*L*ower *D*uwamish *W*aterway *G*roup

*Port of Seattle / City of Seattle / King County / The Boeing Company*

# QUALITY ASSURANCE PROJECT PLAN: ENHANCED NATURAL RECOVERY/ACTIVATED CARBON CANDIDATE PLOT SURFACE AND SUBSURFACE SEDIMENT SAMPLING FOR PCB ANALYSES FOR THE LOWER DUWAMISH WATERWAY

## FINAL

**For submittal to:**

**The US Environmental Protection Agency**
**Region 10**
Seattle, WA

**The Washington State Department of Ecology**
**Northwest Regional Office**
Bellevue, WA

**October 24, 2014**


**Prepared by:** Windward environmental LLC

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# Title and Approval Page
# LDW ENR/AC Candidate Plot Sediment Sampling
# Quality Assurance Project Plan

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|---|---|---|
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## Distribution List

This list identifies all individuals to receive a copy of the approved QA Project Plan, either in hard copy or electronic format, as well as any subsequent revisions.

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## Acronyms

| ACRONYM | Definition |
|---|---|
| AC | activated carbon |
| AOPC | area of potential concern |
| ARI | Analytical Resources, Inc. |
| CD | compact disc |
| COC | chain of custody |
| CSL | cleanup screening level |
| DGPS | differential global positioning system |
| DQI | data quality indicator |
| EAA | early action area |
| ECD | electron capture detection |
| Ecology | Washington State Department of Ecology |
| ENR | enhanced natural recovery |
| EPA | US Environmental Protection Agency |
| FC | field coordinator |
| GC | gas chromatography |
| GPS | global positioning system |
| HSP | health and safety plan |
| ID | identification |
| LCS | laboratory control sample |
| LDW | Lower Duwamish Waterway |
| LDWG | Lower Duwamish Waterway Group |
| LOD | limit of detection |
| LOQ | limit of quantification |
| MDL | method detection limit |
| MLLW | mean lower low water |
| NAD83 | North American Datum of 1983 |
| NSR | net sedimentation rate |
| % RSD | percent relative standard deviation |
| PCB | polychlorinated biphenyl |
| PM | project manager |
| PSEP | Puget Sound Estuary Program |
| QA | quality assurance |

| ACRONYM | Definition |
|---|---|
| QAPP | quality assurance project plan |
| QC | quality control |
| RL | reporting limit |
| RPD | relative percent difference |
| SCO | sediment cleanup objective |
| SDG | sample delivery group |
| SWAC | spatially weighted average concentration |
| TOC | total organic carbon |
| USCG | US Coast Guard |
| WAAS | Wide Area Augmentation System |
| Windward | Windward Environmental LLC |

# 1 Introduction

This quality assurance project plan (QAPP) describes the quality assurance objectives, methods, and procedures for sampling surface and subsurface sediment in the Lower Duwamish Waterway (LDW) and chemically analyzing these samples. Data from these studies will be used to determine if polychlorinated biphenyl (PCB) concentrations in select areas within the LDW are within the targeted range for the enhanced natural recovery (ENR)/activated carbon (AC) pilot study (EPA and Ecology 2000, 2014). Results will be used to help finalize selection of plot areas for the study. This QAPP presents the study design, including details on project organization, field data collection, laboratory analysis, and data management. This QAPP was prepared in accordance with guidance from the US Environmental Protection Agency (EPA) (2002) and Washington State Department of Ecology (Ecology) (2008)).

This plan is organized into the following sections:

- Section 2 – Project Management
- Section 3 – Data Generation and Acquisition
- Section 4 – Assessment and Oversight
- Section 5 – Data Validation and Usability
- Section 6 – References

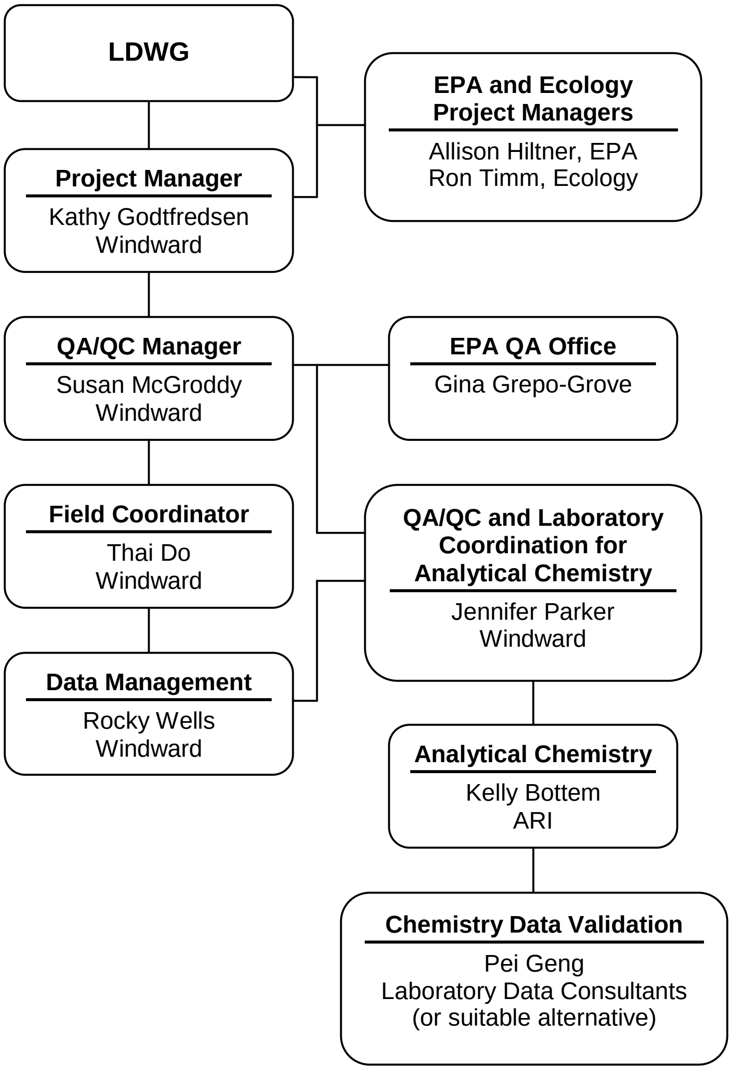
A health and safety plan (HSP) designed for the protection of on-site personnel from physical, chemical, and other hazards posed during field sampling activities is included as Appendix A. Field collection forms are included as Appendix B.

# 2 Project Management

This section describes the overall management of the project, including key personnel, project description, problem definition and background, quality objectives and criteria, special training requirements and certification, and documents and record keeping.

## 2.1 Project Organization and Team Member Responsibilities

Figure 2-1 shows the overall project organization for the studies described in this QAPP. Responsibilities of project team members, as well as those of the laboratory project managers, are described in the following sections.




## Figure 2-1. Project organization

### 2.1.1 Project management

The Lower Duwamish Waterway Group (LDWG), EPA, and the Ecology will be involved in all aspects of this project, including discussion, review, and approval of the QAPP, and interpretation of the results of the investigation. EPA and Ecology will be represented by their project managers (PMs) for this project, Allison Hiltner and Ron Timm, respectively.

Kathy Godtfredsen will serve as the Windward Environmental LLC (Windward) PM, responsible for overall project coordination and providing oversight on planning and coordination, work plans, all project deliverables, and performance of the administrative tasks needed to ensure timely and successful completion of the project.

She will also be responsible for coordinating with LDWG, EPA, and Ecology on schedule, deliverables, and other administrative details. Dr. Godtfredsen can be reached as follows:

Kathy Godtfredsen
Windward Environmental LLC
200 W. Mercer Street, Suite 401
Seattle, WA 98119
Telephone: 206.577.1283
Facsimile: 206. 973.0348
Email: kathyg@windwardenv.com

### 2.1.2 Field coordination

Thai Do will be the Windward field coordinator (FC). The FC is responsible for managing field activities and general field quality assurance/quality control (QA/QC) oversight. Mr. Do will ensure that appropriate protocols for sample collection, preservation, and holding times are observed and oversee delivery of environmental samples to the designated laboratories for chemical and toxicological analyses. Deviations from this QAPP will be reported to the Windward PM for consultation. Significant deviations from the QAPP will be further reported to representatives of LDWG, EPA, and Ecology. Mr. Do can be reached as follows:

Thai Do
Windward Environmental LLC
200 W. Mercer Street, Suite 401
Seattle, WA 98119
Telephone: 206.812.5407
Facsimile: 206. 973.0348
Email: thaid@windwardenv.com

### 2.1.3 Quality assurance/quality control

Susan McGroddy of Windward will serve as QA/QC manager for the project. As the QA/QC manager, she will provide oversight for both the field sampling and laboratory programs and will supervise data validation and project QA coordination, including coordination with the EPA QA officer, Gina Grepo-Grove.

Dr. McGroddy can be reached as follows:

Susan McGroddy
Windward Environmental LLC
200 W Mercer Street, Suite 401
Seattle, WA 98119
Telephone: 206.812.5421
Facsimile: 206.973.0348
Email: susanm@windwardenv.com

Ms. Grepo-Grove can be reached as follows:

Gina Grepo-Grove
US Environmental Protection Agency, Region 10
1200 6th Avenue
Seattle, WA 98101
Telephone: 206.553.1632
Email: grepo-grove.gina@epa.gov

Jennifer Parker of Windward will serve as the QA/QC coordinator for chemical analyses. Ms. Parker can be reached as follows:

Jennifer Parker
Windward Environmental LLC
200 W Mercer Street, Suite 401
Seattle, WA 98119
Telephone: 206.812.5442
Facsimile: 206. 973.0348
Email: jenniferp@windwardenv.com

The QA/QC coordinator will ensure that samples are collected and documented appropriately and coordinate with the analytical and toxicity testing laboratories to ensure that QAPP requirements are followed. Independent third-party review and validation of analytical chemistry data will be provided by Laboratory Data Consultants, Inc. (or a suitable alternative). The data validation PM at Laboratory Data Consultants can be reached as follows:

Pei Geng
Laboratory Data Consultants, Inc.
2701 Loker Avenue West, Suite 220
Carlsbad, CA 92010
Telephone: 760.827.1100 ext 141
Email: pgeng@lab-data.com

### 2.1.4 Laboratory project management

Jennifer Parker of Windward will serve as the laboratory coordinator for the analytical chemistry laboratory. Analytical Resources, Inc. (ARI) will perform chemical analyses of the sediment samples. The laboratory PM at ARI can be reached as follows:

Kelly Bottem
Analytical Resources, Inc.
4611 S 134th Place, Suite 100
Tukwila, WA 98168-3240
Telephone: 206.695.6211
Email: kellyb@arilabs.com

The laboratories will accomplish the following:

- Adhere to the methods outlined in this QAPP, including those methods referenced for each procedure
- Adhere to documentation, custody, and sample logbook procedures
- Implement QA/QC procedures defined in this QAPP
- Meet all reporting requirements
- Deliver electronic data files as specified in this QAPP
- Meet turnaround times for deliverables as described in this QAPP
- Allow EPA and the QA/QC third-party auditors to perform laboratory and data audits

### 2.1.5 Data management

Rocky Wells of Windward will oversee data management to ensure that analytical data are incorporated into the LDWG database with appropriate qualifiers following acceptance of the data validation. QA/QC of the database entries will ensure accuracy.

## 2.2 Problem Definition/Background

As outlined in the Second Amendment (EPA and Ecology 2014) to the Administrative Order on Consent for Remedial Investigation/Feasibility Study (AOC) for the LDW (EPA and Ecology 2000), an ENR/AC pilot study is being performed by LDWG. One of the goals of the study is to evaluate the performance of ENR augmented with AC as compared with that of ENR alone in reducing exposure to PCBs in sediment across a range of PCB concentrations.

As an initial task in this effort, LDWG identified 13 candidate areas for the pilot study and recommended nine of the areas for sampling (LDWG 2014). Candidate plots were identified for three types of areas: intertidal, subtidal, and subtidal with some scour potential. Areas were identified if they met the following criteria and considerations (LDWG 2014).

**Criteria**

- Located in Area of Potential Concern 1 (AOPC 1)
- Located in Category 2/3 (or Category 1 area with "light" scour potential)
- Contained point-based surface PCB concentration data greater than the sediment cleanup objective (SCO) and less than two times the cleanup screening level (CSL), and had a **s**patially weighted average concentration (SWAC) for a 1-acre area greater than the SCO

**Considerations**

- Could accommodate approximately two 0.5-acre plots, ideally with both located in similar water depths
- Located in the waterway with no in-water ownership by a private party to facilitate plot access
- Preferably had a modeled net sedimentation rate (NSR) of greater than 1 cm/year in subtidal areas and greater than 0.5 cm/year in intertidal areas to minimize erosion potential
- Preferably did not have very active berthing areas that require maintained navigation depths (for Category 1 areas considered for scour mitigation plots)
- Located away from areas where the majority of the test plot would be covered by an in-water structure (for ease of material placement for the pilot)
- Oriented along bathymetry contours if technology assignments were based on shoaling in the navigation channel or berthing areas
- Located away from sites with a greater potential for recontamination (based on FS Appendix J, Figure J-9a (AECOM 2012))

LDWG, EPA, and Ecology met to discuss the nine recommended areas relative to the criteria described in LDWG (2014), and with some modifications (see Section 3.1), EPA/Ecology approved these areas. Candidate areas selected for sampling are shown on Map 2-1.

Based on this process, three candidate plot areas were identified in intertidal locations, three areas were identified in subtidal areas, and three were identified in scour mitigation areas. These areas will be sampled (as outlined in this QAPP[1]) and the data

[1] As discussed in the AOC, LDWG will also collect baseline data prior to pilot study construction and will collect post-construction monitoring data.

will be used to select one area of each type for the pilot study, which will be conducted according to the AOC (EPA and Ecology 2000). The results of the pilot study will ultimately be used by EPA/Ecology to help determine acceptable remedial actions for specific areas in the LDW.

## 2.3 Project/Task Description and Schedule

In accordance with this QAPP, surface and subsurface sediment samples will be collected from each of the nine candidate areas (Map 2-1). Samples from six of the nine areas (two from each area type – intertidal, subtidal, scour mitigation) will be analyzed for PCB Aroclors and total organic carbon (TOC). For the remaining three areas (one from each area type), samples will be collected and archived in the event that the first two areas per area type do not meet the requirements for the study (i.e., do not have the requisite PCB concentrations in surface sediment). In addition, subsamples from the first six areas will be archived for potential future analysis, if needed. A detailed sampling design for the areas is presented in Section 3.1.

Sampling, which is expected to take less than 2 weeks, will be conducted following approval of the QAPP by EPA/Ecology. Samples collected from the six areas will be submitted to ARI for analysis (with a 3-week turn-around time), and the results will be submitted to LDC for validation (with a 3-week turn-around time). Validated data will be submitted to EPA/Ecology within 65 calendar days of final QAPP approval. A working meeting will be held with EPA/Ecology approximately 7 calendar days after the submittal of the validated data to select the three areas for the study (or determine if the archived samples from one or more of the backup areas should be analyzed for PCBs and TOC).

A data package will be shared with EPA/Ecology at the meeting. This package will contain the results of the field sampling, chemical analysis, and validation (and any QAPP deviations). A map will be included that shows the actual sampling locations and total PCB data. All data will be summarized in tables (including PCB Aroclors and total PCBs for individual locations and averaged for each study plot) and included on an attached compact disc (CD). This package is for documentation purposes only and is not a formal deliverable requiring agency approval.

## 2.4 Quality Objectives and Criteria

The overall data quality objective for this project is to develop and implement procedures that will ensure the collection of representative data of known, acceptable, and defensible quality. Parameters used to assess data quality are precision, accuracy, representativeness, comparability, completeness, and sensitivity. These parameters are discussed, and specific data quality indicators (DQIs) for sediment chemistry analysis are presented in Section 3.4.2.

## 2.5 SPECIAL TRAINING/CERTIFICATION

The Superfund Amendments and Reauthorization Act of 1986 required the Secretary of Labor to issue regulations providing health and safety standards and guidelines for workers engaged in hazardous waste operations. The federal regulation 29CFR1910.120 requires training to provide employees with the knowledge and skills enabling them to perform their jobs safely and with minimum risk to their personal health. All sampling personnel will have completed the 40-hour HAZWOPER training course and 8-hour refresher courses, as necessary, to meet the Occupational Safety and Health Administration regulations.

## 2.6 DOCUMENTATION AND RECORDS

The following sections describe documentation and records needed for field observations and laboratory analyses.

### 2.6.1 Field observations

All field activities will be recorded in a field logbook maintained by the FC. The field logbook will provide a description of all sampling activities, conferences associated with field sampling activities, sampling personnel, and weather conditions, plus a record of all modifications to the procedures and plans identified in this QAPP and the HSP (Appendix A). Soil classification, including percent silt and sand estimates, will be estimated by qualified field personnel following American Society for Testing and Materials (2001) soil classification procedures and Puget Sound Estuary Program (PSEP) (1997) protocols. The field logbook will consist of bound, numbered pages. All entries will be made in indelible ink. The field logbook is intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the sampling period.

The following forms, included as Appendix B, will also be used to record pertinent information after sample collection:

- Surface Sediment Collection Form
- Sediment Core Collection Form
- Protocol Modification Form

### 2.6.2 Laboratory records

The various laboratory record requirements for the sediment chemistry data are described below. ARI is accredited by Ecology to conduct the sediment chemical analyses.

The chemistry laboratory will be responsible for internal checks on sample handling and analytical data reporting, and will correct errors identified during the QA review.

