FINAL

Quality Assurance Project Plan

River Operable Unit Remedial Investigation

Bradford Island
Bonneville Lock and Dam Project
Cascade Locks, Oregon

Prepared by:

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September 7, 2007

Contract No. W9128F-04-D-0001
Task Order No. DT01

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LIST OF ACRONYMS

AES	Axys Environmental Systems, Inc.
A/E	Architecture/Environmental
ATL	Acceptable Tissue Level
BEHP	bis(2-ethylhexyl)phthalate
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	centimeter
COI	contaminant of interest
COR	contracting officer's representative
COPC	contaminant of potential concern
CTL	Critical Tissue Level
DGPS	differentially corrected Global Positioning System
DOC	dissolved organic carbon
DOD	Department of Defense
DQCR	daily quality control report
DQO	data quality objective
EDL	Estimated Limit of Detection
EPA	Environmental Protection Agency
ERA	Ecological Risk Assessment
GPS	Global Positioning System
HAZWOPER	Hazardous Waste Operations and Emergency Response
HTRW	hazardous, toxic, and radioactive waste
IATA	International Air Transport Association
IDW	investigation-derived waste
ITR	independent technical review
kg	kilogram
L	liter
LCS	laboratory control sample
LNAPL	light non-aqueous phase liquid
MDL	method detection limit
mg	milligram
MQL	method quantitation limit
MRL	method reporting limit
MS/MSD	matrix spike/matrix spike duplicate
NRWQC	National Recommended Water Quality Criteria
NTCRA	Non-time critical removal action
NWTPH-Dx	Northwest Total Petroleum Hydrocarbon – Diesel Range

ODEQ	Oregon Department of Environmental Quality
OSHA	Occupational Safety & Health Administration
OU	operable unit
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PDT	Project Delivery Team
PM	Project Manager
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RI	remedial investigation
RI/FS	Remedial Investigation/Feasibility Study
RPD	relative percent difference
SIM	selective ion monitoring
SLV	Screening Level Value
S/N	signal-to-noise ratio
SOP	Standard Operating Procedure
SOW	Statement of Work
SVOC	Semi-volatile Organic Compounds
TOC	total organic carbon
URS	URS Corporation
USEPA	United States Environmental Protection Agency
USACE	United States Army Corps of Engineers
VSP	Visual Sample Plan

A PROJECT MANAGEMENT

A 1.0 Distribution List

Oregon Department of Environmental Quality
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Attn: Bob Schwarz

US Army Corps of Engineers – Portland District
333 SW First Ave, Portland, OR 97208
Attn: Mark Dasso, Michael Gross, Kitia Chambers

US Army Corps of Engineers – Seattle District
4735 E Marginal Way South, Seattle, WA 98134
Attn: John Wakeman

URS Corporation
111 SW Columbia, Suite 1500
Portland, Oregon 97201
Attn: Jeff Wallace, Chi-Wah Wong, Usha Vedigari, Heather Loso, Christina Wheeler, Brian McNamara, Ashley Burt, Chris Moody

A 2.0 Project Organization

The United States Army Corps of Engineers (USACE) Portland District is performing a remedial investigation/feasibility study (RI/FS) in the vicinity of Bradford Island at Bonneville Dam, Oregon. The project area has been divided into two operable units (OUs) based on media affected and geographical area: the Upland OU, which encompasses work that has taken or will take place on Bradford Island, and the River OU, which encompasses work that has taken or will take place in the Columbia River proximate to the Bonneville Dam. This Quality Assurance Project Plan (QAPP) describes the sampling and analysis activities intended to address the identified data needs for the River OU.

The USACE has elected to complete a removal action for a portion of the River OU during late 2007. Some of the sampling activities and procedures have been affected by the timing of the removal action. The Management Plan (URS, 2007) provides additional detail about the removal action and management of the in-water sampling activities during the removal.

USACE personnel and contractors assigned to this project are listed below along with a brief description of their respective roles.

A 2.1 USACE Personnel

USACE Project Manager – Mark Dasso, Engineer. The USACE Project Manager (PM) will have project management authority throughout the life of the project and is responsible for overall management and execution of the project, including project quality, cost, and schedule.

USACE Technical Lead and COR – Mike Gross, Engineer. Mr. Gross manages the Project Delivery Team (PDT) to deliver quality products on time and within budget. He is the main point of contact for architecture/environmental (A/E) contractors and task orders. He initiates and manages this task order (preparing statement of work, [SOW], negotiating, etc.). He manages PDT funding by assessing finding needs and communicating these to the PM, and tracks schedules. He also acts as PM if directed to do so (i.e. for extended PM absences, etc.), and in other times assists the PM as necessary.

USACE Technical Team Support – John Wakeman, risk assessor. Mr. Wakeman assists Mr. Gross to achieve the technical objectives of this project. He will help keep the USACE PM and technical lead informed of technical issues.

USACE Independent Technical Reviewers (ITR) – Thomas Georgian, chemist, and **Sam Bass,** geologist of the USACE Hazardous, Toxic, and Radioactive Waste (HTRW) Center of Expertise are ITRs. The ITRs are responsible for assuring that the technical approach to the project is scientifically defensible and that the plans and reports are sufficient to support project decisions.

USACE Bonneville Dam Contacts – Pat Hunter will serve as the facility contact for URS and its subcontractors and coordinate all onsite activities with dam operations staff. **Sue Fox** (USACE) serves as the dive safety officer for project activities that require underwater diving operations.

A 2.2 Contractors to USACE

URS Corporation (URS) is responsible for the development of the QAPP to ensure it accurately describes the sampling and analytical methodologies to be used for the collection and testing of the environmental samples. URS will accomplish the activities described in this QAPP including the collection of samples, overseeing the analytical testing and preparing a data report summarizing the activities and results of this project. **Jeff Wallace** will serve as URS' Project Manager. **Brian McNamara** will direct all field operations and serve as the site health and safety officer. **Ashley Burt** will assist Brian in completing the field operations. **Christina Wheeler, PhD** is the project chemist who will be responsible for data quality review according to the quality assurance procedures detailed in this QAPP. **Chris Moody** will serve as the assistant project manager, assist with coordination of this plan, and provide technical direction to the field team as needed.

URS will subcontract with an analytical laboratory and a marine services company to provide a boat to facilitate sediment sampling and deployment and retrieval of fish traps. URS will also

subcontract with a diving company to allow collection of a limited number of sediment and clam samples.

A2.3 Other

Collection of Smallmouth Bass via angling techniques will be necessary as part of completion of this work. The USACE or URS will contract with a permitted fishing guide or as has been done for previous fish sampling, work with the Oregon Bass and Panfish Club to complete the angling work.

A 3.0 Project Background, Problem Definition, and Objectives

A 3.1 Project Background

Contaminated sediment has been detected in the Columbia River near Bradford Island. The origin of the contaminants (primarily polychlorinated biphenyls [PCBs]) is believed to be related to the disposal of PCB-containing electrical equipment in the river. The USACE removed the electrical equipment in 2002. The USACE is planning to implement a non-time critical removal action (NTCRA) in late 2007, where the electrical equipment was located. Removal action alternatives considered were discussed in the *Draft Engineering Evaluation and Cost Analysis, Bradford Island Disposal Site* (URS, 2005). The selected action consists of hydraulic dredging at three hot spots. The plans and specifications for the removal action and biological opinion are provided elsewhere.

This QAPP describes sampling of in-water media (sediment, surface water, tissue) to support the remedial investigation (RI) and risk assessment. A separate QAPP for upland investigation will also be developed and implemented.

A 3.1.1 Site History

Bonneville Dam is located on the Columbia River approximately 40 miles east of Portland, Oregon, near Cascade Locks, Oregon at River Mile 146 (Figure 1). The "Bonneville Lock and Dam Project" was built by the USACE and involved building two powerhouses, a spillway, and a navigation lock. The first powerhouse was completed in 1938 and is located between the Oregon shore and Bradford Island. The second powerhouse was built in 1982, and is located between the Washington shore and Cascades Island. Bonneville Dam is currently operated and maintained by the USACE Portland District.

Bradford Island is a natural island that was incorporated into the Bonneville Lock and Dam Project. From about 1942 until about 1982, the northeast portion of Bradford Island was used as a landfill to dispose of household garbage, oil and grease, paint, solvents, scrap metals, mercury vapor lamps, pesticide residues, cables, and sand blast grit. Some electrical components were also placed in the landfill. The landfill, which has been closed since the early 1980s, is about one-half acre in size and holds an estimated 8,800 cubic yards of material (USACE, 2005).

During hydrographic and underwater dive surveys conducted in October and November 2000, the USACE identified the presence of waste-related items submerged in the Columbia River just offshore of the landfill. Some of these items included electrical components that contained PCBs. Most of the identified electrical items were located near three debris piles located in shallow water along the north and east shorelines of the island. The in-water debris was removed in February and March, 2002. The removal activities are described in the *Technical Memorandum, In-Water Removal Work* (URS, 2002). A comprehensive sediment investigation conducted in 2004 delineated the approximate extent of impacted sediments in the vicinity of the electrical equipment disposal area. Limited sampling of benthic tissue and water have also been collected. These past investigations are described in greater detail in the Management Plan (URS, 2007).

A 3.2 Problem Definition

Additional data are required to characterize the Bradford Island River OU to allow the USACE to prepare a RI report and baseline risk assessment, and to complete a feasibility study of supplemental remedial action, which may be required after the NTCRA.

A 3.3 Project Objectives

This section provides a brief summary of the project objectives and data uses.

The principal objective of the RI is to characterize potential impacts in environmental media that may pose a risk to human and ecological receptors. Sampling will be completed both before and after the removal action to meet different objectives. Individual objectives for the River OU are summarized below:

- Assess the potential for contaminant contribution from upland sources to site sediment.
- Assess the magnitude of sediment contamination in the forebay.
- Assess the nature of the sediment impacts related to site releases within the forebay.
- Assess the nature and extent of sediment impacts related to releases from the site downstream of the dam. Sediment samples will be collected downstream initially to determine if additional evaluations, including tissue sampling, downstream of the dam is necessary.
- Assess the magnitude of PCB impacts to selected ecological receptors.
- Describe the potential for PCBs to bioaccumulate/biomagnify in selected receptors.
- Assess the contaminant contribution from upstream sources to site sediment.
- Estimate human health and ecological risks associated with sediment and surface water contamination.
- Develop a preliminary cleanup goal for sediments that includes PCBs as Aroclors.

The Management Plan describes the objectives in more detail, using the Environmental Protection Agency's (EPA) data quality objective (DQO) and systematic planning processes. Table 1 provides a summary of the project objectives and how each objective will be accomplished.

A 4.0 Project/Task Description and Schedule

Sediment, surface water and biological tissue samples for a variety of wildlife species will be collected and analyzed for contaminants of interest (COIs) as determined in the Management Plan (URS, 2007). The data will be evaluated to determine if the objectives outlined above have been met. The following sections discuss the tasks, products, and schedule that will be used to support the sampling effort.

A 4.1 Work Tasks and Products

The work tasks and products to be completed as part of this sampling effort include:

- Pre-removal collection and analysis of sediment and clam tissue within the removal area footprint.
- Tabulate and report pre-removal sample results.
- Analysis of archived Smallmouth Bass and Large Scale Sucker samples collected from the forebay in 2006.
- Tabulate and report archived fish sample results.
- Post-removal collection and analysis of sediment downstream of the removal action and sediment and biological tissue in the forebay, reference area and downstream of the removal action area.
- Prepare a technical memorandum that that describes the field effort for both the pre- and post-removal sample collection.
- Statistical evaluation of the forebay and reference area results to determine if additional archived samples are needed to meet project objectives.
- Selection of a subset of archived samples of clams, crayfish and sediment in the forebay and reference areas for congener analysis.
- Prepare a report that presents all historical and current sampling results and assesses if the project objectives have been accomplished.

A 4.2 Project Schedule

Sampling collection is scheduled to occur in two phases, pre- and post- sediment removal. Pre-removal sampling will occur in the forebay only and is scheduled for September 2007. The post-

removal sampling will take place during February and March 2008. Table 2 presents the proposed project schedule. Sampling is required in the removal area prior to the removal action to characterize the correlation between sediment and clam concentrations at the upper end of the expected concentrations of COIs. Sampling will be performed after the removal action to represent post removal conditions in the risk assessment. The majority of the sampling activities described in this QAPP are scheduled to occur in February 2008.

A 5.0 Quality Objectives and Performance Criteria

The Management Plan describes in detail the data quality objectives for the River OU. As stated in the Management Plan, to meet the objectives the data will consist of primarily new information, with the exception of archived fish tissue within the forebay (smallmouth bass and largescale sucker). The new information will consist of samples from the following media: sediment, water and tissue. A trophic model will be used to estimate the potential for PCBs and other constituents to transfer through the food web. Computer modeling of Columbia River velocity and current direction by the Corps will be used to identify depositional areas downstream of the site. Table 1 summarizes the remedial investigation objectives and strategy for the River OU.

A 6.0 Special Training/Certification

The Accident Prevention Plan (URS, 2001) that describes the health, safety, and training requirements for the sampling event will be used by URS. All site personnel will meet the Hazardous Waste Operations and Emergency Response (HAZWOPER) training requirements and other requirements of 29 CFR 1910.120(e), including:

- Forty hours of initial off-site training or its recognized equivalent;
- Eight hours of annual refresher training for all personnel (as required);
- Eight hours of supervisor training for personnel serving as the Site Health and Safety Officer;
- Three days of work activity under the supervision of a trained and experienced supervisor.

All sampling will be accomplished from a boat or barge. Site personnel shall use a U.S. Coast Guard-approved life jacket or buoyant work vest, and shall conduct work in accordance with the Occupational Safety and Health Administration (OSHA) requirements of 29 CFR 1926.106 ("Working over or near water"). Site personnel working in or under water (diving is required for sediment collection) shall conduct work in accordance with the relevant OSHA requirements of 29 CFR 1910 Subpart T ("Commercial Diving Operations").

All site personnel will participate in medical surveillance programs that meet the requirements of 29 CFR 1910.120(f). Prior to the start of operations at the site, the Site Health and Safety Officer will conduct a site safety briefing, which will include all personnel involved in site operations. All site personnel are to attend the briefings and sign the briefing form. Briefings

will also be conducted if new personnel report to the site. For each briefing, the Site Health and Safety Officer will complete a site safety briefing form that will be kept in the project file.

A 7.0 Documents and Records

The following documents and records will be produced during this investigation:

- River OU QAPP
- Sampling records (field notebooks and forms, chain-of-custody records, photographs)
- Daily Quality Control Reports
- Analytical data and data quality review summary – Pre-removal sample results
- Analytical data and data quality review summary – Archived fish sample results
- Analytical data and data quality review summary – Post-removal sample results
- Technical memorandum – River OU field summary
- Data Evaluation Report

All field activities will be recorded in a bound field logbook that has consecutively numbered pages. The field notebook will provide a daily record of significant events, observations, and measurements taken during the field investigation. The field notebook is intended to provide sufficient data and observations to enable the field team to reconstruct events that occurred during the project. The field notebook will contain the following at a minimum:

- Date and time of sample collection
- Weather conditions, including temperature
- The station number and name
- Location of sampling point, i.e. global positioning system (GPS) coordinates
- Sample identification number
- Type of sample, matrix, species (biological samples)
- Field measurements made: water depth, temperature, etc.
- Field observations, especially any unexpected odors or stains
- References, such as maps or photographs of the sampling site
- Any procedural steps taken that deviate from those outlined in this QAPP
- Physical observations

The field team will complete Daily Quality Control Reports (DQCRs) each day during the site activities. Appendix A contains a copy of the DQCR form and other sampling forms. The DQCRs will be dated and signed by a field team representative and submitted to the USACE weekly. If significant modifications to the QAPP are required, USACE will be contacted as soon as possible. Attachments to the DQCR may include quality assurance sample tables, chain-of-custody records, field screening results, and any other pertinent project forms. The DQCR will contain, at a minimum, the following information:

- Location at time of sampling

- Field instrument measurements
- Field instrument calibrations
- List of samples collected and shipped
- Departures from the QAPP
- Discussion of problems encountered and resolutions
- Instructions from USACE

Interpretation of the data will be provided in the technical memorandum or reports to determine if the stated objectives have been met.

B DATA GENERATION AND ACQUISITION

B 1.0 Sampling Process Design

This section describes the sampling process design and rationale that will be used to govern the River OU sample collection. Figure 2 provides an overview of the sampling areas. URS will complete the sampling activities in three areas: an upstream reference area, the forebay, and a downstream area. The rationale for the selection of the sampling areas was presented in the Management Plan (URS, 2007).

B 1.1 Upstream Reference Area

The EPA has guidance for conducting and interpreting background data (USEPA, 2002a). As indicated in the guidance:

> *"Background information is important to risk managers because the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program, generally, does not clean up to concentrations below natural or anthropogenic background levels. The reasons for this approach include cost-effectiveness, technical practicability, and the potential for recontamination of remediated areas by surrounding areas with elevated background concentrations."*

The objective of sampling the upstream reference area is two-fold:

1. To provide data for the incremental risk assessment approach. The relative influence of upstream sources of COIs on risks associated from the forebay will be distinguished by conducting an incremental risk analysis. The incremental risk approach compares forebay-specific risks with risks estimated for the upstream reference area. If the forebay risk is greater than upstream reference risk, the incremental risk will be estimated.
2. Recent upstream sampling results outside the eddy area caused by the dam and powerhouses appear to indicate that COIs are present in the sediment and surface water entering the forebay. This investigation is designed to assess whether the concentrations

of chemicals detected in the forebay are statistically different from the upstream reference area.

The stations for background sediment samples were selected to meet the following criteria:

- The stations should be upstream of and unaffected by the site related waste handling activities, or potential upstream transport of chemical due to the observed flow reversal conditions.
- The reference sample stations should reflect background or ambient concentrations of all COIs.
- The reference samples should exhibit similar sediment characteristics (i.e., total organic carbon and grain size) as forebay samples.

The background area was selected on the basis of similar bathymetry and velocities as the forebay since this should represent similar sediment characteristics. The reference area is located between River Miles 150 and 151 on the north and south shores of the river (Figure 3).

The media sampled in the reference area includes surface sediment, surface water, benthic tissue, and fish. All media within the upstream reference area will be collect during the post-removal sampling effort. The details of the sampling design for each media is presented below.

B 1.1.1 Surface Water

Five surface water samples will be collected in the reference area (Figure 4). The upstream samples should be collected after the downstream sample to avoid creating any conditions (e.g., motorboat-induced turbidity) that might affect the quality of the downstream sample. Surface water sample stations will be identified by use of a hand-held GPS device.

Samples will be collected using both grab sampling and high-volume methods. Grab sampling methods will be used to collect samples for analysis of total and dissolved metals, semi-volatile organic compounds (SVOCs), northwest total petroleum hydrocarbons diesel range (NWTPH-Dx), and organic carbon (total and dissolved) (Table 3, 4 and 7). High-volume methods using a specialized pump and an XAD resin column will be used to collect samples for analysis of total Aroclor PCBs (sum of dissolved and particulate fractions), PCB congeners, and SVOCs (Tables 3, 4 and 8). Analytes were chosen based on the COI analysis completed in the Management Plan (URS, 2007).

B 1.1.2 Sediment

Surface sediment samples will be collected using a box core (or other surface deployed device) at 21 randomly selected grid stations in the upstream reference area (Figure 3). The area was selected to be similar in nature to the forebay, i.e. grain size and total organic carbon (TOC) content. Fourteen of the 21 stations will be analyzed initially and the remaining seven stations will be analyzed if necessary to obtain the statistical power for comparison to the forebay data set (see Section B1.4 for a discussion of the statistical procedures). Figure 3 depicts the grid stations and identifies the 14 samples that will be analyzed initially. The sediment samples will be analyzed for total metals, PCB Aroclors, SVOCs, NWTPH-Dx, total organic carbon and grain

size (Tables 3, 4 and 5). A subset of the sediment samples will be selected for PCB congener analysis. In order to avoid short-scale unwarranted and inconsistent variability in the sediment and co-located clam samples, the sample from each station will consist of 10 to 30 sub samples within the 50 by 50 foot station boundaries.

B 1.1.3 Tissue

Both benthic (clams and crayfish) and fish (sculpin and smallmouth bass) tissue will be collected in the reference area. Clam samples will be co-located with surface sediment samples discussed above in Section B1.1.2. Data from the co-located clams and sediment will be used in the development of the trophic model. The USACE will attempt to acquire 21 sculpin and crayfish samples in the vicinity of the sediment stations using traps. Seventeen smallmouth bass will be collected from within reference area using angling techniques. With the exception of the smallmouth bass, each tissue sample will consist of a composite of several individual organisms. Sample volumes required shown in Table 6.

A general description of the tissue sampling procedure is summarized below. Specific details for individual species are summarized in Section B 2.3. Further sampling details are provided in Appendix B - Standard Operating Procedures (SOPs). Upon capture in the field, the field biologist will identify each species of fish. Non-target species will be released. Fish that are retained will be inspected to ensure that they meet acceptable requirements (e.g. proper size, no obvious damage to tissues, skin intact, etc.). Fish to be kept will be stunned, rinsed in river water, weighed, and measured. Individual fish will then be double-wrapped in acetone-rinsed foil and placed in a plastic zip-lock bag along with a sample identification tag. The bagged specimens will be placed on ice in the field. Fish may remain on ice for a maximum of 24 to 48 hours, prior to shipment to the laboratory.

B 1.2 Forebay

The proposed forebay sampling area was selected on the basis of where impacted sediment may have been re-deposited or resident fish would likely be found. Therefore, the shore of the river has been selected within the spillway and first powerhouse forebays up to the upstream end of Goose Island. Three sediment sample stations have also been located at the mouth of Eagle Creek for assessing the potential for human health risks from contact with sediment during fishing activities.

The forebay sampling activities will take place in two phases, the pre-removal sampling will consist of clams and sediment collected from the removal action footprint and post-removal sampling will consist of the remainder of sampling necessary to meet project objectives. Additional pre-removal sediment and co-located clam samples are necessary in the forebay to allow trophic modeling to be completed.

B 1.2.1 Surface Water

Five post-removal surface water samples will be collected in the forebay area (Figure 5). Similar to the reference area, the samples will be collected using both grab sampling and high-volume methods.

