HEAD OF SWAN ISLAND LAGOON
SEDIMENT FIELD SAMPLING PLAN
PORTLAND HARBOR SUPERFUND SITE

OCTOBER 22, 2018

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ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
ALS	ALS Environmental in Kelso, Washington
ASAOC	Administrative Settlement Agreement and Order on Consent
ASTM	American Society for Testing and Materials
COCs	contaminants of concern
CRD	Columbia River Datum
CSM	Conceptual Site Model
DGPS	differential global positioning system
EPA	United States Environmental Protection Agency
FS	feasibility study
FSP	Field Sampling Plan
Gravity	Gravity Marine Services
ID	identification number
IDW	investigation-derived waste
LWG	Lower Willamette Group
NAD83	North American Datum of 1983
NAPL	Non-aqueous phase liquid
NAVD88	North American Vertical Datum of 1988
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PID	photoionization detector
PDI	Pre-Remedial Design Investigation
PGG	Pacific Groundwater Group
PHSS	Portland Harbor Superfund Site
Pre-RD Group	Pre-Remedial Design AOC Investigation Group
PTW	principal threat waste
PSEP	Puget Sound Estuary Program
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RI	remedial investigation
RM	river mile
ROD	Record of Decision
SDU	Sediment Decision Unit
SIL	Swan Island Lagoon
SMA	Sediment Management Area
SOP	Standard Operating Procedure
SOW	Statement of Work
TestAmerica	TestAmerica Laboratories
TOC	total organic carbon
USACE	United States Army Corps of Engineers

1.0 INTRODUCTION

The Record of Decision (ROD) described a post-ROD sampling effort for the Portland Harbor Superfund Site (PHSS) (Figure 1) located in Portland, Oregon, to delineate and refine the sediment management area (SMA) footprints, refine the Conceptual Site Model (CSM), determine baseline conditions, and support remedial design (United States Environmental Protection Agency [EPA] 2017a). On December 19, 2017, EPA entered into an Administrative Settlement Agreement and Order on Consent (ASAOC) with the Pre-Remedial Design Agreement and Order on Consent Investigation Group (Pre-RD Group) to conduct the Pre-Remedial Design Investigation and Baseline Sampling (PDI) studies at the PHSS (EPA 2017b). The ASAOC includes a Statement of Work (SOW) and the PDI Work Plan (Geosyntec 2017), which generally describe the agreed upon field investigation activities, data analyses, schedule, and deliverables for the PDI.

Following the submittal of the more general Work Plan, the Pre-RD Group submitted to EPA Field Sampling Plans (FSPs) that specify sampling scopes such as surface sediment, core, biological and bathymetry investigations. The PDI Surface Sediment FSP (AECOM and Geosyntec 2018a) proposes to collect the following types of samples within the PHSS: 1) 428 random stratified samples within a grid system (for establishing a new baseline dataset); 2) 178 targeted (nonrandom) samples located in SMA areas to support further refinement of the SMA footprints; and 3) 60 surface grab samples will be co-located with the 60 deep in-water core stations in SMA areas. The PDI Subsurface Sediment Field Sampling Plan (AECOM and Geosyntec, 2018b) proposes to collect 90 subsurface cores, 30 “shallow” cores from banks and 60 “deep” cores collocated with surface sediment grabs grab locations. Collectively, 74 surface samples and 14 subsurface cores will be collected in the Swan Island Lagoon (SIL).

In the SIL, the PDI data will supplement and update the 1997-2007 Remedial Investigation/Feasibility Study (RI/FS) surface sediment data for purposes of remedial design and evaluating remedy effectiveness, but with fewer samples for the SIL than in the RI/FS dataset. The surface sediment samples proposed herein for the SIL will support (1) the refinement of the SIL SMA footprint and technology assignments, (2) delineation of the extent of principal threat waste (PTW), and (3) the evaluation of remedy effectiveness, particularly as baseline sampling for an Enhanced Natural Recovery (ENR) Pilot Study.

This FSP was prepared to support focused sediment sampling efforts located within SIL Study Area (Study Area; Figure 2) and, except as noted herein, follows the Surface and Subsurface Sediment FSP sampling and analysis protocols produced by the Pre-RD Group (AECOM and Geosyntec 2018a and 2018b). The Pre-RD Group FSPs are largely derived from the Lower Willamette Group (LWG) RI Rounds 2 and 3 FSPs (Integral Consulting [Integral] 2004 and 2006).

1.1 PROJECT SETTING

The PHSS is located in Portland, Oregon, on the Lower Willamette River immediately downstream of the urban downtown area from river mile (RM) 1.9 upstream to 11.8. The

Study Area is located within the SIL, which is on the northeastern side of the Lower Willamette River in the PHSS between RM 8 and RM 9.2.

1.2 PROJECT OVERVIEW

Surface and subsurface sediment samples will be collected within the Study Area at the head of the SIL, RM 8.8 to RM 9.2, outside the Essential Salmonid Habitat. Surface sediment samples will target the 0- to 30-centimeter (cm) depth interval. Subsurface sediment cores will have location-specific recovery criteria that will be divided into sample intervals by stratigraphic units. The target depth of the cores is the native material (estimated 10 to 20 feet below sediment surface). Sampling and analysis methods will be consistent and comparable with those used for the RI/FS and PDI.

Sediment samples from 10 surface locations and 3 core locations (collocated with 3 surface locations) will be analyzed for the ROD contaminants of concern (COCs: polychlorinated biphenyls [PCBs], total polynuclear aromatic hydrocarbons (TPAHs), and three dioxin/furans (12378-PeCDD, 2378-TCDD, and 23478-PeCDF), grain size, specific gravity, total solids, and total organic carbon (TOC). Split samples from these locations will be archived for future possible data needs.

2.0 PROJECT ORGANIZATION/FIELD TEAM

2.1 TEAM ORGANIZATION AND RESPONSIBILITIES

Team organization is detailed in the Quality Assurance Project Plan (QAPP) (Appendix A). PGG is coordinating activities for this FSP including management of all subcontractors, field sampling, analysis, and reporting scoping tasks. The Project Manager and Coordinator, Janet Knox (PGG), will be responsible for overall project coordination and providing oversight on all project deliverables. Jeffrey Parker (PGG) is the project's Technical and Field Coordinator.

The Laboratory Coordinator, Inger Jackson (PGG), will be responsible for coordination with labs regarding sample volumes, logistics, schedule, detection limits and matrix interferences, data deliverable, and coordinating with data Quality Assurance (QA) reviewers.

Gravity Marine Services (Gravity), of Fall City, Washington, will provide vessel support. Analytical laboratories include ALS Environmental (ALS) in Kelso, Washington, and TestAmerica Laboratories (TestAmerica) in Fife, Washington, Sacramento, California, and Knoxville, Tennessee. Sayler Data Solutions, Inc. will provide data validation services.

2.2 COMMUNICATION/INFORMATION FLOW

The communication strategy is outlined in Section 2 of the QAPP (Appendix A). Briefly, the Field Coordinator, Jeff Parker, will be the point of contact for field staff during the implementation of this FSP. Deviations from this FSP or the QAPP will be reported to the Project Coordinator for consultation.

3.0 SAMPLING DESIGN AND APPROACH

A total of 10 locations for surface sediment sampling and 3 locations for subsurface sediment sampling were selected to supplement the current data and: a) update the spatial extent (horizontal and vertical) of contamination in the area of the ROD-selected remedy (Alternative F Modified); b) refine the SMA footprint and technology assignments in the SIL; c) delineate the extent of PTW; and d) provide baseline sampling for an ENR Pilot Study. The sampling and analysis results will also support the evaluation of remedy effectiveness after implementation.

Methods for sediment sampling are consistent with EPA-approved sampling plans from the PDI (AECOM and Geosyntec 2018a and b), RI (Integral 2004 and 2006), EPA guidance on collecting sediment data (EPA 2014), and Puget Sound Estuary Program (PSEP) protocols (PSEP 1996). See Table 1 for a summary of sample types, numbers, and analyses.

3.1 SURFACE SEDIMENT

A total of 10 surface sediment samples will be collected according to a Euclidean Distance Analysis sample design. All surface sediment sampling stations within the Study Area are presented in Figure 2. Table 2 summarizes surface sediment locations.

For the sediment sample design, PGG used the x and y coordinates proposed for the PDI sampling in 2018 to perform a Euclidean Distance Analysis from the PDI points to identify spatial data gaps. PGG filled the largest data gaps and reran the Euclidean Distance Analysis multiple times to optimally fill the data gaps with 10 samples.

3.1.1 Surface Sample Types, Locations, Depths

Surface sample types and sampling depth intervals are consistent and comparable with the PDI and previous RI/FS protocols. All surface grab samples will be collected with a hydraulic power grab sampler (see Section 4.3 below for more details). Figure 2 shows proposed surface sediment sample stations within the Study Area. Table 2 presents sample location coordinates and sample identification numbers (IDs). Surface sediment samples will target the interval from 0 to 30 centimeters.

3.1.2 Surface Sample Nomenclature

Sample nomenclature will be developed as follows to relate samples to river mile to 3 significant figures and sample interval. All samples will have a unique identifying sample ID that includes the following:

- River Mile to identify up/downriver (lagoon) locations, and letters A-G identify cross-river locations. (e.g., 8.85D)

- Sample Depth. The actual depth interval of the collected sample (top ## to bottom ##). For example, if the penetration depth of the grab sampler is 27 cm, the sample ID will include "0to27".
- Sample Date. The date of sample collection will be added to the sample ID in the following month, day, year format: MMDDYY

For example, a surface grab sample from position 8.85D, where the grab sampler penetrated to a depth of 27 cm, and was collected on October 15, 2018 would have the sample ID 8.85D-0to27-101518.

Field duplicate samples will substitute the location for numerical sequence beginning at 511 (e.g. 511-0-27-101518). Equipment rinseate blanks will combine the numerical sequence beginning at 611 and the date (e.g. 611-101518). Additional data fields that describe each unique sample feature, location, and attributes will be recorded in the field forms and will be included in the project database.

3.2 SUBSURFACE SEDIMENT

Subsurface core samples will be collected at 3 selected locations as shown and described in Figure 2 and Table 3. The proposed core locations and depths were selected to complement the 3 core locations proposed for the PDI for the head of the SIL, which will refine the vertical SMA extent for pre-remedial design.

3.2.1 Subsurface Sample Types, Locations, Depths

Figure 2 shows proposed locations. Subsurface sediment samples from cores will target a penetration depth of 20 ft (to the top of native materials). Table 3 presents the location, core depths, and location identification numbers (IDs).

Cores included in the RI/FS data set were processed according to more than one method of sample selection (e.g., stratigraphic breaks and equal intervals). During the Round 2 core processing, LWG composited core sediment from stratigraphic units, where long stratigraphic units were divided into multiple intervals (Integral 2004). Stratigraphic breaks may be identified in the field by a major change in the two dominant grain sizes, depositional regime, or presence/absence of anthropogenic material/indicators such as sheen, NAPL, or debris.

For the PDI, the Pre-RD Group proposed to process the cores in general accordance with RI Round 2 protocols (Integral 2004). Accordingly, the cores taken during the PDI will be sectioned for sampling by 2 ft intervals unless lithology indicates otherwise. The minimum interval thickness will be 1 ft and maximum thickness will be about 3 ft (AECOM and Geosyntec 2018b). The first samples will be collected from the 0- to 2-ft interval, regardless of stratigraphy. One-foot sample intervals may be collected and archived from the depth expected to be the bottom of contamination and the retained sediment from the very bottom of each core, regardless of the bottom sample interval thickness, will be processed and archived.

For this FSP, the core materials will be divided longitudinally and one half of the divided core will be sampled according to the criteria used for the RI and the PDI, as described above. Note that the PDI FSP calls for the uppermost sample to be from 0 to 2 ft, whereas the uppermost sample was from 0 to 1 ft for RI Round 2 cores. For this investigation, the uppermost samples will be collected from 0 to 1 ft and 1 to 2 ft, as sample volume permits; else 0 to 2 ft. Either method will provide data comparable to the PDI core samples. The remaining half of the divided core will be archived. Core intervals collected below the minimum recovery depth will be sectioned horizontally and archived whole.

Proposed subsurface core station IDs, mudline elevations, and coordinates are presented in Table 3. Figure 2 presents the proposed core locations within the Site. Core location and sample IDs will correspond with the surface sediment station ID; therefore, the core station IDs will not be numerically sequential.

3.2.2 Subsurface Sample Nomenclature

Sample nomenclature will be developed as follows to relate samples to the river mile, sample type, and sample interval. All samples will have a unique identifying sample ID that includes the following:

- River Mile to identify up/downriver (lagoon) locations, and letters A-G identify cross-river locations. (e.g., 8.85D)
- Sample type. SC for Sediment Core.
- Sample Depth. The actual depth interval of the collected sample in feet (top ## to bottom ##). For example, if the depth interval is 0 to 1 ft, the sample ID will include “0to1”.
- Sample Date. The date of sample collection will be added to the sample ID in the following month, day, year format: MMDDYY

For example, a sediment core sample from river mile and position 8.85A for the 0 to 1 ft interval collected on October 15, 2018 would have the sample ID 8.85A-SC-0to1-101518.

Field duplicate samples will substitute the river mile and position for numerical sequence beginning at 521 (e.g. 521-SC-1to2-101518). Equipment rinseate blanks will combine the numerical sequence beginning at 611 and the date (e.g. 611-101518). Additional data fields that describe each unique sample feature, location, and attributes will be recorded in the field forms and will be included in the project database.

3.3 SAMPLING SCHEDULE

The overall project schedule is contingent on receipt of permits and subcontractor services. Sediment sampling is targeted for October 2018. Sediment sampling is expected to last two days using one sampling vessel.

4.0 SAMPLE COLLECTION PROCEDURES

The following sections describe the procedures and methods that will be used during surface and subsurface sediment sampling, including sampling procedures, recordkeeping, sample handling, storage and shipping, and field quality control procedures. All field sampling activities will follow procedures outlined in the project Health and Safety Plan (Appendix B).

4.1 SAMPLING VESSELS AND EQUIPMENT

Gravity will operate the vessel and perform the surface and subsurface sediment sampling activities. Gravity will utilize one sampling vessel, equipped with hydraulic power grab sampler and Vibratory Core Tube Driver (vibracore) to complete the work. Gravity will use the 27 foot R/V *Cayuse* for sampling. The vessel 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 be mobilized from the City of Portland public boat launch at N. Basin Avenue or the Fred Devine dock of Ensign Street.

The hydraulic power grab sampler will target penetration depths of 30 cm and retrieved on deck. A medium-sized power grab, designed and manufactured by Gravity, will be used for this project. Gravity's medium-sized power grab has a recovery volume of about 0.05 to 0.08 cy for acceptable grabs. Samples will be collected on the vessel and stored on ice until transferred to the analytical laboratory.

Vibracore tubes will be advanced up to 20 feet. 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. Core processing will occur on land in a protected, decontaminated area with tables and cover.

Equipment and supplies will include all equipment for positioning, sampling, processing, recording, and shipping samples. Sample containers and preservatives, as well as coolers and packing material, will be supplied by the analytical laboratory. An equipment checklist is provided in Appendix C.

4.2 STATION POSITIONING AND VERTICAL CONTROL

Station positioning and vertical control will be performed as outlined in the PDI FSPs (AECOM and Geosyntec 2018a and b). A differential global positioning system (DGPS) unit will be used to confirm the horizontal sampling locations to an accuracy of 1 to 2 meters. The DGPS 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 foot in North American Datum 1983 (NAD83) Oregon State Plane Coordinate System, Oregon North Zone.

Vertical control will be established using an on-board fathometer and lead line to measure depth to mudline at sample locations. Water depths will be converted to elevations in feet North American Vertical Datum of 1988 (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 feet above Columbia River Datum (CRD). CRD depths will be converted to NAVD88 Elevations using the USACE conversion for Mile 7.5 to Broadway Bridge: CRD is 5.28 feet above the NAVD88 elevation at RM 9.7.

4.3 GRAB COLLECTION AND PROCESSING

In general, sample collection will be performed as described in the PDI Surface Sediment FSP (AECOM and Geosyntec 2018a) based on the RI Round 2 FSP (Integral 2004) and the RI Round 3 FSP (Integral 2006), except as otherwise noted herein.

Standard Operating Procedures (SOPs) are provided in Appendix D. The Sediment SOPs are from the FSP for RI Round 2 SOP (Integral 2004) as extracted in PDI Sediment FSPs, and are consistent with Appendix D of the FSP for RI Round 3 (Integral 2006), which were all approved by the EPA. The Appendix D SOPs include lists of needed supplies and equipment and SOPs for equipment decontamination, sediment sample collection, sediment sample processing, chain-of-custody, packaging, and shipping samples. The SOPs for this FSP are included in Appendix D, and will be provided in hard copy to the project team.

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). 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 minimum penetration (20 cm) has been achieved.

For this sampling, the acceptance penetration depth for grab samples is 20 cm, as was used in the RI Round 2 and 3 sampling (Integral, 2004 and 2006), Geosyntec's 2016 sampling in the SIL (Geosyntec 2016), and the PDI FSP (AECOM and Geosyntec 2018a).

A minimum of three consecutive casts of the grab sampler will be attempted at each location, while trying to achieve the 30-cm target, 20-cm minimum penetration depth. Additional attempts may be made based on professional judgement of the Field Coordinator. If a 20-cm penetration depth cannot be obtained, the sample of the greatest depth will be retained. If field conditions preclude the field crews from collecting proposed target samples (e.g., limited access, poor recovery, safety concerns, debris/rock/bedrock causing refusal), then the Field Coordinator will adjust or abandon the location and record the reason in the field log book.

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. Large organisms and pieces of debris will be removed and noted in the sample log sheet. Large organisms will be returned to the SIL. 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 C). The following information will be recorded: sediment texture; sediment color; presence, type, and strength of odors; sheens; grab penetration depth (nearest cm), degree of leakage, or sediment surface disturbance; and any 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 °C until transport to the laboratory.

At approximately five percent of the stations, rinseate blanks will be prepared and submitted to the laboratory for analysis. Five percent of 10 grab samples equates to the minimum of 1 rinseate blanks for this FSP. In addition, field duplicates and matrix spike/matrix spike duplicates will be collected at five percent of the stations (1 each). Temperature blanks will be one per cooler.

4.4 CORE COLLECTION AND PROCESSING

Subsurface core sample collection will be performed as described in Section 4.0 of the RI Round 2 FSP (Integral 2004), and as described in the PDI Subsurface Sediment FSP (AECOM and Geosyntec, 2018b). A SOP from the RI Round 2 coring SOP as extracted in PDI FSPs is included in Appendix D. In general, coring will follow these steps:

- Core tube caps will be removed immediately prior to placement into coring device, in order 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 or refusal.
    - After a brief pause, the core tube will be extracted from the sediment using only the minimum vibratory power needed for extraction. The vibracore may be rotated to shear the sediments at the base, depending on vessel practices.
    - As soon as the core tube daylights 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 crew will take appropriate field precautions, as described in the RI FSPs and Appendix B of the PDI Subsurface Sediment FSP (AECOM and Geosyntec, 2018b).
- The following core collection data will be recorded on the vessel in the core collection log (Appendix C):
    - Date/Time. Local date and time when the vibracoring began 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, sheens, debris, etc. observed at each of the cut ends of the core section.

- 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 at least 80% recovery versus penetration.
  - Core tube is in good condition (not excessively bent).
- 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 offsite 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.
- If a core sample does not meet the core acceptance criteria (as defined above), then field protocols will be followed as described below:
  - During the subsurface sediment coring efforts, the field crew 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).
  - 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 for all three attempts (< 60% recovery) then the Field Coordinator will decide and document if additional cores should be attempted and location adjusted further from the target location.

4.4.1 Core processing

Core samples will be processed concurrently with core collection. 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 then be systematically logged, described, and photographed.

After the core is exposed, a mini-RAE 3000 photoionization detector (PID) with 10.6 eV 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 notebook. 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 the RI Round 2 FSP (Integral 2004) (Appendix D).

The cores will be photographed prior to sampling generally following the RI Round 2 FSP procedures (Integral 2004) as cited in the PDI Subsurface Sediment FSP (AECOM and Geosyntec, 2018b).

After each core is cut open, an experienced geologist will describe the sediment on a core log (Appendix C). The following information will be recorded for each core:

- Physical sediment description (i.e., sediment type, density/consistency, color)
- Odor (e.g., hydrogen sulfide, petroleum)
- Visual stratification and lenses
- Vegetation
- Debris
- Evidence of biological activity (e.g., detritus, shells, tubes, bioturbation, live or dead organisms)
- Presence of oil sheen
- Other distinguishing characteristics or features

If cohesive sediments are encountered a hand-held field torvane will be used to measure shear strength and pocket penetrometer to measure compressive strength within each sample interval following manufacturer's instructions for use and calibration of field equipment.

Subsampled sediment will be 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. 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. Pre-labeled jars for chemical testing will be filled with the homogenized sediment.

One half of the divided core will be subsampled at intervals generally consistent with the criteria used in the RI Round 2 and PDI Subsurface Sediment FSP core processing (Integral 2004, and AECOM and Geosyntec 2018b). Note that the PDI FSP calls for the uppermost sample to be from 0 to 2 ft, whereas the uppermost sample was from 0 to 1 ft for RI Round 2 cores. For this investigation, the uppermost samples collected will be from 0 to 1 ft and 1 to 2 ft, as sample volume permits; else 0 to 2 ft.

For this FSP, the core materials will be divided longitudinally, and one half of the divided core will be sampled according to the criteria used for the RI and the PDI. One half of the divided core will be sectioned for sampling by 2 ft intervals unless lithology indicates otherwise. The minimum interval thickness will be 1 ft and maximum thickness will be about 3 ft (AECOM and Geosyntec 2018b).

These samples will provide data comparable to the PDI core and surface samples. The remaining half of the divided core will be archived without sample removal. Core intervals collected below the minimum recovery depth will be sectioned horizontally and archived whole.

Core intervals collected below the minimum recovery depth will be sectioned horizontally and archived. The retained sediment from the very bottom of the core, regardless of the bottom sample interval thickness, will also be collected and archived.

The visual description of sediment lithology (dominant grain sizes) will be the primary criteria for determining sample intervals (i.e., lithologic units) in the cores. The boundaries of lithologic units will be determined primarily by changes in the top two dominant grain sizes estimated visually (e.g., a change from a silty sand to a gravelly sand or to a sandy silt) (Integral, 2004). Stratigraphic breaks may also be identified in the field by a major change in the depositional regime, or presence/absence of anthropogenic material/indicators such as sheen, NAPL, or debris (AECOM and Geosyntec 2008b).

Sample handling and storage procedures will follow those described for surface sediment samples in Section 4.3. One rinsate blank will be collected and no field duplicates or matrix spike/matrix spike duplicate cores will be collected during subsurface sampling, although field duplicates will be collected from surface grab samples. Temperature blanks will be one per cooler.

4.5 VISUAL DESCRIPTION

For consistency with RI and PDI data, sediment descriptions and terms used will follow the criteria below, from the RI Rounds 2 and 3 FSPs (Integral 2004 and 2006), which are modified from methods presented in ASTM D 2488 (ASTM 2000). The PDI FSPs also propose using the method ASTM D 2488 for visual descriptions.

1. Visual estimates of the grain-size percentages of sediment units within each core will be recorded on the core logs so that the total sum will add up to 100%. Estimates of gravel, sand, and fines (silt and clay) content will generally be made to the nearest quartiles:

    - 0% to 25%
    - >25% to 50%
    - >50% to 75%
    - >75% to 100%.

    The sediment may also be described narratively on the log based on the estimated grain-size percentages. The dominant constituent grain size will be the primary unit descriptor, with the abundance of other grain sizes present described using the following terms:

    - The grain-size adjective (e.g., gravelly, sandy, silty, or clayey), if estimated to constitute more than 25% of the sediment
    - *With*, for example, sand with silt, silt with sand, etc. if estimated to constitute less than 25% of the sediment

- *Trace*, if estimated less than 5% of the sediment (and not included in the total 100%).

2. For other features observed, such as organics or debris, additional descriptive terms may include:
    - *Mostly*, if estimated to comprise 50% or more of the unit
    - *Some*, if estimated to comprise more than 25% to 50% of the unit
    - *Little*, if estimated to be 25% of the unit or less
    - *Trace*, if estimated less than 5% (and not included in the total 100%).

3. Consistency will be described using the following terms:
    - Density:
        - *loose*, if easily penetrated with a sampling spoon, or
        - *dense*, if penetration is more difficult.
    - Consistency:
        - *very soft*, if present as an ooze that holds no shape
        - *soft*, if saggy
        - *stiff*, if it holds a shape
        - *very stiff*, if penetration with a spoon is low
        - *hard*, if no penetration with a spoon is possible.

4. Other observations (e.g., obvious anthropogenic material [paint chips, sandblast grit, glass, metal, plastic], dramatic color, sheen, odor, etc.). Sheen will be evaluated using the PDI hydrocarbon screening method (Appendix D).

4.6 SAMPLE HANDLING AND TRANSPORT

Chain-of-custody procedures will be followed as described in the RI Round 2 FSP and RI Round 3 FSP (Integral 2004 and 2006) and referenced in the PDI FSPs (AECOM and Geosyntec 2018a and b). Sediment samples will be stored on ice at 4°C in a field cooler and shipped to appropriate laboratories.

4.7 FIELD LOGBOOK AND FORMS

All field activities will be recorded in a field logbook and field data recorded on field forms (Appendix C of this FSP). Standard record keeping procedures will be followed consistent with the RI Round 2 FSP (Integral 2004), and PDI FSPs (AECOM and Geosyntec 2018a and b).

PDI FSP logbook protocol is included verbatim for reference:

- Logbooks will be bound, with consecutively numbered pages.
- Removal of any pages, even if illegible, will be prohibited.
- Entries will be made legibly with black (or dark) waterproof ink.
- Unbiased, accurate language will be used.

- Entries will be made while activities are in progress or as soon afterward as possible (the date and time that the notation is made should be noted, as well as the time of the observation itself).
- Each consecutive day's first entry will be made on a new, blank page.
- The date and time, based on a 24-hour clock (e.g., 0900 a.m. for 9 a.m. and 2100 for 9 p.m.), will appear on each page.
- When field activity is complete, the logbook will be entered into the project file.

The type of information that may be included in the field logbook and/or field data forms includes the following:

- Names of all field staff and oversight staff
- Sampling vessel
- A record of site health and safety meetings, updates, and related monitoring
- Station name and location
- Date and collection time of each sample
- Observations made during sample collection, including weather conditions, complications, and other details associated with the sampling effort

4.8 DECONTAMINATION PROCEDURES

Equipment decontamination procedures will be performed as outlined in detail in the Appendix D Sediment Sampling SOP. The SOP is based on the RI Round 2 FSP (Integral 2004), and as excerpted in the PDI FSPs (AECOM and Geosyntec 2018a and b).

Decontamination of field sampling equipment will occur between stations. For recasts at a location, the grab sampler will be rinsed/sprayed with river water until all solid material is removed. New sampling spoons will be used per grab.

Between stations, the decontamination steps will include an initial rinse with vessel river water 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 grab may be scrubbed using Simple Green™, followed by Alconox™ or other phosphate-free detergent, and then a rinse with deionized water. 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.

4.9 INVESTIGATION-DERIVED WASTE DISPOSAL

Investigation-derived waste (IDW) disposal will occur as described in the as described in the Management of IDW SOP (Appendix D). Excess sediment will be containerized, and a waste determination made before it is disposed of at an appropriate waste facility.

Any excess 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.

Phosphate-free detergent-bearing liquid wastes from decontamination of the grab sampling equipment will be washed overboard or disposed into the sanitary sewer system.

Tyvek, gloves, paper towels, plastic sheeting, and other waste material generated during sampling will be placed in heavyweight garbage bags or other appropriate containers and placed in normal refuse containers for disposal at a non-hazardous solid waste landfill.

Used core tubes will be washed and then recycled.

4.10 FIELD QUALITY CONTROL

All Quality Assurance/Quality Control (QA/QC) procedures are detailed in the QAPP (Appendix A), which is consistent with the portions of the PDI QAPP relevant to surface and subsurface sediment sampling (AECOM and Geosyntec 2018c). Requirements for QA/QC samples are provided in Table 5. Field duplicates and other field QC samples, such as temperature blanks, and rinsate blanks, will be collected as outlined in the project QAPP. Rinsate blanks will be collected by pouring deionized water over the sampling spoons and core tubes (if not liner is used) after field decontamination.

5.0 LABORATORY ANALYSIS

For analytical consistency such as with preparation methods and detection and reporting limits, the same laboratories listed in the PDI Sediment FSPs and PDI QAPP are also used to perform the physical and chemical analyses:

PCBs (8082 and 1668B), TPAHs, 12378-PeCDD, 2378-TCDD, and 23478-PeCDF.

- ALS in Kelso, Washington, will analyze for PAHs and total solids.
- TestAmerica in:
  - Fife (Seattle), Washington, will analyze for PCB Aroclors (EPA Method 8082), TOC, grain size, and total solids.
  - Sacramento, California, will analyze for TPAHs, Pentachlorodibenzo-p-dioxin (12378-PeCDD), Tetrachlorodibenzofuran (2378-TCDD), and Pentachlorodibenzofuran (23478-PeCDF).
  - Knoxville, Tennessee, will analyze for PCB congeners (EPA Method 1668B) and specific gravity.

All 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 all analyses in Table 4. The analytes and analytical methods are provided in Table 6 for each sample type. Additional details on the analytical methods, QA/QC requirements and procedures, and laboratory-specific QA/QC requirements are detailed in the QAPP (Appendix A).

6.0 DATA MANAGEMENT AND REPORTING

6.1 FIELD DATA MANAGEMENT

The following data management procedures will be performed in the field:

- All samples will be given a unique identifier (Sections 3.1.2 and 3.2.2 of this FSP).
- All samples will be collected and transported under chain-of-custody control (Section 4.6 of this FSP).
- Deviations from the FSP are clearly recorded in logbooks.
- Field logbooks and data sheets will be maintained (Section 4.7 of this FSP).
- Field QA/QC samples will be collected according to the QAPP (Appendix A) (Section 4.10 of this FSP).

6.2 POST-ANALYSIS DATA MANAGEMENT

Analytical laboratories will be required to adhere to all QA/QC procedures outlined in the QAPP. Laboratories will provide all 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 QAPP by a third-party data validator. Ecochem, Inc. will perform the data validation for this project.

Following data validation, all 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.

6.3 REPORTING

The field sampling report will summarize field sampling activities, including sampling locations (maps), requested sample analyses, sample collection methods, and any deviations from the FSP. Data summaries and evaluations will be included in the FSP Report.

7.0 REFERENCES

AECOM (AECOM Technical Services) and Geosyntec (Geosyntec Consultants, Inc.) 2018a. Surface Sediment Field Sampling Plan, Portland Harbor Pre-Remedial Design Investigation and Baseline Sampling. FINAL. Portland Harbor Superfund Site. May 23, 2018 (Revision 1 with revised protocol June 6, 2018; Revision 2 with new upriver stations June 22, 2018)

AECOM and Geosyntec 2018b. Subsurface Sediment Field Sampling Plan, Portland Harbor Pre-Remedial Design Investigation and Baseline Sampling. FINAL. Portland Harbor Superfund Site. Rev 1 (April 3, 2018); Rev 2 (May 30, 2018); Rev 3 (July 10, 2018), Rev 4 (July 12, 2018)

AECOM and Geosyntec 2018c. Quality Assurance Project Plan Portland Harbor Pre-Remedial Design Investigation and Baseline Sampling. Portland Harbor Superfund Site. 23 March.

AECOM and Geosyntec 2018d. Health and Safety Plan Portland Harbor Pre-Remedial Design Investigation and Baseline Sampling. Portland Harbor Superfund Site. 13 March.

ASTM (American Society of Testing and Materials) 2000. ASTM D-2488-00. Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).

EPA (United States Environmental Protection Agency) 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. 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. United States Environmental Protection Agency Region 10, Seattle, Washington. January.

EPA 2017b. ASAOC between US 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. 18 December.

Geosyntec (Geosyntec Consultants, Inc.) 2016. Sampling and Analysis Plan Sediment Sampling Swan Island Lagoon Portland, Oregon. 12 January.

Geosyntec. 2017. PDI Work Plan. Portland Harbor Pre-Remedial Design Investigation and Baseline Sampling; Portland Harbor Superfund Site, Portland, Oregon. Prepared for the Pre-RD AOC Group as an attachment to the ASAOC for EPA Region 10. 19 December.

Integral 2004. Round 2 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. 21 June (Sediment Sampling SOPs in Appendix F [June 21]. Note: some of the SOPs are dated March 22 in the June version.

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. 13 October.

Kleinfelder, 2014. Sediment Sampling and Analysis Plan, Portland Harbor, Portland, Oregon. Prepared for de maximis Inc. 7 November.

PSEP (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.

Table 1. Summary of Sediment Sample Types, Numbers, and Analyses

Sediment Sample Type	Number of Stations	Number of Samples	Analyses
Surface Grabs	10	10	COCs
Subsurface Core	3	approx. 15	COCs

Notes:

Surface samples will target 0 to 30 centimeter depth

Study Area = Swan Island Lagoon Study Area between RM 8.8 and 9.2

Acronyms:

COCs = contaminants of concern PCBs (8082 Aroclors and 1668B Congeners), TPAHs, 12378-PeCDD, 2378-TCDD, and 23478-PeCDF.

Table 2. Surface Sediment Sample Locations and Analyses

Location ID	Proposed Locations (NAD 1983)[a] Easting (ft)	Northing (ft)	Target Depth (cm)	Sample ID	Analyses (COCs[b])
A-9.03	7636157.29	698930.798	30	A-9.03-0to##-MMDDYY	X
B-9.00	7636024.24	699127.901	30	B-9.00-0to##-MMDDYY	X
B-9.15	7636685.86	698596.635	30	B-9.15-0to##-MMDDYY	X
C-8.94	7635894.94	699371.588	30	C-8.94-0to##-MMDDYY	X
D-8.83	7635509.64	699805.935	30	D-8.83-0to##-MMDDYY	X
D-8.90	7635818.31	699564.251	30	D-8.90-0to##-MMDDYY	X
D-9.09	7636557.53	698895.728	30	D-9.09-0to##-MMDDYY	X
E-8.99	7636235.09	699344.819	30	E-8.99-0to##-MMDDYY	X
E-9.02	7636335.87	699213.481	30	E-9.02-0to##-MMDDYY	X
G-9.15	7636965.16	698936.263	30	G-9.15-0to##-MMDDYY	X

Notes:

Sample names will include Station ID and depth of sampling interval in cm.

Footnotes:

a) Horizontal Projection: NAD 1983 Oregon State Plain North (International Feet)

b) see Table 4 for a summary of analyses and Table 6 for a list of analytes

Acronyms:

NAD = North American Datum

ft = feet

cm = centimeters

COCs = contaminants of concern

Table 3. Subsurface Sediment Sample Locations and Analyses

Location ID	Proposed Locations (NAD 1983) [a] Easting (ft)	Northing (ft)	Mudline Depth (NAVD88) [b]	Mudline Depth (below CRD ft) [b]	Target Penetration Depth (ft)	Minimum Recovery[c] (ft)	Example Sample ID	Analyses COCs[d]
D-8.90	7635818	699564.251	18.0	23.3	20	10.8	D-8.90-SC-0to##-MMDDYY	X
D-9.09	7636558	698895.728	9.6	14.9	20	8.0	D-9.09-SC-0to##-MMDDYY	X
E-9.02	7636336	699213.481	15.0	20.3	20	8.0	E-9.02-SC-0to##-MMDDYY	X

Notes:

Sample names will include Station ID and depth of sampling interval in ft.

USACE Conversion from CRD to NAVD88 for river mile 7.5 to Broadway Bridge: CRD is 5.28 feet above NAVD88 at River Mile 9.7.

Samples will be collected from one side of a divided core, the other half will be archived. See FSP for more details.

Footnotes:

a) Horizontal Projection: NAD 1983 Oregon State Plain North (International Feet)

b) Elevations from 2009 NOAA bathymetry

c) Minimum Recovery is the estimated thickness sediment below the Depth to Remedial Action Level (PH ROD) plus 5 feet.

d) See Table 4 for a summary of analyses and Table 6 for a list of analytes.

Acronyms:

NAD = North American Datum

ft = feet

COCs = contaminants of concern

Table 4. Sample Containers, Preservation, Holding Times, and Sample Volume

Analyte Group	Analytical Method	Container[1] Type	Container[1] Size	Preservation	Holding Time	Archive Preservation	Archive Holding Time	Analytical Laboratory
PAHs	EPA 8270D-SIM	AG-TL	8 oz	Cool to 0-6°C	14 days from collection to preparation; 40 days extraction to analysis	Freeze to <-10°C	1 year	
PCB Cogeners	EPA 1668A	AG-TL	4 oz[2]	Cool to 0-6°C until receipt by laboratory. Then store in the dark at <-10° C	1 year from collection to preparation; 1 year from extraction to analysis	Freeze to <-10°C	1 year	TAL-Knoxville
Specific Gravity	ASTM D-854			NA[3]	None	NA[3]	None	
PCDD/Fs	EPA 1613B	AG-TL	4 oz[2]	Cool to 0-6°C until receipt by laboratory. Then store in the dark at <-10° C	1 year from collection to preparation; 1 year from extraction to analysis	Freeze to <-10°C	1 year	TAL-Sacramento
Total Organic Carbon	EPA 9060	G-TL	4 oz	Cool to 0-6°C	28 days from collection to analysis	Freeze to <-10°C	1 year	
PCB Aroclors	EPA 8082A	G-TL	8 oz	Cool to 0-6°C	14 days from collection to preparation; 40 days extraction to analysis	Freeze to <-10°C	1 year	
Grain Size	ASTM D422	G-TL	16 oz	NA[3]	None	NA[3]	None	TAL-Seattle
Total Solids	EPA 160.3 Modified	note 5	note 5	Cool to 0-6°C	7 days from collection to analysis	Freeze to <-10°C	1 year	ALS-Kelso TAL-Seattle
Archive	--	AG-TL	8 oz	--	--	Freeze to <-10°C	--	ALS-Kelso
Archive	--	G-TL	8 oz	--	--	Freeze to <-10°C	--	TAL-Seattle

Acronyms:

AG = amber glass; G = glass; TL = Teflon-lined lid; P = plastic; oz. = ounce;PCB = polychlorinated biphenyls; PCDD/Fs = polychlorinated dibenzo-p-dioxins and furans; TPH = total petroleum hydrocarbons; TA = TestAmerica

Note:

1) The size and number of containers may be modified by analytical laboratory. Archive samples will be collected for all of the sediment grab samples.
2) Dioxins / Furans and PCB Congeners, and Specific Gravity require the jar to be 2/3 full because they will be frozen.
3) Samples for grain size and specific gravity may be cooled to 0-6°C, and frozen to <-10°C
4) ALS minimum sample volume is 4 oz of material, preferred volume is 6 to 8 oz.
5) Sediment for Total Solids will come from jar(s) sent to TA Seattle and ALS Kelso as needed.

Table 5. Field Quality Control Sample Requirements

QA/QC Sample Type	Frequency
Temperature Blanks	1 per cooler
Blind Field Duplicates	5 percent (1 per 20 samples)[a]
Field Equipment Rinsate Blanks	5 percent (1 per 20 samples)
Matrix Spike/ Matrix Spike Duplicate	5 percent (1 per 20 samples)[b]

Acronyms:

QA/QC = quality assurance/quality control

Footnotes:

a) Field Duplicate analyses will be performed on the surface sediment samples.

b) PAHs, PCB Aroclors, and TOC. Field personnel must collect additional volume to account for MS/MSD samples where needed. Analyses performed by 1600 series methods will not require MS/MSD. MS/MSD analyses will be performed on the surface sediment samples.