The laboratory data package will be submitted electronically and will include the following:

- **Project narrative –** This summary, in the form of a cover letter, will present any problems encountered during any aspect of analysis. The summary will include, but not be limited to, discussion of quality control, sample shipment, sample storage, and analytical difficulties. Any problems encountered by the laboratory, and their resolutions, will be documented in the project narrative.
- **Records –** Legible copies of the chain-of-custody (COC) forms will be provided as part of the data package. This documentation will include the time of receipt and the condition of each sample received by the laboratory. Additional internal tracking of sample custody by the laboratory will also be documented.
- **Sample results –** The data package will summarize the results for each sample analyzed. The summary will include the following information, when applicable:
  - Field sample identification code and the corresponding laboratory identification code
  - Sample matrix
  - Date of sample extraction/digestion
  - Date and time of analysis
  - Weight and/or volume used for analysis
  - Final dilution volumes or concentration factor for the sample
  - Total solids in the samples
  - Identification of the instruments used for analysis
  - Identification of cleanup procedures used on sample extracts
  - Method detection and reporting limits
  - All data qualifiers and their definitions
- **QA/QC summaries –** These summaries will contain the results of all QA/QC procedures. Each QA/QC sample analysis will be documented with the same information required for the sample results (see above). The laboratory will make no recovery or blank corrections. The required summaries are listed below.
  - The calibration data summary will contain the concentrations of the initial calibration and daily calibration standards and the date and time of analysis. The response factor, percent relative standard deviation, relative

percent differences (RPD), and the retention time for each analyte will be listed, as appropriate. Results for standards to indicate instrument sensitivity will be reported.

- The internal standard area summary will report the internal standard areas, as appropriate.
- The method blank analysis summary will report the method blank analysis associated with each sample and the concentrations of all compounds of interest identified in these blanks.
- The surrogate spike recovery summary will report all surrogate spike recovery data for organic analyses. The names and concentrations of all compounds added, percent recoveries, and QC limits will be listed.
- The matrix spike recovery summary will report the matrix spike or matrix spike/matrix spike duplicate recovery data for analyses, as appropriate. The names and concentrations of all compounds added, percent recoveries, and QC limits will be included in the data package. The RPD for all matrix spike duplicate analyses will be reported.
- The matrix duplicate summary will report the RPD for all matrix duplicate analyses. The QC limits for each compound or analyte will be listed.
- The laboratory control analysis summary will report the results of the analyses of laboratory control samples. The QC limits for each compound or analyte will be included in the data package.
- The relative retention time summary will report the relative retention times for the primary and confirmational columns of each analyte detected in the samples, as appropriate.

The contract laboratories for this project will submit data electronically, in Microsoft Excel® or delimited-text format. Guidelines for electronic data deliverables for chemical data are as follows:

- Each row of data will contain only one analyte result for a given sample. Therefore, one complete sample will require multiple rows.
- Each row should contain the following information at a minimum: Windward sample identifier, sample matrix, laboratory sample identifier (if used), date of sampling, date of laboratory analysis, laboratory method, analyte name, measured result, laboratory qualifiers, units, and measurement basis.
- If using a spreadsheet file to produce the electronic deliverable, the value representing the measured concentration or detection limit will be rounded to

show the correct number of significant figures and will not contain any trailing digits that are hidden in the formatting.

- If using a database program to produce the electronic deliverable, the value representing the measured concentration or detection limit will be stored in a character field, or a field in addition to the numeric result field will be provided to define the correct number of significant figures.
- If an analyte is not detected then the laboratory qualifier will be U, and the value in the result column will be the sample-specific reporting limit (RL). Quantified results between the detection limit and the RL will be laboratory J-qualified.
- Analytical results of laboratory samples for QA/QC will be included and clearly identified in the file with unique laboratory sample identifiers. Additional columns may be used to distinguish the sample type (e.g., matrix spike, matrix spike duplicate).
- If replicate analyses are conducted on a submitted field sample, the laboratory sample identifier must distinguish among the replicates.
- Wherever possible, all analytes and replicates for a given sample will be grouped together.

An example of the acceptable organization of the electronic deliverable for chemical data is provided in Table 2-1.

**Table 2-1. Example of acceptable organization of the electronic data deliverable**

| Field Name | Required or Optional |
|---|---|
| Event name | required |
| Chain of custody ID | required |
| Laboratory sample ID | required |
| Matrix | required |
| Sample collection date/time | required |
| Requested analysis | required |
| Analyte | required |
| Chemical Abstracts Services registry number | required |
| Date/time analyzed | required |
| Detection limit | required |
| Reporting limit | required |
| Reporting limit type | required |
| Sample type | required |
| Sample result | required |

| Field Name | Required or Optional |
|---|---|
| Units and measurement basis | required |
| Number of significant figures in each sample result | required |
| Laboratory qualifier | required[a] |
| Analysis batch | required |
| True value/spiked amount | optional |
| Percent recovery | required[a] |
| Upper limit | optional |
| Lower limit | optional |
| Analyst | required |
| Dilution | required |
| Extraction batch | required |
| Extraction date/time | required |
| Extraction method | required |
| Total solids | required |
| Laboratory notes | optional |
| Laboratory | required |

[a] Required when available. Not all samples are qualified. Field samples have no percent recovery.

ID – identification

### 2.6.3 Data reduction

Data reduction is the process by which original data are converted or reduced to a specified format or unit to facilitate analysis of the data. For example, a final analytical concentration may need to be calculated from a diluted sample result. Data reduction requires that all aspects of sample preparation that could affect the test result, such as sample volume analyzed or dilutions required, be taken into account in the final result. It is the laboratory analyst's responsibility to reduce the data, which are subjected to further review by the laboratory PM, the Windward PM, the project QA/QC coordinator, and independent reviewers. The data will be generated in a form amenable to review and evaluation. Data reduction may be performed manually or electronically. If performed electronically, all software used must be demonstrated to be true and free from unacceptable error.

During chemical analysis, samples are occasionally diluted after the initial analysis if the estimated concentration curve for one or more of the target analytes is above the calibration curve. In these instances, concentrations from the initial analysis will be identified as the "best result" for all target analytes other than the chemical(s) that was originally above the calibration range. The "best result" for this qualified analyte(s) will be taken from the diluted sample.

After third party data validation, total PCBs will be calculated in accordance with the methods of the Washington State Sediment Management Standards, using only detected values for seven Aroclors.[2] For individual samples in which none of the seven Aroclors are detected, total PCBs will be given a value equal to the highest RL of the seven Aroclors and assigned a U-qualifier indicating the lack of detected concentrations.

# 3 Data Generation and Acquisition

This section describes the collection and handling of sediment samples for chemical analyses. Elements include sampling design, sampling methods, sample handling and custody requirements, analytical methods, quality assurance/quality control, instrument/equipment testing and frequency, inspection and maintenance, instrument calibration, supply inspection/acceptance, non-direct measurements, and data management.

## 3.1 SAMPLING DESIGN

This section describes the sampling design developed to meet the data needs presented in Section 2.2 for the placement of sediment samples, and the chemical analysis of these samples.

As discussed in Section 2.2, nine candidate areas[3] were selected for sampling to represent different physical conditions: intertidal, subtidal, and scour mitigation (areas of scour potential identified in the feasibility study) (Map 2-1 and Maps 3-1a through 3-1f, Table 3-1). The exact locations of many of these areas were slightly modified, as noted in Table 3-1, from their locations in the Candidate Plot Locations Memorandum (LDWG 2014) to facilitate sampling and access for the pilot study. For example, candidate area 8 (formerly candidate area 12) was moved slightly away from the shoreline to avoid riprap.

[2] Aroclors 1016, 1221, 1232, 1242, 1248, 1254, and 1260.

[3] Note that the numbering of the areas was updated from LDWG (2014) so that the areas would be sequentially numbered in this QAPP (see Table 3-1 for a key).

**Table 3-1. Pilot candidate areas for sediment sampling**

| Candidate Area | Former Name in LDWG (2014) | Area Type | | | Modifications from LDWG (2014) |
|---|---|---|---|---|---|
| | | Intertidal | Subtidal | Scour Mitigation | |
| 1 | 1 | | | X | Area aligned with dock face and property line, and plots placed side-by-side. |
| 2 | 2 | | | X | Area aligned with end of docks and property line. |
| 3 | 3 | X | | | Area aligned with bathymetry and elongated along property line. |
| 4 | 4 | | X | | Area shape modified in consultation with EPA. |
| 5 | 6 | | | O | Area moved further south and reshaped to avoid federal land ownership access issue. This area was designated Recovery Category 2 in the FS and was considered a subtidal area and a scour mitigation area in LDWG (2014). It was selected as a backup scour mitigation area in this QAPP because of active berthing and shipping in Slip 1. |
| 6 | 8 | | X | | None |
| 7 | 10 | | O | | Area moved slightly to the west to avoid shoaling area in navigation channel. |
| 8 | 12 | X | | | Area moved slightly offshore to avoid riprap and elongated along the intertidal. |
| 9 | 13 | O | | | Area moved slightly offshore to avoid riprap/ bulkhead, elongated along the intertidal, and moved slightly north based on PCB distribution. |

Notes: X = sample and analyze; O = sample and archive (backup area)
FS – feasibility study
LDWG – Lower Duwamish Waterway Group
QAPP – quality assurance project plan

As described in Table 3-1, six of the candidate areas were identified for sediment sampling and analysis, and three of the areas (representing one of each physical condition) were identified for sampling and archiving. These three areas serve as backup areas in the event that the sample results from the areas sampled and analyzed do not have the targeted PCB concentrations.

The three candidate areas selected for backup, as indicated in Table 3-1, are those recommended in the Candidate Plot Locations Memorandum (LDWG 2014), with one exception. In LDWG (2014), candidate area 2 was recommended as a scour mitigation backup area, and area 5 (using QAPP terminology) was recommended as a possible scour mitigation area. As shown in Table 3-1, area 2 is now a candidate area for scour mitigation and area 5 is a backup. This change is recommended because of active berthing activity in Slip 1 (where area 5 is located).

Within each candidate area, two adjacent half-acre plots were established (i.e., one for ENR with AC amendment, and one for ENR alone). Eight surface sediment samples (e.g., four from each half-acre plot) and two subsurface sediment samples (e.g., one from each half-acre plot) will be collected from each candidate area.

For surface sediment samples, each half-acre plot was equally divided into quadrants. A surface sediment sampling location was placed in the center of each quadrant. Surface sediment samples will be collected from the 0-to-10-cm depth interval and analyzed for total PCBs, total solids, and TOC and then archived for grain size. An additional 16-oz jar of sediment will be also retained and archived for potential future analysis.

One subsurface sediment sample will also be collected from each half-acre plot. This sample will be collected from the center of each half-acre plot; analyzed for total PCBs, total solids, and TOC; and archived for grain size. In the intertidal areas, the subsurface sediment sample will be collected from the 0-to-45-cm (e.g., 0-to-1.5-ft) depth; in the subtidal and scour mitigation areas, the subsurface sediment sample will be collected from the 0-to-61-cm (0-to-2-ft) depth. An additional 16-oz jar of sediment will also be retained and archived for potential future analysis.

Table 3-2 provides the target coordinates for the collection of surface and subsurface sediment samples from each candidate area.

**Table 3-2. Sediment sampling locations and target coordinates**

| Sampling Location and Sample ID | Easting (X)[a] | Northing (Y)[a] | Latitude[b] | Longitude[b] | Mudline Elevation (ft MLLW) | Surface Sediment[c] | Sediment Core[d] |
|---|---|---|---|---|---|---|---|
| **LDW-PILOT1** | | | | | | | |
| LDW-PILOT1A-SS1 | 1267034 | 211210 | 47.5689615 | -122.345941 | -22 | X | |
| LDW-PILOT1A-SS2 | 1267105 | 211189 | 47.5689100 | -122.345652 | -16 | X | |
| LDW-PILOT1A-SS3 | 1267085 | 211118 | 47.5687144 | -122.345728 | -22 | X | |
| LDW-PILOT1A-SS4 | 1267014 | 211139 | 47.5687659 | -122.346017 | -28 | X | |
| LDW-PILOT1A-SC1 | 1267060 | 211164 | 47.5688380 | -122.345834 | -22 | | X |
| LDW-PILOT1B-SS1 | 1266994 | 211067 | 47.5685697 | -122.346093 | -30 | X | |
| LDW-PILOT1B-SS2 | 1267065 | 211047 | 47.5685183 | -122.345804 | -24 | X | |
| LDW-PILOT1B-SS3 | 1267045 | 210976 | 47.5683226 | -122.345880 | -26 | X | |
| LDW-PILOT1B-SS4 | 1266974 | 210996 | 47.5683741 | -122.346169 | -32 | X | |
| LDW-PILOT1B-SC1 | 1267019 | 211022 | 47.5684462 | -122.345987 | -28 | | X |

| Sampling Location and Sample ID | Easting (X)[a] | Northing (Y)[a] | Latitude[b] | Longitude[b] | Mudline Elevation (ft MLLW) | Surface Sediment[c] | Sediment Core[d] |
|---|---|---|---|---|---|---|---|
| **LDW-PILOT2** | | | | | | | |
| LDW-PILOT2A-SS1 | 1266883 | 210644 | 47.5674019 | -122.346508 | -36 | X | |
| LDW-PILOT2A-SS2 | 1266956 | 210631 | 47.5673719 | -122.346213 | na | X | |
| LDW-PILOT2A-SS3 | 1266943 | 210558 | 47.5671718 | -122.346257 | na | X | |
| LDW-PILOT2A-SS4 | 1266871 | 210571 | 47.5672019 | -122.346553 | -38 | X | |
| LDW-PILOT2A-SC1 | 1266913 | 210601 | 47.5672869 | -122.346383 | -36 | | X |
| LDW-PILOT2B-SS1 | 1266858 | 210498 | 47.5670018 | -122.346597 | -36 | X | |
| LDW-PILOT2B-SS2 | 1266931 | 210486 | 47.5669718 | -122.346302 | -34 | X | |
| LDW-PILOT2B-SS3 | 1266918 | 210413 | 47.5667718 | -122.346346 | -32 | X | |
| LDW-PILOT2B-SS4 | 1266846 | 210425 | 47.5668018 | -122.346642 | -36 | X | |
| LDW-PILOT2B-SC1 | 1266888 | 210456 | 47.5668868 | -122.346472 | -36 | | X |
| **LDW-PILOT3** | | | | | | | |
| LDW-PILOT3A-SS1 | 1266281 | 208035 | 47.5602207 | -122.348738 | -2 | X | |
| LDW-PILOT3A-SS2 | 1266342 | 208017 | 47.5601746 | -122.348490 | 2 | X | |
| LDW-PILOT3A-SS3 | 1266317 | 207935 | 47.5599474 | -122.348582 | 2 | X | |
| LDW-PILOT3A-SS4 | 1266257 | 207953 | 47.5599934 | -122.348830 | 0 | X | |
| LDW-PILOT3A-SC1 | 1266299 | 207985 | 47.5600840 | -122.348660 | 2 | | X |
| LDW-PILOT3B-SS1 | 1266232 | 207871 | 47.5597661 | -122.348922 | 0 | X | |
| LDW-PILOT3B-SS2 | 1266293 | 207853 | 47.5597202 | -122.348674 | 2 | X | |
| LDW-PILOT3B-SS3 | 1266269 | 207770 | 47.5594931 | -122.348766 | 2 | X | |
| LDW-PILOT3B-SS4 | 1266208 | 207788 | 47.5595390 | -122.349014 | -2 | X | |
| LDW-PILOT3B-SC1 | 1266251 | 207820 | 47.5596296 | -122.348844 | 0 | | X |
| **LDW-PILOT4** | | | | | | | |
| LDW-PILOT4A-SS1 | 1267132 | 207744 | 47.5594681 | -122.345270 | -34 | X | |
| LDW-PILOT4A-SS2 | 1267186 | 207760 | 47.5595148 | -122.345050 | -34 | X | |
| LDW-PILOT4A-SS3 | 1267214 | 207669 | 47.5592656 | -122.344929 | -34 | X | |
| LDW-PILOT4A-SS4 | 1267159 | 207652 | 47.5592180 | -122.345153 | -34 | X | |
| LDW-PILOT4A-SC1 | 1267173 | 207706 | 47.5593670 | -122.345101 | -34 | | X |
| LDW-PILOT4B-SS1 | 1267222 | 207456 | 47.5586833 | -122.344880 | -32 | X | |
| LDW-PILOT4B-SS2 | 1267276 | 207473 | 47.5587321 | -122.344662 | -32 | X | |
| LDW-PILOT4B-SS3 | 1267306 | 207383 | 47.5584882 | -122.344534 | -34 | X | |
| LDW-PILOT4B-SS4 | 1267252 | 207366 | 47.5584378 | -122.344754 | -32 | X | |
| LDW-PILOT4B-SC1 | 1267264 | 207420 | 47.5585856 | -122.344708 | -34 | | X |

| Sampling Location and Sample ID | Easting (X)[a] | Northing (Y)[a] | Latitude[b] | Longitude[b] | Mudline Elevation (ft MLLW) | Surface Sediment[c] | Sediment Core[d] |
|---|---|---|---|---|---|---|---|
| **LDW-PILOT5** | | | | | | | |
| LDW-PILOT5A-SS1 | 1267899 | 206748 | 47.5567786 | -122.342085 | -26 | X | |
| LDW-PILOT5A-SS2 | 1268008 | 206726 | 47.5567232 | -122.341642 | -26 | X | |
| LDW-PILOT5A-SS3 | 1267999 | 206675 | 47.5565829 | -122.341673 | -26 | X | |
| LDW-PILOT5A-SS4 | 1267888 | 206696 | 47.5566359 | -122.342123 | -26 | X | |
| LDW-PILOT5A-SC1 | 1267949 | 206711 | 47.5566802 | -122.341880 | -26 | | X |
| LDW-PILOT5B-SS1 | 1268116 | 206705 | 47.5566720 | -122.341202 | -28 | X | |
| LDW-PILOT5B-SS2 | 1268224 | 206685 | 47.5566229 | -122.340761 | -26 | X | |
| LDW-PILOT5B-SS3 | 1268216 | 206639 | 47.5564980 | -122.340790 | -26 | X | |
| LDW-PILOT5B-SS4 | 1268108 | 206656 | 47.5565380 | -122.341229 | -26 | X | |
| LDW-PILOT5B-SC1 | 1268167 | 206671 | 47.5565829 | -122.340993 | -26 | | X |
| **LDW-PILOT6** | | | | | | | |
| LDW-PILOT6A-SS1 | 1267888 | 205622 | 47.5536926 | -122.342041 | -34 | X | |
| LDW-PILOT6A-SS2 | 1267935 | 205638 | 47.5537371 | -122.341850 | -34 | X | |
| LDW-PILOT6A-SS3 | 1267977 | 205513 | 47.5533994 | -122.341669 | -34 | X | |
| LDW-PILOT6A-SS4 | 1267928 | 205498 | 47.5533535 | -122.341868 | -34 | X | |
| LDW-PILOT6A-SC1 | 1267932 | 205568 | 47.5535469 | -122.341857 | -34 | | X |
| LDW-PILOT6B-SS1 | 1267966 | 205379 | 47.5530292 | -122.341703 | -32 | X | |
| LDW-PILOT6B-SS2 | 1268018 | 205396 | 47.5530787 | -122.341497 | -34 | X | |
| LDW-PILOT6B-SS3 | 1268077 | 205251 | 47.5526851 | -122.341245 | -34 | X | |
| LDW-PILOT6B-SS4 | 1268034 | 205255 | 47.5526926 | -122.341418 | -34 | X | |
| LDW-PILOT6B-SC1 | 1268011 | 205332 | 47.5529033 | -122.341520 | -34 | | X |
| **LDW-PILOT7** | | | | | | | |
| LDW-PILOT7A-SS1 | 1268355 | 204076 | 47.5494802 | -122.340025 | -36 | X | |
| LDW-PILOT7A-SS2 | 1268426 | 204098 | 47.5495428 | -122.339741 | -36 | X | |
| LDW-PILOT7A-SS3 | 1268447 | 204027 | 47.5493504 | -122.339649 | -36 | X | |
| LDW-PILOT7A-SS4 | 1268377 | 204006 | 47.5492879 | -122.339933 | -34 | X | |
| LDW-PILOT7A-SC1 | 1268401 | 204052 | 47.5494153 | -122.339837 | -36 | | X |
| LDW-PILOT7B-SS1 | 1268398 | 203935 | 47.5490952 | -122.339840 | -34 | X | |
| LDW-PILOT7B-SS2 | 1268469 | 203956 | 47.5491578 | -122.339556 | -36 | X | |
| LDW-PILOT7B-SS3 | 1268490 | 203886 | 47.5489654 | -122.339464 | -36 | X | |
| LDW-PILOT7B-SS4 | 1268419 | 203864 | 47.5489028 | -122.339748 | -34 | X | |
| LDW-PILOT7B-SC1 | 1268444 | 203910 | 47.5490303 | -122.339652 | -36 | | X |

