8	1236	QAPP Worksheet #14/16, Project Task and Schedule, pages 64-69	A detailed schedule is included but it focuses on deliverables only and does not include key activities such as data collection and generation of field and analytical data; data assessments and reviews. Include this information in the schedule.	QAPP Worksheet #14/16 will be revised to include details for planned field work. The revised portion of the table showing the PDI Field Efforts will be provided in the revised document.	The response is acceptable pending EPA's review of the revised PDI Work Plan.

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1	1227	QAPP Worksheet #1 and 2, Title and Approval Page, page 3				
2	1228	QAPP Worksheet #3 and #5 and Worksheet #9, pages 4 and 19				
2a	1229	QAPP Worksheet #3 and #5 and Worksheet #9, pages 4 and 19				
2b	1230	QAPP Worksheet #3 and #5 and Worksheet #9, pages 4 and 19				
3	1231	QAPP Worksheet #4, 7 and 8, Project Organization and QAPP Distribution, under EPA Regulatory Program, page 4				
4	1232	QAPP Worksheet #10, Conceptual Site Model, pages 20 through 24				
5	1233	QAPP Worksheet #11, Project Data Quality Objectives, Develop the Analytical Approach, page 27				
6	1234	QAPP Worksheet #11, Project Data Quality Objectives, Specify Performance or Acceptance Criteria, page 27				
7	1235	QAPP Worksheet #12.1 through 12.9, Measurement Performance Criteria, Sensitivity rows, pages 39-60				
8	1236	QAPP Worksheet #14/16, Project Task and Schedule, pages 64-69				

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9	1237	QAPP Worksheet #15.3B, PALs and Laboratory Specific MDLs/PQLs – PAHs in Water by 8270-SIM, page 75	Seven PAHs (benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenz[a,h]anthracene, and indeno[1,2,3-cd]perylene) are focused contaminants of concern (COCs); have PHSS screening levels; they have surface water CULs that are below both ALS-Kelso laboratory method detection limits (MDLs) and PQLs. Note in the revised QAPP if these MDLs/PQLs will achieve the project-specific objectives or if method modifications or other approaches will be applied to improve analytical sensitivities or to evaluate the data. The laboratory should be contacted and the planned approach on achieving the project's quality objective should be included in this section of the QAPP to update the current language.	ALS-Kelso has an ultra-low modification to Method 8270D-SIM that can achieve a PQL of 3.4 ng/L for PAHs. The associated MDLs meet the CULs for all indicated PAHs except benzo[a]pyrene (MDL = 0.41 ng/L, CUL = 0.12 ng/L) and dibenz[a,h]anthracene (MDL = 0.45 ng/L, CUL = 0.12 ng/L). The modified method and the associated sensitivity limits have been incorporated into QAPP Worksheet #15.3b.  Analysis of organics in runoff water will be performed both on grab samples and on samples submitted on polyurethane foam (PUF) filters from metered high volume samplers, which will have improved sensitivity over the grab sample analyses currently presented in the QAPP. The sensitivity limits and associated method/laboratory information associated with analysis of organics on PUF filters will be added to the QAPP.  The following text has been added to the introductory section of Worksheet #15: "In some cases, the laboratory's MDL is greater than the matrix-specific CUL developed for a target analyte, which is indicated in the methods-specific tables by highlighting the affected CUL. In most cases where the laboratory limits do not meet the CULs, analytical method selected to support this project is the most sensitive method commercially available and the sensitivity limits provided by the laboratory are representative of the currently achievable analytical technical capabilities. In other cases, a less sensitive method (such as Method 8082A for PCBs as Aroclors) will be used in conjunction with a more sensitive method. The sensitivity performance for the affected analytes does not meet one of the measurement performance criteria for MDLs (see Worksheet #12) and is a limitation on data usability for comparison to CULs; however the site is fully characterized,  and the analytical results will be of sufficient sensitivity to support RD to address areas of known contamination and the evaluation of recontamination potential from runoff."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