Table 6. Analyte List

Parameter Group	Parameter	Units	CAS No.	Analytical Method	ROD Cleanup Levels[1]	Surface Sediment	Subsurface Sediment
Conventional	Clay	%	NA	ASTM D7928 and D6913	NV	X	X
Conventional	Silt	%	NA	ASTM D7928 and D6913	NV	X	X
Conventional	Fine Sand	%	NA	ASTM D7928 and D6913	NV	X	X
Conventional	Medium Sand	%	NA	ASTM D7928 and D6913	NV	X	X
Conventional	Coarse Sand	%	NA	ASTM D7928 and D6913	NV	X	X
Conventional	Gravel	%	NA	ASTM D7928 and D6913	NV	X	X
Conventional	Specific Gravity	g/cc	NA	ASTM D-854	NV	X	X
Conventional	Total Solids	%	NA	EPA 160.3M	NV	X	X
Conventional	Total Organic Carbon	mg/kg	7440-44-0	EPA 9060	NV	X	X
Dioxins/Furans	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	pg/g	40321-76-4	EPA 1613B	0.2	X	X
Dioxins/Furans	2,3,4,7,8-Pentachlorodibenzofuran	pg/g	57117-31-4	EPA 1613B	0.3	X	X
Dioxins/Furans	2,3,7,8-�CDD_EQ	ug/kg	NA	EPA 1613B	NV	X	X
Dioxins/Furans	2,3,7,8-Tetrachlorodibenzo-p-dioxin	pg/g	1746-01-6	EPA 1613B	0.2	X	X
PAHs	2-Methylnaphthalene	ug/kg	91-57-6	EPA 8270D-SIM	NV	X	X
PAHs	Acenaphthene	ug/kg	83-32-9	EPA 8270D-SIM	NV	X	X
PAHs	Acenaphthylene	ug/kg	208-96-8	EPA 8270D-SIM	NV	X	X
PAHs	Anthracene	ug/kg	120-12-7	EPA 8270D-SIM	NV	X	X
PAHs	Benzo(a)anthracene	ug/kg	56-55-3	EPA 8270D-SIM	NV	X	X
PAHs	Benzo(a)pyrene	ug/kg	50-32-8	EPA 8270D-SIM	NV	X	X
PAHs	Benzo(b)fluoranthene	ug/kg	205-99-2	EPA 8270D-SIM	NV	X	X
PAHs	Benzo(g,h,i)perylene	ug/kg	191-24-2	EPA 8270D-SIM	NV	X	X
PAHs	Benzo(k)fluoranthene	ug/kg	207-08-9	EPA 8270D-SIM	NV	X	X
PAHs	Chrysene	ug/kg	218-01-9	EPA 8270D-SIM	NV	X	X
PAHs	Dibenz(a,h)anthracene	ug/kg	53-70-3	EPA 8270D-SIM	NV	X	X
PAHs	Fluoranthene	ug/kg	206-44-0	EPA 8270D-SIM	NV	X	X
PAHs	Fluorene	ug/kg	86-73-7	EPA 8270D-SIM	NV	X	X
PAHs	Indeno(1,2,3-cd)pyrene	ug/kg	193-39-5	EPA 8270D-SIM	NV	X	X
PAHs	Naphthalene	ug/kg	91-20-3	EPA 8270D-SIM	NV	X	X
PAHs	Phenanthrene	ug/kg	85-01-8	EPA 8270D-SIM	NV	X	X
PAHs	Pyrene	ug/kg	129-00-0	EPA 8270D-SIM	NV	X	X
PAHs	cPAHs (BaP Equivalent)	ug/kg	NA	EPA 8270D-SIM	12	X	X
PAHs	PAHs	ug/kg	NA	EPA 8270D-SIM	23000	X	X
PCB Aroclors	PCB-1016	ug/kg	12674-11-2	EPA 8082	NV	NA	X
PCB Aroclors	PCB-1221	ug/kg	11104-28-2	EPA 8082	NV	NA	X

Table 6. Analyte List

Parameter Group	Parameter	Units	CAS No.	Analytical Method	ROD Cleanup Levels[1]	Surface Sediment	Subsurface Sediment
PCB Aroclors	PCB-1232	ug/kg	11141-16-5	EPA 8082	NV	NA	X
PCB Aroclors	PCB-1242	ug/kg	53469-21-9	EPA 8082	NV	NA	X
PCB Aroclors	PCB-1248	ug/kg	12672-29-6	EPA 8082	NV	NA	X
PCB Aroclors	PCB-1254	ug/kg	11097-69-1	EPA 8082	NV	NA	X
PCB Aroclors	PCB-1260	ug/kg	11096-82-5	EPA 8082	NV	NA	X
PCB Aroclors	Total PCBs Aroclors	ug/kg	NA	EPA 8082	9	NA	X
PCB Congeners	PCB 1	ng/g	2051-60-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 2	ng/g	2051-61-8	EPA 1668A	NV	X	NA
PCB Congeners	PCB 3	ng/g	2051-62-9	EPA 1668A	NV	X	NA
PCB Congeners	PCB 4	ng/g	13029-08-8	EPA 1668A	NV	X	NA
PCB Congeners	PCB 5	ng/g	16605-91-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 6	ng/g	25569-80-6	EPA 1668A	NV	X	NA
PCB Congeners	PCB 7	ng/g	33284-50-3	EPA 1668A	NV	X	NA
PCB Congeners	PCB 8	ng/g	34883-43-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 9	ng/g	34883-39-1	EPA 1668A	NV	X	NA
PCB Congeners	PCB 10	ng/g	33146-45-1	EPA 1668A	NV	X	NA
PCB Congeners	PCB 11	ng/g	2050-67-1	EPA 1668A	NV	X	NA
PCB Congeners	PCB 12	ng/g	2974-92-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 13	ng/g	2974-90-5	EPA 1668A	NV	X	NA
PCB Congeners	PCB 14	ng/g	34883-41-5	EPA 1668A	NV	X	NA
PCB Congeners	PCB 15	ng/g	2050-68-2	EPA 1668A	NV	X	NA
PCB Congeners	PCB 16	ng/g	38444-78-9	EPA 1668A	NV	X	NA
PCB Congeners	PCB 17	ng/g	37680-66-3	EPA 1668A	NV	X	NA
PCB Congeners	PCB 18	ng/g	37680-65-2	EPA 1668A	NV	X	NA
PCB Congeners	PCB 19	ng/g	38444-73-4	EPA 1668A	NV	X	NA
PCB Congeners	PCB 20	ng/g	38444-84-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 21	ng/g	55702-46-0	EPA 1668A	NV	X	NA
PCB Congeners	PCB 22	ng/g	38444-85-8	EPA 1668A	NV	X	NA
PCB Congeners	PCB 23	ng/g	55720-44-0	EPA 1668A	NV	X	NA
PCB Congeners	PCB 24	ng/g	55702-45-9	EPA 1668A	NV	X	NA
PCB Congeners	PCB 25	ng/g	55712-37-3	EPA 1668A	NV	X	NA
PCB Congeners	PCB 26	ng/g	38444-81-4	EPA 1668A	NV	X	NA
PCB Congeners	PCB 27	ng/g	38444-76-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 28	ng/g	7012-37-5	EPA 1668A	NV	X	NA

Table 6. Analyte List

Parameter Group	Parameter	Units	CAS No.	Analytical Method	ROD Cleanup Levels[1]	Surface Sediment	Subsurface Sediment
PCB Congeners	PCB 29	ng/g	15862-07-4	EPA 1668A	NV	X	NA
PCB Congeners	PCB 30	ng/g	35693-92-6	EPA 1668A	NV	X	NA
PCB Congeners	PCB 31	ng/g	16606-02-3	EPA 1668A	NV	X	NA
PCB Congeners	PCB 32	ng/g	38444-77-8	EPA 1668A	NV	X	NA
PCB Congeners	PCB 33	ng/g	38444-86-9	EPA 1668A	NV	X	NA
PCB Congeners	PCB 34	ng/g	37680-68-5	EPA 1668A	NV	X	NA
PCB Congeners	PCB 35	ng/g	37680-69-6	EPA 1668A	NV	X	NA
PCB Congeners	PCB 36	ng/g	38444-87-0	EPA 1668A	NV	X	NA
PCB Congeners	PCB 37	ng/g	38444-90-5	EPA 1668A	NV	X	NA
PCB Congeners	PCB 38	ng/g	53555-66-1	EPA 1668A	NV	X	NA
PCB Congeners	PCB 39	ng/g	38444-88-1	EPA 1668A	NV	X	NA
PCB Congeners	PCB 40	ng/g	38444-93-8	EPA 1668A	NV	X	NA
PCB Congeners	PCB 41	ng/g	52663-59-9	EPA 1668A	NV	X	NA
PCB Congeners	PCB 42	ng/g	36559-22-5	EPA 1668A	NV	X	NA
PCB Congeners	PCB 43	ng/g	70362-46-8	EPA 1668A	NV	X	NA
PCB Congeners	PCB 44	ng/g	41464-39-5	EPA 1668A	NV	X	NA
PCB Congeners	PCB 45	ng/g	70362-45-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 46	ng/g	41464-47-5	EPA 1668A	NV	X	NA
PCB Congeners	PCB 47	ng/g	2437-79-8	EPA 1668A	NV	X	NA
PCB Congeners	PCB 48	ng/g	70362-47-9	EPA 1668A	NV	X	NA
PCB Congeners	PCB 49	ng/g	41464-40-8	EPA 1668A	NV	X	NA
PCB Congeners	PCB 50	ng/g	62796-65-0	EPA 1668A	NV	X	NA
PCB Congeners	PCB 51	ng/g	68194-04-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 52	ng/g	35693-99-3	EPA 1668A	NV	X	NA
PCB Congeners	PCB 53	ng/g	41464-41-9	EPA 1668A	NV	X	NA
PCB Congeners	PCB 54	ng/g	15968-05-5	EPA 1668A	NV	X	NA
PCB Congeners	PCB 55	ng/g	74338-24-2	EPA 1668A	NV	X	NA
PCB Congeners	PCB 56	ng/g	41464-43-1	EPA 1668A	NV	X	NA
PCB Congeners	PCB 57	ng/g	70424-67-8	EPA 1668A	NV	X	NA
PCB Congeners	PCB 58	ng/g	41464-49-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 59	ng/g	74472-33-6	EPA 1668A	NV	X	NA
PCB Congeners	PCB 60	ng/g	33025-41-1	EPA 1668A	NV	X	NA
PCB Congeners	PCB 61	ng/g	33284-53-6	EPA 1668A	NV	X	NA
PCB Congeners	PCB 62	ng/g	54230-22-7	EPA 1668A	NV	X	NA

Table 6. Analyte List

Parameter Group	Parameter	Units	CAS No.	Analytical Method	ROD Cleanup Levels[1]	Surface Sediment	Subsurface Sediment
PCB Congeners	PCB 63	ng/g	74472-34-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 64	ng/g	52663-58-8	EPA 1668A	NV	X	NA
PCB Congeners	PCB 65	ng/g	33284-54-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 66	ng/g	32598-10-0	EPA 1668A	NV	X	NA
PCB Congeners	PCB 67	ng/g	73575-53-8	EPA 1668A	NV	X	NA
PCB Congeners	PCB 68	ng/g	73575-52-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 69	ng/g	60233-24-1	EPA 1668A	NV	X	NA
PCB Congeners	PCB 70	ng/g	32598-11-1	EPA 1668A	NV	X	NA
PCB Congeners	PCB 71	ng/g	41464-46-4	EPA 1668A	NV	X	NA
PCB Congeners	PCB 72	ng/g	41464-42-0	EPA 1668A	NV	X	NA
PCB Congeners	PCB 73	ng/g	74338-23-1	EPA 1668A	NV	X	NA
PCB Congeners	PCB 74	ng/g	32690-93-0	EPA 1668A	NV	X	NA
PCB Congeners	PCB 75	ng/g	32598-12-2	EPA 1668A	NV	X	NA
PCB Congeners	PCB 76	ng/g	70362-48-0	EPA 1668A	NV	X	NA
PCB Congeners	PCB 77	ng/g	32598-13-3	EPA 1668A	NV	X	NA
PCB Congeners	PCB 78	ng/g	70362-49-1	EPA 1668A	NV	X	NA
PCB Congeners	PCB 79	ng/g	41464-48-6	EPA 1668A	NV	X	NA
PCB Congeners	PCB 80	ng/g	33284-52-5	EPA 1668A	NV	X	NA
PCB Congeners	PCB 81	ng/g	70362-50-4	EPA 1668A	NV	X	NA
PCB Congeners	PCB 82	ng/g	52663-62-4	EPA 1668A	NV	X	NA
PCB Congeners	PCB 83	ng/g	60145-20-2	EPA 1668A	NV	X	NA
PCB Congeners	PCB 84	ng/g	52663-60-2	EPA 1668A	NV	X	NA
PCB Congeners	PCB 85	ng/g	65510-45-4	EPA 1668A	NV	X	NA
PCB Congeners	PCB 86	ng/g	55312-69-1	EPA 1668A	NV	X	NA
PCB Congeners	PCB 87	ng/g	38380-02-8	EPA 1668A	NV	X	NA
PCB Congeners	PCB 88	ng/g	55215-17-3	EPA 1668A	NV	X	NA
PCB Congeners	PCB 89	ng/g	73575-57-2	EPA 1668A	NV	X	NA
PCB Congeners	PCB 90	ng/g	68194-07-0	EPA 1668A	NV	X	NA
PCB Congeners	PCB 91	ng/g	68194-05-8	EPA 1668A	NV	X	NA
PCB Congeners	PCB 92	ng/g	52663-61-3	EPA 1668A	NV	X	NA
PCB Congeners	PCB 93	ng/g	73575-56-1	EPA 1668A	NV	X	NA
PCB Congeners	PCB 94	ng/g	73575-55-0	EPA 1668A	NV	X	NA
PCB Congeners	PCB 95	ng/g	38379-99-6	EPA 1668A	NV	X	NA
PCB Congeners	PCB 96	ng/g	73575-54-9	EPA 1668A	NV	X	NA

Table 6. Analyte List

Parameter Group	Parameter	Units	CAS No.	Analytical Method	ROD Cleanup Levels[1]	Surface Sediment	Subsurface Sediment
PCB Congeners	PCB 97	ng/g	41464-51-1	EPA 1668A	NV	X	NA
PCB Congeners	PCB 98	ng/g	60233-25-2	EPA 1668A	NV	X	NA
PCB Congeners	PCB 99	ng/g	38380-01-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 100	ng/g	39485-83-1	EPA 1668A	NV	X	NA
PCB Congeners	PCB 101	ng/g	37680-73-2	EPA 1668A	NV	X	NA
PCB Congeners	PCB 102	ng/g	68194-06-9	EPA 1668A	NV	X	NA
PCB Congeners	PCB 103	ng/g	60145-21-3	EPA 1668A	NV	X	NA
PCB Congeners	PCB 104	ng/g	56558-16-8	EPA 1668A	NV	X	NA
PCB Congeners	PCB 105	ng/g	32598-14-4	EPA 1668A	NV	X	NA
PCB Congeners	PCB 106	ng/g	70424-69-0	EPA 1668A	NV	X	NA
PCB Congeners	PCB 107	ng/g	70424-68-9	EPA 1668A	NV	X	NA
PCB Congeners	PCB 108	ng/g	70362-41-3	EPA 1668A	NV	X	NA
PCB Congeners	PCB 109	ng/g	74472-35-8	EPA 1668A	NV	X	NA
PCB Congeners	PCB 110	ng/g	38380-03-9	EPA 1668A	NV	X	NA
PCB Congeners	PCB 111	ng/g	39635-32-0	EPA 1668A	NV	X	NA
PCB Congeners	PCB 112	ng/g	74472-36-9	EPA 1668A	NV	X	NA
PCB Congeners	PCB 113	ng/g	68194-10-5	EPA 1668A	NV	X	NA
PCB Congeners	PCB 114	ng/g	74472-37-0	EPA 1668A	NV	X	NA
PCB Congeners	PCB 115	ng/g	74472-38-1	EPA 1668A	NV	X	NA
PCB Congeners	PCB 116	ng/g	18259-05-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 117	ng/g	68194-11-6	EPA 1668A	NV	X	NA
PCB Congeners	PCB 118	ng/g	31508-00-6	EPA 1668A	NV	X	NA
PCB Congeners	PCB 119	ng/g	56558-17-9	EPA 1668A	NV	X	NA
PCB Congeners	PCB 120	ng/g	68194-12-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 121	ng/g	56558-18-0	EPA 1668A	NV	X	NA
PCB Congeners	PCB 122	ng/g	76842-07-4	EPA 1668A	NV	X	NA
PCB Congeners	PCB 123	ng/g	65510-44-3	EPA 1668A	NV	X	NA
PCB Congeners	PCB 124	ng/g	70424-70-3	EPA 1668A	NV	X	NA
PCB Congeners	PCB 125	ng/g	74472-39-2	EPA 1668A	NV	X	NA
PCB Congeners	PCB 126	ng/g	57465-28-8	EPA 1668A	NV	X	NA
PCB Congeners	PCB 127	ng/g	39635-33-1	EPA 1668A	NV	X	NA
PCB Congeners	PCB 128	ng/g	38380-07-3	EPA 1668A	NV	X	NA
PCB Congeners	PCB 129	ng/g	55215-18-4	EPA 1668A	NV	X	NA
PCB Congeners	PCB 130	ng/g	52663-66-8	EPA 1668A	NV	X	NA

Table 6. Analyte List

Parameter Group	Parameter	Units	CAS No.	Analytical Method	ROD Cleanup Levels[1]	Surface Sediment	Subsurface Sediment
PCB Congeners	PCB 131	ng/g	61798-70-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 132	ng/g	38380-05-1	EPA 1668A	NV	X	NA
PCB Congeners	PCB 133	ng/g	35694-04-3	EPA 1668A	NV	X	NA
PCB Congeners	PCB 134	ng/g	52704-70-8	EPA 1668A	NV	X	NA
PCB Congeners	PCB 135	ng/g	52744-13-5	EPA 1668A	NV	X	NA
PCB Congeners	PCB 136	ng/g	38411-22-2	EPA 1668A	NV	X	NA
PCB Congeners	PCB 137	ng/g	35694-06-5	EPA 1668A	NV	X	NA
PCB Congeners	PCB 138	ng/g	35065-28-2	EPA 1668A	NV	X	NA
PCB Congeners	PCB 139	ng/g	56030-56-9	EPA 1668A	NV	X	NA
PCB Congeners	PCB 140	ng/g	59291-64-4	EPA 1668A	NV	X	NA
PCB Congeners	PCB 141	ng/g	52712-04-6	EPA 1668A	NV	X	NA
PCB Congeners	PCB 142	ng/g	41411-61-4	EPA 1668A	NV	X	NA
PCB Congeners	PCB 143	ng/g	68194-15-0	EPA 1668A	NV	X	NA
PCB Congeners	PCB 144	ng/g	68194-14-9	EPA 1668A	NV	X	NA
PCB Congeners	PCB 145	ng/g	74472-40-5	EPA 1668A	NV	X	NA
PCB Congeners	PCB 146	ng/g	51908-16-8	EPA 1668A	NV	X	NA
PCB Congeners	PCB 147	ng/g	68194-13-8	EPA 1668A	NV	X	NA
PCB Congeners	PCB 148	ng/g	74472-41-6	EPA 1668A	NV	X	NA
PCB Congeners	PCB 149	ng/g	38380-04-0	EPA 1668A	NV	X	NA
PCB Congeners	PCB 150	ng/g	68194-08-1	EPA 1668A	NV	X	NA
PCB Congeners	PCB 151	ng/g	52663-63-5	EPA 1668A	NV	X	NA
PCB Congeners	PCB 152	ng/g	68194-09-2	EPA 1668A	NV	X	NA
PCB Congeners	PCB 153	ng/g	35065-27-1	EPA 1668A	NV	X	NA
PCB Congeners	PCB 154	ng/g	60145-22-4	EPA 1668A	NV	X	NA
PCB Congeners	PCB 155	ng/g	33979-03-2	EPA 1668A	NV	X	NA
PCB Congeners	PCB 156	ng/g	38380-08-4	EPA 1668A	NV	X	NA
PCB Congeners	PCB 157	ng/g	69782-90-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 158	ng/g	74472-42-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 159	ng/g	39635-35-3	EPA 1668A	NV	X	NA
PCB Congeners	PCB 160	ng/g	41411-62-5	EPA 1668A	NV	X	NA
PCB Congeners	PCB 161	ng/g	74472-43-8	EPA 1668A	NV	X	NA
PCB Congeners	PCB 162	ng/g	39635-34-2	EPA 1668A	NV	X	NA
PCB Congeners	PCB 163	ng/g	74472-44-9	EPA 1668A	NV	X	NA
PCB Congeners	PCB 164	ng/g	74472-45-0	EPA 1668A	NV	X	NA

Table 6. Analyte List

Parameter Group	Parameter	Units	CAS No.	Analytical Method	ROD Cleanup Levels[1]	Surface Sediment	Subsurface Sediment
PCB Congeners	PCB 165	ng/g	74472-46-1	EPA 1668A	NV	X	NA
PCB Congeners	PCB 166	ng/g	41411-63-6	EPA 1668A	NV	X	NA
PCB Congeners	PCB 167	ng/g	52663-72-6	EPA 1668A	NV	X	NA
PCB Congeners	PCB 168	ng/g	59291-65-5	EPA 1668A	NV	X	NA
PCB Congeners	PCB 169	ng/g	32774-16-6	EPA 1668A	NV	X	NA
PCB Congeners	PCB 170	ng/g	35065-30-6	EPA 1668A	NV	X	NA
PCB Congeners	PCB 171	ng/g	52663-71-5	EPA 1668A	NV	X	NA
PCB Congeners	PCB 172	ng/g	52663-74-8	EPA 1668A	NV	X	NA
PCB Congeners	PCB 173	ng/g	68194-16-1	EPA 1668A	NV	X	NA
PCB Congeners	PCB 174	ng/g	38411-25-5	EPA 1668A	NV	X	NA
PCB Congeners	PCB 175	ng/g	40186-70-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 176	ng/g	52663-65-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 177	ng/g	52663-70-4	EPA 1668A	NV	X	NA
PCB Congeners	PCB 178	ng/g	52663-67-9	EPA 1668A	NV	X	NA
PCB Congeners	PCB 179	ng/g	52663-64-6	EPA 1668A	NV	X	NA
PCB Congeners	PCB 180	ng/g	35065-29-3	EPA 1668A	NV	X	NA
PCB Congeners	PCB 181	ng/g	74472-47-2	EPA 1668A	NV	X	NA
PCB Congeners	PCB 182	ng/g	60145-23-5	EPA 1668A	NV	X	NA
PCB Congeners	PCB 183	ng/g	52663-69-1	EPA 1668A	NV	X	NA
PCB Congeners	PCB 184	ng/g	74472-48-3	EPA 1668A	NV	X	NA
PCB Congeners	PCB 185	ng/g	52712-05-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 186	ng/g	74472-49-4	EPA 1668A	NV	X	NA
PCB Congeners	PCB 187	ng/g	52663-68-0	EPA 1668A	NV	X	NA
PCB Congeners	PCB 188	ng/g	74487-85-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 189	ng/g	39635-31-9	EPA 1668A	NV	X	NA
PCB Congeners	PCB 190	ng/g	41411-64-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 191	ng/g	74472-50-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 192	ng/g	74472-51-8	EPA 1668A	NV	X	NA
PCB Congeners	PCB 193	ng/g	69782-91-8	EPA 1668A	NV	X	NA
PCB Congeners	PCB 194	ng/g	35694-08-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 195	ng/g	52663-78-2	EPA 1668A	NV	X	NA
PCB Congeners	PCB 196	ng/g	42740-50-1	EPA 1668A	NV	X	NA
PCB Congeners	PCB 197	ng/g	33091-17-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 198	ng/g	68194-17-2	EPA 1668A	NV	X	NA

Table 6. Analyte List

Parameter Group	Parameter	Units	CAS No.	Analytical Method	ROD Cleanup Levels[1]	Surface Sediment	Subsurface Sediment
PCB Congeners	PCB 199	ng/g	52663-75-9	EPA 1668A	NV	X	NA
PCB Congeners	PCB 200	ng/g	52663-73-7	EPA 1668A	NV	X	NA
PCB Congeners	PCB 201	ng/g	40186-71-8	EPA 1668A	NV	X	NA
PCB Congeners	PCB 202	ng/g	2136-99-4	EPA 1668A	NV	X	NA
PCB Congeners	PCB 203	ng/g	52663-76-0	EPA 1668A	NV	X	NA
PCB Congeners	PCB 204	ng/g	74472-52-9	EPA 1668A	NV	X	NA
PCB Congeners	PCB 205	ng/g	74472-53-0	EPA 1668A	NV	X	NA
PCB Congeners	PCB 206	ng/g	40186-72-9	EPA 1668A	NV	X	NA
PCB Congeners	PCB 207	ng/g	52663-79-3	EPA 1668A	NV	X	NA
PCB Congeners	PCB 208	ng/g	52663-77-1	EPA 1668A	NV	X	NA
PCB Congeners	PCB 209	ng/g	2051-24-3	EPA 1668A	NV	X	NA
PCB Congeners	Total PCBs Congeners	ng/g	NA	EPA 1668A	9	X	NA

Notes:

[1] From Table 17 of the ROD (EPA 2017).

Abbreviations:

-- = not provided
µg/kg = micrograms per kilogram
ASTM = American Society for Testing and Materials
BaP = benzo(a)pyrene
CAS = Chemical Abstract Service
cPAH = carcinogenic polycyclic aromatic hydrocarbons
DDx = dichlorodiphenyltrichloroethane and its derivatives
g/cc = grams per cubic centimeter
EPA = Environmental Protection Agency
LL = Low-level
mg/kg = milligrams per kilograms
NA = not applicable
NWTPH-Dx = Northwest Total Petroleum Hydrocarbon-Diesel Extended
ng/g = nanograms per gram
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
pg/g = picograms per gram

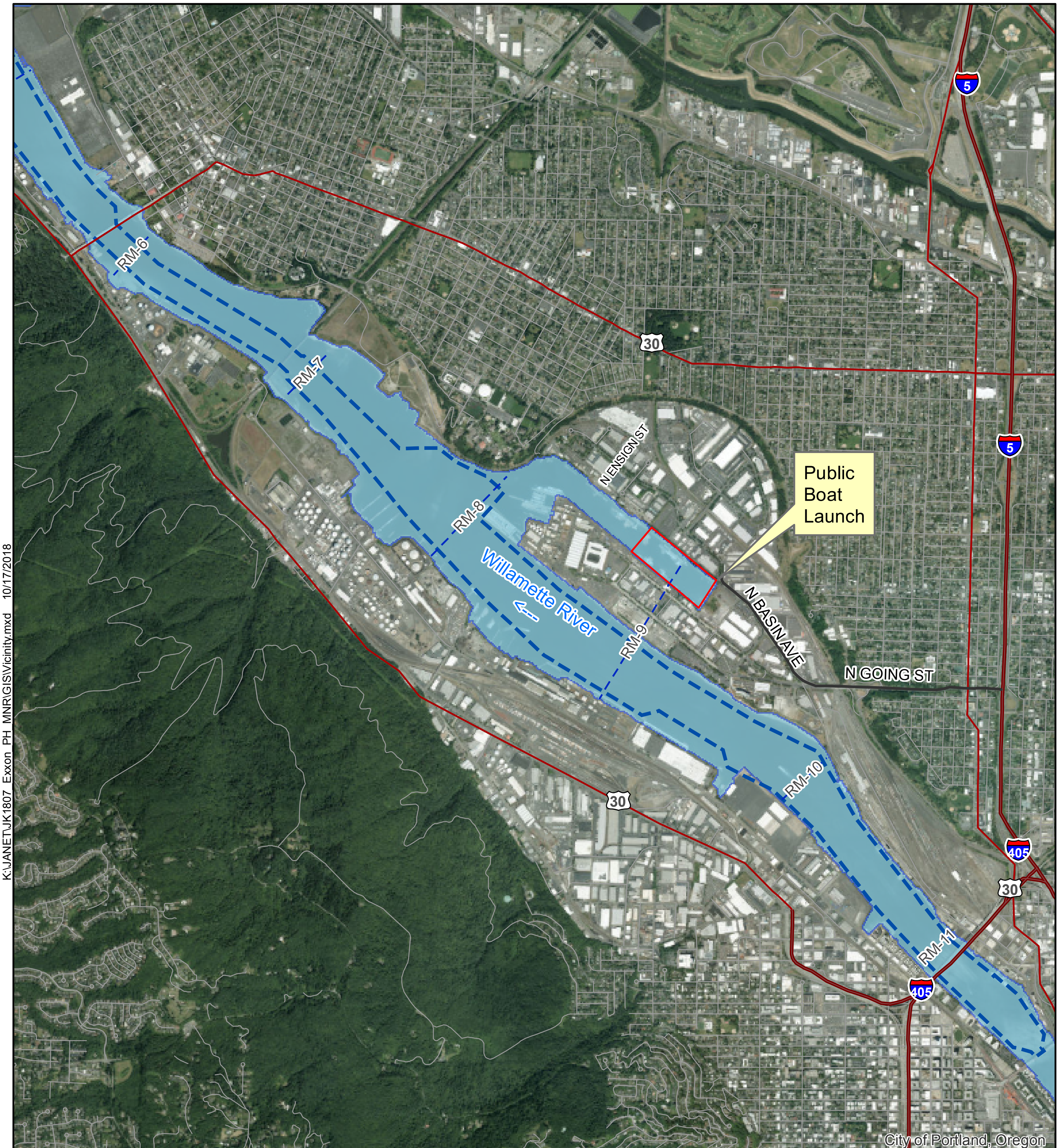

Figure 1

Portland Harbor Site Map

Head of Swan Island Lagoon
Sediment Sampling and Analysis

PGG

- Proposed 2018-2019 Surface Sample Locations
- Proposed Subsurface (Core) Location

PDI 2018 Surface Sediment Sampling Locations

- Stratified Random Sample
- Additional SMA Sample
- Surface Grab at Co-located Core Location
- RI/FS Subsurface Core Sediment Analysis Locations
- RI/FS Surface Sediment Sample Locations Used in Total PCBs Interpolation
- Selected Remedy Sediment Management Area (SMA)
- Harborlines (Approximate)
- Docks and Structures
- Taxlot Boundary
- Essential Salmonid Habitat 2015
- City of Portland Stormwater Outfall
- River Mile
- Swan Island Sediment Decision Unit

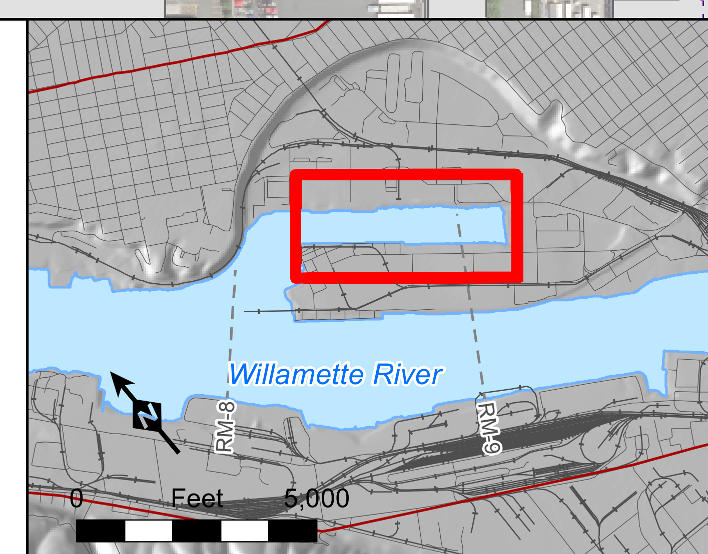

Figure 2

Head of Swan Island Lagoon
Sediment Sampling Locations

Head of Swan Island Lagoon
Sediment Sampling and Analysis

PgG

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APPENDIX A
QUALITY ASSURANCE PROJECT PLAN

QUALITY ASSURANCE PROJECT PLAN
HEAD OF SWAN ISLAND LAGOON
SEDIMENT SAMPLING INVESTIGATION

October 19, 2018

QUALITY ASSURANCE PROJECT PLAN
HEAD OF SWAN ISLAND LAGOON
SEDIMENT SAMPLING INVESTIGATION

Prepared for:

de maximis, inc.

Prepared by:

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October 19, 2018
JK1807

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APPENDIX A

QUALITY ASSURANCE PROJECT PLAN SIGNATURES

This Quality Assurance Project Plan (QAPP), developed October 5, 2018 for the Swan Island Lagoon Sediment Investigation in the Portland Harbor Superfund Site, was developed and has been reviewed and approved by the undersigned. Copies of the completed and signed QAPP shall be distributed to the undersigned and to all field personnel.

Date: 10/19/18

Prepared by: Inger Jackson — Pacific Groundwater Group Laboratory Coordinator

Date: 10/19/18

Reviewed by: Jeffrey Parker — Pacific Groundwater Group Technical Coordinator

Date: 10/19/18

Approved by: Janet Knox — Pacific Groundwater Group Project Coordinator

DISTRIBUTION LIST

QAPP Recipient	Title	Organization	Contact Information
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Inger Jackson	Laboratory Coordinator	PGG	inger@pgwg.com
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1.0 INTRODUCTION

The Record of Decision (ROD) described a post-ROD sampling effort for the Portland Harbor Superfund Site (PHSS) (Figure 1) located in Portland, Oregon, to delineate and refine the sediment management area (SMA) footprints, refine the Conceptual Site Model (CSM), determine baseline conditions, and support remedial design (United States Environmental Protection Agency [EPA] 2017a). On December 19, 2017, EPA entered into an Administrative Settlement Agreement and Order on Consent (ASAOC) with the Pre-Remedial Design Agreement and Order on Consent Investigation Group (Pre-RD Group) to conduct the Pre-Remedial Design Investigation and Baseline Sampling (PDI) studies at the PHSS (EPA 2017b). The ASAOC includes a Statement of Work (SOW) and the PDI Work Plan (Geosyntec 2017), which generally describe the agreed upon field investigation activities, data analyses, schedule, and deliverables for the PDI.

Following the submittal of the more general Work Plan, the Pre-RD Group submitted to EPA Field Sampling Plans (FSPs) that specify sampling scopes such as surface sediment, core, biological and bathymetry investigations. The PDI Surface Sediment FSP (AECOM and Geosyntec, 2018a) and the PDI Subsurface Sediment FSP (AECOM and Geosyntec, 2018b) detail PDI sampling throughout the PHSS, including the Swan Island Lagoon (SIL). Collectively, 74 surface samples and 14 subsurface cores will be collected in the SIL for the PDI studies.

To complement the PDI investigation, the Surface and Subsurface Sediment Field Sampling Plan Head of Swan Island Lagoon (Head of SIL Sediment FSP) (Pacific Groundwater Group, 2018) was prepared to support sediment sampling in the Head of SIL (Figure 2).

1.1 SIL SEDIMENT INVESTIGATION OBJECTIVES

In the SIL (Figure 2), the PDI data will supplement and update the 1997-2007 Remedial Investigation/Feasibility Study (RI/FS) surface sediment data for purposes of remedial design and evaluating remedy effectiveness, but with fewer samples for the SIL than in the RI/FS dataset. The surface sediment samples for the Head of SIL FSP will support (1) the refinement of the SIL SMA footprint and technology assignments, (2) delineation of the extent of principal threat waste (PTW), and (3) the evaluation of remedy effectiveness, particularly as baseline sampling for an Enhanced Natural Recovery (ENR) Pilot Study.

1.2 QAPP OBJECTIVES

This Head of SIL Quality Assurance Project Plan (QAPP) supports the Head of SIL Sediment FSP and provides quality control (QC) elements to satisfy the data quality objectives (DQOs) for each task specified in the Head of SIL Sediment Investigation FSP. The QAPP establishes protocols that are necessary to ensure that the data generated are of a quality sufficient to support the DQOs and to ensure that valid conclusions are drawn from the Head of SIL Sediment Sampling. Except where noted herein, the Head of SIL QAPP follows the relevant sediment protocols described in the PDI Investigation QAPP (AECOM and Geosyntec, 2018c).

1.3 QAPP DOCUMENT OVERVIEW

This Head of SIL Sediment QAPP follows the document structure of the PDI Investigation QAPP.

- Section 2, Project Management identifies the roles and responsibilities of the individuals involved the project and their different organizations.
- Section 3, Background and Objectives summarizes the objectives of the Head of SIL Sediment FSP, the DQOs, and Quality Assurance (QA) objectives and acceptance criteria.
- Section 4, Data Generation and Acquisition summarizes how sediment samples will be collected, handled, and analyzed and Quality Control (QC) objectives.

- Section 5, Data Quality Assessment summarizes how the program will be evaluated for compliance with the QAPP and to determine if the data may be used for the intended purpose.
- Section 6, Data Validation and Usability describes how the data conforms to the project objectives and estimate the effect of any deviations.

2.0 PROJECT MANAGEMENT

This section presents the organizational structure for the Head of SIL Sediment Sampling that consists of Pacific Groundwater Group (PGG) and subcontractors Gravity Marine Services (Gravity), ALS Environmental (ALS), Test America, Inc. (TA), and Ecochem, Inc. (Ecochem). All official communication should be through the Head of SIL Project Coordinator.

2.1 PGG ORGANIZATION AND RESPONSIBILITIES

PGG is managing and coordinating activities on behalf of de maximis, inc. for the Head of SIL Sediment FSP including management of all subcontractors (except NRC for excess sediment disposal), field sampling, analysis, and reporting.

2.1.1 Head of SIL Project Coordinator and Manager

Janet Knox of PGG will be the Project Coordinator and Manager and will be responsible for overall project coordination and providing oversight on all project deliverables. In this role, Ms. Knox will be the primary point of contact for information to and from de maximis. In addition, she will oversee and coordinate Head of SIL Sediment Sampling activities with the internal PGG project team and subconsultants.

If changes to the Head of SIL Sediment Investigation FSP or QAPP are needed, Ms. Knox will discuss proposed changes with applicable project team members. If immediate changes are needed based on conditions in the field or laboratory, Ms. Knox will notify de maximis as soon as possible.

2.1.2 Head of SIL Technical Coordinator

Jeffrey Parker of PGG will be the project Technical Coordinator and will oversee all technical aspects of project planning, sample collection, reporting, and data evaluation activities to confirm compliance with the objectives stated in the Head of SIL Sediment FSP.

2.1.3 Head of SIL Laboratory Coordinator

Inger Jackson of PGG will be the Laboratory Coordinator and will be responsible for coordination with labs regarding sample volumes, logistics, schedule, detection limits and matrix interferences, data deliverable, and coordinating with data Quality Assurance (QA) reviewer, Ecochem.

2.2 FIELD SUBCONSULTANT TEAM ORGANIZATION AND RESPONSIBILITIES

Field activities will be supported by subconsultant, who will report directly to the Project Manager, Ms. Knox or Technical Coordinator, Mr. Parker of PGG.

2.2.1 Head of SIL Field Coordinator

Mathew Luxon of PGG will be the Field Coordinator and will be responsible for general field coordination and oversight. Mr. Luxon will be the point of contact for field staff during the implementation of this FSP.

2.2.2 Head of SIL Vessel Support

Gravity Marine Services (Gravity), of Fall City, Washington, will provide vessel support during sediment sample collection.

2.3 ANALYTICAL LABORATORY SERVICES

Two analytical laboratories were selected to perform the analyses identified in the Head of SIL Sediment FSP, which are consistent with laboratories providing the same analyses for the PDI. Each laboratory is National Environmental Laboratory Accreditation Program-accredited for the analytical testing assigned to them and maintains an internal QA program and (Appendix A). This section identifies the laboratories performing the specific analyses. In the event that a selected analytical laboratory is unable to analyze samples in a timely manner, the Laboratory Coordinator may authorize alternate qualified laboratories operated by ALS Environmental or TestAmerica Laboratories, Inc. for sample analysis.

2.3.1 ALS Environmental

ALS Environmental (ALS) of Kelso, Washington, will perform sediment analysis for polycyclic aromatic hydrocarbons (PAHs). ALS' Quality Assurance Manual is presented in Appendix A. The ALS laboratory manager for this project is Howard Holmes.

2.3.2 TestAmerica Laboratories, Inc.

Multiple TestAmerica Laboratories, Inc. (TestAmerica) will be performing analytical services for the Head of SIL Sediment FSP. Elaine Walker with TestAmerica Seattle of Fife, Washington will be TestAmerica's laboratory manager and will coordinate analytical services for all TestAmerica labs.

TestAmerica Seattle will perform sediment analyses for polychlorinated biphenyls (PCB) Aroclors, total organic carbon (TOC), total solids, percent moisture, and grain-size. TestAmerica Seattle's Quality Assurance Manual is presented in Appendix A.

TestAmerica of Knoxville, Tennessee, will perform sediment analysis for PCB congeners and specific gravity. TestAmerica Knoxville's Quality Assurance Manual is presented in Appendix A.

TestAmerica of Sacramento, California will perform sediment analysis for dioxins/furans (D/F). TestAmerica Sacramento's Quality Assurance Manual is presented in Appendix A.

3.0 BACKGROUND AND OBJECTIVES

3.1 BACKGROUND

The PHSS Site includes the Head of SIL. Background information for both the PHSS Site and Head of SIL are summarized below.

3.1.1 PHSS Background and Description

The PHSS is approximately 2,190 acres extending from river mile (RM) 1.9 to Rm 11.8 of the Lower Willamette River. Background and other PHSS characteristics are described in detail in the Final Remedial Investigation Report (EPA 2016a).

On December 1, 2000, the PHSS was listed on the National Priorities List by EPA mainly due to concerns about potential risks to human health and the environment from consuming fish. The most widespread contaminants found at the PHSS include, but are not limited to, the focused contaminants of concern (COCs), which include PCBs, PAHs, dichlorodiphenyltrichloroethane (DDT) and its derivatives (DDx), and dioxins and furans (D/F). A remedial investigation and feasibility study (RI/FS) was initiated in 2001 by a small subset of potentially responsible parties (PRPs) known as the Lower Willamette Group (LWG), and completed by EPA in 2016 (EPA 2016a, 2016b). The EPA issued a ROD on January 3, 2017, which detailed the selected final remedy for the in-river portion of the PHSS. The ROD described a post-ROD sampling effort for the PHSS to delineate and better refine the SMA footprints, refine the conceptual site model, update current conditions, and support remedial design (EPA 2017a).

