Table 4-7. Summary of samples to be collected from Hammersley Inlet.

Sample ID [a]	Description	TOC/ GS	SVOC	Resin	Pest	PCB [b]	Dioxin/ Furan	TPH	TBT	Metal	S2 NH3	TVS	Lipids	PB210	Cs137	Bioassay
HI-01-SS-00	Surface	X	X		X	X	X			X	X					X
HI-01-SC-12	Subsurface	P	P		P	P				P	P					
HI-02-SS-00	Surface	X	X		X	X	X			X	X					X
HI-02-SC-12	Subsurface	P	P		P	P				P	P					
HI-03-SS-00	Surface	X	X		X	X	X			X	X					X
HI-03-SC-12	Subsurface	P	P		P	P				P	P					
HI-04-SS-00	Surface	X	X		X	X	X			X	X					X
HI-04-SC-12	Subsurface	P	P		P	P				P	P					
HI-05-SS-00	Surface	X	X		X	X	X			X	X					X
HI-05-SC-12	Subsurface	P	P		P	P				P	P					
HI-06-SS-00	Surface	X	X		X	X	X			X	X					X
HI-06-SC-12	Subsurface	P	P		P	P				P	P					
HI-07-TS-00	Tissue		X			X	X			X			X			
HI-07-SS-00	Surface	X	X			X	X			X	X					
HI-08-TS-00	Tissue		X			X	X			X			X			
HI-08-SS-00	Surface	X	X			X	X			X	X					
HI-09-TS-00	Tissue		X			X	X			X			X			
HI-09-SS-00	Surface	X	X			X	X			X	X					
HI-10-TS-00	Tissue		X			X	X			X			X			
HI-10-SS-00	Surface	X	X			X	X			X	X					
Archived Samples																
HI-01-SC-01	Subsurface															
HI-01-SC-23	Subsurface															
HI-01-SC-34	Subsurface															
HI-02-SC-01	Subsurface															
HI-02-SC-23	Subsurface															

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Table 4-7 (continued). Summary of samples to be collected from Hammersley Inlet.

Sample ID [a]	Description	TOC/ GS	SVOC	Resin	Pest	PCB [b]	Dioxin/ Furan	TPH	TBT	Metal	S2 NH3	TVS	Lipids	PB210	Cs137	Bioassay
HI-02-SC-34	Subsurface															
HI-03-SC-01	Subsurface															
HI-03-SC-23	Subsurface															
HI-03-SC-34	Subsurface															
HI-04-SC-01	Subsurface															
HI-04-SC-23	Subsurface															
HI-04-SC-34	Subsurface															
HI-05-SC-01	Subsurface															
HI-05-SC-23	Subsurface															
HI-05-SC-34	Subsurface															
HI-06-SC-01	Subsurface															
HI-06-SC-23	Subsurface															
HI-06-SC-34	Subsurface															

[a] Example of sample ID: HI-01-SS-00 = Hammersley Inlet, Station 01, Surface Sediment, 0-10 cm interval. Additional identifiers: SC = sediment core; SS = surface sediment; TS = tissue; WC = wood waste core; WS = wood waste surface. See Section 6.1.1.

[b] PCBs analyzed as Aroclors for sediment and wood waste samples; PCBs analyzed as Aroclors and congeners for tissue and co-located surface sediment samples.

Bioassay = Sediment Management Standards acute and chronic tests
Ce137 = Cesium-137
Dioxin/furan = 2,3,7,8-substituted isomers and congeners
Metals = Antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc
P = For sediment cores, 1-2 foot interval samples analyzed pending surface sample results.
Pb210 = Lead-210
PCB = Polychlorinated biphenyls
Resin = Wood waste indicator compounds, e.g., guaiacols and fatty acids
Pest = Chlorinated pesticides
SVOC = Semi-volatile organic compounds
TBT = Tributyltin
TOC = Total organic carbon
TPH =Total petroleum hydrocarbons as NWTPH-HCID (hydrocarbon identification)
TVS = Total volatile solids
X =Samples submitted for laboratory analysis.

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4.4.3 Tissue Samples

Bivalves will be collected from four intertidal stations within Hammersley Inlet to evaluate bioaccumulation of COPCs in tissue. One station (HI-7) has been identified at Eagle Point and one station (HI-8) has been identified at Munson Point (see Figure 4-2); the remaining two stations will be established at areas commonly used for shellfish harvesting based on local input (e.g., the Squaxin Island Tribe). Samples from all stations will be analyzed for tissue COPCs. A surface sediment sample will be collected at each tissue sampling station and submitted for the same analyses, as well as ancillary testing (e.g., TOC). The chemical analyte list, analytical methods, target detection limits, and comparative criteria are discussed in Section 7.1.

4.5 Reference Sample Location

Reference sediments, which closely match the grain size characteristics of the test sediments, will be run with each test batch for all three bioassays. The reference sediment is used for test comparisons and interpretations. Carr Inlet (Figure 4-5) will be used as the reference area; the specific collection sites will be determined based on sample physical characteristics.

4.5.1 Sediment

Representative surface sediment (0 to 10 cm) samples will be collected at up to three locations within the Carr Inlet reference area (Ecology 2008). An aliquot from each location will be homogenized and submitted to each laboratory for chemical analysis. The chemical analyte list, analytical methods, target detection limits, and comparative criteria are discussed in Section 7.1.

4.5.2 Bioassays

Bioassays will be conducted to determine acute and chronic toxicity of sensitive test organisms as a comparison to Oakland Bay, Shelton Harbor, and Hammersley Inlet samples. Toxicity tests will include amphipod mortality, juvenile polychaete growth, and bivalve larvae development. Details on toxicity testing methodology are provided in Section 7.2.

4.5.3 Tissue

Bivalves will be collected from one intertidal station within Carr Inlet to evaluate bioaccumulation of COPCs in tissue (see Figure 4-5). The sample will be analyzed for tissue COPCs. No surface sediment sample will be collected at the tissue sampling station. The chemical analyte list, analytical methods, target detection limits, and comparative criteria are discussed in Section 7.1.

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Figure 4-5. Reference sediment sample area, Carr Inlet, Washington.

05-07-08/rtb/HEC-R/06-03388-007-003-001/Sampling Plan

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5.0 Quality Assurance / Quality Control

The purpose of the project QA/QC is to provide confidence in project data results through a system of quality control performance checks with respect to data collection methods, laboratory analysis, data reporting, and appropriate corrective actions to achieve compliance with established performance and data quality criteria. This section presents the QA/QC procedures to ensure that the investigation data results are defensible and usable for their intended purpose.

5.1 Measurements of Data Quality

Data quality objectives (DQOs) are qualitative or quantitative statements derived from the planning process. DQOs are used to clarify the study objectives and define the appropriate type of data to collect to support project decisions. Additional guidance on the development of DQOs is found in *Guidance for the Data Quality Objective (DQO) Process,* USEPA 600/R-96/005 (USEPA 1996). Acceptance and performance criteria establish the quality and quantity of data needed to meet the project DQOs (Table 5-1). DQOs are based on PSDDA guidelines established for QA1 data review (PTI 1989a), and as updated by DMMP clarification paper *Modifications to the Chemical Testing Quality Assurance Guidelines* (Fox 2002). General acceptance or performance criteria for the collection, evaluation, or use of environmental data for this investigation are outlined in Section 7 – Laboratory Analytical Procedures.