10	1238	QAPP Worksheet #15.8A, PALs and Laboratory Specific MDLs/PQL-Organochlorine Pesticides in Soil/Sediment by Method 1699M, page 90	Dieldrin has a soil/sediment CUL that is below the ALS-Kelso laboratory MDL and PQL. Address as noted in QAPP specific comment number 5.	ALS-Kelso is in the process of updating its Method 1699M GC/MS/MS instruments and the new instrumentation is expected to show improved sensitivity performance. The new instruments are expected to be installed and ready to support analysis before the start of project sampling in January, contingent on supply chain impacts due to COVID. ALS will also explore improving the sensitivity performance of their current instrumentation, as the current MDL of 0.077 ug/kg is close to the CUL of 0.07 ug/kg. This information has been added as a footnote to Worksheet #15.8a. See also response to Comment #1237.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
11	1239	QAPP Worksheet #15.8B, PALs and Laboratory Specific MDLs/PQL-Organochlorine Pesticides in Water by Method 1699M, page 91	The DDX components are both COCs and recontaminant potential chemicals (RPCs); they have surface water CULs that are below the ALS-Kelso laboratory MDLs and PQLs. Address as noted in QAPP specific comment number 5.	The QAPP will be revised to indicate that aqueous OCP samples will be analyzed using HRGC/HRMS at the ALS-Burlington facility. See also response to Comment #1237.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
12	1240	QAPP Worksheet #15.9A, PALs and Laboratory Specific MDLs/PQL-PCDDs/PCDFs in Soil/Sediment by Method 1613B, page 92	Four dioxins listed, including 2,3,7,8-TCDD, 1,2,3,7,8-PeCDD, 2,3,4,7,8-PeCDF, and 1,2,3,4,7,8-HxCDF, are both COCs and RPCs and have soil/sediment CULs that are below the CFA laboratory MDLs. Address as noted in QAPP specific comment number 5.	CFA has provided EDLs that meet the CULs for all target PCDD/PCDF compounds and will report non-detected results as EDL U. These EDLs have been added to Worksheet #15.9a. CFA is in the process of integrating new standards into their calibration that will also lower the PQLs for both water and soil media and expects these lower calibrated ranges will be available before project sampling begins.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
13	1241	QAPP Worksheet #15.10A, PALs and Laboratory Specific MDLs/PQL-Metals in Soil/Sediment by Method 6020B, page 94	Arsenic has a soil/sediment CUL that is below the ARI laboratory MDL and PQL. Address as noted in QAPP specific comment number 5.	The laboratory MDL and PQL for sediments are both below the CUL of 3.0 mg/kg; however, the aqueous MDL and PQL are above the CUL of 0.018 ug/L. ARI has a Method 6020B modification that allows for a 2x or a 5x concentration of samples to improve sensitivity. However, performing this modification requires samples that do not have elevated mineral concentrations. ARI's experience with storm water samples indicates that it is unlikely that this modification will be available, but ARI will evaluate samples that are ND on a sample-specific basis to determine if concentrated analysis is practical. This information has been added as a footnote to QAPP Table 15.10b.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
14	1242	QAPP Worksheet #19 and 30.2, Project Laboratory Identification, page 109	Add the laboratories' certification expiration date.	Laboratory certification expiration dates have been added to Worksheet #19 and 30.2.	The response is acceptable pending EPA's review of the revised PDI Work Plan.