The PDI is intended to assist in meeting the objectives of the post-ROD sampling effort. In the SIL, the PDI data will supplement and update the 1997-2007 Remedial Investigation/Feasibility Study (RI/FS) surface sediment data for purposes of remedial design and evaluating remedy effectiveness, but with fewer samples for the SIL than in the RI/FS dataset.

3.1.2 Head of SIL Sediment Sampling and Objectives

The PHSS is located in Portland, Oregon, on the Lower Willamette River immediately downstream of the urban downtown area from river mile (RM) 1.9 upstream to 11.8. The Head of SIL (Figure 2) is located within the SIL, which is on the northeastern side of the Lower Willamette River in the PHSS between RM 8 and RM 9.2. The Head of SIL sampling will occur in the SIL between RM 8.8 and RM 9.2.

The Head of SIL Sediment Sampling is intended to complement data collected for the PDI to support (1) the refinement of the SIL SMA footprint and technology assignments, (2) delineation of the extent of principal threat waste (PTW), and (3) the evaluation of remedy effectiveness, particularly as baseline sampling for an Enhanced Natural Recovery (ENR) Pilot Study.

3.2 DATA QUALITY OBJECTIVES

To generate data that will meet the Head of SIL Sediment FSP objectives, it is necessary to define the types of decisions that will be made, identify the intended uses of the data, and design a data collection program. These are steps in the DQO process. DQOs entail the desired type, range of applicability, and quality of data based on desired decisions and acceptable decision errors. Articulating DQOs is necessary to ultimately obtain sufficient data of known defensible quality for the intended use. The DQO process will assist in determining the necessary quantities, quality, sensitivity, sample handling procedures, and data assessment requirements for the data collected.

The DQO development presented herein adheres to the framework presented in the EPA document "Guidance on Systematic Planning Using the Data Quality Objectives Process" (EPA 2006). The following subsections provide an overview of the seven-step process and DQOs for the Head of SIL Sediment FSP.

3.2.1 Step 1: State the Problem

The ROD states that a post-ROD sampling effort is conducted to support the remedial design, refine the CSM, and establish a baseline dataset for comparison to post-remedy conditions. The PDI study covers many elements outlined by EPA for post-ROD sampling and data collection, including: surface and subsurface sediment, surface water, sediment porewater, bathymetry, and fish tissue (smallmouth bass [SMB]). However, the PDI surface and subsurface sampling will result in fewer samples for the SIL than in the RI/FS dataset. Additional samples are needed to support pre-remedial and remedial design.

3.2.2 Step 2: Identify the Goals of the PDI

1) Assist in refining the scope and extent of the remedial actions that will be performed in the SIL, including refining SMAs, informing technology assignments consistent with the decision tree in the ROD, and refining the horizontal and vertical extent of the dredging and capping areas.

2) Collect data to facilitate completion of the third-party allocation by PRPs; this allocation process is independent of EPA oversight.

3) Add data to existing baseline dataset for future long-term monitoring.

4) Update and evaluate Site conditions to refine the CSM.

3.2.3 Step 3: Identify Information Inputs

To achieve the goals of the Head of SIL Sediment FSP, the following information inputs will be collected:

Inputs for Goals 1 through 4 –To determine the current river bed conditions in the Head of SIL, 10 surface sediment samples and 3 co-located subsurface sediment samples will be collected and analyzed for the sediment COCs listed in Table 2 of this QAPP. Split samples will be archived for future possible analyses. These data, from SMA and non-

SMA areas, will refine the SMA footprints, which forms the basis for remedial design, and adds to the CSM. Taken together with other data sets, these data support third-party allocation.

3.2.4 Step 4: Define the Boundaries of the Study

The Head of SIL Sediment Sampling (Figure 2) is located on the northeastern side of the Lower Willamette River in the PHSS between RM 8.8 and RM 9.2.

3.2.5 Step 5: Develop the Analytical Approach

The field investigation component of the Head of SIL Sediment FSP will collect site-specific data integral to achieving the goals listed above. Data will be collected from surface and subsurface sediment sampling events.

Surface sediment samples will target the 0- to 30-centimeter (cm) depth interval. Subsurface sediment cores will have location-specific recovery (or penetration) criteria that will be divided into sample intervals by stratigraphic units. See the Head of SIL Sediment FSP for more details regarding sample collection and processing. Sampling and analysis methods will be consistent and comparable with those used for the RI/FS and PDI.

Sediment samples from 10 surface locations and 3 core locations will be analyzed for polychlorinated biphenyls (PCBs, Aroclor and Congener), total polynuclear aromatic hydrocarbons (TPAHs), and three dioxin/furans (12378-PeCDD, 2378-TCDD, and 23478-PeCDF), grain size, specific gravity, total solids, and total organic carbon (TOC). Samples will be archived for possible further analysis.

3.2.6 Step 6: Specify Performance or Acceptance Criteria

The measurement performance criteria for data associated with the specific analyses include precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS). To meet PARCCS requirements, QC criteria are provided in the standard field and laboratory methods. These criteria include the use of the following:

- Field duplicates, laboratory duplicates, laboratory control sample/laboratory control sample duplicates (LCS/LCSD), and matrix spike/matrix spike duplicate samples (MS/MSD) to assess precision.
- Matrix spikes, LCS, surrogates, calibration results, and field and method blanks to assess accuracy and bias.
- Field sampling design and sample collection SOPs to determine representativeness.
- Standard methods and the consistent use of field and laboratory SOPs, method detection limit (MDL) studies, and calibration to achieve comparability.
- Blanks, including field and laboratory QC blanks, to determine and assess sensitivity, cross-contamination, and bias.

Specific objectives for each PARCCS criterion 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 Section 3.3.

3.2.7 Step 7: Develop the Plan for Obtaining Data

The Head of SIL Sediment FSP strategy is based upon the ROD, and is details in the FSP. The basis of the sampling design and approach and sampling locations are presented in Section 3 of the Head of SIL Sediment FSP (PGG 2018).

3.3 QUALITY OBJECTIVES AND CRITERIA OF MEASUREMENT

3.3.1 PARCCS Overview

This QA program addresses both field and laboratory activities. Quality assurance objectives are formally measured through the computation of performance measures known as data quality indicators (DQIs), which are in turn compared to pre-defined Measurement Quality Objectives (MQOs) specific to the project objectives (EPA 2002). The DQIs for measurement data are expressed in terms of PARCCS. Evaluation of DQIs provides the mechanism for ongoing control and evaluation of data quality throughout the project, and ultimately will be used to define the data quality achieved for the various measurement parameters. The field QA/QC program will be accomplished through the collection of field duplicates, equipment (rinseate) blanks, and MS/MSD, as applicable (Table 2). The analytical QA/QC program will be assessed through the internal laboratory QC performed, including but not limited to method blanks, LCS recoveries, surrogate recoveries, and MS/MSD recoveries. The following sections describe the DQIs in greater detail, with a discussion of the associated MQOs.

3.3.2 Precision

Precision refers to the reproducibility or degree of agreement among duplicate measurements of a single analyte. The closer the numerical values of the measurements, the more precise the measurement. Poor precision stems from random errors (i.e., mechanisms that can cause both high and low measurement errors at random). Precision is usually stated in terms of standard deviation, but other estimates, such as the coefficient of variation (relative standard deviation), range (maximum value minus minimum values), and relative range are common and may be used pending review of the data.

During the collection of data using field methods and/or instrumentation, precision is checked by reporting several measurements taken at one location and comparing the results. Precision will be determined from replicate/duplicate samples and will be expressed as the relative percent difference (RPD) between replicate/duplicate and parent sample results, computed as follows:

$$RPD = \frac{X_1 - X_2}{(X_1 + X_2)/2} \times 100$$

Where:

X_1 and X_2 are reported concentrations for each replicate sample and subtracted differences represent absolute values.

For field duplicates, the precision goals for this project are as follows:

- RPD = 50% for solid samples, and
- RPD = 30% for liquid samples

For laboratory duplicates (chemistry), the RPD goals are defined by the laboratory acceptance criteria determined from control limits or defined by the specific method. With regard to grain size analysis, laboratory triplicates and relative standard deviation (RSD) goals are defined by the laboratory acceptance criteria as defined by the specific method.

Precision will be determined through the collection of field duplicates and the analysis of MS/MSD and LCS/LCSD pairs for the work performed at the Site. The overall precision of measurement data is a mixture of sampling and analytical factors. Analytical precision is much easier to control and quantify than sampling precision; there are more historical data related to individual method performance, and the "universe" is not limited to the samples received in the 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 sediment 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. Laboratory duplicate pairs are used to assess the precision or variability of the laboratory process.

3.3.3 Accuracy and Bias

Accuracy refers to the degree of difference between measured or calculated values and the true value. The closer the numerical value of the measurement comes to the true value, or actual concentration, the more accurate the measurement. The converse of accuracy is bias, in which a systematic mechanism tends to consistently introduce errors in one direction or the other. Bias in environmental sampling can occur in one of three ways; these mechanisms and their associated diagnostic and management methods are as follows:

- 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, field blanks, trip blanks, and method blanks. 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 formula 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 FSPs. Through regular review of field procedures, deficiencies will be documented and corrected in a timely manner.

- High or low bias can occur due to poor recoveries, poor calibration, or other system control problems. The effects of these mechanisms on analytical accuracy may be expressed as the percent recovery of an analyte that has been added to the environmental sample at a known concentration before analysis. 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 formula for data qualification based on high or low analyte recoveries outside of the laboratory and/or method acceptance limits.
- Accuracy, when potentially affected by high or low recoveries as described in the third bullet above, is presented as percent recovery (%R), which is defined as:

$$\%R = \frac{Spiked\ Sample\ Concentration - Sample\ Concentration}{Spike\ Concentration} \times 100$$

- Accuracy goals for analytical results are presented as upper and lower control limits for LCS and MS/MSD percent recovery in Table 1. Laboratory control limits will be used for the accuracy goals for surrogates. The current values are presented for informational purposes only. Data review/validation will be based on the most current laboratory control limits in effect at the time of analysis.

3.3.4 Representativeness

Representativeness is defined by the degree to which the data accurately and precisely describe a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. If the results are reproducible, the data obtained can be said to represent the environmental condition. Representativeness is ensured by collecting sufficient numbers of 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.

3.3.5 Completeness

Completeness is defined as the percentage of measurements made that are judged to be valid measurements. The completeness goal is essentially the same for data uses in that sufficient amounts of valid data are to be generated.

There are limited historical data on the completeness achieved by individual methods. However, based on historical datasets associated with the EPA's Contract Laboratory Program, data have been found to be 80% to 85% complete on a nationwide basis.

The percent completeness for each set of samples will be calculated as follows:

$$\%\ Completeness = \frac{Valid\ Data}{Total\ Data\ Planned} \times 100$$

The QA objective for completeness for the parameters will be 90%.

3.3.6 Comparability

Comparability expresses the confidence with which one data set can be compared to another data set measuring the same property. Comparability is ensured using established and approved analytical methods, consistency in the basis of analysis (dry weight, volume), consistency in reporting units (micrograms per kilogram [μg/kg], milligrams per kilograms [mg/kg]), and analysis of standard reference materials. Comparable data sets must contain the same variables of interest and must possess values that can be converted to a common unit of measurement. Comparability is normally a qualitative parameter that is dependent upon other data quality elements. For example, if the detection limits for a target analyte were significantly different for two different methods, the two methods would not be comparable. By using standard sampling and analytical procedures, and carefully assessing laboratory capabilities, datasets will be comparable. Sediment data collected here will be directly comparable to the PDI sediment data collected because this investigation uses the same analytical laboratories and methods, sampling SOPs, and protocols.

3.3.7 Sensitivity

Sensitivity refers to the minimum magnitude at which analytical methods can resolve quantitative differences among sample concentrations. If the minimum magnitude for a particular analytical method is sufficiently below an action level or risk screening criterion, then the method sensitivity is deemed sufficient to fully evaluate the dataset with respect to the desired reference values. Frequently, risk-based screening levels fall below the sensitivity of even the most sensitive analytical methods. In such cases, it is necessary to review the qualifications of several laboratories, both from the standpoint of sensitivity as well as other DQIs, to select the best laboratory for the project.

The MDL is a theoretical limit determined through an MDL study in which the concentration of a spiked solution is tested at least seven times and the concentration of method blanks is tested at least seven times. The standard deviation of the recovered concentrations is computed and multiplied by the t-distribution value to arrive at the MDL. The higher of the two MDLs is then used as the MDL for the analyte and test method. The project quantitation limit (PQL), sometimes referred to as the reporting limit (RL), is a quantifiable value and usually the lowest concentration standard used in the calibration curve. In practice, to allow for matrix interferences variability in instrument control, a RL of three to eight times the MDL is typically selected.

Analytical sensitivity is readily evaluated by comparing method RLs and/or MDLs to risk-based screening values, such as ROD Table 17 COC cleanup levels. The results of this analysis are presented in Table 1 of this QAPP, which demonstrate the suitability of the selected methods to meet the project requirements within the limits of technical practicability. Both the PQLs and the MDLs will be recorded in the project database; however, analytical results will be reported to the MDLs consistent with previous RI studies and the PDI study to meet the majority of the project reporting requirements.

3.4 SPECIAL TRAINING / CERTIFICATIONS

Health and safety training will include the following:

- Initial training of Site workers in 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER), per 29 Code of Federal Regulation (CFR) 1910.120, with supervisor training for the field manager and annual 8-hour refresher training thereafter for all field staff

All sampling personnel will have completed the 40-hour HAZWOPER training course and 8-hour refresher courses, as necessary. The 40-hour course meets the OSHA regulation 29 CFR 1910.120(e)(3). Documentation of course completion will be required, and copies will be maintained in personnel files. All subcontractors performing work during the Head of SIL Sediment Sampling will be required to conduct all activities in accordance with applicable health and safety regulations and site-specific requirements. A copy of the project HASP will be provided to each subcontractor. However, subcontractors will be responsible for the health and safety of their personnel. Each day before work commences, a tailgate health and safety meeting will be conducted by the field coordinators with participation by the full contractor field team.

All sampling activities conducted during the Head of SIL Sediment Sampling will be performed by individuals with training and experience in the specific sampling and monitoring techniques. Individuals collecting samples will be trained, as necessary, on the specific requirements provided in the field SOPs.

3.5 DOCUMENTATION AND RECORDS

Documentation involves generating, maintaining, and controlling field data, laboratory analytical data, field logs, reports, and any other data relevant to the project. Bound field logbooks, loose-leaf coring logs, or automated field data entry records generated with personal data assistants (PDAs) are examples of documents. This project will have dedicated field logbooks, forms, and databases that will not be used for other projects. Entries will be dated, and the time of entry will be recorded. Sample collection data as well as visual observations will be documented on forms or PDAs or, when forms are not available or applicable, in the field logbook. To the extent possible, field data will be recorded on field forms or PDAs and not repeated in the field notebook. Any sample collection equipment, field analytical equipment, and equipment used to make physical measurements will be identified in the field documentation. Calculations, results, equipment usage, maintenance, and repair and calibration data for field sampling, analytical, and physical measurement equipment will also be recorded in field documentation. Once completed, the field forms, field databases, and field logbook will become part of the project file.

Office data management will involve establishing and maintaining a project file. The project file will include the following:

- Head of SIL Sediment Sampling planning documents, such as this QAPP and HASP
- FSP and schedules
- SOPs (for both the field and laboratory)

- Field sampling logs
- Field screening data
- QA auditing and inspection reports
- Laboratory analytical data
- Calculations
- Drawings and figures
- Reports
- External and internal correspondence
- Notes/minutes of meetings and phone conversations

All project-related information will be routed to the Project Manager who will be responsible for distributing the information to appropriate personnel. The official project files will be maintained in the Seattle, Washington, offices of PGG.

4.0 DATA GENERATION AND ACQUISITION

4.1 SAMPLE DESIGN

Below are overviews of the sampling designs for the Head of SIL Sediment Sampling. Complete sampling designs and rationales are described in the Head of SIL Sediment FSP (PGG 2018).

4.1.1 Surface Sediment Sampling

A total of 10 surface sediment samples will be collected according to an Euclidean Distance Analysis sample design. All surface sediment sampling stations are presented in Figure 2. The surface sediment locations are summarized in Table 2 of the Head of SIL Sediment FSP (PGG 2018).

For the sediment sample design, PGG used the x and y coordinates proposed for the PDI sampling in 2018 to perform a Euclidean Distance Analysis from the PDI points to identify spatial data gaps. PGG filled the largest data gaps and reran the Euclidean Distance Analysis multiple times to optimally fill the data gaps with 10 samples.

4.1.2 Subsurface Sediment Sampling

Subsurface core samples will be collected at 3 selected locations as shown and described in Figure 2 and Table 3. The proposed core locations and depths were selected to complement the 3 core locations proposed for the PDI for the Head of the SIL, which, together, will refine the vertical SMA extent for pre-remedial design.

4.2 SAMPLE METHODS

The Head of SIL Sediment FSP (PGG 2018) contains complete descriptions of the sample collection and handling methods, the types and numbers of samples that will be collected, the rationale for collection, and the analyses that will be performed. The sections below provide a general description of the sampling methods.

4.2.1 Sample and Field QC Nomenclature

Sample containers will be labeled with an identification number that uniquely identifies the sample. The sample nomenclature number will be logged in the field logbook or applicable sampling form as prescribed in the Head of SIL Sediment FSP (PGG 2018), along with the following information about the sampling event:

- Sampling personnel
- Date and time of collection
- Field sample location and depth (as appropriate)
- Type of sampling (composite or grab)
- Method of sampling
- Intended analyses

4.2.1.1 Surface Sediment Sample and Field QC Nomenclature

Sample nomenclature will be developed as follows to relate samples to river mile to 3 significant figures and sample interval. All samples will have a unique identifying sample ID that includes the following (Table 3):

- River Mile to identify up/downriver (lagoon) locations, and letters A-G identify cross-river locations. (e.g., 8.85D)
- Sample type. NOT USED FOR SURFACE SAMPLES
- Sample Depth. The actual depth interval of the collected sample (top ## to bottom ##). For example, if the penetration depth of the grab sampler is 27 cm, the sample ID will include “0to27”.
- Sample Date. The date of sample collection will be added to the sample ID in the following month, day, year format: MMDDYY

For example, a surface grab sample from position 8.85D, where the grab sampler penetrated to a depth of 27 cm and was collected on October 15, 2018 would have the sample ID 8.85D-0to27-101518.

Field duplicate samples will substitute the location for numerical sequence beginning at 511 (e.g. 511-0-27-101518). Equipment rinseate blanks will combine the numerical sequence beginning at 611 and the date (e.g. 611-101518). Additional data fields that describe each unique sample feature, location, and attributes will be recorded in the field forms and will be included in the project database.

4.2.1.2 Subsurface Sediment Sample and Field QC Nomenclature

Sample nomenclature will be developed as follows to relate samples to the river mile, sample type, and sample interval. All samples will have a unique identifying sample ID that includes the following (Table 3):

- River Mile to identify up/downriver (lagoon) locations, and letters A-G identify cross-river locations. (e.g., 8.85D)
- Sample type. SC for Sediment Core.
- Sample Depth. The actual depth interval of the collected sample in feet (top ## to bottom ##). For example, if the depth interval is 0 to 1 ft, the sample ID will include "0to1".
- Sample Date. The date of sample collection will be added to the sample ID in the following month, day, year format: MMDDYY

For example, a sediment core sample from river mile and position 8.85A for the 0 to 1 ft interval collected on October 15, 2018 would have the sample ID 8.85A-SC-0to1-101518.

Field duplicate samples will substitute the river mile and position for numerical sequence beginning at 521 (e.g. 521-SC-1to2-101518). Equipment rinseate blanks will combine the numerical sequence beginning at 611 and the date (e.g. 611-101518). Additional data fields that describe each unique sample feature, location, and attributes will be recorded in the field forms and will be included in the project database.

4.2.2 Collection Methods

The sample collection methods, location control, field equipment, and decontamination procedures to be used are described in detail in the Head of SIL Sediment FSP.

4.2.3 Field Generated Waste and Waste Disposal

Any excess sediment remaining after processing will be containerized and a waste determination made before it is disposed of at an appropriate facility.

Disposal of other investigation-derived waste (IDW) disposal will occur as described in the RI FSPs, consistent with later sampling in the SIL by Kleinfelder (2014) and Geosyntec (2016), and proposed in the PDI FSPs (AECOM and Geosyntec 2018a and b).

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. Phosphate-free detergent-bearing liquid wastes from decontamination of the grab sampling equipment will be washed overboard or disposed into the sanitary sewer system.

Tyvek, gloves, paper towels, plastic sheeting, and other waste material generated during sampling will be placed in heavyweight garbage bags or other appropriate containers and placed in normal refuse containers for disposal at a non-hazardous solid waste landfill.

Used core tubes will be washed and then recycled. Leftover sediment after core processing, and oily or other potentially contaminated IDW will be placed in appropriate containers, characterized for disposal, and disposed of at an appropriate waste facility.

4.3 SAMPLE HANDLING

4.3.1 Hold Times

The first step in proper sample handling and custody is observance of analytical holding times, which can vary from 7 days to 1 year depending upon the media and analytical method(s) selected for the samples. Knowledge of required holding times will have a direct impact on the scheduling of sample collection, packing, and shipping activities. The sample containers, volumes, preservations, and holding times applicable to each analytical method are shown in Table 4 of this QAPP.

4.3.2 Sample Custody

Sample collection and sample custody procedures are designed so that field custody of samples is maintained and documented. These procedures provide identification and documentation of the sampling event and the sample chain-of-custody from shipment of sample bottle ware and pre-cleaned sampling supplies, through sample collection, to receipt of the samples by the laboratory. When used in conjunction with the laboratory's custody procedures and documentation, these data establish full legal custody and allow complete tracking of a sample from preparation and receipt of sample bottle ware to sample collection, preservation, and shipping through laboratory receipt, sample analysis, and data validation. The chain-of-custody is defined as the sequence of persons who have the item in custody. Field custody procedures, sample packing, and shipping are described below. The persons responsible for sample custody, and a brief description of their duties, are as follows:

- **Laboratory Sample Custodian or Commercial Supplier**: Verifies that the bottle ware is certified clean; arranges for bottle ware shipment to field sampling personnel.
- **Field Staff**: Receive sample bottle ware from laboratory, inspect bottle ware for physical integrity; retain shipping invoice or packing list from shipping courier as documentation of transfer of bottle ware; collect and preserve samples; retain bottle ware and samples under custody until sample shipment; relinquish samples to shipping courier or to laboratory representative.
- **Laboratory Project Manager (LPM)**: Verifies reported laboratory analyses to the sample Chain-of-Custody Record; assures that chain-of-custody documentation is incorporated into the project file.

A sample or other physical evidence is in custody if it is or was:

- In the field investigator's, transferee's, or laboratory technician's actual possession.
- In the field investigator's, transferee's, or laboratory technician's view after being in his/her physical possession.
- In the field investigator's, transferee's, or laboratory technician's physical possession and then he/she secured it to prevent tampering.
- Placed in a designated secure area.

4.3.3 Chain-of-Custody Record

The field Chain-of-Custody Record is used to record the custody of samples or other physical evidence collected and maintained. This form will not be used to document the collection of split or duplicate samples. The Chain-of-Custody Record also serves as a sample logging mechanism for the analytical laboratories' sample custodian.

The following information must be supplied in the indicated spaces in detail to complete the field Chain-of-Custody Record:

- Project-specific information, including the project number and project name.
- The signature of the sampler and/or the sampling team leader in the designated signature block.
- The sampling location identification number, date, and time of sample collection, grab or composite sample designation, and sample preservation type must be included on each line (each line should contain only those samples collected at a specific location).
- The total number of sample containers must be listed in the indicated space for each sample, and the total number of individual containers must also be listed for each type of analysis.
- The field investigator and subsequent transferee(s) must document the transfer of the samples listed on the Chain-of-Custody Record in the spaces provided at the bottom of the form. Both the person relinquishing the samples and the person receiving them must sign the form and provide the date and time that this occurred in the proper space on the form. Usually, the last person receiving the samples or evidence should be a laboratory sample custodian.
- The remarks column at the bottom of the form is used to record air bill numbers or registered or certified mail serial numbers.

The Chain-of-Custody Record is a serialized document; once it is completed, it becomes an accountable document and must be maintained in the project file. The suitability of any other form for chain-of-custody should be evaluated based on its inclusion of the above information in a legible format. Examples of Chain-of-Custody Records for each laboratory described in this document are provided as Appendix B.

4.3.4 Sample Packing and Shipping

Samples are packed for shipping in waterproof ice chests and coolers. Depending upon container type, the sample containers may be individually sealed in Ziploc® or other similar plastic bags prior to packing them in the cooler with bubble wrap or Styrofoam packing. Wet ice will be double-bagged in plastic bags (to inhibit cross contamination of samples by melt water) and placed with the samples in the cooler to maintain the samples at a temperature of 0 to less than 6 degrees Celsius (°C) during shipping.

The Chain-of-Custody Record that identifies the samples is signed as "relinquished" by the principal sampler or responsible party. This Chain-of-Custody Record is sealed in a waterproof plastic bag and is placed inside the cooler, typically by taping the bag to the inside lid of the cooler.

Following packing, the cooler lid is sealed with packing tape. Two custody seals are signed, dated, and affixed from the cooler lid to the cooler body on two adjacent sides, and are also covered with clear tape. This ensures that tampering with the cooler contents will be immediately evident.

The sample coolers will be shipped by courier to the laboratory or delivered directly by a project team member in accordance with laboratory schedule requirements. A copy of the shipping invoice is retained by the field manager and becomes part of the sample custody documentation.

4.4 LABORATORY PROCEDURES

The analytical laboratories named in this QAPP have established programs of sample custody that are designed to ensure that each sample is accounted for at all times. The objectives of these sample custody programs include the following:

- Unique identification of the samples, as appropriate for the data required
- Analysis of the correct samples and traceability to the appropriate record
- Preservation of sample characteristics
- Protection of samples from loss or damage
- Documentation of any sample alteration (e.g., filtration, preservation)
- Establishing a record of sample integrity for legal purposes

Procedures for sample custody protocol are maintained by the laboratories and adhered to by laboratory personnel. The sample custody procedures are in the laboratories' SOP libraries and/or QA manuals.

4.4.1 Intra-Laboratory and Sub Laboratory Sample Transfer

The laboratory project manager will ensure that a sample-tracking record is maintained that follows each sample through all stages of laboratory processing. The sample-tracking record must contain, at a minimum, the names of individuals responsible for performing the analysis; the dates of sample extraction, preparation, and analysis; and the type of analysis being performed.

Any sample, homogenate, or sample extract that will need further analysis that is not performed by the initial contracted laboratory and that requires inter- or intra-laboratory transfer will be subject to all specifications described in the previous section. Sample matrices and analyses per specific laboratory, as shown in Table 1 and 4, will not be subcontracted to outside laboratories or transferred to other laboratories within the specific laboratory organization without consultation with the Project Manager and the Project Lab Coordinator.

4.4.2 Archived Samples

All excess sediment samples submitted to the analytical laboratory will be archived at less than -10 °C. The laboratories will maintain chain-of-custody documentation and proper storage conditions for the entire time that the samples are in their possession. All laboratories for this project will store the excess samples for at least six months following completion of data validation. The laboratories will not dispose of the samples for this project until they are authorized to do so by the Project Manager. Holding times for archival preservation will follow EPA-approved QAPPs from the RI (Striplin Environmental Associates [Striplin] 2002, Integral 2004).

4.5 ANALYTICAL METHODS

Solid samples will be extracted, prepared, and analyzed for organic and inorganic parameters by the methods specified in EPA's Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846). Sample analysis methods will follow the laboratory SOPs and the referenced methods. The QC limits for these analyses are shown in Table 1. A list of referenced Laboratory SOPs for these analyses are provided as Appendix A. Analytical methods are generally consistent with EPA-approved QAPPs from the RI (Striplin 2002, Integral 2004) and PDI (AECOM and Geosyntec 2018c), EPA guidance on collecting and manipulating sediment data (EPA 2014), and Puget Sound Estuary Program (PSEP) protocols (PSEP 1996).

4.6 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. Precision reflects the influence of the inherent variability in any measurement system, and accuracy reflects the degree to which the measured value represents the actual or "true" value for a given parameter and includes elements of both bias and precision.

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. Table 6 summarizes the requirements for the collection of QC samples in the field.

4.6.1 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. Table 2 provides a summary of the types and frequency of collection of field QC samples.

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. One field duplicate will be prepared for every 20 environmental samples collected. See Section 4.2.1 for field duplicate sample nomenclature.

Equipment Blanks: Field equipment blanks will be 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. Field equipment blanks will consist of rinseate blanks collected by pouring de-ionized water over or through decontaminated sampling equipment and collected in the appropriate sample containers (1-liter amber glass). Equipment surfaces exposed during actual sampling will be rinsed. These samples will be analyzed along with the field samples. No rinseate blanks will be collected from disposable field equipment. Field equipment rinseate blanks will be generated for all chemical parameter groups, with one equipment blank 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 task-specific FSPs provide more detail on the procedures for generating equipment blanks. See Section 4.2.1 for equipment rinseate blank sample nomenclature. The following is a list of the equipment that will require rinseate blanks:

- VV = Van Veen sampler
- SC = sediment core tube
- SS = spoons and bowls

The results of the analyses of these QC sample types will be used as independent, external checks on laboratory and field contamination as well as the precision of analyses.

4.6.2 Analytical Laboratory Quality Control

The analytical laboratories QC procedures will be consistent with the requirements of the analytical methods and the laboratories SOPs (Appendix A). The LPMs will oversee the activities of all 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 Section 5 for further details). Types and frequencies of analytical QC samples are shown in Table 4.

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 are within proper QC limits. Additional internal QC includes collection and analysis of field and laboratory QC samples, as described in the sections that follow.

4.6.2.1 Method Blanks

Method blanks 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). The purpose of the method blank is to ensure that contaminants are not introduced by the bottle ware, reagents, standards, personnel, or the sample preparation environment.

4.6.2.2 Matrix Spikes and Matrix Spike Duplicates

MS/MSD duplicate pairs provide information to assess precision and accuracy. The MS is a second, extra aliquot 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 is calculated. Results are expressed as %R. The MS is used to evaluate the effect of the sample matrix on the accuracy of the analysis. The MSD is a third, extra aliquot of an environmental sample that is also spiked with the same known concentrations of analytes used for the MS. The two spiked aliquots are processed separately, and the results are compared to determine the effects of the matrix on the precision and accuracy of the analysis. Results are expressed as RPD and %R.

One MS/MSD set will be analyzed for every 20 investigative samples as applicable to the method. The MS/MSD will be site-specific and field personnel will therefore be responsible for collecting additional sample volumes to account for the MS/MSD samples.

4.6.2.3 Laboratory Control Sample

LCS 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. LCS are fortified with spike standard solutions containing target parameters of interest. The recovery of these standards is quantitatively measured during analysis, and historical records are maintained on the percent recovery for each sample.

4.6.2.4 Surrogate Spikes

Surrogate spike analyses provide information on a laboratory’s ability to recover the analytes of interest. The surrogate spike is carried through the entire analytical procedure, and the recoveries of the surrogate spikes are calculated. Results are expressed as percent recovery for each sample. Surrogates are added to samples based on the specifications of the individual analytical method.

4.6.2.5 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.

4.7 INSTRUMENT/EQUIPMENT QUALITY CONTROL

4.7.1 Laboratory Instrument/Equipment Quality Control

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 and 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. All maintenance of instruments and procedures will be documented in maintenance log/record books. Each of the laboratories has SOPs for preventive maintenance that are contained in their individual QA manuals.

4.7.2 Field Equipment Quality Control

Field equipment requiring calibration, maintenance, inspection, and decontamination will be conducted in accordance with the project-specific FSPs, SOPs, and manufacturers' instructions.

4.8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Sample container requirements are shown in Table 4. Other supplies include, but are not limited to, DI water, chemicals for decontamination, sample collection equipment, and personal protective equipment. All will be obtained from reputable suppliers with appropriate documentation or certification. Supplies will be inspected to confirm that they meet use requirements, and certification records will be kept in project files.

4.9 DATA MANAGEMENT

Documentation and data management are critical steps in maintaining quality during the Head of SIL Sediment FSP activities. Documentation and data management begin with the development of appropriate field forms prior to field mobilization, continue with appropriate recordkeeping in the field and adequate analytical documentation and reporting, and conclude with thorough records management and database population after the work has been completed.

4.9.1 Field Logbooks and Forms

The following data management procedures will be performed in the field:

- All samples will be given a unique identifier (Sections 3.1.2 and 3.2.2 of the Head of SIL Sediment FSP) (PGG 2018).

- All samples will be collected and transported under chain-of-custody control (Section 4.6 of the Head of SIL Sediment FSP) (PGG 2018).
- Deviations from the Head of SIL Sediment FSP are clearly recorded in logbooks.
- Field logbooks and data sheets will be maintained (Section 4.7 of the Head of SIL Sediment FSP) (PGG 2018).
- Field QA/QC samples will be collected according to this QAPP.

Field visits and sample collection programs are documented using a combination of field logbooks and specific field log forms.

A logbook will be used to document a summary of the day's activities and non-repetitive tasks, including the following:

- Time of arrival and departure from the Site, including lunch breaks
- Names of field team members
- Time of arrival and departure of subcontractors
- The nature of the daily health and safety tailgate meeting
- Instrument calibration
- Supply deliveries
- Weather
- Interaction with agency or client personnel
- Incident occurrence and management
- Any other irregular or ad hoc activities

As such, the logbook(s) will provide a comprehensive overview of all site activities throughout the Head of SIL Sediment Sampling. The level of detail of the documentation within each logbook entry will depend upon the duration of an individual visit and the applicability of field forms to the tasks performed.

4.9.2 Electronic Data Management

The project database will be the single master data repository for all locations, samples, analytical chemistry results, field measurements and other content in a tabular format. The project database will store data in a format where field names and valid values are compatible with a variety of formats such as the PHSS RI Database, PDI's EQuIS data model, and EPA's Scribe.NET schema. Laboratories will provide all 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 QAPP by a third-party data validator. Ecochem, Inc. will perform the data validation for this project.

Following data validation, all data, supplementary information, and validator qualifiers will be compiled into a database for the project.

4.9.3 Geospatial standards

Project geospatial standards will be consistent with the PDI Data Quality Management Plan (DQMP) (AECOM and Geosyntec, 2018d). This includes geodetic standards for vertical datum, horizontal datum, and coordinate system and projection.

5.0 DATA QUALITY ASSESSMENT

Assessments or evaluations are designed to determine whether the QAPP is being implemented as approved, to increase confidence in the information obtained, and ultimately to determine whether the information may be used for their intended purpose.

5.1.1 Corrective Action for Measurement Systems

When a problem situation arises regarding any significant impediment to the progress of the project, corrective action will be implemented to identify the problem and its source. Appropriate documentation of this action will be recorded in the project file.

Personnel responsible for the initiation and approval of a corrective action will be the laboratory QA manager (for a corrective action at the laboratory) and the Project Manager (for corrective actions identified during field activities and/or during the data validation effort). The Project Manager will be responsible for the approval of corrective action measures.

5.1.1.1 Laboratory Corrective Action and Response

When the analysis of any sample indicates the analytical system may be out of control, the laboratory will stop analysis until the source of the problem is identified and corrected. The laboratory manager is also notified, and the corrective action is approved and implemented. This corrective action may include, but is not limited to, the following:

- Removal of an instrument from service
- Isolation and correction of the source of the problem
- Reanalysis of the failing QC sample

To minimize the chances for an out-of-control situation to occur, the laboratory manager will be provided feedback on performance evaluations in a timely manner by analysts, group supervisors, and the laboratory QA manager.

5.1.1.2 Field Measurement Corrective Action and Response

Technical staff and project personnel will be responsible for reporting suspected technical or QA nonconformances or suspected deficiencies of any activity or issued document by reporting the situation to the Field Coordinator. This supervisor will be responsible for assessing the suspected problems in consultation with the Project Manager and for making a decision based on the potential for the situation to impact the quality of the data. If it is determined that the situation indicates a reportable nonconformance requiring corrective action, a nonconformance report will be initiated by the field manager.

The Field Coordinator will be responsible for ensuring that corrective action for nonconformances is initiated by:

- Evaluating reported nonconformances
- Controlling additional work on nonconforming items
- Determining the disposition or action to be taken
- Maintaining a log of nonconformances
- Reviewing nonconformance reports and corrective actions taken
- Ensuring nonconformance reports are included in the final Site documentation in project files

If appropriate, the Field Coordinator will ensure that no additional work that is dependent on the nonconforming activity is performed until the corrective actions are completed.

Corrective actions for field measurements may include the following:

- Repeating measurements to check the error
- Checking for proper adjustments for ambient conditions such as temperature
- Checking the batteries
- Recalibrating
- Checking the calibration
- Replacing the instrument measuring devices
- Stopping work (if necessary)

The Field Coordinator or his/her designee is responsible for Site activities. In this role, the Field Coordinator at times is required to adjust the Site programs to accommodate site-specific needs. When it becomes necessary to modify a program, the responsible person notifies the Field Coordinator of the anticipated change and implements the necessary changes after obtaining the approval of the Field Coordinator.

Corrective actions will be implemented and documented in the field logbook. No staff member will initiate a corrective action without prior communication of findings through the Field Coordinator.

5.2 QUALITY ASSURANCE REPORTING PROCEDURES

This section presents the QA reporting procedures that will be implemented for this project.

5.2.1 Reporting Responsibility and Recordkeeping

Comprehensive records will be maintained by PGG to provide evidence of QA activities.

These records will include the following documentation:

- Results of performance and systems audits
- Data validation summary reports
- Significant QA problems and proposed corrective actions

- Changes to this QAPP

The proper maintenance of QA records is essential to provide support in any evidentiary proceedings. The original QA records will be kept in the Project Manager's records.

6.0 DATA VALIDATION AND USABILITY

This section describes the stages of data quality assessment after data have been received. It addresses data reduction, review, verification, and validation. It also discusses the procedures for evaluating the usability of data with respect to the DQOs set forth in Section 3.

6.1 DATA REDUCTION

Raw analytical data generated in the laboratory are collected on printouts from the instruments and associated data system or are manually recorded in bound notebooks. Analysts review data as they are generated to determine that the instruments are performing within specifications. This review includes calibration checks, surrogate recoveries, blank checks, retention time reproducibility, and other QC checks as specified in the SOPs and applicable to the method. If any problems are noted during the analytical run, corrective action is taken and documented.

6.2 DATA REVIEW

Data review is an initial and relatively non-technical step of data assessment that primarily addresses issues of completeness and data handling integrity. In data review, the reviewer will ensure that the necessary reporting components have been included in laboratory reports, such as necessary fields (e.g., collection/analysis dates, units) as well as the presence of (but not implications of) QA/QC data components (e.g., LCS records, surrogate results).

6.3 DATA VERIFICATION AND VALIDATION

Data verification is a more technical process than data review in that the core technical aspects of data quality (e.g., precision, accuracy) are evaluated through a review of the results of QA/QC measures, such as LCS and surrogates.

Following interpretation and data reduction by an analyst, data are transferred to the laboratory sample management system either by direct data upload from the analytical data system or manually. The data are reviewed by the group leader or another analyst and marked on the sample management system as being verified. The person performing the verification reviews the data, including QC information, prior to verifying the data. If data package deliverables have been requested, the laboratory will complete the appropriate forms summarizing the QC information and transfer copies of the raw data (e.g., instrument printouts, spectra, chromatograms) to the Data Packages Group. This group will combine the information from the various analytical groups and the analytical reports from the laboratory sample management system into one package. This package is reviewed by the LPM for conformance with SOPs and to ensure that project QC goals have been met. Any analytical problems are discussed in the case narrative, which is also included with the data package deliverables.

Following data verification by the laboratory, data validation will be conducted.

A full validation as described for EPA Stage 4 validation (review of raw data and calculation checks) will be conducted on 10% of the data per analytical test and per matrix where instrument outputs are generated as part of the analysis (e.g., HRMS, GC, ICPMS, etc.). For those analyses where instrument outputs are not generally part of the procedure but where data are recorded for purposes of calculation or data reduction to a final result (e.g., total solids, grain size), 10% of the data per analytical test and per matrix will be validated as described under EPA Stage 3 by the project data validation team. EPA Stage 2A data validation (review of summary forms presented for applicable method QA/QC parameters) will be conducted on 90% of the laboratory data by the project data validation team. The project data validation team is considered independent since the members of the team are not affiliated with the analytical laboratories, the sampling effort, or to the data user (EPA 2002b). If during the EPA Stage 2A data validation, systematic data quality issues are identified with the analytical data, the laboratory will be contacted, and the data will be validated at an EPA Stage 4 level until the data quality issues are resolved.

Validation may be done on hard-copy data with the assistance of an automated validation screening program performed electronically, if applicable and/or available. Data will be evaluated based on the method requirements, work plan requirements, and current laboratory criteria at the time samples were submitted to the laboratory. If there are QC results outside of criteria range or method requirements, the affected data may be qualified based on the potential effect of the out of compliance item on the data quality. Qualifiers will be assigned using professional and technical judgement of qualified validation personnel and guidance for assigning data qualifiers outlined in the EPA documents National Functional Guidelines for Organic Superfund Methods Data Review (EPA 2017c), January 2017; National Functional Guidelines for Inorganic Superfund Methods Data Review (EPA 2017d), January 2017; and National Functional Guidelines for High Resolution Superfund Methods Data Review (EPA 2016c). Region 10 EPA validation guidance may also be utilized if a validation element is not covered in National Functional Guidelines and is available in the regional guidance.