| Sampling Location and Sample ID | Easting (X)[a] | Northing (Y)[a] | Latitude[b] | Longitude[b] | Mudline Elevation (ft MLLW) | Surface Sediment[c] | Sediment Core[d] |
|---|---|---|---|---|---|---|---|
| **LDW-PILOT8** | | | | | | | |
| LDW-PILOT8A-SS1 | 1271861 | 199275 | 47.5365063 | -122.325454 | -6 | X | |
| LDW-PILOT8A-SS2 | 1271902 | 199313 | 47.5366131 | -122.325293 | 2 | X | |
| LDW-PILOT8A-SS3 | 1271969 | 199242 | 47.5364215 | -122.325016 | 2 | X | |
| LDW-PILOT8A-SS4 | 1271928 | 199203 | 47.5363147 | -122.325177 | -4 | X | |
| LDW-PILOT8A-SC1 | 1271915 | 199258 | 47.5364639 | -122.325235 | -2 | | X |
| LDW-PILOT8B-SS1 | 1271995 | 199132 | 47.5361230 | -122.324901 | -6 | X | |
| LDW-PILOT8B-SS2 | 1272036 | 199170 | 47.5362298 | -122.324739 | 2 | X | |
| LDW-PILOT8B-SS3 | 1272103 | 199099 | 47.5360381 | -122.324463 | 0 | X | |
| LDW-PILOT8B-SS4 | 1272062 | 199061 | 47.5359314 | -122.324624 | -6 | X | |
| LDW-PILOT8B-SC1 | 1272049 | 199116 | 47.5360806 | -122.324682 | 0 | | X |
| **LDW-PILOT9** | | | | | | | |
| LDW-PILOT9A-SS1 | 1276186 | 194411 | 47.5234045 | -122.307570 | 0 | X | |
| LDW-PILOT9A-SS2 | 1276235 | 194422 | 47.5234377 | -122.307374 | 2 | X | |
| LDW-PILOT9A-SS3 | 1276260 | 194315 | 47.5231436 | -122.307265 | 2 | X | |
| LDW-PILOT9A-SS4 | 1276211 | 194303 | 47.5231104 | -122.307461 | 0 | X | |
| LDW-PILOT9A-SC1 | 1276223 | 194363 | 47.5232741 | -122.307417 | 0 | | X |
| LDW-PILOT9B-SS1 | 1276236 | 194196 | 47.5228163 | -122.307352 | 0 | X | |
| LDW-PILOT9B-SS2 | 1276285 | 194207 | 47.5228495 | -122.307156 | 0 | X | |
| LDW-PILOT9B-SS3 | 1276310 | 194099 | 47.5225554 | -122.307048 | 2 | X | |
| LDW-PILOT9B-SS4 | 1276261 | 194088 | 47.5225221 | -122.307243 | 0 | X | |
| LDW-PILOT9B-SC1 | 1276273 | 194147 | 47.5226858 | -122.307200 | 0 | | X |

[a] Coordinates are in Washington State Plane N, NAD83, US ft.

[b] Coordinates are in decimal degrees, NAD83.

[c] Surface sediment samples will be collected from the 0-to-10-cm interval.

[d] Sediment core sample from intertidal areas (ENR 3, 8, and 9) will be collected from 0 to 45 cm (0 to1.5 ft), and core samples collected from subtidal and scour mitigation areas (ENR 1, 2, 4, 5, 6, and 7) will be collected from the 0-to-61-cm (0-to-2-ft) interval.

MLLW – mean lower low water

na – bathymetry not available because barge was present at the time of survey

NAD83 – North American Datum of 1983

## 3.2 Sampling Methods

The sampling methods for surface and subsurface sediment sampling are described in this section. There may be contingencies during field activities that require modification of the general procedures outlined below. Modification of procedures will be at the discretion of the FC after consultation with the Windward PM and the boat operator, if applicable. EPA and Ecology will be consulted immediately in the event that significant deviations from the sampling design are required (e.g., significant relocation of a sample). All modifications will be recorded in the field logbook and the Protocol Modification Form (Appendix B).

### 3.2.1 Identification scheme

Each sediment sample will be assigned a unique alphanumeric ID number. The first three characters of the ID are "LDW" to identify the LDW project area. The next characters are "PILOT" to indicate the pilot candidate area in this study, followed by a consecutive number for the candidate area and a letter "A" or "B" to identify one of the two half-acre study plots at each candidate area. Next, "SS" or "SC" will be included to indicate the type of sample to be collected (surface sediment or sediment core, respectively), followed by a consecutive number identifying the specific quadrant within the candidate plot. For example, the surface sediment sample collected in the upper left quadrant of study plot A at LDW-PILOT1 will be identified as LDW-PILOT1A-SS1. The sediment core from the same plot will be identified as LDW-PILOT1A-SC1.

### 3.2.2 Location positioning

Target sample locations will be located using a Trimble NT300D differential global positioning system (DGPS). The DGPS includes a global positioning system (GPS) receiver unit onboard the sampling vessel and a US Coast Guard (USCG) beacon differential receiver. The GPS unit will receive radio broadcasts of GPS signals from satellites. The USCG beacon receiver will acquire corrections to the GPS signals to produce positioning accuracy to within 1 to 2 m.

Northing and easting coordinates of the vessel will be updated every second and displayed directly on a computer onboard the vessel. The coordinates will then be processed in real time and stored at the time of sampling using the positioning data management software package. Washington State Plane Coordinates, North (North American Datum of 1983 [NAD83]) will be used for the horizontal datum. The vertical datum will be the National Ocean Service mean lower low water (MLLW) datum. Vertical control will be provided by the ship's depth finder and corrected for tidal influence after sampling is completed. Tidal elevation will be determined by calling the National Ocean Service for data from their automated tide gage located at Pier 54 (206.749.9218). At intertidal locations sampled on shore at low tide, vertical elevations will be estimated by noting the tide level at the time of sampling, along with the approximate elevation of the sampling location relative to water level.

To ensure the accuracy of the navigation system, a checkpoint will be located at a known point such as a pier face, dock, piling, or similar structure that is accessible by the sampling vessel. At the beginning and end of each day, the vessel will be stationed at the check point, a GPS position reading will be taken, and the reading will be compared with the known land-survey coordinates. The two position readings should agree, within the limits of survey vessel operational mobility, to within 1 to 2 m.

A handheld GPS (Magellan ColorTrak) unit enabled with Wide Area Augmentation System (WAAS) will be used during sampling in intertidal areas that cannot be sampled from the primary sampling vessel. The WAAS enhancements produce positioning accuracy to within 3 m. Washington State Plane coordinates North (NAD83) will be used for the horizontal datum.

#### 3.2.3 Surface sediment collection and processing

Surface sediment collection and processing will follow standardized procedures for the Puget Sound area that have been developed by PSEP (1997). Surface sediment will be collected from each quadrant location shown in Maps 3-1a through 3-1f using a van Veen or pneumatic grab sampler deployed from a sampling vessel, if feasible. Some intertidal locations may be too shallow to access from the sampling vessel, in which case surface sediment will be sampled by hand from the shoreline during low tide. As part of the planning process prior to sampling, tide tables will be reviewed to verify sampling vessel accessibility to the intertidal locations.

Sediment from the 0-to-10-cm depth interval will be collected to represent the biologically active horizon and to compare directly with data from previous surface sediment studies conducted in the LDW. Sediment grab samples that are comprised of gravel will be rejected.

The surface sediment samples will be collected using a van Veen or pneumatic grab sampler as described in the following steps:

1. Using GPS, maneuver the sampling vessel to the approximate pre-identified sampling location.
2. Open the grab sampler jaws into the deployment position.
3. Guide the sampler overboard until it is clear of the vessel.
4. Using GPS, position the sampling vessel such that the GPS receiver, mounted on the winch arm right over the grab sampler, is within 1 to 2 m of the intended sampling location.
5. Lower the sampler through the water column to the bottom at approximately 0.3 m/s.
6. Record the GPS location of the boat when the sampler reaches bottom.
7. Record the water depth and time
8. Retrieve the sampler and raise it at approximately 0.3 m/s.

9. Guide the sampler aboard the vessel and place it on the work stand on the deck, using care to avoid jostling that might disturb the integrity of the sample.
10. Examine the sample using the following sediment acceptance criteria:
    - Sediment is not extruded from the upper face of the sampler.
    - Overlying water is present (indicating minimal leakage).
    - The sediment surface is relatively flat (indicating minimal disturbance or winnowing).
    - A penetration depth of at least 11 cm is achieved.

If these sample acceptance criteria are not achieved, the sample will be rejected. If an acceptable grab sample cannot be obtained in three attempts, the target sampling location will be moved as close as possible to the original location, but no further than 10 m away. If it is not possible to obtain a sample at this second location, EPA and Ecology will be consulted to discuss repositioning the station.

After sample acceptance, the following observations will be noted on the Surface Sediment Collection Form (Appendix B):

- GPS location
- Depth as read by the boat's depth sounder
- Gross characteristics of the surficial sediment including texture, color, biological structures, odor, and presence of debris or oily sheen
- Gross characteristics of the vertical profile (i.e., changes in sediment characteristics and redox layer, if visible)
- Maximum penetration depth (nearest 0.5 cm)
- Comments relative to sample quality

For intertidal locations that must be sampled from the shoreline, sediment will be collected by scooping sediment from a depth of 10 cm with a clean, stainless steel spoon.

A minimum of 1.5 L of sediment will be collected at each location and processed as follows (PSEP 1997):

1. Carefully siphon off any overlying water, taking care to avoid disturbing the overlying fines.
2. Transfer sediment from the 0-to-10-cm depth directly from the sampler into a pre-cleaned stainless steel bowl using a clean stainless steel spoon or spatula. Sediment that comes into contact with the grab sampler will not be collected.

3. Remove any large non-sediment items such as rocks, shells, wood chips, or organisms (e.g., clams) prior to homogenization.
4. Homogenize by stirring until textural and color homogeneity are achieved.
5. For intertidal samples collected by hand at low tide, spoon sediment by hand from the 0-to-10-cm depth into a pre-cleaned stainless steel bowl and homogenized as described above.
6. Divide the homogenized sediment into the appropriate sample containers as described in Section 3.3.1.
7. Thoroughly check all sample containers for proper identification, analysis type, and lid tightness.
8. Pack each container carefully to prevent breakage and place inside a cooler with ice or frozen gel packs for storage at the proper temperature (i.e., 0 to 6 °C for all samples).

Excess sediment will be returned to the sampling location, and the grab sampler will be decontaminated between sampling locations. For decontamination procedures between collection activities, see Section 3.2.5.

### 3.2.4 Sediment core collection and processing

1. Sediment cores will be collected using a vibracorer deployed from a sampling vessel at each core location shown in Maps 3-1a through 3-1f. Sediment will be collected from targeted depths ranging from 1.5 to 2 ft (45 to 61 cm) below the mudline (see Table 3-2) or until refusal, whichever is reached first. The vibracorer consists of a vibrating power head attached to a 6-ft-long, 4-in.-diameter core barrel. Sediment core samples will be collected according to the following procedures: The sampling vessel will be maneuvered to the proposed sampling location.
2. The vibracorer and a pre-cleaned (e.g. decontaminated) and dedicated core tube liner will be deployed. The core tube liner will not be used at more than one location.
3. Continuous core samples will be collected to a depth of the project requirements or until refusal.
4. The depth of core penetration will be measured and recorded.
5. The sample core tube will be extracted, and the assembly will be retrieved aboard the vessel or on land.

6. The core sample will be evaluated at the visible ends of the core tube to verify the retention of the sediment in the core tube. If the sediment core is acceptable (see criteria below), the processing of the core will begin on the boat after it is collected.

Once the tube is onboard the sampling vessel, the core catcher will be inspected for signs of sediment loss during retrieval, and the percent recovery will be estimated for each core. The percent recovery is estimated as the sample length recovered divided by the penetration depth. The following data will be recorded on the Sediment Core Collection Form (Appendix B):

- Sampling location, time, and water depth
- Mudline elevation
- Core tube penetration depth and sample recovery
- Physical description of core tube (e.g., intact, bent, full core catcher)

The core tubes will be inspected for adherence to the following criteria:

- Recovered sediment was collected to a depth of at least 1.5 or 2 ft (45 or 60 cm, depending on area type) below mudline.
- Core tube is not overfilled.
- Overlying water is present and the surface interval is intact.
- Estimated recovery is greater than 75%.
- Core tube appears intact without obstructions or blocking.

If sample acceptance criteria are not achieved in the first core, the sample will be set aside and up to two additional core drives will be advanced at locations within 10 m of the proposed location. If sample acceptance criteria are not achieved in any of the three cores, oversight personnel will be consulted to discuss whether an alternative location should be sampled. The sampling location may be repositioned at a location greater than 10 m from the proposed location, following discussions with EPA, Ecology, and LDWG representatives. If an alternative location is not selected, the core with the highest sampling depth and recovery will be used.

While the core tube is on deck, the overlying water will be siphoned off using plastic tubing or a similar siphoning device. The cores will be capped, taped, and labeled with the station ID and "top" and "bottom." Core tubes will be stored horizontally and sealed to minimize loss of moisture while waiting to be processed.

Field notes of all core samples will be maintained as samples are collected. The following information will be included on the Sediment Core Collection Form (Appendix B):

- Mudline elevation of each sediment core location relative to MLLW
- Location of each sediment core as determined using DGPS measurements
- Date and time of collection for each sediment core
- Names of field supervisor and person(s) collecting and logging the sample
- Observations made during sample collection, including weather conditions, complications, ship traffic, and other details associated with the sampling effort
- The location and sample identification
- Estimated depth of sediment recovered using the vibracorer
- Any deviations from the approved sampling plan recorded on a Protocol Modification Form (Appendix B)

Sediment core processing will be performed on the boat. Sediment from each accepted core will be homogenized and placed in sample jars in a cooler for transport to the laboratories.

All working surfaces and instruments will be thoroughly cleaned, decontaminated, and covered with aluminum foil to minimize outside contamination between sampling events. Disposable chemically resistant (e.g., nitrile) gloves will be discarded after processing at each sampling location and new gloves put on prior to handling decontaminated instruments or work surfaces.

Sample containers (i.e., jars and bottles) will be kept in the original packaging as received from the analytical laboratory (i.e., coolers and/or boxes) until they are used to collect the samples; a sample container will be withdrawn from the original packaging only when a sample is to be collected and placed within the container. The container will immediately be labeled and returned to a sturdy plastic cooler that contains ice and/or frozen gel packs.

The steps for processing the sediment core samples are as follows:

1. Carefully cut along the polycarbonate core liner to expose the sediment core for processing. The sediment samples should be collected into separate stainless steel containers, labeled, covered with aluminum foil, and stored on ice.
2. Take photographs of each core before sampling.

3. Record a description of each core on the Sediment Core Collection Form (Appendix B), to include the following parameters, as appropriate:
   - Elevation of bed at sampling location
   - Sample recovery depth (in centimeters)
   - Odor (e.g., hydrogen sulfide, petroleum)
   - Vegetation
   - Debris
   - Biological activity (e.g., detritus, shells, tubes, bioturbation, live or dead organisms)
   - Presence of oil sheen
   - Any other distinguishing characteristics or features, such as lithology, redox depth, sediment lenses, etc.
4. Transfer material from each core that will make up the sample for laboratory analysis into single clean stainless steel bowl and homogenize.
5. Using a clean stainless steel spoon, completely fill pre-labeled sample containers for analysis (see Section 3.3.1) taking care to avoid sediment contacting the core liner.
6. Thoroughly check all sample containers for proper identification, analysis type, and lid tightness.
7. Carefully pack each container to prevent breakage and place inside a cooler with ice or frozen gel packs for storage at the proper temperature (0 to 6 °C for all samples).

#### 3.2.5 Decontamination procedures

All sediment sampling and homogenizing equipment, including the mixing bowl and stainless-steel implements, will be decontaminated following PSEP (1997) guidelines between locations or samples using the following procedures:

1. Rinse with site water and wash with a scrub brush until free of sediment.
2. Wash with phosphate-free detergent.
3. Rinse with site water.
4. Rinse with distilled water.

Acid or solvent washes will not be used in the field because of safety considerations and problems associated with rinsate disposal and sample integrity. Specifically:

- The use of acids or organic solvents may pose a safety hazard to the field crew.

