Lower Duwamish Waterway Group

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

# *Lower Duwamish Waterway Remedial Investigation*

## QUALITY ASSURANCE PROJECT PLAN: FISH, CRAB, AND CLAM TISSUE COLLECTION AND CHEMICAL ANALYSES

## ADDENDUM FOR ADDITIONAL FISH, CRAB, AND CLAM SAMPLING IN THE LOWER DUWAMISH WATERWAY IN 2007 – FINAL

**August 23, 2007**

**Prepared by:** Windward environmental LLC

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

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## Acronyms

| ACRONYM | Definition |
|---|---|
| **ARI** | Analytical Resources, Inc. |
| **ASTM** | American Society for Testing and Materials |
| **Axys** | Axis Analytical Services, Ltd. |
| **cPAH** | carcinogenic polycyclic aromatic hydrocarbon |
| **Brooks Rand** | Brooks Rand Laboratory |
| **CPUE** | catch-per-unit effort |
| **DQI** | data quality indicator |
| **DQO** | data quality objective |
| **Ecology** | Washington State Department of Ecology |
| **EPA** | US Environmental Protection Agency |
| **FC** | field coordinator |

| ACRONYM | Definition |
|---|---|
| FS | feasibility study |
| GPS | global positioning system |
| HHRA | human health risk assessment |
| ID | identification |
| LDC | Laboratory Data Consultants, Inc. |
| LDW | Lower Duwamish Waterway |
| LDWG | Lower Duwamish Waterway Group |
| NAD83 | North American Datum of 1983 |
| NOAA | National Oceanic and Atmospheric Administration |
| NMFS | National Marine Fisheries Service |
| PCB | polychlorinated biphenyl |
| PM | project manager |
| POS | Port of Seattle |
| PSEMP | Puget Sound Estuary Program |
| QA/QC | quality assurance / quality control |
| QAPP | quality assurance project plan |
| RI | remedial investigation |
| R/V | research vessel |
| SOP | standard operating procedure |
| WDFW | Washington State Department of Fish and Wildlife |
| Windward | Windward Environmental LLC |

# 1.0 Introduction

The purpose of this addendum to the fish, crab, and clam tissue collection and chemical analysis quality assurance project plans (QAPPs) (Windward 2004b, c) is to document the methods that will be used to collect and chemically analyze additional composite tissue samples of shiner surfperch, English sole, Dungeness crabs, and clams from the Lower Duwamish Waterway (LDW) in 2007. The *Lower Duwamish Waterway Remedial Investigation Quality Assurance Project Plan: Fish and Crab Tissue Collection and Chemical Analyses* (Windward 2004c), hereafter referred to as the 2004 fish and crab QAPP, and the *Lower Duwamish Waterway Remedial Investigation Quality Assurance Project Plan: Benthic Invertebrate Sampling of the Lower Duwamish Waterway* (Windward 2004b), hereafter referred to as the 2004 benthic invertebrate QAPP, provide background information and describe the objectives of the 2004 fish, crab, and clam tissue sampling efforts.

In combination with existing data collected in 1997, 2004, 2005, and 2006, data from this study will be used to provide additional insight into polychlorinated biphenyl (PCB) tissue chemical concentrations in LDW aquatic species. In combination, these datasets will provide a time series of PCB concentrations in fish and crab tissues collected from the LDW and inform the design and interpretation of future monitoring studies. The data from this sampling event will also provide additional information regarding inorganic arsenic and PCB concentrations in clams in the LDW. These data will not be used to recalculate baseline ecological or human health risks (Windward 2007b, c), revise risk conclusions presented in those documents, or re-calibrate the food web model presented in the remedial investigation (RI). The cleanup alternatives in the feasibility study will be based on the baseline risk assessments and food web model presented in the RI report, which, as noted previously, will not be modified to incorporate the 2007 data. This QAPP addendum addresses details that are specific to the 2007 sampling activities. The 2004 QAPPs are referenced, as appropriate, for details that remain unchanged from the original sampling designs.

This addendum 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 to protect onsite 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; data management procedures are provided in Appendix C.

# 2.0 Project Management

This section describes the overall management of the project, including key personnel, project description, problem definition and background, special training requirements and certification, and documents and record keeping. Data quality objectives (DQOs) and criteria are as described in the 2004 fish and crab QAPP (Windward 2004c).

## 2.1 Project Organization and Team Member Responsibilities

This sampling effort will be performed by Windward Environmental LLC (Windward) for the Lower Duwamish Waterway Group (LDWG). A copy of this QAPP will be provided to the US Environmental Protection Agency (EPA) and the Washington State Department of Ecology (Ecology) prior to sampling, and they will be provided with documentation of results and interpretation of the investigation. Overall project organization and responsibilities of project team members are described in Section 2.1 of the 2004 QAPPs (Windward 2004b, c). Kathy Godtfredsen will serve as the Windward project manager (PM). She will be responsible for overall project coordination; oversight on planning, coordination, and all project deliverables. Matt Luxon will serve as the Windward task manager; he will be responsible for project planning and coordination, production of project deliverables, and the performance of the administrative tasks needed to ensure timely and successful completion of the project. The field coordinator (FC), quality assurance / quality control (QA / QC) coordinator, and laboratory manager for this sampling and analysis effort are different from those specified in the 2004 QAPPs. Thai Do will serve as the Windward FC, and Marina Mitchell will serve as the Windward QA / QC coordinator.