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9	1237	QAPP Worksheet #15.3B, PALs and Laboratory Specific MDLs/PQLs – PAHs in Water by 8270-SIM, page 75				
10	1238	QAPP Worksheet #15.8A, PALs and Laboratory Specific MDLs/PQL Organochlorine Pesticides in Soil/Sediment by Method 1699M, page 90				
11	1239	QAPP Worksheet #15.8B, PALs and Laboratory Specific MDLs/PQL Organochlorine Pesticides in Water by Method 1699M, page 91				
12	1240	QAPP Worksheet #15.9A, PALs and Laboratory Specific MDLs/PQL PCDDs/PCDFs in Soil/Sediment by Method 1613B, page 92				
13	1241	QAPP Worksheet #15.10A, PALs and Laboratory Specific MDLs/PQL Metals in Soil/Sediment by Method 6020B, page 94				
14	1242	QAPP Worksheet #19 and 30.2, Project Laboratory Identification, page 109				

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15	1243	QAPP Worksheet #20, Field QC Summary, Introductory text, page 110	The fourth sentence says, "No sampling for volatile constituents is planned and TBs and ambient blanks are not required." Aqueous VOCs are indicated on other QAPP worksheets. For example, on Worksheet #15.1 (page 102), ethylbenzene is listed for surface water samples, and on Worksheet #19 and 30.1 (Continued) (page 104), DRET extracts are listed for VOC analysis. Worksheet #20 also lists VOC quality control trip and field blanks on page 111. Clarify or delete the statement quoted in this comment.	This statement has been deleted from the introductory text for Worksheet #20.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
16	1244	QAPP Worksheet #37, Data Usability Assessment, 2nd paragraph, page 153	Describe the circumstances under which data would be rejected and removed from the final data set; how limitations in the final data set will be documented and communicated to all end data users and stakeholders; and the data usability assessment process that will be used to confirm that the data are usable are adequate to make the site decisions.	The discussion in the second paragraph of Worksheet #37 has been expanded to include the following text: "Data that is rejected during the validation process in accordance with the data qualification conventions (Worksheet #36) will be evaluated against the project DQOs (Worksheet #11) by the HGL Chemistry QA Manager to determine if rejection is the appropriate final decision for the affected data. In addition, the HGL Chemistry QA Manager will evaluate DQI performance to determine whether any data points are of insufficient quality for the intended use, even if the affected results did not require rejection under the validation conventions." The fourth paragraph of Worksheet #37 has been revised to include the following text: "Project deliverables that present analytical data will include a section addressing data quality and any limitations or gaps in the data set that were identified during the data evaluation process and the potential impact on decision-making."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
17	1245	QAPP Appendix A.1, ALS Environmental-Kelso Laboratory Information, pdf page 697	This appendix contains an SOP titled, "Extraction Method for Organotins in Sediment, water and Tissue". This SOP, document ID EXT-OSWT, Rev 12.0, is not listed on Worksheet #23. Add this analytical SOP to Worksheet #23.	SOP EXT-OSWT has been added to the laboratory preparation methods listed in Worksheet #23.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
18	1246	QAPP Appendix A.1, ALS Environmental-Kelso Laboratory Information, pdf page 697	This appendix is missing SOP SVM-8270L, "Semi-Volatile Organic Compounds by GC/MS Low Level Procedure." This SOP is listed on Worksheet #23. Add this analytical SOP to Appendix A.1.	This analytical SOP has been added to Appendix A.1.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
19	1247	QAPP Appendix A.2, Analytical Resources, Inc. (ARI) Laboratory Information, pdf page 1179	The Analytical Resources, Inc. standard operating procedures (SOPs) listed in Worksheet #23 and the laboratory QA Manual are noted as confidential business information and are not included in this Appendix. The fly sheet notes that the documents are available on request from the ARI point of contact listed in Worksheet #3/5. At a minimum, include the title and signature pages of the SOPs in the appendix.	The title and signature pages of the ARI SOPs and laboratory QAM have been added to Appendix A.2; the appendix fly sheet has been revised to indicate the inclusion of this material.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
20	1248	QAPP Appendix A.3, Cape Fear Analytical Laboratory Information, pdf page 1181	This appendix is missing SOP CF-OA-E-001, "Dioxin/Furan/PCB Congener Sample Processing". The Cape Fear affiliated laboratory is GEL; their SOP GL-GC-E-127 titled, "Modified Elutriate Test" is also missing from this Appendix A.3. This SOP is listed on Worksheet #23. Add these analytical SOPs to Appendix A.3. The SOP cover and signature pages can be included for proprietary SOPs.	The requested SOPs will be added to Appendix A.3	The response is acceptable pending EPA's review of the revised PDI Work Plan.