B 1.2.2 Sediment

Pre-removal

Prior to the removal action five biased samples will be collected within the removal action footprint for characterizing the correlation between sediment and clam concentrations at the upper end of the expected sediment contamination concentrations. Figure 6 depicts the removal area footprint and areas where sampling will occur before the removal action. One composite sample will be collected from each of the five removal areas depicted in the figure.

Post-removal

Following the removal, sediment sampling will be conducted at 21 randomly selected grid stations. The post-removal sampling locations are depicted on Figure 7. Section B 1.4 describes the statistical approach used to select the grid stations. Fourteen of the 21 stations will be analyzed initially and the remaining seven stations will be archived by the contracted laboratory and analyzed if necessary to obtain the statistical power for comparison to the reference data set (see Section B 1.4 for a discussion of the statistical procedures). As described in Section B 1.1.3 co-located clams, and traps for crayfish, and sculpin, will be collected from each grid station where a sediment sample was collected. Figure 7 depicts the grids and identifies the 14 samples that will be analyzed initially.

Three purposeful samples will be collected in areas where people wade in the river at the mouth of Eagle Creek. The samples will consist of the upper 6 inches of sediment. Figure 8 depicts the Eagle Creek sample stations.

B 1.2.3 Tissue

Pre-removal

As part of the September 2007 pre-removal sampling event, co-located clam samples will be collected with the sediment samples in the removal action footprint as described above in B.1.2.2. Additionally, 17 smallmouth bass collected from the forebay in 2006 and up to 10 largescale sucker which have been collected from the Juvenile Bypass system on the second powerhouse will be analyzed. If possible, additional largescale suckers collected from the Juvenile Bypass System during the spring and summer of 2007 will be used for analysis. The largescale sucker sample will consist of one composite of several individual fish, as long as the fish are of similar size and weight. Individual bass will be used for analysis. The archived samples were part of an earlier evaluation requested by the DEQ for a possible fish advisory. Appendix C contains the Memorandum for the Record that describes the sampling techniques and results for this work

Post-removal

The remaining tissue samples in the forebay will generally consist of the same numbers and species as selected in the reference area to allow comparison between the two data sets (with the exception of the largescale suckers discussed above). Clam samples will be co-located with surface sediment samples as discussed in Section B1.1.3. URS will attempt to acquire 21 sculpin

and crayfish samples near the sediment stations using traps. Except for the clam shells, the tissue samples will consist of whole-body composites.

B 1.3 Downstream

No sediment samples have been collected from depositional areas downstream of the dam in previous investigations of the Bradford Island site. However, this area has been investigated by the USACE and others to assess the impact of dissolved gas generated from the dam on anadromous fish. The study information collected for the dissolved gas investigation includes bathymetry and flow velocity measurements. This information was used in the Management Plan to identify possible sediment depositional areas near the dam. These include:

1. Upstream of the confluence of the old lock and the main river
2. Upstream of the confluence of the new lock and the main river
3. Directly across the river from the downstream end of Cascades Island on the Washington State shore
4. The area between Hamilton Island and Ives Island
5. The south side of Pierce Island
6. A deeper portion of the river at approximately River Mile 140.

The post-removal sediment results will be used to determine if additional evaluations, including tissue sampling, downstream of the dam are necessary to complete the RI/FS. Six surface sediment samples will be collected at the stations outlined above. Each sample will consist of a composite of up to three samples from each station. Figure 9 depicts the downstream sampling stations.

B 1.4 Statistical-based Sampling Plan for the Upstream Reference Area and Forebay

The purpose of this section is to lay out the procedure on how to determine if the concentrations of chemicals detected in the forebay are statistically different from the upstream reference area, and to support the human health and ecological risk assessments. In particular, the reference area is assumed to be unaffected by the forebay activities, and an elevated mean concentration in the forebay compared to that of the upstream reference area will warrant further evaluation.

This section describes the details of the sampling plan for both the upstream reference area and the forebay, using appropriate methods of statistical analysis with a high degree of confidence, to confirm or disprove the intended hypothesis testing. This sampling plan is applicable to both sediment and tissue sampling, since in particular the sediment and benthic tissue samples are designed to be co-located, as described in previous sections. In addition, to avoid short-scale unwarranted and inconsistent variability in the sediment samples, each sediment sample collected is a 10 to 30-point random composite samples, within an approximately 50 foot by 50 foot grid.

B 1.4.1 Statistical Sampling Methodology

The statistical method to compare the mean concentration of a COI in the forebay to the average concentration in the upstream reference area is used in this study for the purpose of developing the statistical sampling plan. The current USEPA guidance (USEPA, 2002b) recommends a systematic/grid sampling approach, and a PC-based software, Visual Sample Plan (VSP) Version 4.7, was developed by Pacific Northwest National Laboratory to implement the recommendations from this guidance. VSP was used to assist on the sampling plan design, including determination of the number of samples required and locating the coordinates where samples should be collected, in a probabilistic approach.

Systematic sampling, also called grid sampling or regular sampling, consists of collecting samples at locations in a specified pattern, such as in a square or rectangular grid. Several options for systematic two-dimensional sampling in space are plausible, and for this sampling plan, an unaligned grid, as illustrated in Figure 7-1(b) of USEPA (USEPA, 2002b) was selected. In this design, the location within a grid cell is chosen randomly, and the grid cells are evenly distributed across the study area. This design has the advantages of randomness combined with adequate, uniform spatial coverage. When samples are taken at regular intervals with quasi-randomness, estimation of spatial correlations and recognizing pattern may be more readily attainable.

B 1.4.2 Development of the Statistical Sampling Approach

The key input parameters for developing a statistical sampling approach include: the setting of hypothesis, the desired confidence level in being able to make statistical inferences of hypothesis testing, and the width of gray region (Δ) for the differences between site and reference concentrations. The null hypothesis (or the baseline condition) for this study is "Site is Clean," as suggested by VSP (Hassig, 2005). In this hypothesis formulation, the true mean in the site is assumed to be less than or equal to the true mean in the reference, unless there is convincing evidence in the data to declare the baseline condition to be false.

A 95% confidence level (or false rejection rate, α=0.05) is selected for this study because it is a common choice in the statistical analysis of environmental data. The power of detection is set to be between 80% to 90% (or false acceptance rate, β=0.05 to 0.1). The false acceptance rate is the probability of not rejecting a false null hypothesis, or in other words, β is the chance a specific dirty site is condemned as clean. The false acceptance rate, in general, is acceptable to be slightly higher in order to relax the burden of collecting large amount of samples.

The definition (or width) of gray region, Δ, which is the distance from the action level (i.e., difference between the true means at 0) to the outer bound of the gray region, is selected to be approximately one standard deviation. The gray region can be considered as a range of true means where we are willing to accept that dirty site is clean with probability, from α to 1-β (i.e., 5% to 80-90% in our case). This input is necessary in the hypothesis testing and the width should be selected in a reasonable, practical range. If the gray region is reduced to an unreasonable small range, the sample size grows to be extremely large.

B 1.4.3 Initial Sampling Approach

A parametric systematic sampling approach is used to determine the number of samples and to specify sampling locations. This parametric assumption will be examined in post-sampling data analysis. Both parametric and non-parametric equations rely on assumptions about the population. Typically, however, non-parametric equations require fewer assumptions and allow for more uncertainty about the statistical distribution of concentrations at the site. The trade-off is that if the parametric assumptions are valid, the required number of samples is usually less than if a non-parametric equation was used.

The equation used to calculate the number of samples is based on a two-sample Student's t-test. For this site, the null hypothesis is rejected in favor of the alternative one if the difference between the site and reference area means is sufficiently larger than zero. The number of samples to collect is calculated so that if the inputs to the equation are true, the calculated number of samples will cause the null hypothesis to be rejected.

The formula used to calculate the number of samples is:

$$m = n = \frac{2s^2}{\Delta^2}\left(z_{1-\alpha} + z_{1-\beta}\right)^2 + 0.25z_{1-\alpha}^2$$

where

n = number of samples for the site and is equal to m,

m = number of samples for the reference area and is equal to n,

s = estimated standard deviation of the measured values,

Δ = width of the gray region, which is set equal to s in this analysis,

α = acceptable probability of incorrectly concluding the difference between the means exceeds zero = 0.05,

β = acceptable probability of incorrectly concluding the difference between the means is less than zero = 0.2,

$z_{1-\alpha}$ = value of the standard normal distribution such that the proportion of the distribution less than $z_{1-\alpha}$ is $1-\alpha = 1.645$,

$z_{1-\beta}$ = value of the standard normal distribution such that the proportion of the distribution less than $z_{1-\beta}$ is $1-\beta = 0.842$.

Assuming the data are following a normal distribution, and using the lower bound of power of detection ($1-\beta$) described previously at 80%, the number of samples required, in each of the site (n) and reference area (m) is calculated to be **14**. The following table lists the sampling location

coordinates (the center point of an approximately 50 by 50 feet grid), based on the systematic sampling with random unaligned grid:

Initial Forebay Samples		
Sample ID	**X Coord**	**Y Coord**
FB-01	1632731.2752	724904.9266
FB-02	1631959.6290	724698.1650
FB-03	1633415.8639	723563.4494
FB-04	1633194.2629	723225.1123
FB-05	1631985.0208	722904.3528
FB-06	1631246.3510	723012.5152
FB-07	1630483.9382	722635.2660
FB-08	1631271.4130	722331.8837
FB-09	1631907.1967	722058.8397
FB-10	1632777.7718	722285.0029
FB-11	1633706.3853	722775.1044
FB-12	1633961.9886	723391.8351
FB-13	1634370.0157	723764.6875
FB-14	1635305.6642	724390.7981

Initial Upstream Samples		
Sample ID	**X Coord**	**Y Coord**
US-01	1647051.4618	736735.1542
US-02	1646978.9026	736662.5950
US-03	1646771.1193	736520.7746
US-04	1646484.1804	736167.8728
US-05	1646309.3786	736065.6303
US-06	1646200.5398	735956.7914
US-07	1646058.7194	735818.2692
US-08	1645844.3399	735534.6285
US-09	1645596.9788	735290.5656
US-10	1645422.1770	735185.0249
US-11	1645349.6177	735039.9064
US-12	1645065.9771	734832.1232
US-13	1645029.6975	734723.2843
US-14	1644706.4790	734406.6621

B 1.4.4 Alternative Sampling Approach

If the data do not follow a normal distribution, and if a higher power of detection (1-β) is evidently required to be achieved (particularly due to high sample standard deviation which renders an unacceptable broad width of the gray region), a non-parametric random sampling with higher power of detection is used to determine the number of samples and to specify sampling locations. The equation used to calculate the number of samples is based on a Wilcoxon Rank Sum test, as follows:

$$m = n = 1.16 \times \left(\frac{2s^2}{\Delta^2} \left(z_{1-\alpha} + z_{1-\beta} \right)^2 + 0.25 z_{1-\alpha}^2 \right)$$

where

n = number of samples for the site and is equal to m,

m = number of samples for the reference area and is equal to n,

s = estimated standard deviation of the measured values,

Δ = width of the gray region, which is set equal to s in this analysis,

α = acceptable probability of incorrectly concluding the difference between the means exceeds zero = 0.05,

β = acceptable probability of incorrectly concluding the difference between the means is less than zero = 0.1,

$z_{1-\alpha}$ = value of the standard normal distribution such that the proportion of the distribution less than $z_{1-\alpha}$ is $1-\alpha = 1.645$,

$z_{1-\beta}$ = value of the standard normal distribution such that the proportion of the distribution less than $z_{1-\beta}$ is $1-\beta = 1.282$.

Hence, using the non-parametric assumption and the upper bound of power of detection ($1-\beta$) described previously at 90%, the number of samples required, in each of the site (n) and reference area (m) is calculated to be **21**. Thus, an additional seven samples are required in this alternative sampling approach. The following table lists the additional sampling location coordinates if this sampling approach is adopted:

Additional Forebay Samples		
Sample ID	**X Coord**	**Y Coord**
FB-15	1632381.6669	724856.6547
FB-16	1632432.2620	723711.7057
FB-17	1632557.8129	723093.3207
FB-18	1630655.8108	723106.4380
FB-19	1631519.6758	721957.7411
FB-20	1633129.3505	722484.3053
FB-21	1634780.2509	724120.2145

Additional Upstream Samples		
Sample ID	**X Coord**	**Y Coord**
US-15	1646906.8930	736592.9257
US-16	1646557.2894	736312.5832
US-17	1646131.8284	735887.1221
US-18	1645917.4488	735676.0407
US-19	1645666.7896	735359.4186
US-20	1645277.6082	735039.4983
US-21	1644782.8861	734548.0743

Since it is unknown if the data will follow a normal distribution until the original 14 samples are analyzed, the additional 7 samples needed if a non-normal distribution is observed, will be collected and archived at the analytical laboratory.

B 1.4.5 Post-sampling Data Analysis

Post data collection activities generally follow those outlined in USEPA's Guidance for Data Quality Objectives (USEPA, 2000). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools, including but not limited to box plots, scatter plots and normal probability plots, will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

Because the primary objective for sampling for this site is to compare the difference between the site and reference area mean value, the data will be assessed in this context. Results of the exploratory and quantitative assessments of the data will be reported, along with conclusions that may be supported by them.

B 2.0 Sampling Methods

This section describes surface water, sediment, and tissue sampling methods, sampling processing procedures, equipment decontamination procedures, and investigation-derived waste (IDW) handling procedures. Table 4 summarizes the number of primary and quality control (QC) samples required for the surface and sediment water sampling.

B 2.1 Surface Water

Surface water from the Columbia River will be sampled using both grab sampling and high-volume methods. All samples will be collected from an anchored boat with the motor turned off. Both high volume and grab samples will be collected concurrently at each of the ten surface water stations. Due to the limited number of high-volume sample sampling apparatuses, each sample location shown in Figures 4 and 5 will be analyzed sequentially.

B 2.1.1 Grab Samples

Grab samples will be obtained by using a peristaltic or centrifugal pump with the intake placed near the riverbed at each station. The sample analyses, total number of sample containers to be filled (i.e., primary plus QC), preservation requirements and hold times are listed in Table 7. In addition to the COIs, water quality measurements will be taken, including pH, dissolved oxygen and common anions at all sample locations to ensure water environments are similar.

B 2.1.2 High-Volume Water Samples

High-volume water sampling methods will be used to collect samples for analysis of organic compounds at each station described above in Section B 1.1. The high volume water sampling method is used to concentrate trace levels of particulate-bound and dissolved-phase chemicals from a large volume of water for analysis by standard analytical methods. Volumes of up to 1000 liters (L) can be pumped, which allows for the measurement of low levels of COIs in waters. The particulate and dissolved-phased samples from each sample station will be analyzed for SVOCs and PCB congeners. One field blank will be analyzed at a location chosen by the field sampling team leader.

An Infiltrex 300 High Volume Sampling System (Infiltrex pump), supplied by Axys Environmental Systems (AES) of Sidney, British Columbia, will be used to collect high volume water samples. The Infiltrex pump draws large volumes of water through a two-stage filter, the components of which act as the sampling media. The first sample component is a wound glass fiber cartridge filter element (1 micron filter rating) on which particulate matter are retained. The second sample component is a column packed with a macroreticular porous resin (XAD resin). The filters and the columns, which are provided by AES, represent the sample media for each sample station. Multiple filters may be needed if they become clogged by turbid site conditions. If multiple filters are needed they will be composited into one filtrate sample during analysis by AES.

The standard operating procedures (SOPs) in Appendix B describe the equipment need, general operating notes, decontamination procedures, and pump operation. The field procedures for the high volume water sampling are also summarized below:

- On arrival at the sampling station, the boat will be securely anchored facing into the current, the motor will be turned off and raised out of the water, and the water depth will be measured with a sounding line. The minimum water depth at a sample station should be approximately three feet, and the bottom of the intake tube should be near the riverbed at the sampling station. A period of approximately five minutes will be allowed to pass before deploying the column for sampling.
- To begin sampling, the pump will be turned on and the pump speed adjusted to a flow rate of approximately 1.5 to 2 liters/minute. Water passing out of the pump outlet will not be collected, and will be allowed to flow back into the river at a location downstream of the sample inlet.
- The pump speed and pumping rate will be periodically calibrated using a graduated cylinder and stopwatch. The total volume of water pumped will be periodically recorded from the totalizer on the Infiltrex pump. The pump flow rate and total volume purged will be recorded in the log book.
- The Infiltrex pump will be run for approximately 6 to 8 hours, depending on field conditions. Total volumes purged at each sample station will be approximately 700 liters. Sampling will stop at the conclusion of the work day and will not extend over multiple days due to equipment and project time constraints. Care will be taken to pump at similar rates as well as pumping similar volume sizes at each sample station.
- After the completion of pumping, the column will be clearly marked with the sampling station, wrapped in aluminum foil and bubble wrap, and placed in iced coolers in accordance with the Infiltrex SOP (Appendix B). The columns will be double bagged and supported above the ice to avoid being immersed in the ice or melt-water during transport to the laboratory.

B 2.2 Sediment Samples

As discussed in Section B.1.0, sediment samples will be collected in three areas; a reference area, the forebay and downstream of the dam complex.

Sediment samples will be collected using one of two methods: a box core or via manual grab by a commercial diver. Box core sampling will only take place in areas where past sampling with the box core has been successful. Divers will be deployed to collect sediment samples in the remaining collections areas. Divers will be used exclusively during the pre-removal to sample within the removal action footprint. The sampling methods are described below.

B 2.2.1 Box Core Sampling Protocol

Prior to installing the stainless steel rectangular box in the box core frame assembly, it will be thoroughly decontaminated. Prior to moving to starting the work, the interior of the grab

sampler will be washed with soap and water and rinsed with distilled water followed by a rinse with river water. Decontamination between discrete samples will consist of rinsing with river water, unless there are obvious signs of light non-aqueous phase liquids (LNAPL) present in either the water or on the box core during sample collection.

The closure plate pivot arm is moved to the horizontal position and the safety rod(s) are inserted into the frame assembly to prevent pre-tripping the mechanism. An appropriate amount of weight should be added to the main frame assembly if previous sampling attempts yield insufficient sample penetration. The rectangular sampling box is then mounted bolted into position on the main frame.

Each sampling station will have established coordinates that will be located using a differentially corrected GPS. Section B 1.4 summarizes the sediment station coordinates per sampling area.

At the desired sample station, the box core is gently positioned outboard of the vessel, and the safety rods are removed. The sampler will descend in the water column at a rate no faster than 1 foot per second to omit the creation of a bow wave. On contact with the bottom (denoted by slackness in the lowering line) the box core will be slowly raised to the surface so as not to disturb the collected sediment.

Once the box core is secured on deck, a stainless steel cover plate is inserted between the pivot arm closure plate and the bottom of the rectangular sample box, then attached in place by either screws or clamp mechanisms. The sample box is then detached from the frame assembly and moved in the upright position to a processing location.

When the recovered sampler is placed on a secure processing stand, the contents of the grab will be inspected for acceptability. The following criteria will be required for an acceptable grab:

- The sediment is not extruded above the upper face of the box. This is usually corrected by using less weight on the grab, or slowing the descent rate.
- Overlying water is present indicating minimal leakage. The water should not be excessively turbid, otherwise sample disturbance has occurred.
- The surface of the recovered sample is intact and relatively flat, with no sign of channeling or sample washout.
- The desired penetration is achieved and there is no evidence of sediment loss through incomplete closure of the sampler, impacting the bottom at an angle.

If a grab is deemed unacceptable, the contents will be discarded overboard, the box core will be rinsed with site water and the grab repeated.

Prior to processing of an acceptable grab, the overlying water should be removed with a siphon tube, being careful not to siphon off the upper layer sediments. Remove any large organisms, debris and other material unrepresentative of the sediments and document it. Before collecting the sediments for chemical analysis the grab contents should be thoroughly described. The information shall be recorded on a sediment sampling form (Appendix A). If the sample is acceptable, the following observations should be noted on a field log or notebook before

sediment is removed and placed into sample collection containers for subsequent shipment to a laboratory.

The upper six inches of the sediment sample will be removed from the grab sampler for chemical analysis. The sample will be extracted using disposable utensils that are not in contact with the sides of the sample box. The sediment will be placed in a laboratory-provided jar. To meet the statistical requirements (see Section B 1.4) between 10 and 30 individual sub-stations will be collected at each station and composited by the laboratory. Each sample station will be logged using the following information:

- Station location
- Sample depth
- Gross characteristics of the sediment
  - Texture
  - Color
  - Biological observations (e.g. live organisms, shells, tubes, plant material)
  - Presence of debris (e.g. wood chips or fibers, man-made debris or trash)
  - Odor (e.g. hydrogen sulfide, ammonia, oil, creosote, etc.)
  - Color (Munsell scale)
  - Sheen
- Vertical profile information
  - Stratification, other changes in sediment characteristics
  - Presence and depth of redox potential discontinuity layer, if visible
- Maximum penetration depth (centimeter [cm])
- Comments regarding sample quality (leakage, disturbance, any other pertinent observations)

B 2.2.2 Diver Sampling Protocol

If necessary, the diver will be deployed at the predetermined sample station. The sampling station will have established coordinates that will be located using a DGPS. The diver will use a stainless steel spoon to collect sediment in the sample container. The container will be positioned down current in an attempt to capture resuspended fines.

B 2.3 Tissue samples

The tissue samples consist of two representative benthic receptors (clam and crayfish) and three fish species (largescale sucker, sculpin and smallmouth bass). The Management Plan provides additional detail on the rationale for selection of the targeted tissue species.

All tissue samples will be homogenized (whole-body) by contracted laboratory based on sample location. The clams will not be depurated prior to analysis. All remaining homogenized tissue will be archived frozen by the laboratory for potential future analyses. For the Smallmouth Bass, and Sculpin, PCB congener analysis will be performed on all samples, with a subset being selected for PCB Aroclors. For the benthic tissue (clams and crayfish), PCB congener analysis will be performed on the archived homogenized samples, after PCB Aroclor data results have been considered. The rationale for selecting which sediment and benthic tissue are analyzed for Aroclors and PCB congeners is presented in the Management Plan. In general, congeners will be analyzed to represent a range of Aroclor concentrations (including non-detects) and locations to develop a site-specific relationship between Aroclors and PCB congeners.

B 2.3.1 Asian Clam

Clam (*Corbicula fluminea*) tissue sample collection will be attempted at every sediment sampling location in the forebay and reference locations. Clams will not be collected at the downstream stations. The clams will be collected by either the diver or by removing them from the box core.