Table 5-1. Project-Specific Data Quality Objectives

	Replicate Criteria		Matrix Spike Criteria		Surrogate Spike Criteria	
Parameter	Warning Limits [a]	Action Limits [b]	Warning Limits [a]	Action Limits [b]	Warning Limits [a]	Action Limits [b]
Conventionals	None	20 percent	NA	NA	NA	NA
Metals	None	20 percent	None	75 to 125 percent	NA	NA
Semivolatiles	35 percent	50 percent	50 to 150 percent	None	50 percent	EPA CLP
Pesticides	35 percent	50 percent	50 to 150 percent	None	60 percent	EPA CLP

[a] PSEP defines warning limits as "numerical criteria that serve to alert data reviewers and users to possible problems within the analytical system. When a warning limit is exceeded, the laboratory is not obligated to halt analyses, but the reported data may be qualified during subsequent QA/QC review."

[b] PSEP defines action limits as "numerical criteria that, when exceeded, require specific action by the laboratory before data may be reported. Action limits are intended to serve as contractual controls on laboratory performance".

Conventionals include the following analyses: TOC, ammonia, sulfides, grain size, TVS.
Metals include the following analyses: Metals and TBT.
Semivolatiles include the following analyses: SVOCs, PCBs, dioxin/furans, resins.
EPA CLPControl limits are compound specific limits established by EPA's Contract Laboratory Program (CLP).

Acceptance and performance criteria are often specified in terms of the precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters. Numerical

acceptance criteria cannot be assigned to all PARCC parameters, but general performance goals are established for most data collection activities. Data assessment procedures throughout this SAP outline the steps to be taken, the responsible individuals, and the implications if QA objectives are not met. PARCC parameters are briefly defined below.

5.1.1 Precision

Precision measures the reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements compared to their average value, usually stated in terms of standard deviation or coefficient of variation. It also may be measured as the relative percent difference (RPD) between two values. Precision includes the interrelated concepts of instrument or method detection limits (MDLs) and multiple field sample variance. Sources of this variance are sample heterogeneity, sampling error, and analytical error.

5.1.2 Accuracy

Accuracy measures the bias of the measurement system. Sources of this error include sampling process, field contamination, preservation, handling, sample matrix, sample preparation, and analysis. Data interpretation and reporting may also be significant sources of error. Typically, analytical accuracy is assessed through the analysis of spiked samples and may be stated in terms of percent recovery or the average (arithmetic mean) of the percent recovery. Blank samples are also analyzed to assess sampling and analytical bias (i.e., sample contamination). Background measurements similarly assess measurement bias.

5.1.3 Representativeness

Representativeness expresses the degree to which data represent a characteristic of a population, a parameter variation at a sampling point, or an environmental condition. Representativeness is a qualitative parameter, which is most concerned with proper design of the measurement program. Sample/measurement locations may be biased (judgmental) or unbiased (random or systematic). For unbiased schemes, the sampling must be designed not only to collect samples that represent conditions at a sample location, but also to select sample locations that represent the total area to be sampled.

5.1.4 Completeness

Completeness for sample collection is defined as the percentage of specified samples listed in the SAP that were actually collected. Completeness shall be 95% for this project. Completeness for acceptable data is defined as the percentage of acceptable data out of the total amount of data generated. Acceptable data includes data that passes all QC criteria or data that may not pass all of the QC criteria but has appropriate corrective actions taken. If risk assessment is the means for defining cleanup levels, acceptable data shall be defined by the risk assessor.

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5.1.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set may be compared to another. Sample data should be comparable with other measurement data for similar samples and sample conditions. This goal is achieved through the use of standard techniques to collect and analyze samples.

5.2 Quality Assurance and Quality Control for Chemistry Sediment Samples

Laboratory QC samples will be used to evaluate the data precision, accuracy, representativeness, and comparability of the analytical results.

Analytical performance is monitored through QC samples and spikes, such as laboratory method blanks, surrogate spikes, QC check samples, matrix spikes, matrix spike duplicates, duplicate samples, and duplicate injections. All QC samples are applied on the basis of a laboratory batch. Two basic types of batches are used: the preparation batch and the run (i.e., analytical) batch. The preparation batch includes all samples processed as a unit during organic sample preparation, metals digestion, or wet chemistry preparation. Preparation batches do not exceed 20 samples excluding associated QC samples. The QC samples associated with sample preparation include method blanks, laboratory control samples (LCS), matrix spikes, and duplicates. The run batch includes all samples analyzed together in the run sequence. The run sequence is typically defined by the analytical method. For some analyses, such as TOC, the run batch is equivalent to the preparation batch. The QC samples associated with the run sequence include calibration standards, instrument blanks, and reference standards.

Instances may arise where high sample concentrations, nonhomogeneity of samples, or matrix interferences preclude achieving the detection limits or associated QC target criteria. In such instances, data will not be rejected *a priori* but will be examined on a case-by-case basis. The laboratory will report the reason for deviations from these detection limits or noncompliance with QC criteria in the case narrative.

5.2.1 Laboratory Method Blanks

A laboratory method blank is an analyte-free material processed in the same manner and at the same time as a project sample. The laboratory method blanks serve to demonstrate a contamination-free environment in the laboratory. The goal is for method blanks to be free of contamination. Low level contamination may be present, but must be less than the PQL as defined by the method standard operating procedure (SOP). If contamination is greater, the samples are reanalyzed. If contaminants are present in the method blank but not in project samples, no further action is required. All sources of contamination that are not common laboratory contaminants as defined in the method SOPs must be investigated as part of the

corrective action process. Sample results must not be blank-subtracted unless specifically required by the analytical method.

5.2.2 Surrogate Standards

For certain organic methods, all samples, including the laboratory method blank and standards, are spiked with a set of specific surrogate standards to monitor the accuracy of the analytical determination. Surrogate spikes are added at the start of the laboratory preparation process.

Surrogate recoveries must be within QC criteria for method blanks and LCSs to demonstrate acceptable method performance. If surrogate recoveries are outside QC criteria for method blanks or LCSs, corrective action is required and the QC Manager should be notified. Surrogate recoveries in the samples indicate the method performance on the particular sample matrix. Surrogate recoveries that are outside QC criteria for a sample indicate a potential matrix effect. Matrix effects must be verified based on review of recoveries from the method blank or LCS, sample reanalysis, or evaluation of interfering compounds. Sample clean-up procedures required by Ecology-approved SOPs must be implemented to alleviate potential matrix problems

5.2.3 Laboratory Control Sample

An LCS consists of a method blank spiked with target compounds of interest near the mid-point of the calibration range. The LCS is processed by the same sample preparation, standard addition, and analysis as the project samples. The recovery of target analytes in the LCS is an estimation of method accuracy.