21	1249	QAPP Appendix A.4, Northwest Testing, Inc. Laboratory Information, pdf page 1371	The Northwest Testing Inc. SOPs listed in Worksheet #23 and the laboratory QA Manual are noted as confidential business information and are not included in this Appendix. The fly sheet notes that the documents are available on request from the Northwest Testing point of contact listed in Worksheet #3/5. At a minimum include the title and signature pages of the SOPs in the appendix.	The title and signature pages of the Northwest Testing SOPs and laboratory QAM have been requested for addition to Appendix A.4; the appendix fly sheet has been revised to indicate the inclusion of this material.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
22	2016	Worksheet 9 Project Scoping Session Participants Sheet, page 19			

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15	1243	QAPP Worksheet #20, Field QC Summary, Introductory text, page 110				
16	1244	QAPP Worksheet #37, Data Usability Assessment, 2nd paragraph, page 153				
17	1245	QAPP Appendix A.1, ALS Environmental-Kelso Laboratory Information, pdf page 697				
18	1246	QAPP Appendix A.1, ALS Environmental-Kelso Laboratory Information, pdf page 697				
19	1247	QAPP Appendix A.2, Analytical Resources, Inc. (ARI) Laboratory Information, pdf page 1179				
	1248	QAPP Appendix A.3, Cape Fear Analytical Laboratory Information, pdf page 1181				
20						
21	1249	QAPP Appendix A.4, Northwest Testing, Inc. Laboratory Information, pdf page 1371				
22	2016	Worksheet 9 Project Scoping Session Participants Sheet, page 19	Revise the worksheet to list the title for Wesley Thomas as 'Project Manager' and remove the role of 'Stormwater Coordinator'.	The title for Wesley Thomas will be revised to PM on Worksheet #9.		

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<b>General Comments on the Health and Safety Plan</b>					
Following are EPA's comments on the HydroGeoLogic, Inc. Health and Safety Plan (HASP), Appendix C of the Draft Pre-Design Investigation Work Plan, prepared by HydroGeoLogic, Inc. on behalf of the Swan Island Basin Remedial Design Group and dated June 2021.					
	1250	Introductory Comment	Note that EPA does not approve HASPs but reviews for completeness.		
1	1251	Wildfire Smoke	With more frequent wildfires in Oregon and the West, EPA recommends including a section with wildfire smoke safety protocol in the event of poor air quality from significant airborne PM2.5 or PM10. Procedures could be similar to those promulgated by Cal OSHA, which states that actions such as event delaying, location moving, or face mask/respirator wearing be instituted when certain air quality index (AQI) levels are reached. Also, consider adding wildfire smoke hazards to appropriate AHAs.	The following will be added to Contingency Plans: "Wildfire smoke safety protocol Smoke from wildfires contains chemicals, gases and fine particles that can harm health. The greatest hazard comes from breathing fine particles in the air, which can reduce lung function, worsen asthma and other existing heart and lung conditions, and cause coughing, wheezing and difficulty breathing. Protection from Wildfire Smoke will apply when the current Air Quality Index (AQI) for PM2.5 particulate is 151 or greater ("unhealthy") and when it is reasonably anticipated that employees may be exposed to wildfire smoke. • At the start of each shift and periodically thereafter, as needed, AQI forecasts and current AQI for PM2.5 will be checked at the following websites or using another effective method (telephone, email, text, etc.) from the agencies listed below: o The U.S. EPA AirNow o The U.S. Forest Service o The Interagency Wildland Fire Air Quality Response Program o The local air pollution control district o The local air quality management district If the current AQI is 151 or greater. The following controls will occur: • Implement a system for communicating wildfire smoke hazards • Train employees in the hazards of wildfire smoke and the administrative and personal protection measures. • Implement engineering controls, where feasible, to reduce employee exposure. Examples include providing enclosed structures or vehicles for employees to work in where the air is filtered. • Whenever engineering controls are not feasible or do not reduce employee exposures changes will be made to work procedures or schedules (delay) when practicable. Examples include changing the location where employees work or their work schedules. • Provide proper respiratory protection equipment, such as disposable filtering facepiece respirators (dust masks), other half facepiece respirators, or full facepiece respirators."	The response is acceptable pending EPA's review of the revised PDI Work Plan. Note that there is a new Oregon OSHA temporary rule on wildfire smoke that has been in effect since August 9, 2021.
2	1252	Incident Reporting	Include instructions for the employee reporting of injuries or incidents.	Bullet 8 of the General Site Rules will be revised to state: "Report incidents and significant near misses in accordance with HGL's H&S Procedure 09, Incident Reporting and Investigation."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
3	1253	Dive Plan	The HASP indicates that a dive plan will be submitted by the contractor. The dive plan must be submitted to EPA for review and approval at least 45 days prior to commencement of dive operations.	The text will be revised to state: "Hazards associated with diving in a river (to be addressed by subcontractor Dive Operations Plan. The subcontractor's plan will be submitted to EPA at a minimum 45 days before dive operations begin.)"	The response is acceptable pending EPA's review of the revised PDI Work Plan.