- Disposal and spillage of acids and solvents during field activities pose an environmental concern.
- Residues of solvents and acids on sampling equipment may affect sample integrity for chemical testing.

Any sampling equipment that cannot be cleaned to the satisfaction of the FC will not be used for further sampling activity.

### 3.2.6 Field-generated waste disposal

Excess sediment and equipment decontamination water will be returned to each sampling location after sampling is completed for that location. All disposable sampling materials and personal protective equipment used in sample processing, such as disposable coveralls, gloves, and paper towels, will be placed in heavyweight garbage bags or other appropriate containers. Disposable supplies will be removed from the site by sampling personnel and placed in a normal refuse container for disposal as solid waste.

## 3.3 Sample Handling and Custody Requirements

This section describes how individual samples will be processed, labeled, tracked, stored, and transported to the laboratory for analysis. In addition, this section describes sample custody procedures and shipping requirements. Sample custody is a critical aspect of environmental investigations. Sample possession and handling must be traceable from the time of sample collection, through laboratory and data analyses, to delivery of the sample results to the recipient.

### 3.3.1 Sample handling procedures

Sediment samples for chemical analyses will be placed in appropriately sized, certified-clean, labeled, wide-mouth glass jars and capped with Teflon®-lined lids (Table 3-3). All sediment sample containers will be filled leaving a minimum of 1 cm of headspace to prevent breakage during shipping and storage. Prior to shipment, each glass container will be wrapped in bubble wrap and placed in a cooler with wet ice.

**Table 3-3. Sample containers and laboratory conducting chemical analyses of sediment samples**

| Parameter | Container | Laboratory |
|---|---|---|
| PCBs (as Aroclors), TOC, and total solids | 8-oz glass jar[a] | ARI |
| Archive (chemical analyses)[b] | 16-oz glass jar | ARI |
| Archive (grain size analysis)[c] | 16-oz glass jar | ARI |

[a] Triplicate volume will be required per 20 samples to provide sufficient volume for laboratory QA/QC samples.
[b] Archive sediment will be frozen at ARI in the event that additional chemical analyses are necessary.

c Archive sediment will be refrigerated at ARI in the event that grain size analysis is necessary.

ARI – Analytical Resources, Inc.
PCB – polychlorinated biphenyl
TOC – total organic carbon
QA – quality assurance
QC – quality control

Sample labels will be waterproof and self-adhering. Each sample label will contain the project number, sample identification, preservation technique, analyses, date, and time of collection, and initials of the person(s) preparing the sample. A completed sample label will be affixed to each sample container. The labels will be covered with clear tape immediately after they have been completed to protect them from being stained or spoiled from water and sediment.

At the laboratory, a unique sample identifier will be assigned to each sample (using either project ID or laboratory ID). The laboratory will ensure that a sample tracking record follows each sample through all stages of laboratory processing. The sample tracking record must contain, at a minimum, the name/initials of responsible individuals performing the analyses, dates of sample extraction/preparation and analysis, and the type of analysis being performed.

### 3.3.2 Sample custody procedures

Samples are considered to be in custody if they are: 1) in the custodian's possession or view, 2) retained in a secured place (under lock) with restricted access, or 3) placed in a container and secured with an official seal(s) such that the sample cannot be reached without breaking the seal(s). Custody procedures will be used for all samples throughout the collection, transport, and analyses, and for all data and data documentation whether in hard copy or electronic format. Custody procedures will be initiated during sediment sample collection. A COC form will accompany samples to the analytical laboratory. Each person who has custody of the samples will sign the COC form and ensure that the samples are not left unattended unless properly secured. Minimum documentation of sample handling and custody will include:

- Sample location, project name, and unique sample number
- Sample collection date and time
- Any special notations on sample characteristics or problems
- Initials of the person collecting the sample
- Date sample was sent to the laboratory
- Shipping company name and waybill number

The FC will be responsible for all sample tracking and custody procedures for samples in the field. The FC will be responsible for final sample inventory and will maintain sample custody documentation. The FC will also complete COC forms prior to removing samples from the sampling area. At the end of each day, and prior to transfer, COC entries will be made for all samples. Information on the labels will be checked against sample log entries, and sample tracking forms and samples will be recounted. COC forms will accompany all samples. The COC forms will be signed at each point of transfer. Copies of all COC forms will be retained and included as appendices to QA/QC reports and data reports. Sediment samples will be shipped in sealed coolers to the analytical laboratories. The FC will ensure that the laboratory has accepted delivery of the shipment at the specified time.

The laboratories will ensure that COC forms are properly signed upon receipt of the samples and will note questions or observations concerning sample integrity on the COC forms. The laboratories will contact the FC and project QA/QC coordinator immediately if discrepancies are discovered between the COC forms and the sample shipment upon receipt.

The laboratory will ensure that a sample-tracking record follows each sample through all stages of laboratory processing. The sample-tracking record must contain, at a minimum, the name/initials of individuals responsible for performing the analyses, dates of sample extraction/preparation and analysis, and the types of analyses being performed.

### 3.3.3 Shipping requirements

Coolers with sediment samples for chemical and grain-size analyses will be couriered to the appropriate analytical laboratory. The temperature inside the cooler(s) containing chemistry samples will be checked upon receipt at the laboratory by measuring the temperature of blank water samples packed inside the coolers. The laboratories will specifically note any coolers that do not contain ice packs or that are not sufficiently cold (4° ± 2°C) upon receipt. Each sample will be assigned a unique laboratory number, and samples will be grouped in appropriate sample delivery groups (SDGs). Samples will be assigned a specific storage area within the laboratory and will be kept there until analyzed. The laboratories will not dispose of the environmental samples for this project until notified in writing by the QA/QC coordinator.

## 3.4 Analytical Methods

A summary of the analyses to be conducted is presented in Table 3-4. Laboratory methods, sample handling, and DQIs for the sediment samples collected for chemical analysis are described in this section.

### Table 3-4. Summary of number of sediment samples and analyses

| Sediment Type | No. of Samples | Sampling Gear | Analyses |
|---|---|---|---|
| Surface sediment samples | 48[a] | van Veen or pneumatic grab, or by hand (intertidal) | PCBs (as Aroclors), total solids, and TOC |
| Subsurface core samples | 12[b] | vibracorer | PCBs (as Aroclors), total solids, and TOC |

a An additional 24 surface sediment samples will be collected from the backup areas and archived for potential chemical and grain size analyses.

b An additional 6 subsurface core samples will be collected from the backup areas and archived for potential chemical and grain size analyses.

PCB – polychlorinated biphenyl

TOC – total organic carbon

### 3.4.1 Laboratory methods and sample handling

Chemical analyses of the sediment samples will be conducted at ARI. In addition to the analyses specified, additional sediment from each sample will be archived at ARI in the event that additional chemical and grain size analyses are necessary. Analytical methods and sample handling requirements are presented in Table 3-5.

### Table 3-5. Laboratory analytical methods and sample handling requirements for sediment samples

| Parameter | Method | Reference | Maximum Sample Holding Time[a] | Preservative |
|---|---|---|---|---|
| PCBs as Aroclors | GC/ECD | EPA 8082 | none | cool/≤6°C |
| TOC | combustion | EPA 9060 | 28 days | cool/≤6°C |
| Total solids | oven-dried | PSEP (1986)/ SM 2540-G | 14 days | cool/≤6°C |

a All sample extracts will be archived frozen at the laboratory until the Windward PM authorizes their disposal.

GC – gas chromatography

ECD – electron capture detection

EPA – US Environmental Protection Agency

PCB – polychlorinated biphenyl

PSEP – Puget Sound Estuary Program

TOC – total organic carbon

### 3.4.2 Data quality indicators

The parameters used to assess data quality are precision, accuracy, representativeness, comparability, completeness, and sensitivity. Table 3-6 lists specific DQIs for laboratory chemical analyses of sediment samples. These parameters are discussed in more detail in the following sections.

### Table 3-6. Data quality indicators for sediment analyses

| Parameter | Units | Sensitivity | | Precision | Accuracy | Completeness |
|---|---|---|---|---|---|---|
| | | RL/LOQ | MDL/LOD | | | |
| PCBs as Aroclors | µg/kg dw | 10 | 5 | ±50% | 30 – 150% | 95% |
| TOC | % dw | 0.01 | 0.0047 | ±30% | 75 – 125% | 95% |
| Total solids | % ww | 0.1 | na | ±20% | na | 95% |

LOD – limit of detection
LOQ – limit of quantification
MDL – method detection limit
na – not applicable
PCB – polychlorinated biphenyl
RL – reporting limit
TOC – total organic carbon

*Precision*

Precision is the measure of the reproducibility among individual measurements of the same property, usually under similar conditions, such as multiple measurements of the same sample. Precision is assessed by performing multiple analyses on a sample and is expressed as an RPD when duplicate analyses are performed and as a percent relative standard deviation (% RSD) when more than two analyses are performed on the same sample (e.g., triplicates). Precision is assessed by laboratory duplicate analyses (duplicate samples, matrix spike duplicates, laboratory control sample [LCS] duplicates) for all parameters. When duplicate samples are not available or spiking of the matrix is inappropriate; precision is assessed by laboratory triplicate analyses (e.g., TOC). Precision measurements can be affected by the nearness of a chemical concentration to the method detection limit (MDL), where the percent error (expressed as either % RSD or RPD) increases. The DQI for precision varies depending on the analyte (Table 3-6). The equations used to express precision are as follows:

$$\text{RPD} = \frac{(\text{measured conc} - \text{measured duplicate conc})}{(\text{measured conc} + \text{measured duplicate conc}) \div 2} \times 100$$

$$\%\text{RSD} = (\text{SD}/\text{D}_{\text{ave}}) \times 100$$

where:

$$\text{SD} = \sqrt{\left(\frac{\left(\sum \text{Dn} - \text{D}_{\text{ave}}\right)^2}{(\text{n}-1)}\right)}$$

D = sample concentration
$D_{ave}$ = average sample concentration
n = number of samples
SD = standard deviation

*Accuracy*

Accuracy is an expression of the degree to which a measured or computed value represents the true value. Accuracy is expressed as a percentage recovery for matrix spike, surrogate spike, and laboratory control sample analyses. The DQI for accuracy varies, depending on the analyte (Table 3-6). Below is the equation used to express accuracy for spiked samples:

$$\text{Percent recovery} = \frac{\text{spike sample result} - \text{unspiked sample result}}{\text{amount of spike added}} \times 100$$

*Representativeness*

Representativeness expresses the degree to which data accurately and precisely represent an environmental condition. The sampling approach was designed to address the specific data needs described in Section 2.2. Assuming those needs are met, the samples collected should be considered adequately representative of the environmental conditions they are intended to characterize.

*Comparability*

Comparability expresses the confidence with which one dataset can be evaluated in relation to another dataset. The sample collection and chemical and physical testing will adhere to the most recent PSEP QA/QC procedures (PSWQAT 1997) and EPA and PSEP analytical protocols.

*Completeness*

Completeness is a measure of the amount of data that is determined to be valid in proportion to the amount of data collected. Completeness will be calculated as follows:

$$\text{Completeness} = \frac{\text{number of valid measurements}}{\text{total number of data points planned}} \times 100$$

The DQI for completeness for all components of this project is 95%. Data that have been qualified as estimated because the QC criteria were not met will be considered valid for the purpose of assessing completeness. Data that have been qualified as rejected will not be considered valid for the purpose of assessing completeness.

*Sensitivity*

Analytical sensitivity is a measure of both the ability of the analytical method to detect the analyte and the concentration that can be reliably quantified. The minimum concentration of the analyte that can be detected is the MDL or limit of detection (LOD). The minimum concentration that can be reliably quantified is the RL or limit of quantification (LOQ). ARI uses MDLs/LODs and RLs/LOQs for reporting analyte concentrations. For this study, MDLs/LODs and RLs/LOQs will be used as measures of sensitivity for each ARI analysis.

ARI will report detected concentrations above the RL/LOQ without qualification and will report detected concentrations between the MDL/LOD and the RL/LOQ with a J qualifier indicating the concentration is estimated. The RLs/LOQs and MDLs/LODs are presented in Table 3-6.

## 3.5 Quality Assurance/Quality Control

The QA/QC criteria for the laboratory analyses are described below.

### 3.5.1 Sample delivery group

Project- and/or method-specific quality control measures such as matrix spikes and matrix spike duplicates will be analyzed per SDG or sample batch. An SDG is defined as no more than 20 samples or a group of samples received at the laboratory within a 2-week period.

### 3.5.2 Laboratory quality control criteria

The analyst will review results of QC analyses (described below) from each sample group immediately after a sample group has been analyzed. The QC sample results will then be evaluated to determine whether control limits have been exceeded. If control limits are exceeded in the sample group, the project QA/QC coordinator will be contacted immediately, and corrective action, such as method modifications followed by reprocessing of the affected samples, will be initiated before processing a subsequent group of samples.

All primary chemical standards and standard solutions used in this project will be traceable to the National Institute of Standards and Technology, Environmental Resource Associates, National Research Council of Canada, or other documented, reliable, commercial sources. The accuracy of the standards will be verified by comparison with an independent standard. Laboratory QC standards are verified a multitude of ways. Second-source calibration verifications are run (i.e., same standard, two different vendors) for calibrations. New working standard mixes (calibrations, spikes, etc.) are verified against the results of the original solution and must be within 10%. Newly purchased standards are verified against current data. Any impurities found in the standard will be documented. The following sections summarize the procedures that will be used to assess data quality throughout sample analysis. Table 3-7 summarizes the QC procedures and sample analyses to be performed by the laboratory. The associated control limits for precision and accuracy are summarized in Table 3-6.

## Table 3-7. Quality control sample analysis summary

| Analysis Type | Initial Calibration | Continuing Calibration | Laboratory Control Samples | Matrix Replicates | Matrix Spikes | Matrix Spike Duplicates | Method Blanks | Surrogate Spikes |
|---|---|---|---|---|---|---|---|---|
| PCB Aroclors | prior to analysis | every 10 to 20 analyses or 12 hrs | 1 per 20 samples | none | 1 per batch or SDG | 1 per batch or SDG | each batch or SDG | each sample[a] |
| TOC | daily | every 10 samples | na | 1 per 20 samples | 1 per 20 samples | na | each batch or SDG | na |
| Percent solids | na | na | na | 1 per 20 samples | na | na | na | na |

na – not applicable
PCB – polychlorinated biphenyl
SDG – sample delivery group
TOC – total organic carbon

*Matrix Replicates*

Analytical replicates provide information on the precision of the analysis and are useful in assessing potential sample heterogeneity and matrix effects. Analytical replicates are subsamples of the original sample that are prepared and analyzed as a separate sample, assuming sufficient sample matrix is available.

*Matrix Spikes and Matrix Spike Duplicates*

The analysis of matrix spike samples provides information on the extraction efficiency of the method on the sample matrix. By performing duplicate matrix spike analyses, information on the precision of the method is also provided for organic analyses.

*Method Blanks*

Method blanks are analyzed to assess possible laboratory contamination at all stages of sample preparation and analysis.

*Surrogate Spikes*

All project samples analyzed for organic compounds will be spiked with appropriate surrogate compounds as defined in the analytical methods. Surrogate recoveries will be reported by the laboratories; however, no sample results will be corrected for recovery using these values.

*Laboratory Control Samples*

LCS are analyzed as a measure of the accuracy of the analyses. LCS recoveries will be reported by the laboratories; however, no sample results will be corrected for recovery using these values.

## 3.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

Prior to each field event, measures will be taken to test, inspect, and maintain all field equipment. All equipment used, including the GPS unit and digital camera will be tested for use before leaving for the field event.

The FC will be responsible for overseeing the testing, inspection, and maintenance of all field equipment. The laboratory PM will be responsible for ensuring that laboratory equipment testing, inspection, and maintenance requirements are met. The methods used in calibrating the analytical instrumentation are described in the following section.

## 3.7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

Multipoint initial calibration will be performed on each instrument at the start of the project, after each major interruption to the analytical instrument, and when any continuing calibration does not meet the specified criteria. The number of points used in the initial calibration is defined in each analytical method. Continuing calibrations will be performed every 12 hrs or 10 to20 samples for PCB Aroclor analysis and once every 10 samples for TOC analysis to ensure proper instrument performance. In addition, if an Aroclor is detected in a sample, then the standard for that Aroclor must be analyzed in the continuing calibration within 72 hrs of the original detection of the Aroclor.

Calibration of analytical equipment used for chemical analyses includes instrument blanks or continuing calibration blanks, which provide information on the stability of the baseline established. Continuing calibration blanks will be analyzed immediately after the continuing calibration verification at a frequency of one blank for every 10 samples analyzed for TOC and one blank for every 12 hours or 10 to 20 samples analyzed for PCB Aroclors. If the continuing calibration does not meet the specified criteria, the analysis must stop. Analysis may resume after corrective actions have been taken to meet the method specifications. All project samples analyzed by an instrument found to be out of compliance must be reanalyzed.

None of the field equipment requires calibration.

## 3.8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

The field team leaders for each sampling event will have a checklist of supplies required for each day in the field. The FC will gather and check these supplies daily for satisfactory conditions before each field event. Batteries used in the GPS unit and digital camera will be checked daily and recharged as necessary. Supplies and consumables for field sampling will be inspected upon delivery and accepted if the condition of the supplies is satisfactory. For example, jars will be inspected to ensure that they are the correct size and quantity and were not damaged in shipment.

## 3.9 DATA MANAGEMENT

All field data will be recorded on field forms (see Appendix B), which will be checked for missing information by the FC at the end of each field day and amended. After sampling is completed, all data from field forms will be entered into a Microsoft Excel® spreadsheet. A QC check will be done within 24 hours to ensure that 100% of the data were properly transferred from the field forms to the spreadsheet. This spreadsheet will be kept on the Windward network drive, which is backed up daily. Field forms will be archived in the Windward library. All photographs will be transferred to a CD each day.

The analytical laboratory is expected to submit data in an electronic format, as described in Section 2.6.2. The laboratory PM will contact the project QA/QC coordinator prior to data delivery to discuss specific format requirements.

A library of routines will be used to translate typical electronic output from laboratory analytical systems and to generate data analysis reports. The use of automated routines ensures that all data are consistently converted into the desired data structures and that operator time is kept to a minimum. In addition, routines and methods for quality checks will be used to ensure such translations are correctly applied.