LCS recovery must be within the control limits to demonstrate acceptable method performance. If the LCS recovery values are outside QC criteria for the target analytes, recovery values are significantly low, or the compounds were detected in the samples, then corrective action is required. After corrective action is complete, sample re-analysis is required for the failed parameters. For any deviations from the LCS control limits that cannot be resolved by sample re-analysis within holding times, the QC Manager must be notified immediately. If critical samples are affected, the Project Manager may determine that re-sampling is required.

5.2.4 Matrix Spike Sample

A matrix spike (MS) sample consists of a project sample split into two parts and processed as two separate samples in a manner identical to that of the rest of the samples. In addition to the regular addition of monitoring standards (internal standards, surrogate), spiking analytes are added to the sample aliquot. Generally, all method target analytes, if compatible, are added. A subset of target analytes may be used if indicated in the method SOP and approved during review of the SOP. An MS must be prepared for every batch of 20 samples (or fewer) for a given matrix if sufficient sample allows. Field and trip blanks must not be chosen for spiking. The laboratory must analyze a site-specific MS sample for every batch that contains samples from the site, even if the batch contains samples from other sites.

MS recovery values are a measure of the performance of the method on the sample being analyzed. MS recovery values outside the control limits applied to the LCS indicate matrix effects. Sample clean-up procedures may be warranted for samples with severe matrix effects. The laboratory should notify the QC Manager of these instances to determine an appropriate corrective action.

5.2.5 Matrix Spike Duplicate Sample

The matrix spike duplicate (MSD) sample is commonly prepared in conjunction with the MS sample. The MSD sample is prepared from a separate portion of the client sample and processed with the same additions as the MS. The MSD is prepared for methods that do not typically show concentrations of target analytes above MDLs, such as organic methods. The RPD values between the recovery values in the MS and MSD measure the precision of the analytical method on the actual project samples. For this project, QC criteria for RPDs are 35 percent for sediments unless the laboratory provides additional statistical criteria.

5.2.6 Duplicate Sample

A duplicate sample consists of a set of two samples obtained in an identical manner from the same project sample. The collection of duplicate samples from a heterogeneous matrix requires homogenization to ensure that representative portions are analyzed. One sample per batch of 20 samples or fewer per matrix is analyzed in lieu of a MSD.

The duplicate is prepared for methods that typically show concentrations of target analytes above MDLs, such as metals and wet chemistry analytes. The RPD values between the recovery values in the original and duplicate measure the precision of the analytical method on the actual project samples. For this project, QC criteria for RPDs are 35 percent for sediments unless the laboratory provides additional statistical criteria.

5.2.7 Other Laboratory QC Samples

The laboratory performs analysis of other QC samples or standards, depending on the analytical method. Standard QC samples or standards are documented in the specific method SOP. Method-specific QC samples or standards include internal standard spikes for gas chromatography (GC)/mass spectrometry (MS) methods; post-digestion spikes and serial dilutions for metals analysis; and interference check samples for inductively-plasma analysis. Results of all associated QC should be reported.

5.2.8 Performance Evaluation Samples

As part of the laboratory approval process, the laboratory must analyze external performance evaluation (PE) samples provided by an outside certifying agency on an annual basis. The laboratory must maintain acceptable scores on PE samples as part of the approval process. For this project any PE failures for project target compounds must be reported to the QC Manager immediately.

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5.3 Quality Assurance and Quality Control for Bioassay Sediment Samples

The detailed SOPs for the bioassay tests proposed for this investigation will be provided by the selected biological laboratory upon request. This section summarizes toxicity test QA/QC procedures to be implemented to ensure the test results are valid. Standard QA/QC procedures include the use of negative controls, positive controls, reference sediment samples, laboratory replicates, and daily water quality measurements. In addition, close contact with the biological laboratory will be maintained prior to and during the testing period to resolve any QA/QC problems or testing methodology issues in a timely manner.

5.3.1 Negative Control

The negative control consists of clean, inert material tested in parallel with the test sediments under identical test conditions. The biological testing laboratory provides this clean material, which usually consists of sediment collected from the original location from which the test organisms were harvested. Test acceptability criteria are based on results of the negative control. A test with at least 90% survival (70% mean normal survivorship for larval development) in negative control test chambers is considered acceptable.

5.3.2 Positive Control

A positive control will be run for each bioassay. Positive controls are chemicals known to be toxic to the test organism and that provide an indication of the sensitivity of the particular organisms used in a bioassay. Cadmium chloride or another appropriate reference toxicant will be used for the amphipod mortality, larval development, and juvenile polychaete growth bioassays.

5.3.3 Reference Sediment

Reference sediments, which closely match the grain size characteristics of the test sediments, will be run with each test batch for all three bioassays. The reference sediment is used for test comparisons and interpretations. Carr Inlet will be used as the reference area; the specific collection sites will be determined based on sample physical characteristics. All reference sediments will be analyzed for SVOCs, pesticides, PCBs, metals, dioxins, furans, total solids, TOC, bulk ammonia, bulk sulfides, and grain size.

All bioassays have performance standards for reference sediments (PSEP 1995). Failure to meet these standards may result in the requirement to retest.

5.3.4 Laboratory Replication

Five laboratory replicates of each test sediment, reference sediment, negative control, and elutriate concentration will be run for each respective bioassay. The replication of tests provides

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multiple observations of effects to test organisms so that statistical comparisons can be made between test and reference sediments.

5.3.5 Bioassay Water Quality

Water quality monitoring will be conducted for the amphipod, larval development, and juvenile polychaete growth bioassays. This consists of daily measurements of salinity, temperature, pH, and dissolved oxygen (every third day for juvenile polychaete growth bioassay). Ammonia and sulfides will be determined at test initiation and termination and interstitial salinity will be determined prior to the test setup. Monitoring will be conducted for all test and reference sediments and negative controls (including seawater controls). Parameter measurements must be within the limits specified for each bioassay as listed in Table 5-2. Measurements for each treatment will be made on a separate chemistry beaker set up to be identical to the other replicates within the treatment group. In addition, interstitial ammonia measurements at test initiation and test termination will be conducted for the amphipod test.

Table 5-2. Water Quality Control Limits.

Test (*Test Species*)	Temperature	Salinity	Dissolved Oxygen	pH [c]
Amphipod Mortality (*E. estuarius; R. abronius*)	15 ± 1 °C	Ambient [a]	NA [b]	---
Larval Development (*Mytilus sp.*)	16 ± 1 °C	28 ± 1 ppt	> 60% saturation	---
Larval Development (*D. excentricus*)	15 ± 1 °C	28 ± 1 ppt	> 60% saturation	---
Juvenile Polychaete Growth (*N. arenaceodentata*)	20 ± 1 °C	28 ± 2 ppt	NA [b]	---

[a] Same as interstitial salinity of test sediment
[b] Continuous aeration is required by the protocol, so the dissolved oxygen should not be a cause of concern
[c] pH is monitored as a water quality parameter. There are generally no control limits for pH; however, measurements of pH may be useful in interpreting results (Ecology 2003).