4	1254	Element Compliance	The HASP has been reviewed for compliance with Occupational Safety and Health Administration's (OSHA's) 29 Code of Federal Regulations (CFR) 1910.120(b)(1)(ii) requirements for elements of a HASP.	No response required.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
5	1255	COVID-19	Although COVID-19 protocol is discussed in Appendix G, additional mention and reference should be made elsewhere in the plan – e.g., Section 5.10 Biological Hazards, Section 7.1 Personal Protective Equipment, and/or JHAs. It is currently only referenced in the JHA for Working over Water from Boats and Docks.	Under Hazards of Concern, Other, the text on COVID-19 will be expanded to reference the AHA Coronavirus Practices to Prevent Exposure.  Under Additional Protective Equipment Requirements, Head & Eye, the text will be revised to include "Face masks are to be worn in accordance with the AHA Coronavirus Practices to Prevent Exposure".	The response is acceptable pending EPA's review of the revised PDI Work Plan.
6	1256	Rubber Work Boots	Revise the HASP to include a requirement for rubberized, steel-toed work boots or leather, steel-toed work boots with disposable covers to be worn when working with contaminated sediment, consistent with other Project Areas at PHSS. This requirement reduces the potential for migration of contaminants sediments off the Site.	On page 13 the text pertaining to Boots under Additional PPE Requirements will be revised to include the following:  Boots: Leather steel-toe or composite toe. Disposable covers are to be worn over the boots when working on contaminated sediment.  Rubber: on sediment sampling vessels, shallow water (if waders not required), and whenever working on contaminated sediment. Please see also response to comment #1265.	Revise the text to clarify that disposable covers should only be used for visitors, infrequent staff, etc. and rubber boots should be used for primary field staff.
7	1257	AED	An automated external defibrillator (AED) is required to be onsite, and on vessels and personnel trained in its use before work may start.	A bullet will be added to General Site Rules that states: "An automated external defibrillator (AED) is required to be on site and on vessels whenever work is being conducted. At least 2 personnel on site at any one time will have CPR/AED certification." In addition, Column 4 in the Personnel and Responsibilities Section will be changed from "First Aid" to "First Aid & CPR/AED" and an AED will be included in the list of emergency equipment under Contingency Plans.	The response is acceptable pending EPA's review of the revised PDI Work Plan.

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	1250	Introductory Comment				
1	1251	Wildfire Smoke	Note that there is a new Oregon OSHA temporary rule on wildfire smoke that has been in effect since August 9, 2021.	The text in HASP Section 13 (Contingency Plans Summarized below:) was updated to be consistent with the regulations from the Oregon temporary rule on wildfires. The following text was added:  "• The SSO will notify field personnel when the ambient air concentration at the work location is at or above the following levels and when it drops below levels requiring protection: o 35.5 µg/m3 (AQI 101); o 150.5 µg/m3 (AQI 201); o 500.4 µg/m3 (AQI 501); and • The following exposure controls will be implemented: o AQI ≥ 101. Control by use of NIOSH-approved respirators that protect from PM2.5 particulates. o AQI ≥ 201. • When engineering and administrative controls cannot reduce hazardous levels, KN-95 or NIOSH approved respirators will be used. o AQI ≥ 501. Stop work until conditions approve. "		
2	1252	Incident Reporting				
3	1253	Dive Plan				
4	1254	Element Compliance				
5	1255	COVID-19	Additional mention and reference to COVID-19 should be made elsewhere in the plan (e.g., Section 5.10 Biological Hazards, Section 7.1 Personal Protective Equipment, and/or JHAs). It is currently only referenced in the JHA for Working over Water from Boats and Docks.	EPA rescinded this comment per email sent from Madi Novak to Shane Cherry dated Wed 2/23/2022: "As I indicated during the meeting, EPA reviewed the discussion of COVID safety practices in the HASP in light of your comments below. EPA rescinds the 2/1/22 responsiveness comment regarding the HASP."		