Written documentation will be used to clarify how field and analytical laboratory duplicates and QA/QC samples were recorded in the data tables and to provide explanations of other issues that may arise. The data management task will include keeping accurate records of field and laboratory QA/QC samples so that project team members who use the data will have appropriate documentation. Data management files will be stored on a secure computer.

# 4 Assessment and Oversight

## 4.1 COMPLIANCE ASSESSMENTS AND RESPONSE ACTIONS

EPA, Ecology, or their designees may observe field activities during each sampling event, as needed. If situations arise where there is an inability to follow QAPP methods precisely, the Windward PM will determine the appropriate actions or consult EPA and Ecology if the issue is significant.

### 4.1.1 Compliance assessments

Laboratory and field performance assessments consist of on-site reviews conducted by EPA of QA systems and equipment for sampling, calibration, and measurement. EPA personnel may conduct a laboratory audit prior to sample analysis. Any pertinent laboratory audit reports will be made available to the project QA/QC coordinator upon request. Analytical laboratories are required to have written procedures addressing internal QA/QC; these procedures will be submitted for review by the project QA/QC coordinator to ensure compliance with the QAPP. All laboratories and QA/QC coordinators are required to ensure that all personnel engaged in sampling and analysis tasks have appropriate training.

#### 4.1.2 Response actions for field sampling

The FC, or a designee, will be responsible for correcting equipment malfunctions throughout field sampling and for resolving situations in the field that may result in nonconformance or noncompliance with the QAPP. All corrective measures will be immediately documented in the field logbook, and protocol modification forms will be completed.

#### 4.1.3 Corrective action for laboratory analyses

Analytical laboratories are required to comply with the standard operating procedures previously submitted to the project QA/QC coordinator. The laboratory PMs will be responsible for ensuring that appropriate corrective actions are initiated as required for conformance with this QAPP. All laboratory personnel will be responsible for reporting problems that may compromise the quality of the data.

The project QA/QC coordinator will be notified immediately if any QC sample exceeds the project-specified control limits (Table 3-6). The analyst will identify and correct the anomaly before continuing with the sample analysis. The laboratory PM will document the corrective action taken in a memorandum submitted to the project QA/QC coordinator within 5 days of the initial notification. A narrative describing the anomaly, the steps taken to identify and correct the anomaly, and the treatment of the relevant sample batch (i.e., recalculation, reanalysis, re-extraction) will be submitted with the data package using the Protocol Modification Form.

### 4.2 Reports to Management

The FC will prepare a summary following the sampling event documenting sample coordinates and whether any QAPP deviations occurred. The project QA/QC coordinator will also prepare a summary when analyses are complete documenting any laboratory deviations. Electronic data deliverables will be delivered to EPA, and data will be exported into the Ecology Environmental Information Management System. The electronic data deliverable will include:

- Task
- Location name
- Location description

- Sample name
- Sample description
- Sample matrix
- Sample type
- Sample depth
- Parent sample
- Sample date
- Sample coordinates (including horizontal datum and coordinate type)
- Sampling method
- Chemical group
- Chemical and CAS number
- Sample result value
- Qualifier (post validation)
- Units and basis
- Detection status
- Validation status
- Number of significant figures
- Reporting limits
- Analysis method
- Analysis date
- Laboratory
- Sample delivery group
- Lab QC average (yes/no field to indicate if averaging was conducted)
- Field QC average (yes/no field to indicate if averaging was conducted)
- Sample dilution
- Calculated values (e.g., total PCBs and TOC normalized PCB results)

# 5 Data Validation and Usability

## 5.1 Data Validation

Data are not considered final until validated. Data validation will be conducted following EPA (2008, 2010) guidance.

The data validation process begins within the laboratory with the review and evaluation of data by supervisory personnel or QA specialists. The laboratory analyst is responsible for ensuring that the analytical data are correct and complete, that appropriate procedures have been followed, and that QC results are within the acceptable limits. The project QA/QC coordinator is responsible for ensuring that all analyses performed by the laboratories are correct, properly documented, and complete, and that they satisfy the project data quality objectives specified in this QAPP.

Independent third-party data review and compliance screening (Level 2a) validation of the total solids, TOC, and PCB Aroclor data will be conducted by Laboratory Data Consultants, Inc.

Quality assurance review of the sediment chemistry data will be performed in accordance with the QA requirements of the project, the technical specifications of the analytical methods indicated in Table 3-5, and EPA (2008, 2010) guidance for data review. Data validation qualifiers that are found in EPA (2008, 2010) guidance will be applied to the data upon validation. The EPA PM may have EPA peer review the third-party validation or perform data assessment/validation on a percentage of the data.

## 5.2 Reconciliation with Data Quality Objectives

Data quality assessment will be conducted by the project QA/QC coordinator in consultation with EPA guidelines. The results of the third-party independent review and validation will be reviewed, and cases where the projects DQIs were not met will be identified. The usability of the data will be determined in terms of the magnitude of the DQI exceedance.

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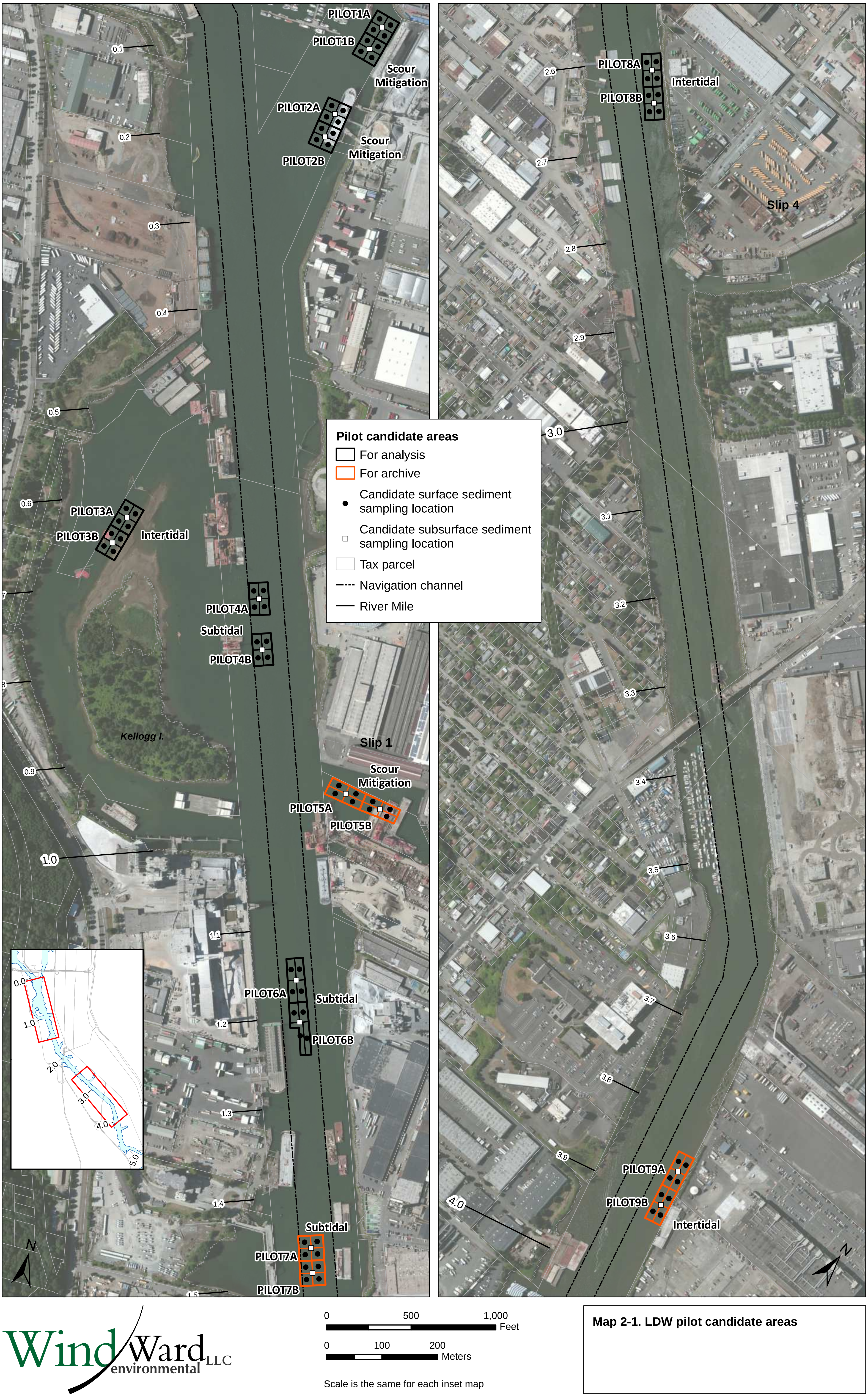
PSWQAT. 1997. Recommended quality assurance and quality control guidelines for the collection of environmental data in Puget Sound. Prepared for U.S. Environmental Protection Agency Region 10. Puget Sound Water Quality Action Team, Olympia, WA.

# Maps

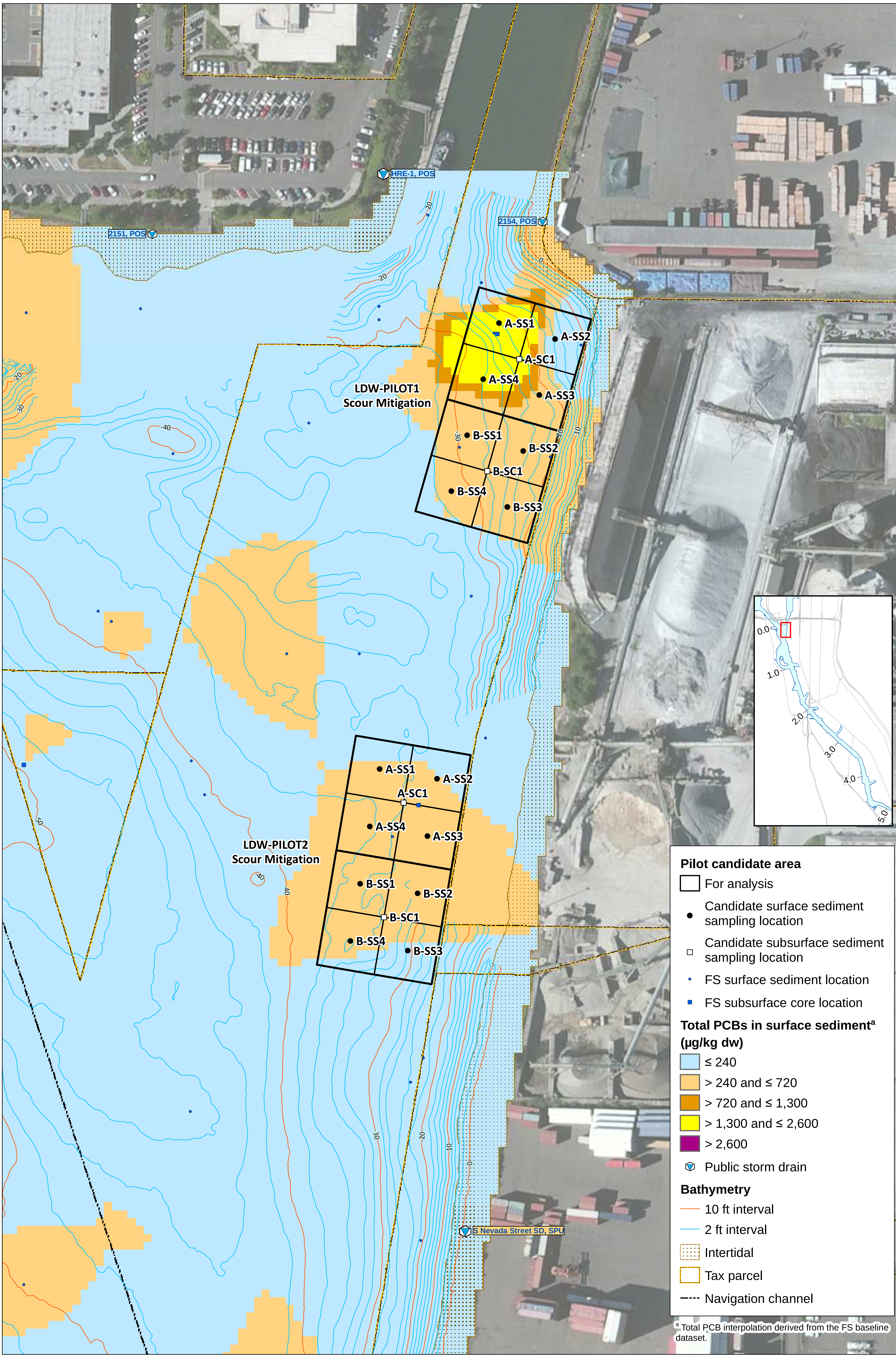



Map 2-1. LDW pilot candidate areas

Windward environmental LLC

Prepared by craigh, 10/27/2014; W:\Projects\00-08-06_Duwamish_RI\data\GIS\Sampling 2014\QAPP\Map 2-1 5961 Candidate sampling locations.mxd

Orthophoto source: US-WA-Seattle-Tacoma, 08/01/2011, 1 foot resolution. Microsoft, 2011.

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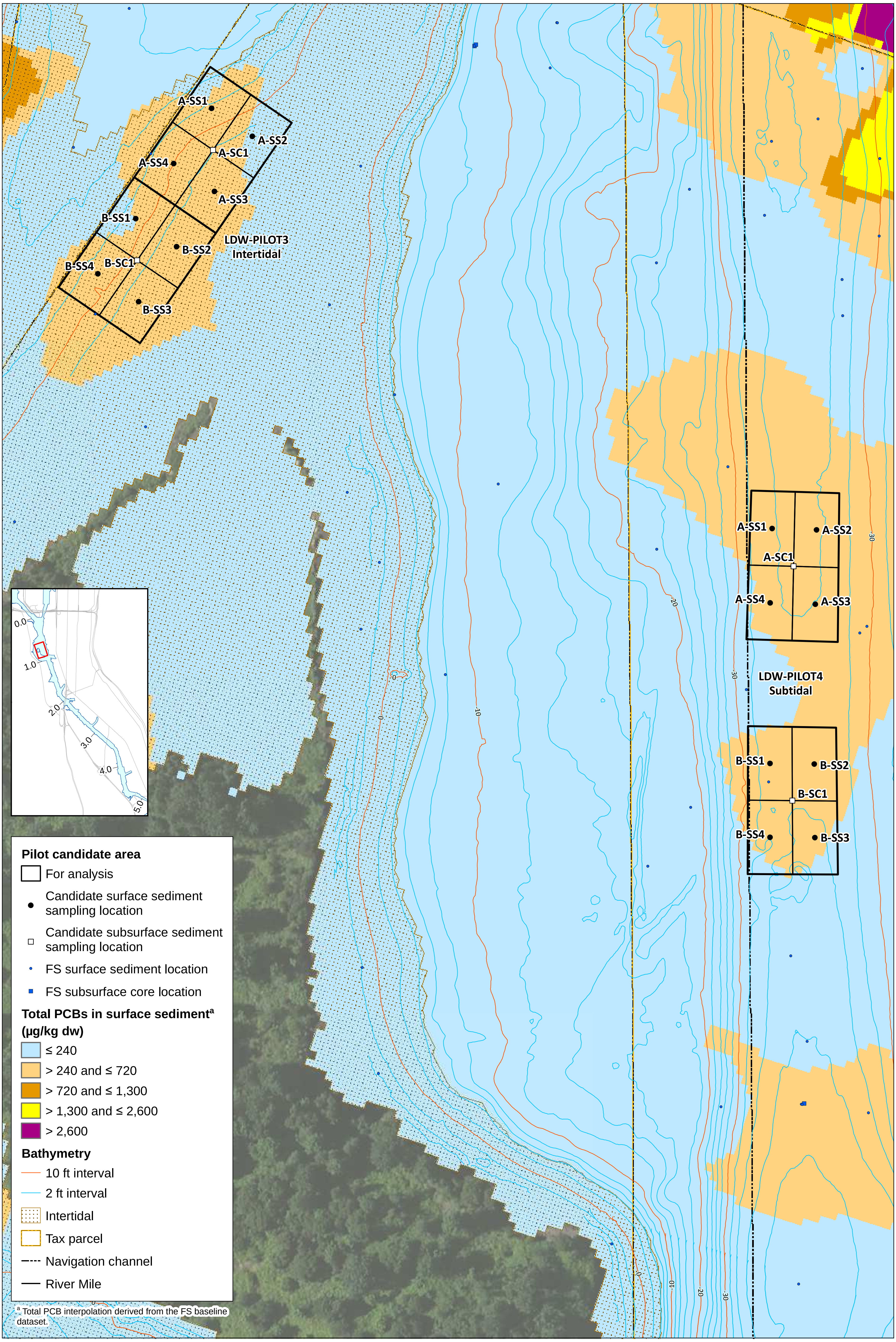
**Map 3-1a. Sediment sampling locations for candidate areas 1 and 2**

Prepared by craigh, 10/27/2014; W:\Projects\00-08-06_Duwamish_RI\data\GIS\Sampling 2014\QAPP\Map 3-1a 5961 Candidate sampling locations.mxd

Orthophoto source: US-WA-Seattle-Tacoma, 08/01/2011, 1 foot resolution. Microsoft, 2011.