Approximately 70 grams of homogenized tissue (i.e., fifty to sixty clams) will be required per sample. However, if 30 grams are available for a sample, the sample will be submitted and analyses will be prioritized. Anticipated potential analyses include PCBs (Aroclors and possibly congeners), lipid content and other COIs presented in Table 6. Additional clam collection details are provided in SOP-3 in Appendix B.

B 2.3.2 Crayfish/Sculpin

Crayfish and sculpin tissue sample collection will be attempted at every sediment sampling location in the forebay and reference locations. Appendix B contains an SOP with additional sampling procedures for crayfish and sculpin. Each crayfish or sculpin trap will consist of three main components: a cylindrical aluminum (or plastic) trap, an anchoring device (for securing the trap to the river bottom), and a float for locating the apparatus. All three components will be connected to one another with new nylon rope. The traps will consist of two one-way opening gates that effectively allow the specimens to enter but not escape. URS will follow the trap manufacturer's recommended procedures for handling, setting, deployment, and retrieval.

Sculpin 3-6 inches in length will be considered valid samples. Fish of other sizes shall be returned to the river with minimum handling. Sculpin individuals up to two inches feed on planktonic crustaceans and aquatic insect larvae especially that of midges and mayflies (Page and Burr, 1991). Larger sculpins feed on minnows and other fishes. There is no size requirement for retaining crayfish in the traps.

Before use, a representative can per each case of canned tuna or salmon used in the crayfish traps will be analyzed for PCB Aroclors by EPA Method 8082. The bait will not be used if detectable levels of PCB Aroclors are observed. Every effort will be made to use cans with a single lot number for both the PCB Aroclor pre-analysis and baiting. The canned bait will be punctured with a designated stainless steel knife and placed within each trap immediately before deployment.

Traps used to capture sculpin will be baited with a shrimp pellet bait or another bait as necessary. The bait will be placed in bait jars that will allow the scent of the bait to be dispersed.

The crayfish or sculpin will be removed from the traps by URS for logging and proper handling and labeling. All specimens will be identified as to the location of their respective traps, and be classified (description, length, weight, condition of organisms, etc.) by URS according to the Field Sampling Sheet included in Appendix A.

A minimum of ten crayfish and two to five individual sculpin will be collected and composited per grid sample location to generate a representative tissue sample with sufficient mass for the selected analyses.

B 2.3.4 Smallmouth Bass

Sampling for smallmouth bass (*Micropterus dolomieu)* in the reference area will be by angling. Archived samples of smallmouth bass from the forebay will be used. The goal is to catch at least 17 bass, plus three extra fish to be taken in case there is any loss during field, shipping, or laboratory activities. Sampling will occur over a period estimated to be up to six working days. Smallmouth bass of 12-16 inches length will be considered valid samples. Fish of other sizes shall be returned to the river with minimum handling. No fish with radio tags may be kept as part of this effort. All sampling must be consistent with Oregon 2005 Sports Fishing Regulations (OAR 635.023) or the conditions of any scientific collection permits.

Each day, the lead sampler will fill in a data collection sheet with data on each fish that is caught (Appendix A). This sheet includes the date, boat name, samplers' names, sample ID, collection time, species, size, and GPS location of where the fish was caught, GPS northing and easting, and observations and photos of abnormalities. Fish weight to within the nearest gram will also be recorded. Appendix B contains a SOP with additional sampling procedures for the bass.

B 2.3.5 Largescale Sucker

In addition to the archived samples of Largescale Sucker (*Catostomus macrocheilus*); additional samples will be collected within the Bonneville Juvenile Bypass Facility by a USACE biologist. The Bonneville Juvenile Bypass system consists of a screen and collector (the corner collector) upstream of the second powerhouse. The bypass flume begins at the southeastern corner of the powerhouse, where a gate is removed to allow about 5,000 cubic feet per second of water to spill into the chute carrying fish downstream. The fish re-enter the river just beyond the westernmost tip of Cascades Island, over one-half mile downstream. An attempt will be made to collect an additional five largescale suckers during operation of the bypass system (June through August 2007). Appendix B contains a SOP with additional sampling procedures for the sucker.

B 2.3.6 Contingencies

If insufficient mass is obtained for a particular species, the field leader will continue sampling until sufficient sample mass is obtained for chemical analysis. If insufficient sample masses are obtained, the analytes shall be analyzed in the following general priority order: PCB congeners, lipids, percent moisture, polynuclear aromatic hydrocarbons (PAHs), and metals.

B 2.4 Decontamination Procedures

Potential sources of contamination in the field include sampling equipment, sediment, boat engine exhaust, and dust. Sample handling will be minimized and sources of contamination will be carefully avoided. Samplers will wear disposable nitrile gloves during all sample handling procedures. To minimize potential contamination by sediment, fish will be rinsed with distilled water before they are wrapped in acetone, washed aluminum foil and placed in resealable plastic bags. To avoid potential contamination from ice, whole fish will be wrapped in aluminum foil and placed in watertight plastic bags, and the crushed ice will be placed in separate plastic bags. To minimize sample contamination, the following practices will be followed:

- Caught fish will only be placed on clean surfaces, such as aluminum foil (dull side touching the fish).
- Ice chests will be cleaned with nonionic detergents and rinsed with distilled water prior to any sampling activities.
- Samples will be placed in sealable, waterproof plastic bags to avoid contamination from melting ice.
- All lines, hooks, nets and gaffs used in sampling will be free from contaminants such as oils, grease, and fuels.
- All utensils or equipment used directly in handling fish (e.g., such as measuring boards) will be cleaned in the laboratory prior to each field sampling effort and placed in aluminum foil.
- The field team will clean this equipment between sampling sites by rinsing with ambient water and rewrapping in aluminum foil.

Any other non-disposable sampling equipment will be decontaminated prior to initiation of sampling and between sampling locations. In the field, 5-gallon buckets will be used to collect the decontamination water.

B 2.5 Investigation-Derived Waste (IDW) Handling

This project should not generate significant amounts of IDW. Decontamination water, not containing methanol, generated during cleaning of sampling equipment will be poured out on-site. Personnel protective equipment and other solid wastes (aluminum foil pans, gloves, paper towel, e.g.) will be placed in trash bags and disposed of in an on-site dumpster.

B 2.6 Sampling Summary

Table 4 summarizes the number of primary and QC samples required for the sampling.

B 3.0 Sample Handling and Custody

This section describes the sample handling procedures from sample collection through sample disposal. The purpose of these procedures is to ensure that the quality of samples is maintained during collection, transportation, storage, and analysis.

B 3.1 Sample Labeling and Identification

All samples will be labeled and accompanied by a chain-of-custody form when delivered to the laboratory for analysis. Information on the sample label shall contain, at a minimum, sample identification number, matrix, analysis requested, sampling date and time, and the initials of the field sampler.

The tissue samples (clams will be shucked prior to packaging) will be wrapped in acetone-washed aluminum foil, placed in a pre-labeled resealable plastic bag, and stored in a cooler on dry ice for shipment to the analytical laboratory.

The clamshells will be placed in a pre-labeled resealable plastic bag with the same sample ID as the tissue that was extruded from the shell. URS will store the resealable plastic bag of shells in order to gauge the age of the collected clams, if this information becomes necessary.

All samples will be labeled in the following manner:

- The last two letters of the sample ID will designate the sample matrix.
    - TC – Clam, CF – Crayfish, SB – Smallmouth Bass, SC – Sculpin, LS – Largescale Sucker, SW – Surface Water, SD - Sediment.
- An example of a sample identification number for a clam sample collected at sample location number 46 on November 12, 2007 is 07111246TC (or date 2007-11-12 + sample ID number 46 + sample matrix TC).
- An example of a sample identification number for a sculpin sample collected at sample location number 12 on November 12, 2007 is 07111212SC.

B 3.2 Sample Packaging and Shipment

Samples will be packed in coolers using bubble wrap and ice packs, dry ice, or crushed ice to maintain samples at 4 degrees Celsius during transport to the laboratory. All samples will be accompanied by chain-of-custody forms. Chain-of-custody records will be maintained by URS to document and verify sample transfer to the laboratory. A temperature blank, consisting of a small jar of water labeled "temperature blank," will be shipped with each cooler. This will facilitate the measurement of the cooler temperature upon lab receipt.

Processed tissue samples will be shipped on crushed ice or dry ice in coolers via Federal Express with adequate ice to keep samples cool for at least two days. Shipping procedures for non-hazardous substance shipment using dry ice as a refrigerant are as follows:

- As long as the dry ice is being used solely as a coolant for non-hazardous material, such as the fish samples captured during this program, International Air Transport Association (IATA) regulations apply and exempt the shipper from having to fill out hazardous substance paperwork.
- Each cooler must have dry ice labels on the outside of the cooler, which include a Class 9 diamond label.
- For Federal Express, there is a special handling section on the airbill that must be filled out for all coolers containing dry ice. The information required includes the total number of packages containing dry ice and the kilograms of dry ice per package (cooler).
- Federal Express has a weight limitation of 200 kilograms (kg) per package or individual cooler.

As long as the dry ice is being used solely for cooling the fish samples, there is no limitation on the amount of dry ice that can be shipped on an individual courier flight.

B 3.3 Sample Custody

After sample collection, samples will be kept in the custody of field personnel until formally transferred to the laboratory or storage area. For the purposes of this work, custody will be defined as follows:

- Samples are in plain view of the field personnel; or
- Samples are stored inside an appropriate container that is in plain view of the field personnel; or
- Samples are stored inside any locked space such as a cooler, locker, car, truck, or trailer to which field personnel have the only immediately available key(s) or lock combination.

Custody Records

Custody records, defined as formal chain-of-custody forms, will be maintained for all samples. The information on the chain-of-custody form shall contain, at a minimum, the following:

- Project Name
- Sample identification number
- Date and time of sample collection
- Sample location identification and/or description
- Sample matrix type
- Sample preservation
- Signatures of sample handlers
- Type of analyses requested
- Number of containers submitted for each sample
- Method of shipment
- Cooler ID number
- Signatures indicating relinquishment and acceptance of samples including date and time of sample transfer

- Phone number and name of person to whom results should be reported

The field coordinator from URS will be responsible for sample tracking and chain-of-custody procedures in the field. At the end of the work day, the field coordinator, or his/her designee, will fill out the chain-of-custody forms prior to transferring samples into shipping coolers, and will ensure that the field notebook has been filled out. All information on the chain-of-custody forms will be cross-checked against field notebook entries and sample labels prior to sample transfer. One chain-of-custody form will be filled out for each cooler. The chain-of-custody form will be sealed in a resealable plastic bag and taped to the inside lid of the cooler prior to sealing the cooler for shipping.

Custody seals will be affixed to the shipping containers. The custody seals will contain, at a minimum, the name and title of the person responsible for the samples, the signature of that person, and the date when the custody seal was applied.

Laboratory Custody Procedures

A sample custodian at the laboratory will accept custody of the shipped samples from the carrier and enter the preliminary information about the samples into a sample receipt log, including the initial of the person delivering the samples and the status of the custody seals on the coolers (i.e., broken versus unbroken). The custodian responsible for sample log-in will follow the laboratory's SOP for opening the coolers, checking cooler temperature, checking the contents, and verifying that the information on the chain-of-custody forms agrees with the samples received.

B 4.0 Analytical Methods, Screening Levels, and Reporting Limits

Analytical methods and associated performance criteria, screening levels, and reporting limits for sample analysis are discussed briefly below. The analytical methods are based on the most current analytical protocols as cited. The project-specific QC criteria are based on the performance criteria listed in the following documents in order of priority:

- *Department of Defense (DOD) Quality Systems Manual for Environmental Laboratories* (DODEDQW, 2006)

- *USACE "Shell" for Analytical Chemistry Requirements, Appendix I of EM 200-1-3 (USACE, 2001)*

- Test Methods as represented in *SW-846 Manual, Test Methods for Evaluating Solid Waste, Physical/Chemical Method*s (USEPA, 2004) or other cited method.

- In-house laboratory performance criteria (in these instances, URS will obtain documentation from the laboratories detailing how these values are generated (i.e., number of samples, sample matrix etc.).

Screening levels for surface water are based on the National Recommended Water Quality Criteria (NRWQC) (USEPA, 2006) and Oregon Department of Environmental Quality (ODEQ)

Surface Water Quality Criteria (ODEQ, 2004). All surface water sample results will be compared to the NRWQC and ODEQ criteria because the surface water (i.e., the Columbia River) is the water body that ultimately may receive any contamination. In general, sediment results will be compared to ODEQ's screening level values (SLV) for ecological risk assessment (ERA) for freshwater sediment (ODEQ, 2001) and ODEQ's sediment bioaccumulation SLVs (ODEQ, 2007). Screening levels for tissue will be based on the Acceptable Tissue Levels (ATLs) and Critical Tissue Levels (CTLs) as referenced in ODEQ bioaccumulation guidance (ODEQ, 2007). These levels will be finalized upon contracting with the analytical laboratory. Screening levels and associated reporting limits are presented in Tables 9 through 11 for surface water (grab and high-volume samples), and sediment.

B 4.1 Chemical Analyses

B 4.1.1 Total and Dissolved Metals

Sediment, grab water, benthic and fish tissue will be analyzed for total metals by 6000/7000 series EPA Methods (see Tables 4 through 6). Additionally, the surface water samples will be analyzed for total and dissolved metals (Table 4 and 7). Performance criteria for the method shall be defined in the method (USEPA, 1994). The extraction methods for each sample matrix will be determined in conjunction with the contracted laboratory.

B 4.1.2 Polychlorinated Biphenyls

All sample media will be analyzed for PCBs as Aroclors using EPA Method 8082 (with the exception of the XAD water samples which will only be analyzed for PCB congeners). Additional PCB congener analyses will be performed on selected samples using EPA 1668A. All fish tissue will be analyzed for PCB congeners. Congener analyses for sediment, crayfish, and clam tissue will be dependent upon initial Aroclor results. Sufficient sample volume will be collected and homogenized for each sample to allow for the analysis of both Aroclors and congeners. Samples that are not immediately analyzed for PCB congeners will be archived frozen (-20°C) by the analytical laboratory. Performance criteria for each PCB method shall be as defined in the method (USEPA, 1999, or most recent version). The extraction methods for each sample matrix will be determined in conjunction with the contracted laboratory.

High-volume (XAD resin) surface water samples will be analyzed for all PCB congeners by EPA Method 1668A. The Infiltrex extraction apparatus consists of a macroreticular porous resin (XAD resin) contained within a stainless steel or Teflon column and glass fiber filters which prevent particulate matter entering the column. Prior to field use, each column will be pre-spiked with a known amount of deuterated anthracene (PAH surrogate) and C^{13}-labeled PCB congeners to allow subsequent laboratory analysis of analyte breakthroughs and recoveries. The labeled compounds will be used as surrogates to determine neutral organic recoveries from each of the XAD resin columns. Analytes which are adsorbed to the XAD resin are classified as the dissolved fraction. The glass fiber filters will be analyzed for the particulate fraction. PCB results will then be reported separately by whole water concentrations, dissolved fraction

concentrations, and particulate fraction concentrations. Performance criteria for the method shall be as defined in the method (USEPA, 1999, or most recent version).

B 4.1.3 Polynuclear Aromatic Hydrocarbons and Bis(2-ethylhexyl)phthalate

High-volume (XAD resin) surface water samples, sediment samples and tissue samples will be analyzed for PAHs and bis(2-ethylhexyl)phthalate (BEHP) by EPA Method 8270-SIM. Selective Ion Monitoring (SIM) will be used instead of a full scan monitoring due to the low detection limits needed for the screening level criteria. The specific extraction methods and semivolatile organic analytes targeted will be determined in conjunction with the contracted laboratory. The XAD resin extraction procedure will be consistent with that described above for PCBs. Project-specific performance criteria for the method is listed in Tables 9 and 10.

B 4.1.4 Total Organic Carbon and Dissolved Organic Carbon

Surface water grab samples will be analyzed for TOC and dissolved organic carbon (DOC) by EPA Method 9060. Sediment samples will be analyzed by the modified Plumb method. Note that screening levels are not applicable since TOC and DOC are not contaminants of potential concern.

B 4.1.5 Lipids

Lipids will be determined by a gravimetric method, using a portion of the solvent extract from the PCB Aroclor or Congener analysis.

B 4.1.6 Moisture Content

A gravimetric moisture content analysis will be performed on all samples.

B 4.2 Analytical Method Limits

Sensitivity requirements for analytical methods are driven by the project objectives. The laboratory methods and method reporting limits should ensure sufficient sensitivity to meet project objectives (the screening levels). The method detection limit (MDL), method quantitation limit (MQL), and method reporting limit (MRL) are defined below from reference (USACE, 2001).

Method Detection Limit

The MDL is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero, and it is determined from analysis of a sample in a given matrix containing the analyte.

Method Quantitation Limit

The MQL represents the value for which the laboratory has demonstrated the ability to reliably quantify target analytes within prescribed performance criteria for the method performed. Operationally, it is equivalent to the concentration of the lowest calibration standard in the initial calibration curve and must be at least three times the MDL.

Method Reporting Limit

The MRL is a threshold value below which the laboratory reports a result of non-detect. It may be based on project-specific concentrations of concern, regulatory action levels, or sensitivity capability of method and instrument. The MRLs are adjusted based on the sample matrix and any necessary sample dilutions. Operationally, it is equivalent to the MQL adjusted based on the sample matrix and any necessary dilutions.

B 4.3 Assignment of Numbers to Nondetected Values and Summation of PCBs for Calculation of Total PCBs

All PCB Arolcors will be reported down to their MDLs, if detected. For all nondetected PCB Aroclor values the qualifier "U" will be associated with their MRL and not MDL (e.g., 1.6U, where the MRL was 1.6 and the MDL was somewhat lower). Alternatively, PCB congener nondetected values will be presented using their associated sample specific estimated limit of detection (EDL) value. As described in Method 1668 the signal-to-noise ratio (S/N) for chromatographic peaks for each congener must be greater or equal to 2.5. The congeners that do not meet this criteria are considered non-detect and the laboratory calculates an EDL for these congeners as the product of 2.5 times the concentration equivalent of the background noise level. This EDL takes the place of both the typical MRL and MDL.

The following summation criteria for PCBs will be used:

- Quantified PCBs (Aroclors or congeners) will be summed.
- Nondetected PCBs will not be summed, unless:
    - No detections occur.
    - In that case, the highest MRL (for Aroclors) and EDL (for congeners) will be presented with the "U" qualifier for the sum.

B 5.0 Quality Control

The overall quality assurance objectives for field sampling and laboratory analysis are to produce data of known and appropriate quality to support the project objectives. Appropriate procedures and quality control checks will be used so that known and acceptable levels of accuracy and precision are maintained for each data set. Field quality control and laboratory quality control samples will be employed to evaluate data quality. Quality control samples are controlled samples introduced into the analysis stream whose results are used to review data quality and to calculate the accuracy and precision of the chemical analysis program. The purpose of each type of quality control sample, collection and analysis frequency, and evaluation criteria are described in this section. Laboratory quality control samples, as described in the referenced methods, will be followed.

The quality of field and laboratory measurements will generally be determined by the quality control requirements and quality criteria described in analytical methods. All quality control measurements and data assessment for this project will be conducted on samples from and within batches of samples from this project alone when possible.

Quality control checks for sample collection will be accomplished by a combination of chain-of-custody protocols, field quality control samples, and laboratory quality assurance (QA) as

described in the sampling or analytical methods. The QC measures may include the following: rinsate and method blanks; matrix, surrogate, and laboratory control spikes; and laboratory duplicate samples. The laboratory will notify the URS Project Chemist of any quality control exceedances outlined in this QAPP immediately.

B 5.1 Field Quality Control Samples

Field quality control samples are collected to evaluate the quality of the field sampling program. Specifically, field duplicate samples are collected to monitor the variability associated with sample collection techniques and equipment rinsate blank samples are collected to monitor the effectiveness of decontamination procedures. Field quality control samples will be selected by the sampling team and designated in the field logbook, as appropriate.

Field Duplicates

Due to the statistical design being implemented on several media, field duplicates are not necessary to evaluate the variability associated with sample collection, therefore field duplicates will not be performed on these media.

Rinsate Blanks

All other equipment is anticipated to be disposable or dedicated to a sample location (aluminum pans, tubing, etc.). Rinsate blanks normally necessary to monitor cross-contamination of samples by sampling equipment will not be collected.

Field Blanks

A field blank sample will be collected on the Infiltrex high volume XAD system to measure background levels of chemicals of potential concern (COPCs) in the atmosphere, instrument tubing and XAD column and filters. The field blank will be collected by pumping laboratory provided deionized water through the Infiltrex system, including column and filters. The columns and filters will be analyzed under the same analytical conditions as the primary samples.

B 5.2 Laboratory Quality Control Samples

Laboratory QC checks are accomplished by analyzing initial and continuing calibration samples, method blanks, surrogate spikes, laboratory control samples (LCS), and laboratory duplicate samples. Not all of these QC samples will be required for all methods.

Method Blanks

Method blanks are used to check for laboratory contamination and instrument bias. Laboratory method blanks will be analyzed at a minimum frequency of 1 in 20 samples or one per analytical batch. Analytical results for each sample shall be clearly associated with a particular method blank. In order to evaluate low level determinations of target compounds in samples, the laboratory will report any detected concentration found in method blanks that exceed control criteria specified in this QAPP.

Laboratory Control Samples

LCS are used to monitor the laboratory's day-to-day performance of routine analytical methods, independent of matrix effects. The LCS is prepared by spiking deionized water with standard solutions prepared independently of those used in establishing instrument calibration. The LCS are extracted and analyzed with each batch of samples. Results are compared on a per-batch basis to established control limits and are used to evaluate laboratory performance for precision and accuracy. LCS may also be used to identify any background interference or contamination of the analytical system that may lead to the reporting of elevated concentration levels or false positive measurements.

Matrix Spike/Matrix Spike Duplicate Samples

Matrix spikes are used to assess sample matrix interferences and analytical errors, as well as to measure the accuracy of the analysis. Known concentrations of analytes are added to environmental samples; the matrix spike/matrix spike duplicate (MS/MSD) samples are then processed through the entire analytical procedure and the recovery of the analytes is calculated. Results are expressed as percent recovery of the known spiked amount. MS will be analyzed at a minimum frequency of one per twenty samples or one per analytical batch. The MS samples will be analyzed for the same parameters as the associated field samples in the same analytical batch. Project-specific MSD samples are not required for this project.