6	1256	Rubber Work Boots	Revise the text to clarify that disposable covers should only be used for visitors, infrequent staff, etc. and rubber boots should be used for primary field staff.	Text will be added indicating that disposable covers are to be worn only by visitors and infrequent staff and that rubber boots are required for primary field staff.		
7	1257	AED				

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8	1258	Medical Surveillance	Clearly indicate whether each of the proposed personnel is required to be in chemical/biological surveillance per 29 CFR 1910.120 based on their accumulated exposure days over the past year.	The following text will be added to the notes for the Personnel and Responsibilities table. "HGL personnel are in a medical surveillance program per 29 CFR 1910.120 regardless of their accumulated exposure days or their frequency of respirator use. If they are involved in hazard waste field-work, noise louder than 85 dBA, respirator use and potential over exposure to other materials as required by OSHA (lead, asbestos, etc.) they are in the annual/biennial medical surveillance program."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
<b>Specific Comments on the Health and Safety Plan</b>					
1	1259	Waste Characteristics, page 4	The statement that "wastes are not anticipated to be hazardous" is misleading. On page 2 it states that there are several chemical groups of interest related to historical releases in the area (e.g., PCBs, DDT, and PAHs), which are known to be hazardous to humans, regardless of their classification by Occupational Safety and Health Administration (OSHA) or its Hazardous Waste Operations and Emergency Response (HAZWOPER) standard. The Contaminants of Interest table beginning page 6 also details the presence of these specific chemicals.	The text under Waste Characterization has been revised according to the Contaminants of Interest list, as follows: Waste Characteristics: Check as many as applicable. ~ Corrosive ~ Flammable ~ Radioactive x Toxic x Volatile ~ Reactive ~ Inert Gas ~ Unknown x Carcinogenic ~ Other Specify: Wastes are not anticipated to be hazardous.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
2	1260	Work Zones, page 4	The text should state whether work zones will be modified based on sampling results or other means as described in Principle Disposal Methods and Practices for Investigation Derived Waste section directly below. Clarify whether work zone needs based on analytical sample data or other rationale.	The text under Work Zones will be revised to include the following statement "Analytical results from contaminant characterization will be used to adjust the need for Work Zones."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
3	1261	Contaminants of Interest, page 8	The ACGIH TLV and OSHA PEL stated for Aldrin appears to be incorrect and should be listed as 0.25 mg/m3 (skin) for both.	The 2021 ACGIH TLV for Aldrin of 0.05 mg/m3 (skin) is correct. The OSHA PEL for Aldrin is 0.25 mg/m3 (skin). The table has been noted to reflect the higher OSHA PEL as well as the TLV.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
4	1262	Stinging Insects, page 11	Instructions should be given for allergic persons to carry an Epi-pen or equivalent if physician directs and alert team to their allergy.	Bullet item 12 of the General Site Rules will be revised to include the following statement: "Field staff with severe allergic reactions to stinging insects shall alert the SSHO and other field staff during the daily Tailgate Safety Meeting and carry an Epi-pen (if prescribed by a physician) with them while on site."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
5	1263	General Site Rules, page 11	Heavy, sudden rains are a factor at the project location and precautions/planning elements should be included in this section. For example, raingear can be critical during overwater activities.	An additional bullet item will be added to the General Site Rules that states: "There is the potential for sudden, heavy rains at the site and field personnel should keep abreast of weather conditions, carry adequate raingear, and be aware of potential shelter locations if conditions should require suspension of activities."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
6	1264	Activity Hazard Analysis, page 12	Answers "Yes" to whether permit-required confined spaces will need to be entered. A confined space program should be referenced and attached that shows project compliance with OSHA's 29 CFR 1910.146 standard.  If confined spaces are to be entered, the subsequent question ("Does the project require specialized training or competent persons for excavations, fall protection, equipment operators, etc.?" ) on the same page should also state that confined space training is required.	The following revisions will be made to the text pertaining to confined space entry. Does the project have permit-required confined spaces that will need to be entered to accomplish the identified project tasks? x Yes ~ No If yes, attach HGL's H&S Procedure 26, Confined Space Entry (Attachment E) which complies with the OSHA General Industry Confined Space Standard, 29 CFR 1910.146 and the OSHA regulation that addresses confined spaces in the construction industry, 29 CFR 1926 Subpart AA. Confined space entry locations will be determined in the field.  The first sentence will be revised to state: "Specialized training will be required for confined space entry, boating, barge, and diving activities."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