Prepared by craigh, 10/27/2014; W:\Projects\00-08-06_Duwamish_RI\data\GIS\Sampling 2014\QAPP\Map 3-1b 5961 Candidate sampling locations.mxd

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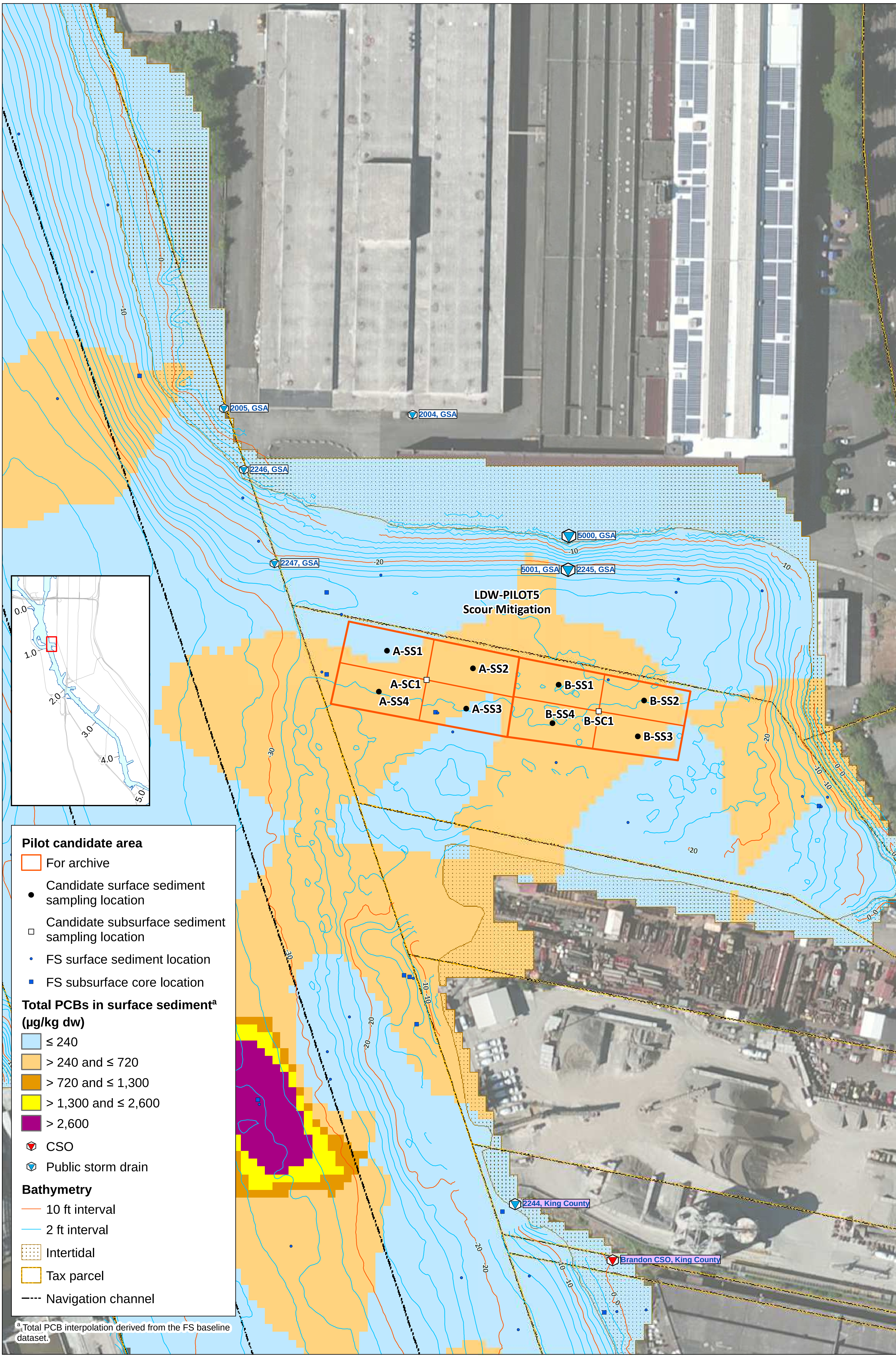
N

0 100 200 Feet

0 25 50 Meters

**Map 3-1b. Sediment sampling locations for candidate areas 3 and 4**

Orthophoto source: US-WA-Seattle-Tacoma, 08/01/2011, 1 foot resolution. Microsoft, 2011.




Wind Ward LLC environmental

N

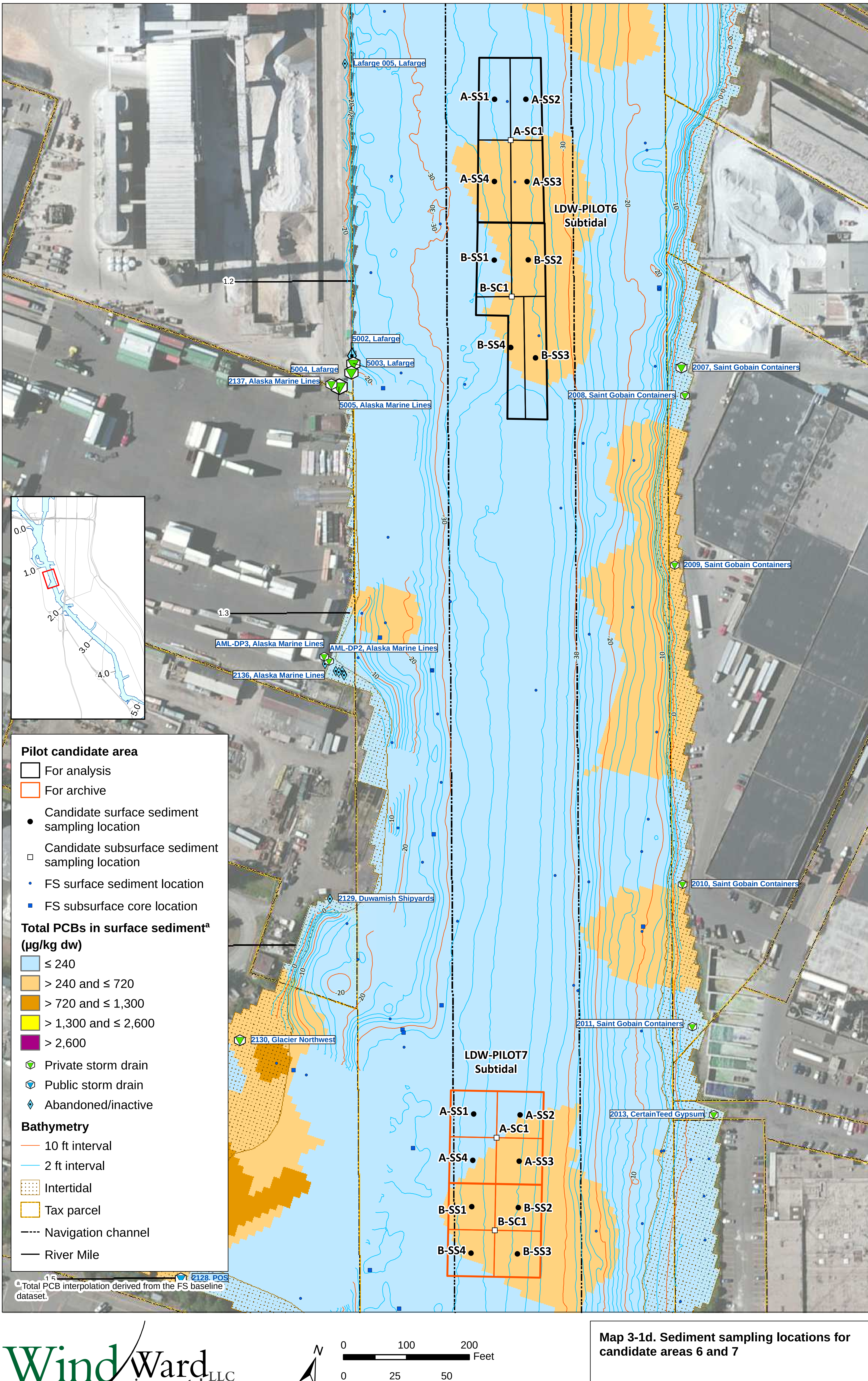
0 100 200 Feet

0 25 50 Meters

**Map 3-1c. Sediment sampling locations for candidate area 5**

Prepared by craigh, 10/27/2014; W:\Projects\00-08-06_Duwamish_RI\data\GIS\Sampling 2014\QAPP\Map 3-1c 5961 Candidate sampling locations.mxd

Orthophoto source: US-WA-Seattle-Tacoma, 08/01/2011, 1 foot resolution. Microsoft, 2011.

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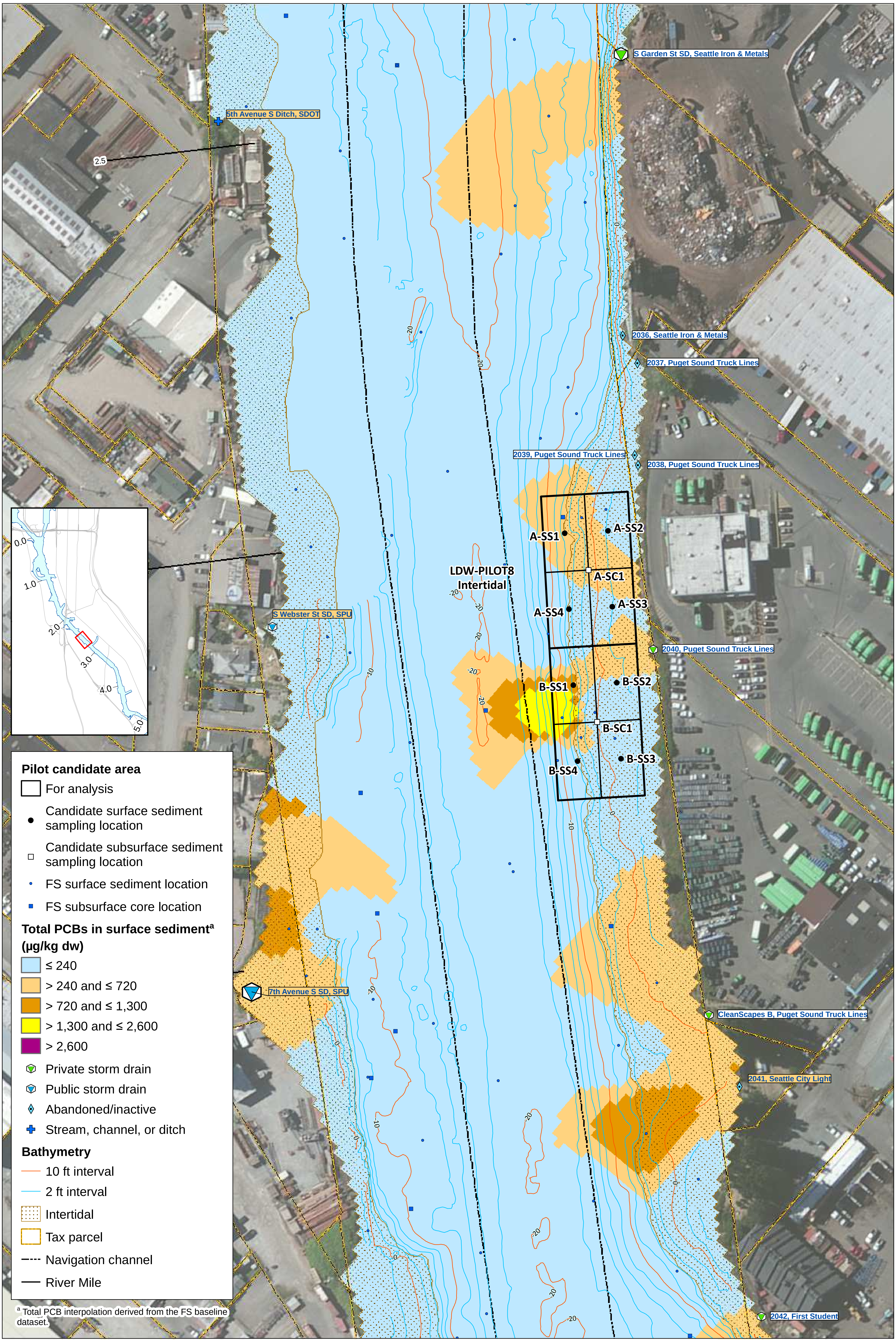
**Map 3-1d. Sediment sampling locations for candidate areas 6 and 7**

Orthophoto source: US-WA-Seattle-Tacoma, 08/01/2011, 1 foot resolution. Microsoft, 2011.

Prepared by craigh, 10/27/2014; W:\Projects\00-08-06_Duwamish_RI\data\GIS\Sampling 2014\QAPP\Map 3-1d 5961 Candidate sampling locations.mxd




Wind Ward environmental LLC

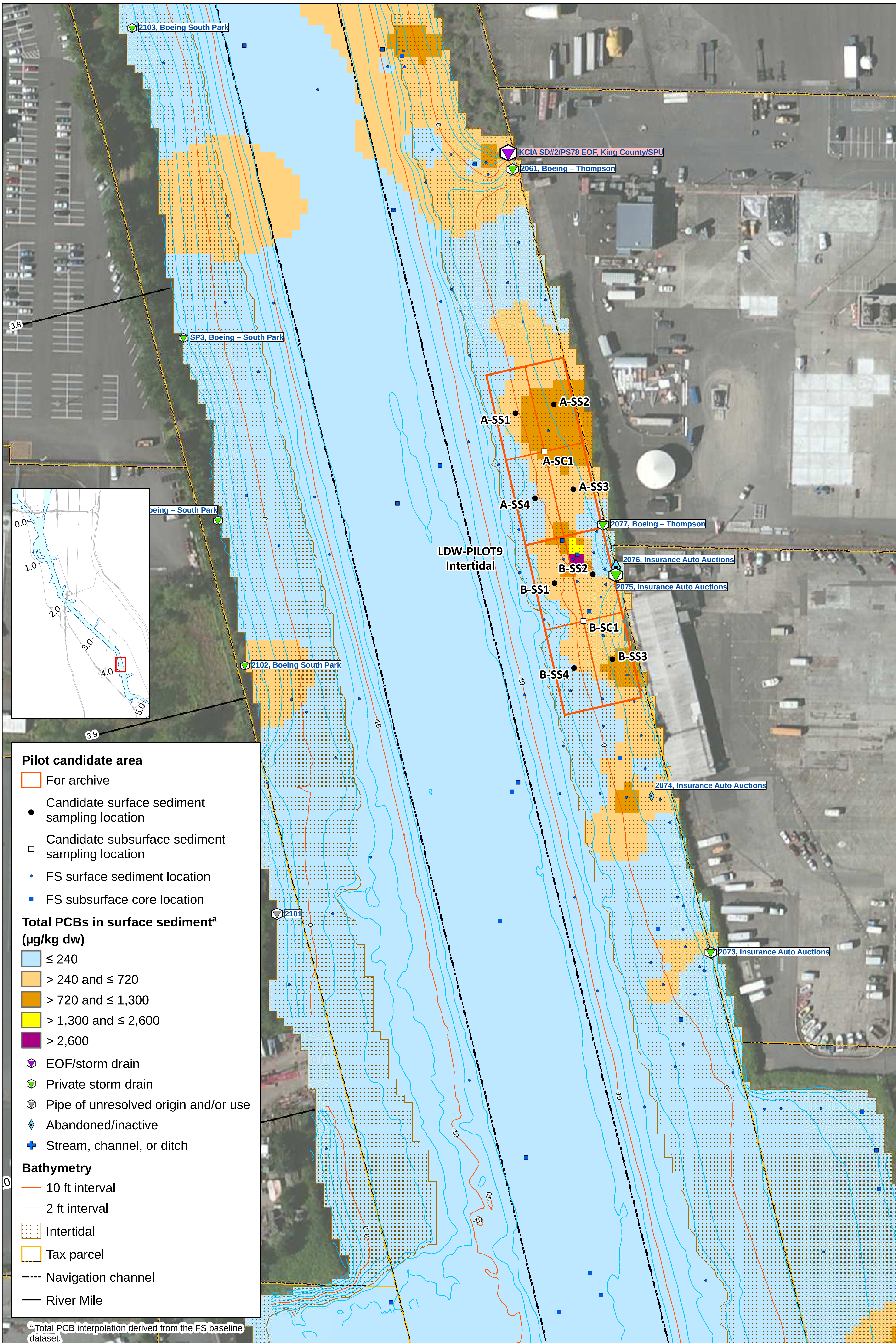
0 100 200 Feet

0 25 50 Meters

**Map 3-1e. Sediment sampling locations for candidate area 8**

Prepared by craigh, 10/27/2014; W:\Projects\00-08-06_Duwamish_RI\data\GIS\Sampling 2014\QAPP\Map 3-1e 5961 Candidate sampling locations.mxd

Orthophoto source: US-WA-Seattle-Tacoma, 08/01/2011, 1 foot resolution. Microsoft, 2011.




Windward environmental LLC

N

0 100 200 Feet

0 25 50 Meters

**Map 3-1f. Sediment sampling locations for candidate area 9**

Prepared by craigh, 10/27/2014; W:\Projects\00-08-06 Duwamish_RI\data\GIS\Sampling 2014\QAPP\Map 3-1f 5961 Candidate sampling locations.mxd

Orthophoto source: US-WA-Seattle-Tacoma, 08/01/2011, 1 foot resolution. Microsoft, 2011.

# APPENDIX A. HEALTH AND SAFETY PLAN

# Lower Duwamish Waterway Group

*Port of Seattle / City of Seattle / King County / The Boeing Company*

# QUALITY ASSURANCE PROJECT PLAN: ENHANCED NATURAL RECOVERY-ACTIVATED CARBON CANDIDATE PLOT SURFACE AND SUBSURFACE SEDIMENT SAMPLING FOR PCB ANALYSES FOR THE LOWER DUWAMISH WATERWAY

## APPENDIX A: HEALTH AND SAFETY PLAN

## FINAL

**For submittal to:**

**The US Environmental Protection Agency**
**Region 10**
Seattle, WA

**The Washington State Department of Ecology**
**Northwest Regional Office**
Bellevue, WA

**October 24, 2014**

**Prepared by:** Windward environmental LLC

200 West Mercer Street, Suite 401 ♦ Seattle, Washington ♦ 98119

# APPENDIX A: HEALTH AND SAFETY PLAN

**TITLE AND APPROVAL PAGE**
**LDW CANDIDATE PLOT**
**SURFACE AND SUBSURFACE SEDIMENT SAMPLING**
**HEALTH AND SAFETY PLAN**

By their signature, the undersigned certify that this Health and Safety Plan (HSP) is approved and that it will be used to govern health and safety aspects of fieldwork described in the Quality Assurance Project Plan to which it is attached.