Kathy Godtfredsen (Windward PM)
Windward Environmental LLC
200 W. Mercer St., Suite 401
Seattle, WA 98119
Telephone: 206.812.5413
Facsimile: 206.217.0089
Email: kathyg@windwardenv.com

Matt Luxon (task manager)
Windward Environmental LLC
200 W. Mercer St., Suite 401
Seattle, WA 98119
Telephone: 206.812.5420
Facsimile: 206.217.0089
Email: mattl@windwardenv.com

Thai Do (FC)
Windward Environmental LLC
200 W. Mercer St., Suite 401
Seattle, WA 98119

Telephone: 206.812.5407
Facsimile: 206.217.0089
Email: thaid@windwardenv.com

Marina Mitchell (QA / QC coordinator)
Windward Environmental LLC
200 W. Mercer St., Suite 401
Seattle, WA 98119
Telephone: 206.812.5424
Facsimile: 206.217.0089
Email: marinam@windwardenv.com

Analytical Resources, Inc. (ARI); Axys Analytical Services, Ltd. (Axys); and Brooks Rand Laboratory (Brooks Rand) will perform chemical analyses. Sue Dunnihoo will serve as the laboratory PM for ARI, Georgina Brooks will serve as the laboratory manager for Axys, and Elizabeth Madonick (or other qualified personnel) will serve as the laboratory PM for Brooks Rand. Laboratory Data Consultants, Inc. (LDC), will provide independent third-party review and validation of analytical chemistry data. The contact information for these individuals is given below.

Susan Dunnihoo (laboratory PM)
Analytical Resources, Inc.
4611 S 134th Place, Suite 100
Tukwila, WA 98168
Telephone: 206.695.6207
Email: sue@arilabs.com

Georgina Brooks (laboratory PM)
Axys Analytical Services, Ltd.
P.O. Box 2219
2045 Mills Road
Sidney, British Columbia V8L 3S8
Telephone: 250.656.0881
Email: gbrooks@axys.com

Elizabeth Madonick (laboratory PM)
Brooks Rand Laboratory
3958 Sixth Avenue NW
Seattle, WA 98107
Telephone: 206.632.6206
Email: elizabeth@brooksrand.com

Stella Cuenco (data validation PM)
Laboratory Data Consultants, Inc.
7750 El Camino Real, Suite 2C

Carlsbad, CA 92009-8519
Telephone: 760.634.0437
Email: scuenco@lab-data.com

No beach seining is proposed, so no beach seine oversight is necessary. See the 2004 fish and crab QAPP (Windward 2004c) and 2004 benthic invertebrate QAPP (Windward 2004b) for additional details on project organization and team member responsibilities that remain unchanged from the 2004 QAPPs.

## 2.2 PROBLEM DEFINITION/BACKGROUND

LDWG is completing an RI of the LDW. Information collected during the RI process will be used to help identify and evaluate remedial alternatives in the feasibility study (FS) (EPA 1988). Following remediation of sediment contamination, monitoring of chemical concentrations in sediment and tissue will occur in the LDW to evaluate whether risks to human health and ecological receptors have been reduced as a result of remedial activities. LDWG anticipates that collection and analysis of fish, crab, and clam tissues may be part of the monitoring program, although the actual monitoring design will be developed later. To effectively plan for monitoring, LDWG requires additional information on fish, crab, and clam tissues in 2007.

A key consideration in establishing a monitoring program is to identify factors other than sediment contamination that might affect monitored media, including biological tissue. If factors other than sediment contamination were to affect tissue-residue concentrations, monitoring programs could be designed so that resulting data can be interpreted in the appropriate context.

The largest available tissue chemistry dataset for the LDW was collected in 2004 (Windward 2005b, c). Both fillet and whole-body fish tissue-residue concentrations from that sampling event, particularly for PCBs, were substantially higher than tissue concentrations detected in the LDW during the previous decade. There are at least four potentially important factors that may contribute to observed differences in tissue PCB concentrations over time. These factors include natural inter-annual variability in fish tissue, seasonal variability in fish tissue, short-term perturbations to the system (such as dredging or other sediment disturbance), and changes in loading from sources within and adjacent to the river. One hypothesis to explain changes in fish tissue concentrations from 2004 to 2005 and 2006 (Anchor and King County 2007) is related to a specific short-term disturbance of the system: several large dredging events were completed within the LDW and just downstream of the LDW boundary in the East and West Waterways concurrent with and 8 months prior to 2004 sampling. It is possible that increased PCB concentrations in tissue were a result of PCB releases from the dredged material into the water column, making PCBs more bioavailable to LDW fish and crab species and resulting in higher tissue concentrations. Additional fish tissue samples collected by LDWG in 2005 (Windward 2006, 2007a) and by King County in 2006 (Anchor and King County 2007) indicated that PCB concentrations were substantially lower than in the 2004 samples, providing additional support for

the dredging hypothesis. Seasonal variations are not likely to have been responsible for differences in concentrations among 2004, 2005, and 2006 fish tissue samples because all were collected at the same time of year.

Fish and crab tissue data collected in 2004 and 2005 showed differences in PCB chromatograms, and different Aroclors were quantitated. PCB congener analysis for a subset of samples in 2007 will help to assess inter-annual variability in PCB congener patterns and assess the relationship between total PCB concentrations based on Aroclor or PCB congener sums.

In the human health risk assessment (HHRA), excess cancer risk estimates related to inorganic arsenic in the seafood consumption scenarios were almost entirely driven by concentrations of inorganic arsenic in clams, represented by eight composite clam tissue samples. These risk estimates are uncertain because the inorganic arsenic concentrations in these eight samples were much higher relative to total arsenic concentrations than those in other studies from the Mid-Atlantic (Greene and Crecelius 2006) or Puget Sound (Ecology 2002) or identified in a literature review (EPA 2003). The eight composite clam tissue samples were collected from locations in the LDW with sediment arsenic concentrations that were generally similar to or lower than both the average arsenic concentration in LDW sediments and natural background arsenic concentrations. Possible reasons for the unusual ratio of inorganic arsenic to total arsenic include: 1) analytical methods and inter-laboratory variability, 2) species-specific differences, or 3) the presence of sediment in the guts of clams that were not depurated.