6.3.1 Data Validation and Usability Determination

While data verification is a technical process in which the data's adherence to core PARCCS elements is evaluated, it still does not answer the final question of the usability of the data and the implications of any departures from data expectations. The data validation process is designed to answer these questions through: 1) the assignment of data qualifiers based on the data verification results; and 2) a case-by-case review of data quality issues with respect to QAPP objectives to render a final assessment of data usability.

The final step of data evaluation entails a comparison of data quality performance with the QAPP-specific DQOs. Validation of the analytical data is the process of determining that the data support the task-specific DQOs. Validation is performed by the independent validator as well as the project team, as data usability is also determined once put into context of the entire data set.

6.4 DATA EVALUATION ROLES AND RESPONSIBILITIES

The components of data evaluation will be performed by the entities noted in the following list:

- Data reduction will be performed by the analytical laboratory.
- Data review will be performed both by the laboratory and by the data validator.
- Data verification will be performed both by the laboratory and by the data validator.
- Data validation and usability determination will be performed by the data validator and the project team.

6.5 DATA REPORTING

Laboratory reports will contain an EPA Level 2 Data Package and an EPA Level 4 Data Package.

6.5.1 EPA Level 2 Data Package

- Case Narrative: Description of sample types, tests performed, any problems encountered, corrective actions taken, and general comments are given.
- Analytical Data: Data are reported by sample or by test. Pertinent information (such as dates sampled, received, prepared, or extracted) is included on each results page. The PQL and MDL for each analyte are also provided. In addition to a hard-copy report or PDF copy of the report, laboratories will provide an electronic data deliverable (EDD) in a text format corresponding to each analytical report.
- Laboratory Performance QC Information: The results of the LCS and surrogate recoveries (as applicable) analyzed with the data set are listed, together with the control limits. Also, the analytical results for method blanks generated during analysis of organic and inorganic parameters are reported.
- Laboratory Duplicate Data: Laboratory duplicate results together with RPD control limits are reported.
- Matrix-Specific QC Information: The results of any field sample duplicates, MSs, and MSDs that are requested, along with the specific laboratory acceptance criteria, are reported.
- Methodology: The reference for the applied analytical method (or methods) is cited.
- Email Communications: Email communications between the laboratory and consultant team that provide additional instructions or corrections to the laboratory are included.
- Chain-of-Custody: Chain-of-custody documentation and sample receiving documentation are included.

6.5.2 EPA Level 4 Data Package

An EPA Level 4 Data Package includes all the elements listed above for the EPA Level 2 package, but also includes the following:

- All the pertinent standards information and traceability and standard logbook information for individual standard solutions
- All the pertinent calibration data and continuing calibration data, including tune information
- All the raw data chromatograms and instrument printouts for the sample results and calibration data
- Internal standard area and retention time summaries
- Ion abundance ratio summaries for high resolution mass spectroscopy analyses
- All the pertinent sample preparation information
- Preparation batch and analytical batch associations
- Before and after manual integration chromatograms
- Run logs for all analyses
- Any correspondence that occurred between the laboratory and the client regarding sample issues

6.6 DATA SUMMATION RULES

Analyte summations and carbon normalization will be calculated following the rules defined in the Portland Harbor Remedial Investigation/Feasibility Study (RI/FS), Appendix A (EPA 2016), or as updated in the PDI QAPP, Summation Rule Document (pending EPA approval). The calculated values will be stored as separate analyte concentrations in the project database. Deviations from this approach that may result from data review and analysis will be fully documented and reported in any project deliverables or data exports.

All field duplicates, lab replicates, and parent samples will be loaded, clearly linked, and stored in the project database. Exports will clearly discriminate parent from duplicate and replicate samples; calculations related to these samples may use maximum value, average, or include all sample values.

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Table 1. Analyte List, Cleanup Levels and Analytical Quantitation Limits

PARCCS:	Comparability			Sensitivity					Accuracy and Precision			
									MS/MSD		LCS/LCSD	
Parameter	CAS Number	Laboratory	Method	ROD Cleanup Levels [1]	Project Quantitation Limits [2]	Achievable Laboratory MDLs [2]	Laboratory EDLs	Units	Percent Recovery (%)	RPD (%)	Percent Recovery (%)	RPD (%)
Dioxins/Furans [3]												
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	1746-01-6	TA Sacramento	EPA 1613B	0.20	1	0.15	0.028	pg/g	-- — --	--	67 — 158	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	40321-76-4	TA Sacramento	EPA 1613B	0.20	5	0.300	0.030	pg/g	-- — --	--	70 — 142	--
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	57117-31-4	TA Sacramento	EPA 1613B	0.30	5	0.29	0.019	pg/g	-- — --	--	68 — 160	--
Grain Size												
Clay	STL00587	TA Seattle	ASTM D7928 and D6913	NA	0.010	NA		%	-- — --	--	-- — --	--
Silt	STL00586	TA Seattle	ASTM D7928 and D6913	NA	0.010	NA		%	-- — --	--	-- — --	--
Fine Sand	STL00585	TA Seattle	ASTM D7928 and D6913	NA	0.010	NA		%	-- — --	--	-- — --	--
Medium Sand	STL00584	TA Seattle	ASTM D7928 and D6913	NA	0.010	NA		%	-- — --	--	-- — --	--
Coarse Sand	STL00583	TA Seattle	ASTM D7928 and D6913	NA	0.010	NA		%	-- — --	--	-- — --	--
Gravel	STL00581	TA Seattle	ASTM D7928 and D6913	NA	0.010	NA		%	-- — --	--	-- — --	--
PAHs												
PAHs	NA	ALS Kelso	EPA 8270D-SIM	23000	NA	NA		µg/kg	-- — --	--	-- — --	--
cPAHs (BaP equivalent)	NA	ALS Kelso	EPA 8270D-SIM	12	NA	NA		µg/kg	-- — --	--	-- — --	--
Acenaphthene	83-32-9	ALS Kelso	EPA 8270D-SIM	NA	0.5	0.032		µg/kg	51 — 82	40	70 — 130	40
Acenaphthylene	208-96-8	ALS Kelso	EPA 8270D-SIM	NA	0.5	0.029		µg/kg	51 — 80	40	70 — 130	40
Anthracene	120-12-7	ALS Kelso	EPA 8270D-SIM	NA	0.5	0.026		µg/kg	56 — 87	40	70 — 130	40
Benzo(a)anthracene	56-55-3	ALS Kelso	EPA 8270D-SIM	NA	0.5	0.033		µg/kg	65 — 97	40	70 — 130	40
Benzo(a)pyrene	50-32-8	ALS Kelso	EPA 8270D-SIM	NA	0.5	0.036		µg/kg	64 — 103	40	70 — 130	40
Benzo(b)fluoranthene	205-99-2	ALS Kelso	EPA 8270D-SIM	NA	0.5	0.057		µg/kg	63 — 99	40	70 — 130	40
Benzo(g,h,i)perylene	191-24-2	ALS Kelso	EPA 8270D-SIM	NA	0.5	0.059		µg/kg	56 — 101	40	70 — 130	40
Benzo(k)fluoranthene	207-08-9	ALS Kelso	EPA 8270D-SIM	NA	0.5	0.045		µg/kg	62 — 99	40	70 — 130	40
Chrysene	218-01-9	ALS Kelso	EPA 8270D-SIM	NA	0.5	0.027		µg/kg	63 — 100	40	70 — 130	40
Dibenz(a,h)anthracene	53-70-3	ALS Kelso	EPA 8270D-SIM	NA	0.5	0.058		µg/kg	56 — 104	40	70 — 130	40
Fluoranthene	206-44-0	ALS Kelso	EPA 8270D-SIM	NA	0.5	0.032		µg/kg	45 — 96	40	70 — 130	40
Fluorene	86-73-7	ALS Kelso	EPA 8270D-SIM	NA	0.5	0.039		µg/kg	52 — 83	40	70 — 130	40
Indeno(1,2,3-cd)pyrene	193-39-5	ALS Kelso	EPA 8270D-SIM	NA	0.5	0.064		µg/kg	61 — 105	40	70 — 130	40
2-Methylnaphthalene	91-57-6	ALS Kelso	EPA 8270D-SIM	NA	0.5	0.047		µg/kg	52 — 85	40	70 — 130	40
Naphthalene	91-20-3	ALS Kelso	EPA 8270D-SIM	NA	0.5	0.089		µg/kg	48 — 77	40	70 — 130	40
Phenanthrene	85-01-8	ALS Kelso	EPA 8270D-SIM	NA	0.5	0.033		µg/kg	48 — 85	40	70 — 130	40
Pyrene	129-00-0	ALS Kelso	EPA 8270D-SIM	NA	0.5	0.032		µg/kg	59 — 98	40	70 — 130	40
PCB Congeners [3]												
Total PCBs	--	TA Knoxville	EPA 1668A	9	NA	NA		ng/g	-- — --	--	-- — --	--
PCB 1	2051-60-7	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	50 — 150	50	50 — 150	50
PCB 2	2051-61-8	TA Knoxville	EPA 1668A	NA	0.010	0.0023		ng/g	-- — --	--	-- — --	--
PCB 3	2051-62-9	TA Knoxville	EPA 1668A	NA	0.010	0.0021		ng/g	50 — 150	50	50 — 150	50
PCB 4	13029-08-8	TA Knoxville	EPA 1668A	NA	0.020	0.0035		ng/g	50 — 150	50	50 — 150	50
PCB 5	16605-91-7	TA Knoxville	EPA 1668A	NA	0.010	0.0026		ng/g	-- — --	--	-- — --	--
PCB 6	25569-80-6	TA Knoxville	EPA 1668A	NA	0.010	0.0022		ng/g	-- — --	--	-- — --	--
PCB 7	33284-50-3	TA Knoxville	EPA 1668A	NA	0.010	0.0038		ng/g	-- — --	--	-- — --	--
PCB 8	34883-43-7	TA Knoxville	EPA 1668A	NA	0.020	0.0020		ng/g	-- — --	--	-- — --	--
PCB 9	34883-39-1	TA Knoxville	EPA 1668A	NA	0.010	0.0037		ng/g	-- — --	--	-- — --	--
PCB 10	33146-45-1	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 11	2050-67-1	TA Knoxville	EPA 1668A	NA	0.020	0.0090		ng/g	-- — --	--	-- — --	--
PCB 12	2974-92-7	TA Knoxville	EPA 1668A	NA	0.020	0.012		ng/g	-- — --	--	-- — --	--
PCB 13	2974-90-5	TA Knoxville	EPA 1668A	NA	0.020	0.012		ng/g	-- — --	--	-- — --	--
PCB 14	34883-41-5	TA Knoxville	EPA 1668A	NA	0.010	0.0035		ng/g	-- — --	--	-- — --	--
PCB 15	2050-68-2	TA Knoxville	EPA 1668A	NA	0.010	0.0048		ng/g	50 — 150	50	50 — 150	50
PCB 16	38444-78-9	TA Knoxville	EPA 1668A	NA	0.010	0.0072		ng/g	-- — --	--	-- — --	--

Table 1. Analyte List, Cleanup Levels and Analytical Quantitation Limits

PARCCS:	Comparability			Sensitivity					Accuracy and Precision			
									MS/MSD		LCS/LCSD	
Parameter	CAS Number	Laboratory	Method	ROD Cleanup Levels [1]	Project Quantitation Limits [2]	Achievable Laboratory MDLs [2]	Laboratory EDLs	Units	Percent Recovery (%)	RPD (%)	Percent Recovery (%)	RPD (%)
PCB 17	37680-66-3	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 18	37680-65-2	TA Knoxville	EPA 1668A	NA	0.020	0.014		ng/g	-- — --	--	-- — --	--
PCB 19	38444-73-4	TA Knoxville	EPA 1668A	NA	0.010	0.0021		ng/g	50 — 150	50	50 — 150	50
PCB 20	38444-84-7	TA Knoxville	EPA 1668A	NA	0.020	0.0056		ng/g	-- — --	--	-- — --	--
PCB 21	55702-46-0	TA Knoxville	EPA 1668A	NA	0.020	0.0066		ng/g	-- — --	--	-- — --	--
PCB 22	38444-85-8	TA Knoxville	EPA 1668A	NA	0.010	0.0023		ng/g	-- — --	--	-- — --	--
PCB 23	55720-44-0	TA Knoxville	EPA 1668A	NA	0.010	0.0021		ng/g	-- — --	--	-- — --	--
PCB 24	55702-45-9	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 25	55712-37-3	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 26	38444-81-4	TA Knoxville	EPA 1668A	NA	0.020	0.0046		ng/g	-- — --	--	-- — --	--
PCB 27	38444-76-7	TA Knoxville	EPA 1668A	NA	0.010	0.0021		ng/g	-- — --	--	-- — --	--
PCB 28	7012-37-5	TA Knoxville	EPA 1668A	NA	0.020	0.0056		ng/g	-- — --	--	-- — --	--
PCB 29	15862-07-4	TA Knoxville	EPA 1668A	NA	0.020	0.0046		ng/g	-- — --	--	-- — --	--
PCB 30	35693-92-6	TA Knoxville	EPA 1668A	NA	0.020	0.014		ng/g	-- — --	--	-- — --	--
PCB 31	16606-02-3	TA Knoxville	EPA 1668A	NA	0.020	0.0022		ng/g	-- — --	--	-- — --	--
PCB 32	38444-77-8	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 33	38444-86-9	TA Knoxville	EPA 1668A	NA	0.020	0.0066		ng/g	-- — --	--	-- — --	--
PCB 34	37680-68-5	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 35	37680-69-6	TA Knoxville	EPA 1668A	NA	0.010	0.0027		ng/g	-- — --	--	-- — --	--
PCB 36	38444-87-0	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 37	38444-90-5	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	50 — 150	50	50 — 150	50
PCB 38	53555-66-1	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 39	38444-88-1	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 40	38444-93-8	TA Knoxville	EPA 1668A	NA	0.030	0.013		ng/g	-- — --	--	-- — --	--
PCB 41	52663-59-9	TA Knoxville	EPA 1668A	NA	0.030	0.013		ng/g	-- — --	--	-- — --	--
PCB 42	36559-22-5	TA Knoxville	EPA 1668A	NA	0.010	0.0033		ng/g	-- — --	--	-- — --	--
PCB 43	70362-46-8	TA Knoxville	EPA 1668A	NA	0.020	0.0048		ng/g	-- — --	--	-- — --	--
PCB 44	41464-39-5	TA Knoxville	EPA 1668A	NA	0.030	0.015		ng/g	-- — --	--	-- — --	--
PCB 45	70362-45-7	TA Knoxville	EPA 1668A	NA	0.020	0.010		ng/g	-- — --	--	-- — --	--
PCB 46	41464-47-5	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 47	2437-79-8	TA Knoxville	EPA 1668A	NA	0.030	0.015		ng/g	-- — --	--	-- — --	--
PCB 48	70362-47-9	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 49	41464-40-8	TA Knoxville	EPA 1668A	NA	0.020	0.0054		ng/g	-- — --	--	-- — --	--
PCB 50	62796-65-0	TA Knoxville	EPA 1668A	NA	0.020	0.0060		ng/g	-- — --	--	-- — --	--
PCB 51	68194-04-7	TA Knoxville	EPA 1668A	NA	0.020	0.010		ng/g	-- — --	--	-- — --	--
PCB 52	35693-99-3	TA Knoxville	EPA 1668A	NA	0.010	0.0029		ng/g	-- — --	--	-- — --	--
PCB 53	41464-41-9	TA Knoxville	EPA 1668A	NA	0.020	0.0060		ng/g	-- — --	--	-- — --	--
PCB 54	15968-05-5	TA Knoxville	EPA 1668A	NA	0.010	0.0023		ng/g	50 — 150	50	50 — 150	50
PCB 55	74338-24-2	TA Knoxville	EPA 1668A	NA	0.010	0.0026		ng/g	-- — --	--	-- — --	--
PCB 56	41464-43-1	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 57	70424-67-8	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 58	41464-49-7	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 59	74472-33-6	TA Knoxville	EPA 1668A	NA	0.030	0.016		ng/g	-- — --	--	-- — --	--
PCB 60	33025-41-1	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 61	33284-53-6	TA Knoxville	EPA 1668A	NA	0.040	0.011		ng/g	-- — --	--	-- — --	--
PCB 62	54230-22-7	TA Knoxville	EPA 1668A	NA	0.030	0.016		ng/g	-- — --	--	-- — --	--
PCB 63	74472-34-7	TA Knoxville	EPA 1668A	NA	0.010	0.0027		ng/g	-- — --	--	-- — --	--
PCB 64	52663-58-8	TA Knoxville	EPA 1668A	NA	0.010	0.0027		ng/g	-- — --	--	-- — --	--
PCB 65	33284-54-7	TA Knoxville	EPA 1668A	NA	0.030	0.015		ng/g	-- — --	--	-- — --	--
PCB 66	32598-10-0	TA Knoxville	EPA 1668A	NA	0.010	0.0024		ng/g	-- — --	--	-- — --	--

Table 1. Analyte List, Cleanup Levels and Analytical Quantitation Limits

PARCCS:	Comparability			Sensitivity					Accuracy and Precision			
									MS/MSD		LCS/LCSD	
Parameter	CAS Number	Laboratory	Method	ROD Cleanup Levels [1]	Project Quantitation Limits [2]	Achievable Laboratory MDLs [2]	Laboratory EDLs	Units	Percent Recovery (%)	RPD (%)	Percent Recovery (%)	RPD (%)
PCB 67	73575-53-8	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 68	73575-52-7	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 69	60233-24-1	TA Knoxville	EPA 1668A	NA	0.020	0.0054		ng/g	-- — --	--	-- — --	--
PCB 70	32598-11-1	TA Knoxville	EPA 1668A	NA	0.040	0.011		ng/g	-- — --	--	-- — --	--
PCB 71	41464-46-4	TA Knoxville	EPA 1668A	NA	0.030	0.013		ng/g	-- — --	--	-- — --	--
PCB 72	41464-42-0	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 73	74338-23-1	TA Knoxville	EPA 1668A	NA	0.020	0.0048		ng/g	-- — --	--	-- — --	--
PCB 74	32690-93-0	TA Knoxville	EPA 1668A	NA	0.040	0.011		ng/g	-- — --	--	-- — --	--
PCB 75	32598-12-2	TA Knoxville	EPA 1668A	NA	0.030	0.016		ng/g	-- — --	--	-- — --	--
PCB 76	70362-48-0	TA Knoxville	EPA 1668A	NA	0.040	0.011		ng/g	-- — --	--	-- — --	--
PCB 77	32598-13-3	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	50 — 150	50	50 — 150	50
PCB 78	70362-49-1	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 79	41464-48-6	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 80	33284-52-5	TA Knoxville	EPA 1668A	NA	0.010	0.0022		ng/g	-- — --	--	-- — --	--
PCB 81	70362-50-4	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	50 — 150	50	50 — 150	50
PCB 82	52663-62-4	TA Knoxville	EPA 1668A	NA	0.010	0.0029		ng/g	-- — --	--	-- — --	--
PCB 83	60145-20-2	TA Knoxville	EPA 1668A	NA	0.020	0.0054		ng/g	-- — --	--	-- — --	--
PCB 84	52663-60-2	TA Knoxville	EPA 1668A	NA	0.010	0.0042		ng/g	-- — --	--	-- — --	--
PCB 85	65510-45-4	TA Knoxville	EPA 1668A	NA	0.030	0.012		ng/g	-- — --	--	-- — --	--
PCB 86	55312-69-1	TA Knoxville	EPA 1668A	NA	0.060	0.046		ng/g	-- — --	--	-- — --	--
PCB 87	38380-02-8	TA Knoxville	EPA 1668A	NA	0.060	0.046		ng/g	-- — --	--	-- — --	--
PCB 88	55215-17-3	TA Knoxville	EPA 1668A	NA	0.020	0.0064		ng/g	-- — --	--	-- — --	--
PCB 89	73575-57-2	TA Knoxville	EPA 1668A	NA	0.010	0.0030		ng/g	-- — --	--	-- — --	--
PCB 90	68194-07-0	TA Knoxville	EPA 1668A	NA	0.030	0.014		ng/g	-- — --	--	-- — --	--
PCB 91	68194-05-8	TA Knoxville	EPA 1668A	NA	0.020	0.0064		ng/g	-- — --	--	-- — --	--
PCB 92	52663-61-3	TA Knoxville	EPA 1668A	NA	0.010	0.0028		ng/g	-- — --	--	-- — --	--
PCB 93	73575-56-1	TA Knoxville	EPA 1668A	NA	0.020	0.0070		ng/g	-- — --	--	-- — --	--
PCB 94	73575-55-0	TA Knoxville	EPA 1668A	NA	0.010	0.0035		ng/g	-- — --	--	-- — --	--
PCB 95	38379-99-6	TA Knoxville	EPA 1668A	NA	0.010	0.0042		ng/g	-- — --	--	-- — --	--
PCB 96	73575-54-9	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 97	41464-51-1	TA Knoxville	EPA 1668A	NA	0.060	0.046		ng/g	-- — --	--	-- — --	--
PCB 98	60233-25-2	TA Knoxville	EPA 1668A	NA	0.020	0.0064		ng/g	-- — --	--	-- — --	--
PCB 99	38380-01-7	TA Knoxville	EPA 1668A	NA	0.020	0.0054		ng/g	-- — --	--	-- — --	--
PCB 100	39485-83-1	TA Knoxville	EPA 1668A	NA	0.020	0.0070		ng/g	-- — --	--	-- — --	--
PCB 101	37680-73-2	TA Knoxville	EPA 1668A	NA	0.030	0.014		ng/g	-- — --	--	-- — --	--
PCB 102	68194-06-9	TA Knoxville	EPA 1668A	NA	0.020	0.0064		ng/g	-- — --	--	-- — --	--
PCB 103	60145-21-3	TA Knoxville	EPA 1668A	NA	0.010	0.0031		ng/g	-- — --	--	-- — --	--
PCB 104	56558-16-8	TA Knoxville	EPA 1668A	NA	0.010	0.0021		ng/g	50 — 150	50	50 — 150	50
PCB 105	32598-14-4	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	50 — 150	50	50 — 150	50
PCB 106	70424-69-0	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 107	70424-68-9	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 108	70362-41-3	TA Knoxville	EPA 1668A	NA	0.020	0.0040		ng/g	-- — --	--	-- — --	--
PCB 109	74472-35-8	TA Knoxville	EPA 1668A	NA	0.060	0.046		ng/g	-- — --	--	-- — --	--
PCB 110	38380-03-9	TA Knoxville	EPA 1668A	NA	0.020	0.007		ng/g	-- — --	--	-- — --	--
PCB 111	39635-32-0	TA Knoxville	EPA 1668A	NA	0.010	0.002		ng/g	-- — --	--	-- — --	--
PCB 112	74472-36-9	TA Knoxville	EPA 1668A	NA	0.010	0.004		ng/g	-- — --	--	-- — --	--
PCB 113	68194-10-5	TA Knoxville	EPA 1668A	NA	0.030	0.014		ng/g	-- — --	--	-- — --	--
PCB 114	74472-37-0	TA Knoxville	EPA 1668A	NA	0.010	0.003		ng/g	50 — 150	50	50 — 150	50
PCB 115	74472-38-1	TA Knoxville	EPA 1668A	NA	0.020	0.007		ng/g	-- — --	--	-- — --	--
PCB 116	18259-05-7	TA Knoxville	EPA 1668A	NA	0.030	0.012		ng/g	-- — --	--	-- — --	--

Table 1. Analyte List, Cleanup Levels and Analytical Quantitation Limits

PARCCS:	Comparability			Sensitivity					Accuracy and Precision							
									MS/MSD				LCS/LCSD			
Parameter	CAS Number	Laboratory	Method	ROD Cleanup Levels [1]	Project Quantitation Limits [2]	Achievable Laboratory MDLs [2]	Laboratory EDLs	Units	Percent Recovery (%)			RPD (%)	Percent Recovery (%)			RPD (%)
PCB 117	68194-11-6	TA Knoxville	EPA 1668A	NA	0.030	0.012		ng/g	--	—	--	--	--	—	--	--
PCB 118	31508-00-6	TA Knoxville	EPA 1668A	NA	0.010	0.0022		ng/g	50	—	150	50	50	—	150	50
PCB 119	56558-17-9	TA Knoxville	EPA 1668A	NA	0.060	0.046		ng/g	--	—	--	--	--	—	--	--
PCB 120	68194-12-7	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	--	—	--	--	--	—	--	--
PCB 121	56558-18-0	TA Knoxville	EPA 1668A	NA	0.010	0.0023		ng/g	--	—	--	--	--	—	--	--
PCB 122	76842-07-4	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	--	—	--	--	--	—	--	--
PCB 123	65510-44-3	TA Knoxville	EPA 1668A	NA	0.010	0.0024		ng/g	50	—	150	50	50	—	150	50
PCB 124	70424-70-3	TA Knoxville	EPA 1668A	NA	0.020	0.0040		ng/g	--	—	--	--	--	—	--	--
PCB 125	74472-39-2	TA Knoxville	EPA 1668A	NA	0.060	0.046		ng/g	--	—	--	--	--	—	--	--
PCB 126	57465-28-8	TA Knoxville	EPA 1668A	NA	0.010	0.0027		ng/g	50	—	150	50	50	—	150	50
PCB 127	39635-33-1	TA Knoxville	EPA 1668A	NA	0.010	0.0023		ng/g	--	—	--	--	--	—	--	--
PCB 128	38380-07-3	TA Knoxville	EPA 1668A	NA	0.020	0.010		ng/g	--	—	--	--	--	—	--	--
PCB 129	55215-18-4	TA Knoxville	EPA 1668A	NA	0.040	0.023		ng/g	--	—	--	--	--	—	--	--
PCB 130	52663-66-8	TA Knoxville	EPA 1668A	NA	0.010	0.0023		ng/g	--	—	--	--	--	—	--	--
PCB 131	61798-70-7	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	--	—	--	--	--	—	--	--
PCB 132	38380-05-1	TA Knoxville	EPA 1668A	NA	0.010	0.0024		ng/g	--	—	--	--	--	—	--	--
PCB 133	35694-04-3	TA Knoxville	EPA 1668A	NA	0.010	0.0030		ng/g	--	—	--	--	--	—	--	--
PCB 134	52704-70-8	TA Knoxville	EPA 1668A	NA	0.020	0.0086		ng/g	--	—	--	--	--	—	--	--
PCB 135	52744-13-5	TA Knoxville	EPA 1668A	NA	0.020	0.0074		ng/g	--	—	--	--	--	—	--	--
PCB 136	38411-22-2	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	--	—	--	--	--	—	--	--
PCB 137	35694-06-5	TA Knoxville	EPA 1668A	NA	0.010	0.0036		ng/g	--	—	--	--	--	—	--	--
PCB 138	35065-28-2	TA Knoxville	EPA 1668A	NA	0.040	0.023		ng/g	--	—	--	--	--	—	--	--
PCB 139	56030-56-9	TA Knoxville	EPA 1668A	NA	0.020	0.0060		ng/g	--	—	--	--	--	—	--	--
PCB 140	59291-64-4	TA Knoxville	EPA 1668A	NA	0.020	0.0060		ng/g	--	—	--	--	--	—	--	--
PCB 141	52712-04-6	TA Knoxville	EPA 1668A	NA	0.010	0.0035		ng/g	--	—	--	--	--	—	--	--
PCB 142	41411-61-4	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	--	—	--	--	--	—	--	--
PCB 143	68194-15-0	TA Knoxville	EPA 1668A	NA	0.020	0.0086		ng/g	--	—	--	--	--	—	--	--
PCB 144	68194-14-9	TA Knoxville	EPA 1668A	NA	0.010	0.0034		ng/g	--	—	--	--	--	—	--	--
PCB 145	74472-40-5	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	--	—	--	--	--	—	--	--
PCB 146	51908-16-8	TA Knoxville	EPA 1668A	NA	0.010	0.0040		ng/g	--	—	--	--	--	—	--	--
PCB 147	68194-13-8	TA Knoxville	EPA 1668A	NA	0.020	0.0048		ng/g	--	—	--	--	--	—	--	--
PCB 148	74472-41-6	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	--	—	--	--	--	—	--	--
PCB 149	38380-04-0	TA Knoxville	EPA 1668A	NA	0.020	0.0048		ng/g	--	—	--	--	--	—	--	--
PCB 150	68194-08-1	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	--	—	--	--	--	—	--	--
PCB 151	52663-63-5	TA Knoxville	EPA 1668A	NA	0.020	0.0074		ng/g	--	—	--	--	--	—	--	--
PCB 152	68194-09-2	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	--	—	--	--	--	—	--	--
PCB 153	35065-27-1	TA Knoxville	EPA 1668A	NA	0.020	0.0036		ng/g	--	—	--	--	--	—	--	--
PCB 154	60145-22-4	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	--	—	--	--	--	—	--	--
PCB 155	33979-03-2	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	50	—	150	50	50	—	150	50
PCB 156	38380-08-4	TA Knoxville	EPA 1668A	NA	0.020	0.0048		ng/g	50	—	150	50	50	—	150	50
PCB 157	69782-90-7	TA Knoxville	EPA 1668A	NA	0.020	0.0048		ng/g	50	—	150	50	50	—	150	50
PCB 158	74472-42-7	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	--	—	--	--	--	—	--	--
PCB 159	39635-35-3	TA Knoxville	EPA 1668A	NA	0.010	0.0022		ng/g	--	—	--	--	--	—	--	--
PCB 160	41411-62-5	TA Knoxville	EPA 1668A	NA	0.040	0.023		ng/g	--	—	--	--	--	—	--	--
PCB 161	74472-43-8	TA Knoxville	EPA 1668A	NA	0.010	0.0028		ng/g	--	—	--	--	--	—	--	--
PCB 162	39635-34-2	TA Knoxville	EPA 1668A	NA	0.010	0.0022		ng/g	--	—	--	--	--	—	--	--
PCB 163	74472-44-9	TA Knoxville	EPA 1668A	NA	0.040	0.023		ng/g	--	—	--	--	--	—	--	--
PCB 164	74472-45-0	TA Knoxville	EPA 1668A	NA	0.010	0.0036		ng/g	--	—	--	--	--	—	--	--
PCB 165	74472-46-1	TA Knoxville	EPA 1668A	NA	0.010	0.0024		ng/g	--	—	--	--	--	—	--	--
PCB 166	41411-63-6	TA Knoxville	EPA 1668A	NA	0.020	0.010		ng/g	--	—	--	--	--	—	--	--

Table 1. Analyte List, Cleanup Levels and Analytical Quantitation Limits

PARCCS:	Comparability			Sensitivity					Accuracy and Precision			
									MS/MSD		LCS/LCSD	
Parameter	CAS Number	Laboratory	Method	ROD Cleanup Levels [1]	Project Quantitation Limits [2]	Achievable Laboratory MDLs [2]	Laboratory EDLs	Units	Percent Recovery (%)	RPD (%)	Percent Recovery (%)	RPD (%)
PCB 167	52663-72-6	TA Knoxville	EPA 1668A	NA	0.010	0.0025		ng/g	50 — 150	50	50 — 150	50
PCB 168	59291-65-5	TA Knoxville	EPA 1668A	NA	0.020	0.0036		ng/g	-- — --	--	-- — --	--
PCB 169	32774-16-6	TA Knoxville	EPA 1668A	NA	0.010	0.0023		ng/g	50 — 150	50	50 — 150	50
PCB 170	35065-30-6	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 171	52663-71-5	TA Knoxville	EPA 1668A	NA	0.020	0.0086		ng/g	-- — --	--	-- — --	--
PCB 172	52663-74-8	TA Knoxville	EPA 1668A	NA	0.010	0.0030		ng/g	-- — --	--	-- — --	--
PCB 173	68194-16-1	TA Knoxville	EPA 1668A	NA	0.020	0.0086		ng/g	-- — --	--	-- — --	--
PCB 174	38411-25-5	TA Knoxville	EPA 1668A	NA	0.010	0.0029		ng/g	-- — --	--	-- — --	--
PCB 175	40186-70-7	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 176	52663-65-7	TA Knoxville	EPA 1668A	NA	0.010	0.0021		ng/g	-- — --	--	-- — --	--
PCB 177	52663-70-4	TA Knoxville	EPA 1668A	NA	0.010	0.0021		ng/g	-- — --	--	-- — --	--
PCB 178	52663-67-9	TA Knoxville	EPA 1668A	NA	0.010	0.0024		ng/g	-- — --	--	-- — --	--
PCB 179	52663-64-6	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 180	35065-29-3	TA Knoxville	EPA 1668A	NA	0.020	0.0074		ng/g	-- — --	--	-- — --	--
PCB 181	74472-47-2	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 182	60145-23-5	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 183	52663-69-1	TA Knoxville	EPA 1668A	NA	0.020	0.0052		ng/g	-- — --	--	-- — --	--
PCB 184	74472-48-3	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 185	52712-05-7	TA Knoxville	EPA 1668A	NA	0.020	0.0052		ng/g	-- — --	--	-- — --	--
PCB 186	74472-49-4	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 187	52663-68-0	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 188	74487-85-7	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	50 — 150	50	50 — 150	50
PCB 189	39635-31-9	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	50 — 150	50	50 — 150	50
PCB 190	41411-64-7	TA Knoxville	EPA 1668A	NA	0.010	0.0026		ng/g	-- — --	--	-- — --	--
PCB 191	74472-50-7	TA Knoxville	EPA 1668A	NA	0.010	0.0024		ng/g	-- — --	--	-- — --	--
PCB 192	74472-51-8	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 193	69782-91-8	TA Knoxville	EPA 1668A	NA	0.020	0.0074		ng/g	-- — --	--	-- — --	--
PCB 194	35694-08-7	TA Knoxville	EPA 1668A	NA	0.010	0.0026		ng/g	-- — --	--	-- — --	--
PCB 195	52663-78-2	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 196	42740-50-1	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 197	33091-17-7	TA Knoxville	EPA 1668A	NA	0.010	0.0029		ng/g	-- — --	--	-- — --	--
PCB 198	68194-17-2	TA Knoxville	EPA 1668A	NA	0.020	0.0074		ng/g	-- — --	--	-- — --	--
PCB 199	52663-75-9	TA Knoxville	EPA 1668A	NA	0.020	0.0074		ng/g	-- — --	--	-- — --	--
PCB 200	52663-73-7	TA Knoxville	EPA 1668A	NA	0.010	0.0029		ng/g	-- — --	--	-- — --	--
PCB 201	40186-71-8	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 202	2136-99-4	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	50 — 150	50	50 — 150	50
PCB 203	52663-76-0	TA Knoxville	EPA 1668A	NA	0.010	0.0025		ng/g	-- — --	--	-- — --	--
PCB 204	74472-52-9	TA Knoxville	EPA 1668A	NA	0.010	0.0026		ng/g	-- — --	--	-- — --	--
PCB 205	74472-53-0	TA Knoxville	EPA 1668A	NA	0.010	0.0021		ng/g	50 — 150	50	50 — 150	50
PCB 206	40186-72-9	TA Knoxville	EPA 1668A	NA	0.010	0.0029		ng/g	50 — 150	50	50 — 150	50
PCB 207	52663-79-3	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	-- — --	--	-- — --	--
PCB 208	52663-77-1	TA Knoxville	EPA 1668A	NA	0.010	0.0020		ng/g	50 — 150	50	50 — 150	50
PCB 209	2051-24-3	TA Knoxville	EPA 1668A	NA	0.010	0.0021		ng/g	-- — --	--	-- — --	--
Other												
Total Organic Carbon	7440-44-0	TA Seattle	EPA 9060	NA	2000	44.4		mg/kg	68 — 149	32	68 — 149	32
Specific Gravity	NA	TA Seattle	ASTM D854	NA	TBD	TBD		g/cc	-- — --	--	-- — --	--
Total Solids	NA	ALS Kelso/TA	EPA 160.3M	NA	NA	NA		NA	-- — --	20	-- — --	20

Notes:

[1] From Table 17 of the ROD (EPA 2017).

Table 1. Analyte List, Cleanup Levels and Analytical Quantitation Limits

PARCCS:	Comparability			Sensitivity					Accuracy and Precision			
									MS/MSD		LCS/LCSD	
Parameter	CAS Number	Laboratory	Method	ROD Cleanup Levels [1]	Project Quantitation Limits [2]	Achievable Laboratory MDLs [2]	Laboratory EDLs	Units	Percent Recovery (%)	RPD (%)	Percent Recovery (%)	RPD (%)

[2] Project action limits and laboratory MDLs are reported on a dry weight basis.

[3] Samples will be reported to sample specific EDLs. Method 1668 also reports to sample specific EMLs.

Accuracy and precision values, as well as MDLs, provided by the laboratory. These are presented for informational purposes only. Data review/validation will be based on the most current control limits in effect at the time of analysis.

Abbreviations:

-- = not provided
µg/kg = micrograms per kilogram
ASTM = American Society for Testing and Materials
BaP = benzo(a)pyrene
BEHP = Bis(2-ethylhexyl) phthalate
CAS = Chemical Abstract Service
cPAH = carcinogenic polycyclic aromatic hydrocarbons
DDx = dichlorodiphenyltrichloroethane and its derivatives
EDL = Estimated detection limit
EML = Estimated minimum level
EPA = Environmental Protection Agency
g/cc = grams per cubic centimeter
LCS = Laboratory Control Sample
LCSD = Laboratory Control Sample Duplicate
MS/MSD = Matrix Spike/ Matrix Spike Duplicate
NA = not applicable
ng/g = nanograms per gram
PAH = polycyclic aromatic hydrocarbons
PARCCS = Precision, Accuracy, Representativeness, Completeness, Comparability and Sensitivity
PCB = polychlorinated biphenyl
pg/g = picograms per gram
ROD = record of decision
RPD = Relative Percent Difference
SIM = Selective Ion Monitoring
SOP = Standard Operating Procedure
SVOCs = semi volatile organic compounds
TA = TestAmerica
ug/kg = micrograms per kilograms

Table 3. Data Quality Objectives for Individual Project Task

Task	DQO STEP 1 State the Problem	DQO STEP 2 Identify the Goals of the Study	DQO STEP 3 Identify the Information Inputs	DQO STEP 4 Define the Boundaries of the Study	DQO STEP 5 Determine the Analytic Approach	DQO STEP 6 Specify Performance or Acceptance Criteria	DQO STEP 7 Describe the Plan for Obtaining the Data
Surface Sediment Sampling	Many of the surface sediment data for the Site are over 10 years old. Updating the surface sediment dataset is key to refining the active remedial SMA footprints and updating the CSM.	Obtain SMA baseline characterization data adequate to refine the remedial footprint for allocation purposes (goal 1), establish current baseline conditions to evaluate future remedy performance (goal 2), evaluate recovery changes within the site (goal 3), and update the upriver reach datasets (goal 4).	428 random stratified surface sediment samples from throughout the site and 178 discrete targeted surface sediment samples located in SMAs and 60 targeted surface sediment samples co-located with sediment cores will be collected. The analytical suite for the samples is shown in Tables 2a and 2b of the QAPP.	Geographic Boundary: The random stratified samples will be distributed over the entire Site from RM 1.9 to RM 11.8, whereas the targeted samples will focus on the SMAs. Upriver samples will be distributed from RM 11.8 to 26.4. Temporal Boundary: The surface sediment samples will be collected in the first half of 2018.		The acceptance criteria will entail the attainment of laboratory QA/QC results consistent with Section 3 of the QAPP.	The surface sediment samples will be collected from the upper 30 centimeters of sediment from three sampling points at each sampling location and homogenized into a three-point composite sample. The rationale for the sampling locations and analytical strategy is further explained in the PDI Work Plan and task-specific FSP.
Subsurface Sediment Coring	The vertical land horizontal extent of subsurface contamination has not been fully defined in SMAs with active remediation by previous studies.	Obtain SMA baseline characterization data adequate to refine the remedial footprint for allocation purposes (goal 1) and evaluate recovery changes within the site (goal 3).	90 subsurface sediment cores will be collected in SMAs that have limited data coverage. Target depths for sampling are based on the vertical extent of contamination observed in surrounding cores and anticipated depth to native material. If the vertical depth of contamination was not reached in a previous core, the depth of the current core will be extended an additional 2 to 4 feet. The analytical suite for the samples is shown in Table 2a of the QAPP.	Geographic Boundary: Sediment cores will be collected from target area within or along SMA boundaries. Temporal Boundary: The subsurface sediment samples will be collected in summer of 2018.		The acceptance criteria will entail the attainment of laboratory QA/QC results consistent with Section 3 of the QAPP.	The subsurface samples will be subsampled into 2-foot increments (unless stratigraphy indicates otherwise) and homogenized. 1-foot intervals near the bottom of contamination may be archived. The rationale for the sampling locations and analytical strategy is further explained in the PDI Work Plan and task-specific FSP.