October 24, 2014

Kathy Godtfredsen
Project Manager

Date

October 24, 2014

Thai Do
Corporate Health and Safety Manager

Date

October 24, 2014

Thai Do
Field Coordinator/Health and Safety Officer

Date

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## Acronyms

| ACRONYM | Definition |
|---|---|
| AC | activated carbon |
| CPR | cardiopulmonary resuscitation |
| ENR | enhanced natural recovery |
| EPA | US Environmental Protection Agency |
| FC | Field Coordinator |
| HSM | Corporate Health and Safety Manager |
| HSO | Field Health and Safety Officer |
| HSP | health and safety plan |
| LDW | Lower Duwamish Waterway |
| OSHA | Occupational Safety and Health Administration |
| PAH | polycyclic aromatic hydrocarbon |
| PCB | polychlorinated biphenyl |
| PFD | personal flotation device |
| PM | Project Manager |
| PPE | personal protective equipment |
| SIM | selected ion monitoring |
| TBT | tributyltin |

## A.1 Introduction

This site-specific health and safety plan (HSP) describes safe working practices for conducting field activities at potentially hazardous sites and for handling potentially hazardous materials/waste products. This HSP covers elements as specified in 29CFR1910§120. The procedures and guidelines contained in this plan are based on generally recognized health and safety practices. Any changes or revisions to this plan will be made by a written amendment, which will become a permanent part of this plan. The goal of the HSP is to establish procedures for safe working practices for all field personnel.

This HSP addresses all activities associated with collection and handling of sediment samples in the Lower Duwamish Waterway (LDW) in support of the enhanced natural recovery/activated carbon (ENR/AC) sediment chemistry pilot study. During site work, this HSP will be implemented by the Field Coordinator (FC), who is also the designated site Health and Safety Officer (HSO), in cooperation with the Corporate Health and Safety Manager (HSM) and the Project Manager.

All personnel involved in fieldwork on this project are required to comply with this HSP. The contents of this HSP reflect anticipation of the types of activities to be performed, knowledge of the physical characteristics of the site, and consideration of chemical data from previous investigations at the site. The HSP may be revised based on new information and/or changed conditions during site activities. Revisions will be documented in the project records.

Observers for the sampling event who are not field personnel will be given a safety briefing by the HSO on physical and chemical hazards. Agency observers, or their designees, will be advised of chemicals that may be present at the site and where those chemicals may be located. In addition, appropriate attire and any precautions necessary while walking along the shoreline will be discussed.

## A.2 Site Description and Project Scope

### A.2.1 Site Description

The sampling area is in the LDW (see Map 2-1 in the QAPP). The area is affected by tidal fluctuations. The QAPP to which this HSP is attached provides complete details of the sampling program. The following section summarizes the types of work that will be performed during field activities.

### A.2.2 Scope of Work

Specific tasks to be performed are as follows:

- Collection of surface sediment grab samples from a boat (subtidal or intertidal) or on foot (intertidal)
- Collection of subsurface sediment cores from a boat (subtidal or intertidal)

Additional details on the sampling design and sampling methods are provided in Sections 3.1 and 3.2, respectively.

## A.3 Health and Safety Personnel

Key health and safety personnel and their responsibilities are described below. These individuals are responsible for implementation of this HSP.

**Windward Project Manager:** The Windward project manager (PM) has overall responsibility for the successful outcome of the project. The PM will ensure that adequate resources and budget are provided for the health and safety staff to carry out their responsibilities during fieldwork. The PM, in consultation with the HSM, makes final decisions concerning implementation of the HSP.

**Field Coordinator/Health and Safety Officer:** Because of the limited scope and duration of fieldwork, the FC and HSO will be the same person. The FC/HSO will direct field sampling activities, coordinate the technical components of the field program with health and safety components, and ensure that work is performed according to the QAPP.

The FC/HSO will implement this HSP at the work location and will be responsible for all health and safety activities and the delegation of duties to a health and safety technician in the field, if appropriate. The FC/HSO also has stop-work authority, to be used if there is an imminent safety hazard or potentially dangerous situation. The FC/HSO or his designee shall be present during sampling and operations.

**Corporate Health and Safety Manager:** The HSM has overall responsibility for preparation, approval, and revisions of this HSP. The HSM will not necessarily be present during fieldwork, but will be readily available, if required, for consultation regarding health and safety issues during fieldwork.

**Field Crew:** All field crew members must be familiar with and comply with the information in this HSP. They also have the responsibility to report any potentially unsafe or hazardous conditions to the FC/HSO immediately.

## A.4 Hazard Evaluation and Control Measures

This section covers potential physical and chemical hazards that may be associated with the proposed project activities, and presents control measures for addressing these hazards. The activity hazard analysis, Section A.4.3, lists the potential hazards associated with each site activity and the recommended site control to be used to minimize each potential hazard.

Confined space entry will not be necessary for this project. Therefore, hazards associated with this activity are not discussed in this HSP.

### A.4.1 Physical Hazards

For this project, it is anticipated that physical hazards will present a greater risk of injury than chemical hazards. Physical hazards are identified and discussed below.

#### A.4.1.1 Slips, trips, and falls

As with all field work, caution should be exercised to prevent slips on slick surfaces. In particular, sampling from a boat or other floating platform requires careful attention to minimize the risk of falling down or of falling overboard. The same care should be used in rainy conditions or on the shoreline where slick rocks are found. Slips can be minimized by wearing boots with good tread, made of material that does not become overly slippery when wet.

Trips are always a hazard on the uneven deck of a boat, in a cluttered work area, or in the intertidal zone where uneven substrate is common. Personnel will keep work areas as free as possible from items that interfere with walking.

Falls may be avoided by working as far from exposed edges as possible, by erecting railings, and by using fall protection when working on elevated platforms. For this project, no work is anticipated that would present a fall hazard.

#### A.4.1.2 Sampling equipment deployment

A grab sampler and a vibracorer will be used to collect sediment samples from the boat. The sampling equipment will be deployed from the stern of the boat by a winch. Care will be taken to ensure that the samplers are safely guided from the stern over the railing and into the water. Before sampling activities begin, there will be a training session for all field personnel for the equipment that will be onboard the sampling vessel.

At some locations in the intertidal area, sampling may be conducted by hand using stainless steel spoons.

#### A.4.1.3 Falling overboard

Most of the sampling activities will be done from a boat. As with any work from a floating platform, there is a chance of falling overboard. Personal flotation devices (PFDs) will be worn while working on the boat.

#### A.4.1.4 Manual lifting

Equipment and samples must be lifted and carried. Back strain can result if lifting is done improperly. During any manual handling tasks, personnel should lift with the load supported by their legs and not their backs. For heavy loads, an adequate number of people will be used, or if possible, a mechanical lifting/handling device will be used.

#### A.4.1.5 Heat stress, hypothermia, or frostbite

Sampling operations and conditions that might result in the occurrence of heat stress are not anticipated. The sampling will occur during the time of year when cold weather conditions may occur, making hypothermia or frostbite a concern. The FC/HSO will monitor all crew members for early symptoms of hypothermia (e.g., shivering, muscle incoordination, mild confusion). If such symptoms are observed, the FC/HSO will take immediate steps to reduce heat loss by providing extra layers of clothing or by temporarily moving the affected crew member to a warmer environment.

#### A.4.1.6 Weather

In general, field team members will be equipped for the normal range of weather conditions. The FC/HSO will be aware of current weather conditions, and of the potential for those conditions to pose a hazard to the field crew. Some conditions that might force work stoppage are electrical storms, high winds, or high waves resulting from winds. In the event of heavy rain, field team members will not sample near a flowing combined sewer overflow because of potentially high levels of fecal coliform bacteria.

#### A.4.1.7 Sharp objects

Sampling operations might result in exposure of field personnel to sharp objects on top of or buried within the sediment. If encountered, field personnel should not touch these objects. Also, field personnel should not dig in the sediment by hand.

### A.4.2 VESSEL HAZARDS

Because of the high volumes of vessel and barge traffic on the LDW, precautions and safe boating practices will be implemented to ensure that the field boat does not interrupt vessel traffic. Additional potential vessel emergency hazards and responses are listed in Table A-1.

## Table A-1 Potential vessel emergency hazards and responses

| Potential Emergency Hazard | Response |
|---|---|
| Fire or explosion | If manageable, attempt to put out a small fire with a fire extinguisher. Otherwise, call the Coast Guard or 911 and evacuate the area (by rescue boat or swimming) and meet at a designated area. The FC/HSO will take roll call to make sure everyone evacuated safely. Emergency meeting places will be determined in the field during the daily safety briefing. |
| Medical emergency/ personal injury | At least one person with current first aid and cardiopulmonary resuscitation (CPR) training will be aboard the vessel at all times. This person will attempt to assess the nature and severity of the injury, call 911 immediately, and apply CPR if necessary. Stop work and wait for medical personnel to arrive. Fill out a site accident report. |
| Person overboard | All persons aboard the sampling vessel will wear a PFD at all times. Have one person keep an eye on the person and shout the distance (boat lengths) and direction (o'clock) of the person from the vessel. Stop work and use the vessel to retrieve the person in the water. |
| Sinking vessel | Call the Coast Guard immediately. If possible, wait for a rescue boat to arrive to evacuate vessel personnel. See fire/explosion section for emergency evacuation procedures. The FC/HSO will take a roll call to make sure everyone is present. |
| Lack of visibility | If the navigation visibility or personal safety is compromised because of smoke, fog, or other unanticipated hazards, stop work immediately. The vessel operator and FC/HSO will assess the hazard and, if necessary, send out periodic horn blasts to mark vessel location to other vessels potentially in the area, move to a secure location (i.e., berth), and wait for the visibility to clear. |
| Loss of power | Stop work and call Coast Guard for assistance. Use oars to move vessel towards the shoreline. Vessel personnel should watch for potential collision hazards and notify vessel operator if hazards exist. Secure vessel to a berth, dock, or mooring as soon as possible. |
| Collision | Stop work and call Coast Guard for assistance. The FC/HSO and vessel operator will assess damage and potential hazards. If necessary, vessel will be evacuated and secured until repairs can be made. |

### A.4.3 CHEMICAL HAZARDS

Previous investigations have shown that some chemicals are present at higher-than-background concentrations in the sampling area. For the purposes of discussing potential exposure to chemicals in sediments, the chemicals of concern are metals, tributyltin (TBT), petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs).

#### A.4.3.1 Exposure routes

Potential routes of chemical exposure include inhalation, dermal contact, and ingestion. Exposure will be minimized by using safe work practices and by wearing the appropriate personal protective equipment (PPE). Further discussion of PPE requirements is presented in Section A.7.

**Inhalation —**Inhalation is not expected to be an important route of exposure.

**Dermal exposure —** Dermal exposure to hazardous substances associated with sediments, surface water, or equipment decontamination will be controlled by the use of PPE and by adherence to detailed sampling and decontamination procedures.

**Ingestion —** Ingestion is not considered a major route of exposure for this project. Accidental ingestion of surface water is possible. However, careful handling of equipment and containers aboard the boat should prevent the occurrence of water splashing or spilling during sample collection and handling activities.

#### A.4.3.2 Description of chemical hazards

**Metals and tributyltin** — Exposure to metals may occur via ingestion or skin contact. As mentioned above, neither is likely as an exposure route. Metal fumes or metal-contaminated dust will not be encountered during field and sample handling activities. Large amounts of sediment would need to be ingested for any detrimental effects to occur. Momentary skin contact allows little, if any, opportunity for passage of any of these metals into the body. Field procedures require immediate washing of sediments from exposed skin.

**Petroleum hydrocarbons and PAHs —** Exposure to petroleum hydrocarbons and PAHs may occur via ingestion or skin contact. The most important human health exposure pathway for this group of chemicals, inhalation, is not expected to occur at this site. Animal studies have also shown that PAHs can cause harmful effects on the skin, body fluids, and ability to fight disease after both short- and long-term exposure, but these effects have not been seen in people. Some PAHs may reasonably be expected to be carcinogens. Large amounts of sediment would need to be ingested for any detrimental effects to occur. Momentary skin contact allows little, if any, opportunity for passage of any of these compounds into the body. Field procedures require immediate washing of sediments from exposed skin.

**PCBs —** Prolonged skin contact with PCBs may cause acne-like symptoms known as chloracne. Irritation to eyes, nose, and throat may also occur. Acute and chronic exposure can damage the liver, and cause symptoms of edema, jaundice, anorexia, nausea, abdominal pains, and fatigue. PCBs are a suspected human carcinogen. Skin absorption may substantially contribute to the uptake of PCBs. Large amounts of sediment would need to be ingested for any detrimental effects to occur. Momentary skin contact allows little, if any, opportunity for passage of any of the compounds into the body. Field procedures require immediate washing of sediments from exposed skin.

### A.4.4 ACTIVITY HAZARD ANALYSIS

The activity hazard analysis summarizes the field activities to be performed during the project, outlines the hazards associated with each activity, and presents controls that can reduce or eliminate the risk of the hazard occurring.

Table A-2 presents the activity hazard analysis for sediment sampling.

**Table A-2. Activity hazard analysis**

| Activity | Hazard | Control |
|---|---|---|
| Sediment sampling from a boat | Falling overboard | Use care in boarding/departing from vessel. Deploy and recover the sampler from the back deck of the boat. Wear PFD. |
| | Skin contact with contaminated sediments or liquids | Wear modified Level D PPE. |
| | Back strain | Use appropriate lifting technique when deploying and retrieving heavy equipment, or seek help. |
| Sediment sampling by hand in intertidal zone | Skin contact with contaminated sediments or liquids | Wear modified Level D PPE. |

## A.5 Work Zones and Shipboard Access Control

During sampling and sample handling activities, work zones will be established to identify where sample collection and processing are actively occurring. The intent of the zone is to limit the migration of sample material out of the zone and to restrict access to active work areas by defining work zone boundaries.

### A.5.1 Work Zone

The work zone on the boat or the beach will encompass the area where sample collection and handling activities are performed. Only persons with appropriate training, PPE, and authorization from the FC/HSO will be allowed to enter the work zone while work is in progress.

### A.5.2 Decontamination Station

A decontamination station will be set up, and personnel will clean soiled boots or PPE prior to leaving the work zone. The station will have the buckets, brushes, soapy water, rinse water, or wipes necessary to clean boots, PPE, or other equipment leaving the work zone. Plastic bags will be provided for expendable and disposable materials. If the location does not allow the establishment of a decontamination station, the FC/HSO will provide alternatives to prevent the spread of contamination.

Decontamination of the boat will also be completed at the end of each work day. Cockpit and crew areas will be rinsed down with LDW water to minimize accumulation of sediment.

### A.5.3 Access Control

Security and control of access to the boat will be the responsibility of the FC/HSO and boat captain. Boat access will be granted only to necessary project personnel and authorized visitors. Any security or access control problems will be reported to the client or appropriate authorities.

## A.6 Safe Work Practices

Following common sense rules will minimize the risk of exposure or accidents at a work site. These general safety rules will be followed on site:

- Do not climb over or under obstacles of questionable stability.
- Do not eat, drink, smoke, or perform other hand-to-mouth transfers in the work zone.
- Work only in well-lighted spaces.
- Never enter a confined space without the proper training, permits, and equipment.
- Make eye contact with equipment operators when moving within the range of their equipment.
- Be aware of the movements of shipboard equipment when not in the operator's range of vision.
- Get immediate first aid for all cuts, scratches, abrasions, or other minor injuries.
- Use the established sampling and decontamination procedures.
- Always use the buddy system.
- Be alert to your own and other workers' physical condition.
- Report all accidents, no matter how minor, to the FC/HSO.
- Do not do anything dangerous or unwise even if ordered by a supervisor.

## A.7 Personal Protective Equipment and Safety Equipment

Appropriate PPE will be worn as protection against potential hazards. In addition, a PFD will be required when working aboard the boat. Prior to donning PPE, the field crew will inspect their PPE for any defects that might render the equipment ineffective.

Fieldwork will be conducted in Level D or modified Level D PPE, as discussed below in Sections A.7.1 and A.7.2. Situations requiring PPE beyond modified Level D are not anticipated. Should the FC/HSO determine that PPE beyond modified Level D is necessary, the HSM will be notified, and an alternative selected.

### A.7.1 Level D Personal Protective Equipment

Workers performing general activities in which skin contact with contaminated materials is unlikely will wear Level D PPE. Level D PPE includes the following:

- Cotton overalls or rain gear

- Chemical-resistant steel-toed boots
- Chemical-resistant gloves
- Sunglasses
- Hard hats (when operating onboard sampling vessel and the grab sampler is raised above the deck)

### A.7.2 Modified Level D Personal Protective Equipment

Workers performing activities where skin contact with contaminated materials is possible and in which inhalation risks are not expected will be required to wear an impermeable outer suit. The type of outerwear will be chosen according to the types of chemical contaminants that might be encountered. Modified Level D PPE includes the following:

- Impermeable outer garb such as rain gear
- Chemical-resistant steel-toed boots
- Chemical-resistant outer gloves

### A.7.3 Safety Equipment

In addition to PPE that will be worn by shipboard personnel, basic emergency and first aid equipment will also be provided. Equipment for the field team will include:

- A copy of this HSP
- First aid kit adequate for the number of personnel
- Emergency eyewash

The FC/HSO will ensure that the safety equipment is aboard. Equipment will be checked daily to ensure its readiness for use.

## A.8 Monitoring Procedures for Site Activities

A monitoring program that addresses the potential site hazards will be maintained. For this project, air, dust, and noise monitoring will not be necessary. No volatile organic compounds have been identified among the expected contaminants, the sampled media will be wet and will not pose a dust hazard, and none of the equipment emits high-amplitude (>85 dBA) sound. For this project, the monitoring program will consist of all workers monitoring themselves and their co-workers for signs that might indicate physical stress or illness.

All personnel will be instructed to look for and inform each other of any deleterious changes in their physical or mental condition during the performance of all field activities. Examples of such changes are as follows:

- Headaches
- Dizziness
- Nausea
- Symptoms of heat stress
- Blurred vision
- Cramps
- Irritation of eyes, skin, or respiratory system
- Changes in complexion or skin color
- Changes in apparent motor coordination
- Increased frequency of minor mistakes
- Excessive salivation or changes in papillary response
- Changes in speech ability or speech pattern
- Shivering
- Blue lips or fingernails

If any of these conditions develop, work shall be halted immediately and the affected person(s) evaluated. If further assistance is needed, personnel at the local hospital will be notified, and an ambulance will be summoned if the condition is thought to be serious. If the condition is the direct result of sample collection or handling activities, procedures will be modified to address the problem.