MS samples will be identified on the chain-of-custody form, and additional sample volumes will be provided to the laboratory. MS analyses not meeting quality control criteria specified in this QAPP will be further evaluated through additional cleanup or reanalysis once. If subsequent analyses result in out of control recoveries, both results will be reported by the laboratory and the corresponding data flagged.

Laboratory Duplicate Samples

Precision of the analytical system is evaluated by using laboratory duplicates. Laboratory duplicates are two portions of a single homogeneous sample analyzed for the same parameter. Laboratory duplicates with be analyzed at a minimum frequency of 1 in 20 samples or one per analytical batch.

B 5.3 Analytical Data Quality Indicators

Analytical data quality indicators of precision, accuracy (bias), representativeness, comparability, completeness, and sensitivity are defined below. Project specific performance criteria are outline in Tables 9 and 10. These project-specific criteria are based primarily on criteria listed in DOD Appendix B (DODEDQW, 2006). Where there is no established criteria the project-specific QC criteria are based on criteria found in the documents outlined in Section 4.0. Any data that falls outside of the project-specific criteria must be justified, and the effects on decisions must be assessed. In the cases where project-specific criteria are not met response actions will be taken, these are explained in section C 1.2

B 5.3.1 Precision

Precision is defined as the degree of agreement between or among independent, similar, or repeated measures. Precision is related to analytical variability and for this project will be measured as the relative percent difference (RPD) between results for laboratory duplicate pairs. Precision will be calculated as the RPD as follows:

$$\%RPD_i = \frac{2|O_i - D_i|}{(O_i + D_i)} \times 100\%$$

where:

$\%RPD_i$	=	Relative percent difference for compound *i*
O_i	=	Value of compound *i* in original sample
D_i	=	Value of compound *i* in duplicate sample

The resultant RPD will be compared to project-specific acceptance criteria shown in Tables 9 and 10. The RPD will be reviewed during data quality review, and the reviewer will note any deviations from the specified limits and comment on any effects on the data.

B 5.3.2 Accuracy

Accuracy is the amount of agreement between a measured value and the true value. Laboratory accuracy will be measured as the percent recovery of MS samples and LCS samples. Additional potential bias will be quantified by the analysis of method blank samples. Accuracy shall be calculated as percent recovery of the target analyte as follows:

$$\%R_i = (Y_i \div X_i) \times 100\%$$

where:

$\%R_i$	=	percent recovery for compound *i*
Y_i	=	measured analyte concentration in sample *i*
X_i	=	known analyte concentration in sample *i*

The LCS resultant percent recoveries will be compared to project-specific acceptance criteria shown in Tables 9 and 10. The LCS acceptance ranges will be used for the MS recoveries as well. If the objective criteria are not met, the laboratory will justify why the acceptability limits were exceeded and implement appropriate corrective actions discussed in Section C 1.2. Percent recoveries will be reviewed during data quality review, and the reviewer will note any deviations from the specified limits and comment on any effects on the data.

B 5.3.3 Representativeness

Representativeness is a qualitative parameter that expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a parameter that focuses primarily on the proper design of the sampling program or the subsampling of a given sample. The sampling design is discussed in Section B 1.0.

B 5.3.4 Comparability

Comparability is a qualitative parameter that expresses the confidence with which data from one study can be compared with data from another. This goal will be achieved by using standard techniques to collect and analyze representative samples and by reporting analytical results in appropriate units. Comparability will be evaluated during the data quality review.

B 5.3.5 Completeness

Completeness for usable data is defined as the percentage of usable data out of the total amount of planned data. Completeness for usable data shall be defined as 95% for each individual analytical method. Completeness will be calculated as follows:

$$\%C = \frac{A}{I} x100\%$$

where:

$\%C$	=	Percent completeness (analytical)
A	=	Measurements that are judged to be usable (based on project-specific requirements)
I	=	Intended number of measurements

Invalid data (i.e., data qualified as "R," rejected) will be identified during the data quality review.

B 5.3.6 Sensitivity

The sensitivity of the analytical methods (i.e., method reporting limits) identified for this project are sufficient to allow comparison of project results to decision criteria.

B 6.0 Equipment Maintenance

Laboratory instrumentation will be examined and tested prior to being put into service and will be maintained according to the manufacturer's instructions. All laboratory instruments will be maintained as specified in the project laboratory's QA plan and according to manufacturers' instructions. Manufacturer's instructions will be followed for any additional equipment that is required for this project.

B 7.0 Instrument Calibration

Laboratory instrument calibration will be conducted in accordance with the QC requirements identified in the DOD QSM (DODEDQW, 2006) manufacturers' instructions and the laboratory SOP. General requirements are discussed below.

B 7.1 Laboratory Instruments

As stated in DoD QSM, EPA SW-846 and applicable laboratory SOPs, calibration of all analytical instrumentation is required to ensure that the analytical system is operating correctly and functioning at the sensitivity required to meet project objectives. Each instrument will be calibrated with standard solutions appropriate to the instrument and analytical method. QC requirements for calibration must meet or exceed the requirments specified in Appendix B of the DoD QSM. For those analytical methods not specified in the DoD QSM, calibration should follow guidelines set forth in the cited method. The calibration and maintenance history of the fixed laboratory instrumentation is an important aspect of the project's overall QA/QC program. As such, all initial and continuing calibration procedures will be implemented by trained personnel following the manufacturer's instructions and in accordance with applicable EPA protocols to ensure the equipment is functioning within the tolerances established by the manufacturer and the method-specific analytical requirements.

B 7.2 Standard Solutions

A critical element in the generation of quality data is the purity/quality and traceability of the standard solutions and reagents used in the analytical operations. To ensure the highest purity possible, all primary reference standards and standard solutions will be obtained from a reliable commercial source. The laboratories will maintain a written record of the supplier, lot number, purity/concentration, receipt/preparation date, preparer's name, method of preparation, expiration date, and all other pertinent information for all standards, standard solutions, and individual standard preparation logs.

Standard solutions will be validated prior to use. Validation procedures can range from a check for chromatographic purity to verification of the concentration of the standard solution using another standard solution prepared at a different time or obtained from a different source. Stock and working standard solutions will be checked regularly for signs of deterioration, such as discoloration, formation of precipitates, or change of concentration. Care will be exercised in the proper storage and handling of standard solutions, and all containers will be labeled as to compound, concentration, solvent, expiration date, and preparation data (initials of preparer/date of preparation). Reagents will be examined for purity by subjecting an aliquot or subsample to the corresponding analytical method as well.

B 8.0 Data Management

The approach to data management for this project will ensure that measurement data maintain their integrity through the use of appropriate documentation procedures.

B 8.1 Data Reduction

The laboratory will perform inhouse analytical data reduction under the direction of the laboratory QA manager. Data reduction will be conducted as follows:

- Raw data produced by the analyst will be processed and reviewed for attainment of QC criteria as outlined in this QAPP and/or established EPA methods, for overall reasonableness, and for transcription or calculations errors.
- Upon acceptance of the preliminary reports by the laboratory QA data reviewer, final reports will be generated. The turnaround for the final data reports will be negotiated with the contracted analytical laboratory.

Laboratory data reduction procedures will be those specified in EPA SW-846 (4th edition) and those described in the laboratory SOPs. The data reduction steps will be documented, signed, and dated by the analyst.

The laboratories will maintain detailed procedures for laboratory record keeping in order to support the validity of all analytical work. Each data report package will contain the laboratories' written certification that the requested analytical method was run and that all QA/QC checks were performed. The laboratory program administrator will provide the USACE Project Manager with QC reports of their external audits if appropriate, which will become part of the project files.

B 8.2 Laboratory Data Deliverables

The laboratory data reports will consist of data packages that will contain complete documentation and all raw data to allow independent data verification and review of analytical results from laboratory bench sheets, instrument raw data outputs, chromatograms, and mass spectra. Each laboratory data report will include the following:

- Case narrative identifying the laboratory analytical batch number. The laboratory manager or their designee must sign the narrative.
- Matrix and number of samples included.
- Analyses performed and analytical methods used.
- Description of any problems or exceedances of QC criteria and corrective action taken.
- Copy of chain-of-custody records for all samples included in the analytical batch.
- Tabulated sample analytical results with units, data qualifiers, percent solids, sample weight or volume, dilution factor, laboratory batch and sample number, field sample number, and dates sampled, received, extracted, and analyzed all clearly specified. Surrogate percent recoveries will be included for organic analyses.
- All calibration, QC, and sample raw data including bench sheets, preparation logs, chromatograms, mass spectra, quantitation reports, and other instrument output data.

- Blank summary results indicating samples associated with each blank.
- Matrix spike result summaries with calculated percent recovery.
- Laboratory control sample results, when applicable, with calculated percent recovery.
- Electronically formatted data deliverable results.

B 8.3 Electronic Data Management

The USACE and/or its contractors will use an electronic data management system to track and report the following:

- Sample location (northing and easting), using coordinate systems compatible with earlier field work.
- Sample collection information including sample number, matrix, type of sample (primary, MS, duplicate), date of collection, and sampler.
- Analytical results including concentration, units, qualifier and analytical method.

Laboratory electronic data deliverables will be directly loaded into the data management system, thereby avoiding hand-entry errors. After data quality review is performed, the changes in values or qualifiers will be incorporated into the project data management system. A report will be produced and verified against the reviewed Laboratory Certificates.

C ASSESSMENT AND OVERSIGHT

C 1.0 Assessments and Response Actions

C 1.1 Assessments

Assessments will be used to increase the user's understanding of the activity being assessed and to provide a basis for improving that activity. Assessments, including performance and systems audits, may be conducted by the USACE to determine whether:

- The QA program has been documented in accordance with specified requirements
- The documented program has been implemented
- Any nonconformances were identified and corrective action or identified deficiencies was implemented

As the Contracting Officer's Representative (COR) for this project, the Portland District Technical Lead will be responsible for initiating audits, selecting the audit team, and overseeing audit implementation. The Contractor, URS, is responsible for supervising and checking that samples are collected and handled in accordance with this plan and that documentation of work is adequate and complete. The Contractor is also responsible for ensuring that the project performance satisfies the QA objectives set forth in this QAPP.

Reports and technical correspondence will be peer reviewed by qualified individuals before being finalized. Copies of all audit reports will be submitted to the USACE Project Manager upon completion.

Performance Audits

Performance audits are used to determine the status and effectiveness of laboratory measurement systems and to provide a quantitative measure of the quality of data generated. For laboratories, this audit can involve the use of standard reference materials. These samples have known concentrations of constituents that are analyzed as unknowns in the laboratory. Results of the laboratory analyses are calculated and compared for accuracy against the known concentrations of the samples and evaluated in relation to the project measurement quality objectives. Standard reference samples will be used according to the requirements of the laboratory methods selected for this project.

Technical Systems Audits

Technical system audits are used to confirm the adequacy of the data collection (field operation) and data generation (laboratory operation) systems. On-site audits are conducted to determine whether the project-specific plans, field methods and laboratory SOP are being properly implemented. A system audit may cover the field or laboratory portions of the project. As COR for this project, the Portland District Technical Lead may request that a system audit of the field methods or laboratory operations be performed.

C 1.2 Response Actions

The ultimate responsibility for maintaining quality throughout the project rests with the USACE PM. The day-to-day responsibility for assuring the quality of field and laboratory data rests with the Contractor, URS, and the laboratory program administrator, to be determined, respectively.

Any nonconformance with the established QC procedures will be expeditiously identified and controlled. Where procedures are not in compliance with the established protocol, corrective actions will be taken immediately. Subsequent work that depends on the nonconforming activity will not be performed until the identified nonconformance is corrected.

Field Corrective Action

The URS project manager will review the procedures being implemented in the field for consistency with the established protocols. Sample collection, preservation, labeling, etc., will be checked for completeness. Where procedures are not strictly in compliance with the established protocol, the deviations will be documented and corrected. Corrective actions will be defined by the Technical Lead as appropriate. Upon implementation of the corrective action, the technical lead will provide the USACE Project Manager with a written memo documenting field implementation. The memo will become part of the project file.

Laboratory Corrective Action

The laboratory QA data reviewer will review the data generated to ensure that all QC samples have been run as specified in the cited method and URS protocol. Recoveries of LCS, MS, and surrogate samples for consistency with method and project-specific accuracy, and RPD for matrix replicate and MS/MSD samples for consistency with method and project-specific precision.

Laboratory personnel will be alerted that corrective actions are necessary if any of the following occur:

- The QC data are outside the warning or acceptance windows established for precision and accuracy. The laboratory project manager will contact the laboratory QA manager to discuss out-of-control data sets. If the analyses cannot produce data sets that are within control, the URS chemist will be notified within 48 hours of any analysis that fails to meet the measurement quality objectives specified in this QAPP.
- Blanks contain contaminants at concentrations above the levels specified in the laboratory QA plan for any target compound.
- Undesirable trends are detected in MS or LCS recoveries or RPDs between matrix replicates and MS/MSD.
- Unusual changes in MDL are observed.
- Deficiencies are detected by the laboratory QA manager during internal or external audits, or from the results of internal performance evaluation samples.

If any nonconformances in analytical methodologies or QC sample results are identified by the analyst, corrective actions will be implemented immediately. Specific corrective actions are outlined in each laboratory SOP. Corrective action procedures will be handled initially at the bench level by the analyst, who will review the preparation or extraction procedure for possible errors, check the instrument calibration, spike and calibration mixes, instrument sensitivity, etc. The analyst will immediately notify his/her supervisor of the identified problem and the investigation that is being conducted. If the problem persists or cannot be identified, the matter will be referred to the laboratory supervisor and laboratory QA manager for further investigation. Once resolved, full documentation of the corrective action procedure will be filed by the laboratory QA manager, and if data are affected, the URS PM will be provided a corrective action memo for inclusion into the project file.

Corrective action may include, but will not be limited to the following:

- Performing appropriate sample cleanup procedures
- Reanalyzing suspect samples if holding time criteria permit
- Evaluating and amending sampling and/or analytical procedures
- Accepting data with an acknowledged level of uncertainty

- Recalibrating analytical instruments
- Evaluating and attempting to identify limitations of the data

Data deemed unacceptable following the implementation of the required corrective action measures will be rejected during data evaluation and follow-up corrective actions will be explored.

Corrective Actions Following Data Evaluation

Field and laboratory data generated for this project will be reviewed to ensure that all project objectives are met. If any nonconformances are found in the field procedures, sample collection procedures, field documentation procedures, laboratory analytical and documentation procedures, and data evaluation and quality review procedures, the impact of those nonconformances on the overall project objectives will be assessed. Appropriate actions, including resampling and reanalysis, may be recommended to the USACE Project Manager so that the project objectives can be accomplished.

C 2.0 Reports to Management

A sampling and analysis data report will be prepared that documents the results of this investigation as described in Section A 7.0.

D DATA VALIDATION AND USABILITY

D 1.0 Data Review, Verification, and Validation

The purpose of the data quality review is to eliminate unacceptable analytical data and to designate a data qualifier for any data quality limitation discovered. The data quality review will include a review of laboratory performance criteria and sample-specific criteria. The reviewer will determine whether the measurement quality objectives have been met, and will calculate the data completeness for the project.

The data are reviewed in accordance with the criteria contained in the DOD QSM and the EPA guidance documents modified for the analytical methods used. A full validation of all the data (i.e., checks of column confirmation and calibrations) will be performed on 10% of the data. A full validation of the data is not anticipated, however, pending results of the initial 10% check it may be necessary. The data quality review will include verification of the following:

- Compliance with this QAPP
- Chain-of custody records
- Case Narrative
- Proper sample collection and handling procedures
- Holding times
- Field QC results

- Laboratory blank analysis
- Method detection and reporting limits
- Laboratory duplicate precision
- MS recoveries
- LCS recoveries
- Surrogate compound recoveries
- Data completeness and format
- Data qualifiers assigned by the laboratory
- Primary and secondary column verification (on 10%)
- Instrument calibration verification (on 10%)
- Instrumentation calibration linearity (on 10%)
- Verification of reported data in electronic data deliverable with the hard copy deliverable

Qualifiers will be added to data during the review as necessary. Qualifiers applied to the data as a result of the review will be limited to:

U The analyte was analyzed for but was not detected above the reporting limit.

J The analyte was detected at a concentration less than the laboratory reporting limit, and the result is therefore considered an estimated quantity.

UJ The analyte was not detected above the sample reporting limit. However, the reporting limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified. No associated value is reported.

Results of the data quality review will be included in a data quality review report that will provide a basis for meaningful interpretation of the data quality and evaluate the need for corrective actions and/or comprehensive data validation.

D 2.0 Reconciliation with User Requirements

After the field work, chemical analyses, and data quality reviews have been completed, a data quality review report will be prepared. In this report, all data generated for this project will be reconciled with the project objectives. The report will include an evaluation of overall precision, accuracy, completeness, representativeness, comparability, and sensitivity of the sampling data; it will include an assessment of the overall usability of the data and describe any limitations on its use; and it will summarize any audit information, indicating any corrective actions taken. The data quality review report will be appended to the sampling and analysis data report.

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TABLES

Table 1. Data Quality Objectives

Problem Statement:
Additional data are required to characterize the Bradford Island River OU for preparation of an RI report and baseline risk assessment, and to permit evaluation of engineering alternatives to address areas requiring remediation.

Decisions to be made	Data Requirements	Investigation Strategy	Decision Criteria/ Performance Specifications
Determine the nature and magnitude of sediment contamination in the Forebay	Sediment chemical data	Collect surface sediment from within the forebay. Sample locations will be at 21 randomly selected grid stations. 14 of the 21 stations will be initially analyzed and the remaining 7 stations will be analyzed if necessary to obtain the statistical power for comparison to upstream.	Laboratory reporting limits will be based on screening levels. Laboratory analyses will be based on the chemicals of interest as defined in the Management Plan.
Determine the nature and extent of sediment impacts related to releases from the site downstream of the dam.	Sediment chemical data	Collect surface sediment samples from 5 locations between the tailrace of the dam and Pierce and Ives Islands (River Mile 142).	Locations of the sediment samples will be based on identifying areas of lower relative velocity that correspond to depositional areas in the river. Laboratory analyses will be based on the chemicals of interest as defined in the Management Plan. Laboratory reporting limits will be based on screening levels.

Decisions to be made	Data Requirements	Investigation Strategy	Decision Criteria/ Performance Specifications
Determine the magnitude of PCB impacts to selected ecological receptors in the Forebay	Tissue chemical data.	Collect 21 benthic tissue (clams) samples that are co-located with sediment locations in the forebay. Attempt to acquire 21 sculpin and crayfish samples corresponding to sediment/clam collection area. Analyze 17 archived smallmouth bass samples and 5 largescale sucker collected from within forebay.(1)	Laboratory analyses will be based on the chemicals of interest as defined in the Management Plan. Laboratory reporting limits will be based on screening levels.
Describe the potential for PCBs to bioaccumulate in selected receptors	Physical data required for the food web model. Tissue, sediment and surface water data.	Use data from other data needs to fill this requirement.	Laboratory reporting limits will be based on screening levels.

Decisions to be made	Data Requirements	Investigation Strategy	Decision Criteria/ Performance Specifications
Determine the ambient contaminant contribution from upstream sources to site contamination levels	Sediment chemical data	Collect 21 co-located surface sediment and clam samples from area that is similar in nature to forebay, i.e. grain size and TOC content. Sample locations will be at 21 randomly selected grid points. Attempt to acquire 21 sculpin and crayfish samples in the area of the sediment/clam collections. Collect 17 smallmouth bass from within reference area. 14 of the 21 stations will be initially analyzed and the remaining 7 stations will be analyzed if necessary to obtain the statistical power for comparison to upstream.	Laboratory reporting limits will be based on screening levels.
Determine the clam sediment relationship at higher sediment concentrations	Sediment and clam chemical data	Collect 5 co-located surface sediment and clam samples from within the removal area footprint prior to implementing the removal action	Laboratory reporting limits will be based on screening levels.
Determine a preliminary cleanup goal for sediments that includes PCBs as Aroclors	Sediment chemical data for both Aroclors and congeners	All sediment samples will be analyzed for PCBs as Aroclors and then archived samples will be selected for congeners analysis based on a range of Aroclor results.	Laboratory reporting limits will be based on screening levels.