Abbreviations:
COC = contaminant of concern
CSM = conceptual site model
D/U = downtown/upstream
DQO = Data Quality Objective
FSP = Field Sampling Plan
PCB = polychlorinated biphenyl
QA/QC = quality assurance/quality control
QAPP = Quality Assurance Project Plan
RAL = remedial action level
RM = river mile
ROD = Record of Decision
SMA = sediment management area

Table 2. Field Quality Control Sample Requirements

QA/QC Sample Type	Frequency
Temperature Blanks	1 per cooler
Blind Field Duplicates	5 percent (1 per 20 samples)[a]
Field Equipment Rinsate Blanks	5 percent (1 per 20 samples)
Matrix Spike/ Matrix Spike Duplicate	5 percent (1 per 20 samples)[b]

Acronyms:

QA/QC = quality assurance/quality control

Footnotes:

a) Field Duplicate analyses will be performed on the surface sediment samples.

b) PAHs, PCB Aroclors, and TOC. Field personnel must collect additional volume to account for MS/MSD samples where needed. MS/MSD analyses will be performed on the surface sediment samples.

Table 3. Sample Nomenclature

Sample/QC Type	Location		Sample Type	Sample Interval Depth	Sample Date	Example
	RM Number	Letter				
Surface Sediment Sample	8.83-9.15 (identifying up/down river mile location)	A - G (identifying cross-river location)	(not used for surface sediment samples)	Actual Depth Inverval of Sample Collection, in format Top Depth in cm "to" Bottom Depth in cm	Date of Sample Collection in format MMDDYY	**D8.83-0to27-101518** for surface sediment sample collected from location D8.83, grab sampler penetrated to a depth of 27 cm, sample collected October 15, 2018
Subsurface Sediment Samples	8.83-9.15 (identifying up/down river mile location)	A - G (identifying cross-river location)	SC (to identify sediment core)	Actual Depth Inverval of Sample Collection, in format Top Depth in feet "to" Bottom Depth in feet	Date of Sample Collection in format MMDDYY	**D8.90-SC-1to2-101518** for subsurface core sample collected from location D8.90 for the 0 to 1 foot interval collected on October 15, 2018
Sediment Field Duplicate Sample. Frequency of 5 percent (1 per 20 samples)	Location substitued for numerical sequence beginning at 511		(not used for surface sediment field duplicate samples)	Actual Depth Inverval of Sample Collection, in format Top Depth in cm "to" Bottom Depth in cm	Date of Sample Collection in format MMDDYY	**511-0to27-101518** if first surface sediment duplicate sample is of sample collected between 0 and 27 cm on October 15, 2018
Equipment Rinseate Blank - regardless of blank collected from surface sediment sampling equipment or sediment core sampling equipment. Frequency of 5 percent (1 in 20 samples) or 1 per week per equipment.	Location substitued for numerical sequence beginning at 611		(not used for equipment rinseate blank samples)	(not used for equipment rinseate blank samples)	Date of Sample Collection in format MMDDYY	**611-101518** if first rinseate blank sample is collected on October 15, 2018

Table 4. Sample Containers, Preservation, Holding Times, and Sample Volume

Analyte Group	Analytical Method	Container[1] Type	Container[1] Size	Preservation	Holding Time	Archive Preservation	Archive Holding Time	Analytical Laboratory
PAHs	EPA 8270D-SIM	AG-TL	8 oz	Cool to 0-6°C	14 days from collection to preparation; 40 days extraction to analysis	Freeze to <-10°C	1 year	
PCB Congeners	EPA 1668A	AG-TL	4 oz[2]	Cool to 0-6°C until receipt by laboratory. Then store in the dark at <-10° C	1 year from collection to preparation; 1 year from extraction to analysis	Freeze to <-10°C	1 year	TAL-Knoxville
Specific Gravity	ASTM D-854			NA[3]	None	NA[3]	None	
PCDD/Fs	EPA 1613B	AG-TL	4 oz[2]	Cool to 0-6°C until receipt by laboratory. Then store in the dark at <-10° C	1 year from collection to preparation; 1 year from extraction to analysis	Freeze to <-10°C	1 year	TAL-Sacramento
Total Organic Carbon	EPA 9060	G-TL	4 oz	Cool to 0-6°C	28 days from collection to analysis	Freeze to <-10°C	1 year	
TPH Diesel	NWTPH-Dx	G-TL	8 oz	Cool to 0-6°C	14 days from collection to preparation; 40 days extraction to analysis	Freeze to -20°C	1 year	TAL-Seattle
PCB Aroclors	EPA 8082A			Cool to 0-6°C	14 days from collection to preparation; 40 days extraction to analysis	Freeze to <-10°C	1 year	
Grain Size	ASTM D422	G-TL	16 oz	NA[3]	None	NA[3]	None	TAL-Seattle
Total Solids	EPA 160.3 Modified	note 4	note 4	Cool to 0-6°C	7 days from collection to analysis	Freeze to <-10°C	1 year	ALS-Kelso TAL-Seattle
Archive	--	AG-TL	8 oz	--	--	Freeze to <-10°C	--	ALS-Kelso
Archive	--	G-TL	8 oz	--	--	Freeze to <-10°C	--	TAL-Seattle

Acronyms:

AG = amber glass; G = glass; TL = Teflon-lined lid; P = plastic; oz. = ounce;PCB = polychlorinated biphenyls; PCDD/Fs = polychlorinated dibenzo-p-dioxins and furans; TA = TestAmerica

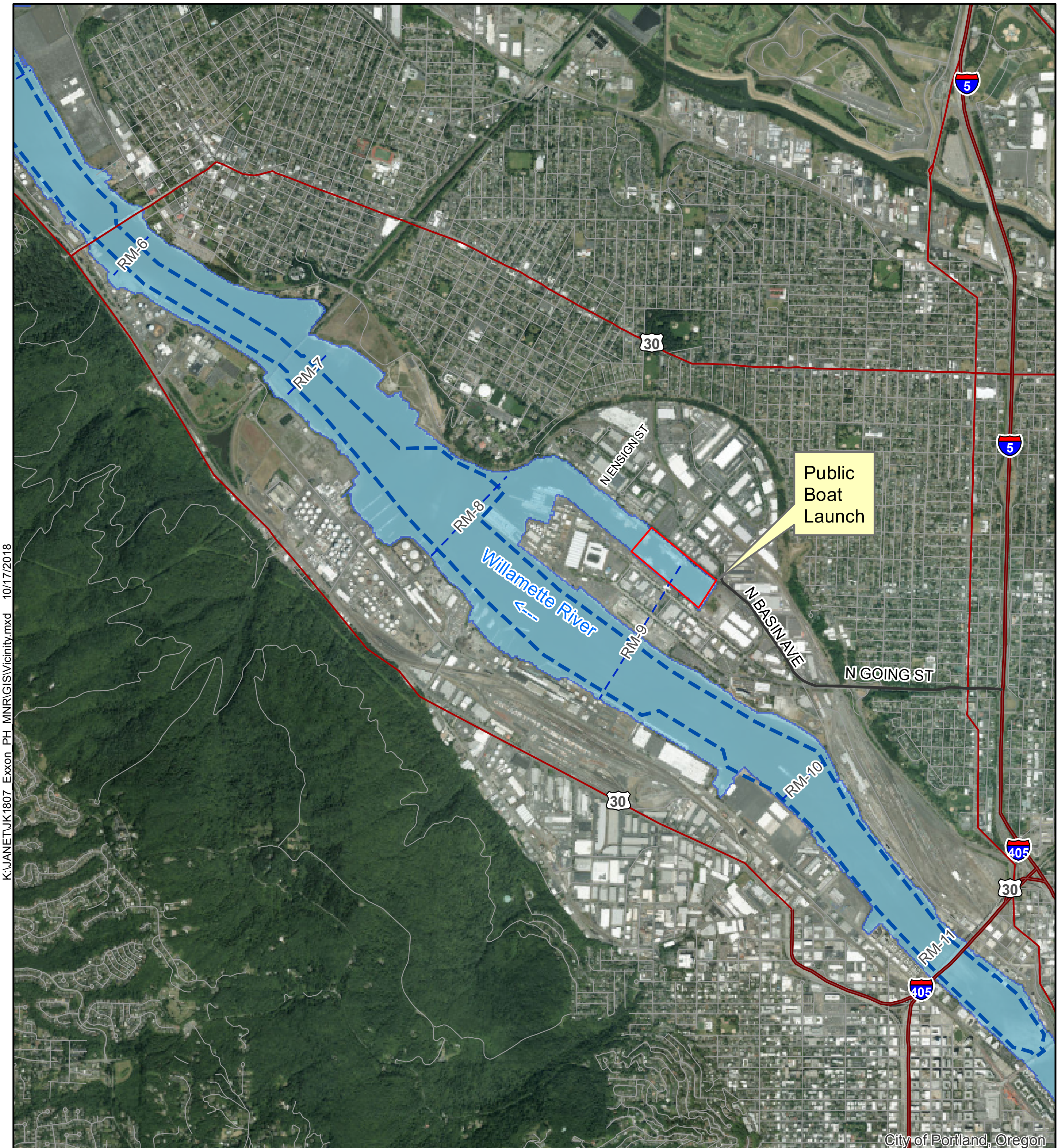
Note:

1) The size and number of containers may be modified by analytical laboratory. Archive samples will be collected for all of the sediment grab samples.
2) Dioxins / Furans and PCB Congeners, and Specific Gravity require the jar to be 2/3 full because they will be frozen.
3) Samples for grain size and specific gravity may be cooled to 0-6°C, and frozen to <-10°C
4) Sediment for Total Solids will come from jar(s) sent to TA Seattle and ALS Kelso as needed.

Table 5. Laboratory Quality Control Sample Frequency

Parameter	Method	Method Blanks	MS/MSD	LCS/LCSD	Laboratory Duplicate	Surrogate Recovery
PAHs	EPA 8270D-SIM	1 per extraction batch	1 per 20 samples	1 per extraction batch	1 per 20 samples	Per method
PCB Aroclors	EPA 8082A	1 per extraction batch	1 per 20 samples	1 per extraction batch	NA	Per method
TOC	EPA 9060	1 per extraction batch	1 per 20 samples	1 per extraction batch	NA	NA
PCB Congeners	EPA 1668A	1 per extraction batch	NA	Per method	1 per 20 samples	Per method
Dioxins/Furans	EPA 1613B	1 per extraction batch	NA	Per method	1 per 20 samples	Per method
Grain Size	ASTM D7928 and D6913	NA	NA	NA	Triplicate analysis per 20 samples	NA
Specific Gravity	ASTM D854	NA	NA	NA	Triplicate analysis per 20 samples	NA
Total Solids	EPA 160.3M	1 per analytical batch	NA	NA	1 per 10 samples	NA

Abbreviations:
DRO = Diesel Range Organics
ASTM = American Society for Testing and Materials
BEHP = Bis(2-ethylhexyl) phthalate
EPA = Environmental Protection Agency
LCS = Laboratory Control Sample
LCSD = Laboratory Control Sample Duplicate
MS = Matrix Spike
MSD = Matrix Spike Duplicate
NA = Not Applicable
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
TPH = total petroleum hydrocarbon
TOC = Total Organic Carbon



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Project Area
Federal Navigation Channel
River Mile
Ordinary High Water

0 Miles 1

N

Figure 1

Portland Harbor Site Map

Head of Swan Island Lagoon
Sediment Sampling and Analysis

PGG

Proposed 2018-2019 Surface Sample Locations

Proposed Subsurface (Core) Location

PDI 2018 Surface Sediment Sampling Locations

- Stratified Random Sample
- Additional SMA Sample
- Surface Grab at Co-located Core Location
- RI/FS Subsurface Core Sediment Analysis Locations
- RI/FS Surface Sediment Sample Locations Used in Total PCBs Interpolation
- Selected Remedy Sediment Management Area (SMA)

- Harborlines (Approximate)
- Docks and Structures
- Taxlot Boundary
- Essential Salmonid Habitat 2015
- City of Portland Stormwater Outfall
- River Mile
- Swan Island Sediment Decision Unit

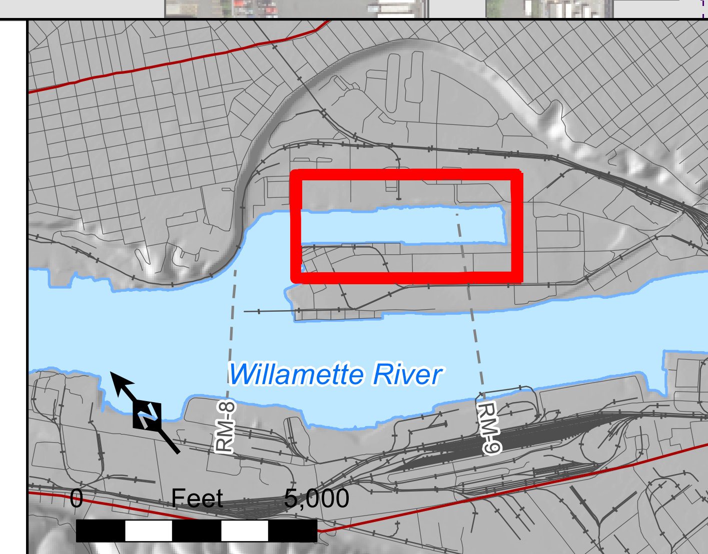

Figure 2

Head of Swan Island Lagoon Sediment Sampling Locations

Head of Swan Island Lagoon
Sediment Sampling and Analysis

PgG

APPENDIX A
LABORATORY SOPS

APPENDIX B
HEALTH AND SAFETY PLAN

HEAD OF SWAN ISLAND LAGOON
SEDIMENT SAMPLING
HEALTH AND SAFETY PLAN
FINAL

October 16, 2018

HEAD OF SWAN ISLAND LAGOON SEDIMENT SAMPLING HEALTH AND SAFETY PLAN FINAL

Prepared for:

de maximis, inc.

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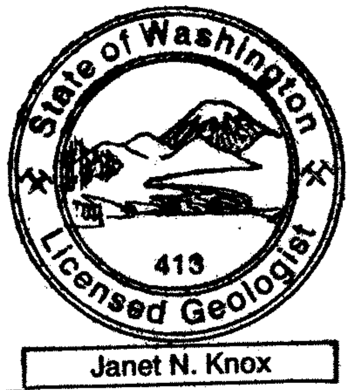
October 16, 2018

TABLE OF CONTENTS

APPENDICES

SIGNATURE

This report, and Pacific Groundwater Group's work contributing to this report, were reviewed by the undersigned and approved for release.



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Washington State Geologist No. 413

HASP SUMMARY

The purpose of this HASP is to analyze the job steps and safety requirements appropriate for each methodology as described in the FSP.

Project Name:	Head of Swan Island Lagoon Sediment Investigation	Project Number:	JK1807.01
Summary Revision Date:	October 16, 2018	Client Name:	de maximis, inc. for ExxonMobil Global Services Company
Report ALL Health & Safety (H&S) Incidents, no matter how minor, to PGG Headquarters: 206-329-0141 **Injury, Property Damage, Vehicle, Security, Regulatory Inspection, Environmental Impact, and any potentially work related injury, discomfort/ pain, or damage.**			
Identify the nearest Occupational Clinic and Hospital to the study area that accepts PGG Workers Compensation Insurance (see Attachment A for instructions). If the nearest such clinic or hospital is an unreasonable distance from the study area, identify nearer hospitals or clinics.			
Occupational Clinic:	Adventist Health Occupational Medicine	Nearest Hospital:	Legacy Emanuel Medical Center
Address:	10201 SE Main Street Portland, OR 97216	Address:	2801 N Gantenbein Avenue Portland, OR 97227
Phone Number:	503.251.6363	Phone Number:	503.413.2200
Key Personnel			
Project Manager:	Janet Knox	Cell Phone:	206.375.5432
Field Coordinator:	Jeff Parker	Cell Phone:	206.734.0937
Safety Supervisor:	David Wampler	Cell Phone:	520.275.8223
Client Project Manager:	Dave Roberson	Cell Phone:	281.685.2044
List Subcontractors and their Safety Officers: Gravity Marine Safety Officer: Jeff Wilson 425-591-2831; Captain: Peter Jenkins 425-238-4833			

1.0 INTRODUCTION

This HASP is designed to identify, evaluate, and control safety and health hazards and to outline emergency response actions for Pacific Groundwater Group (PGG)-managed activities on the study area. Preliminary identification of field activities is included for the following studies on the Pre-Job Hazard Assessment forms included in Attachment D:

- Surface sediment sampling study
- Subsurface sediment sampling study

Because the field activities for these studies are similar, this single HASP has been developed to apply to both. In instances where one set of field activities involves unique risks, requirements, precautions, operations, or necessary oversight, this will be clearly identified. Information that is presented in this HASP for these two studies includes: scope of work, detailed field maps, additional study area information, hospital route maps, safety hazards and control measures, requirements for personal protective equipment, work zone delineations, and key emergency contact information.

This HASP must be kept on-site during work activities and made available to all workers, including subcontractors and other study area occupants for informational purposes. PGG subcontractors are expected to independently characterize, assess, and control study area hazards created by their specific scope of work.

1.1 PROJECT ASSUMPTIONS

- Study management will assist in locating vessels and structures located in and nearby the study area that may potentially interfere with project operations.
- No confined spaces will be entered on this project.
- No excavations will be entered.
- No lone workers will participate in the field sampling activities.
- Work will be performed during daylight hours.

Work crews will work estimated 12-hour days, 13 days at a time, for 2 weeks (with 7 contingency days). A fatigue management plan will be created if the duration of work exceeds a 14-hour day.

2.0 STUDY AREA INFORMATION AND SCOPE OF WORK

2.1 STUDY AREA LOCATION

The study area encompasses an approximately 0.5-mile stretch of the Willamette River, within Swan Island Lagoon in Portland Harbor, from approximately RM 8.8 to RM 9.2.

2.2 SITE BACKGROUND/HISTORY

The Site extends from RM 8.8 of the Willamette River to RM 9.2 (Appendix D), within Swan Island Lagoon, accessible primarily from the main channel of the river and a boat ramp located on the north-east corner of the lagoon. The Willamette River is a dynamic waterbody that originates within Oregon in the Cascade Mountain Range and flows approximately 187 miles north to its confluence with the Columbia River. Land use along the Lower Willamette River in the Portland Harbor includes marine terminals, manufacturing and other commercial and municipal operations, and public facilities, parks, and open spaces.

The shorelines along most of the Portland Harbor area have been developed for industrial, commercial, and municipal operations; the Portland Harbor area serves as a major shipping route for containerized and bulk cargo. In addition, the Portland Harbor area has historically received, and currently receives, discharges from industrial and municipal sources including point- and non-point sources that discharge to the Lower Willamette River.

Common shoreline features within the harbor include constructed bulkheads, piers, wharves, buildings extending over the water, and steeply sloped banks armored with riprap or other fill materials.

On December 1, 2000, the Site was listed on the National Priorities List by EPA mainly due 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 the Site include, but are not limited to, polychlorinated biphenyls, polycyclic aromatic hydrocarbons, dichlorodiphenyltrichloroethane (DDT) and its derivatives, and dioxins/furans. A remedial investigation and feasibility study was initiated in 2001 by a small subset of potentially responsible parties known as the Lower Willamette Group and completed by EPA in 2017.

2.3 CLIENT OR THIRD-PARTY OPERATIONS INVOLVED IN FIELD ACTIVITIES

Gravity Marine Services (Gravity): will provide research vessels, equipment, and staff to conduct in-water subsurface sediment sampling and surface sediment sampling, in addition to providing general research vessel support.

2.4 SCOPE OF WORK

PGG will mobilize staff primarily from Seattle, Washington to conduct in-water sediment sampling in the Willamette River. Sampling studies are described below:

Surface Sediment Sampling Study: Surface (0 to 30 centimeter) sediment samples at 7 locations will be collected via a hydraulic power grab sampler operated from an aluminum research vessel operated by Gravity, a subcontractor to PGG. All vessel operations and sediment sampling equipment will be operated by Gravity. Gravity will be responsible for operating the following equipment:

- Research vessel
- Hydraulic power grab sampler

PGG will provide on-board oversight, document the sampling process, and conduct on-board sample processing of surface sediment samples. On-board sample processing will involve transferring sediment samples to a stainless-steel bowl where the sample will be homogenized, then transferring samples to sample bottles/containers, after which they will be shipped to the lab for analysis.

Subsurface Sediment Sampling Study: samples at 3 locations will be collected via a Vibracore System operated from an aluminum research vessel operated by Gravity. All vessel operations and sediment sampling equipment will be operated by Gravity. Gravity will be responsible for operating the following equipment:

- Research vessel

- Vibracore
- Sawzall, to cut the sediment cores to manageable lengths
- Power drill, to drill a small hole in the sediment core to drain excess water out

PGG staff will provide on-board oversight and document the sampling process. Additional PGG staff will conduct on-shore processing of the core lengths for geologic characterization and sample collection for laboratory analysis.

2.5 SCOPE OF WORK RISK ASSESSMENT

The surface and subsurface sediment sampling studies involve work that qualifies overall as 'medium risk'. Hazards include boat work, work in the vicinity of heavy equipment (crane and attached grab/core sampler), and intermittent work with material that may contain chemicals at concentrations that could cause adverse environmental and human health effects without proper handling and PPE.

3.0 SAFETY, HEALTH, AND ENVIRONMENT

3.1 DRIVING AND VEHICLE SAFETY

The proper operation of vehicles is critical to protecting the safety of PGG employees and subcontractors. Drivers face numerous hazards while operating vehicles. Some of the hazards include collision with another vehicle, collision with a fixed object, vehicle break down or failure, or falling asleep or becoming otherwise incapacitated while driving. All employees will adhere to the following key practices:

- Authorized Drivers - Managers must authorize drivers following evaluation of driver criteria to drive and maintain a leased or rented vehicle, a client or customer-owned vehicle, or a personal vehicle operated in the course of conducting PGG business.
- PGG prohibits use of all portable hand-held electronic devices while operating a motor vehicle/ equipment, which includes being stopped at a traffic light or stop sign. This includes cell phones and two-way radios. Electronic devices include, but are not limited to, all mobile phones, pagers, iPods, MP3s, GPS, DVD players, tablets, laptops, and other portable electronic devices that can cause driver distraction.
- Vehicle Inspections - Vehicle inspection is to include a 360-degree walk around and visual inspection under the vehicle for leaks and obstructions prior to moving the vehicle.
- Secure Loads - Cargo is only to be carried within the passenger compartment of a vehicle when segregated and restrained to prevent objects from becoming distractions, obstructions, or projectiles to occupants should emergency vehicle maneuvers be required (e.g., harsh braking or crash). All applicable laws and regulations regarding securing of loads must be met.
- Backing Up - Reversing the vehicle is to be avoided if possible. If backing up is necessary, use the following guidelines:

- Pre-plan all vehicle movements.
- If the pull-through method of parking is not possible, drivers will scan parking spot/area for hazards and back in; thereby, facilitating departure where the first move is forward.
- Avoid tight spaces.
- Vehicles over 10,000 pounds gross vehicular weight are required to have a competent spotter in place when backing. A competent spotter is one that has received spotter training.
- All vehicles shall have a competent spotter in place when backing in an active work zone. Parking and public access areas are recommended but not required to have a spotter.

3.2 FITNESS FOR DUTY

Fitness for Duty means that individuals are in a state (physical, mental, and emotional) that enables them to perform assignments competently and in a manner that does not threaten the health and safety of themselves or others. Employees should report to work fit for duty and unimpaired by substances or fatigue. Supervisors must observe their employees and work with the employee, management, and HR to address deficiencies. PGG will not tolerate retaliation against any employee for filing a complaint or concern regarding their fitness for duty or participating in any way in an investigation.

3.2.1 Medical Surveillance

All PGG employees undergo medical monitoring at the onset of employment and, at a minimum, after any significant change or possibility of change to an employee's health or physical capabilities. Medical monitoring provides a streamlined process to determine if employees meet the physical requirements to perform assigned duties as defined by applicable regulations. It is also designed to provide a means to collect data relevant to exposure to chemical and physical agents for the protection of the workers and to confirm the effectiveness of health and safety programs.

3.2.2 Fatigue

One aspect of fit for duty is fatigue management. PGG has developed procedures that limit work periods or require additional rest under certain circumstances, including during long-distance travel or when working at high altitudes. These procedures also set limits on extended work periods of 14 hours per day. If longer work hours are necessary for the project, the Project Manager must be notified who will interview employees before approval.

3.2.3 Substance Abuse

Drug and alcohol abuse pose a serious threat to the health and safety of employees, clients, and the general public as well as the security of job sites, equipment, and facilities. PGG is committed to the elimination of illegal drug use and alcohol abuse in its workplace and regards any misuse of drugs or alcohol by employees to be unacceptable. PGG prohibits the use, possession, presence in the body, manufacture, concealment, transportation, promotion, or sale of the following items or substances on company premises. Company premises refer to all property, offices, facilities, land, buildings, structures, fixtures, installations, aircraft, automobiles, vessels, trucks and all other vehicles and equipment, whether owned, leased, or used.

- Illegal drugs (or their metabolites), designer and synthetic drugs, mood or mind-altering substances, and drug use related paraphernalia unless authorized for administering currently prescribed medication
- Controlled substances that are not used in accordance with physician instructions or non-prescribed controlled substances
- Any drug or substance, regardless of state and/or federal legality, that alters the mood or mind of the user, except for those medications prescribed in the employee's name or over-the-counter medications; employees must consult with their health care provider about any prescribed medication's effect on their ability to perform work safely and disclose any restrictions to their supervisor

3.3 HAND SAFETY

The hands are exposed to hazards more than any body part, and warrant addition safety precautions. All personnel shall have gloves in their immediate possession 100% of the time when in a shop or on a work location. Gloves that address the hazard shall be worn when employees work with or near any materials or equipment that present the potential for hand injury due to sharp edges, corrosives, flammable and irritating materials, extreme temperatures, splinters, etc.

3.4 HAZARD COMMUNICATION

Hazardous materials that may be encountered as existing environmental or physical/health contaminants are listed in Section 8.1, Potential Chemical Hazards. Their properties, hazards, and associated required controls will be communicated to all affected staff and subcontractors including these key elements:

- All personnel shall be briefed on the hazards of any chemical product they use and shall be aware of and have access to the Safety Data Sheets (SDS).
- All containers shall be properly labeled to indicate their contents. Labeling on any containers not intended for single-day, individual use shall contain additional information indicating potential health and safety hazards (flammability, reactivity, etc.).

In addition, any employee or organization (contractor or subcontractor) intending to bring any hazardous material onto this PGG-controlled study area must first provide a copy of the item's SDS to the Field Coordinator or Safety Supervisor for review and filing. The Field Coordinator or Safety Supervisor will maintain copies of all SDS on-site along with this HASP. SDS may not be available for locally obtained products, in which case an alternate form of product hazard documentation will be acceptable.

3.5 HAZARDOUS MATERIAL HANDLING AND WASTE MANAGEMENT

If hazardous, solid, and/or municipal wastes are generated during any phase of the project, the waste shall be accumulated, labeled, and disposed of in accordance with applicable Federal, State, and/or local regulations.

3.6 HOUSEKEEPING AND PERSONAL HYGIENE

Basic housekeeping requirements for work areas, as well as personal hygiene and sanitation standards shall be upheld by each employee. It is the responsibility of each employee to:

- Ensure their work environment is maintained in a safe manner with minimized clutter and unused equipment
- Maintain personal hygiene using soap, sanitization wipes/cleaners, and water as necessary to ensure hands and face are clean after completing work activities and prior to breaks or meals
- Keep work areas and other non-permitted areas clear of food and beverages
- Maintain a supply of clearly-distinguished/labeled potable water for personal use
- Promptly dispose of personal and work-related waste in a suitable trash receptacle designated prior to the initiation of work
- Alert other employees to unsafe conditions caused by unkempt work areas

3.7 LONE WORKER

No lone workers (i.e., where personnel are out of visual and audio range of others) will participate in the field sampling tasks for this project. Lone workers may conduct activities at the onshore sample processing area when other employees are not present.

3.8 SAFETY OBSERVATIONS

Safety observations are observations made by employees and subcontractors of a condition or behavior that could contribute to an incident, prior to the incident occurring. Observations can also identify positive behaviors or interventions which contribute to the prevention of incidents. Refer to Section 3.9 for PGG policy on handling safety observations that require urgent response to prevent or minimize imminent or potential safety incidents.

3.9 STOP WORK AUTHORITY

PGG empowers and expects all employees and subcontractors to exercise their Stop Work Authority if an incident appears imminent, or when hazardous behaviors or conditions are observed. A stop work request can be informal if the situation can be easily corrected, or may require shutting down operations if revised procedures are necessary to mitigate the hazard. If a PGG employee observes an imminently hazardous situation on a study area controlled by others (i.e., a client-managed contractor), the employee can always stop work for themselves by removing themselves from the situation.

Employees also may attempt to stop work to avoid allowing the contractor to come to harm by immediately notifying the contractor foreman or project engineer, or if necessary, the client or party managing the contractor.

No employee should object to the issuance of a stop-work request, nor can any disciplinary action be levied against the employee. All employees must agree that the situation has been mitigated before resuming work. No employee will be disciplined for refusing to work if they feel it is unsafe.

3.10 COLD WEATHER AND COLD WATER CONDITIONS FOR ON-WATER WORK

- Cold weather conditions are considered those conditions below a Wind Chill Temperature of 50 degrees Fahrenheit (10 degrees Celsius). Working in a marine environment increases hypothermic risk due to the moisture content in the air. Recognizing the increased risk for exposure to hypothermia in cold weather conditions, the project will establish the following: For air temperatures below 50 degrees Fahrenheit, personnel should dress in layers and shall not use cotton as base layer as it reduces insulation capabilities when wet. All personnel shall have a set of dry clothing.
- Field Coordinator will maintain verbal communication with field personnel and monitor for signs of cold stress including:
    - shivering
    - lack of coordination, stumbling, fumbling hands
    - slurred speech
    - pale, cold skin
  - Any staff that express discomfort from cold or show signs of cold stress will be asked to stay in the boat cabin and provided with warm insulating clothing and warm liquids until they are comfortable to resume outdoor work.
- Assumes PGG staff or subcontractors are not exposed to significant potential of falling into water. Significant potential of falling into water can be defined as placing one's body beyond the life line or outer boat railing while performing job duties. Boarding/off boarding at the dock is not included in this definition and assumes all boarding/off-boarding is performed after the vessel has been secured at the dock.
- Assumes rescue of man-over-board (MOB) can be performed within 3 minutes.
- Assumes no ice or snow conditions are occurring or are forecasted to occur during the days of on-water work.
- Stop Work occurs when the water or air temperature (including effects of wind chill) are below a 32 degrees Fahrenheit threshold. Work will resume after the temperature threshold is met or exceeded.
- The Wind Chill Chart Below can be used to determine the effects of wind speed on temperature.

Wind Chill Chart

Temperature (°F)

Wind (mph) / Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes; 10 minutes; 5 minutes

Wind Chill (°F) = $35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

Employees and subcontractors who will be exposed to cold weather conditions will watch a training video on the physiological effects of cold water immersion found at: https://www.youtube.com/watch?v=J1xohI3B4Uc

PPE that will be worn during cold weather conditions below 50 degrees F include but are not limited to the following:

- Three layers of non-cotton clothing; examples include down, wool, or other synthetic materials to provide insulation when wet
- Outer layer to break the wind
- Hat or hardhat liner
- Insulated footwear
- Gloves that allow for insulation and dexterity; hand warmers will also be provided.

4.0 ROLES AND RESPONSIBILITIES

Roles and responsibilities for the project team are defined below.

The Project Manager (PM) is ultimately responsible for the development of this HASP and establishing a budget to implement the controls and training required. The PM is also responsible for ensuring that the plan is implemented, that appropriate documentation is generated, and that records are maintained. The PM is also responsible for reviewing and approving this HASP and assisting with other H&S matters upon request.

A Safety Coordinator may be appointed to oversee implementation of the HASP in the field. All project team members are responsible for reviewing and abiding by this HASP, performing daily (or more frequent) safety meetings, stopping work when necessary to correct unsafe behaviors or conditions, and reporting incidents promptly to the Project Manager and PGG headquarters.

4.1 PROJECT MANAGER: JANET KNOX

The Project Manager has overall management authority and responsibility for all study area operations, including safety. The Project Manager will provide the Supervisor with work plans, staff, and budgetary resources, which are appropriate to meet the safety needs of the project operations. Some of the Project Manager's specific responsibilities include the following:

- Approving the type (full time, collateral duty, alternates) and qualifications (training and years of experience) of Safety Supervisors per the requirements of each task.
- Updating the HASP to reflect changes in conditions or the scope of work. HASP updates must be reviewed and approved by the PM.
- Coordinating with the Supervisor to review work tasks with the work crew.
- Assisting as needed to report incidents and verify that incidents and observations are logged.
- Working with the Supervisor to develop and implement corrective action plans to correct deficiencies discovered during Site inspections.
- Checking that all personnel and visitors have received the proper training, orientation, and medical clearance prior to entering the study area.
- Selecting an alternate Safety Officer by name and informing them of their duties, in the event that the Safety Officer must leave or is absent from the study area.
- Verifying that personnel to whom this HASP applies, including PGG subcontractors, have received a copy of it, with ample opportunity to review the document and to ask questions.
- Providing adequate authority and resources to the Safety Supervisor or Field Coordinator to allow for the successful implementation of all necessary procedures.
- Maintaining regular communications with the Field Coordinator and Safety Supervisor.
- Coordinating the activities of PGG subcontractors and ensuring that they are aware of the pertinent health and safety requirements for these projects, when applicable.
- Approving amendments to the HASP (in conjunction with the Safety Supervisor or Field Coordinator).
- Coordinating activities with the client as needed to ensure the safe implementation of this HASP.

4.2 FIELD COORDINATOR: JEFF PARKER

The Field Coordinator has the responsibility and authority to direct work operations at the job site according to the provided work plans and HASP. The field coordinator for this project is Jeff Parker. The Field Coordinator's responsibilities include:

- Issuing a "Stop Work Order" under the conditions set forth in this HASP.
- Discussing deviations or drift from the work plan with the Project Manager.
- Reviewing Job Safety Analyses with the work crew.
- Discussing safety issues with the Project Manager and field personnel.
- Reporting incidents and ensuring incidents and observations are logged.
- Verifying that all operations are in compliance with the requirements of this HASP and halting any activity that poses a potential hazard to personnel, property, or the environment.

In absence of the Safety Supervisor, the Field Coordinator can assume the Safety Supervisor responsibilities as well.

4.3 SAFETY SUPERVISOR: DAVID WAMPLER

The Safety Supervisor has the overall responsibility and authority to manage the implementation and adherence to this HASP. The primary Safety Supervisor is anticipated to be David Wampler. Additional Safety Supervisors may be designated by the PM as needed. The Project Manager may act as the Safety Supervisor while on-site. The Safety Supervisor's responsibilities include the following:

- Inspecting the study area for compliance with this HASP.
- Issuing a "Stop Work Order" under the conditions set forth in this HASP.
- Temporarily suspending individuals from field activities for infractions against the HASP pending consideration by the Project Manager.
- Assisting with the development and implementation of corrective actions for study area safety deficiencies.
- Assisting with the implementation of this HASP and ensuring compliance.
- Assisting with inspections of the study area for compliance with this HASP and applicable health and safety procedures.

4.4 EMPLOYEES

Responsibilities of employees associated with this project include, but are not limited to:

- Understanding and abiding by the procedures specified in the HASP and other applicable safety policies and clarifying those areas where understanding is incomplete.

- Providing feedback to management for continuous improvement relating to omissions and modifications in the HASP or other safety policies and procedures.
- Notifying the Supervisor or Safety Supervisor of unsafe conditions and acts.
- Stopping work if there is doubt about how to safely perform a task or if unsafe acts or conditions are observed (including subcontractors or team contractors).
- Speaking up and refusing to work on any study or operation where the procedures specified in this HASP or other safety policies are not being followed.
- Contacting the Safety Supervisor, Field Coordinator, or the PM at any time to discuss potential concerns.

4.5 SUBCONTRACTORS

Each PGG subcontractor is responsible for assigning specific work tasks to their employees. Each subcontractor's management will provide qualified employees and allocate sufficient time, materials, and equipment to safely complete assigned tasks. In particular, each subcontractor is responsible for equipping its personnel with any required personnel protective equipment (PPE) and all required training.

PGG considers each subcontractor to be an expert in all aspects of the work operations for which they are tasked to provide, and each subcontractor is responsible for compliance with the regulatory requirements that pertain to those services as well as all other requirements applicable to their work. Each subcontractor is expected to perform its operations in accordance with its own unique safety policies and procedures, to ensure that hazards associated with the performance of the work activities are properly controlled.

Hazards not listed in this HASP but known to any subcontractor, or known to be associated with a subcontractor's services, must be identified and addressed to the PGG Project Manager or the Safety Supervisor prior to beginning work operations. The Supervisor or authorized representative has the authority to halt any subcontractor operations, and to remove any subcontractor or subcontractor employee from the study area for failure to comply with established health and safety procedures or for operating in an unsafe manner.

PGG will have the following subcontractors on-site. Each subcontractor will prepare a HASP addressing the field activities for which they are responsible.

Gravity will provide research vessels, equipment, and staff to conduct sampling, including subsurface sediment sampling and surface sediment sampling, in addition to providing general research vessel support.

4.6 VISITORS

Authorized visitors (e.g., client representatives, regulators, PGG management staff, etc.) requiring entry to any work location on the study area will be briefed by the Project Manager, Field Coordinator, or Safety Supervisor on the hazards present at that location. Visitors will read, sign (Section 13.0), and comply with the HASP. Visitors will be escorted at all times at the work location and will be responsible for compliance with their employer's health and safety policies. In addition, this HASP specifies the minimum acceptable qualifications, training, and PPE that are required for entry to any controlled work area; visitors must comply with these requirements at all times. If the visitor requires entry to an area but does not comply with the safety requirements associated with the area, all work activities within the area must be suspended. Unauthorized visitors, and visitors not meeting the specified qualifications, will not be permitted within established controlled work areas.

5.0 TRAINING AND DOCUMENTATION

The following sections describe the standard practices or programs that PGG will establish to prepare employees to perform work safely and consistent with PGG policy and procedures.

5.1 HASP/SITE ORIENTATION

The Field Coordinator shall conduct a Project/Site-specific HASP orientation prior to the start of field operations, with support as needed by the Safety Supervisor. Minimum items to be covered are listed in Attachment C.

5.2 WORKER TRAINING AND QUALIFICATIONS

All personnel at this study must be qualified and experienced in the tasks they are assigned, including HAZWOPER training.

Check all required training on the table below. Verify training records of employees and subcontractors.

Table 5.2.1 Site-Specific Training Requirements

HAZWOPER Activities			
Activity	**Medical Surveillance**	**Training**	**Applies to**
Surface sediment collection/sampling Subsurface sediment collection/sampling All sediment handling in processing laboratory	Yes	HASP Orientation	All Employees
		Boat Safety Orientation	All Employees performing project work on a vessel
		HAZWOPER 40-hour	All Employees working in the exclusion and contamination reduction zones
		HAZWOPER 8-hour refresher	All Employees and Subcontractors working in the exclusion and contamination reduction zones
		Cold Water Training	All Employees and Subcontractors performing project work on a vessel

5.2.1 Competent Person

A competent person is an employee who, through education, training, and experience, has knowledge of applicable regulatory requirements, is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

These activities require a competent person. Mark all that apply in the table below and list the name of the person.

	Activity	Name of Person
☒	Safe Vessel Operation, including motoring, docking, and operation of sediment and surface water sampling equipment	Gravity Captains: Mike Duffield, Rene Trudeau, Peter Jenkins, John Schaefer. Gravity Deckhands/Scientists: Shawn Hinz, Jeff Wilson, Jeff Schut, Chad Furulie, Edward Sloan.

6.0 HAZARD ASSESSMENT AND CONTROL

PGG has adopted an approach to hazard assessment and control that incorporates both qualitative and quantitative methods to identify hazards and the degree to which they may impact employees and operations. This approach involves the following:

6.1 PRE-JOB HAZARD ASSESSMENT/JOB SAFETY ANALYSIS

A pre-job hazard assessment is to be developed for the surface and subsurface sampling tasks. This assessment lays out the steps of the job, potential hazards, and mitigation measures. A copy of the JHA is included in Attachment C.

The Hazard Assessment should include consideration of the following hazard categories when identifying hazards and task specific controls:

- Energy Sources (line of fire, electricity, pressure, compression/tension)
- Fall (slip/trip, fall to same level, fall from height)
- Contact with (struck against, struck by, contact with sharp/abrasives)
- Caught (in, under, between, by)
- Strain/Overexertion (lifting, repetition, push/pull, bending, twisting)
- Exposure (temperature, radiation, noise, chemicals, radiation, hazardous atmosphere)

7.0 PHYSICAL HAZARD ASSESSMENT

A physical hazard is a hazard that threatens the physical safety of an individual; contact with the hazard typically results in an injury. The following table summarizes the physical hazards or activities containing physical hazards present at the study area and the associated procedures that address protection and prevention of harm.

All hazards listed below must be included in Attachment C for implementation and reference.