7	1265	Additional Personal Protective Equipment Requirements, page 12	Safety glasses should be included as standard field equipment. Rubber safety-toe boots (or other material capable of being decontaminated) should be required for personnel working on sediment sampling vessels in addition to shallow water (if waders not required).	Under Head and Eye, the Other box will be checked and the following specification added: "Safety glasses are needed whenever there is a splash potential."  The requirement for rubber safety boots will be amended to state: "Rubber: on sediment sampling vessels, shallow water (if waders not required), and whenever working on contaminated sediment." See also see response to comment #1264.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
8	1266	Health and Safety Monitoring Equipment and Action Levels, Action Level Guidelines for Photoionization Detector, page 14	Provide the rationale for an action level of ">10 ppm above background in breathing zone".	The following text will be added to the action level guidelines for the Photoionization Detector: "Rationale for >10ppm action level is as follows: Eight of the 11 VOCs of concern have STELS and/or TLVs above 10 ppm. 1,2 dichloroethane has a TLV of 200 ppm and makes up 60% of the total vapor in air concentration."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
9	1267	Health and Safety Monitoring Equipment and Action Levels, Response for Combustible Gas Indicator, page 14	Response discusses use of a photoionization detector (PID) to monitor for VOCs. Is this verbiage in the correct row of the table? It appears instead to correspond to the PID row.	The response will be revised to state: "Monitoring with a Combustible Gas Indicator is required during any confined space entry in accordance with HGL's H&S Procedure 26, Confined Space Entry (Attachment E)."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
10	1268	Health and Safety Monitoring and Action Levels Table, page 14	The text seems to indicate that a combustible gas meter will be used for confined space entries, though the plan did not include guidance language for confined space entries.	Please see response to comment #1264.	The response is acceptable pending EPA's review of the revised PDI Work Plan.

APPENDIX E (Continued from Previous Page)  
 EPA Review of Draft Pre-Design Investigation Work Plan  
 Response to Comments Matrix  
 May 10, 2022

#	Reference No.	Document	EPA's Draft Final PDI Work Plan Comments on February 1, 2022	SIB Response on February 17, 2022	EPA's Draft Final PDI Work Plan Comments on April 5, 2022	SIB Response on May 10, 2022
8	1258	Medical Surveillance				
1	1259	Waste Characteristics, page 4				
2	1260	Work Zones, page 4				
3	1261	Contaminants of Interest, page 8				
4	1262	Stinging Insects, page 11	Instructions should be given for allergic persons to carry an Epi- pen or equivalent if physician directs and alert team to their allergy.	Bullet item 12 of the General Site Rules will be revised to include the following statement: "Field staff with severe allergic reactions to stinging insects shall alert the SSHO and other field staff during the daily Tailgate Safety Meeting and carry an Epi-pen (if prescribed by a physician) with them while on site."		
5	1263	General Site Rules, page 11				
6	1264	Activity Hazard Analysis, page 12				
7	1265	Additional Personal Protective Equipment Requirements, page 12				
8	1266	Health and Safety Monitoring Equipment and Action Levels, Action Level Guidelines for Photoionization Detector, page 14				
9	1267	Health and Safety Monitoring Equipment and Action Levels, Response for Combustible Gas Indicator, page 14				
10	1268	Health and Safety Monitoring and Action Levels Table, page 14				

**APPENDIX E**  
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#	Reference No.	Document	EPA Draft PDI Work Plan Comments on August 13, 2021	SIB Response on September 10, 2021	EPA's October 7, 2021 Reply to Suggested Revisions
11	1269	Health and Safety Monitoring and Action Levels Table, page 14	The action levels associated with the use of a dust monitor are not clear and should be revised.	The reference to 10 milligrams per cubic meter (mg/m <sup>3</sup> ) Nuisance dust has been removed from the Action Level Guideline. The action level will be 2 – 2.5 mg/m <sup>3</sup> for visible dust.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
12	1270	AHA Inspections, Surveys, and Sampling from a Watercraft, page 5 of 5	The text should state clearly that a personal flotation device (PFD) is to be worn at all times when working over or near water. The text should also be modified to be more applicable and instructive to the Willamette River.	The text on Page 5 regarding PPE currently states that a Type I or V U.S. Coast Guard-approved PFD is required (when working on or near water). This text will be revised to state "Type I or V U.S. Coast Guard-approved PFDs will be worn at all times whenever working on or near water." In addition, the text pertaining to other PPE (PFDs) under Additional PPE Requirements will be revised to as follows: "Type I (off shore) and V (on shore) personal flotation devices and Waders. To be worn whenever working on or near water."  A flag will be added to this AHA that states: This AHA will be revised and modified daily during the daily Tailgate Safety Meeting to include specific daily weather and river conditions for the portion of the Willamette River where activities will occur."	