Table 2. Proposed Schedule for River OU Sampling and Analysis

Task Description	Responsible Party	Start	Finish
Task 1: Preparation for Sampling and Analysis			
Notice to Proceed	USACE	7/16/2007	7/16/2007
Subcontractor Procurement	URS	7/16/2007	8/3/2007
Prepare and Submit Revised QAPP	URS	7/12/2007	9/7/2007
Task 2: Conduct Pre-Removal Field Investigation	URS		
Collect samples		9/17/2007	9/21/2007
Task 3: Conduct Post-Removal Field Investigation	URS	2/1/08	2/28/08
Collect samples			
Task 4: Laboratory Analysis and Data Review	URS		
Analyze samples – Pre-Removal	Analytical Lab	9/21/2007	10/21/2007
Analyze samples – Post-Removal	Analytical Lab	3/3/2008	4/4/2008
Review lab data and prepare data quality report	URS	4/4/2008	5/2/2008
Task 5: Reporting			
Prepare data report	URS	5/2/2008	6/6/2008

Table 3. Summary of Chemical Analytes

Chemicals of Interest (COIs)	Sediment (Reference & Forebay)	Sediment (Downstream)	Tissue	Grab Water	Surface Water (XAD)
INORGANICS					
Aluminum	X		X	X	
Antimony	X		X	X	
Arsenic	X	X	X	X	
Barium	X		X	X	
Beryllium	X	X	X	X	
Cadmium	X	X	X	X	
Chromium	X		X	X	
Cobalt	X	X	X	X	
Copper	X	X	X	X	
Lead	X		X	X	
Mercury	X	X	X	X	
Nickel	X		X	X	
Thallium	X	X	X	X	
Vanadium	X	X	X	X	
Zinc	X	X	X	X	
PCBs					
Aroclor 1016	X	X	X		
Aroclor 1221	X	X	X		
Aroclor 1232	X	X	X		
Aroclor 1242	X	X	X		
Aroclor 1248	X	X	X		
Aroclor 1254	X	X	X		
Aroclor 1260	X	X	X		
Total PCBs (as congeners)	X	X	X		X
SVOCs					
Acenaphthene	X		X	X	X
Anthracene	X		X	X	X
Benzo(a)anthracene	X		X	X	X
Benzo(a)pyrene	X		X	X	X
Benzo(b)fluoranthene	X		X	X	X
Benzo(g,h,i)perylene	X		X	X	X
Benzo(k)fluoranthene	X		X	X	X
Bis(2-ethylhexyl)phthalate	X		X	X	X
Butyl benzyl phthalate	X		X	X	X
Carbazole	X		X	X	X
Chrysene	X		X	X	X
Dibenz(a,h)anthracene	X		X	X	X
Di-n-Butyl Phthalate	X		X	X	X
Di-n-octyl phthalate	X		X	X	X
Fluoranthene	X		X	X	X
Indeno(1,2,3-cd)pyrene	X		X	X	X
p-Cresol	X		X	X	X
Phenanthrene	X		X	X	X
Pyrene	X		X	X	X
TPHs					
Diesel Range Hydrocarbons	X	X		X	
Motor Oil Range Hydrocarbons	X	X		X	
GENERAL CHEMISTRY					
Grain Size	X	X		X	
Moisture Content	X	X		X	
TOC	X	X		X	
% Lipids			X	X	

Table 4. Summary of Sampling Phases

Sampling Phase Number	Sampling Phase Name	Media	Number of Stations	Primary Analyses	# of QC Samples[4]	Total # of Samples
I	**Pre-Removal**	Sediment	5	PCB Aroclors, Metals, SVOCs	2	7
		Clams	5	PCB Aroclors, Metals, SVOCs	2	7
II	**Archived Fish**	Bass	17	PCB Aroclors, PCB Congeners, Metals, SVOCs	1	18
		Lg. Scale Sucker	1	PCB Aroclors, PCB Congeners, Metals, SVOCs	2	3
III	**Post-Removal Primary[1]**	Sediment - Forebay	14	PCB Aroclors, Metals, SVOCs	1	15
		Sediment - Reference	14	PCB Aroclors, Metals, SVOCs	1	15
		Sediment - Downstream	6	PCB Aroclors, Metals, SVOCs	2	8
		Clams	14	PCB Aroclors, Metals, SVOCs	1	15
		Crayfish	14	PCB Aroclors, Metals, SVOCs	1	15
		Sculpin	14	PCB Aroclors, PCB Congeners, Metals, SVOCs	1	15
		Bass	17	PCB Aroclors, PCB Congeners, Metals, SVOCs	1	18
		XAD (water) - Reference[2]	5	PCB Congeners, SVOCs	1	12
		XAD (water) - Forebay[2]	5	PCB Congeners, SVOCs	0	10
		Grab water - Reference	5	Metals, PAHs, TPH-Dx	2	7
		Grab water - Forebay	5	Metals, PAHs, TPH-Dx	2	7
IV	**Post-Removal Secondary[1]**	Sediment - Forebay	7	PCB Aroclors, Metals, SVOCs	1	8
		Sediment - Reference	7	PCB Aroclors, Metals, SVOCs	1	8
		Clams	7	PCB Aroclors, Metals, SVOCs	1	8
		Crayfish	7	PCB Aroclors, Metals, SVOCs	1	8
		Sculpin	7	PCB Aroclors, PCB Congeners, Metals, SVOCs	1	8
V	**Aroclor to Congener[3]**	Sediment	8	PCB Congeners	1	9
		Clams	8	PCB Congeners	1	9
		Crayfish	8	PCB Congeners	1	9

Notes:

1 = Post-Removal primary and secondary samples will be collected simultaneously. Post-removal secondary samples will only be analyzed if necessary to meet statistical requirements.

2 = XAD samples have both a resin column and a filter which will be analyzed separately.

3 = A minimum of 8 samples will be selected. The final number will depend on initial Aroclor analytical results.

4 = All sample matrixes will have a matrix spike (MS) performed, for the non-statistical sampling events a field duplicate will be performed (therefore a '1' indicates a MS and a '2' indicates a MS and a field duplicate will be analyzed).

Table 5. Sediment Collection Sampling Summary

Analyte	Method	Container Description	Preservation	Holding Times
Total Metals[1]	6000/ 7000	Fill one 8oz WMGJ per each sub sample (approximately 10 sub samples per sample location) Laboratory will homogenize all sub samples prior to analysis.	Cool to 4 °C	6 months
Total Mercury	7471A		Cool to 4 °C	6 months
PCB Aroclors	EPA 8082-M		Cool to 4 °C	14days/40days[2]
SVOCs	EPA 8270-SIM		Cool to 4 °C	14days/40days[2]
Total Organic Carbon	Modified Plumb[3]		Cool to 4 °C	28 days
TPH	NWTPH-Dx		Cool to 4 °C	14days/40days[2]
PCB congeners	EPA 1668A		Cool to 4 °C Frozen (-18 °C)	14days/40days[2] 1 year
Grain Size	PSEP[4]		none	6 months to analysis
				Total

Notes:
WMGJ = Wide mouth glass jar with teflon-lined lid
[1] Metals list: Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Lead, Nickel, Thallium, Vanadium, and Zinc
[2] Samples extracted within 14 days and extracts analyzed within 40 days after extraction. PCB samples may be preserved frozen extending the initial hold time to 6 months.
[3]Plumb, R. H. Jr., *Procedures for Handling and Chemical Analysis of Sediment & Water Samples*, May 1981, USACE Publication.
[4]Puget Sound Estuary Program: Recommended Protocols For Measuring Selected Environmental Variables in Puget Sound. Tetra Tech, Inc. March 1986.

Table 6. Tissue Collection Sampling Summary

Analytes	Method	Container Description	Sample Mass (minimum)	Preservation	Holding Times (preserved frozen)
Total Metals	6000/ 7000	Aluminum foil and Ziploc bags (whole body); glass jar (homogenate)	4g	Field preserve on ice (4°C). Laboratory preserve frozen (-18°C).	2 Years
Total Mercury	7471A		4g		2 Years
PCB Aroclors	EPA 8082-M		20g[1]		1Year[2]
PCB congeners	EPA 1668A		30g		1Year[2]
SVOCs	EPA 8270-SIM		10g		1Year[2]
Lipids	NOAA		--[1]		1 month
% Solids	Gravimetric		2g		1 month
Minimum Homogenate Needed = 71g					

Notes:
Benthic tissue will consist of clams.
TBD - To Be Determined. Congener analyses are contingent on Aroclor samples results and will be analyzed on archived sediment.
[1] A portion of the solvent extract from the Aroclor analysis will be used to determine lipid content.
[2]Holding time to extraction. After extraction, holding time 40 days to analyze.

Table 7. Grab Surface Water Collection Sampling Summary

Analytes	Analytical Method	Container Description	Preservation	Field Filtered	Hold Time
Metals[1] (Total)	6000/ 7000	1 L HDPE bottle	HNO_3 to pH< 2; Cool to 4 °C	No	6 months
Metals[1] (Dissolved)	6000/ 7000	1 L HDPE bottle	HNO_3 to pH< 2; Cool to 4 °C	Yes	6 months
Mercury (Total)	7471A	500 ml HDPE bottle	HNO_3 to pH< 2; Cool to 4 °C	Yes	28 days
Mercury (Dissolved)	7471A	500 ml HDPE bottle	HNO_3 to pH< 2; Cool to 4 °C	Yes	28 days
SVOCs (Total)	EPA 8270-SIM	1 L AGB	Cool to 4 °C	No	7 days / 40 days[2]
SVOCs (Dissolved)	EPA 8270-SIM	1 L AGB	Cool to 4 °C	Yes	7 days / 40 days[2]
TPH (Total)	NWTPH-Dx	1 L AGB	Cool to 4 °C	No	7 days / 40 days[2]
TPH (Dissolved)	NWTPH-Dx	1 L AGB	Cool to 4 °C	Yes	7 days / 40 days[2]
Organic Carbon (Total)	EPA 415.2	250 mL AGB	H_2SO_4 to pH<2; Cool to 4°C	No	28 days
Organic Carbon (Dissolved)	EPA 415.2	250 mL AGB	H2SO4 to pH<2; Cool to 4 °C	Yes	28 days
Anions (Sulfate, Nitrate, Chloride)	EPA 300.0	500 ml HDPE bottle	Cool to 4 °C	No	28 days
Dissolved Oxygen	Field Instrument	--	--	--	--
pH	Field Instrument	--	--	--	--

Notes:
5 primary samples (forebay) + 5 primary samples (reference) = 10 total primary samples
Field filtration will be performed by pumping sample volume through a 0.45 µm filter
AGB = Amber glass bottle
HDPE = High density polyethylene
[1] Metals list: Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Lead, Nickel, Thallium, Vanadium, and Zinc.
[2] 7 days to extract/40 days after extraction to analysis.

Table 8. High-Volume XAD Surface Water Collection Sampling Summary

Analytes	Method	Container Description	Preservation	Holding Times
PCB congeners	EPA 1668A	XAD column resin and filter[1]	Cool to 4 °C	1 year[2]
SVOCs	EPA 8270 (modified)			

Notes:
[1] Infiltrex system consists of a resin filled column (250g of divinylbenzene resin material) and a glass fiber filter. Both component will be analyzed separately to represent dissolved and particulate phase analytes.
[2] Recommended by AXYS Analytical Services

Table 9
Measurement Performance Criteria for Surface Water

Parameter	Method	Laboratory Reporting Limits		EPA NRWQC (2006) (ug/L)[1]		ODEQ Water Quality Criteria (2004) (Fresh) Surface Water (ug/L)[2]		Project-Specific Control Limits[3]					
		MDL (ug/L)	RL (ug/L)	Chronic	Human Health (Water+Organism)	Chronic	Human Health (Water+Organism)	Surrogate Recovery (%)	MS/MSD Recovery (%)	MS/MSD RPD (%)	LCS/LCSD Recovery (%)	LCS/LCSD RPD (%)	Laboratory Duplicate RPD (%)
Total Petroleum Hydrocarbons													
Diesel-range	NWTPH-Dx (Ecology, 1997)			NE	NE	NE	NE	--	69-123	30	69-123	30	30
Oil-range	NWTPH-Dx (Ecology, 1997)			NE	NE	NE	NE	--	--	--	--	--	--
1,4-Difluorobenzene (gasoline-range)	*Surrogate*	--	--	--	--	--	--	50-150	--	--	--	--	--
o-Terphenyl (diesel- and oil-range)	*Surrogate*	--	--	--	--	--	--	50-150	--	--	--	--	--
SVOCs	**EPA 8270-SIM or EPA 8270C with High Volume Injection**												
Acenaphthene				NE	670	NE	670	--	45-110	30	45-110	30	30
Anthracene				NE	8,300	NE	8300	--	55-110	30	55-110	30	30
Benz(a)anthracene				NE	0.0038	NE	0.0038	--	55-110	30	55-110	30	30
Benzo(a)pyrene				NE	0.0038	NE	0.0038	--	55-110	30	55-110	30	30
Benzo(b)fluoranthene				NE	0.0038	NE	0.0038	--	45-120	30	45-120	30	30
Benzo(g,h,i)perylene				NE	NE	NE	NE	--	40-125	30	40-125	30	30
Benzo(k)fluoranthene				NE	0.0038	NE	0.0038	--	45-125	30	45-125	30	30
Bis(2-ethylhexyl) phthalate (BEHP)				NE	1.2	NE	NE	--	40-125	30	40-125	30	30
Butyl benzyl phthalate				NE	1,500	NE	NE	--	45-115	30	45-115	30	30
Carbazole				NE	NE	NE	NE	--	50-115	30	50-115	30	30
Chrysene				NE	0.0038	NE	0.0038	--	55-110	30	55-110	30	30
Dibenz(a,h)anthracene				NE	0.0038	NE	0.0038	--	40-125	30	40-125	30	30
Di-n-butyl phthalate				NE	2,000	NE	2000	--	55-115	30	55-115	30	30
Di-n-octyl phthalate				NE	NE	NE	NE	--	35-135	30	35-135	30	30
Fluoranthene				NE	130	NE	NE	--	55-115	30	55-115	30	30
Fluorene				NE	1,100	NE	1100	--	50-110	30	50-110	30	30
Indeno(1,2,3-cd)pyrene				NE	0.0038	NE	0.0038	--	45-125	30	45-125	30	30
p-Cresol (4-methylphenol)				NE	NE	NE	NE	--	45-125	30	45-125	30	30
Phenanthrene				NE	NE	NE	NE	--	50-115	30	50-115	30	30
Pyrene				NE	830	NE	830	--	50-130	30	50-130	30	30
2,4,6-Tribromophenol	*Surrogate (8270C)*	--	--		--	--	--	40-125	--	--	--	--	--
2-Fluorobiphenyl	*Surrogate (8270C)*	--	--		--	--	--	50-110	--	--	--	--	--
2-Fluorophenol	*Surrogate (8270C)*	--	--		--	--	--	20-110	--	--	--	--	--
Nitrobenzene-d5	*Surrogate (8270C)*	--	--		--	--	--	40-110	--	--	--	--	--
Phenol-d6	*Surrogate (8270C)*	--	--		--	--	--	45-135	--	--	--	--	--
Terphenyl-d14	*Surrogate (8270C)*	--	--		--	--	--	50-135	--	--	--	--	--
Fluoranthene-d10	*Surrogate (8270-SIM)*	--	--			--	--	45-135	--	--	--	--	--
Fluorene-d10	*Surrogate (8270-SIM)*	--	--			--	--	45-135	--	--	--	--	--
Terphenyl-d14	*Surrogate (8270-SIM)*	--	--			--	--	50-135	--	--	--	--	--
Polychlorinated Biphenyls (ug/kg)	**EPA SW-846 8082**												
Aroclor-1016				NE	NE	NE	NE	--	25-145	30	25-145	30	--
Aroclor-1221				NE	NE	NE	NE	--	--	--	--	--	--
Aroclor-1232				NE	NE	NE	NE	--	--	--	--	--	--
Aroclor-1242				NE	NE	NE	NE	--	--	--	--	--	--
Aroclor-1248				NE	NE	NE	NE	--	--	--	--	--	--
Aroclor-1254				NE	NE	NE	NE	--	--	--	--	--	--
Aroclor-1260				NE	NE	NE	NE	--	30-145	30	30-145	30	--
Aroclor-1262				NE	NE	NE	NE	--	--	--	--	--	--
Aroclor-1268				NE	NE	NE	NE	--	--	--	--	--	--
Total PCBs				0.014	6.4E-05	0.014	6.4E-05	--	--	--	--	--	--
Decachlorobiphenyl	*Surrogate*	--	--	--	--	--	--	60-125	--	--	--	--	--
Metals (Total and Dissolved)	**EPA SW-846**												
Aluminum	6010B			NE	NE	87	NE	--	80-120	20	80-120	20	20
Antimony	6010B			NE	NE	NE	NE	--	80-120	20	80-120	20	20
Arsenic	6020			150	0.018	NE	0.018	--	80-120	20	80-120	20	20
Barium	6010B			NE	NE	NE	NE	--	80-120	20	80-120	20	20
Beryllium	6020			NE	NE	NE	NE	--	80-120	20	80-120	20	20
Cadmium	6010B			0.25	NE	NE	NE	--	80-120	20	80-120	20	20
Chromium	6010B			74 (Cr^{+3}) 11 (Cr^{+6})	NE	NE	NE	--	80-120	20	80-120	20	20
Cobalt	6010B			NE	NE	NE	NE	--	80-120	20	80-120	20	20
Copper	6010B			9.0	1,300	NE	NE	--	80-120	20	80-120	20	20
Lead	6010B			2.5	NE	NE	NE	--	80-120	20	80-120	20	20
Mercury	7471A			0.77	NE	NE	NE	--	80-120	20	80-120	20	20
Nickel	6010B			52	610	NE	NE	--	80-120	20	80-120	20	20
Thallium	6010B			NE	0.24	NE	NE	--	80-120	20	80-120	20	20
Vanadium	6010B			NE	NE	NE	NE	--	80-120	20	80-120	20	20
Zinc	6010B			120	7,400	NE	NE	--	80-120	20	80-120	20	20
Other													
Sulfate	EPA 300			NE	NE	NE	NE	--	75-125	30	75-125	30	30
Nitrates	EPA 300			NE	10,000	NE	NE	--	75-125	30	75-125	30	30
Chloride	EPA 300			23,000	NE	NE	NE	--	75-125	30	75-125	30	30
Total Organic Carbon	SM 5310C			NE	NE	NE	NE	--	75-125	30	75-125	30	30

Notes:
MDLs and RLs will be added to this table after the laboroatory has been contracted during the procurement process.
µg/L - microgram per liter
EPA - U.S. Environmental Protection Agency
LCS/LCSD - laboratory control sample/laboratory control sample duplicate
MDL - method detection limit
MS/MSD - matrix spike/matrix spike duplicate
NE - not established
NWTPH-Dx - Northwest Total Petroleum Hydrocarbons—diesel range
ODEQ - Oregon Department of Environmental Quality
RL - reporting limit
RPD - relative percent difference
SIM - select ion monitoring
-- Not Applicable
1 = EPA National Recommended Water Quality Criteria, 2006.
2 = Oregon DEQ Water Quality Criteria Summary (OAR 340-041, Table 33A, 33B, and 33C)
3 = Project-specifc QC criteria was established using (1) DOD QSM, (2) Shell, (3) specificed analytical method requirements in that order.

Table 10
Measurement Performance Criteria for Solids (Sediment and Tissue)