5.4 Data Validation

At a minimum, all laboratory data will undergo a QA1 review (PTI 1989a). If requested by Ecology, the data will be reviewed following QA2 procedures (PTI 1989b). If data fail the review, the laboratory will be contacted and the data will be reanalyzed, qualified, or unqualified with an explanation. For each data type, the quality of the data will be summarized in validation memos.

In addition, laboratory data packages will be provided for the chemistry data to allow independent data verification and validation. The data packages will consist of the sample results followed by a cover letter describing procedures used and analytical problems encountered, qualifiers used, reconstructed ion chromatogram (GC/MS), mass spectra of detected target compounds (GC/MS), chromatograms, quantification reports, and calibration data summaries. Dilution volumes, sample sizes, percent moisture, and surrogate recoveries will be

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presented on each summary sheet with the analytical results. A similar package is also assembled for each quality control sample (e.g., method blank).

The following types of data will be reviewed:

- Analytical laboratory summary reports including QC summary data for surrogates, method blanks, LCSs, and MS/MSD samples. Acceptance and performance criteria will be developed from the current laboratory control limits even if those limits differ from the limits listed in Section 7;
- Calibration summary data will be checked to verify that all positive results for target compounds were generated under an acceptable calibration as defined by the analytical method;
- Field QC results for blanks and;
- Field data such as sample identifications and sample dates will be checked against the laboratory report.

Raw data files from the field and laboratory may not be reviewed unless there is a significant problem noted with the summary information.

After receipt from the laboratory, project data will be validated as described in the following section.

5.4.1 Evaluation of Completeness

The QC Manager verifies that the laboratory information matches the field information and that the following items are included in the data package:

- Chain-of-custody forms;
- Case narrative describing any out-of-control events and summarizing analytical procedures;
- Data report forms;
- QA/QC summary forms;
- Calibration summary forms; and
- Chromatograms documenting any QC problems.

If the data package is incomplete, the QC Manager contacts the laboratory, which must provide all missing information within one day.

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5.4.2 Evaluation of Compliance

The actual data validation follows the procedures that are briefly outlined below:

- Review the data to check field and laboratory QC results to verify that holding times and acceptance and performance criteria were met, and to note any anomalous values;
- Review chromatograms, mass spectra, and other raw data if provided as backup information for any apparent QC anomalies;
- Ensure all analytical problems and corrections are reported in the case narrative and that appropriate laboratory qualifiers are added;
- For any problems identified, review concerns with the laboratory, obtain additional information if necessary, and check all related data to determine the extent of the error; and
- Apply data qualifiers to the analytical results to indicate potential limitations on data usability.

QC Managers will follow qualification guidelines in applicable QA1 or QA2 guidelines. If no QA1 or QA2 guidelines exist, then applicable USEPA National and Regional Data Review guidelines will be used.

5.4.3 Data Validation Reporting

The QC Manager will perform the following reporting functions:

- Alert the Project Manager to any QC problems, obvious anomalous values, or discrepancies between the field and laboratory data, and resolve any issues;
- Discuss QC problems in a data validation memo for each laboratory report, the data validation memo and copy of the data package will be sent to Project Manager;
- Review the laboratory electronic data deliverable (EDD) and electronic field data, enter the data qualifiers into the database, and prepare analytical data summary tables. The tables will summarize those samples and analytes for which detectable concentrations were exhibited as well as complete analytical summary tables. The tables will include field QC samples; and
- At the completion of all field and laboratory efforts for site, the QC Manager will prepare a data review/validation memorandum. The memorandum will summarize planned versus actual field and laboratory activities and data usability concerns.

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6.0 Field Procedures

This section describes the procedures for positioning, sample collection, processing, identification, documentation, equipment decontamination, and waste handling for the proposed field investigation. Samples will be collected for sediment and wood waste chemistry, toxicity, tissue residues, and radioisotope dating. The laboratory methods for chemical analysis, toxicity testing, and radio isotope analysis are presented in Section 7. Field activity SOPs are provided in Appendix A and field forms are presented in Appendix B. The Site-Specific Health and Safety Plan is provided in Appendix D.

6.1 Sampling Platforms

A shallow-draft vessel, owned and operated by Research Support Services will be used for the surface and subsurface sediment/wood waste collection; the geophysical survey will be conducted by Golder Associates from their vessel equipped with specialized survey equipment. Tissue samples may also be collected using a small inflatable boat in areas not accessible by foot from shore.

6.2 Station Positioning and Navigation

A differential global positioning system (DGPS) will be used for station positioning of all vessel sediment sampling stations. The vessels used for these activities will operate navigation equipment that provides accurate station positioning, and that assures sample stations and water depths are accurately recorded. The DGPS will be used aboard the vessel for station positioning. The DGPS receiver will be capable of surveying positions to within 2 meter (m) accuracy. For manually-collected samples, a hand-held GPS unit enabled with Wide Area Augmentation System (WAAS) will be used to record the sampling station coordinates. Accuracy of the WAAS-enabled GPS unit will be within 3 m. Horizontal coordinates will be referenced to the Washington State Plane coordinate system under the North American Datum of 1983 (NAD 83). The vertical datum will be the National Ocean Service mean lower low water (MLLW) datum. Vertical control collected by the vessel depth finder will be corrected for tidal influence after completion of the field activities.

Prior to initiating field work, a control check point will be established that can be accessed by the sampling vessel (e.g., dock, piling). At the beginning and end of each day, the check point will be surveyed from the vessel and compared to the known coordinates. The control check point position as recorded by the vessel should not differ by more than 2 m from the land-surveyed coordinates.

For vessel-deployed sampling, the DGPS receiver will be placed above the sampling device deployment boom to accurately record the position. At surface sediment grab stations, once the sampling device has been deployed, the actual position will be recorded when the device reaches the sediment floor and the deployment cable is in a vertical position. At these locations, water

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depths will be measured directly by lead-line and converted to mudline elevations after correction for tide.

Coordinates of the proposed sampling stations will be programmed as waypoints into the vessel's navigation system and used to guide the vessel to the appropriate locations. The target sample coordinates are provided in Table 6-1.

6.3 Geophysical Survey Data Collection

6.3.1 Electrical resistivity imaging (ERI)

The ERI method detects differences in electrical (resistivity) properties of geologic materials. These differences can result from variations in lithology and mineralogy, water content, or pore-water chemistry. The method involves transmitting an electric current into the ground between two current electrodes and measuring the voltage between two separate potential electrodes. The measured point, called a sounding, represents the apparent resistance of the entire area beneath the electrodes. A combination of different electrode arrangements is used to collect enough soundings to produce an apparent resistivity profile below the ERI survey transects.

An IRIS Sycal-ERI system that consists of a control console and multi-channel electrode cables powered by a 12-volt battery will be used at Shelton Harbor. In shallow waters, less than 20 feet deep, the system can be used in a continuous profiling mode while towing an array.

6.3.2 Sub-Bottom Profiler (SBP)

The SBP system images the subsurface using a high-frequency acoustic transducer. Acoustic pulses are reflected at boundaries where there is a change in acoustic properties (e.g., density). These changes occur at the boundary between sediment layers (silt to sand) or where there are buried discrete targets (rocks, cables, pipelines).