To assess possible differences in analytical methods, archived samples from the 2004 sampling event were analyzed at two separate laboratories and the inorganic arsenic concentrations reported by the two laboratories were similar. Therefore, differences in analytical methods did not appear to be the cause.

To assess species-specific differences in the ratio of inorganic to total arsenic,[1] clams of the same species collected in the LDW (*Mya arenaria*) were also collected in two background areas in Puget Sound (Windward 2005a). The ratio of inorganic to total arsenic concentrations in clams from background areas was much lower than that in clams from the LDW and similar to the ratio found in other Puget Sound locations. This indicates that species-specific differences were not the cause of the anomalous inorganic arsenic concentrations in the LDW clams.

Results of the 2007 sampling effort will be used to evaluate the potential influence of depurating clams prior to analysis. Half of the clams will be analyzed following depuration, and half will be analyzed without depuration. It is notable that previous Puget Sound studies that did not depurate clams prior to analysis identified lower ratios of inorganic arsenic to total arsenic (Ecology 2002) than the ratios observed in LDW clams collected in 2004; thus, it is possible that the unusual inorganic arsenic to

[1] Clams collected by Ecology (2002) were a different species than the clams collected in the LDW.

total arsenic ratio is unrelated to depuration. Nevertheless, additional data collected during the same time of year will be useful in assessing whether the unusual ratio is affected by depuration and whether it is persistent.

If depuration proves to be an influential factor in concentrations of inorganic arsenic in clams, analysis of clam tissue could provide information to assess the role of depuration on cPAH concentrations in clam tissues. For this reason, and because cPAHs in clam tissue may be of interest for future monitoring, clam tissue will be archived for the potential analysis of cPAHs.

Total PCB concentrations will also be analyzed in a subset of clam samples to provide additional temporal data for clams (PCBs were not analyzed in clams as part of the 2005 sampling event). Both depurated and non-depurated clam samples will be analyzed to determine the importance of depuration on clam total PCB concentrations.

In summary, additional sampling of fish and crabs for the analysis of PCBs and clams for the analysis of PCBs and inorganic and total arsenic is needed to:

- Provide additional information to aid in the design of future monitoring programs and in the interpretation of fish, crab, and clam tissue samples collected in the future for monitoring or other purposes
- Provide additional insight into interpreting differences in the data collected in the past relative to variability or the potential influence of dredging events
- Determine whether depuration of clams prior to compositing and analysis affects the concentration of PCBs or inorganic arsenic in composite clam tissue samples
- Assess inter-annual variability in PCB congener patterns and assess the relationship between total PCB concentrations based on Aroclor or PCB congener sums
- Evaluate the variability in inorganic arsenic concentrations in clam tissue and provide additional detail to evaluate whether a relationship exists between concentrations in clam tissue and surface sediment
- Because cPAHs in clam tissue may be of interest for future monitoring, clam tissue will be archived for potential analysis of cPAHs

Based on potential trends in the prior data, fish and crab tissue data should be collected prior to any additional dredging within the LDW because if there is indeed an increase in tissue concentrations as a result of dredging, it may take multiple years for chemical concentrations in tissue to return to pre-dredging conditions. LDWG knows of no dredging scheduled for the LDW in the summer or fall of 2007. After fall 2007, the schedule for future dredging activities, and therefore the potential for dredging activities to affect fish and crab tissue, is less certain.

## 2.3 PROJECT/TASK DESCRIPTION AND SCHEDULE

This section describes the timing of tissue sample collection for fish, crabs, and clams. Chemical analyses of the samples described in Section 3.4.2 will be completed approximately 6 weeks[2] after compositing and homogenization is completed. Data validation will be completed approximately 3 weeks after receipt of the chemistry data. A draft data report will be completed approximately 45 days following receipt of the validated data.

### 2.3.1 Fish and crab sampling

To meet the objectives presented in Section 2.2, English sole, shiner surfperch, and Dungeness crabs[3] will be collected from the LDW as described in Section 3.0. Samples will be collected from multiple areas in the LDW; these areas are the same fish and crab tissue collection areas sampled in 2004 and 2005. Sampling for English sole will include both fillet and whole-body tissue samples; sampling for Dungeness crabs will include both edible meat and hepatopancreas tissue samples.

Fish sampling in the LDW will take place during the first 2 weeks of September 2007. The timing of the sampling effort may be contingent on the timing of Muckleshoot tribal fishing and will be coordinated with the tribal representative, Glen St. Amant. This sampling period was selected to match as closely as possible the main 2004 and 2005 collection periods, when trawling was conducted from August 30 to September 8, 2004,[4] and from August 29 to September 6, 2005.

### 2.3.2 Clam tissue and co-located sediment sampling

Clam and co-located sediment samples will be collected from intertidal areas in the LDW from August 24 to 28, 2007, when very low tides occur. Intertidal areas sampled in 2004 plus two additional locations described in Section 3.1.2 will be sampled.

## 2.4 SPECIAL TRAINING/CERTIFICATION

A scientific collection permit has been obtained from the Washington State Department of Fish and Wildlife (WDFW). A permit for incidental take of the federally threatened species bull trout has been obtained from US Fish and Wildlife Service. Training requirements for personnel participating in sample collection are provided in the 2004 fish and crab QAPP (Windward 2004c).

[2] Samples archived for potential PCB congener analyses may be analyzed following review of the PCB Aroclor results.

[3] Slender crabs will be collected in areas where a sufficient number of Dungeness crabs cannot be obtained.

[4] Shiner surfperch were also collected from August 2 through August 6, 2004.