Parameter	Method	Laboratory Reporting Limits		ODEQ Level II SLVs for ERA (2001)[1,2] (mg/kg dry)	ODEQ Sediment Bioaccumulation SLVs (2007)[3] (mg/kg dry)				ODEQ ATLs for Fish/Shellfish (2007)[4] (mg/kg wet)			ODEQ CTLs for Fish/Shellfish (2007)[5] (mg/kg wet)	Project-Specific Control Limits[6]					
		MDL (ug/kg)	RL (ug/kg)	Freshwater Sediment	Birds (Indivdual)	Mammals (Individual)	Fish (Freshwater)	Humans (Subsistence)	Birds (Individual)	Mammals (Indivdual)	Humans[7] (subsistence/tribal)	Freshwater	Surrogate Recovery (%)	MS/MSD Recovery (%)	MS/MSD RPD (%)	LCS/LCSD Recovery (%)	LCS/LCSD RPD (%)	Laboratory Duplicate RPD (%)
Semivolatile Organic Compounds	**EPA 8270-SIM or EPA 8270C**																	
Acenaphthene				0.290	NE	NE	NE	NE	NE	NE	NE	NE	--	45-110	60	45-110	60	--
Anthracene				0.057	NE	NE	NE	NE	NE	NE	NE	NE	--	55-105	60	55-105	60	--
Benz(a)anthracene				0.032	NE	NE	NE	NE	NE	NE	NE	NE	--	50-110	60	50-110	60	--
Benzo(a)pyrene				0.032	NE	NE	NE	NE	NE	NE	NE	NE	--	50-110	60	50-110	60	--
Benzo(b)fluoranthene				NE	NE	NE	NE	NE	NE	NE	NE	NE	--	45-115	60	45-115	60	--
Benzo(g,h,i)perylene				0.300	NE	NE	NE	NE	NE	NE	NE	NE	--	40-125	60	40-125	60	--
Benzo(k)fluoranthene				0.270	NE	NE	NE	NE	NE	NE	NE	NE	--	45-125	60	45-125	60	--
Bis(2-ethylhexyl) phthalate				0.750	NE	NE	NE	NE	NE	NE	NE	NE	--	45-125	60	45-125	60	--
Butyl benzyl phthalate				NE	NE	NE	NE	NE	NE	NE	NE	NE	--	50-125	60	50-125	60	--
Carbazole				0.140	NE	NE	NE	NE	NE	NE	NE	NE	--	45-115	60	45-115	60	--
Chrysene				0.057	NE	NE	NE	NE	NE	NE	NE	NE	--	55-110	60	55-110	60	--
Dibenz(a,h)anthracene				0.033	NE	NE	NE	NE	NE	NE	NE	NE	--	40-125	60	40-125	60	--
Di-n-butyl phthalate				0.110	NE	NE	NE	NE	NE	NE	NE	NE	--	55-110	60	55-110	60	--
Di-n-octyl phthalate				NE	NE	NE	NE	NE	NE	NE	NE	NE	--	40-130	60	40-130	60	--
Fluoranthene				0.111	NE	360	37	62	NE	0.0095	20	19	--	55-115	60	55-115	60	--
Fluorene				0.077	NE	NE	NE	NE	NE	NE	NE	NE	--	50-110	60	50-110	60	--
Indeno(1,2,3-cd)pyrene				0.017	NE	NE	NE	NE	NE	NE	NE	NE	--	40-120	60	40-120	60	--
p-Cresol (4-methylphenol)				NE	NE	NE	NE	NE	NE	NE	NE	NE		40-120	60	40-120	60	
Phenanthrene				0.042	NE	NE	NE	NE	NE	NE	NE	NE	--	50-110	60	50-110	60	--
Pyrene				0.053	NE	18,000	1.9	47	NE	0.0095	15	1.0	--	45-125	60	45-125	60	--
2,4,6-Tribromophenol	*Surrogate (8270C)*	--	--	--	--	--	--	--	--	--	--	--	40-125	--	--	--	--	--
2-Fluorobiphenyl	*Surrogate (8270C)*	--	--	--	--	--	--	--	--	--	--	--	50-110	--	--	--	--	--
2-Fluorophenol	*Surrogate (8270C)*	--	--	--	--	--	--	--	--	--	--	--	20-110	--	--	--	--	--
Nitrobenzene-d5	*Surrogate (8270C)*	--	--	--	--	--	--	--	--	--	--	--	40-110	--	--	--	--	--
Phenol-d6	*Surrogate (8270C)*	--	--	--	--	--	--	--	--	--	--	--	45-135	--	--	--	--	--
Terphenyl-d14	*Surrogate (8270C)*	--	--	--	--	--	--	--	--	--	--	--	50-135	--	--	--	--	--
Fluoranthene-d10	*Surrogate (8270-SIM)*	--	--	--	--	--	--	--	--	--	--	--	60-120	--	--	--	--	--
Fluorene-d10	*Surrogate (8270-SIM)*	--	--	--	--	--	--	--	--	--	--	--	60-120	--	--	--	--	--
Terphenyl-d14	*Surrogate (8270-SIM)*	--	--	--	--	--	--	--	--	--	--	--	30-125	--	--	--	--	--
Polychlorinated Biphenyls (ug/kg)	**EPA SW-846 8082**																	
Aroclor-1016				NE	NE	NE	NE	NE	NE	NE	NE	NE	--	40-140	50	40-140	50	--
Aroclor-1221				NE	NE	NE	NE	NE	NE	NE	NE	NE	--	--	--	--	--	--
Aroclor-1232				NE	NE	NE	NE	NE	NE	NE	NE	NE	--	--	--	--	--	--
Aroclor-1242				NE	NE	NE	NE	NE	NE	NE	NE	NE	--	--	--	--	--	--
Aroclor-1248				0.021	NE	NE	NE	NE	NE	NE	NE	NE	--	--	--	--	--	--
Aroclor-1254				0.007	NE	NE	NE	NE	NE	NE	NE	NE	--	--	--	--	--	--
Aroclor-1260				NE	NE	NE	NE	NE	NE	NE	NE	NE	--	60-130	50	60-130	50	--
Aroclor-1262				NE	NE	NE	NE	NE	NE	NE	NE	NE	--	--	--	--	--	--
Aroclor-1268				NE	NE	NE	NE	NE	NE	NE	NE	NE	--	--	--	--	--	--
Total PCBs		--	--	0.034	0.0018	0.044	0.022	4.6E-05	0.035	0.88	5.7E-04	0.43	--	--	--	--	--	--
Decachlorobiphenyl	*Surrogate*	--	--	--	--	--	--	--	--	--	--	--	60-125	--	--	--	--	--
Polychlorinated Biphenyls (ug/kg)[8]	**EPA 1668**																	
PCB 77				NE	8.0E-06	3.0E-04	3.2E-03	6.4E-06	1.6E-04	5.8E-03	7.6E-05	NE	--	--	--	--	--	--
PCB 81				NE	4.1E-06	9.8E-05	6.5E-04	2.1E-06	8.0E-05	2.0E-03	2.5E-05	NE	--	--	--	--	--	--
PCB 105				NE	3.9E-03	9.4E-04	6.2E-02	2.1E-05	8.0E-02	2.0E-02	2.5E-04	NE	--	--	--	--	--	--
PCB 114				NE	4.0E-02	9.8E-04	6.5E-02	2.1E-05	8.0E-01	2.0E-02	2.5E-04	NE	--	--	--	--	--	--
PCB 118				NE	4.9E-02	1.2E-03	7.9E-02	2.6E-05	8.0E-01	2.0E-02	2.5E-04	NE	--	--	--	--	--	--
PCB 123				NE	4.9E-02	1.2E-03	7.9E-02	2.6E-05	8.0E-01	2.0E-02	2.5E-04	NE	--	--	--	--	--	--
PCB 126				NE	3.9E-06	2.8E-07	6.5E-05	6.2E-09	8.0E-05	5.8E-06	7.6E-08	NE	--	--	--	--	--	--
PCB 156				NE	4.9E-03	1.2E-03	7.9E-02	2.6E-05	8.0E-02	2.0E-02	2.5E-04	NE	--	--	--	--	--	--
PCB 157				NE	4.9E-03	1.2E-03	7.9E-02	2.6E-05	8.0E-02	2.0E-02	2.5E-04	NE	--	--	--	--	--	--
PCB 167				NE	4.9E-02	1.2E-03	7.9E-02	2.6E-05	8.0E-01	2.0E-02	2.5E-04	NE	--	--	--	--	--	--
PCB 169				NE	4.9E-04	1.2E-06	7.9E-02	2.1E-08	8.0E-03	2.0E-05	2.5E-07	NE	--	--	--	--	--	--
PCB 189				NE	2.7E-01	6.6E-03	4.3E-01	1.4E-04	8.0E-01	2.0E-02	2.5E-04	NE	--	--	--	--	--	--
Metals	**EPA SW-846**																	
Aluminum	6010B			NE	NE	NE	NE	NE	NE	NE	NE	NE	--	80-120	25	80-120	25	25
Antimony	6010B			3	NE	NE	NE	NE	NE	NE	NE	NE	--	80-120	25	80-120	25	25
Arsenic	6020			6 (As^{+5})	7	7	7	7	13	7.6	7.6E-04	6.6	--	80-120	25	80-120	25	25
Barium	6010B			NE	NE	NE	NE	NE	NE	NE	NE	NE	--	80-120	25	80-120	25	25
Beryllium	6020			NE	NE	NE	NE	NE	NE	NE	NE	NE	--	80-120	25	80-120	25	25
Cadmium	6010B			0.6	1	1	1	1	8.4	5.6	0.49	0.15	--	80-120	25	80-120	25	25
Chromium	6010B			37 (total)	NE	NE	NE	NE	NE	NE	NE	NE	--	80-120	25	80-120	25	25
Cobalt	6010B			NE	NE	NE	NE	NE	NE	NE	NE	NE	--	80-120	25	80-120	25	25
Copper	6010B			36	NE	NE	NE	NE	NE	NE	NE	NE	--	80-120	25	80-120	25	25
Lead	6010B			35	17	17	17	17	9.3	34	0.5	0.12	--	80-120	25	80-120	25	25
Mercury	7471A			0.2	0.07	0.07	0.07	0.07	0.074	0.12	0.049	0.088	--	80-120	25	80-120	25	25
Nickel	6010B			18	NE	NE	NE	NE	NE	NE	NE	NE	--	80-120	25	80-120	25	25
Thallium	6010B			NE	NE	NE	NE	NE	NE	NE	NE	NE	--	80-120	25	80-120	25	25
Vanadium	6010B			NE	NE	NE	NE	NE	NE	NE	NE	NE	--	80-120	25	80-120	25	25
Zinc	6010B			123	NE	NE	NE	NE	NE	NE	NE	NE	--	80-120	25	80-120	25	25

Notes:

MDLs and RLs will be added to this table after the laboroatory has been contracted during the procurement process.

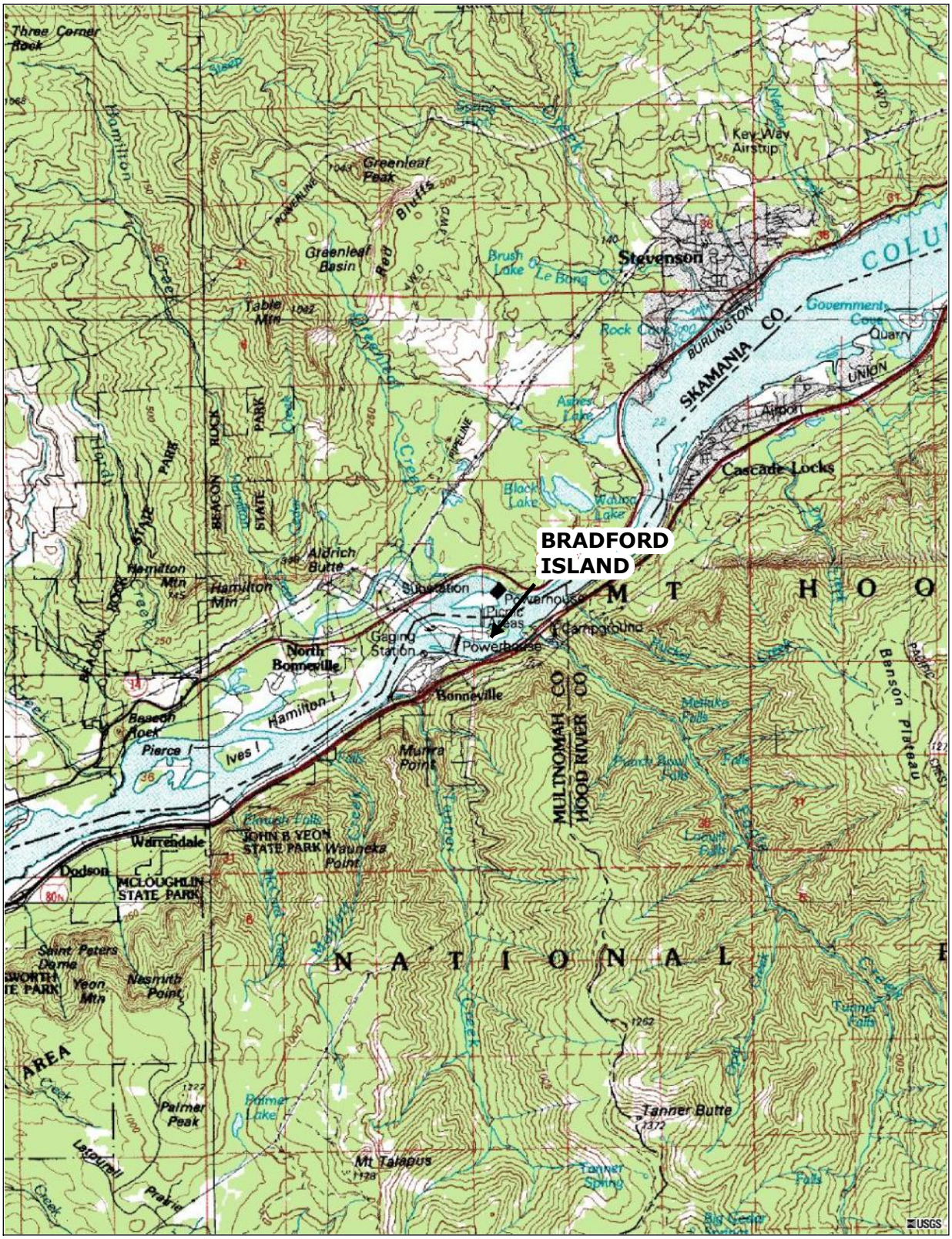
µg/kg - microgram per kilogram
ATL - Acceptable Tissue Levels
CTL - Critical Tish Level
EPA - U.S. Environmental Protection Agency
LCS/LCSD - laboratory control sample/laboratory control sample duplicate
MDL - method detection limit
MS/MSD - matrix spike/matrix spike duplicate
NE - not established
ODEQ - Oregon Department of Environmental Quality
PCBs - Polychlorinated Biphenyls
RL - reporting limit
RPD - relative percent difference
SIM - select ion monitoring
-- Not Applicable

1 = Table 2 in Guidance for Ecological Risk Assesment (ERA): Levels I, II, II, IV, Oregon Department of Environmental Quality (ODEQ), Final December 2001.
2 = For tissue consitutents where screening criteria is unavaliable use screening criteria for sediment as the target RL and MDL.
3 = Table A-1 in Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment, Oregon Department of Environmental Quality (ODEQ), Final January 31, 2007.
4 = Table A-3a in Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment, Oregon Department of Environmental Quality (ODEQ), Final January 31, 2007.
5 = Table A-4 in Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment, Oregon Department of Environmental Quality (ODEQ), Final January 31, 2007.
6 = Project-specifc QC criteria was established using (1) DOD QSM, (2) Shell, (3) specificed analytical method requirements in that order.
7 = Lowest values of either carcinogen or non-carcinogen criteria.
8 = Specific QC criteria should be followed as outlined in EPA Method 1668.

Table 11. Target Reporting Limits – High-Volume XAD Samples

Analyte	Target Method Reporting Limit (mg/L)	Screening Level Criteria
PCBs[1]		
PCBs (209 congeners)	0.0000025	See Table 9
PCBs (Aroclor equivalents)	0.000025	
SVOCs[1]		
Acenaphthene	0.00625	See Table 9
Anthracene	0.00625	
Benzo(a)anthracene	0.00625	
Benzo(a)pyrene	0.00625	
Benzo(b)fluoranthene	0.00625	
Benzo(g,h,i)perylene	0.00625	
Benzo(k)fluoranthene	0.00625	
Bis(2-ethylhexyl)phthalate (BEHP)	0.625-6.25	
Butyl benzyl phthalate	0.625-6.25	
Carbazole	0.00625	
Chrysene	0.00625	
Dibenzo(a,h)anthracene	0.00625	
Di-n-butyl phthalate	0.625-6.25	
Di-n-octyl phthalate	0.625-6.25	
Fluoranthene	0.00625	
Fluorene	0.00625	
Indeno(1,2,3-cd)pyrene	0.00625	
p-Cresol	0.00625	
Phenanthrene	0.00625	
Pyrene	0.00625	

FIGURES



Source: Hood River (45121-E1) 1:100,000 USGS Topographic Map
Vancouver (45122-E1) 1:100,000 USGS Topographic Map

0 0.5 1 1.5 2
Miles

VICINITY MAP

URS

SEPTEMBER 2007
25695254

BRADFORD ISLAND
CASCADE LOCKS, OREGON

FIGURE 1

O:\25692709 USACE\53-F0072173.00 Brdford1\Omaha DT-01\In-water QAPP\FIG 1.mxd

O:\25692709 USACE\53-F0072173.00 Brdford1\Omaha DT-01\In-water QAPP\Fig 2 Bonneville Area Overview.mxd

	JOB No. 25695254.00009	DESIGNED: CM	PROJ. ENGINEER: –	URS	BRADFORD ISLAND	BONNEVILLE AREA OVERVIEW
	Imagery provided by USACE	DRAWN BY: SB	APPROVED BY: JTW	111 S.W. Columbia, Suite 1500 Portland, Oregon 97201 (tel) 503-222-7200 (fax) 503-222-4292	CASCADE LOCKS, OREGON	DRAWING NUMBER: FIGURE 2 GIS FILE NUMBER: Fig 2 SHEET: REV.
		CHECKED BY: –	DATE: SEPT 2007			

Explanation

Reference Sample Locations

- Initial
- Additional
- Grid

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O:\25692709 USACE\53-F0072173.00 Brdford1\Omaha DT-01\In-water QAPP\Figures-non-pdf\Fig 3 Reference Sampling Locations-Sediment.mxd

Explanation

Reference Sample Locations

Surface Water Locations

Imagery provided by USACE

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BRADFORD ISLAND

CASCADE LOCKS, OREGON

REFERENCE SAMPLING LOCATIONS - SURFACE WATER

DRAWING NUMBER: FIGURE 4

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SHEET:

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Explanation

Forebay Sample Locations

- Surface Water Locations

JOB No. 25695254.00009	DESIGNED: CM	PROJ. ENGINEER: –	URS	BRADFORD ISLAND	FOREBAY SAMPLING LOCATIONS - SURFACE WATER
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DRAWING NUMBER: FIGURE 5
GIS FILE NUMBER: Fig 5.mxd
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EXPLANATION

- 60 — BATHYMETRIC CONTOURS (FEET MSL)
- REMOVAL AREA BOUNDARY
- BRADFORD ISLAND SHORELINE

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BRADFORD ISLAND

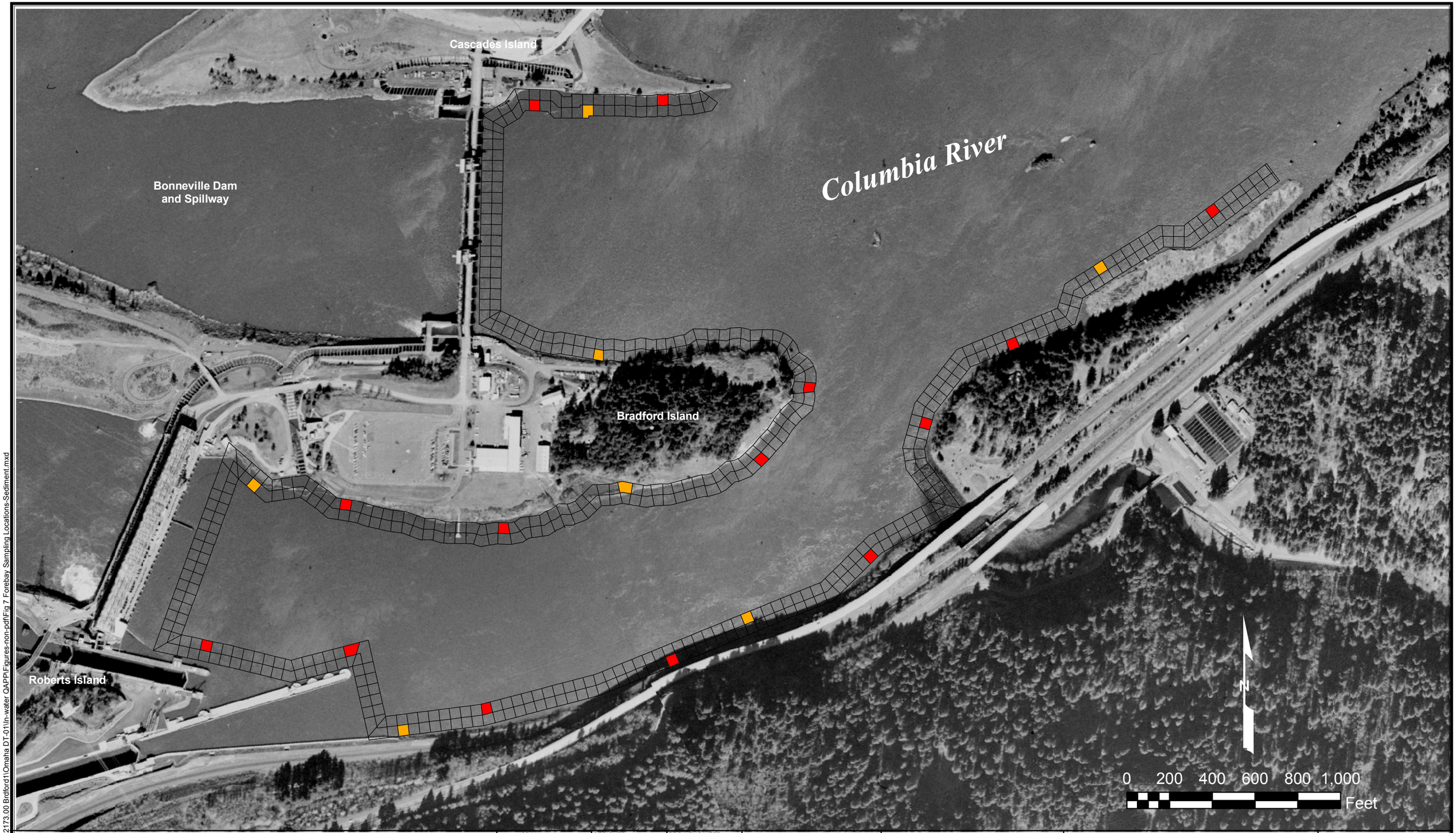
CASCADE LOCKS, OREGON

REMOVAL AREA FOOTPRINT AND PRE-REMOVAL SAMPLING AREAS

DRAWING NUMBER: FIGURE 6

CAD FILE NUMBER: FIGURE 6

SHEET: | REV.:



Explanation

Forebay Sample Locations

- Initial
- Additional
- Grid

JOB No. 25695254.00009	DESIGNED: CM	PROJ. ENGINEER: –	URS	BRADFORD ISLAND	FOREBAY SAMPLING LOCATIONS - SEDIMENT
Imagery provided by USACE	DRAWN BY: SB	APPROVED BY: JTW	111 S.W. Columbia, Suite 1500 Portland, Oregon 97201 (tel) 503-222-7200 (fax) 503-222-4292	CASCADE LOCKS, OREGON	DRAWING NUMBER: FIGURE 7 GIS FILE NUMBER: Fig 7 SHEET: REV.
	CHECKED BY: –	DATE: SEPT 2007			

O:\25692709 USACE\53-F0072173.00 Bridford\Omaha DT-01\In-water QAPP\Figures-non-pdf\Fig 7 Forebay Sampling Locations-Sediment.mxd

Explanation

Approximate Sediment Stations

Imagery provided by USACE

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BRADFORD ISLAND

CASCADE LOCKS, OREGON

EAGLE CREEK SEDIMENT SAMPLING STATIONS

DRAWING NUMBER: FIGURE 8

GIS FILE NUMBER: Fig 8

SHEET: REV.

O:\25692709 USACE\53-F0072173.00 Brdford\1\Omaha DT-01\In-water QAPP\Figures-non-pdf\Fig 8 Eagle Creek Sediment Sampling Stations.mxd

Cascades Island
Bonneville Dam Spillway
Bradford Island
North Bonneville
Robins Island
Bonneville
Hamilton Island
Columbia River
Ives Island
Pierce Island
N
0 0.2 0.4 0.6 0.8 1
Miles

Explanation

- **Approximate Sediment Stations**

JOB No. 25695254.00009	DESIGNED: CM	PROJ. ENGINEER: –	URS	BRADFORD ISLAND	DRAWING NUMBER: FIGURE 9
Imagery provided by USACE	DRAWN BY: SB	APPROVED BY: JTW	111 S.W. Columbia, Suite 1500 Portland, Oregon 97201 (tel) 503-222-7200 (fax) 503-222-4292	CASCADE LOCKS, OREGON	DOWNSTREAM SAMPLING STATIONS
	CHECKED BY: –	DATE: SEPT 2007			GIS FILE NUMBER: Fig 9
					SHEET: / REV.

O:\25692709 USACE\63-F0072173.00 Bradford\Omaha DT-01\In-water QAPP\Figures-non-pdf\FIG 9 Downstream Sampling Stations.mxd

APPENDIX A

Bradford Island Clam Sampling

Sample Location Number:	Date:
Weather Conditions:	Time:

Analyses

_____Archive

Sample Collection

Sampling Method:
QC Samples Collected:
Collocated Sediment Sample Collected:
Number of *Corbicula* (alive):
Number of *Corbicula* (dead):
Sampler Team:

Tissue Description

Specimen ID #	Species	Length	Weight	Comments

Length	Width	Weight

Bradford Island Fish Sampling

Boat:	Date:
Sampler's Name:	

Tissue Description

Sample ID #	Collection Time (24 h)	Species (SB, WP, WS)	GPS Location		Observations (abnormalities, weight in g)
			Northing	Easting	Photo Number as appropriate

Codes shown below:

SB = Smallmouth Bass
SC = Sculpin
LS = Largescale Sucker
CF = Crayfish

Data collection - Please record information in the above table for each fish caught:

1. Note location with GPS
2. Note time of day the fish was caught
3. Measure length and weight of fish
4. Note species type

Sample packaging, labeling and custody:

1. Pre-label Ziploc-style baggie with the sample ID (see numbering scheme below), Date, and Time.
3. For smallmouth, Sculpin, and sucker, wrap whole fish in new aluminum foil.
4. Place wrapped whole fish in baggies. Make sure baggie is entirely sealed.
5. Place tissue phial in clean baggie. Make sure baggie is entirely sealed.
6. Store fish in a cooler with ice. Do not allow melted ice or water to touch the fish.
7. Fill out Chain of Custody form (to be provided).
8. Freeze whole fish for at least 8 hours.