13	1271	AHA DPT – Sediment Sampling on Land and Over Water, Slips, trips, and falls Hazard Controls, page 5 of 8	Where it states fall protection is required when exposed to falls greater than 6 feet, this should state 4 feet to comply with the OSHA 29 CFR 1910 General Industry Fall Protection standard.	The text will be revised to state 4 feet.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
<b>Editorial Comments on the Health and Safety Plan</b>					
1	1272		The lack of section numbering makes it difficult to reference or locate specific areas of the HASP. EPA recommends revising the HASP with section numbering for ease of reading.	The HASP has been revised to include numbering for the following Sections: Section 1 General Site Information Section 2 Project-Specific Hazardous Material Summary Section 3 Contaminants of Interest Section 4 General Site Rules Section 5 Activity Hazard Analysis Section 6 Additional PPE Requirements Section 7 Personnel and Responsibilities Section 8 H&E Monitoring Equipment Section 9 Decontamination Procedures Section 10 Hazardous Materials Inventory Section 11 Emergency Contacts Section 12 Medical Emergency Section 13 Contingency Plans Section 14 Health and Safety Plan Approvals	The response is acceptable pending EPA's review of the revised PDI Work Plan.
<b>General Comments on the Emergency Response Plan</b>					
Following are EPA's comments on the HydroGeoLogic, Inc. Emergency Response Plan (ERP), Appendix D of the Draft Pre-Design Investigation Work Plan, prepared by HydroGeoLogic, Inc. on behalf of the Swan Island Basin Remedial Design Group and dated June 2021.					
1	1273	Emergency Medical Treatment and First Aid	The ERP should more clearly state or reference (e.g., HASP instructions) employee instructions for medical treatment or first aid. This is required in an ERP per OSHA's 29 CFR 1910.120(l)(2)(viii).	The following text will be added to Section 1.1 Purpose and Scope: "This plan is to be used in conjunction with HGL's Health and Safety Plan (HASP) for work at the SIB Project Area. Procedures for emergency medical treatment and first aid are specified in the HASP."	The response is acceptable pending EPA's review of the revised PDI Work Plan.
2	1274	Element Compliance	The ERP has been reviewed for compliance with OSHA's 29 CFR 1910.120(l)(2) requirements for elements of an ERP.	No response required.	The response is acceptable pending EPA's review of the revised PDI Work Plan.
<b>Specific Comments on the Emergency Response Plan</b>					
1	1275	Section 1.1 Purpose and Scope, page 1-1	Section states that ERP describes actions necessary in event of personnel injury, however content within speaks to rescue and mitigation operations, but not care steps for an injured employee. This information should be provided or referenced if located in the HASP.	Please see response to Comment #1273.	The response is acceptable pending EPA's review of the revised PDI Work Plan.

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11	1269	Health and Safety Monitoring and Action Levels Table, page 14				
12	1270	AHA Inspections, Surveys, and Sampling from a Watercraft, page 5 of 5				
13	1271	AHA DPT – Sediment Sampling on Land and Over Water, Slips, trips, and falls Hazard Controls, page 5 of 8				
1	1272					
1	1273	Emergency Medical Treatment and First Aid				
2	1274	Element Compliance				
1	1275	Section 1.1 Purpose and Scope, page 1-1				