## 2.5 DOCUMENTATION AND RECORDS

Procedures for documenting field observations, laboratory records, and data reduction are provided in the 2004 fish and crab QAPP (Windward 2004c) and the 2004 benthic invertebrate QAPP (Windward 2004b). The analytical laboratories will generate data packages in the format described in Section 2.6.2 of the 2004 fish and crab QAPP (Windward 2004c). Data reduction procedures will be as described in Section 2.6.3 of the 2004 fish and crab QAPP (Windward 2004c). A data report will be prepared to document all activities associated with the collection, handling, and analysis of samples. Details on the preparation of the data report are provided in Section 2.6.4 of the 2004 fish and crab QAPP (Windward 2004c); however, note that the data report will not be submitted to EPA and Ecology for approval.

The following field collection forms (Appendix B), will also be used to record pertinent information after sample collection:

- Protocol Modification Form
- Target Species Tally Form
- Non-Target Species Tally Form
- Clam Collection Form
- Surface Sediment Collection Form
- Specimen Label
- Composite Sample Form

# 3.0 Data Generation and Acquisition

This section describes the collection and processing of fish, crab, and clam tissue samples for chemical analyses. Elements include sampling design, sampling methods, sample handling, and analytical methods. Details regarding custody requirements, QA / QC, instrument and equipment testing and frequency, inspection and maintenance, instrument calibration, supply inspection and acceptance, non-direct measurement, and data management are provided in Sections 3.3 and 3.5 through 3.10 of the 2004 QAPPs (Windward 2004c, b); however, note that samples will be analyzed at different laboratories (i.e., ARI, Axys, and Brooks Rand) than those indicated in the 2004 QAPPs.

## 3.1 SAMPLING DESIGN

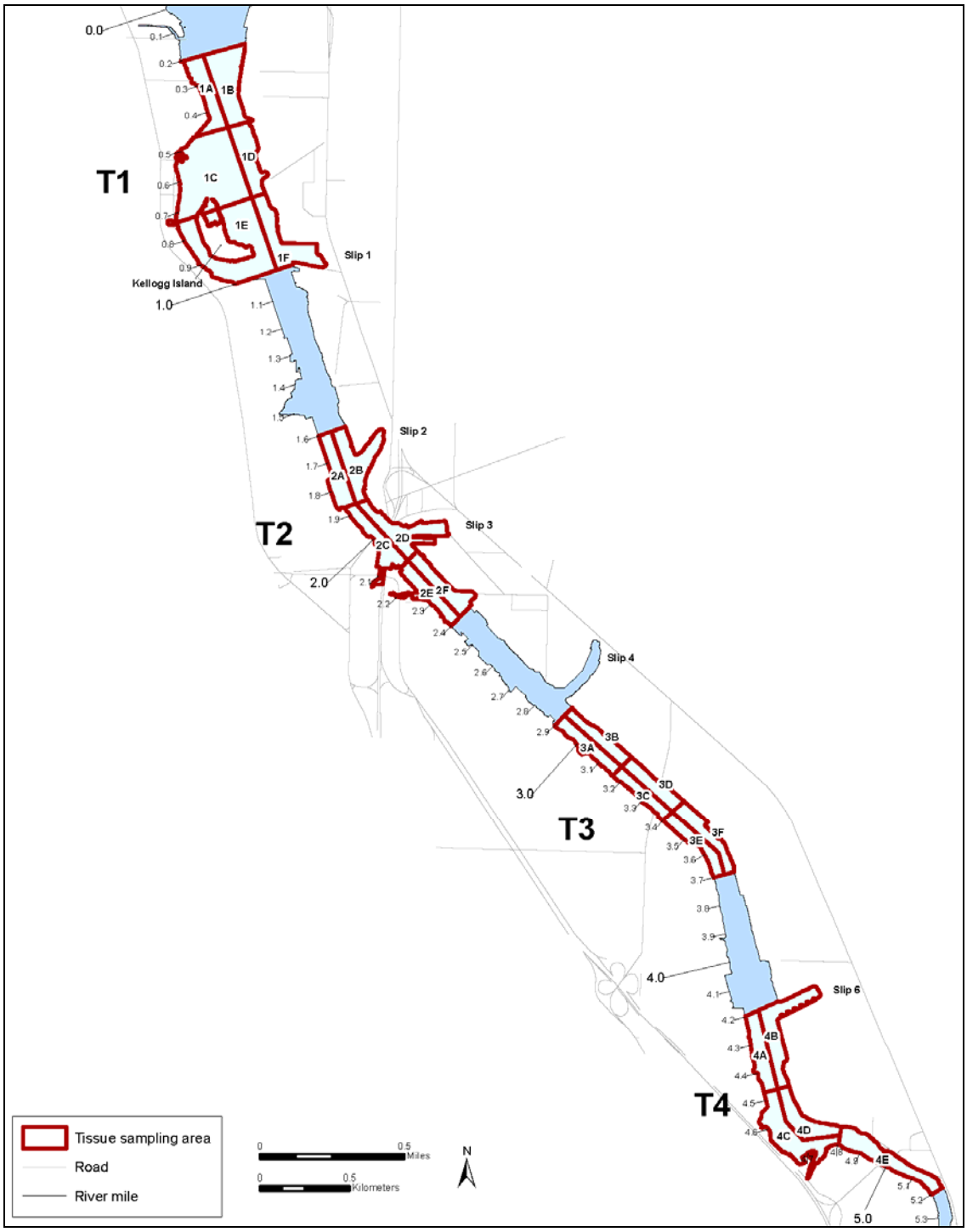
### 3.1.1 Fish and Crab Sampling

Samples of shiner surfperch (whole-body composite tissue samples), English sole (both whole-body and fillet composite tissue samples),[5] and Dungeness crabs (both edible meat and hepatopancreas composite tissue samples)[6] will be collected in LDW Areas T1, T2, T3, and T4 (Figure 3-1 and Table 3-1). The number of composite tissue samples for this sampling effort was selected to obtain a dataset comparable to that collected in 2004 and 2005. For fish and crabs, the proposed design (Table 3-1) is the same as that for the sampling conducted in 2005 (Windward 2005d), with the following exceptions:

- Pacific staghorn sculpin will not be collected in 2007 because they were only sampled at a low level (n = 1 composite tissue sample per area) in 2005 and were not sampled by King County in 2006.
- Three composite crab tissue samples will be created per area rather than one, to allow for analyses of variability within each area. However, it may be that only one sample will be collected in Area T4 because it has been more difficult to collect crabs in Area T4 during past sampling events, likely because the salinity is lower in this area.