Bradford Island Sediment Sampling

Sample Number:	Date:
Weather Conditions:	Time:

Analyses

_____PCB-Aroclors	_____VOCs	_____% Moisture
_____PCB – Congeners	_____Pesticides	_____Grain Size
_____Metals	_____Butyltins	_____pH
_____SVOCs	_____Diesel/Heavy Range Organics	_____TOC
_____PAHs	_____Archive	

Sample Collection

Sampling Method:

QC Samples Collected:

Water Sample Collected:

Decontamination Method: Soap wash, water rinse, acetone & nitric acid wash, water rinse

Sample Team:

Sample Location

Latitude: _____ N

Longitude: _____W

Description of Location:

Description of River Bottom:

Water Depth:

Sediment Depth:

Sediment Description

Color:

Texture:

UCSC Classification:

Odor/sheen:

Benthic Organisms:

Depth of bioactive layer:

Vegetation:

Other Comments

Bottom Condition:

Number of Corbicula at sampling station:

Bradford Island Tissue Sampling

Date:	
Boat:	
Sampler's Name(s):	**Page 1 of __**

Sample ID	**Collection Time (24 h)**	**Species (SB, WP, WS)**	**Size (cm)**	**GPS Location**		**Observations (abnormalities, weight in g)**
				Northing	**Easting**	**Photo number as appropriate**
BD _ _ _						
BD _ _ _						
BD _ _ _						
BD _ _ _						
BD _ _ _						
BD _ _ _						

Codes shown below

SB = Smallmouth Bass
SC = Sculpin
LS = Largescale Sucker
CF = Crayfish

Data collection - Please record information in the above table for each fish caught:

1. Note location with GPS
2. Note time of day the fish was caught
3. Measure length and weight of fish
4. Note species type

Sample packaging, labeling and custody:

1. Pre-label Ziploc-style baggie with the sample ID (see numbering scheme below), Date, and Time.
3. For smallmouth, Sculpin, and sucker, wrap whole fish in new aluminum foil.
4. Place wrapped whole fish in baggies. Make sure baggie is entirely sealed.
5. Place tissue phial in clean baggie. Make sure baggie is entirely sealed.
6. Store fish in a cooler with ice. Do not allow melted ice or water to touch the fish.
7. Fill out Chain of Custody form (to be provided).
8. Freeze whole fish for at least 8 hours.

A-2 **Example data table**

Station_location		Date	Time	Individual_ sample_ code	Chain_of_ custody_ #	Replicate_ code [b]	Species_ Organ_ code [c]	Matrix	Length (cm)	Weigh t (g)	Comp_sample_code d/	PCB-Aroclor	PCB-con-gener	Lipid	Observation_Photo_#
X_Easting	Y_Northing														
7631806	697569	25-Nov-07	0954h	BD001	5661123	R01	SBWB	TS	113	34	BD001*R01*TS*SBWB*C00	x		x	Lesion, dorsal fin, photo 051025-03
7631807	697850	25-Nov-07	1445h	BD002	5661123	R01	WPWB	TS	126	26	BD002R01TSWPWBC00	x		x	
7788000	697999	30-Nov-07	0800h	BD043	3688771	R01	WSMB	TS	1500	40000	BD043R01TSWSMBC00	x	TBD	x	

[a] Data are for illustration purposes only

[b] Replicate R02 would be a field replicate or R01

[c] Codes shown above

Bradford Island Surface Water Sampling

Sample Number:		Date:
Weather Conditions:		Time:
Analyses		
_____PCB-Aroclors	_____VOCs	_____TSS
_____PCB – Congeners	_____Pesticides	_____Hardness
_____Metals	_____Butyltins	_____pH
_____SVOCs	_____Diesel/Heavy Range Organics	_____TOC
_____PAHs		_____DOC
Sample Collection		
Sampling Method:		
QC Samples Collected:		
Sediment Sample Collected:		
Decontamination Method:		
Sample Team:		
Sample Location		
Latitude: _____ N		
Longitude: _____W		
Description of Location:		
Water Depth:		
Water Quality Readings		
pH		
Turbidity		
Dissolved Oxygen		
Conductivity		
Reduction-Oxidation Potential		
Temperature		
Other Comments		

URS

DATE _____

DAY	S	M	T	W	TH	F	S

WEATHER	BRIGHT SUN	CLEAR	OVERCAST	RAIN	SNOW
TEMP	To 32	32-50	50-70	70-85	85 up
WIND	Still	Moder	High	Report No.	
HUMIDITY	Dry	Moder	Humid		

PROJECT MANAGER _____

PROJECT _____

JOB NO. _____

CONTRACT NO. _____

SUB-CONTRACTOR ON SITE:

EQUIPMENT ON SITE:

WORK PERFORMED (INCLUDING SAMPLES COLLECTED):

SHEET _____ OF _____

DAILY QUALITY CONTROL REPORT

PROJECT _____ REPORT NO. _____

JOB NO. _____ DATE _____

QUALITY CONTROL ACTIVITIES (INCLUDING FIELD CALIBRATIONS):
HEALTH AND SAFETY LEVELS AND ACTIVITIES:
PROBLEMS ENCOUNTERED/CORRECTION ACTION TAKEN:
SPECIAL NOTES:
TOMORROW'S EXPECTATIONS:

BY _____ TITLE _____

SHEET ____ OF ____

DAILY QUALITY CONTROL REPORT

PROJECT _____ REPORT NO. _____

JOB NO. _____ DATE _____

ADDITIONAL COMMENTS:

BY _____ TITLE _____

SHEET _____ OF _____

DAILY QUALITY CONTROL REPORT

APPENDIX B

STANDARD OPERATING PROCEDURE – 1
HIGH-VOLUME WATER SAMPLING WITH INFILTREX 300

SUMMARY

The purpose of this standard operating procedure (SOP) is to describe equipment needs, general notes, decontamination procedures, and pump operation for the Infiltrex 300 Organic Sampling System (hereinafter referred to as the "Infiltrex pump" or "pump"). The Infiltrex pump is provided by AXYS Environmental Systems (AXYS) of Sidney, British Columbia. The SOP described below is to be used by the field sampling team and is based on information provided in the User's Manual and verbal communications provided to URS by AXYS personnel.

Read the *User's Manual* for the Infiltrex pump prior to use. Use this SOP in conjunction with the procedures outlined in the *User's Manual*, not in place of the manual.

CONTACT INFORMATION

AXYS Environmental Systems (250.655.5850)
PO Box 2219, 2045 Mills Road
Sidney, British Columbia, Canada
V8L 3S8

Infiltrex Pump Rental/Operation:
Jeannette Bedard (250.655.5874)
Customer Service

AXYS Laboratory (Analysis/Column/Filter):
Georgina Brooks (250.655.5800)
Senior Project Manager

EQUIPMENT

Infiltrex 300
Generator
Teflon-lined pump tubing
XAD column(s)
Wound Glass filter(s)
1-inch wrench/socket
Laboratory tongs, 6-inches long
Stainless-steel bowl
Brush (for cleaning filter housing)
5-gallon buckets (3)
Alconox Soap
Methanol (5-gallons)
Methanol spray bottle
De-ionized water

GENERAL NOTES

1. XAD column material and pumping volumes are determined prior to shipment of the Infiltrex pump and with the help of AXYS laboratory contact.
2. Multiple glass filters may be needed depending on the turbidity of the water. Prepare accordingly.
3. If pressure in the pump reaches 18 psi during pump operation, the wound glass filter is likely becoming clogged. AXYS recommends changing the filter at 18 psi.
4. Do not decontaminate unit while an XAD column or glass filter is attached to the Infiltrex pump.
5. Decontaminate the pump prior to using it.
6. Decontaminate the pump in between sampling stations.
7. Decontaminate the pump after using it, prior to shipping back to AXYS.
8. Dry out pump in between pumping operations, after decontaminating, and after using the pump.
9. The pump will have to be primed prior to initial use.

DECONTAMINATION PROCEDURE

1. Verify XAD column and glass filter are not attached to the Infiltrex pump.
2. Brush out/use spray bottle (containing methanol) on filter housing and XAD column housing.
3. Attach the "by-pass" column or tubing where the XAD column is attached (bypass column/tubing provided by AXYS).
4. Cut two short lengths of tubing for inlet and outlet ports. Obtain three 5-gallon buckets, Alconox® soap (or equivalent), methanol, and de-ionized water (DIW).
5. Prime pump.
6. Run tap water/Alconox soap through pump for 5 minutes. Disconnect tubing and run pump until it is dry.
7. Reattach tubing and run DIW through pump for 5 minutes. Disconnect tubing and run pump until it is dry.
8. Disconnect bypass tubing from totalizer. This will serve as the outlet for the final step in the decontamination procedure.
9. Reattach tubing and run 100 percent methanol (3 to 4 liters needed) through pump for 5 minutes. Disconnect tubing and run pump until it is dry.

XAD COLUMN AND GLASS FILTER INSTALLATION PROCEDURES

XAD Column

1. XAD columns are shipped in a cooler on blue ice. Don nitrile gloves prior to handling column.
2. Remove XAD column from packing material. Save packing material for return trip to AXYS Laboratory.
3. Remove XAD column caps and save for return shipping.
4. Attach XAD column (right side up) to the column housing on pump and tighten nut ¾ turn past finger tight.

Glass Filter

1. Obtain 6-inch long laboratory-type tongs (narrow) and a 1-inch wrench.
2. Don nitrile gloves prior to handling filter or filter housing.
3. Use 1-inch wrench to remove filter housing.
4. Remove glass filter from plastic and aluminum foil packing material using tongs.
5. Install glass filter and filter housing. Tighten filter housing using a 1-inch wrench.

PUMP OPERATION

1. Attach Teflon-lined tubing. Extend tubing down to desired depth.
2. Press totalizer reset button to zero out the totalizer.
3. Prime Pump.
4. Plug pump into generator or AC adapter and turn power switch on.
5. Default pumping rate is 2 liters per minute. Adjust using flow meter controller as needed.
6. Periodically record totalizer reading and flow rate (using a graduated cylinder) to verify flow rate.
7. Pump the predetermined volume of water based on totalizer reading and flow rate.
8. If pressure in the pump reaches 18 psi and flow rate drops, the wound glass filter is likely becoming clogged. AXYS recommends changing filter at 18 psi. Follow procedure described below for filter removal.
9. Turn pump off.

XAD COLUMN AND GLASS FILTER REMOVAL/SHIPPING PROCEDURES

XAD Column

1. Don nitrile gloves prior to handling column.
2. Remove XAD column from the column housing on pump and replace column-shipping caps.
3. Place XAD column into shipping material provided with the column and label accordingly.
4. Ship to AXYS laboratory on ice in a cooler at a temperature of 4°C using standard chain-of-custody procedures.

Glass Filter

1. Obtain a clean stainless steel bowl and place beneath filter housing.
2. Use 1-inch wrench to remove filter housing, being careful not to spill water from filter housing (which will be full of water).
3. Pour water from filter housing into laboratory-provided glass jar, label sampling station information on jar.
4. Use 6-inch long laboratory-type tongs (narrow) to extract glass filter from housing.
5. Wrap glass filter in methanol-washed aluminum foil. Wrap again in aluminum foil. Place wrapped filter into shipping material provided with the filter and label accordingly.
6. Ship to AXYS laboratory, along with filter housing water, on ice in a cooler at a temperature of 4°C using standard chain-of-custody procedures.

STANDARD OPERATING PROCEDURE – 2
SEDIMENT SAMPLING

SUMMARY

This procedure establishes the guidelines for both conventional and undisturbed sediment sample collection and sample containerization with a variety of sampling devices. Methods of preventing sample and equipment cross-contamination are included.

EQUIPMENT

- Box core sampler
- Hand-operated piston core sampler
- Gravity core sampler
- Dredges
- Stainless steel grab sampler
- Vibracoring system

PROCEDURES

Subareal Sediment Sampling

The sampling procedure is as follows:

1. Insert scoop, trowel, or auger into sediment surface and remove sample.
2. Collect samples for volatile organics analysis from the sampling device or from unmixed sediment placed in a stainless steel bowl.
3. For all samples other than volatile organics analysis, place the sample in a stainless steel bowl and stir thoroughly with a stainless steel spoon or spatula to provide a homogeneous mass prior to placing in the sample containers.
4. Fill the sample containers with the mixed sediment.
5. Store the full sample containers on ice in a cooler chest and maintain at 4°C.
6. Decontaminate all sampling equipment according to the equipment decontamination procedures discussed at the end of this SOP.

Subaqueous Sediment Sampling

The Project Manager or field staff will determine what method of sampling that will be used, depending on the nature of the sediments to be sampled.

If operating from a survey vessel, prepare to deploy the sampler once the vessel is on station. Secure all vessel discharges and ensure that all exhaust fumes are directed away from the sample collection area until the sample has been collected.

Do not include non-representative materials such as twigs or debris in the sample. Sediments contacting the side of the sampler or core liner will not be included in chemistry samples. Aliquot size, container type, storage conditions, and holding times will follow specifications in the project plans.

Carefully label all samples with the location number, analytical method, date, time, and type of sample. Use the appropriate codes established for the project when preparing this information.

Decontaminate all sampling equipment according to the equipment decontamination procedures discussed at the end of this SOP.

Stream Sediment Sampling

Obtain the sediment sample as close as possible to surface water sampling locations. Collect the sediment samples prior to measuring the discharge and collecting water samples (if necessary), or collect the sediment sample at a point just downstream of the water sampling point. The sample should be collected in an area of sediment accumulation, such as inside of stream meanders, quiet willow areas, or low-velocity zones. Avoid areas of net erosion such as high-velocity, turbulent-flow zones.

If possible, remain on the stream bank. If the sample cannot be obtained from the bank, enter the stream from a point downstream of the sediment sampling location. Collect the sediment sample by reaching into the stream with the stainless steel scoop and scoop a sample in an upstream direction. Attempt to minimize the loss of fine material winnowed from the samples by the moving water.

Place the sample in a stainless steel beaker or bowl and gently mix with a stainless steel spoon. Transfer the sediment samples to the appropriate sample containers using the stainless steel spoon. Do not mix samples for volatile organics analysis. If duplicate or split samples are to be obtained, transfer the sediment directly from the stainless steel beaker into the sample containers in the same manner as standard samples.

Subaqueous Sediment Sampling for the Preservation of Fines

The Project Manager or field staff will determine what method of sampling will be used, depending on the nature of the sediments to be sampled.

If operating from a survey vessel, prepare to deploy the sampler once the vessel is on station. Secure all vessel discharges and ensure that all exhaust fumes are directed away from the sample collection area until the sample has been collected.

Insert the stainless steel box sediment sampler or van Veen grab into the sediment surface and remove slowly to avoid disturbance of the sample and loss of any fine materials.

Do not include nonrepresentative materials such as twigs or debris in the sample. Sediments contacting the side of the sampler or core liner will not be included in chemistry samples. Follow the specifications in the project plans for aliquot size (i.e., mass, container type, storage conditions, and holding times.

Carefully label all samples with the location number, analytical method, date, time, and type of sample. Use the appropriate codes established for the project when preparing this information.

Decontaminate all sampling equipment according to the equipment decontamination procedures discussed at the end of this SOP.

Core Logging

Photograph and describe the sediment core sample in the core log, including the following characteristics:

- Station number
- Date and time of collection
- Photograph information (time, direction of photograph, roll number/frame number)
- Station coordinates
- Weather conditions
- Names of persons collecting and logging the sample
- Sample recovery
- Physical soil description in accordance with the Unified Soil Classification System (USCS)
- Odor (e.g., hydrogen sulfide, petroleum)
- Visible stratifications and lenses
- Vegetation
- Debris
- Biological activity (e.g., detritus, shells, tubes, bioturbation, live or dead organisms)
- Presence of oil sheen
- Any other distinguishing characteristics or features

DECONTAMINATION

Decontamination of Coring Equipment

Prior to field operations, wash coring equipment, including barrels and liners with a laboratory-grade detergent and water solution, rinse with distilled water, then dilute nitric acid (10 percent), then distilled water. Cap liners and core barrels on each end with foil and core caps to prevent contamination during transit or field operations when not in use. Between stations, rinse the core barrel with ambient water. Rinse any core barrels and liners reused between stations for a composite with ambient water to dislodge any remaining sediments, wash with a laboratory-grade detergent solution, and rinse with distilled water.

Decontamination of Sampling Implements

Decontaminate sampling implements and processing materials by washing the equipment with a laboratory-grade detergent and water solution, rinsing with tap water, and then rinsing with distilled water, 10-percent nitric acid, methanol, and finally distilled water. Because the use of solvents may interfere with volatile organics analyses, utensils for volatile organics subsampling will be washed with laboratory-grade detergent and rinsed with distilled water only. Wrap decontaminated equipment or cover with aluminum foil. Decontaminate subsampling and processing equipment before use at each station, and between depth intervals at a location in order to prevent cross contamination of samples.

ATTACHMENTS

Exhibit 1 Dip Sampler

Exhibit 2 Hand-Operated Piston Core Samplers

Exhibit 3 Gravity Core Samplers

Exhibit 4 Dredges

Exhibit 5 Stainless-Steel Grab Samplers

Exhibit 1
Dip Sampler

Assemble the dip sampler, which consists of a pole to which a beaker or scoop is attached by means of a clamp or other device. The pole can be made of bamboo, wood, aluminum, or nonreactive material, and be either telescoping or fixed length.

1. To obtain a sample, submerge the dip sampler and pull it through the sediments.
2. Transfer the sample into the appropriate sample container by decanting the liquid and retaining the sediments.
3. Repeat the sampling procedure until the required amount of sediment is obtained.

Exhibit 2
Hand-Operated Piston Core Samplers

Assemble the hand corer according to the manufacturer's specifications. If the corer is equipped with a piston, adjust the clearance so that the piston slides in the barrel with only slight resistance, but is tight enough to create ample suction in the barrel. Plastic core sleeves, if used, will be either new or thoroughly decontaminated and placed in the corer according to the manufacturer's specifications.

1. Lower the corer to the sediment surface or into the borehole to the desired depth. Once the sampler is positioned at the interval to be sampled, secure the piston line and manually drive the core barrel into the sediment in one slow, continuous effort. Handles can be attached to the drive rods to apply additional force when necessary.

2. Retrieve the corer by manually lifting the sampler to the surface with the drive rods. Repeat this process for each specified core interval.

3. If the corer is equipped with a plastic sleeve, remove the sleeve when the sampler is retrieved from the sediment and seal and label it. Indicate the top of the core on the sleeve. If the sample is designated for chlorinated organic testing, make special provisions to replace the plastic liners with another nonreactive material.

4. If the corer is not equipped with plastic sleeves, extrude the sediment core onto a clean surface lined with plastic wrap and aluminum foil. First, wrap the core in plastic, being careful not to break or damage the core; then wrap this in aluminum foil so that the ends of the foil are folded over, creating a squared-off end. Tape the foil closed on both ends and along the seam.

5. Affix a piece of tape to the core wrapping and label with the sample interval, date, and sampling personnel. Be sure to indicate the orientation of the core on the label (i.e., top and bottom).

6. If the core is to be sampled in the field, use a stainless steel scoop or spoon to remove the samples from the core at the intervals specified in the project plans, and place the samples in the appropriate containers.

7. Discard any leftover sediment according to the specifications in the project plans.

Exhibit 3
Gravity Core Samplers

Assemble the corer according to the manufacturer's specifications. Install new or thoroughly decontaminated nonreactive core barrel liners per the manufacturer's specifications.

1. Attach a strong retrieval line or wire rope to the sampler and lower the sampler at a controlled descent of approximately 1 foot per second.

2. When the sampler penetrates the sediment (indicated by a slack retrieval line), immediately pull the sampler free of the bottom, using a motorized winch if available. Raise the corer at a controlled ascent rate.

3. Once the corer reaches the water surface, measure the length from the top of the core tube to the surface of the recovered sediment in the core.

4. Bring it on board and, if possible, secure it to the deck.

5. Label the sleeve in such a way as to properly identify the sample orientation, sample designation, date, core interval, and sampling personnel.

6. If the corer is not equipped with plastic sleeves, extrude the sediment core onto a clean surface lined with plastic wrap and aluminum foil. First, wrap the core in the plastic, being careful not to break or damage the core. Then wrap this in aluminum foil so that the ends of the foil are folded over, creating a squared-off end. Tape the foil closed on both ends and along the seam.

7. Affix a piece of tape to the core wrapping and label with the sample interval, date, and sampling personnel. Be sure to indicate the orientation of the core on the label (i.e., top and bottom).

Exhibit 4
Dredges

The Site Manager will determine the type of dredge used for sediment sampling. The types that can be used include Ponar, Petersen, and Ekman van Veen dredges.

Inspect the dredge according to the SOP, Equipment Calibration, Operation, and Maintenance, to ensure that it is working properly. Take care to ensure that the messenger line system is working properly.

1. Attach a strong retrieval line to the dredge. Lower the dredge at a controlled descent of approximately 1 foot per second until the sediment surface is encountered. A slack retrieval line indicates that the dredge has reached the sediment surface.

2. The closing mechanism on the dredge buckets is not activated by impact, drop the weighted messenger on the messenger line.

3. After closing the buckets, immediately begin to retrieve the sampler, either by hand or with a motorized winch.

4. When the dredge reaches the water surface, allow it to drain overboard for a few moments before placing it on the vessel deck and securing it.

5. Field treatment of the sample will follow the specifications in the project plans. In general, this treatment will consist of sieving the sample immediately or transferring it directly to a sample container for labeling and storage.

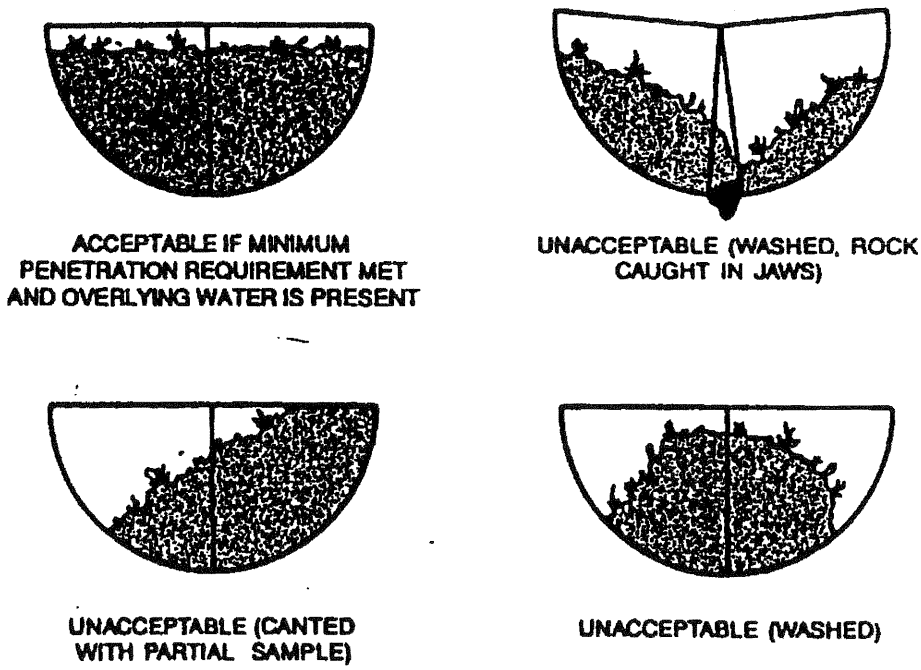
6. Dispose of excess sediment according to the specifications in the project plans.