Sub bottom profiling data will be collected using a Geopacoustics or Datasonics sub-bottom profiler system. The data are displayed and recorded to a laptop computer: the software will integrate GPS data and realtime positioning.

6.4 Sample Collection

6.4.1 Surface Samples

Surface sediment samples will be collected at a total of 48 sampling locations, including background and references. Surface wood waste samples will be collected at a total of 13 sampling locations. All 61 surface sediment samples will be submitted for chemical analysis and toxicity testing. Tables 4-3, 4-5, and 4-7 list surface samples to be collected; Table 6-1 lists the analytical and biological testing methods, and sample container, volume, and preservation requirements.

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Table 6-1. Sample Analysis Summary, Preservation, Sample Container, and Holding Times.

Matrix	Number of Samples [a]	Analytical Parameters/ Method	Sample Preservation	Technical Holding Time [b]	Sample Container(s)
Sediment and Wood Waste					
	112	SVOCs/SW-846 Method 8270D	Cool to 4°C	Extract within 14 days of collection; analyze within 40 days of extraction.	One 8-oz wide-mouth glass jar with Teflon-lined lid.
			Freeze, -18°C	Extract within 1 year of collection, analyze within 40 days of extraction	
	32	Wood Resin/ SW-846 Method 8270D	Cool to 4°C	Extract within 14 days of collection; analyze within 40 days of extraction.	One 8-oz wide-mouth glass jar with Teflon-lined lid.
			Freeze, -18°C	Extract within 1 year of collection, analyze within 40 days of extraction	
	32	Chlorinated Guaiacols /NCASI CP-86.07	Cool to 4°C	Extract within 30 days of collection; analyze within 40 days of extraction.	One 8-oz wide-mouth glass jar with Teflon-lined lid.
			Freeze, -18°C	Extract within 1 year of collection, analyze within 40 days of extraction	
	61	Dioxin/Furans/ USEPA Method 1613B	Cool to 4°C	Extract within 14 days of collection; analyze within 40 days of extraction.	One 8-oz wide-mouth glass jar with Teflon-lined lid.
			Freeze, -18°C	Extract within 1 year of collection, analyze within 40 days of extraction	
	99	Pesticides/SW-846 Method 8081B	Cool to 4°C	Extract within 14 days of collection; analyze within 40 days of extraction.	One 8-oz wide-mouth glass jar with Teflon-lined lid.
			Freeze, -18°C	Extract within 1 year of collection, analyze within 40 days of extraction	
	112	PCBs/SW-846 Method 8082	Cool to 4°C	Extract within 14 days of collection; analyze within 40 days of extraction.	One 8-oz wide-mouth glass jar with Teflon-lined lid.
			Freeze, -18°C	Extract within 1 year of collection, analyze within 40 days of extraction	
	13	PCB congeners/ USEPA Method 1668	Cool to 4°C	Extract within 1 year of collection.	One 8-oz wide-mouth glass jar with Teflon-lined lid.
			Freeze, -18°C	Extract within 1 year of collection, analyze within 40 days of extraction	

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Table 6-1 (continued). Sample Analysis Summary, Preservation, Sample Container, and Holding Times.

Matrix	Number of Samples [a]	Analytical Parameters/ Method	Sample Preservation	Technical Holding Time [b]	Sample Container(s)
	10	NWTPH-HCID/Ecology NWTPH-HCID	Cool to 4°C	Extract within 14 days of collection; analyze within 40 days of extraction.	One 8-oz wide-mouth glass jar with Teflon-lined lid.
	6	Organotins /(Krone, et. al., 1989)	Cool to 4°C	Extract within 14 days of collection; analyze within 40 days of extraction.	One 8-oz wide-mouth glass jar with Teflon-lined lid.
			Freeze, -18°C	Extract within 1 year of collection, analyze within 40 days of extraction	
	112	Metals/SW-846 Methods 6000/7000 Series	Cool to 4°C	180 days from collection (28 days for mercury).	One 8-oz wide-mouth glass jar with Teflon-lined lid.
			Freeze, -18°C	2 years from collection (28 days for mercury)	
	112	TOC/SW-846 9060 (Plumb)	Cool to 4°C	14 days from collection.	One 8-oz wide-mouth glass jar with Teflon-lined lid.
			Freeze, -18°C	6 months from collection	
	112	Grain Size/PSEP	Cool to 4°C	180 days from collection	One 16-oz wide-mouth glass jar with Teflon-lined lid.
	32	Total Volatile Solids/ USEPA Method 160.4	Cool to 4°C	14 days from collection.	One 8-oz wide-mouth glass jar with Teflon-lined lid.
			Freeze, -18°C	6 months from collection	
	112	Sulfide/SW-846 9030	Cool to 4°C, with 5ml of zinc acetate	7 days from collection.	One 2-oz wide-mouth glass jar with Teflon-lined lid.
	112	Ammonia/PSEP	Cool to 4°C	7 days from collection.	One 8-oz wide-mouth glass jar with Teflon-lined lid.
	3 Cores	Core Dating (cesium 137 and lead 210)	Cool to 4oC	Analyze Cores as soon as possible.	Two 8-oz wide-mouth glass jar with Teflon-lined lid.
	42	Sediment Toxicity (Bioassay)d	Cool to 4oC	14 days from collection	Three 1-L wide-mouth glass jar with Teflon-lined lid.

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Table 6-1 (continued). Sample Analysis Summary, Preservation, Sample Container, and Holding Times.

Matrix	Number of Samples [a]	Analytical Parameters/ Method	Sample Preservation	Technical Holding Time [b]	Sample Container(s)
			Cool to 4°C, nitrogen atmosphere	8 weeks from collection	
Tissue					
	15	SVOCs/SW-846 Method 8270D	Cool to 4°C	Extract within 14 days of collection; analyze within 40 days of extraction.	One 8-oz wide-mouth glass jar with Teflon-lined lid.
	15	Dioxin/Furans/ USEPA Method 1613B	Cool to 4°C	Extract within 1 year of collection. analyze within 40 days of extraction.	One 8-oz wide-mouth glass jar with Teflon-lined lid.
	15	Pesticides/SW-846 Method 8081B	Cool to 4°C	Extract within 14 days of collection; analyze within 40 days of extraction.	One 8-oz wide-mouth glass jar with Teflon-lined lid.
	15	PCB congeners/ USEPA Method 1668	Cool to 4°C	Extract within 1 year of collection.	One 8-oz wide-mouth glass jar with Teflon-lined lid.
	15	PCB Aroclor /SW-846 Method 8082	Cool to 4°C	Extract within 1 year of collection. analyze within 40 days of extraction.	One 8-oz wide-mouth glass jar with Teflon-lined lid.
	15	Metals/SW-846 Methods 6000/7000 Series	Cool to 4°C	180 days from collection (28 days for mercury).	One 8-oz wide-mouth glass jar with Teflon-lined lid.
	15	Percent lipids/ USEPA	Cool to 4°C	14 days from collection.	One 8-oz wide-mouth glass jar with Teflon-lined lid.