[5] In areas where sufficient numbers of English sole cannot be obtained, starry flounder may be collected as a surrogate species.

[6] In areas where sufficient numbers of Dungeness crab cannot be obtained, slender crab may be collected as a surrogate species.




Note: Fish and crab will not be collected from Subarea T4E because the area cannot be easily accessed by the trawl boat, and few target species were collected there in 2004.

**Figure 3-1. LDW fish and crab tissue collection areas**

**Table 3-1. 2007 sampling design for fish and crabs**

| Species | Sample Type | Target Length (cm) | Target Number of Fish or Crabs per Composite Sample | Target Number of Fish or Crabs per Sampling Area | Total Number of Individuals | Number of Composite Samples, by Area | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | T1 | T2 | T3 | T4 |
| English sole[a] | whole body | ≥ 20 | 5 | 30 (15 in T4) | 105 | 6 | 6 | 6 | 3 |
| | fillet | ≥ 20 | 5 | 15 (5 in T4) | 50 | 3 | 3 | 3 | 1 |
| Shiner surfperch | whole body | ≥ 8 | 10 | 60 (40 in T4) | 220 | 6 | 6 | 6 | 4 |
| Dungeness crab[b] | edible meat/ hepato-pancreas | ≥ 9 | 5 | 15 (5 in T4) | 50 | 3/1[c] | 3/1[c] | 3/1[c] | 1/1 |

Note: All samples will be analyzed for PCB Aroclors, lipids, and percent solids. PCB congeners will be analyzed in a subset of samples. Specific samples will be identified based on the preliminary Aroclor data, in consultation with EPA and Ecology.

[a] Starry flounder may be collected as a surrogate species, if needed.

[b] Slender crabs may be collected as a surrogate species, if needed.

[c] If sufficient hepatopancreas tissue mass is available from the crabs collected from a given area, three hepatopancreas samples will be created per area, with each of the hepatopancreas samples corresponding to an edible meat sample created using tissue from the same crabs. If sufficient hepatopancreas tissue mass is not available to create three samples, a single hepatopancreas sample will be created using hepatopancreas tissue from all of the crabs included in the three edible meat samples from that area.

Attempts will be made to collect a sufficient number of Dungeness crabs to create three composite samples of edible meat from each of the four areas. Three samples will allow for the characterization of variability within each area while limiting the overall duration of the effort to 9 days or less. If Dungeness crabs are not caught in an area, slender crabs may be collected as a surrogate species. Based on 2004 and 2005 catch results, the collection of a sufficient number of either species of crab may be difficult in Area T4, the most upstream sampling area.

The target fish and crab size (Table 3-1) will be the same as that specified in Section 3.1.5 of the 2004 fish and crab QAPP (Windward 2004c). To the extent possible, composite tissue samples will be created such that the size distribution of specimens will be similar across all composite tissue samples for a given species, and also similar to the size distribution represented in earlier (2004 and 2005) sampling events, to improve comparability among the datasets. Within each sampling area, captured fish will be distributed into size categories to mimic the size distribution of fish in 2004 and 2005 composite samples to the extent possible, and a targeted number of fish will be randomly selected from each size category based on the proportion of fish in that category.

Five English sole (> 200 mm) will be included in each English sole composite tissue sample; subarea will not be a key consideration in their collection, although each entire sampling area will be trawled. Ten shiner surfperch (> 80 mm) will be included in each shiner surfperch composite sample; one composite sample will be created for each subarea (Figure 3-1). If sufficient numbers of target fish cannot be collected, the compositing scheme will be determined in consultation with EPA and Ecology. Note that consistent with 2005 sampling, Subarea 4E will not be sampled in 2007 because only one shiner surfperch of target size was collected in 2004 and no English sole were captured in this subarea in 2004. Trawling is not practicable in this subarea because of submerged logs and debris.

Five Dungeness crabs (> 90 mm) will be included in each composite sample of Dungeness crab edible meat. Three composite edible meat samples will be created for each area. If sufficient hepatopancreas tissue mass is available from the crabs collected from a given area, three composite hepatopancreas samples will be created from the same crabs used to create the edible meat composites. However, if insufficient hepatopancreas tissue mass is available, a single composite hepatopancreas tissue sample per area will be created from the 15 crabs. For Area T4, only one edible meat and one hepatopancreas composite sample will be created if sufficient tissue is available.

### 3.1.2 Clam sampling

Twelve intertidal locations will be sampled (Figure 3-2 and Table 3-2). The sampling locations and design are the same as that used in 2004 (Windward 2004b), with the following exceptions:

- In 2004, none of the clam specimens were depurated prior to homogenization (Windward 2005a). Consequently, sediment and other materials in the clam guts were analyzed with the clam tissue. In 2007, one composite sample of tissue from depurated clams and one composite sample of tissue from non-depurated clam will be created for each location sampled, and those samples will be chemically analyzed to assess the potential effect of depuration on arsenic tissue concentrations.
- Two new intertidal clam sampling locations (C11 and C12) have been added for 2007. Although the habitat quality is low (Windward 2004a), C11 (RM 2.9 to RM 3.4) was added to evaluate abundance and tissue concentrations of clams from the beach adjacent to Duwamish Waterway Park, a location easily accessed by the public. Location C12 (RM 3.8 to RM 4.0)[7] was added because this beach has medium habitat quality (Windward 2004a) and elevated sediment arsenic concentrations (Windward 2007b).[8]

[7] Note that if sufficient clams cannot be collected at this location, the alternate location of RM 3.56 to RM 3.57 on the east bank will be sampled.