Hazard/ Activity (note: text in this column links to procedure)	Description	Applicable Procedure
Cold Stress	Potential over water during fall months	Training; warm drink hydrate
Biological Hazards	Ticks, spiders, mosquitos, bees, and wasps	Clear working zones of insects
Cranes and Lifting Devices	Vessel mounted A-frame	Activity by Gravity; PGG stand clear
Hand Tools	Aboard research vessel; onshore during core processing and packing	Stand clear, store safely, PPE
Hazardous Waste Operations	Aboard research vessel while handling sediment; onshore during core processing	IDW Plan
Heat Stress	Potential during fall months	Hydrate, Regular Breaks
Marine Safety and Vessel Operations	Willamette River from RM 8.8 to RM 9.2	Activity by Gravity; PGG stand clear
Working On and Near Water	On-board research vessel; onshore during core processing at dock.	Life vest, PPE

8.0 CHEMICAL HAZARD ASSESSMENT

8.1 POTENTIAL CHEMICAL HAZARDS

PGG will perform tasks that can expose personnel to a variety of hazards due to the operational activities, physical conditions of the work locations, and potential presence of environmental contaminants. This section presents a variety of potential chemical hazards, exposure pathways, and related mitigation actions.

Chemical Name	Maximum Concentration Found in Portland Harbor	Media	Primary Routes of Exposure	PEL	TLV	IP electron volts (eV)
METALS						
Arsenic	132 mg/kg	Sediment	Dermal	0.05mg/m^3	0.5 mg/m^3	n/a
	143 mg/kg	Soil				
	0.75 µg/L	Surface Water				
	77 µg/L	Porewater				
Cadmium	44 mg/Ikg	Sediment	Dermal	0.005 mg/m^3	1.1 mg/m^3 Respirable Fraction: 1.2 mg/m^3	n/a
	26 mg/kg	Soil				
	36 µg/L	Porewater				
Chromium	1.92 µg/L	Surface Water	Dermal	0.5 mg/m^3	0.5 mg/m^3	n/a
	147 µg/L	Porewater				
Copper	3,290 mg/Ikg	Sediment	Dermal	1.0 mg/m^3	1.0 mg/m^3	n/a
	13,300 mg/kg	Soil				
	3.68 µg/L	Surface Water				
	182 µg/L	Porewater				
Lead	13,400 mg/Ikg	Sediment	Dermal	0.05 mg/m^3	0.05 mg/m^3	n/a
	4,160 mg/kg	Soil				
	166 µg/L	Porewater				
Manganese	66,200 µg/L	Porewater	Dermal	5 mg/m^3	0.2 mg/m^3	n/a
Mercury	65 mg/kg	Sediment	Dermal	0.1 mg/m^3	0.025 mg/m^3	n/a
	19 mg/kg	Soil				
Vanadium	379 µg/L	Porewater	Dermal	0.5 mg/m^3	0.05 mg/m^3	n/a
Zinc	9,000 mg/Ikg	Sediment	Dermal	15 mg/m^3	10 mg/m^3	n/a
	9,470 mg/Ikg	Soil				
	58 µg/L	Surface Water				
	983 µg/L	Porewater				

Chemical Name	Maximum Concentration Found On-Site	Media	Primary Routes of Exposure	PEL	TLV	IP electron volts (eV)
PESTICIDES						
2,4-5-TP (Silvex)	22 µg/L	Porewater	Dermal	None	None	n/a
2,4-D	0.97 µg/L	Porewater	Dermal	10.0 mg/m^3	10.0 mg/m^3	n/a
aldrin	1,340 µg/kg	Sediment	Dermal	0.25 mg/m^3	0.25 mg/m^3	n/a
	0.005 µg/L	Surface Water				
dieldrin	356 µg/kg	Sediment	Dermal	0.25 mg/m^3	0.25 mg/m^3	n/a
Lindane/ gamma BHC	430 µg/kg	Sediment	Dermal	0.5 mg/m^3	0.5 mg/m^3	n/a
	22 µg/L	Porewater				
DDx, DDD, DDE, DDT*	3,600,000 µg/kg	Sediment	Dermal	1 mg/m^3	0.5 mg/m^3	n/a
	150 µg/kg	Soil				
	0.02 µg/L	Surface Water				
	5.7 µg/L	Porewater				
Chlordanes	2,300 µg/kg	Sediment	Dermal	0.5 mg/m^3	0.5 mg/m^3	n/a
	0.002 µg/L	Surface Water				
Hexachlorobenzene	14,000 µg/kg	Sediment	Dermal	None	0.002 mg/m^3	n/a
	22 µg/kg	Soil				
	0.007 µg/L	Surface Water				
MCPP	34 µg/L	Surface Water	Dermal	None	None	n/a
VOCs and Semi-VOCs						
1,1-DCE	283 µg/L	Porewater	Inhalation	None	None	10.00
cis-1,2-DCE	574,000 µg/L	Porewater	Inhalation	200 ppm	200 ppm	9.65
Benzene	8,200 µg/L	Porewater	Inhalation	1 ppm	0.5 ppm	9.24
Chlorobenzene	30,000 µg/L	Porewater	Inhalation	75 ppm	10 ppm	9.07
Ethylbenzene	11.4 µg/L	Surface Water	Dermal Inhalation	100 ppm	20 ppm	8.77
	905 µg/L	Porewater				
Bis-(2-Ethylhexyl)phthalate (DEHP)	440,000 µg/kg	Sediment	Inhalation	5 mg/m^3	5 mg/m^3	9.64
	27,000 µg/kg	Soil				
	64 µg/L	Surface Water				
Tetrachloro-ethylene (PCE)	12,000 µg/L	Porewater	Inhalation	100 ppm	25 ppm	9.32
Trichloroethylene (TCE)	585,000 µg/L	Porewater	Inhalation	100 ppm	10 ppm	9.45

Chemical Name	Maximum Concentration Found On-Site	Media	Primary Routes of Exposure	PEL	TLV	IP electron volts (eV)
OTHER CONTAMINANTS OF CONCERN						
Cyanide	23 mg/L	Porewater	Inhalation	5 mg/m^3	5 mg/m^3	13.60
Dioxins/furans	66 µg/kg	Sediment	Inhalation	n/a	n/a	9.19/8.89
	0.0022 µg/kg	Soil				
	0.0000009 µg/L	Surface Water				
	0.000013 µg/L	Porewater				
PAHs, total	53,000,000 µg/kg	Sediment	Inhalation	0.2 mg/m^3	0.2 mg/m^3	n/a
	600,000 µg/kg	Soil				
	605 µg/L	Surface Water				
	21,000 µg/L	Porewater				
Polychlorinated biphenyls (PCBs)	37,000 µg/kg	Sediment	Absorption, ingestion	1 mg/m^3 (42% chlorine); 0.5 mg/m^3 (54% chlorine)	1 mg/m^3 (42% chlorine); 0.5 mg/m^3 (54% chlorine)	n/a
	1,020 µg/kg	Soil				
	0.02 µg/L	Surface Water				
Perchlorate	210,000 µg/L	Porewater	Dermal Inhalation	None	None	n/a
TPH-Diesel	28,800 µg/L	Porewater	Inhalation	n/a	100 mg/m^3	n/a
Tributyltin	90,000 µg/kg	Sediment	Dermal	None	None	n/a
	9,470 µg/kg	Soil				
	0.004 µg/L	Surface Water				

* Exposure limits based on DDT.

** Exposure limits based on chlordane.

IP: Ionization Potential

PEL: OSHA Permissible Exposure Limits TLV: Threshold Limit Values (American Conference of Governmental Industrial Hygienists [ACGIH])

"None" is listed where there are no established values in OSHA or ACGIH

mg/m^3 is milligrams per cubic meter in air for inhalation exposure.

8.2 POTENTIAL EXPOSURE PATHWAYS

8.2.1 Inhalation

Constituents that potentially pose an occupational concern to employees by the inhalation route are volatile organic compounds (VOCs) and potentially semi-volatile organic compounds (SVOCs) when handling sediment on the vessel and in the processing laboratory. In the event of a failure of the closed system (e.g., leak or residual sediment found on sampling device), exposure is limited by sample size and known/expected concentration of contaminants. Air monitoring procedures are outlined in Section 8.4, however inhalation exposures are not expected as most work will occur outside or in ventilated areas and high concentrations of volatile organic compounds are not expected.

8.2.2 Skin Contact

Personnel handling residual product or waste and associated equipment may be exposed to chemical hazards by skin contact or adsorption. However, exposure is expected to be limited since workers will be required to wear appropriate PPE (i.e., appropriate work gloves, body clothing, etc.).

8.2.3 Ingestion

Personnel handling residual product or waste and associated equipment, including project hazardous materials, may be exposed by incidental ingestion. Typically, this exposure occurs if proper PPE was not used or personal hygiene was not practiced. Personal protection against exposure via ingestion can be accomplished by performance of proper decontamination procedures when exiting contaminated work areas, as well as using the correct PPE.

8.3 DECONTAMINATION

All possible and necessary steps shall be taken to reduce or minimize contact with chemicals and contaminated/impacted materials while performing field activities. Decontamination steps are outlined as follows:

- All persons and equipment performing sampling or sample processing shall be considered contaminated and must be properly decontaminated prior to exiting to clean areas of the study area.
- All persons and equipment shall be decontaminated according to procedures described in the Field Sampling Plan.
- Avoid reactions between the solutions and contaminated materials. Review the applicable SDS.
- All contaminated PPE and decontamination materials shall be contained, stored, and disposed of in accordance with requirements determined by management.
- Use caution while working around decontamination stations where there may be slip or trip hazards.

- Use disposable equipment when possible and practical.
- All employees performing equipment decontamination shall wear the appropriate PPE to protect against exposure to contaminated materials. PPE may include splash protection, such as face-shields and splash suits, and knee protectors.
- All decontaminated equipment shall be visually inspected for contamination prior to leaving the Contaminant Reduction Zone.
- Any excess sediment remaining after processing will be containerized and a waste determination made before it is disposed of at an appropriate facility.
- Disposal of other investigation-derived waste (IDW) disposal will occur as described in the RI FSPs, consistent with later sampling in the SIL by Kleinfelder (2014) and Geosyntec (2016), and proposed in the PDI FSPs (AECOM and Geosyntec 2018a and b).
- 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. Phosphate-free detergent-bearing liquid wastes from decontamination of the grab sampling equipment will be washed overboard or disposed into the sanitary sewer system.
- Tyvek, gloves, paper towels, plastic sheeting, and other waste material generated during sampling will be placed in heavyweight garbage bags or other appropriate containers and placed in normal refuse containers for disposal at a non-hazardous solid waste landfill.
- Used core tubes will be washed and then recycled. Leftover sediment after core processing, and oily or other potentially contaminated IDW will be placed in appropriate containers, characterized for disposal, and disposed of at an appropriate waste facility.

Decontamination procedures and equipment, equipment for decontamination procedures, and waste handling for decontamination will be identified in the HASP Addendums that will be appended to this Programmatic HASP.

8.4 AIR MONITORING

Monitoring shall be performed within the work area on-site to detect the presence and relative levels of toxic substances based on decisions by the Safety Officer. The data collected shall be used to determine the appropriate levels of PPE. Monitoring equipment shall be calibrated and/or undergo daily bump tests to verify calibrations and confirm alarm function. All instrumentation need to be rated intrinsically safe to prevent fire or explosion.

Instrument	Manufacturer/Model	Substances Detected
Photo Ionization Detector (PID)	RAE Systems mini-RAE Photovac Microtip HNu Model Hnu (min. 10.6 eV bulb)	• Petroleum hydrocarbons • Organic Solvents

Chip Monitoring System for specific chemical detection	Drager CMS	• Specific compounds if PID indicates presence above action level and after consulting with PGG

8.5 HEALTH AND SAFETY ACTION LEVELS

An action level is a point at which increased protection is required due to the concentration of contaminants in the work area or other environmental conditions. The concentration level (above background level) and the ability of the PPE to protect against that specific contaminant determine each action level. The action levels are based on concentrations in the breathing zone.

If ambient levels are measured which exceed the action levels in areas accessible to unprotected personnel, necessary control measures (barricades, warning signs, and mitigation actions to limit, etc.) must be implemented prior to commencing activities at the specific work area.

Personnel should also be able to upgrade or downgrade their level of protection with the concurrence of the Site Safety Supervisor or the Project Manager.

Reasons to upgrade:

- Known or suspected presence of dermal hazards
- Occurrence or likely occurrence of gas, vapor, or dust emission
- Change in work task that will increase the exposure or potential exposure to hazardous materials

Reasons to downgrade:

- New information indicating that the situation is less hazardous than was originally suspected
- Change in site conditions that decrease the potential hazard
- Change in work task that will reduce exposure to hazardous materials

8.6 MONITORING PROCEDURES

The monitoring procedures shown below are general guidelines for sampling activities. The reviewing Manager may modify any or all of these for site-specific application. A reading in excess of an action level outlined below will require additional ventilation for 30 minutes, followed by re-monitoring.

Tasks requiring air monitoring	Parameter	Zone Location and Monitoring Interval	Action Level	Response Action
Surface sediment collection on vessel Subsurface sediment collection Sediment sampling in processing station	**Benzene** (by PID)	Breathing zone, continuously where indicated by VOC readings.	> 0.25 ppm	Cease work, exit the area, and contact the Safety Supervisor and Project Manager. Work can only be resumed after consulting with PGG.
	Vinyl Chloride (by PID)	Breathing zone, continuously where indicated by VOC readings.	> 0.25 ppm	Cease work, exit the area, and contact the Safety Supervisor and Project Manager. Work can only be resumed after consulting with an PGG.
	VOCs and volatile hydrocarbons (total by PID)	Breathing zone – continuously during tasks where exposure to VOCs and volatile hydrocarbons is possible	<5ppm	Continue monitoring; may continue work in required PPE.
			5 - 25 ppm (PID Units sustained for 5 minutes)	1) STOP WORK and notify PM. 2) Investigate the cause of elevated VOC measurements and identify measures to reduce concentrations (cover impacted soils, ventilation, etc.). 3) Work activities shall only continue once levels have decreased to < 5 units above background. 4) If levels continue above 5 units, the team shall contact the Project Manager and Safety Supervisor to report the change of conditions. 5) Perform air monitoring for benzene and vinyl chloride using compound specific meters (e.g., Draeger CMS for benzene and vinyl chloride or equivalent instrument). 6) Compare readings to action levels for benzene (0.25 ppm) and vinyl chloride (0.25 ppm). Resume work if results are below action levels and Total VOC measurements are below 5 Units. 7) If levels continue above 5 ppm, STOP WORK and notify PM.
			> 25 ppm (PID Units sustained for 5 minutes)	Cease work, exit, and contact the Safety Supervisor, Field Coordinator and/or PM.

9.0 ENVIRONMENTAL IMPACT PREVENTION

9.1 INCIDENTAL SPILL PREVENTION AND CONTAINMENT PRACTICES

Spill prevention and containment planning must be conducted and appropriate control measures established, consistent with regulatory requirements. Personnel are not expected to perform a response action related to an uncontrolled release of a hazardous substance. However, in the event of an incidental release of a hazardous material, a response will be performed to absorb, neutralize, or otherwise control the release within the immediate work area. Procedures contained in the SDS of the hazardous material will be implemented to perform the response. The Emergency Response section of this HASP contains information on spill reporting, pre- and post- spill evaluation, and response.

9.2 SPILL PREVENTION AND CONTAINMENT PRACTICES

Work activities may involve the use of hazardous materials (i.e., boat fuels, hydraulic fluids). When these activities exist, the procedures outlined below will be used to prevent or contain spills:

- All hazardous material will be stored in appropriate containers and labelled.
- Tops/lids will be placed back on containers after use.
- Containers of hazardous materials will be stored appropriately away from moving equipment.
- Equipment will be inspected daily for signs of leaks, wear, or strain on parts that, if ruptured or broken, would result in a spill.
- Refueling should occur in designated areas where incidental spills can be prevented from reaching permeable ground surfaces or surface water.
- Whenever possible, position parked or stationary equipment over secondary containment and/or absorbent materials to prevent spills from reaching permeable ground surfaces.
- A spill response kit, to include an appropriate empty container, materials to allow for booming or diking the area to minimize the size of the spill, and appropriate clean-up material (i.e., speedy dri, absorbent pads, etc.) will be available on the project study area and positioned for quick and easy access.

10.0 PERSONAL PROTECTIVE EQUIPMENT

PPE is considered the last line of defense in hazard control. PPE is meant to protect workers when all other methods (elimination, engineering, and administrative) have been exhausted. All employees must be trained in the proper use and maintenance of PPE.

A PPE assessment can be performed to help determine PPE requirements. The Minimum Required PPE Level D per PGG PPE and HAZWOPER Procedures (where applicable):

- Hard hats will be required when working in areas with overhead hazards or where potential energy is stored and the release of it could be hazardous, (e.g. working on the vessel near lines/cables under tension, cranes, using A-Frames, etc.).
- Safety glasses w/ side shields (may be clear or shaded).
- Hearing protection is needed when noise exposure exceeds the OSHA Action Level (85 A-weighted decibels (dBA) for 8-hour Time-weighted Average (TWA))
- Sturdy work boots shall be worn at all times. The crew shall wear safety toe work boots whenever the crew is lifting items > 25 pounds, working around heavy moveable objects, or there is a risk of falling overhead objects.
- US Coast Guard Type III or IV approved personal floatation device (when working near or over water).
- Long pants and shirts with sleeves (short or long–must cover shoulders; no tank or muscle-shirt styles) Complete the table below for task-specific PPE.

10.1 ADDITIONAL PPE NEEDED ON-SITE

Face/Eyes	Head/Ears
Chemical goggles	Hearing protection and Earplugs
Hands	Legs/Feet
Nitrile gloves Cut, abrasion, and puncture-resistant gloves	
Body	Equipment
Sunscreen Insect repellent Long-sleeved shirt High-visibility vest	

11.0 STUDY AREA CONTROL

The purpose of study area control is to protect the public from inadvertently coming into contact with hazards and to protect PGG employees being impacted by hazards. This section details the equipment and actions needed to promote optimal study area control.

11.1 WORKZONE CONSIDERATIONS

Study area layout and study control need to be coordinated to achieve a productive work environment and efficient work process while minimizing exposure of employees and the public to hazards associated with the work.

Consider the following items when planning the study area layout and controls:

- Boat docking/mooring
- Loading/unloading areas
- Boat launching
- "Line of Fire" hazards–overhead utilities, falling/ tipping equipment, release of energy/pressure, flying debris
- Noise, dust, odor suppression
- Contamination containment and decontamination area layout
- Restricted access for areas requiring special training, skills, or certifications
- Overnight safety and security needs

11.1.1 Defined Work Zones

Exclusion Zone:

- Immediately surrounding the sediment collection area. The sediment collection area on the vessel will include a portion of the deck dedicated to where the collected sediment media and associated equipment are retrieved for the following activities:

    - Surface sediment sampling
    - Subsurface sediment sampling

  This will also be the location where the sediment media will be stored on the vessel for transport to the laboratory. This location will be identified during the tailgate meeting. After sediment cores have been collected, they will be transported to the processing station. The exclusion zone in the processing station will be the area where sediment samples are processed and stored for shipment to the analytical laboratory.

Contaminant Reduction Zone:

- The contaminant reduction zone is the area where decontamination takes place; the contaminant reduction zone is identified in two locations:
- On the vessel, the immediate area outside the exclusion zone where sampling media is collected and associated equipment are decontaminated.
- In the processing station, the immediate area outside the exclusion zone where subsurface sediment sample processing takes place and associated equipment is decontaminated.

Support Zone:

- The support zone consists of the following areas:
- All clean spaces used by the project (e.g., wheel house of sampling vessel). The support zone will include a portion of the deck where visitors may stand and remain outside the exclusion and contaminant reduction zones. The support zone also includes vessels and equipment not involved in sediment sampling.
- In the processing station, this will include all areas where workers or visitors would not be exposed to contaminants in the exclusion zone or contaminant reduction zone.

11.2 SIMULTANEOUS AND NEIGHBORING OPERATIONS

Simultaneous and neighboring operations present a need for added coordination and communication to address hazards that are presented by multiple operations.

Activity/Company	Hazard	Controls/Mitigations and Communication methods
Simultaneous/Neighboring Operation (within and bordering the study area)		
Portland Harbor is an active port with ship traffic, dock work, and a variety of other activities occurring in the study area. Activity will be present both in and neighboring the study area.	Vessel collisions, disturbance/interference with sampling equipment	The Portland Harbor Harbormaster will be used as a point of contact for coordinating with Simultaneous and Neighboring operations. If there are significant Simultaneous and Neighboring Operations, additional coordination needs will be determined on a case by case basis. Communication will be performed and coordinated by Gravity.

11.3 SECURITY

All projects should be reviewed for the potential for personal security issues (e.g., assault, robbery, threat, etc.). When on land, the project could have theft or security issues. All vehicles, equipment, and samples should be kept in locked vehicles or inside locked buildings. Personnel should use the buddy system and perform errands in teams where possible. Personnel should not work outside after dark.

12.0 EMERGENCY RESPONSE

12.1 INCIDENT/EMERGENCY CONTACT INFORMATION

PGG requires that all projects plan for reasonably foreseeable emergencies. Prior to the start of study implementation, all personnel shall review the table below for specific information regarding evacuations, muster points, communication, and other study area-specific emergency procedures. The emergency response plan will be reviewed as part of HASP Addendum orientations provided prior to the start of work, when any new PGG or

Subconsultant personnel joins the field team, and whenever there is a change in task or significant change in task location.

12.2 MAN-OVERBOARD SITUATION

If a man-overboard situation occurs, all vessel engines will be stopped immediately. Floatation devices (e.g., life rings) attached to lines will be thrown to the victim from the vessel. The victim will then be brought aboard the vessel; wet clothing will be removed and replaced with dry clothing. The victim may need to be treated for cold stress. No other person should enter the water unless the victim is unconscious or seriously injured. Rescuers must wear life vests and be tethered to the sampling vessel or shore.

PGG Contacts			
Name	**Title**	**Telephone Number/Contact**	**Mobile Phone**
Janet Knox	Project Manager	206.329.0141x222 or 206.842.2725 home	206.375.5432
Jeff Parker	Field Supervisor	Jenn Parker 206.734. 1359	206.734.0937
David Wampler	Safety Supervisor	Kevin Wampler 520.275.5134	520.275.8223
Theo Fehsenfeld	Staff	Tom Fehsenfeld 206.480.0418	206.437.5167
Client Contacts			
Dave Roberson	Client Contact	281.363.8733	281.685.2044
Organization/Agency			
Police Department (local)			911
Fire Department (local)			911
Ambulance Service (EMT will determine appropriate hospital for treatment)			911
Boating Emergency (U.S. Coast Guard)			Dial 911 or Call the Coast Guard on VHF Marine Channel 16
Oregon Emergency Response System (OERS):			Dial 911 or Call OERS at 800.452.0311
National Response Center (NRS) (as listed on the US Coast Guard Website)			1.800.424.8802
Hospital: Legacy Emanuel Medical Center, 2801 N Gantenbein Avenue, Portland, OR 97227			503.413.2200
Occupational Clinic: Adventist Health Occupational Medicine, 10201 SE Main Street, Portland, OR 97216			503.251.6363
Poison Control Center			800.222.1222
Pollution Emergency			800.424.8802

12.3 MUSTER LOCATION

The muster location is in the parking lot at the NRC/Fred Devine lot at 6211 N Ensign St, Portland, Oregon, 97217, as shown with the blue circle in the photograph below.

12.4 COMMUNICATIONS PROCEDURES

Use cell phone, satellite phone, and/or marine radio as appropriate and available.

12.5 INCIDENT REPORTING

Incidents involving or affecting a PGG employee or subcontractor will be reported immediately to 911 if emergency, and then in a prompt manner verbally to the Safety Supervisor and Project Manager.

- If the incident is a significant or life-threatening emergency, the employee or supervisor shall immediately dial 911 or the appropriate emergency contact phone number for your location.
- The employee must notify the Safety Supervisor.
- The employee or supervisor shall contact PGG Headquarters (206-329-0141 x 222) or Janet Knox's cell 206-375-5432.

- Client and account management notifications may apply. The Project Manager will make any necessary notifications.

Any injury, even if no treatment is required, and any incident for which assistance is needed must be immediately communicated to PGG.

Significant Incidents include:

- Fatality;
- Amputation;
- Hospitalization;
- Any single event resulting in more than one employee requiring medical treatment or more than one employee being away from work more than 3 days;
- Any H&S-related Consent Agreement/Order/Lawsuit or enforcement action;
- Any spill or release of a hazardous material that is reportable to a regulatory agency;
- Any Notices of Violation resulting from not operating within a regulatory agency permit/license or consent;
- Any incident resulting in property damage;
- Any security-related incident that could have caused significant harm to an PGG employee; and/or
- Any Near Miss event that may have resulted in any of the above consequences but because of "luck" did not result in harm to persons, property, or the environment.

All Other Incidents include:

- Any injury or illness to an PGG employee or subcontractor, even if it does not require medical attention, including work-related injuries/illnesses that have become significantly aggravated by the work environment;
- An injury to a member of the public, or clients, occurring on a PGG-controlled work area;
- Re-occurring conditions such as back pain or cumulative trauma disorders (e.g., carpal tunnel syndrome);
- Fire, explosion, or flash that is not an intended result of a planned event (e.g., remediation process, laboratory procedure);
- Any incident involving company-owned, rented, or leased vehicles (including personal vehicles used for company business); and/or
- Any failure to comply with the requirements of a regulatory permit issued to PGG.

12.6 MEDICAL EMERGENCIES

In the event of a life-threatening or critical emergency, PGG employees should dial 911 and follow the recommended instructions. However, in less serious situations such as a sprain or cut, and only by the Safety Officer's and injured employee's fully cognitive consent, an injured employee may be driven to the project-designated clinic or hospital. A map to the designated hospital and clinic is attached as Attachment A, and the locations and addresses are included in the table above as well as in the HASP Summary on Page i.

12.7 VEHICLE INCIDENTS

All vehicles should be rented through Enterprise when possible and Enterprise-offered full coverage insurance should be included in the rental rate. Drivers must print and carry the applicable insurance policy for the rental.

In the event of a vehicle incident (including collisions as well as mechanical difficulties such as breakdowns and flat tires) the following responses are recommended:

- For breakdowns and flat tires, contact an emergency provider.
- For rental vehicles, contact the rental company. Enterprise Roadside Assistance can be reached at 1-800-307-6666.
- To the extent possible, PGG personnel should not change flat tires or perform similar repairs.
- If a collision has occurred, assess the situation and move all occupants (except the injured) out of further harm's way. If safe to do so, remove the car from the traveled way. Call 911 if necessary, and
- Report the incident to PGG as soon as practical.
- If appropriate, wait for police to arrive before moving vehicles. Provide insurance information to other drivers if necessary or requested and collect the same. If possible, obtain names and phone numbers of witnesses. Take photographs of the event to document the incident and condition of the vehicle(s).
- *Do not admit liability, agree to pay for damage, or sign a document related to an incident except as required by law.*

12.8 SPILL OR RELEASE

PGG employees or subcontractors are not expected to take action or to participate in rescues or responses to chemical releases (including of petroleum products) beyond the initial discovery of the release and immediate mitigation actions such as closing a valve, placing absorbents, and notifying the client and or public emergency response system (911), unless there is a contractual provision for this response and specially trained employees.

NRC Spill Response will be available for this project to respond to spills or releases. Contact information is 1-800-424-8802.

12.8.1 Environmental Spill/Release Reporting

All environmental spills or releases of hazardous materials (e.g., fuels, solvents, etc.), whether in excess of the Reportable Quantity or not, will be reported to the Field Coordinator and Project Manager who will contact NRC for Spill Response. For this sediment sampling, the most likely spill risk is sediment coring wherein the core encounters buried Nonaqueous Phase Liquid. A spill may also occur due to vessel fuel or lubricant leaks. Both these releases are primarily Gravity Marine's Spill Response responsibility.

If any event occurs in the performance of the field work that causes or threatens to cause a release of Waste Material on, at, or from the Site and that either constitutes an emergency situation or that may present an immediate threat to public health or welfare or the environment, Respondents shall:

- Immediately call NRC Spill Response and take all appropriate action to prevent, abate, or minimize such release or threat of release.
- Immediately contact the Project Manager (Janet Knox) who will contact client (Dave Roberson).

PGG will confirm with NRC Spill Response that appropriate spill reporting is performed. The Oregon Department of Environmental Quality requires the following spills be reported:

- Spill reporting includes any amount of oil (oil-based fluids) to waters of the state.
- Oil spills on land in excess of 42 gallons.
- Hazardous materials that are equal to the quantities provided in the table below. The following numbers must be called in the event of a release:

The Oregon Emergency Response System:	1-800-452-0311
The National Response Center:	1-800-424-8802
The EPA Project Coordinator (or if he/she cannot be reached) the EPA Emergency Response Unit for Region 10	206-553-7660 (project coordinator – David Zhen) 206-553-1263 (emergency response unit)

Hazardous Substance	Regulatory Synonyms	Final Reportable Quantity (pounds)
1,1,1-Trichloroethane	TCA	1,000
Arsenic	N/A	1
Benzene	N/A	10
Cadmium	N/A	10
Carbon Tetrachloride	N/A	10
Chromium	N/A	5,000
Ethyl Benzene	N/A	1,000
Lead	N/A	10
Mercury	N/A	1
Methyl Ethyl Ketone	MEK	5,000

Nickel	N/A	100
Pentachlorophenol	PCP	10
Selenium	N/A	100
Tetrachloroethylene	Perchloroethylene, PCE	100
Toluene	N/A	1,000
Trichloroethylene	Trichloroethene, TCE	100
Xylene	N/A	100

To the best of the PGG team's ability be ready with the following information:

- Where is the spill?
- What was spilled?
- How concentrated is the spilled material?
- Who spilled the material?
- Is anyone cleaning up the spill?
- Are there resource damages (e.g. impacted wildlife)?
- Who is reporting the spill?
- How we can get back to you?

CERCLA Reportable Quantities can be found at: http://www.epa.gov/oem/docs/er/302table01.pdf

The spill containment program addresses the following site-specific information:

- Potential hazardous substance spills and available controls;
- Initial notification and response;
- Spill evaluation and response; and
- Post-spill evaluation, including:
  - Date of spill incident
  - Cause of incident
  - Spill response actions
  - Any outside agencies involved, including their incident reports
  - Lessons learned or suggested improvements

12.9 FIRE

PGG employees are not expected to attempt to put out fires. Stop work, notify all PGG personnel on-site, move upwind, and contact 911 and/or emergency response at the study area. If employees have been properly trained in the operation of a fire extinguisher, they may attempt to put out a small fire, provided that the following conditions are met:

The fire must be small (i.e., smaller than a trash can) and in its early stages.

- The employee must have an escape route.
- The employee must be trained and know they have the right type of extinguisher.
- The employee must be safe from toxic gases.
- There must be no hazardous conditions that could quickly accelerate the fire (i.e., presence of chemicals or materials, especially dry grass, etc.).
- Above all, if in doubt, the employee must not attempt to fight the fire.

13.0 PERSONNEL AND VISITOR ACKNOWLEDGEMENT

By signing below, the undersigned acknowledges that he/she has reviewed the PGG Health and Safety Plan for the Swan Island Lagoon Surface and Subsurface Sediment Investigation. Visitors will also sign below upon reading and agreeing to comply with the HASP. The undersigned also acknowledges that they have been instructed in the contents of this document and understands the information pertaining to the specified work, and will comply with the provisions contained therein. The employee understands that they are not to perform any work that they have not been adequately trained for and that they are to stop work if it is unsafe to proceed. Finally, the employee understands to notify the Safety Supervisor and PGG Headquarters for any incident, including any injury even if no first aid or medical treatment is required.

PRINT NAME	SIGNATURE	ORGANIZATION	DATE
Jeffrey Parker	[signature]	PGG	10/23/18
PETER JENKINS	[signature]	GRAVITY	10/23/18
ED SLOAN	[signature]	GRAVITY	10/23/18
Matt Luxon	[signature]	Acme Env.	10/23/18
Dave Roberson	[signature]	demaximis	10/24/18

APPENDIX A
DIRECTIONS TO MEDICAL FACILITIES

Hospital Location Maps

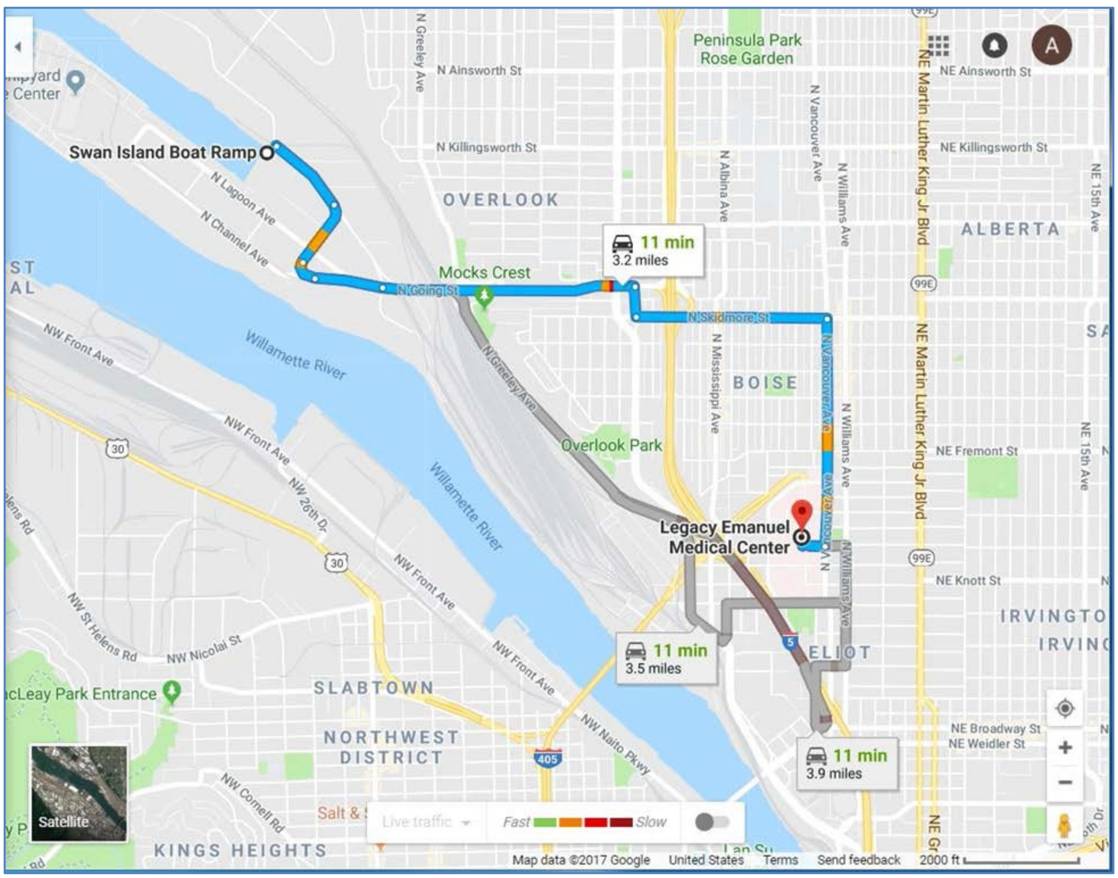
Legacy Emanuel Medical Center

2801 N Gantenbein Ave Portland, OR 97227

503-413-2200

From Swan Island Boat Ramp:

1) Head southeast on N Basin Ave toward N Emerson St
2) Continue onto N Anchor St
3) Use any lane to turn slightly left to stay on N Anchor St
4) Continue straight onto N Channel Ave
5) Continue onto N Going St
6) Turn right onto N Maryland Ave
7) Turn left onto N Skidmore St
8) Turn right onto N Vancouver Ave
9) Turn right onto N Stanton St Destination will be on the right.



PgG

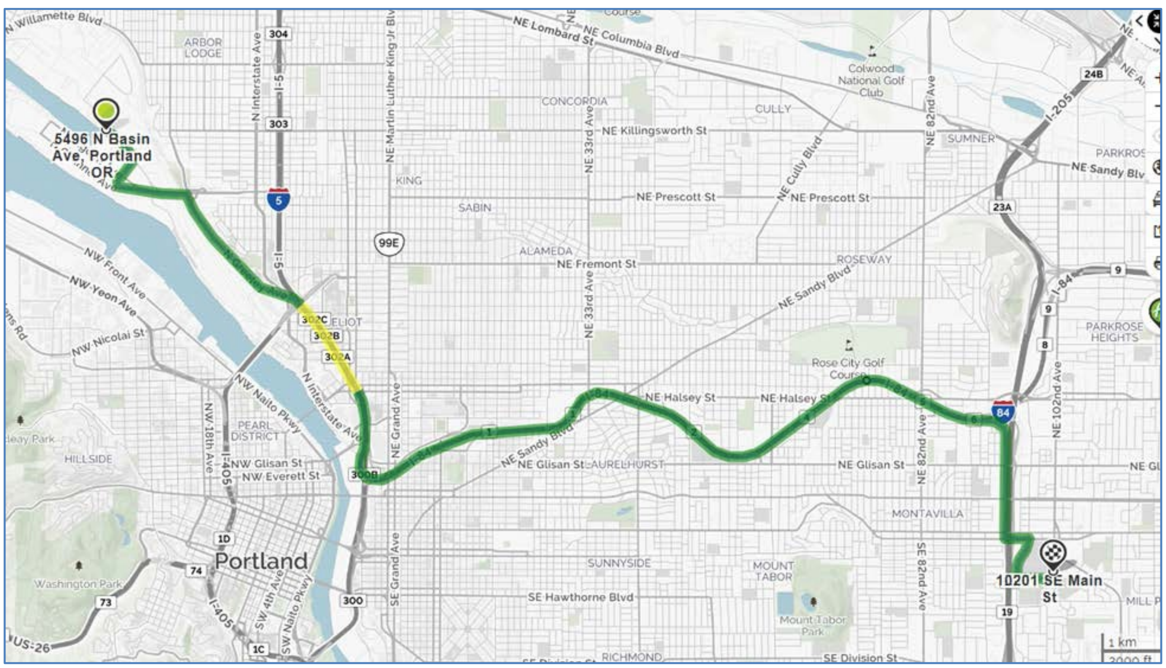
Adventist Health Occupational Medicine

10201 SE Main Street Portland, OR 97216

503-408-7010

From Swan Island Boat Ramp:

1) Head southeast on N Basin Ave toward N Emerson St
2) Stay straight to go onto N Anchor St
3) Keep left at the fork to continue on N Anchor St
4) Turn slight left onto N Channel Ave
5) N Channel Ave becomes N Going St
6) Turn slight right onto ramp
7) Merge onto N Greeley Ave
8) Merge onto I-5/Pacific Hwy 1 S toward Salem
9) Merge onto I-84 E/US-30 E via Exit 301 toward The Dalles
10) Take Exit 6 toward Salem
11) Keep right to take the Glisan St/Stark St ramp
12) Turn left onto SE Washington St
13) Turn right onto SE 99th Ave
14) Turn left onto SE Main St
15) Your destination is on the left.



APPENDIX B
SAFETY INFORMATION AND RESPONSIBILITIES FOR SPECIFIC HAZARDS

Cold Stress

Terms and Definitions

- Cold Stress – The production of physiological effects due to cold temperatures and\or wind chill.
- Equivalent Chill Temperature (ECT) – Also known as Wind Chill (see below).
- Frostnip – Superficial cooling of tissues without cellular destruction.
- Frostbite – Freezing of tissue, resulting in tissue destruction.
- Hypothermia – Condition of reduced core body temperature to 95oF (35oC) resulting in loss of dexterity, loss of mental alertness, collapse, and possible death.
- Wind Chill – The combined effect of air temperature and wind. Also expressed as "equivalent chill temperature" (ECT), wind chill is defined as heat loss resulting from the effects of air temperature and wind velocity upon exposed skin.

Roles and Responsibilities

Manager

- Ensuring the safety of employees on their project sites, consistent with regulatory standards.
- Implement cold stress prevention measures as applicable at each work site.
- Develop/coordinate a work-warning regimen, as applicable.
- Confirm cold stress hazard assessments/evaluations were completed for the planned activities.
- Assign employees physically capable of performing the assigned tasks. Consider acclimation to cold weather when evaluating employee capability.
- Confirm employees are properly trained to recognize the symptoms of cold stress.
- Provide cold stress awareness training.

Safety Supervisor

- Conduct/support cold stress assessments/evaluations.
- Conduct/support incident investigations related to potential cold stress-related illnesses.
- Assist project teams develop appropriate work-warming regimens.
- Identify the tasks that may be most impacted by cold stress and communicate the hazard to the assigned employees.
- Confirm that employees have been trained on the recognition of cold stress-related illnesses.
- Confirm that adequate supplies of warm fluids/drinks are readily available to employees.
- Confirm that a warm/sheltered rest area is available, as applicable.
- Conduct cold stress monitoring, as applicable.
- Implement the work-warming regimen.
- Confirm that first aid measures are implemented once cold stress symptoms are identified.
- Confirm that employees are physically capable of performing the assigned tasks and are not in a physically compromised condition.