[a] The number of samples presented is an estimate; the actual number of samples to be collected will be determined in the field.
[b] Holding times established in Ecology 2008, Table 10
[c] Samples will be analyzed by alpha and gamma spectroscopy.
[d] Bioassay consist of three toxicity tests: amphipod mortality, larval development, and polychaete growth.
°C = Degrees Celsius.
Ecology =Washington Department of Ecology.
USEPA = U.S. Environmental Protection Agency
HCID = Hydrocarbon Identification.
NWTPH = Northwest total petroleum hydrocarbon.
oz = ounce.
PCBs = Polychlorinated Biphenyl Compounds.
Pesticides = Chlorinated Pesticides.
PSEP = Puget Sound Estuary Program Methods.
SVOCs = Semivolatile Organic Compounds.
SW-846 = *Test Methods for Evaluating Solid Waste, Physical Chemical Methods*, 3rd edition, SW-846, 1986.

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The following sections describe the collection and processing of surface samples.

Surface sediment and wood waste will be collected from a boat using a stainless-steel van Veen (modified 0.1 square meters [m^2]), Ekman, Petite Ponar, or similar grab device. If accessible during low tide events, surface sediment samples from intertidal areas may be collected directly with a hand-held stainless-steel surface corer. A total of three grab attempts will be made at each proposed sampling location. If unsuccessful, the station will be moved to a new location within 10 m (33 ft) of the original station. If it is not possible to obtain a sample within this distance, the Herrera project manager will be consulted to determine an appropriate alternate action.

Surface sediment and wood waste samples will be collected from the 0 to 10 cm (0 to 4 inches [in]) interval. Multiple grabs will be necessary to obtain an adequate sample volume for all analyses. Samples will be collected as described in the SOP for surface sediment sampling (Appendix A). Samples will be carefully collected to ensure the following conditions are met, as required by Ecology (2008):

1. Make logbook and field form entries as necessary throughout the sampling process to ensure accurate and thorough record-keeping. Field documentation is described in Section 6.8.

2. Position the sampling vessel at the targeted sampling location.

3. Set the sampler jaws in the open position, place the sampler over the edge of the boat, and lower the sampler to the bottom.

4. Trip the sampler to collect the sample.

5. Record the location using the DGPS; measure and record the water depth.

6. Retrieve the sampler and place it securely in the sampling vessel.

7. Examine the sample for the following sample acceptance criteria:

   - ☐ The sampler is not overfilled with sample so that the sediment surface is not pressed against the top of the sampler.

   - ☐ The sample does not contain large foreign objects (i.e., trash or debris). A sample that is rock/gravel fill will be rejected in favor of depositional material (i.e., sand/silt/clay).

   - ☐ Overlying water is present in the sampler (indicates minimal leakage).

   - ☐ The overlying water is not excessively turbid (indicates minimal sample disturbance).

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- The sediment surface is relatively flat (indicates minimum of disturbance or winnowing).
- The desired penetration depth is achieved (e.g., several centimeters more than the targeted sample depth).

8. If sample acceptance criteria are not achieved, the sample will be rejected and another sample collection attempt will be made.

9. Siphon off any overlying surface water.

10. Collect samples for total sulfides analysis directly from the grab sampler and place the sediment aliquots in appropriate, pre-cleaned, labeled sample containers (Table 6.1).

11. Measure and collect the top 10 cm (4 in) with a stainless steel spoon, avoiding any sediment that is in contact with the inside surface of the grab sampler, then place the sediment into a stainless steel bowl and cover with aluminum foil.

12. Record the following observations of sediment sample characteristics on the field form (Appendix B); if more sample volume is required, repeat steps 4 through 12.

    - Texture
    - Color
    - Biological organisms or structures (i.e., shells)
    - Presence of debris (i.e., natural or anthropogenic objects, including wood and its general size)
    - Presence of oily sheen or obvious contamination
    - Odor (e.g., hydrogen sulfide, petroleum)

13. Wash excess sediment back into the water away from any areas remaining to be sampled.

14. Once sufficient sediment volume has been collected, samples should be placed in the appropriate, pre-cleaned, labeled sample containers as described in Section 6.6, placed in a cooler maintained at 4 ºC, and prepared for shipment to the analytical or biological laboratory as described in Section 6.7.

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15. Confirm all relevant documentation has been completed, entries are accurate, and paperwork has been signed.

16. Decontaminate all sampling equipment as described in Section 6.9 before proceeding to the next sampling location.

Additional sample volume will be collected at stations requiring MS/MSD analysis (collected randomly at the field supervisor's discretion). Aliquots of homogenized sediment will also be collected for toxicity testing at designated locations.

Manual sampling methods (e.g., stainless steel spoon and bowl) may be used at locations exposed during low water conditions. Surface sediment will be collected from the 0 to 10 cm (0 to 4 in) interval. Samples will be collected as described in the SOP for surface sediment.

6.4.2 Wet sieving

A homogenized sample aliquot of sediment collected at locations designated for toxicity testing will be wet sieved in the field. The purpose for wet sieving is to separate the coarse and fine-grained material comprising a sediment sample in order to match appropriate test and reference locations for toxicological testing. A 63-micron sieve is used to separate the silt and clay (fines), from the sand and gravel portion of the sediment sample. The grain size distribution of a given sediment sample is an important physical parameter when conducting bioassays in order to determine an appropriate reference sample for comparison with test sediments. The wet sieving of surface sediment samples is conducted in the field at the time of collection, so that reference samples with similar grain size distributions (as percent fines) can be targeted for the bioassays. The procedure for wet sieving is as follows:

1. Measure and record the exact volume of a small (100 ml) flat-topped beaker. (Note: the 100 ml gradation is generally located slightly below the rim of the beaker; hence, the actual beaker volume is greater than 100 ml).

2. Completely fill the beaker to the rim with an aliquot of homogenized sediment. Lightly tap the beaker on a hard surface to remove any air bubbles, and level the surface.

3. Rinse the entire contents of the beaker through a 63-micron (#230, 4 phi) sieve. Aggregates of material should be gently broken to facilitate sieving. Continue sieving until clear rinsewater passes through the sieve.

4. Carefully transfer the coarse-grained material from the sieve into a 250 ml graduated cylinder.

5. Divide the amount of material measured in the bottom of the graduated cylinder by the capacity of the beaker to determine the decimal percentage of coarse-grained material. Subtract the decimal percentage of coarse-

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grained material from 1 to determine the decimal percentage of fines (silt and clay).

6. Record the percentages of coarse and fine-grained material in the field logbook.

6.4.3 Subsurface Samples

Subsurface sediment samples will be collected at a total of 32 locations and co-located with selected surface sediment locations. Fourteen of the 32 subsurface sediment samples will be initially submitted to the laboratory for analysis. The remaining 18 subsurface sediment samples (12 from Oakland Bay and 6 from Hammersley Inlet) will be archived pending surface sediment chemistry results. Subsurface wood waste samples will be collected at a total of 13 locations co-located with surface wood waste locations. All 13 subsurface wood waste samples will be submitted to the laboratory for chemistry analysis. In addition, underlying native sediment from six of the 13 wood waste cores will be collected and submitted to the laboratory for chemical analysis. Core samples will be collected using a 12 ft (3.7 m) vibracorer. In most cases, the cores will be advanced to a depth of 4 ft (1.2 m) or refusal. Each core will be sampled at 1 ft (0.3 m) intervals, depending upon limitations of the equipment to reach targeted depth horizons. In predetermined locations, the cores will be advanced to the maximum depth of 12 ft (3.7 m) to delineate the depth of wood debris. The core sample will be documented and native sediment from the first 12 in (30 cm) below the wood debris will be collected for analysis.