[8] Note that the locations sampled in 2004 included both low- and high-quality clam habitat beaches.

- In 2004, additional clams were collected at 4 of the 10 locations where beaches are relatively large (C2, C3, C7, and C10) to create a second composite sample of non-depurated clams for each location. Because the beach at location C7 is similar to the size of the smaller beaches, only one sample will be collected from C7 in 2007.
- Inorganic arsenic will be analyzed in all clam samples collected in 2007, rather than in a subset (8 of 14 samples), as in 2004.
- PCB Aroclors will be analyzed in both depurated and non-depurated samples from locations C2-1, C6, C7, C8, C9, and C10-1. These locations were selected to cover the range of total PCB concentrations in 2004 clam samples (Figure 3-3), including locations with higher PCB concentrations, and to provide spatial coverage. Because there was a significant positive regression between clam tissue and sediment, these sample locations should also reflect the range of sediment concentrations from clam beaches.

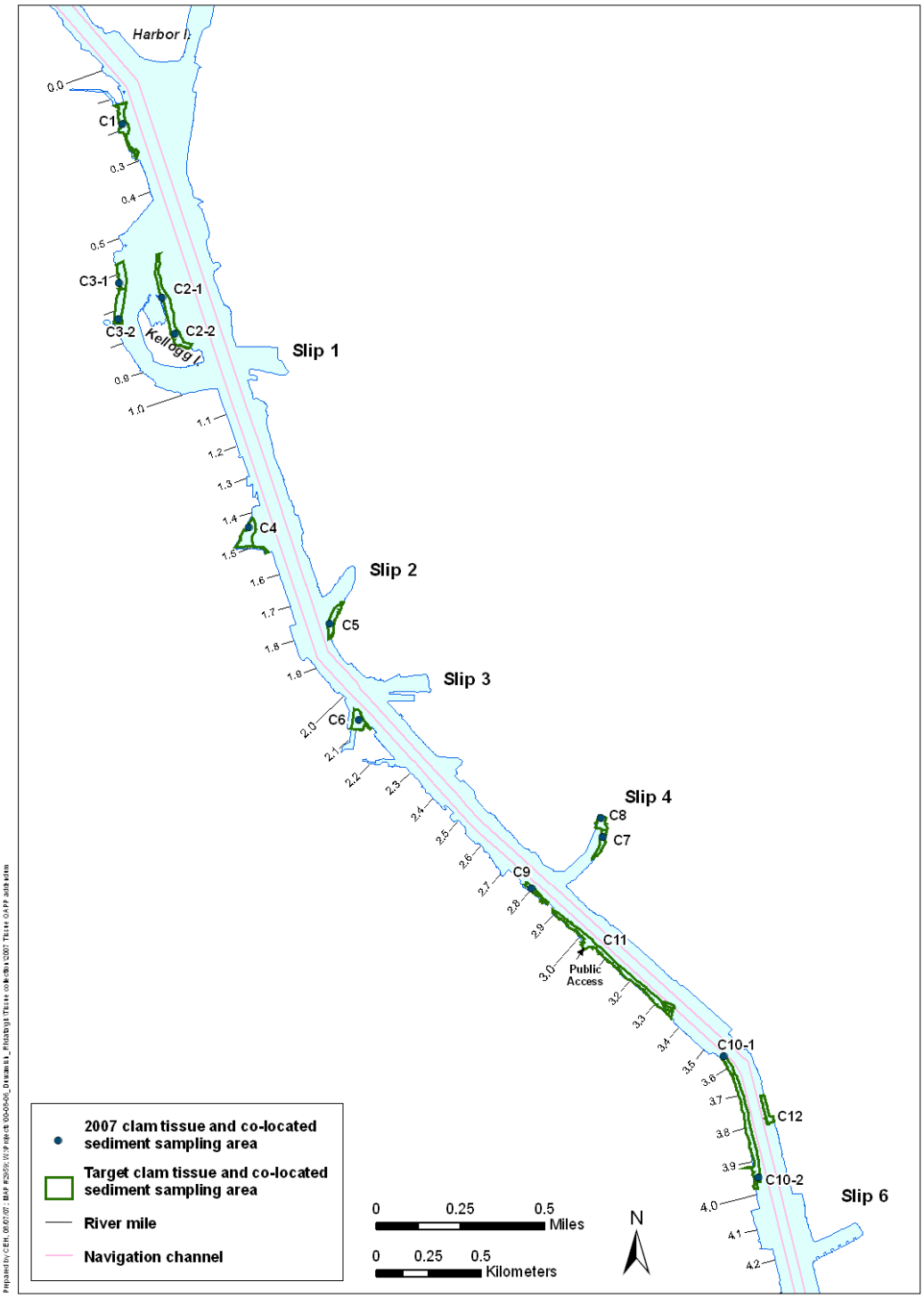
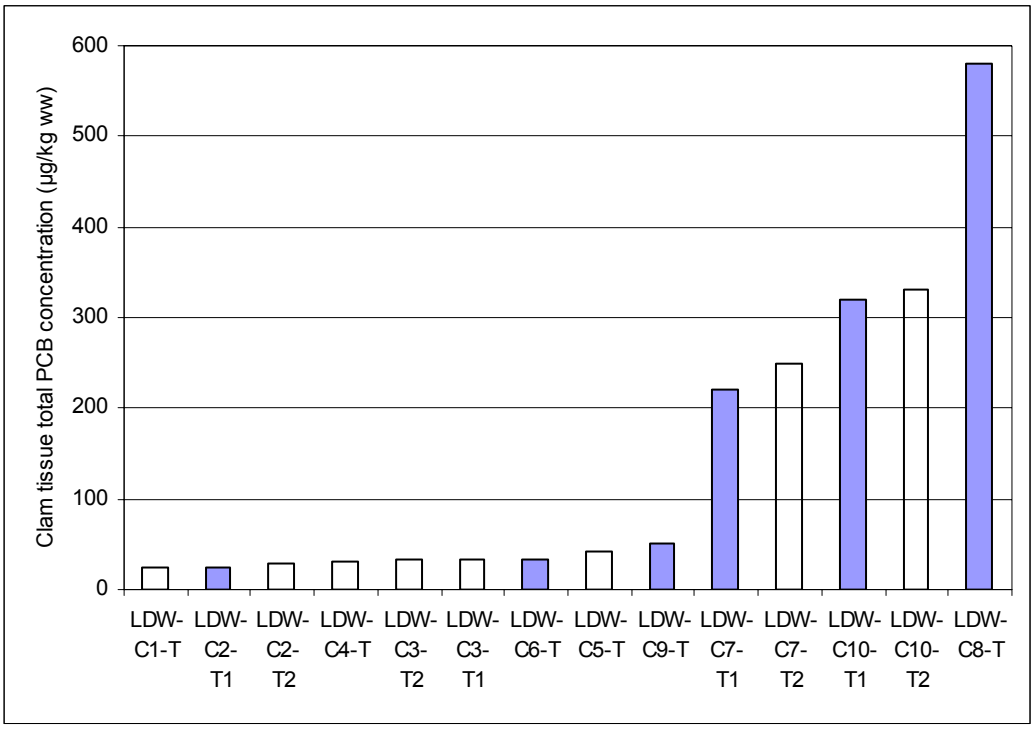