Employee

- Observe each other for the early symptoms of cold stress-related illnesses.
- Maintain an adequate intake of available fluids.

- Report to work in a properly rested condition.
- Report all suspected cold stress-related illnesses.

Requirements

Carefully plan work anticipated to be performed in cool or cold conditions. If possible, heavy work should be scheduled during the warmer parts of the day or when the wind is most calm. Include costs in project budgets for specialized equipment and supplies needed to complete the field activities.

Monitor weather forecasts and weather conditions such as ambient temperature, wind speed, and precipitation. Use observations prior to entering and while in the field to ensure appropriate protections are in place:

- If possible, move the work to a warm location or add shelter/warming to existing work areas.
- If possible, adjust schedule according to the cold conditions, work level and worker acclimatization.
- Take frequent short breaks in warm dry shelters to allow your body to warm up. Limit time of exposure to the cold.
- Provide assistance to prevent body heat loss, such as warm packs, warm non-caffeinated liquids, high-calorie food/snacks, portable heaters, additional PPE, etc.

Before they begin work in a cold environment, employees that might be exposed to cold stress will be informed of the potential for cold stress, how to prevent cold stress, and how to apply first aid if cold stress occurs – including when to contact emergency services.

Personal Protective Equipment (PPE)

Wearing the right clothing is crucial to avoiding cold stress. The type of fabric also makes a difference. Cotton loses its insulation value when it becomes wet. Wool, on the other hand, retains its insulation even when wet. Adequate insulating dry clothing will be required in air or wind chill temperatures below 40 °F (4.4°C).

- Wear at least 3 layers of clothing to help prevent cold stress. It is important to preserve the air space between the body and the outer layer of clothing to retain body heat.
- Wear a middle layer of down, wool, or similar materials to provide insulation.
- Avoid cotton, especially blue jeans.
- Wear an outer layer to break the wind and allow some ventilation (e.g., Gortex® or nylon)
- Do not wear tight clothing. Loose clothing allows better ventilation.
- Wear proper clothing, including head coverings, insulated boots/foorwear, and gloves or mittens for cold, wet, and windy conditions.
- Wear a hat or hardhat liner. Up to 40 percent of body heat can be lost when the head is left exposed.
- Keep a change of dry clothing available in case work clothes become wet.

Adequate, insulating dry clothing that will help maintain core temperatures above 96.8°F (37°C) shall be provided to employees if work is performed in air temperatures below

40°F (4.4°C). Wind chill cooling rate and the cooling power of air are critical factors. The higher the wind speed and the lower the temperature in the work area, the greater the insulation value of the protective clothing required.

If fine work is to be performed with bare hands for more than 10 to 20 minutes in an environment below 60°F (15°C), special provisions should be established for keeping the employees' hands warm. For this purpose, warm air jets, radiant heaters (fuel burner or electric radiator), contact warm plates, or equivalent heating approach should be used.

At air temperatures of 40°F (4.4°C) or less, it is imperative that employees who become immersed in water or whose clothing becomes wet be immediately removed from the cold environment, provided a change of clothing, and be treated for hypothermia.

If the air velocity at the job site is increased by wind, draft, or artificial ventilating equipment, the cooling effect of the wind should be reduced by shielding the work area or by wearing an easily removable windbreak garment. Operation of internal combustion or similar devices within warming shelters is prohibited.

If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work should be modified or suspended until adequate clothing is made available or until weather conditions improve.

Hand and Power Tools

Roles and Responsibilities

Safety Supervisor

- Ensure that all aspects of this procedure are followed and adhered to.
- If a specific tool is not included in the work instructions related to this procedure, appropriate guidelines shall be established prior to work associated with that tool.
- Ensure compliance with applicable client requirements and restrictions regarding hand or power tools.
- Provide technical guidance and support as to this procedure and associated work instructions.

Employees

- Work only with tools for which they are appropriately trained and familiar with.
- Follow manufacturer's recommendations for its use and never modify the equipment without first obtaining authorization from the manufacturer.
- Comply with applicable client requirements and restrictions regarding hand or power tools.

Requirements

- Always refer to the Job Hazard Assessment prior to work commencing and include the identified hazards associated with the anticipated tool use.
- No employee shall use any hand or power tool, unless they are familiar with the use and operation of the equipment or have received specific instruction on its use and operation.

- All tools will be used for which they were designed and in accordance with manufacturer's specifications.
- Use approved tools only. Never modify or use makeshift tools.
- Do not apply excessive force or pressure on tools unless permitted by the manufacturer's specifications. This includes additional force by hammering with body weight, foot or other tools.
- Keep surfaces and handles clean and free of excess oil and grease to prevent slipping.
- Do not carry sharp tools (e.g. knife, chisel, screwdriver, etc.) in pockets.
- All tools shall be properly maintained. Clean, dry, lubricate and repair tools as applicable, and return to a suitable toolbox, room, rack, or other storage area upon completion of a job.
- Ensure proper ergonomics principles are observed when using hand and power tools, such as but not limited to:
    - Avoid static and awkward positions when possible.
    - Move at intervals to reduce muscle fatigue.
    - Do not apply excessive force or pressure on tools.
    - If possible use tools with comfortable grips that are designed to allow the wrist to stay straight. Avoid using a bent wrist.
    - Ensure proper body positioning when using a tool to prevent slips or falls in the event of unanticipated tool behavior (slip, kickback, etc.). Avoid over-reaching.
    - Pull on tools such as a wrench or pliers whenever possible. Loss of balance is more likely when pushing if the tool slips. If pushing is necessary, hold the tool with an open palm.
    - When using power tools, reduce power to the lowest setting that can complete the job safely. This action reduces tool vibration at the source. Consider the need for controls such as limiting time of use.
- When working with utility knives:
    - Draw the knife away from the body, not towards the body.
    - Keep extremities away from the cutting path.
    - Ensure that the blade is sharp and properly installed in the knife.
    - Hand knife to co-worker with the handle first.
    - Cover cutting edge of blades with tape prior to disposal.
- Ensure hand, fingers, and other appendages for the user of the tool and nearby personnel have sufficient clearance in case a tool slips during use.
- Ensure the work surface is stable.
- Utilize good housekeeping practices to ensure tools do not present a tripping or falling hazard.
- Do not throw tools from place to place or from person to person, or drop tools from heights. Hand them, handle first, directly to other workers.
- If the task presents electrical hazards, worker must be competent and use the appropriate insulated tools to perform work that includes the risk of electrical shock. Cushioned grip handles do not protect against electrical shock.
- Do not allow loose clothing, long hair, loose jewelry, rings, and chains to be worn while working with power tools.

Inspections

All tools must be inspected prior to each use. Any tool that is defective or has missing parts must not be used, and shall be tagged ‘out of service’ or ‘do not use’ and immediately removed from service. Tagged tools will be returned to the supervisor for repair or replacement.

Heat Stress

Terms and Definitions

- Acclimated – Employees who have developed physiological adaptation to hot environments characterized by increased sweating efficiency, circulation stability, and tolerance of high temperatures without stress. Acclimatization occurs after 7 to 10 consecutive days of exposure to heat and much of its benefit may be lost if exposure to hot environments is discontinued for a week.
- Chemical Protective Clothing (CPC) – Apparel that is constructed of relatively impermeable materials intended to act as a barrier to physical contact of the Employee with potentially hazardous materials in the workplace. Such materials include Tyvek coveralls (all types) and polyvinyl chloride coveralls and rain suits.
- Heat Cramps – A form of heat stress brought on by profuse sweating and the resultant loss of salt from the body.
- Heat Exhaustion – A form of heat stress brought about by the pooling of blood in the vessels of the skin and in the extremities.
- Heat Rash – A heat-induced condition characterized by a red, bumpy rash with severe itching.
- Heat Stress – The combination of environmental and physical work factors that constitute the total heat load imposed on the body.
- Heat Stroke – The most serious form of heat stress, which involves a profound disturbance of the body's heat-regulating mechanism.
- Sunburn – Caused by unprotected exposure to ultraviolet radiation present in sunlight that is damaging to the skin. The injury is characterized by red painful skin, blisters, and/or peeling.
- Unacclimated – Employees who have not been exposed to hot work conditions for one week or more or who have become heat-intolerant due to illness or other reasons.

Roles and Responsibilities

Managers

- Evaluate the need for heat illness prevention measures and incorporate as appropriate into the Job Hazard Assessment.
- Allocate sufficient resources for the management of heat illness in the field including the provision of water, a shaded break area, and sufficient schedule to allow for breaks.
- Provide heat illness awareness training.
- Assist in developing appropriate work-rest schedules.

Safety Supervisor

- Ensure personnel have received heat illness awareness training.
- Assist in developing appropriate work-rest schedules.
- Conduct/support incident investigations related to potential heat stress-related illnesses.
- Identify those tasks that may be most impacted by heat stress and communicate the hazard to the assigned Employees.
- Confirm that Employees have been trained on the recognition of heat stress.
- Confirm that this procedure is made available to affected Employees.
- Confirm that adequate supplies of appropriate fluids are readily available to Employees.
- Confirm that a proper rest area is available.
- Conduct heat illness monitoring, as applicable.
- Implement the work-rest schedule.
- Confirm that first aid measures are implemented once heat stress symptoms are identified.
- Confirm personnel are physically capable of performing the assigned tasks and are not in a physically compromised condition.
- Report all suspected heat illnesses.

Employee

- Observe each other for the early symptoms of heat illnesses.
- Maintain an adequate intake of available fluids, even if not thirsty.
- Be familiar with heat stress hazards, predisposing factors, and preventative measures.
- Report to work in a properly vested and hydrated condition.
- Report all suspected heat stress-related illnesses

Exposure Controls

It shall be determined whether Employees are or may be exposed to hazardous heat levels. The Field Coordinator shall:

Conduct a heat stress assessment to determine the potential for hazardous exposure of Employees. Assessment shall include, but not limited to:

- Ambient temperature.
- Amount of sunshine (cloudy, clear).
- Weather forecast.
- Other radiant heat sources (e.g. motor, fire, etc.).
- Humidity.
- Air flow.
- Amount or type of physical labor being performed,
- Physical condition of the Employees (e.g., acclimated/not)
- Protective clothing in use.

If potential for hazardous exposure is identified, the Supervisor shall develop and implement a heat stress exposure control plan.

If Employees are or may be exposed, the Supervisor shall:

- If practicable, implement engineering controls (e.g., shelters, cooling devises, etc.) to reduce the exposure of Employees to levels to safe levels. If engineering controls are not practicable, Employee exposure shall be reduced by providing administrative controls, including a work-rest cycle or personal protective equipment.

- If Employees are or may be exposed, the Supervisor shall provide and maintain an adequate supply of cool, fresh, potable water close to the work area for the use of a heat exposed Employee.
- Monitor Employees for signs of potential heat stress. Frequency of monitoring may be increased or decreased depending upon such factors as worker fitness, acclimatization, temperature of the work environment, type of PPE, etc.
- If an Employee shows signs or reports symptoms of heat stress or strain, they shall be removed from the hot environment and treated by an appropriate first aid attendant on site, if available, or by a physician.
- Determine the approximate workload of each worker or group of workers. Use the collected information to develop appropriate work to rest schedules.

Employees shall be instructed in the recognition of heat stress symptoms, the first aid treatment procedures for severe heat stress, and the prevention of heat stress injuries. These symptoms can include nausea or dizziness, heat cramps, extreme thirst, or very dark urine.

Employees shall be encouraged to immediately report any heat stress that they may experience or observe in fellow Employees.

Additional guidelines

- Take frequent short breaks in areas sheltered from direct sunlight; eat and drink small amounts frequently.
- Dry clothing or towels will be available to minimize chills when taking breaks.
- Try to schedule work for the coolest part of the day, early morning and evening.
- Avoid strenuous physical activity outdoors during the hottest part of the day.
- Consult a physician if using medication during work in potential high-heat conditions.
- When working in heat, drink 1 quart of water per hour of work.
- Monitor urine frequency and color to detect dehydration.
- The Buddy System is required when working in high-heat conditions to enable effective communication and cross-observation for indications of heat stress.
- If an Employee is recovering from signs or symptoms of heat stress, they are not to be left alone, and vitals are to be monitored by a trained person during the Employee's recovery. These may include oral temperature, pulse rate, blood pressure, and other indicators of potential heat stress. Values associated with this monitoring shall be recorded.
- Initiate emergency response procedures when necessary.

Personal Protective Equipment

- Wear a hat and light-colored, loose-fitting clothing to reflect the sun.
- Apply sunscreen to exposed skin (SPF 30 or greater, follow directions on label).
- Wear sunglasses with UV protection.
- Pack extra water (chilled when feasible) to avoid dehydration.

- Breaks will be taken in a cool, shaded location, and any impermeable clothing should be opened or removed.

APPENDIX C
JOB HAZARD ASSESSMENT

Job Hazard Assessment

Principal Activities	**Potential Safety/Health Hazards**	**Control Measures**
List principal activities involved in the scope of work	Identify each safety or health hazard	Identify engineering and administrative controls and any specific Personal Protective Equipment (PPE) that is required
ACTIVITY 1 – Mobilize equipment and personnel to study area.	Traffic/driving hazards	• All drivers must have current, valid driver's license on their person. • Complete pre-use visual inspection. Walk around the vehicle to inspect for potential hazards or mechanical issues before driving. • Practice defensive driving and drive in a courteous manner. • Seat belts must be worn by the driver and all passengers. • Obey all speed limits. • Drivers must not use cellular telephones or other communication devices such as two-way radios unless safely parked. • Window surfaces must be cleared of any materials such as ice, frost, mud, or water that can impair visibility. • Travel with headlights on at all times. • Travel during daylight hours when possible. • Equip vehicles with first aid kit, traffic cones, spare tire and jack, cell phone. • Limit activities to no more than 14-hour days. Implement fatigue management plan for >12 hour days.
	Parking hazards	• Park in a clear location, and when feasible back in to parking location to avoid backing out upon departure.
	Lifting hazards/muscle strain	• Practice proper lifting and manual handing of materials and equipment, lift with the knees, avoid twisting, and seek assistance or employ additional handling equipment as needed.
		• Wear abrasion gloves when moving equipment. • No personnel should lift more than 40 pounds without assistance or mechanical aid. Know what items weigh before lifting or test them carefully.

ACTIVITY 2 – Hold Tailgate Safety Briefings and perform daily hazard analysis; review applicable safety procedures; inspect and don Level D PPE; inspect tools and equipment.	Incorrect PPE usage	• Safety Officer should check that required Level D PPE is being used.
	Equipment malfunction	• User should inspect equipment before use.
	Lack of knowledge of tasks being performed	• Discuss tasks to be performed by personnel, potential hazards, and control measures.
	Potential incidents and emergencies	• Follow daily safety briefing regarding work to be performed. • Inform workers of emergency contact information, emergency procedures, and hospital route.
	Severe weather	• Include discussion of severe weather hazards in daily safety briefing and monitor throughout the duration of the task. Implement severe weather procedures as applicable.
	Potential contaminant exposure	• Inform workers of potential for contaminant exposure and implement contaminant exposure avoidance procedures outlined in HASP, as applicable.
ACTIVITY 3 – Evaluate area for hazards (this should be performed regularly throughout the duration of the task).	Slips, trips, and falls	• Personnel should identify and take measurable cautionary steps to observe areas for hazards: ensure pathways are clear and free of obstruction prior to initiating work, ensure all lines are secure prior to initiating work, and adhere to proper housekeeping practices.
	Heat stress/cold stress	• Begin heat stress/cold stress monitoring as applicable and continue throughout duration of task. • Implement heat stress/cold stress prevention procedures, as applicable. • Heat stress: drink plenty of fluids and use appropriate work/rest schedule. • Cold stress: dress in appropriate cold-weather clothing and bring change of dry clothing stored in waterproof bag.
	Water hazards	• Follow all appropriate water safety rules and regulations. • Use appropriate Level D PPE and PFD.
	Severe weather	• Assess severe weather hazards and implement appropriate severe weather procedures.
	Potential contaminant exposure	• Maintain awareness of potential contaminant exposure and implement contaminant avoidance procedures.

ACTIVITY 4 – Load personnel and equipment onto vessel.	Lifting hazards/muscle strain/ergonomic hazards	• Practice proper lifting and manual handing of materials and equipment, lift with the knees, avoid twisting, and seek assistance or employ additional handling equipment as needed. • Wear abrasion gloves when moving equipment. • No personnel should lift more than 40 pounds without assistance or mechanical aid. Know what items weigh before lifting or test them carefully. • Transfer equipment to people on boat rather than carrying equipment onto boat.
	Vessel boarding hazards	• Receive vessel operator's training prior to boarding vessel. • Follow vessel operator's instructions for boarding vessel. • Wear appropriate Level D PPE, including correct type of Personal Flotation Device (PFD). • Maintain three points of contact when boarding vessel. • Follow vessel operator's instructions for loading equipment onto vessel.
	Pinch points/hand injuries	• Be aware of hands, feet, arms, and position of all personnel during tool use and equipment handling. Never position a hand or appendage where it can be pinched or otherwise come into uncontrolled contact with a tool if a wheel rotates, a load releases, or a tool slips.
	Slips, trips, and falls	• Wear appropriate footwear with non-slip soles. • Ensure pathways are clear and free of obstruction prior to initiating work, ensure all lines are secure prior to initiating work, and adhere to proper housekeeping practices. • Maintain three points of contact when boarding vessel.
ACTIVITY 5 – Work aboard a research vessel on water.	Slips, trips, and falls	• Wear appropriate footwear with non-slip soles, and Level D PPE with PFD. • Ensure pathways are clear and free of obstruction prior to initiating work, ensure all lines are secure prior to initiating work, and adhere to proper housekeeping practices. • Maintain three points of contact at all times.
	Lines under tension/line of fire	• Avoid keeping lines/ropes/cables under tension. Keep as much distance as possible between you and any source of potential energy release.

	Moving parts/pinch points/hand injuries	• Be aware of hands, feet, arms, and position of all personnel during tool use and equipment handling. Never position a hand or appendage where it can be pinched or otherwise come into uncontrolled contact with a tool if a wheel rotates, a load releases, or a tool slips.
	Water hazards	• Adhere to all federal, state, and local boating and licensing laws. • Work must be performed in accordance with the "Buddy System" Regulations. • US Coast Guard (USCG)-approved PFD, sized and adjusted to the wearer, shall be worn by all workers when aboard the research vessel. • Vessel operator will provide a safety orientation on boating operations prior to departing dock, which will cover the following: man overboard, power loss/disabled boat, fire onboard, medical emergency. • Ring buoys with at least 90 feet of line shall be provided and readily available for emergency rescue operations. • Ensure vessel has secondary means of propulsion such as oars or paddles. • Workers are to remain seated when vessel is in motion. Avoid standing in vessel whenever possible.
	Man overboard (MOB)/incapacitated person	• Vessel operator will review USCG MOB procedures: • No low visibility/night operations will occur. • When deploying equipment, do not lean over the boat. • Perform safety briefing prior to departure and discuss MOB recovery procedure. • Wear Type I, II, or III PFD at all times on board a boat or on dock. • Person who observes person fall overboard must keep their eyes on him/her. • Immediately cease work operations and commence a rescue procedure. • Bring the vessel to the position of the person in the water (as opposed to having the person swim to the boat). • Throw PFDs or other floatable items into the water to assist the person overboard. • Send a distress call on Channel 16 if person is un-responsive or severely injured.

	Boat in danger of sinking	• Vessel operator will be responsible; however, if the vessel crew is incapacitated, the following procedure shall be followed: • Send a distress call: PANPAN call over VHF Channel 16 if boat is not in imminent danger. • Send a distress call: MAYDAY call over VHF Channel 16 if boat is in imminent danger. • Turn on the bilge pump to begin pumping water to outside of boat. • Assemble the emergency pump and begin pumping water.
	Vessel fire	• Review fire extinguisher location and quantity and confirm fire extinguishers are charged prior to leaving dock. • Remember P.A.S.S: - **P**ull the Pin - **A**im the fire extinguisher at the base of the fire - **S**queeze the handle - **S**weep the base of fire side to side • Hail for help using distress call PANPAN if the boat is not in immediate danger, or MAYDAY if the boat is in immediate danger. • Inflate life raft/abandon ship if necessary (e.g., risk of explosion).
	Medical emergency	• Review first aid kit location and contents prior to departure. • AED shall be rented for the work. • If a severe injury occurs, initiate a MAYDAY call.
	Heat stress/cold stress	• Begin heat stress/cold stress monitoring as applicable and continue throughout duration of task. • Implement heat stress/cold stress prevention • procedures, as applicable. • Heat stress: drink plenty of fluids and use appropriate work/rest schedule. • Cold stress: dress in appropriate cold-weather clothing and bring change of dry clothing stored in waterproof bag.
	Severe weather hazards	• Include discussion of severe weather hazards in daily safety briefing and monitor throughout the duration of the task. Implement severe weather procedures as applicable. • Stop work during severe weather.
	Other commercial/recreational vessel traffic hazards	• Adhere to all federal, state, and local boating and licensing laws.

ACTIVITY 6 – Use a powered grab system to collect the surface sediment samples.	Powered clamshell operation	• Verify that operator is qualified and working in a safe manner. • Ensure that all personnel are familiar with the location of the Emergency Shut-off switches prior to operation and maintain a suitable distance from the operating equipment. • Clamshell operator needs to complete equipment inspection daily prior to initiating study activities. • Use appropriate Level D PPE, including PFD.
	Moving parts/pinch points/hand injuries	• Be aware of hands, feet, arms, and position of all personnel during tool use and equipment handling. Never position a hand or appendage where it can be pinched or otherwise come into uncontrolled contact with a tool if a wheel rotates, a load releases, or a tool slips.
ACTIVITY 7 – Use a Vibracore System to collect subsurface sediment samples.	Drill operation (Vibracore System)	• Verify that operator is qualified and working in a safe manner. • Ensure that all personnel are familiar with the location of the Emergency Shut-off switches on the drill rig prior to operation and maintain a suitable distance from the operating drilling. • Drill rig operator needs to complete drill rig inspection daily prior to initiating project activities. • Use Level D PPE including hard hats, safety glasses, high visibility PFD. • Maintain awareness of the potential of contaminant exposure and implement contaminant exposure avoidance procedures.
	Moving parts/pinch points/hand injuries	• Be aware of hands, feet, arms, and position of all personnel during tool use and equipment handling. Never position a hand or appendage where it can be pinched or otherwise come into uncontrolled contact with a tool if a wheel rotates, a load releases, or a tool slips.
ACTIVITY 8 – Process samples on board vessel. Sediment sample will be transferred to a decontaminated stainless-steel bowl and homogenized with decontaminated stainless-steel spoon. Smaller samples will then be transferred to sample containers and stored until transported to shore for further processing.	Potential contaminant exposure	• Maintain awareness of potential contaminant exposure and implement avoidance procedures. • Use appropriate Level D PPE, including nitrile gloves.

ACTIVITY 9 – Remove the sediment core, cut, and cap. The sediment core will be cut into manageable lengths.	Lifting hazards/muscle strain	• Practice proper lifting and manual handing of materials and equipment, lift with the knees, avoid twisting, and seek assistance or employ additional handling equipment as needed. • Wear abrasion gloves when moving equipment. • No personnel should lift more than 40 pounds without assistance or mechanical aid. Know what items weigh before lifting or test them carefully.
	Potential contaminant exposure	• Maintain awareness of potential contaminant exposure and implement avoidance procedures. • Use appropriate Level D PPE, including nitrile gloves.
ACTIVITY 10 – Move the sediment core to the on-deck storage area and secure in a vertical position.	Lifting hazards/muscle strain	• Practice proper lifting and manual handing of materials and equipment, lift with the knees, avoid twisting, and seek assistance or employ additional handling equipment as needed. • Wear abrasion gloves when moving equipment. • No personnel should lift more than 40 pounds without assistance or mechanical aid. Know what items weigh before lifting or test them carefully.
	Potential contaminant exposure	• Maintain awareness of potential contaminant exposure and implement avoidance procedures. • Use appropriate Level D PPE, including nitrile gloves.
ACTIVITY 11 – Use hand drill to drill a small hole in the sediment core to drain excess water out once the sediment sample has settled.	Potential contaminant exposure	• Maintain awareness of potential contaminant exposure and implement avoidance procedures. • Use appropriate Level D PPE, including nitrile gloves.
ACTIVITY 12 – Move sediment cores off vessel by hand once docked.	Lifting hazards/muscle strain/ergonomic hazards	• Practice proper lifting and manual handing of materials and equipment, lift with the knees, avoid twisting, and seek assistance or employ additional handling equipment as needed. • Wear abrasion gloves when moving equipment. • No personnel should lift more than 40 pounds without assistance or mechanical aid. Know what items weigh before lifting or test them carefully. • Transfer equipment to people on boat rather than carrying equipment onto boat.

	Vessel offloading hazards	• Follow vessel operator's instructions for leaving vessel. • Maintain three points of contact when leaving vessel. • Follow vessel operator's instructions for transferring equipment and samples off vessel.
	Potential contaminant exposure	• Use proper tools for decontamination. • Wear appropriate Level D PPE. • Place spent decontamination water in appropriate containers or jugs, or discharge to site water as appropriate.
ACTIVITY 13 – Decontaminate equipment.	Lifting hazards/muscle strain	• Practice proper lifting and manual handing of materials and equipment, lift with the knees, avoid twisting, and seek assistance or employ additional handling equipment as needed. • Wear Level D PPE, with abrasion gloves when moving equipment. • Wear chemical resistant gloves over abrasion resistant gloves when handling contaminated equipment. • No personnel should lift more than 40 pounds without assistance or mechanical aid. Know what items weigh before lifting or test them carefully.
	Potential contaminant exposure	• Use proper tools for decontamination. • Wear nitrile gloves, and chemical goggles during the decontamination process • Follow other Standard Operating Procedures (SOPs) for decontamination as specified in the Field Sampling Plan.
ACTIVITY 14 – Load/transport sediment cores to core processing station.	Lifting hazards/muscle strain	• Practice proper lifting and manual handing of materials and equipment, lift with the knees, avoid twisting, and seek assistance or employ additional handling equipment as needed. • Wear Level D PPE, with abrasion gloves when moving equipment. • No personnel should lift more than 40 pounds without assistance or mechanical aid. Know what items weigh before lifting or test them carefully.

	Driving hazards	• All drivers must have current, valid driver's license on their person. • Complete pre-use visual inspection. Walk around the vehicle to inspect for potential hazards or mechanical issues before driving. • Practice defensive driving and drive in a courteous manner. • Seat belts must be worn by the driver and all passengers. • Obey all speed limits. • Drivers must not use cellular telephones or other communication devices such as two-way radios unless safely parked. • Window surfaces must be cleared of any materials such as ice, frost, mud, or water that can impair visibility. • Travel with headlights on at all times. • Travel during daylight hours when possible. • Equip vehicles with first aid kit, fire extinguisher, traffic cones, spare tire and jack, cell phone. • Ensure all loads are properly secured.
ACTIVITY 15 – Process sediment samples.	Lifting hazards/muscle strain	• Practice proper lifting and manual handing of materials and equipment, lift with the knees, avoid twisting, and seek assistance or employ additional handling equipment as needed. • Wear Level D PPE, with abrasion gloves when moving equipment. • No personnel should lift more than 40 pounds without assistance or mechanical aid. Know what items weigh before lifting or test them carefully.
	Hand tools	• Employees should work only with tools with which they are appropriately trained and familiar and should receive specific instruction on use and operation of unfamiliar tools. • Use tools only for their designated use and in accordance with manufacturer's specifications. • Use approved tools only. Never modify or use makeshift tools. • Ensure proper ergonomics principles are observed when using power tools. • Avoid placing fingers or other appendages in danger zones; ensure sufficient clearance in the event the tool slips. • Secure tools when not in use. • Do not allow loose clothing, long hair, loose jewelry, rings and chains to be worn when working with power tools.

	Potential contaminant exposure	• Maintain awareness of potential contaminant exposure and implement avoidance procedures. • Use appropriate PPE, including nitrile gloves.
	Ergonomic hazards	• Follow proper ergonomic practices.
ACTIVITY 16 – Ship sediment samples to lab for processing.	Lifting hazards/muscle strain	• Practice proper lifting and manual handing of materials and equipment, lift with the knees, avoid twisting, and seek assistance or employ additional handling equipment as needed. • Wear abrasion gloves when moving equipment. • No personnel should lift more than 40 pounds without assistance or mechanical aid. Know what items weigh before lifting or test them carefully.

APPENDIX D
SITE LOCATION MAP

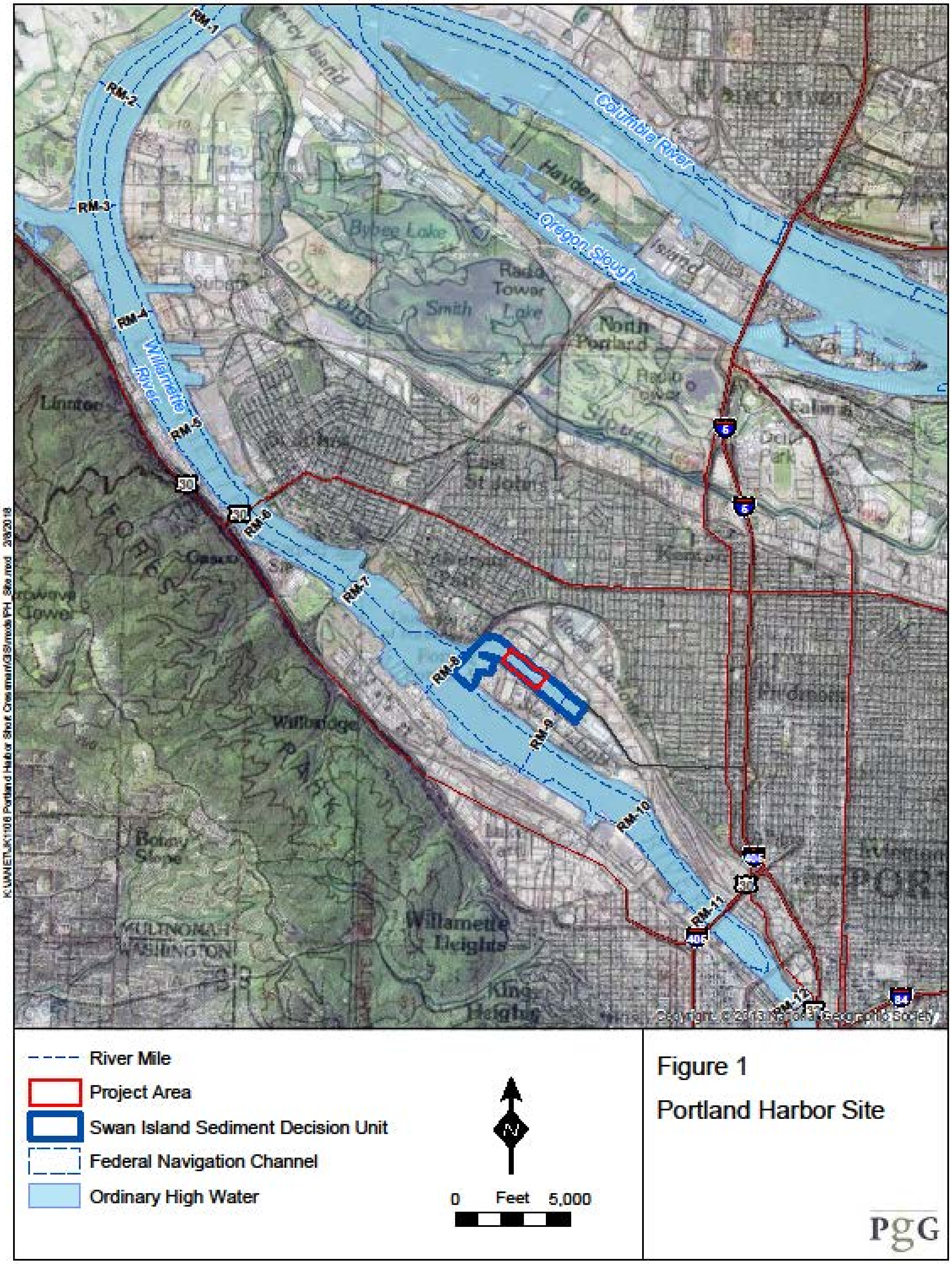


Figure 1

Portland Harbor Site

PgG

APPENDIX C
FIELD FORMS AND CHECKLISTS

Sediment Core Sampling Log

sheet __ of ___

Head of Swan Island Lagoon Sediment Characterization

Location ID:
Weather Conditions:
Sampling Crew:
Boat Crew:

Date:	/ /
Tide stage (ft)	
Water depth (ft)	
Mudline Elev. (ft NAVD 88)	
Core tube length (ft)	
GPS Elevation (ft NAVD88)	

Proposed Coordinates:	N:
	E:

Core Location and Attempts

Attempt #	Time	Actual Coordinates		Target Depth (ft)	Penetration Depth (ft)	Recovery Length (ft)	Recovery (%)	Accept (Y/N)	Drive Description
		Northing	Easting						

If core sectioned in the field for transport:

Section	Length (ft)	Description at Cuts
A		
B		
C		
D		

Core Tube Length (ft)

Additional Comments:

ACME ENVIRONMENTAL

Sediment Core Processing Form

sheet __ of ___

Head of Swan Island Lagoon Sediment Characterization

Location ID:	
Processing Crew:	

Collection Date:	/ /
Processing Date:	/ /

Recovered Length (ft)	PID	Torvane/ Penetrometer	Size % - G	Size % - S	Size % - F	Description (moisture, density, color, odor, sheen, biota, structure, other debris)	Sample Depth (ft)	Subsample #	Summary Sketch
1									
2									
3									
4									
5									
6									
7									
8									
9									
0									

Sample Information

	Subsample ID	**Time**	**Containers**			**Subsample ID**	**Time**	**Containers**
1	__-SC-__to__-10__18				5	__-SC-__to__-10__18		
2	__-SC-__to__-10__18				6	__-SC-__to__-10__18		
3	__-SC-__to__-10__18				7	__-SC-__to__-10__18		
4	__-SC-__to__-10__18				8	__-SC-__to__-10__18		

Additional Comments:

PgG

ACME ENVIRONMENTAL

Sediment Grab Sampling Log

Head of Swan Island Lagoon Sediment Characterization

Location ID:	
Weather:	
Sampling Crew:	
Boat Crew:	

Date:	/ /
Tide Stage (ft)	
Water Depth (ft)	
Mudline Elev. (ft NAVD88)	

Proposed Coordinates:	N:
	E:

GPS Elevation (ft NAVD88)	

Attempt No.	Time	Coordinates		Accepted (Y/N)	Photo (Y/N)	Recovery Depth (cm)	Water Depth (ft)	Comments
		Northing	Easting					

Sediment Description			
Moisture:	Density:	Color:	RPD (cm):
Odor:		Sheen:	
Grain Size % (G/S/F)		Biological:	
Structure:			
Other:			

Sample ID: ______-0to ______-10______18	**Time:**

Additional Comments:

PgG

ACME ENVIRONMENTAL

Equipment List -Boat

Quantity	Item
Health and Safety	
1	First Aid Kit
1	Eye Wash Kit
Each	Cell Phone
4 pr	Sure-grip work gloves
Each	Thermal glove liners
	Snacks
2 bottles each	Refillable water bottles
Personal Protective Equipment	
Each	Steel-toe rubber boots
Each	Rain gear
Each	Safety goggles
Each	Hard hat
12	Ear plugs
800	Disposable nitrile powder-free gloves
Documentation	
1	Camera
1	Dry-erase white board
6	Dry-erase pens (black or blue)
4	Rite-in-the-rain pens
1	Quality Assurance Project Plan
1	Field Sampling Plan
1	Standard Operating Procedures
1	Health and Safety Plan
3 or 4	Waterproof field log book
14 to 20 copies	Daily H&S Meeting form
140	Surface sediment collection forms
14	Core sample collection forms
14	Core sample processing forms
6	Correction forms
2 copies	Sample jar tracking sheet
1	Laminated soil particle size key
1	Munsell soil color key
from lab ~50	Chain-of-custody forms
2	Laminated maps of the site
1	Permits
Miscellaneous	
12 rolls to start	Paper shop towels
3 rolls	Duct tape
12	Assortment of fine- to thick-point sharpies
3	Various highlighter markers
6	Grease pencils
1	Utility knife and replacement blades
1	Scissors
1 big restaurant size rolls	Heavy duty foil

Equipment List -Boat

Sediment Processing Supplies	
2	Lead line
2	Stainless steel rulers
Gravity supplied	Grab siphon pump
Gravity supplied	Stainless steel bowls
Gravity supplied	Stainless steel spoons
6 Gravity will have more	5-gal buckets w/lids to hold sediment waste, decon waste, etc.
2	>20' measuring tape marked at 1/10 ft intervals
1 each	Sieves (2mm and 0.8 - #10 and #20)
1 packet	Filter paper
Decontamination Supplies	
Gravity supplied	Liquinox detergent
Gravity supplied	Dish scrub brushes
Gravity supplied	Long-handled nylon brushes
	Distilled water (for wash and first rinse)
2 gallons/d	Deionized/distilled/organic-free water (from ALS)
2	New garden sprayers for deionized/distilled/organic-free water rinse
2	5-gal buckets (to keep garden sprayers upright)
4	1-gallon glass jars
Gravity supplied	Large rectangular wash bins with high sides (and lids)
Sample Packaging/Shipping	
2352	Sample jars
2352	Sample jar labels
	Clear packing tape
17 rolls	
2,353	Zip-lock bags (1 for each jar)
50	1-gallon zip-lock bags
1 box	2-gallon zip-lock bags
See notes	Bubble wrap
from lab ~50	Coolers
112	Plastic garbage bags
purchased daily	Ice (wet)
7,056"	Fiber tape
from lab ~50	Temperature blanks
from lab ~50	COC seals from lab
from lab ~50	Shipping forms

Equipment List -Core Processing

Quantity	Item
Health and Safety	
see boat	First Aid Kit
see boat	Eye Wash Kits
see boat	Cell Phone
see boat	Thermal glove liners
Personal Protective Equipment	
see boat	Steel-toe rubber boots
see boat	Rain gear
see boat	Safety goggles
see boat	Hard hat
see boat	Ear plugs
see boat	Disposable nitrile powder-free gloves
Documentation	
see boat	Camera
see boat	Dry-erase white board
see boat	Dry-erase pens (black or blue)
see boat	Rite-in-rain pens
see boat	Waterproof field log book
see boat	Work Plan
see boat	Quality Assurance Project Plan
see boat	Field Sampling Plan
see boat	Standard Operating Procedures
see boat	Health and Safety Plan
see boat	Correction forms
see boat	Sample jar tracking sheet
see boat	Laminated soil particle size key
see boat	Munsell soil color key
see boat	Chain-of-custody forms
see boat	Laminated map of the site
Miscellaneous	
see boat	Paper shop towels
see boat	Duct tape
see boat	Assortment of fine- to thick-point sharpies
see boat	Grease pencils
see boat	Various highlighter markers
see boat	Utility knife and replacement blades
see boat	Scissors
1	Brooms and dust pans
1	Garbage bin

Sediment Processing Supplies	
	rubber mallet
see boat	Heavy duty foil
3	3'X6' processing tables
see boat	Stainless steel rulers
2	20' measuring tape marked at 1/10" increments
	Stainless steel bowls
	Stainless steel spoons
see boat	5-gal buckets w/lids to hold sediment waste, decon waste, etc.
1	screwdriver for opening 5 gallon buckets
2	50 gallon garbage cans to store core segments
1 roll	Garbage bags for core sections
28	Cardboard core box for transport
Decontamination Supplies	
Gravity supplie	Liquinox detergent
Gravity supplie	Dish scrub brushes
Gravity supplie	Long-handled nylon brushes
Gravity supplie	Distilled water (for wash and first rinse)
Gravity supplie	Deionized/distilled/organic-free water (from lab)
Gravity supplie	New garden sprayers for deionized/distilled/organic-free water rinse
Gravity supplie	5-gal buckets (to keep garden sprayers upright)
Gravity supplie	Large rectangular wash bins with high sides (and lids)
16 ft	Platic sheeting for under tables
4	2X4's (to direct water flow) buy 3 8ft and cut 1 in 1/2
Sample Packaging/Shipping	
see boat	Sample jars
see boat	Sample jar labels
see boat	Clear packing tape
see boat	Zip-lock bags (1 for each jar)
see boat	1-gallon zip-lock bags
see boat	2-gallon zip-lock bags
see boat	Bubble wrap
see boat	Coolers
see boat	Plastic garbage bags
see boat	Ice (wet)
see boat	Fiber tape
see boat	COC seals from lab
see boat	Shipping forms

Equipment List -Gravity Provided

Number	Item	Category
	Backup GPS	Safety Eqpt
	VHF Radio	Safety Eqpt
	Rescue rope in throw bag	Safety Eqpt
	Air horn	Safety Eqpt
	Waterproof flashlight	Safety Eqpt
	Secondary "kicker" motor	Safety Eqpt
	Bilge pump/emergency pump	Safety Eqpt
	Dock lines	Safety Eqpt
7	USCG approved Type III or V life jackets	Safety Eqpt
	Type 4 throwable ring or cusheon	Safety Eqpt
	Type BC fire extinguisher	Safety Eqpt
	anchor	Safety Eqpt
	First aid kit	Safety Eqpt
	AED	Safety Eqpt
	Oil booms	Safety Eqpt
	PID	Safety Eqpt
	Vibracore sampler, core and tubes	Smpl handlng
	Hydraulic power grab sampler	Smpl handlng
	Bowls, large, stainless	Smpl handlng
	Spoons, small stainless	Smpl handlng
	Spoons, large stainless	Smpl handlng
	Core caps	Smpl handlng
	Core catcher	Smpl handlng
	Hacksaw and Circular saw	Smpl handlng
	Extension cord and power strip	Smpl handlng
	Drywall blade	Smpl handlng
	Rubber mallet	Smpl handlng
	Screwdrivers (Phillips, Flat)	Smpl handlng
	Siphon tubes/pump	Smpl handlng
	Zip ties	Smpl handlng
	4" pipe clamps	Smpl handlng
	Brushes, long handled	Decon
	Brushes, short handled	Decon
	Liquinox	Decon
	5 gallon buckets	Decon
	Wash bins	Decon

APPENDIX D
STANDARD OPERATING PROCEDURES

APPENDIX D
STANDARD OPERATING PROCEDURES

APPENDIX D-1
HYDROCARBON FIELD SCREENING AND FIELD DESCRIPTION KEY FOR POTENTIAL NAPL IN SEDIMENTS (AECOM AND GEOSYNTEC, 2018B)

Appendix B-1
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 course-grained material over fine-grained material, then a sample should be collected just above this interface where NAPL may be pooling above the "aquitard". 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 interio 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 devise.