Exhibit 5
Stainless Steel Grab Sampler

To minimize the loss of fine-grained material during collection in subtidal environments, collect marine surface sediments using a 0.1-m^2 stainless steel van Veen sediment sampler. Conduct sample collection and handling according to Puget Sound protocols and guidance (USEPA 1986; USEPA and PSWQA 1996). Collect sediments from the 0- to 10-centimeter (cm) horizon. Weights may be added to the sampler to increase penetration and ensure the proper horizon thickness, or removed from the sampler to prevent overfilling in soft sediments.

1. When the survey vessel is positioned, lower the van Veen sampler to the bottom at a rate of 1 foot per second.
2. At the instant the sampler impacts the bottom (detectable when the lowering wire slackens), take a position fix.
3. Retrieve the sampler at a slower speed so as not to disturb the grab.
4. Once the sampler is secure on the processing stand, inspect the grab carefully to determine whether it is acceptable (see Figure 1). The following acceptability criteria (USEPA 1986) should be satisfied:
    - Sediment is not extruded from the upper face of the sampler such that organisms may be lost.
    - Overlying water is present (indicates minimal leakage).
    - The grab surface is relatively flat (indicates minimal disturbance or winnowing).
    - The entire surface of the grab is included in the sampler.
    - The following penetration distances are achieved at a minimum:
        - 4 to 5 centimeters cm for medium-coarse sand
        - 6 to 7 cm for fine sand
        - greater than or equal to 10 cm for muddy sediment
5. Should any of these conditions be observed, discard the grab and repeat the drop.
6. Prior to further processing of an acceptable grab, remove the overlying water with a siphon tube.
7. Characterize the first (middle) grab of a unit fully, including observations on sediment color, odor, stratification, texture, consistency, presence of organisms, and distinguishing characteristics (debris or other anthropogenic material). Examine other grabs in the unit and note differences, but subsequent grabs need not be fully characterized.
8. Under the direction of the Site Manager, remove from the grab any organisms, debris, and other material unrepresentative of sediments; describe and document such material in the field log.

Figure 1 van Veen Sediment Grab Acceptability



STANDARD OPERATING PROCEDURE – 3
CLAM SAMPLING

SUMMARY

This procedure establishes the guidelines for the collection and sample processing procedures for clam (*Corbicula fluminea*) tissue samples. The clams will be collected using a sediment sampling device (box core), the use of which is described in SOP-2, or by divers.

PROCEDURES

Field Collection Procedures

Approximately 60 grams of tissue (i.e., twenty to thirty clams) will be required per sample.

The clams will be collected in the same manner by which the sediment sample is collected (i.e., with a box core or by a diver). If the sediment sample is collected with a box core, the sediment sample will first be processed, then all clams retained in the sampler will be collected. If adequate tissue sample volume is not acquired, the box core will be re-deployed. If the sediment sample is collected by a diver, the diver will attempt to locate clams by randomly overturning clastic (pebbles and cobbles) river deposits and excavating shallow areas (less than approximately six inches) using a spoon. The diver will spend up to 30 minutes collecting clams per station. If inadequate sample volume is collected by either method, the clams that are collected will still be processed and submitted to the laboratory.

Immediately after sample collection, the clams will be temporarily stored in clean coolers on wet ice. The clams will be processed on shore at the end of the sampling day. Processing will be conducted using clean, powder-free gloves. Dead clams will be counted, recorded, and removed from the sample. Clams will be measured and weighed. Sample information will be recorded on the tissue sampling form.

SAMPLE PROCESSING

Shucking

The clam samples will be shucked the same day they are collected. Clam shell shucking will be conducted with clam knives designed for rapidly opening bivalve shells and removing the soft tissue from the inside of the clams. Shucking knives have four to six inch long lades with rounded ends. The clam is held in the hollow of the hand with the hinge of the shell pointing towards the thumb. The shucking knife is placed between the valves and inserted into the clam. Once inserted into the clam, the knife is used to sever one of the adductor muscles of the clam. The knife handle is then twisted until the shell pops open. The blade is moved around the inside of the shell until the other adductor muscle is severed. Once the adductor muscles are severed, the knife is run between the shell and the meat for the clam to separate soft tissues from the shell.

Shucking knives will be decontaminated between samples with an acetone wash and analyte-free water rinse.

Decontamination

Shucking knives will be decontaminated between samples with an acetone wash and analyte-free water rinse.

Sample Packaging and Labeling

The shucked tissue samples will be wrapped in acetone-washed aluminum foil, placed in a pre-labeled Ziplock bag, and stored in a cooler on dry ice for shipment to the analytical laboratory.

The clamshells will be placed in a pre-labeled Ziplock bag with the same sample ID as the tissue that was extruded from the shell. URS will store the Ziplock bag of shells in order to gauge the age of the collected clams, if this information becomes necessary.

Samples will be labeled in the same manner indicated in the QAPP with the following exception. The last two letters of the sample ID will designate the sample matrix.

Sample Shipment

Processed tissue samples will be shipped on dry ice in coolers via Federal Express with adequate ice to keep samples frozen for at least two days. Shipping procedures for non-hazardous substance shipment using dry ice as a refrigerant are as follows:

- As long as the dry ice is being used solely as a coolant for non-hazardous material, such as the fish samples captured during this program, International Air Transport Association (IATA) regulations apply, IATA regulations exempt the shipper from having to fill out hazardous substance paperwork.
- Each cooler must have dry ice labels on the outside of the cooler, which include a Class 9 diamond label.
- For Federal Express, there is a special handling section on the airbill, which must be filled out for all coolers containing dry ice. The information required includes the total number of packages containing dry ice, and the kilograms of dry ice per package (cooler).
- Federal Express has a weight limitation of 200 kg per package or individual cooler.
- As long as the dry ice is being used solely for cooling the fish samples, there is no longer a total limitation on the amount of dry ice that can be shipped on an individual courier flight.

REFERENCES

American Society for Testing and Materials (ASTM). 2000. Draft Standard Guide for Conducting In-Situ Field Bioassays with Marine, Estuarine and Freshwater Bivalves. ASTM, Philadelphia, PA. 68 pp.

STANDARD OPERATING PROCEDURE – 4
CRAYFISH SAMPLING

SUMMARY

This SOP describes the rigging, deployment, and retrieval procedures for crayfish traps and crayfish sampling.

The traps that will be used during this in-water work will consist of three main components: a trap, an anchoring device (for securing the trap to the river bottom), and a floatation device for locating the trap. All three components will be connected to one another with new, nylon rope. A part/equipment listing is as follows:

EQUIPMENT

1. Trap – Commercially available metal or plastic crayfish trap.
2. Anchoring Device – Two 10 lbs. cement bricks (securely duct-taped to one another).
3. Floatation Device – Commercially available float will be used.
4. Rope – New, nylon, ¼-inch diameter (minimum), 100 feet in length (minimum).
5. Stainless steel tongs (for handling the crayfish).

TRAP RIGGING AND DEPLOYMENT

Prior to rigging the trap, field personnel will don new, disposable gloves. Traps will be rigged in the following manner:

1. Tie anchor device (two bricks securely duct-taped to one another) and trap together using short piece of nylon rope. Rope should be tight, with approximately 1 inch separating the anchor from the pulley.
2. Label flotation device with "Trap" and a sequential number starting with "1." For example, the first trap to be deployed will have the float labeled "Trap 1." The second trap deployed will be labeled "Trap 2."
3. Connect the anchor and float to one another by feeding the rest of the 100-foot long nylon rope through the attachment point on the float. The rope should be doubled back so that the distance separating the two is approximately 50 feet. Do not tie rope ends together, as the length will have to be adjusted to accommodate the observed depth to the riverbed.
4. Insert punctured (by a knife) and can of bait (tuna) within the trap.
5. Deploy anchor, trap, and float on the riverbed at the desired location.
6. Following deployment the location of each station will be recorded using a hand-held range finder and precise GPS equipment to establish the coordinates of the sample station.

7. The traps will initially be deployed for approximately 1-3 days.

TRAP RETRIEVAL

Before retrieving the trap, field personnel will don new, disposable nitrile gloves and/or use leather gloves to prevent slipping. New nitrile gloves will be donned between sampling locations.

Traps will be retrieved in the following manner:

1. After locating the trap that will be removed, the boat will be positioned adjacent to the floatation device.
2. Field personnel will retrieve the trap by pulling the trap by the rope.
3. Crayfish will be removed from the trap by hand or with steel tongs, logged, wrapped in aluminum foil, and double-bagged in plastic re-sealable bags. Crayfish will then be placed on ice in a cooler.

SAMPLE PROCESSING

Sample Packaging and Labeling

The tissue samples will be wrapped in acetone-washed aluminum foil, placed in a pre-labeled Ziplock bag, and stored in a cooler on dry ice for shipment to the analytical laboratory.

Samples will be labeled in the same manner indicated in the QAPP with the following exception. The last two letters of the sample ID will designate the sample matrix.

Sample Shipment

Processed tissue samples will be shipped on dry ice in coolers via Federal Express with adequate ice to keep samples frozen for at least two days. Shipping procedures for non-hazardous substance shipment using dry ice as a refrigerant are as follows:

- As long as the dry ice is being used solely as a coolant for non-hazardous material, such as the fish samples captured during this program, International Air Transport Association (IATA) regulations apply, IATA regulations exempt the shipper from having to fill out hazardous substance paperwork.
- Each cooler must have dry ice labels on the outside of the cooler, which include a Class 9 diamond label.
- For Federal Express, there is a special handling section on the airbill, which must be filled out for all coolers containing dry ice. The information required includes the total number of packages containing dry ice, and the kilograms of dry ice per package (cooler).
- Federal Express has a weight limitation of 200 kg per package or individual cooler.
- As long as the dry ice is being used solely for cooling the fish samples, there is no longer a total limitation on the amount of dry ice that can be shipped on an individual courier flight.

STANDARD OPERATING PROCEDURE – 5
FISH SAMPLING

SUMMARY

This procedure establishes the guidelines for the collection and sample processing procedures for fish samples. The goal is to collect three different fish species, smallmouth bass, large scale sucker, and sculpin. A Scientific Taking Permit (STP) must be obtained from the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) prior to collecting species for scientific purposes. The STP approval process requires Oregon Department of Fish and Wildlife (ODFW) district biologist review. The STP application is available at http://fishresearch.nwr.noaa.gov/. Application processing typically takes four to six weeks.

PROCEDURES

Smallmouth Bass Collection Procedures

Smallmouth bass will be collected using angling techniques. Angling will be conducted in general accordance with the requirements of the STP and the 2007 Oregon Sport Fishing Regulations (ODFW 2007). As required by the sport fishing regulations, no more than five smallmouth bass may be collect per day, with two daily limits in possession. No more than three bass over 15 inches in length may be collected in one day. Only fish between 12 and 18 inches in length should be kept.

Once hooked, the fish will be retrieved and handled with clean, disposable nitrile gloves or decontaminated work gloves. Handling will be kept to a minimum. Fish will be measured with a standard measuring board. Fish less than 12 inches in length will be handled as little as possible and returned to the river. Fish between 12 and 18 inches in length will be logged using the tissue sampling form (Appendix B). Fish will be measured with a standard measuring board and weighed to the nearest gram. The fish will then be rinsed with distilled water, wrapped in aluminum foil (dull side inward, touching the fish), and double bagged in resealable plastic bags.

Large Scale Sucker Collection Procedures

Large scale suckers will be collected by USACE biologists from the juvenile fish bypass. The collection will be conducted in general accordance with the requirements of the STP and the 2007 Oregon Sport Fishing Regulations (ODFW 2007). There are no daily limits for catching suckers (ODFW 2007). Only fish between 12 and 19 inches in length should be kept.

The fish will be retrieved and handled with clean, disposable nitrile gloves or decontaminated work gloves. Handling will be kept to a minimum. Fish will be measured with a standard measuring board. Fish less than 12 inches in length will be handled as little as possible and returned to the fish bypass system. Fish between 12 and 19 inches in length will be logged using the tissue sampling form (Appendix B). Fish will be measured with a standard measuring board

and weighed to the nearest gram. The fish will then be rinsed with distilled water, wrapped in aluminum foil (dull side inward, touching the fish), and double bagged in resealable plastic bags.

Sculpin Collection Procedures

Sculpin will be collected using minnow traps, and will be conducted in accordance with the requirements of the STP and the 2007 Oregon Sport Fishing Regulations (ODFW 2007). There are no daily limits for catching sculpin (ODFW 2007). Only fish between 3 and 6 inches in length should be kept.

Minnow traps will be deployed and retrieved according to the procedures outlined in SOP-4 (crayfish sampling) with the following exception: two minnow traps will be deployed at each sample location, one baited with bread crumbs, and the other un-baited.

Once the traps are retrieved, the sculpin will be handled with clean, disposable nitrile gloves or decontaminated work gloves. Handling will be kept to a minimum. Fish less than 3 inches in length will be handled as little as possible and returned to the river. Fish between 3 and 6 inches in length will be logged using the tissue sampling form (Appendix B). Fish will be measured with a standard measuring board and weighed to the nearest gram. The fish will then be rinsed with distilled water, wrapped in aluminum foil (dull side inward, touching the fish), and double bagged in resealable plastic bags.

Decontamination

All bait hooks, traps, measuring boards, and hand tools will be decontaminated between samples with ambient water and distilled water.

SAMPLE PROCESSING

Sample Packaging and Labeling

The fish tissue samples will be wrapped in aluminum foil, double bagged in a pre-labeled re-sealable bags, and stored in a cooler on ice for shipment to the analytical laboratory.

Samples will be labeled in the same manner indicated in the QAPP with the following exception. The last two letters of the sample ID will designate the sample matrix (i.e., SB = smallmouth bass, LS = large scale sucker, and SC = sculpin). An example of a sample identification number for a large scale sucker tissue sample collected at sample location number 46 on September 1, 2007 is 07090146LS.

Sample Shipment

Processed tissue samples will be shipped on dry ice in coolers via Federal Express with adequate ice to keep samples frozen for at least two days. Shipping procedures for non-hazardous substance shipment using dry ice as a refrigerant are as follows:

- As long as the dry ice is being used solely as a coolant for non-hazardous material, such as the fish samples captured during this program, International Air Transport Association

(IATA) regulations apply, IATA regulations exempt the shipper from having to fill out hazardous substance paperwork.

- Each cooler must have dry ice labels on the outside of the cooler, which include a Class 9 diamond label.
- For Federal Express, there is a special handling section on the airbill, which must be filled out for all coolers containing dry ice. The information required includes the total number of packages containing dry ice, and the kilograms of dry ice per package (cooler).
- Federal Express has a weight limitation of 200 kg per package or individual cooler.
- As long as the dry ice is being used solely for cooling the fish samples, there is no longer a total limitation on the amount of dry ice that can be shipped on an individual courier flight.

REFERENCES

Oregon Department of Fish and Wildlife, 2007. *2007 Oregon Sport Fishing Regulations*. http://www.dfw.state.or.us/resources/fishing/regulations_2007.pdf.

U.S. Army Corps of Engineers, 2005. Quality Assurance Project Plan, Bradford Island Remedial Investigation/Fesibility Study, Project Phase- Pre-In-Water Interim Action, Fish Advisory Quality Project Plan. Bonneville Dam, Bonneville, Oregon. Prepared by Seattle and Portland Districts. Revison 3, December 12, 2005.

APPENDIX C

August 18, 2006

CENWP-EC-DC

MEMORANDUM FOR RECORD, BRADFORD ISLAND REMEDIATION

SUBJECT: Bradford Island Fish Advisory Sampling Efforts
Bradford Island Disposal Site
Bonneville Lock and Dam – Cascade Locks, Oregon

1. References.
    a. Quality Assurance Project Plan, Revision 3, December 12, 2005

2. The purpose of this memorandum is to document fishing efforts in 2006 at Bradford Island, Bonneville Lock and Dam. This memorandum provides a summary of field activities at the site and the results.

3. Background. Due to pre-1980's waste management practices, equipment was disposed of in the river, and has resulted in a release of PCB's into the river. The equipment was removed in 2002 and additional remedial actions are necessary. As part of remedial actions, USACE is collecting fish tissue to help document accumulation of PCBs in fish tissue that may be caught in the region of the release to allow for a public health evaluation by the states of Washington and Oregon. The USACE is conducting further remedial actions under CERCLA.

4. Proposed actions. USACE is in the process of collecting and analyzing resident game fish from the Columbia River in the vicinity of Bonneville Dam fore-bay for PCBs as well as related parameters. The purpose is to further refine the risk model for the in-water removal and help determine the extent to which fish caught can be safely consumed. This is further discussed in the referenced QAPP, 12/12/2005. Populations were selected by Oregon Department of Human Services (ODHS). The results will aid ODHS and Washington Department of Health for use in determining the appropriateness of fishing advisories in the river above Bonneville Dam. Additionally, the information will be used to support a Remedial Investigation (RI) being carried out by USACE for PCB releases from the Bradford Island Landfill and adjacent banks.

5. Completed actions. All fishing efforts were complete via angling unless otherwise noted.

    A. USGS conducted the first fish sampling efforts January 10-13, 2006. Target species include whole body bass and walleye, as well as sturgeon tissue plugs (attempted to collect via setlines). During this fish sampling effort, sculpin and crayfish traps were also placed on the shores of Bradford Island since the team was already on site and this would not require extra effort. Only sculpin and crayfish were caught; no other fish

were seen. Attempts were un-successful due to poor weather conditions; high winds, rain and cold water temperatures. Detailed documentation can be found in the project files. (Subtotal of samples collected: 16 sculpin, 33 crayfish)

B. ODFW and USDA conducted "opportunistic" sampling as part of a separate study in April and May, 2006, respectively. No target species were collected; however, after discussion with the project team, largescale sucker and peamouth chub were collected and added to the target species list. Detailed documentation can be found in the project files. (Subtotal of samples collected: 2 largescale sucker, 1 peamouth chub)

C. Kitia Howard and Bryan Mason, with the support of the Oregon Bass and Panfish Club (OBPC), conducted sampling June 5th and 6th, 2006. Two boats were used so efforts could be focused in the Boat Restricted Zone (BRZ); most of Bradford Island shores reside in this zone. See attached figure for location of BRZ. Spill was very high at 121,000 cfs, skies were clear. The 1st day was spent primarily on the south side of Bradford Island. Mr. Egan (OBPC information officer and experienced fisherman) commented on the strong currents, noting the site did not appear to be adequate habitat for any of the target species, especially smallmouth bass. A small amount of time was spent on the east tip of the island outside the BRZ; however, currents were very strong so the team did not feel comfortable moving into the BRZ on north side of the island. Both boats drifted downstream along the Oregon shore; however collection efforts still remained minimal. At about noon, boat 2 explored into the small side channel between Goose Island and the mainland. Many smallmouth bass were spawning in this area and were therefore collected. Day 2 of the expedition was not as successful. Winds were very strong and only 4 fish were caught by noon, so efforts ceased. Mr. Egan recommended fishing be postponed until August when water temperatures would be warmer and flows would be down. Detailed documentation can be found in the project files. (Subtotal of samples collected: 14 bass)

D. Kitia Howard, again with the support of the OR Bass and Panfish Club (OBPC), conducted sampling August 15th and 16th, 2006. Again, 2 boats were used so efforts could be focused in the Boat Restricted Zone (BRZ). Spill was almost half of the previous amount at 75,000cfs. Both boats spent the 1st day covering the shore surrounding Bradford Island. Mr. Egan commented on the steep banks surrounding the island, stating smallmouth bass do not tend to favor such conditions. Smallmouth bass like small shelves to feed. Ms. Howard asked Mr. Egan to write down his thoughts about fish in the area. The letter is attached. Walleye and smallmouth bass were the targeted species, however pikeminnow were also accepted. A few bass were caught, as well as a half dozen pikeminnow; however, no walleye were caught. This time around, flows were slow enough, the boats fished the north side of the island; 1 boat on standby for safety at all times. Two fish of acceptable size were caught on the north-side bank, and two bass below the acceptable size range were

released. The fishermen were having a hard time keeping their lines from snagging. Some electrical wires still remain. Mr. Egan noted walleye are very nomadic, and haven't been seen largely in the target area; Hood River, just up-river, would have more likelihood to contain these fish. Day 2, June 16, 2006, began on the north side of the island. The hope was to focus on the target area for success. Fish were scarce, so efforts moved to the south side of Cascade Island, then the north. Fish numbers were very low. Efforts were made on the Washington shoreline as well as around Boat Rock. Only 3 pikeminnow were caught after a full day's effort. About a half dozen smallmouth bass less than eleven inches were caught; however were not kept since they did not meet the specified target length range. Detailed documentation can be found in the project files. (Subtotal of samples collected: 3 bass, 5 pikeminnow)

E. An additional "opportunistic" fish collection effort was completed by Dean Ballinger and his team, at the Bonneville Juvenile Bypass Facility. Efforts were continual through the months of June through August, 2006. Fish were collected via the juvenile bypass system; the peamouth chub limit was collected as well as a few largescale suckers. Detailed documentation can be found in the project files. (Subtotal of samples collected: 33 peamouth chub, 3 largescale sucker)

F. Total OVERALL count of samples:

TOTAL COUNT						
SCULPIN	**CRAYFISH**	**LARGE SS**	**PEAMOUTH**	**BASS**	**WALLEYE**	**PIKEMINNOW**
16	33	5	34	17	0	5

6. All fish samples are being contained at the Bonneville Juvenile Bypass Facility in a locked freezer maintained at or below -4˚F. For further information, or questions, please contact Kitia Howard at kitia.d.howard@usace.army.mil or (503)808-4953.