**Figure 3-2. LDW clam tissue collection areas**




Note: Locations selected for analysis of total PCBs in 2007 samples are shaded.

## Figure 3-3. Total PCB concentrations in 2004 clam samples

## Table 3-2. Clam sampling design comparison – 2004 vs. 2007

| Parameters | Sampling Details | |
|---|---|---|
| | 2004 | 2007 |
| Sampling locations | 10 sampling areas (C1 – C10) | 10 sampling areas sampled in 2004 (C1 – C10) and two new sampling areas (C11 and C12) |
| Number of composite samples | one composite clam tissue sample per sampling area, except two samples at C2, C3, C7, and C10<br>one co-located composite sediment sample for each tissue sample | clams – 30 total composite tissue samples; 2 samples per sampling area (1 depurated and 1 non-depurated) at all areas except C2, C3, and C10, which will have 4 samples per area (2 depurated and 2 non-depurated)[a]<br>sediment – 15 samples total: 1 co-located composite sediment sample for each sampling area using sediment from all depurated and non-depurated clam holes, except 2 samples each at C2, C3, and C10 |
| Analytes | clams – total and inorganic arsenic and total PCBs at all locations, except inorganic arsenic was only analyzed at eight locations; PCB congeners at 8 locations<br>sediment – total arsenic, total solids | clams – total and inorganic arsenic, lipids, and total solids at all locations, total PCBs (Aroclors) at 6 of the 12 locations; samples will be archived for potential cPAH analysis<br>sediment – total arsenic, total solids |

[a] Note that fewer samples may be analyzed if sufficient clams cannot be collected at any given sampling area; in particular, C11 and C12 have not been sampled previously and it is unknown whether sufficient clams will be available to create the targeted samples.

## 3.2 SAMPLING METHODS

Fish and crabs will be collected from the LDW using a high-rise otter trawl (Section 3.2.1.1). Crabs may also be collected in crab traps if sampling crabs via trawl is not successful (Section 3.2.2). Clams will be collected by hand using shovels (Section 3.2.3). Methods for sample identification, tissue sampling, and sample processing, as well as an equipment list are discussed in this section.

During field activities, there may be contingencies 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 captain, if applicable. The PM, EPA, and Ecology will be consulted if modifications to sampling and processing methods are required. All modifications will be recorded on the Protocol Modification Form (Appendix B).

### 3.2.1 Fish samples

#### *3.2.1.1 Fish collection*

Fish will be collected by trawling the LDW in September 2007 using the same trawling methods outlined in Section 3.2.3 of the 2004 fish and crab QAPP (Windward 2004c).

Trawling methods, as described in this section, are based on the systematic sampling of the four sampling areas and their subareas. The expected maximum daily effort is approximately 20 trawls, depending on site conditions and number of fish processed (Eaton 2004). Trawling will be conducted using the research vessel (R/V) *Kittiwake*, captained by Charlie Eaton of Bio-Marine Enterprises, as described in the 2004 fish and crab QAPP (Windward 2004c).