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.

Appendix B-1

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

APPENDIX D
STANDARD OPERATING PROCEDURES

APPENDIX D-2
RI ROUND 2 FSP EXCERPTS – SURFACE SEDIMENT SAMPLING AND PROCESSING, SEDIMENT CORE COLLECTION AND PROCESSING, SAMPLE HANDLING AND STORAGE, CHAIN OF CUSTODY PROCEDURES, AND GENERAL CORE PHOTOGRAPHY PROCEDURES (INTEGRAL 2004) AND (AECOM AND GEOSYNTEC 2018B)

APPENDIX B-2

RI Round 2 FSP Excerpts – Surface Sediment Sampling and Processing, Sediment Core Collection and Processing, Sample Handling and Storage, Chain of Custody Procedures, and General Core Photography Procedures (Integral 2004)

SURFACE SEDIMENT SAMPLING AND PROCESSING

The purpose of this standard operating procedure (SOP) is to define and standardize the methods for collecting surface sediment samples from freshwater or marine environments. For the purpose of this SOP, surface sediments are defined as those from 0 to at most 30 cm below the sediment-water interface. The actual definition of surface sediments is typically program-specific and is dependent on the purpose of the study and the regulatory criteria (if any) to which the data will be compared.

This SOP utilizes and augments the procedures outlined in Puget Sound Estuary Program (PSEP 1996) guidelines. A goal of this SOP is to ensure that the highest quality, most representative data be collected, and that these data are comparable to data collected by different programs that follow PSEP guidelines.

SUMMARY OF METHOD

Sediment samples for chemical and toxicity analysis are collected using a surface sediment sampling device (e.g., grab sampler). If a sample meets acceptability guidelines, overlying water is siphoned off the surface and the sediment is described in the field log. Sediment samples for chemical analysis may be collected directly from the sampler (e.g., volatile organic compounds and sulfides) or sediment from the sampler may be homogenized using decontaminated, stainless-steel containers and utensils prior to being placed in sample jars. Sediment from several sampler casts may also be composited.

SUPPLIES AND EQUIPMENT

A generalized supply and equipment list is provided below. Additional equipment may be required depending on project requirements.

- Sampling device:
  Grab sampler or box corer

- Field equipment:
  Siphoning hose
  Stainless-steel bowls or containers
  Stainless-steel spoons, spatulas, and/or mixer
  Decontamination supplies
  (Alconox™ detergent, 0.1 N nitric acid, methanol dionized water)
  Personal protective equipment for field team
  (rain gear, safety goggles, hard hats, nitrile gloves)
  First Aid kit
  Cell phone

Sample containers
Bubble wrap
Sample jar labels
Clear tape
Permanent markers
Pencils
Coolers
Ice

- Documentation

  Waterproof field logbook
  Field sampling plan
  Health and safety plan
  Correction forms
  Request for change forms
  Waterproof sample description forms

PROCEDURES

EQUIPMENT DECONTAMINATION

The basic procedure used most commonly in Integral field projects to decontaminate field sampling equipment is as follows:

1. Rinse with tap or vessel water.
2. Wash with brush and Alconox™ detergent.
3. Rinse with tap or vessel water.
4. Rinse with distilled water.
5. Rinse with 0.1 N Nitric acid (optional - if metals analysis is to be performed).
6. Rinse with methanol or hexane (optional - if organics analysis is to be performed or adhering petroleum residue present).
7. Rinse with distilled water.
8. Cover with aluminum foil (dull side down).

This procedure may be modified depending on site-specific requirements, as described in PSEP (1986). For example, if sampling is in areas known to be uncontaminated or only slightly contaminated, the solvent and/or acid rinses may be eliminated. Conversely, if creosote or other petroleum-based residue is encountered, a hexane rinse may be added.

Decontamination with acid or solvents should always be performed outdoors using appropriate protective equipment, including, at a minimum, chemical-resistant gloves (e.g., nitrile) and goggles. All decontamination liquids that include solvents or acids should be contained in tightly sealed buckets or other containers for disposal in an approved onshore facility. Alternatively, low-vapor pressure solvents may be evaporated in a well-ventilated open area away from the work zone.

SEDIMENT SAMPLE COLLECTION

To collect sediment for chemical and biological analyses, a sampler that obtains a quantifiable volume of sediment with minimal disturbance of the sediments must be employed. Additionally, the sampler should be composed of a material such as stainless steel or aluminum, or have a non-contaminating coating such as Teflon™. Samplers capable of providing high-quality sediment samples include grab-type samplers (van Veen, Smith-McIntyres, Young grab, power-grab and ponar grab) and box cores (Soutar, mini-Soutar, Gray-O'Hara, spade core). Some programs require a sampler that collects from a specific area (e.g., 0.1 m^2). Most sampling devices are typically a standard size; however, some non-standard sizes are available to meet the requirements of specific programs. Grab samplers, especially the van Veen grab, are the most commonly used samplers to collect surface sediment. Power grab samplers are often used for programs requiring collection of sediment deeper than 10 cm or in areas with debris.

A hydraulic winch system should be used to deploy the sampler at a rate not exceeding 1 m/sec to minimize the bow wake associated with sampler descent. Once the sampler hits the bottom, the jaws are slowly closed and the sampler is brought to the deck of the vessel at a rate not exceeding 1 m/sec to minimize any washing and disturbance of the sediment within the sampler. At the moment the sampler hits the bottom, the time, depth, and location of sample acquisition are recorded in the field logbook.

Once onboard, the sampler is secured, any overlying water is carefully siphoned off, and the sample is inspected to determine acceptability. Criteria used to determine acceptability are those detailed in PSEP (1986), except when noted in the project-specific field sampling plan (FSP). These criteria include but are not limited to:

- There is minimal or no excessive water leakage from the jaws of the sampler.
- There is no excessive turbidity in the water overlying the sample.
- The sampler is not over-penetrated.

- The sediment surface appears to be intact with minimal disturbance.
- The program-specified penetration depths are attained.

If the sample meets acceptability criteria, the sample is recorded and observations entered into a sample description form or log. Once the sample has been characterized, the sediment is then sub-sampled for chemical and biological analyses.

SAMPLE PROCESSING

Sediment for chemical and/or toxicity analyses is removed from the sampler using a stainless-steel spoon. Depending on programmatic goals, the upper 2 to 30 cm of sediment are removed. To prevent possible cross contamination, sediments touching the margins of the sampler are not used.

Samples for volatile compounds (either organics or sulfides) are collected using a decontaminated stainless-steel spoon while sediment is still in the sampler. These sediments are not homogenized. The volatile organics sample jar should be tightly packed with sediment (to eliminate obvious air pockets) and filled so that there is no headspace remaining in the jar. Alternatively, if there is adequate water in the sediment, the container may be filled to overflowing so that a convex meniscus forms at the top, and the cap carefully placed on the jar. Once sealed, there should be no air bubbles. The sulfides sample is preserved with 0.2 N zinc acetate.

The remaining sediment is then placed into a pre-cleaned, stainless-steel bowl. Typically, sediment from a minimum of three separate casts of the sampler is composited at each station. Once a sufficient amount of sediment has been collected, the sediment is homogenized until it is of uniform color and has obtained a smooth consistency. It is then dispensed into pre-cleaned sample jars for the various chemical or biological analyses. Sample jars for biological analyses should be filled to the top with sediment to minimize available headspace. This procedure will minimize any oxidation reactions within the sediment. Sample jars for chemical analysis may be frozen for storage, leaving enough headspace left in the container to allow for expansion of the sediment upon freezing. After dispensing the sediment, the containers are then placed into coolers with ice and are either shipped directly to the analytical laboratories or transported to a storage facility.

CHAIN-OF-CUSTODY

Field

The cruise leader or other designated field sample custodian is responsible for all sample tracking and chain-of-custody procedures until sample custody is transferred to the laboratory. Custody procedures in the field are as follows:

1. Record all field and sample collection activities (including sample identification number, collection time and date) in the field logbook. While being used in the field, the logbook remains with the field team at all times. Upon completion of the sampling effort, the logbook should be reproduced and then kept in a secure area.
2. Complete a chain-of-custody form whenever samples are being transferred or removed from the custody of field sampling personnel. A sample form is provided in Appendix B. Record each individual sample on the form. Include additional information to assist in sample tracking such as collection date and time, number of containers, and sample matrix. The chain-of-custody may also serve as the sample analysis request form, with the required analysis indicated for each individual sample.
3. Sign the form and ensure that the samples are not left unattended unless secured.
4. Store, pack, or ship samples as described in the following section. Place the original completed chain-of-custody form in a sealed plastic bag inside the shipping container. A copy is retained by the shipping party.
5. Complete a separate custody form for each individual shipping container or a single form for all samples in multiple shipping containers in a single shipment, with the number of containers noted on the custody form.
6. Attach completed custody seals to any shipping container that will be sent to the laboratory by delivery service or courier. Delivery personnel are not required to sign the custody form if custody seals are used. Custody seals are used to detect unauthorized tampering with the samples. Gummed paper or tape should be used so that the seal must be broken when the container is opened. The laboratory sample custodian (or other sample recipient) will establish the integrity of the seals.

7. The laboratory custodian (or other sample recipient) acknowledges receipt of the samples by signing, dating, and noting the time of transfer on the chain-of-custody form. The condition of the samples and any problems or irregularities (e.g., cracked or broken jars, loose lids, evidence of tampering) should also be recorded. Return a copy of the completed custody form to the project manger or designated sample coordinator.

Laboratory

The laboratory will designate a sample custodian who is responsible for receiving samples and documenting their progress through the laboratory analytical process. Each custodian will ensure that the chain-of-custody and sample tracking forms are properly completed, signed, and initialed on transfer of the samples. Specific laboratory chain-of-custody procedures should be in writing, included in the laboratory QA plan, and approved prior to beginning sampling and analysis. Laboratory custody procedures should include the following:

- A designated laboratory person initiates and maintains a sample tracking log that will follow each sample through all stages of laboratory processing and analysis.
- The laboratory tracking log includes, at a minimum, the sample number, location and type of storage, date and time of each removal, and signature of the person removing or returning the sample.
- The final disposition of the sample is recorded.

CHAIN-OF-CUSTODY QUALITY CONTROL PROCEDURES

Complete and correct chain-of-custody is essential to ensure and demonstrate sample integrity. Errors in entering information or transferring custody can result in analytical or data reporting errors. Inaccuracies or errors in sample tracking and custody records can compromise data usability, particularly as legal evidence.

Quality control procedures include the following:

- Allow adequate time to take accurate and complete field records and to carefully complete chain-of-custody forms.
- When possible, work in pairs or more to complete the chain-of-custody form and check for accurate information entry.

- Complete all custody records in ink; errors should be neatly crossed out and corrected and initialed by the person making the change.
- Immediately notify the project manager of any deviation from required custody procedures.

PACKING AND SHIPPING SAMPLES

Environmental samples are packed in a manner to reduce the chance of sample breakage, ensure sample integrity, and prevent material leakage and potential exposure to hazardous materials in the event of breakage. Samples are placed in sealed plastic bags and packed in a sturdy container with adequate packing material to prevent breakage. Ice or dry ice may be included to maintain sample storage conditions. Samples are transported by field personnel or shipped via courier or common carrier. Shipping procedures are in accordance with U.S. Department of Transportation regulations (49 CFR 173.6 and 49 CFR 173.24).

All preserved samples should be shipped as soon as possible after completion of sampling. This minimizes the number of people handling samples and protects sample quality and security.

Sample Packing

Upon completion of final sample inventory by the field sample custodian and completion of chain-of-custody, samples are packed as follows:

1. If not already done after sample collection, wipe the outside of each sample container and lid with a disposable cloth to remove any soil or sediment adhering to the outside of the jar and place each container in a sealed plastic bag (e.g., ziplock).
2. Wrap each glass sample container in bubble wrap or place it in a bubble wrap plastic bag. [Note: When samples are being transported by field personnel directly from the field site to the laboratory (thereby ensuring careful handling), this step is recommended but may be omitted. However, this step is required when a courier or delivery service is transporting the samples.]
3. Line the shipping container with heavy-duty plastic bags (e.g., garbage bags) and bubble wrap. Use a leak-proof, sturdy container that can withstand rough treatment during shipping. If ice chests or coolers are used, the drain should be securely plugged and sealed with duct tape.

4. Place the samples tightly in the shipping container:
   - Use dividers or bubble wrap to separate all glass containers
   - Fill any empty space in the shipping cooler or box with packing material so that the jars are held securely.
5. Place the original completed chain-of-custody form in a sealed plastic bag and place it inside the shipping container. If using a cooler or ice chest, the form should be securely taped to the inside of lid.
6. For liquid samples, absorbent material (e.g., vermiculite) should be placed in the container in sufficient quantity such that all liquid could be absorbed.
7. Tie or seal the bag lining the shipping container.
8. If required to meet sample storage requirements, fill the ice chest with crushed or block ice, blue ice (refrigerated samples, 4°C) or dry ice (frozen samples). A temperature blank (provided by the laboratory) should be packed in each cooler.
9. If samples for volatile organics analysis (VOA) are included in the shipping container, two VOA trip blanks (provided by the analytical laboratory) should also be packed in the cooler.
10. Seal shipping container securely with packing or duct tape.
11. If the shipping container will be transported by anyone other than the person who completed and signed the chain-of-custody form, attach completed custody seals so that the shipping container cannot be opened without breaking the seal.
12. Attach a *This End Up* label to each side of the shipping container to ensure that jars are transported in an upright position. A *Fragile* label may also be attached to reduce rough handling of the samples.
13. Label the shipping container with all appropriate information (name of project, time and date, responsible person and company name, address and phone) to enable positive identification.

Sample Shipping

Packed containers may be delivered to the laboratory or storage facility by field personnel, courier, or common carrier (FedEx, UPS). However, any outside carrier or courier service must provide a delivery receipt. The carrier or courier must also ensure delivery time if holding time and storage conditions are critical.

Unless arranged in advance, shipping charges should be prepaid by sender to avoid confusion and possible rejection of the package by the laboratory.

The adequacy of handling and shipping procedures is reflected in the condition of the samples upon receipt by the laboratory:

- No jars are cracked or broken.
- There is no evidence of sample leakage.
- Measuring the temperature of the temperature black indicates that correct storage conditions have been maintained.

The sample custodian or other designated person is responsible for confirming that copies of all shipping documents, completed in full and correctly, are on file at Integral.

QUALITY CONTROL PROCEDURES

Field quality control (QC) samples that may be collected during surface sediment sampling are the same as for any field sampling program. The types and frequency of field QC sample collection are project-specific and will be described in the project field sampling plan. The most commonly collected field QC sample are described below (PSEP 1996):

- **Field Blank**. A field blank is a sample of analyte-free water that is supplied by the laboratory. The field blank is generated by transferring the analyte-free water to another laboratory-supplied sample container while at the field sampling location. Field blank results are used to measure and document any possible onsite contamination.

- **Field Split Sample**. A field split sample consists of aliquots of the same homogenized sediment sample that are equally distributed in two sets of sample containers. These samples may be analyzed identically or analyzed by different laboratories to evaluate repeatability of sample handling and analytical procedures, sample heterogeneity, and analytical procedures.

- **Field Replicate**. A field replicate consists of a second sample that is collected using the same sampling methodology used to obtain the first sample. It is collected at the same sampling location and as soon after the original sample as possible. Analysis of the field replicate allows evaluation of the repeatability of field sampling methodologies, as well as the heterogeneity of the sample matrix. Statistical analysis of multiple replicates may also be used to calculate the likely range of an analyte concentration at a given sampling location.

REFERENCES

PSEP. 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, WA. Tetra Tech and HRA, Inc., Bellevue, WA.

SEDIMENT CORE COLLECTION AND PROCESSING

Sediment cores are collected to evaluate chemical and/or biological characteristics of surface and subsurface sediments at depths that greatly exceed those achieved by grab or other surface samplers. The purpose of this SOP is to define and standardize procedures for the collection of samples from surface and subsurface sediment cores. Additionally, this SOP will help ensure that the highest quality, most representative data are collected, and that these data are comparable to data from other programs. This SOP is based on the procedures outlined in Puget Sound Estuary Program guidelines (PSEP 1996).

SUMMARY OF METHOD

Sediment cores are collected using some type of coring device, including gravity corers, piston corers, vibracorers and diver-driven cores. Actual operations will vary depending on the equipment selected. Selection of the most appropriate corer usually depends on may factors, including but not limited to:

- The quantity of sample required
- The penetration depth required
- The sediment type (e.g. rocky, soft, compact)
- Vessel availability and capability (i.e. size, lifting capacity etc.).

Regardless of the coring method, the core tube should be constructed of a non-contaminating material such as stainless steel or aluminum, or should use a liner constructed of a non-contaminating material (e.g., polycarbonate).

Once the sediment core is collected, it is extruded or split so that the sediment can be sampled, processed, and transported to the analytical laboratory.

Supplies and Equipment

A generalized supply and equipment list is provided below. Additional equipment may be required depending on project requirements.

- Sampling device:
  - Corer
  - Core tubes
  - Core tube liners (optional)
  - Core tube caps

- Field equipment:
  - Aluminum foil
  - Duct tape
  - Hack saw
  - Indelible ink pen

Pipe cutter
Circular saw (if splitting tube longitudinally)
Plunger (if necessary)
Table or tray
Ice (if storing cores)
Stainless-steel bowls
Stainless-steel spoons, spatulas, and/or mixer
Personal protective equipment for field team
(rain gear, safety goggles, hard hats, nitrile gloves) First Aid kit
Cell phone
Sample containers
Bubble wrap
Clear tape
Permanent markers
Pencils
Coolers

- Documentation

Core description forms or log book
Waterproof field logbook
Field sampling plan
Health and safety plan
Correction forms
Request for change forms
Waterproof sample description forms

CORE COLLECTION PROCEDURES

CORER DEPLOYMENT

Gravity and piston corers utilize inertia as the primary driving force to achieve the desired penetration depth. The degree of penetration can be altered by either adjusting the number of weights at the top of the tube or by changing the vertical distance that the core tube is allowed to free-fall. During descent, the corer should be lowered under power to its predetermined free-fall distance above the bottom. The lowering should be halted when this vertical distance equals the difference between the meter wheel reading and the fathometer reading.

If the device is equipped with a trip-weight or a small gravity trip-corer, the free-fall distance will equal the length of the core tube plus the vertical distance between the core cutter and the trip-weight suspended beneath it. When the trip-weight contacts the bottom, it relaxes the tension on the release mechanism and the core tube free-falls into the sediment. Consistent penetration depths can be obtained with this method, as the free-fall distance is independent of winch control and changing bottom depth.

The vibracorer uses a hydraulic system that vibrates and drives a length of aluminum tubing into the sediment. A continuous sediment sample is retained within the tubing with the aid of a stainless-steel core cutter/catcher. Coring can continue until the total sample depth is reached.

CORE RETRIEVAL

The core is extracted from the substrate and pulled onto the sampling vessel using the vessel winch or crane. The amount of pull that is required depends on the coring device and its contents, plus the amount of frictional force against the surface of the core tube that must be overcome. The frictional force depends on the sediment type (e.g. clay-based material requires more pull) and the depth penetrated (PSEP 1996). During core extraction, the wire strain should be steady and continuous, with the vessel held stationary directly above the coring device. Once the core is extracted from the bottom, the winch speed may be increased to about 4 ft/sec.

The core is brought on board the vessel. While the tube is still vertical, overlying water may be siphoned off the top of the core tube. Recovery is estimated to accurately determine the true depth from which the sediments were collected and the location of those sediments within the core barrel. In most cases, recovery is estimated by comparing the length of the sediment core material to the overall penetration depth (as indicated by traces of sediment material on the outer surface of the core tube). The ratio of penetration depth to core material length is calculated to determine the compaction of the sediment during coring. Alternatively, some vibracorers are equipped with a transducer to measure penetration depth. A second transducer is mounted directly above the core tube to determine the height of the sediment column within the core barrel. Recovery can be estimated from the difference between the two transducer readings. Recoveries typically range between 50 and 90 percent.

Continuous core lengths (such as those obtained by a vibracorer) may be sectioned into smaller lengths for ease of handling and/or to represent the desired sampling intervals. The core tube is placed on a secure surface and tightly anchored. Beginning at the top of the core tube, sample sections are marked on the outside of the core tube in indelible ink. Before the tube is cut, a label identifying the station and core section is securely attached to the outside of the casing at the top of each section, and wrapped with transparent tape to prevent loss or damage of the label. (Note that care should be taken when measuring core sections to consider core compaction.) Core sections may then be cut using a manual, heavy-duty pipe cutter.

After the tube is cut, sediment at the end of each tube section cut is visually classified for qualitative sample characteristics. Changes from the top to the bottom of each section of the tube are noted and recorded in the field log or core description forms. If the core section will be stored or transported, the core ends are then covered with aluminum foil, a protective cap, and duct tape to prevent leakage. Ideally, the core sections should be stored upright in a container chilled with ice to approximately 4°C. Empty tubing should be removed to help ensure that each section is full of sediment. This limits disturbance during storage and transport. If necessary, cores should be stored securely in a manner consistent with chain-of-custody procedures. Typically, cores remain in the custody of field staff until sampling is completed and sample jars transported to the analytical laboratory (see SOPs for Surface Sediment Sampling).

CORE PROCESSING PROCEDURES

SEDIMENT CORE EXTRUSION

Cores should be split or extruded and processed within 24 hours of collection, either onboard the vessel or at an onshore sample processing facility. The sediment may be removed from the core tube by either extrusion or longitudinal sectioning (i.e., splitting). Extrusion is done by tilting the core tube until the sediment core slides out onto a clean, aluminum-foil-covered table or tray. Vibration or tapping of the core tube may aid extrusion. If the sediment core does not slide out easily, a plunger may be used to push the sediment out of the tube. The plunger should be cleaned and covered with clean aluminum foil each time it is used. Once the tube is extruded, a thin (0.25 to 0.5 cm) outer layer of the sediment core is scrapped away using a decontaminated, stainless-steel knife (see SOP for Surface Sediment Sampling. This outer material may be used for sediment grain-size determination if sediment volume is of concern, but should not be used for any chemical analyses.

In longitudinal core splitting, the core tube or liner is split with a circular saw to expose the sediment core, or the core material can be run across a splitting knife as it is extruded. If a core tube liner is used, care should be taken to scrap the surface of the sediment core to remove any shavings of liner material.

SEDIMENT SAMPLE PROCESSING

Regardless of how the sediment core is obtained and prepared, the procedures for record keeping, sediment processing and sampling techniques are as follows:

1. Immediately following core extrusion or splitting, collect samples for volatile compounds (either organics or sulfides) using a

decontaminated,stainless-steel spoon. The volatile organics sample jar should be tightly packed (to eliminate obvious air pockets) and filled so that there is no head-space remaining in the jar. Alternatively, if there is adequate water in the sediment, the container may be filled to overflowing so that a convex meniscus forms at the top, and the cap carefully placed on the jar. Once sealed, there should be no air bubbles. The sulfides sample is preserved with 0.2 N zinc acetate.

2. Record core sediment characteristics on a core description form (see attached). Observations should include stratification of color and sediment composition, odor, biological organisms, foreign objects etc.
3. Place remaining core sediment in a decontaminated, stainless-steel bowl (see SOP for Surface Sediment Sampling) and mix thoroughly with a stainless-steel spoon, spatula or mixer until uniform color and texture are achieved. Large rocks or wood pieces may be omitted from the final laboratory sample, but should be noted in the log or description form.
4. If sediment from multiple core sections will be composited, cover the bowl with clean foil and set the bowl aside (refrigerate or keep cool on ice) while handling additional cores. Once all the required sediment has been placed in the bowl, thoroughly mix until uniform color and texture are achieved.
5. Transfer aliquots of homogenized sediment to labeled sample containers provided by the analytical laboratory. Labels should include, at minimum, the company name, project name, sample identifier, date and time of collection, and the initials of sampling personnel.
6. Pack and transport samples as described in the SOP for Surface Sediment Sampling. If samples will be stored, follow procedures specified in the project sampling plan.

QUALITY CONTROL PROCEDURES

Field quality control (QC) samples that may be collected during sediment coring are the same as for any field sampling program. The types and frequency of field QC sample collection are project-specific and will be described in the field sampling plan. The most commonly collected field QC sample are described below (PSEP 1996):

- **Field Blank**. A field blank is a sample of analyte-free water that is supplied by the laboratory. The field blank is generated by transferring the analyte-free water to another laboratory-supplied sample container while at the field sampling location. Field blank results are used to measure and document any possible onsite contamination.

- **Field Split Sample**. A field split sample consists of aliquots of the same homogenized sediment sample that are equally distributed in two sets of sample containers. These samples may be analyzed identically or analyzed by different laboratories to evaluate repeatability of sample handling and analytical procedures, sample heterogeneity, and analytical procedures.

- **Field Replicate**. A field replicate consists of a second sample that is collected using the same sampling methodology used to obtain the first sample. It is collected at the same sampling location and as soon after the original sample as possible. Analysis of the field replicate allows evaluation of the repeatability of field sampling methodologies, as well as the heterogeneity of the sample matrix. Statistical analysis of multiple replicates may also be used to calculate the likely range of an analyte concentration at a given sampling location.

Additional types of QC samples are described in the SOP for Surface Sediment Sampling.

REFERENCES

PSEP. 1996. Puget Sound Estuary Program: Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound. Prepared for U.S. Environmental Protection Agency, Region 10, and Puget Sound Estuary Program Seattle, WA. Tetra Tech and HRA, Inc., Bellevue, WA

As noted in Table 2-3, sampling of selected stations will be monitored for the retrieval or disturbance of items of archaeological significance.

Sample Handling and Storage

Cores will be processed concurrently with core collection. Every effort will be made to process the cores within 24 hours of collection. Cores awaiting processing will be sealed tightly at both ends and stored upright in a refrigerator. If core collection outpaces processing such that significant delays in core processing appear likely, core collection will be suspended to allow the core processing to catch up. The field laboratory will be equipped with a core-cutting table, core-processing tables, a decontamination area, and a storage area with appropriate refrigeration. Appropriate lighting will be installed in the core processing area in order to collect consistent, high quality photographs of the opened cores. Once the field laboratory is located, care will be taken to create a core-processing area that minimizes the potential for outside contamination.

Each core tube will be fixed to the core-cutting table and cut along the long axis using a circular saw. The tube is rotated 180^{o} and cut again. After each core is cut, the entire core tube will be moved to a stainless-steel sampling tray and opened. Each sediment core will then be systematically logged, described, and photographed.

After each core is cut open, an experienced geologist will describe the sediment on a core log (see Appendix D). The qualifications of key personnel for the subsurface sampling effort are presented in Appendix C.

The following information will be recorded for each core:

- Physical sediment description (i.e., sediment type, density/consistency, color)
- Odor (e.g., hydrogen sulfide, petroleum)
- Visual stratification and lenses
- Vegetation
- Debris
- Evidence of biological activity (e.g., detritus, shells, tubes, bioturbation, live or dead organisms)
- Presence of oil sheen
- Other distinguishing characteristics or features.

The visual description of sediment lithology (dominant grain sizes) will be the primary criteria for determining sample intervals (i.e., lithologic units) in the cores.

For consistency, core descriptions and terms used will follow the criteria below, which are modified from methods presented in ASTM D 2488-00 (ASTM 2000).

1. Visual estimates of the grain-size percentages of sediment units within each core will be recorded on the core logs so that the total sum will add up to 100%. Estimates of gravel, sand, and fines (silt and clay) content will generally be made to the nearest quartiles:

    - 0% to 25%
    - >25% to 50%
    - >50% to 75%
    - >75% to 100%.

    The sediment may also be described narratively on the log based on the estimated grain-size percentages. The dominant constituent grain size will be the primary unit descriptor, with the abundance of other grain sizes present described using the following terms:

    - The grain-size adjective (e.g., gravelly, sandy, silty, or clayey), if estimated to constitute more than 25% of the sediment
    - *With*, for example, sand with silt, silt with sand, etc. if estimated to constitute less than 25% of the sediment
    - *Trace*, if estimated less than 5% of the sediment (and not included in the total 100%).

2. For other features observed, such as organics or debris, additional descriptive terms may include:

    - *Mostly*, if estimated to comprise 50% or more of the unit
    - *Some*, if estimated to comprise more than 25% to 50% of the unit
    - *Little*, if estimated to be 25% of the unit or less
    - *Trace*, if estimated less than 5% (and not included in the total 100%).

3. Consistency will be described using the following terms:

    - Density: *loose*, if easily penetrated with a sampling spoon, or *dense*, if penetration is more difficult.
    - Consistency: *very soft*, if present as an ooze that holds no shape
soft, if saggy
stiff, if it holds a shape
very stiff, if penetration with a spoon is low
hard, if no penetration with a spoon is possible.

4. Other observations (e.g., obvious anthropogenic material, dramatic color changes) may also be used to define or help define sample intervals.

The boundaries of lithologic units will be determined primarily by changes in the top two dominant grain sizes estimated visually (e.g., a change from a silty sand to a gravelly sand or to a sandy silt).

With the exception of subsampling for volatile organics (i.e.,VOCs and TPH-G), the cores will be photographed after being described and before any sediment is removed for processing. It is important for each core section to be photographed with adequate lighting from a standard measured distance from the core. Digital photographs will be used later in the production of digital core logs.

Sediment subsampling methods for Round 2A subsurface cores will follow the approach described in Section 2.2.2. Subsampled sediment will be placed into a decontaminated stainless-steel bowl. Adequate volumes of sediment will be collected for all required analyses (see Table 4-1).

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 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 4.6.2 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.

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

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

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 and will accompany the samples at all times. Copies of the chain-of-custody will be included in laboratory and QA/QC reports.

Example chain-of-custody forms are provided in Appendix D. At minimum, the form will include the following information:

- Site name
- Field task leader's name and team members responsible for collection of the listed samples
- Collection date and time of each sample
- Sampling type (e.g., composite or grab)
- Sampling station location
- Number of sample containers shipped
- Requested analysis
- Sample preservation information
- Name of the carrier relinquishing the samples to the transporter, noting date and time of transfer and the designated sample custodian at the receiving facility.

The field task leader, as the designated field sample custodian, will be responsible for all sample tracking and chain-of-custody procedures for samples in the field. The sample custodian will be responsible for final sample inventory and will maintain sample custody documentation. The custodian will complete chain-of-custody forms prior to removing samples from the sampling vessel. Upon transferring samples to the laboratory sample custodian, the field task leader will sign, date, and note the time of transfer on the chain-of-custody form.

The original chain-of-custody form will be transported with the samples to the laboratory. Each laboratory will also designate a sample custodian, who will be responsible for receiving samples and documenting their progress through the laboratory analytical process. Each custodian will ensure that the chain-of-custody and sample tracking forms are properly completed, signed, and initialed upon transfer of the samples.

Chemistry samples will be shipped to the laboratory in ice chests sealed with custody seals. Each ice chest will have three seals, one on the front of the chest and one on each side. The laboratory sample custodian will establish the integrity of the seals at the laboratory.

Upon receipt of the samples at the laboratory, the laboratory sample custodian will inventory the samples by comparing sample labels to those on the chain-of-custody document. The custodian will enter the sample number into a laboratory tracking system by project code and sample designation. The custodian will assign a unique laboratory number to each sample and will be responsible for distributing the samples to the appropriate analyst or for storing samples in an appropriate secure area. Specific laboratory chain-of-custody procedures are described in the laboratory QA plans for each of the designated labs (SEA 2002b).

4.8.2 Sample Shipping

The analytical laboratories will supply sample coolers and packing materials. Upon completion of final inventory by the field sample custodian, individual sample containers will be placed into a sealed plastic bag. Samples will then be packed in a cooler lined with a large plastic bag. Glass jars will be packed to prevent breakage and separated in the shipping container by bubble wrap or other shock-absorbent material. Ice in sealed plastic bags or "blue ice" will then be placed in the cooler to maintain a temperature of approximately 4ºC.

When the ice chest is full, the chain-of-custody form will be placed into a zip-locked bag and taped on the inside lid of the cooler. A temperature and a trip blank will be added to each cooler. Each ice chest will be sealed with three chain-of-custody seals. On each side of the cooler a *This End Up* arrow label will be attached; a *Fragile* label will be attached to the top of the cooler. Coolers will be transported to the laboratory by courier or overnight shipping service. These packaging and shipping procedures are in accordance with U.S. Department of Transportation regulations as specified in 49 CFR 173.6 and 49 CFR 173.24.

The coolers will be clearly labeled with sufficient information (i.e., name of project, time and date container was sealed, person sealing the cooler, and company name and address) to enable positive identification.

4.9 QUALITY CONTROL PROCEDURES

Quality control requirements will be instituted during sampling, laboratory analysis, and data management to ensure that the data quality objectives are met. Detailed information on QA/QC procedures, limits, and reporting are described in detail in the approved project QAPP (SEA 2002b). Field QC requirements are described in the following sections. If quality control problems are encountered, they will be brought to the attention of the CERCLA Project Coordinator. Corrective actions, if appropriate, will be implemented to meet the project's data quality objectives.

4.9.1 Field QC Samples

Field QC samples are used to assess within-station variability (e.g., replicates), evaluate the effectiveness of sample homogenization and within-sample variability

APPENDIX B-5

Core Photography Procedures for Sediment Coring

STANDARD OPERATING PROCEDURE

CORE PHOTOGRAPHY PROCEDURES FOR SEDIMENT CORING

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.

APPENDIX D
STANDARD OPERATING PROCEDURES

APPENDIX D-3
RI ROUND 2 FSP EXCERPT OF PID FIELD HEADSPACE SCREENING (INTEGRAL 2004) AND PID CALIBRATION PROCEDURES (AECOM AND GEOSYNTEC, 2018B)

APPENDIX B-4 – Round 2 FSP Excerpt from PID Field Screening (Integral 2004)

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^{o} 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

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.

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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.[1] 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 ± 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.

[1] 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.

APPENDIX D
STANDARD OPERATING PROCEDURES

APPENDIX D-4
MANAGEMENT OF INVESTIGATION-DERIVED WASTE

STANDARD OPERATING PROCEDURE
MANAGEMENT OF INVESTIGATION-DERIVED WASTE
Revised 10/04/18 for SIL sampling

Introduction

Investigation derived wastes (IDW) generated during the Pre-Remedial Design Investigations at the Portland Harbor Superfund Site may include:

- Sediments
- Surface water
- Other materials:
  - Personal protective equipment
  - Disposable sampling equipment
  - Spent decontamination liquids
  - Plastic sheeting, containers, etc.

The management of these wastes will be conducted to limit exposure of Site personnel to hazardous materials, and to prevent introduction of contaminated materials to uncontaminated environmental media at the Site (sediment). The following Standard Operating Procedures (SOPs) establish protocols for testing, storage, and disposal of these materials. Disposal of laboratory test equipment and supplies will be handled in accordance with the laboratory Quality Assurance Project Plan (QAPP).

General

IDW management will follow guidance described in the Office of Solid Waste and Emergency Response (OSWER) document, Guide to Management of Investigation-Derived Wastes (United States Environmental Protection Agency [EPA] 1992). This guidance discusses factors to consider as part of an IDW management program. These factors include protectiveness of human health and the environment, compliance with applicable and relevant or appropriate requirement (ARAR)-based cleanup levels, land disposal restrictions, storage requirements, recordkeeping and manifesting, and handling of non-Resource Conservation and Recovery Act (RCRA) hazardous wastes. The IDW management program described in this section incorporates these factors in the program. All IDW identified as potentially contaminated with hazardous materials will be stored in a designated and clearly marked IDW management area located at the National Response Corporation (NRC) Portland, Oregon yard. All vessels will also be clearly labeled to indicate the source of the IDW. The IDW storage area will be inspected daily to ensure that storage procedures (as outlined below) are being followed. Any violations of these procedures will be documented and remedied as quickly as possible. Potentially contaminated IDW will be identified based on its: origin, olfactory evidence, and visual evidence. Laboratory testing will be required to determine the proper disposition of these IDW.

Media Specific IDW Management

Sediment

Waste sediments will be generated as excess sample material. All excess sediment collected during sampling will be treated as potentially contaminated with elevated levels of hazardous materials. Waste sediment will be containerized, and a waste determination made before it is disposed of at an appropriate offsite waste facility. The amount of sediment generated will be minimized to the volume necessary for sampling and analysis, to the extent possible. Sediment on the vessel or laboratory processing area may be temporally stored in 5-gallon buckets with lids, then transferred to 55-gallon drums, or stored directly in 55-gallon drums**. Each drum will be labeled using a grease pencil or paint pen to indicate the *date*, *location*, and *contents*** and this information will be recorded in the field log book. Drums will be transferred daily to NRC using the Fred Devine dock as a point of transfer to NRC's management. NRC will profile waste materials for disposal and transport the drums to approved disposal facilities.

Surface Water

Sampling activities may result in the creation of surface water sheens. All observed sheens will be photographed and recorded in the field notebook. In the event of a persistent thick sheen, NRC will be called to respond to the sheen and the Project Coordinator will be informed of the response as soon as practical. Spill prevention and reporting protocols are detailed in the Health and Safety Plan.

NRC will only be called in response to sheen that could be practically contained (e.g., from a core that continued to ooze for a duration long enough to make a containable sheen; blurps and fleeting blebs that disperse and cannot be cleaned up do not warrant a response). NRC may deploy sorbent booms if significant sheen is encountered on the water surface. A small support boat may be used to manage the boom so the sampling vessel can operate without interruption. The Project Coordinator will coordinate with the Field Coordinator and Oregon Emergency Response System (ORES) on additional mitigation measures and agency notifications for releases.

Surface water generated during sediment collection will be returned to the river unless a significant sheen is observed. If a sheen is observed, water will be contained in plastic containers and managed accordingly.

Personal Protective Equipment (PPE)

Investigation-derived PPE consists of gloves, chemically protective clothing, and other one-time use equipment used during the field investigation. All used PPE will be containerized in plastic garbage bags and disposed of on-site for subsequent transport to the municipal landfill.

Decontamination Fluids

Decontamination fluids will be drummed up in either 55-gallon drums or disposed of in sanitary sewers if no significant sheen is observed. Liquinox used on the boat will be discarded overboard if no significant sheen is observed. The decontamination containers will be kept onsite until the water has been analyzed for hazardous materials, at which time the water will be discarded appropriately.

Chemical Liquid Wastes

Chemical liquid wastes will not be generated during this sampling event. Solvents and acids will not be used during sampling or equipment decontamination. If sampling equipment becomes contaminated with oily residue, the residue will be removed with Simple Green, and cleaned by the standard decontamination procedure.

Other Materials

All plastic sheeting, sampling containers, and other disposable equipment that is free from hazardous materials will be containerized in plastic garbage bags and disposed of on-site for subsequent transport to the municipal landfill. Materials that have visible NAPL will also be drummed and shipped off-site for disposal at an approved facility. Non-disposable or bulky materials may be decontaminated and re-used or disposed as solid waste (see SOP for decontamination). Other disposable materials used on-site (tarps covering non-contaminated sediments, caution tape, potable water containers) that have not contacted contaminated media will be disposed as solid waste. Used core tubes will be washed and then recycled.

Testing and Disposal

All drummed materials will be tested to determine the proper disposal method. Composite samples will be collected from drums for analysis. Composite samples will be tested for the parameters necessary to make a waste determination. NRC will profile waste materials for disposal and transport the drums to approved disposal facilities, and provide documentation.

References

United States Environmental Protection Agency (EPA). 1992. Guide to Management of Investigation-Derived Wastes. Office of Solid Waste and Emergency Response. 9345-03FS.

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