The general procedure for collecting sediment cores is as follows:

1. Make logbook and field form entries as necessary throughout the sampling process to ensure accurate and thorough record-keeping. Field documentation is described in Section 6.8.

2. Position the sampling vessel at the targeted sampling location.

3. Record the location using the DGPS; measure and record the water depth.

4. Insert pre-cleaned acetate core tubes equipped with an “eggshell” core catcher to retain material in the core barrel for deployment.

5. The core-sampler is positioned vertically on the bottom and advanced to a sampling depth of approximately 4 ft (1.2 m) or 12 ft (3.7 m) to include all targeted sampling intervals or until refusal.

6. Once sampling is complete, the sampler is extracted and core tube detached from the vibracorer. The core sample will be examined at each end to verify that sufficient sediment was retained. The condition and quantity of material within the core will then be inspected to determine

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acceptability. If sample acceptance criteria are not achieved, the sample will be rejected and another sample collection attempt will be made.

- To verify whether an acceptable core sample has been collected the following criteria must be met:

  a. Target penetration depth or refusal was achieved;

  b. Sediment recovery of at least 65 percent of the penetration depth;

  c. Sample appears undisturbed and intact without any evidence of obstruction or blocking within the core tube or core catcher.

- Percent sediment recovery will be determined by dividing the length of material recovered in the core tube by the depth of core penetration below the mudline. If the sample is deemed acceptable, overlying water will be siphoned from the top of the core tube, and each end of the tube will be capped and sealed with duct tape for storage until processing. The cores will be stored on ice until they are processed. The station number, station coordinates, date and time of collection, sediment description, field crew, and weather conditions will be recorded in the sediment coring log (Appendix B).

7. Record observations of sediment sample characteristics on the field form (Appendix B); if more sample volume is required repeat steps 4 through 11.

8. Process cores at a predetermined location onshore. Label the core, cap it, and store it in an upright vertical position in a container packed with ice until processed. Cores are to be processed as soon as possible.

9. Confirm all relevant documentation has been completed, entries are accurate, and paperwork has been signed.

10. Wash excess sediment back into the water away from any remaining sample areas.

11. Decontaminate all sampling equipment as described in Section 6.9 before proceeding to the next sampling location.

A single acceptable sample for each subsurface interval will be collected. All sediment cores will be processed onboard or at a designated processing location (extrusion, documentation, and

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sample collection for analysis). Disposable nitrile gloves will be worn for all handwork such as sectioning and extruding the core, sub-sampling, mixing samples, and filling sample containers. The gloves will be disposed of between sample composites in order to prevent cross contamination between samples. Sampling implements and processing equipment will be decontaminated prior to processing the sediment cores. Sediment cores will be processed in the same order as collected to minimize holding time. Each section comprising a core sample will be extruded onto a stainless steel tray using a core sample removal tool (a plunger style device that pushes the sample through the core tube). Care will be taken to preserve the integrity of the core section stratums by extruding in order from top (mudline) to bottom (native material). Once the sediment has been extruded, a visual characterization of the sample material will be immediately conducted. The core will then be visually described in the core log and will include the following information and characteristics:

- Station number
- Date and time of collection
- Station coordinates
- Weather conditions
- Names of persons collecting and logging the sample
- Penetration depth
- Percent sediment recovery
- Physical soil description in accordance with the Unified Soil Classification System (USCS)
- Color
- Odor (e.g., hydrogen sulfide, petroleum)
- Visual stratifications and lenses
- Vegetation and/or woody debris
- Biological activity (e.g., detritus, shells, tubes, bioturbation, live or dead organisms)
- Presence of oil sheen or obvious contamination
- Any other distinguishing characteristics or features

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Representative aliquots of sediment will be collected from the 1 ft (0.3 m) intervals using decontaminated stainless steel spoons, to generate the composite sample. Up to twelve samples will be collected from each core representing a 1 ft (0.3 m) vertical horizon. Sediment will be collected from the center of the core that has not been smeared by, or in contact with, the core tube. The volumes removed will be placed in a decontaminated stainless steel bowl or pan, and mixed until homogenous in texture and color. After all the composite sample sediment is collected and homogenized, representative aliquots will be placed in the appropriate, pre-cleaned, labeled sample containers and prepared for shipment to the analytical laboratory for archival.

6.4.4 Radioisotope Cores

Three subsurface cores will be submitted for sedimentation rate and surface mixed layer depth analysis. Each core will be approximately 4 ft (1.2 m) in length. Cores will be divided by the laboratory into 2 cm intervals and only every third interval will be analyzed for lead-210. It is anticipated that each core will have 20 intervals analyzed for lead-210 and two intervals analyzed for cesium-137.

6.5 Tissue Sample Collection

Bivalve tissue samples will be collected and analyzed from Oakland Bay, Shelton Harbor, and Hammersley Inlet. The methods for collecting and processing the samples are described below.

Small shovels and trowels will be used to collect bivalves at low tide from publicly accessible beaches. The bivalves will be rinsed with site water following collection. All composite sample bivalves will be placed directly into pre-cleaned sample jars. Between 10 and 20 bivalves will be collected per composite bivalve tissue sample, depending on size. The shell length and weight for each bivalve retained for analysis will be recorded in the biological sampling log. Upon receipt by the analytical laboratory, the bivalves will be shucked to collect the edible tissues. The tissue from each sample will be homogenized and analyzed.

Tissue samples will be immediately placed on ice in coolers in the field. If not submitted immediately (within 24 hours) to the analytical laboratory, the tissue samples will be kept on ice at less than 4 °C.

6.6 Sample Identification, Containers, and Labels

6.6.1 Sample Identification

Samples will be identified based on the sampling area, location, and sample depth. All samples collected during the investigation will be labeled clearly and legibly. Each sample will be

labeled with a unique alphanumeric sample identification number that identifies characteristics of the sample as follows:

Study Location
SH - Shelton Harbor
OB - Oakland Bay
HI - Hammersley Inlet
RF - Reference
BG - Background

Station Location (associated with each Study Location)
01 - Sample Station 1

Matrix
SS - Sediment Surface
SC - Sediment Core
RI - Radioisotope
WS - Wood Surface
WC - Wood Core
TS - Tissue

Depth
00 - Surface
01 - 0-1 foot
12 - 1-2 foot
23 - 2-3 foot
34 - 3-4 foot
04 - 0-4 foot (radioisotope only)

For example:

SH-01-RI-04 = Shelton Harbor, Station 1, Radioisotope, 0-4 foot interval
OB-09-SC-12 = Oakland Bay, Station 9, Sediment Core, 1-2 foot interval

6.6.2 Sample Containers

Pre-cleaned sample containers will be supplied by the analytical laboratory for the required analyses. Spare sample containers will be carried by the field samplers for archive sample collection, and in case of breakage or possible contamination. Sample containers, preservation techniques, and holding times will follow PSEP (1996) guidelines (see Table 6-1).