## A.9 Decontamination

Decontamination is necessary to prevent the migration of contaminants from the work zone(s) into the surrounding environment and to minimize the risk of exposure of personnel to contaminated materials that might adhere to PPE. The following sections discuss personnel and equipment decontamination. The following supplies will be available to perform decontamination activities:

- Wash buckets
- Rinse buckets
- Long-handled scrub brushes
- Clean water sprayers

- Paper towels
- Plastic garbage bags
- Alconox® or similar decontamination solution

### A.9.1 MINIMIZATION OF CONTAMINATION

The first step in addressing contamination is to prevent or minimize exposure to existing contaminated materials and the spread of those materials. During field activities, the FC/HSO will enforce the following measures:

**Personnel:**

- Minimize walking through areas of obvious or known contamination.
- Do not handle, touch, or smell contaminated materials directly.
- Make sure PPE has no cuts or tears prior to use.
- Fasten all closures on outer clothing, covering with tape if necessary.
- Protect and cover any skin injuries.
- Stay upwind of airborne dusts and vapors.
- Do not eat, drink, chew tobacco, or smoke in the work zones.

**Sampling equipment and boat:**

- Place clean equipment on a plastic sheet or aluminum foil to avoid direct contact with contaminated media.
- Keep contaminated equipment and tools separate from clean equipment and tools.
- Clean boots before entering the boat.

### A.9.2 PERSONNEL DECONTAMINATION

The FC/HSO will ensure that all site personnel are familiar with personnel decontamination procedures. Personnel will perform decontamination procedures, as appropriate, before eating lunch, taking a break, or before leaving the work location. Following is a description of these procedures.

Decontamination procedure:

1. If outer suit is heavily soiled, rinse it off.
2. Wash and rinse outer gloves and boots with water.
3. Remove outer gloves; inspect and discard if damaged.
4. Wash hands if taking a break.
5. Don necessary PPE before returning to work.

Dispose of soiled, expendable PPE before leaving for the day.

### A.9.3 Sampling Equipment Decontamination

Before use at each sampling location, the sampler will be rinsed in river water to dislodge and remove any sediment, washed with detergent, rinsed again with LDW water, and rinsed with deionized water.

### A.9.4 Vessel Decontamination

Most sampling will be conducted from a boat. Care will be taken not to spill any sediment collected in the sampler in the vessel, so vessel decontamination should not be necessary. In the event that any sediment is spilled, the vessel will be rinsed with LDW water at the end of the sampling day to remove sediment from cockpit and crew areas.

## A.10 Disposal of Contaminated Materials

Contaminated materials that may be generated during field activities include PPE, decontamination fluids, and excess sample material. These contaminated materials will be disposed of as an integral part of the project.

### A.10.1 Personal Protective Equipment

Gross surface contamination will be removed from PPE. All disposable sampling materials and PPE, such as disposable coveralls, gloves, and paper towels used in sample processing, will be placed in heavyweight garbage bags. Filled garbage bags will be placed in a normal refuse container for disposal as solid waste.

### A.10.2 Excess Sample Materials

At each sampling location, excess sediment collected will be returned to the water.

## A.11 Training Requirements

Individuals performing work at locations where potentially hazardous materials and conditions may be encountered must meet specific training requirements. It is not anticipated that hazardous concentrations of contaminants will be encountered in sampled material, so training will consist of site-specific instruction for all personnel and oversight of inexperienced personnel by an experienced person for one working day. The following sections describe the training requirements for this fieldwork.

### A.11.1 Project-Specific Training

In addition to HAZWOPER training, as described in Section 2.5 of the QAPP, field personnel will undergo training specifically for this project. All personnel must read this HSP and be familiar with its contents before beginning work. They shall acknowledge reading the HSP by signing the field team HSP review form contained in Attachment A1. The form will be kept in the project files.

The boat captain and FC/HSO or a designee will provide project-specific training prior to the first day of fieldwork and whenever new workers arrive. Field personnel will not be allowed to begin work until project-specific training is completed and documented by the FC/HSO. Training will address the HSP and all health and safety issues and procedures pertinent to field operations. Training will include, but not be limited to, the following topics:

- Activities with the potential for chemical exposure
- Activities that pose physical hazards, and actions to control the hazard
- Ship access control and procedure
- Use and limitations of PPE
- Decontamination procedures
- Emergency procedures
- Use and hazards of sampling equipment
- Location of emergency equipment on the vessel
- Vessel safety practices
- Vessel evacuation and emergency procedures

### A.11.2 DAILY SAFETY BRIEFINGS

The FC/HSO or a designee and the boat captain will present safety briefings before the start of each day's activities. These safety briefings will outline the activities expected for the day, update work practices and hazards, address any specific concerns associated with the work location, and review emergency procedures and routes. The FC/HSO or designee will document safety briefings in the field logbook.

### A.11.3 FIRST AID AND CPR

At least one member of the field team must have first-aid and CPR training. Documentation of which individuals possess first-aid and CPR training will be kept in the project health and safety files.

## A.12 Medical Surveillance

A medical surveillance program conforming to the provisions of 29 CFR 1910§120(f) is not necessary for field team members because they do not meet any of the four criteria outlined in the regulations for implementation of a medical surveillance program:

- Employees who are or may be exposed to hazardous substances or health hazards at or above permissible exposure levels for 30 days or more per year (1910.120(f)(2)(I).
- Employees who must wear a respirator for 30 days or more per year (1910.120(f)(2)(ii)).
- Employees who are injured or become ill due to possible overexposures involving hazardous substances or health hazards from an emergency response or hazardous waste operation (1910.120(f)(2)(iii)).
- Employees who are members of HAZMAT teams (1910.120(f)(2)(iv)).

As described in Section A.8, employees will monitor themselves and each other for any deleterious changes in their physical or mental condition during the performance of all field activities.

## A.13 Reporting and Record Keeping

Each member of the field crew will sign the HSP review form (see Attachment A1). If necessary, accident/incident report forms and OSHA Form 200s will be completed by the FC/HSO.

The FC/HSO or a designee will maintain a health and safety field logbook that records health- and safety-related details of the project. Alternatively, entries may be made in the field logbook, in which case a separate health and safety logbook will not be required. The logbook must be bound and the pages must be numbered consecutively. Entries will be made with indelible blue ink. At a minimum, each day's entries must include the following information:

- Project name or location
- Names of all personnel onboard
- Weather conditions
- Type of fieldwork being performed

The person maintaining the entries will initial and date the bottom of each completed page. Blank space at the bottom of an incompletely filled page will be lined out. Each day's entries will begin on the first blank page after the previous workday's entries.

## A.14 Emergency Response Plan

As a result of the hazards onboard and the conditions under which operations will be conducted, the potential exists for an emergency situation to occur. Emergencies may include personal injury, exposure to hazardous substances, fire, explosion, or release of toxic or non-toxic substances (spills). OSHA regulations require that an emergency response plan be available for use onboard to guide actions in emergency situations.

Onshore organizations will be relied upon to provide response in emergency situations. The local fire department and ambulance service can provide timely response. Field personnel will be responsible for identifying an emergency situation, providing first aid if applicable, notifying the appropriate personnel or agency, and evacuating any hazardous area. Shipboard personnel will attempt to control only very minor hazards that could present an emergency situation, such as a small fire, and will otherwise rely on outside emergency response resources.

The following sections identify the onboard individual(s) who should be notified in case of emergency, provide a list of emergency telephone numbers, offer guidance for particular types of emergencies, and provide directions for getting from any sampling location to a hospital.

### A.14.1 Pre-Emergency Preparation

Before the start of field activities, the FC/HSO will ensure that preparation has been made in anticipation of emergencies. Preparatory actions include the following:

- Meeting with the FC/HSO and equipment handlers concerning the emergency procedures in the event that a person is injured.
- A training session given by the FC/HSO informing all field personnel of emergency procedures, locations of emergency equipment and their use, and proper evacuation procedures.
- A training session given by senior staff operating field equipment, to apprise field personnel of operating procedures and specific risks associated with that equipment.
- Ensuring that field personnel are aware of the existence of the emergency response plan in the HSP and ensuring that a copy of the HSP accompanies the field team.

### A.14.2 Project Emergency Coordinator

The FC/HSO will serve as the Project Emergency Coordinator in the event of an emergency. He will designate his replacement for times when he is not onboard or is not serving as the Project Emergency Coordinator. The designation will be noted in the field logbook. The Project Emergency Coordinator will be notified immediately when an emergency is recognized. The Project Emergency Coordinator will be responsible for evaluating the emergency situation, notifying the appropriate emergency response units, coordinating access with those units, and directing interim actions onboard before the arrival of emergency response units. The Project Emergency Coordinator will notify the HSM and the Project Manager as soon as possible after initiating an emergency response action. The Project Manager will have responsibility for notifying the client.

### A.14.3 Emergency Response Contacts

All onboard personnel must know whom to notify in the event of an emergency situation, even though the FC/HSO has primary responsibility for notification. Table A-3 lists the names and phone numbers for emergency response services and individuals.

**Table A-3. Emergency response contacts**

| Contact | Telephone Number |
|---|---|
| **Emergency Numbers** | |
| Ambulance | 911 |
| Police | 911 |
| Fire | 911 |
| Harborview Medical Center | (206) 323-3074 |
| **Emergency Responders** | |
| US Coast Guard<br>Emergency<br>General information | <br>(206) 286-5400<br>(206) 442-5295<br>UHF Channel 16 |
| National Response Center | (800) 424-8802 |
| EPA | (908) 321-6660 |
| Washington State Department of Ecology – Northwest Region Spill Response (24-hour emergency line) | (206) 649-7000 |
| **Emergency Contacts** | |
| *Project Manager* | |
| Kathy Godtfredsen | (206) 577-1283 |
| *Corporate Health and Safety Manager* | |
| Thai Do | (206) 812-5407 |
| *Field Coordinator/ Field Health and Safety Officer* | |
| Thai Do | (206) 812-5407 |

### A.14.4 Recognition of Emergency Situations

Emergency situations will generally be recognizable by observation. An injury or illness will be considered an emergency if it requires treatment by a medical professional and cannot be treated with simple first-aid techniques.

### A.14.5 DECONTAMINATION

In the case of evacuation, decontamination procedures will be performed only if doing so does not further jeopardize the welfare of site workers. If an injured individual is also heavily contaminated and must be transported by emergency vehicle, the emergency response team will be told of the type of contamination. To the extent possible, contaminated PPE will be removed, but only if doing so does not exacerbate the injury. Plastic sheeting will be used to reduce the potential for spreading contamination to the inside of the emergency vehicle.

### A.14.6 FIRE

Field personnel will attempt to control only small fires, should they occur. If an explosion appears likely, personnel will follow evacuation procedures specified during the training session. If a fire cannot be controlled with a fire extinguisher on board that is part of the required safety equipment, personnel will either withdraw from the vicinity of the fire or evacuate the boat as specified in the training session.

### A.14.7 PERSONAL INJURY

In the event of serious personal injury, including unconsciousness, possibility of broken bones, severe bleeding or blood loss, burns, shock, or trauma, the first responder will immediately do the following:

- Administer first aid, if qualified.
- If not qualified, seek out an individual who is qualified to administer first aid, if time and conditions permit.
- Notify the Project Emergency Coordinator of the incident, the name of the individual, the location, and the nature of the injury.

The Project Emergency Coordinator will immediately do the following:

- Notify the boat captain and the appropriate emergency response organization.
- Assist the injured individual.
- Follow the emergency procedures for retrieving or disposing equipment reviewed in the training session and leave the site en route to the predetermined land-based emergency pick-up.
- Designate someone to accompany the injured individual to the hospital.
- If a life-threatening emergency occurs, i.e., injury where death is imminent without immediate treatment, the FC/HSO or boat captain will call 911 and arrange to meet the Medic One unit at the nearest accessible dock. Otherwise, for emergency injuries that are not life-threatening (i.e., broken bones, minor lacerations, etc.) the Project Emergency Coordinator will follow the procedures

outlined above and proceed to the Harbor Island Marina or to an alternative location of his choice if that would be more expedient.

- Notify the HSM and the Project Manager.

If the Project Emergency Coordinator determines that emergency response is not necessary, he or she may direct someone to decontaminate and transport the individual by vehicle to the nearest hospital. Directions showing the route to the hospital are in Section A.14.10.

If a worker leaves the boat to seek medical attention, another worker should accompany them to the hospital. When in doubt about the severity of an injury or exposure, always seek medical attention as a conservative approach, and notify the Project Emergency Coordinator.

The Project Emergency Coordinator will have responsibility for completing all accident/incident field reports, OSHA Form 200s, and other required follow-up forms.

## A.14.8 Overt Personal Exposure or Injury

If an overt exposure to toxic materials occurs, the first responder to the victim will initiate actions to address the situation. The following actions should be taken, depending on the type of exposure.

### A.14.8.1 Skin contact

- Wash/rinse the affected area thoroughly with copious amounts of soap and water.
- If eye contact has occurred, eyes should be rinsed for at least 15 minutes using the eyewash that is part of the emergency equipment onboard.
- After initial response actions have been taken, seek appropriate medical attention.

### A.14.8.2 Inhalation

- Move victim to fresh air.
- Seek appropriate medical attention.

### A.14.8.3 Ingestion

- Seek appropriate medical attention.

### A.14.8.4 Puncture wound or laceration

- Seek appropriate medical attention.

### A.14.9 Spills and Spill Containment

No bulk chemicals or other materials subject to spillage are expected to be used during this project. Accordingly, no spill containment procedure is required for this project.

### A.14.10 Emergency Route to the Hospital

The name, address, and telephone number of the hospital that will be used to provide medical care is as follows:

Harborview Medical Center
325 - 9th Ave
Seattle, WA
(206) 323-3074

Directions from the vicinity of LDW to Harborview Medical Center are described below.

From the 1st Ave S boat launch:

- Drive east on S River Street.
- Turn left on Occidental Ave S.
- Turn left on E Marginal Way S.
- Turn right on S Michigan Street.
- Look for entrance ramps to I-5 Northbound.
- Head north on I-5.
- Take the James Street exit.
- Head east on James Street to 9th Avenue.
- Turn right on 9th Avenue.
- Emergency entrance will be two blocks south on the right.

From the Harbor Island Marina:

- From marina parking lot, turn sharp right onto Klickitat Way SW
- Turn slight right onto SW Spokane St.
- Turn slight left to take the ramp toward WA-99 N/I-5/Columbian Way
- Keep left at the fork in the ramp
- Stay straight to go onto West Seattle Bridge
- Merge onto I-5 North via the ramp on the left
- Take the James Street exit.
- Head east on James Street to 9th Avenue.

- Turn right on 9th Avenue.
- Emergency entrance will be two blocks south on the right.

## Attachment A1. Field Team Health and Safety Plan Review

I have read a copy of the Health and Safety Plan, which covers field activities that will be conducted to investigate potentially contaminated areas in the LDW. I understand the health and safety requirements of the project, which are detailed in this Health and Safety Plan.

| Signature | Date |
|---|---|
| Signature | Date |
| Signature | Date |
| Signature | Date |
| Signature | Date |
| Signature | Date |
| Signature | Date |
| Signature | Date |
| Signature | Date |
| Signature | Date |

# Appendix B. Field Collection Forms

Surface Sediment Collection Form

Sediment Core Collection Form

Protocol Modification Form

## SURFACE SEDIMENT COLLECTION FORM

| | | | |
|---|---|---|---|
| Project Name: | | Project no. | |
| Date: | | Station: | |
| Start/Stop time: | | | X: |
| Sampling Method: | | | Y: |
| Weather: | | Sample ID: | |
| Crew: | | | |

| | | | | | |
|---|---|---|---|---|---|
| Subsample #: | Sample depth: | Penetration depth | | Time: | |
| Sampling gear: | | | Acceptable sample (circle) | yes | no |
| type: | color: | odor: | | Biota in sample: | |
| cobble | drab olive | none | $H_2S$ | | |
| gravel | gray | slight | petroleum | Comments: | |
| sand C M F | black | moderate | other: | | |
| silt clay | brown | strong | | | |
| organic matter | brown surface | | | | |
| Subsample #: | Sample depth: | Penetration depth | | Time: | |
| Sampling gear: | | | Acceptable sample (circle) | yes | no |
| type: | color: | odor: | | Biota in sample: | |
| cobble | drab olive | none | $H_2S$ | | |
| gravel | gray | slight | petroleum | Comments: | |
| sand C M F | black | moderate | other: | | |
| silt clay | brown | strong | | | |
| organic matter | brown surface | | | | |
| Subsample #: | Sample depth: | Penetration depth | | Time: | |
| Sampling gear: | | | Acceptable sample (circle) | yes | no |
| type: | color: | odor: | | Biota in sample: | |
| cobble | drab olive | none | $H_2S$ | | |
| gravel | gray | slight | petroleum | Comments: | |
| sand C M F | black | moderate | other: | | |
| silt clay | brown | strong | | | |
| organic matter | brown surface | | | | |

# SEDIMENT CORE COLLECTION FORM:

**Core ID** ____________ **Station ID:** ____________

**Project Name:** ____________ **Uncorrected depth:** ____________

**Project Number:** ____________ **NOS water level (tide):** ____________

**Date:** ____________ **Time:** ____________ **NOS-to-ACOE level correction:** ____________

**Weather:** ____________ **ACOE water level (tide):** ____________

**Crew:** ____________ **Water depth (ACOE MLLW):** ____________

**Core penetration:** **Core recovery:** **Percent recovery:**

| Depth | | Sample data | | USCS soil group | Notes: |
|---|---|---|---|---|---|
| Ft below mud surface | Sample interval | Sample number | Percent recovery | | |
| 1<br>2<br>3<br>4<br>5<br>6 | | | | | Lithology/observations: |

## PROTOCOL MODIFICATION FORM

Project Name and Number: ______________________

Material to be Sampled: ______________________

Measurement Parameter: ______________________

______________________

______________________

______________________

______________________

Standard Procedure for Field Collection & Laboratory Analysis (cite reference):

______________________

______________________

______________________

______________________

Reason for Change in Field Procedure or Analysis Variation: ______________________

______________________

______________________

______________________

______________________

Variation from Field or Analytical Procedure: ______________________

______________________

______________________

______________________

______________________

Special Equipment, Materials or Personnel Required: ______________________

______________________

______________________

______________________

______________________

Initiator's Name: ______________________ Date: __________

Project Officer: ______________________ Date: __________

QA Officer: ______________________ Date: __________