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6.6.3 Sample Labels

Sample labels will be made of self-adhering, waterproof material. An indelible pen will be used to fill out each label. Each sample label will contain:

- Project name
- Sample identification number
- Date of collection (day/month/year)
- Time of collection (military format)
- Analysis
- Preservative (as applicable)
- Company name and sampler initials (Herrera/GC).

Sample labels will be protected by packaging tape wrapped around the entire jar to prevent loss or damage of the labels during handling and storage.

6.7 Sample Storage and Delivery

An SOP for sample packing and shipment is provided in Appendix A. All samples will be stored in insulated coolers and preserved by cooling with ice or frozen gelpacks to a temperature of 4 °C or below. Maximum sample holding and extraction times will be strictly adhered to by field personnel and the analytical and testing laboratories. Preparation of jars for shipment to fixed laboratories will be performed in the following manner:

- Samples will be packaged and shipped in accordance with U.S. Department of Transportation regulations as specified in 49 Code of Federal Regulations (CFR) 173.6 and 49 CFR 173.24.

- Place sample containers in plastic zip-loc bubble-pack bags, or wrap in bubble pack and secure with packaging tape.

- Prepare an empty insulated cooler by placing three to four ice packs in a garbage bag at the bottom of the cooler. Place sample containers in a garbage bag and fill with the sample bottles. Add additional bags of ice as needed to surround the bag containing the samples.

- Chain of custody (COC) forms will be enclosed in a plastic bag and taped to the inside lid of the cooler.

- Seal the cooler with strapping tape and a custody seal.

Samples for chemical analyses will be hand-couriered or shipped via overnight delivery to the analytical laboratories once per day or whenever a cooler is filled, and accompanied by the COC record, which identifies the shipment contents. The COC will be signed by the individual relinquishing samples to the onsite laboratory representative. Upon receipt of samples at the

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laboratory, the shipping container seal will be broken and the condition of the samples will be recorded by the receiver. The field personnel will be responsible for the following:

- Packaging the samples;
- Signing the COC before placing inside the cooler to be sealed;
- Applying a shipping label, a waybill, a custody seal, and strapping tape to the cooler;
- Shipping the samples in accordance with the maximum holding time allowed for the analyses to be performed;
- Notifying the laboratory of when the samples are shipped; and
- Confirming receipt of the samples by the laboratory and that the samples were received in good condition.

All sediment samples will be retained for a minimum of six months from the time they were received using standard laboratory handling procedures. They may be removed from the laboratory prior to the end of the six-month period only at the direction of the Herrera project manager.

6.8 Field Documentation

A complete record of field activities will be maintained. Documentation necessary to meet QA objectives for this project includes field notes and field forms, sample container labels, and COC forms. An SOP for field documentation is provided in Appendix A. The field documentation will provide descriptions of all sampling activities, sampling personnel, and weather conditions, and will record all modifications, decisions, and/or corrective actions to the study design and procedures identified in this SAP.

6.8.1 Field Notebooks

Field logbooks will be kept on site during field operations. Daily activities will be recorded in a bound field logbook of water-resistant paper. Separate logbooks consisting of bound, paginated field forms will be kept for sediment core sampling, sediment grab sampling, and an inventory of sample containers (separate from the COC documentation). All entries will be made legibly, in indelible ink, and will be signed and dated. Information recorded will include the following:

- Date, time, place, and location of sampling;
- Onsite personnel and visitors;

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- Daily safety discussion and any safety issues;
- Quality control samples (i.e., duplicate samples, field blanks, etc.);
- Field measurements and their units;
- Number of attempts at each sampling station;
- Observations about site and location (weather, current, odors, appearance, etc.);
- Observations about the samples (DGPS locations, depth as recorded by vessel depth sounder, maximum penetration depth, comments);
- General sediment characteristics (texture, color, biota, odor, sheen, etc.); and
- Equipment decontamination verification.

Field logbooks are intended to provide sufficient data and observations to enable participants to reconstruct events that occur during project field activities. Entries should be factual, detailed, and objective. Unless restricted by weather conditions, all original data recorded in field logbooks, on sample identification tags, on COC records, and on field forms will be written in waterproof ink. If an error is made, the individual responsible may make corrections simply by crossing out the error and entering the correct information. The erroneous information will not be obliterated. All corrections will be initialed and dated. All documentation, including voided entries, will be maintained within project files.

6.8.2 Chain of Custody Procedures

Samples will be retained at all times in the field crew's custody until samples are delivered or shipped to the appropriate laboratory by field personnel. COC forms will be initiated at the time of sample collection to ensure that all collected samples are properly documented and traceable through storage, transport, and analysis. When all line items on the form are completed or when the samples are relinquished, the sample collection custodian will sign and date the form, list the time, and confirm the completeness of all descriptive information contained on the form. Each individual who subsequently assumes responsibility for the samples will sign and date the COC form. The field COC terminates when the laboratory receives the samples. The field sample custodian will retain a copy of the completed, signed COC form(s) for project files.

6.9 Equipment Decontamination Procedures

The vessel-deployed grab samplers, compositing pans, and sampling utensils will be thoroughly decontaminated prior to use in accordance with PSEP protocols (PSEP 1996). The equipment

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will be washed with non-phosphate detergent and in situ water or by repeatedly submersing the equipment overboard. A final rinse with distilled water also will be performed. If a noticeable oily sheen or petroleum odor is observed, sampling bowls and utensils used to process those samples will not be used for subsequent sample processing.

All handwork will be conducted with disposable nitrile gloves, which will be changed after handling each individual sample and between sampling stations to prevent cross-contamination between samples.

Personal non-disposable field equipment (i.e., boots and waterproof gloves and garments) will be rinsed with water and brushed clean prior to leaving the immediate vicinity of the sample collection area. Special attention will be given to removing mud and sediments that may adhere to boot treads.

6.10 Waste Disposal

Investigation-derived waste expected to be generated by sampling activities during the Oakland Harbor sediment study include:

- Excess sediment sample core not submitted to the laboratories; and
- Disposable protective clothing, sampling equipment, and packaging.

6.10.1 Sediment Sample/Sediment Core

Small quantities of excess sediment and rinse water generated during sample processing will be stored in 55-gallon drums adjacent to the processing area. Sediment will be disposed of at a facility permitted for the constituents identified in the associated samples.

6.10.2 Disposable Protective Clothing and Sampling Equipment

Used personal protective equipment (PPE), such as gloves and disposable supplies, such as paper towels and packaging, will be placed in plastic storage bags and disposed of as municipal waste. If PPE contains residual sediment, the PPE will be rinsed off and then disposed of as non-hazardous waste. Waste material (e.g., cardboard, aluminum) will be recycled as feasible.

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