Fish and crab tissue sampling areas are the same as those in 2004 and 2005 (Windward 2004c, 2005c) ), with Areas T1, T2, and T3 each being divided into six subareas (A to F) and Area T4 being divided into four subareas (A to D), as shown in Figure 3-1.[9] At least one trawl will be conducted within each subarea, as described below. Each trawl line will be within the bounding coordinates of the sampling subareas. The specific trawl line and order in which the subareas will be sampled will be determined by the boat captain based on logistical considerations. Within each subarea, an attempt will be made to conduct all trawls outside the navigation channel to capture fish using shallower habitats, although trawling within the channel may be necessary if a sufficient number of fish within targeted size categories (e.g., English sole) are not caught outside the channel. Trawling will not be conducted in waters shallower than 6 ft deep (at the time of trawling) because the high-rise otter trawl is impractical in shallower areas (Eaton 2004). Tidal charts and bathymetry data collected by LDWG (Windward and DEA 2004) will be consulted to optimize the ability to trawl in shallower areas. Subsequent trawls in each subarea may follow the first trawl line or a

[9] Note that Subarea 4E will not be sampled because this area cannot be accessed by the boat, and few target species were captured in this area during the 2004 sampling effort (Windward 2005b).

different trawl line at the discretion of the boat captain, in consultation with the FC. The date, time, and location of the trawl will be recorded on the Target Species Tally Form or Non-Target Species Tally Form, as appropriate (Appendix B), after the trawl net is hauled out of the water.

Trawl start and end points will be recorded using a Trimble NT300D differential global positioning system (GPS) with 1- to-2-m accuracy. When the trawl is deployed on the bottom, GPS and clock readings will be recorded to mark the starting point of the trawl. Final GPS and clock readings will be recorded when net retrieval begins.

The order in which sampling areas and subareas will be trawled over the course of the sampling effort and within a given day will be determined by both the FC and the boat captain. Leaving this decision to the discretion of the field personnel maximizes their ability to respond to field conditions and exercise their professional judgment on fishing conditions. The trawl results will be reported each day to the Windward PM. The maximum trawling effort will be 9 days. If target numbers of fish are not obtained at that point, composite tissue samples will be created for analysis from the available specimens.

#### *3.2.1.2 Fish tissue processing*

Trawling will be conducted from the R/V *Kittiwake* using a live sampling technique, which will minimize the number of non-target species mortalities through species sorting and processing prioritization. All species captured using the methods outlined above will be placed in decontaminated bins filled with LDW water. Target fish and crabs of similar size will be preferentially selected and sorted.

Specimens of target species that do not meet size requirements will be counted, and their lengths will be approximated before they are returned to the LDW. As required by WDFW, specimens of non-target species will be identified to the lowest practical taxa and their numbers estimated. Special care will be taken to ensure that non-target organisms are returned to the LDW quickly, with minimal handling.

Individual fish or crabs of the selected target species will be rinsed in LDW water to remove any foreign material from the external surface. Large target fish will be killed by placing the fish in a resealable plastic bag (i.e., zip-lock bag), grasping the fish by the tail, and forcibly hitting the head of the fish on the processing table. Small fish will be killed by placing them on ice, as recommended by EPA (1995b). Individual specimens of the target species will be grouped by species and general size class and placed in clean holding trays to prevent contamination. All fish will be inspected carefully to ensure that their skin has not been damaged by the sampling equipment. The FC will discard specimens with broken skin.

Individual specimens of the same species from a particular sampling area will be kept together in one large zip-lock bag with the date, time, trawl number, species, and collection method recorded on the outside of the bag in indelible ink. All other pertinent information will be traceable through the field notebook and field collection

forms (Appendix B). The bagged and iced fish will be transported in coolers to Windward, where they will be stored refrigerated, frozen, or on ice in coolers at 4˚ C (±2˚ C). The specimens will be weighed and their lengths measured within 48 hrs of collection. Each individual of the target species will be weighed using an analytical scale accurate to 0.5 g. Total fish length will be measured as the length from the anterior-most part of the fish to the tip of the longest caudal fin ray (when the lobes of the caudal fin are compressed dorsoventrally). Additional observations of fish collected for chemical analysis will include general observations of any visible signs of gender and individual specimen health (e.g., morphological abnormalities, external lesions, parasites, or fin erosion). If time allows, photographs of external abnormalities will also be taken. The FC will be responsible for reviewing the count, length, weight, and external abnormality information of all species and will correct any improperly recorded information. Following the collection of these measurements, the specimens will be individually wrapped in aluminum foil (shiny side out), double bagged in zip-lock bags, labeled, and shipped to ARI within 24 hrs in sturdy coolers with wet ice or frozen gel packs. Samples will be stored frozen at the laboratory.

### 3.2.2 Crab samples

#### *3.2.2.1 Crab collection*

If within the first 3 days of sampling it appears that insufficient numbers of crabs will be captured using the trawl, 12 crab traps (i.e., 3 per area) will be deployed at locations outside of the navigation channel. Traps will be deployed until target numbers of each target species are obtained or the maximum level of effort of 2 days has been met. If traps are used, the trawling effort will be reduced by the same number of days over which trapping occurs. The specific locations to be targeted will be determined based on catch results from trawling.

Crab trap sample locations will be recorded using a GPS unit, upgraded to include the latest Wide Area Augmentation System technology, which provides accuracy within 3 m. Coordinates will be taken at the deployment location. The FC will ensure that specimens are collected within the specified tissue sampling areas. Washington State Plane coordinates North American Datum of 1983 (NAD83) will be used for the horizontal datum.

Crabs will be collected using Ladner 30-in. stainless steel rubber-wrapped crab traps. One trap will be attached to a float at each of the chosen sampling locations. Traps will be baited with a mixture of fish scraps and squid. Crab bait will be placed in mesh bait bags and tied to the inside of the trap so the bag cannot be opened and its contents consumed. All traps will soak for approximately 2 hrs before retrieval. All traps will be retrieved in the same order as they were deployed. The field crew will monitor the traps, to the extent possible, when fishing in areas of high vessel activity. Any trap(s) determined by the FC to be a hazard to navigation will be moved to a new location within the same sampling subarea, away from impending vessel traffic. Any traps lost

during sampling will be replaced, and all traps will be outfitted with a degradable latch to ensure that escape holes will open if the trap is lost. The degradable latch will ensure that lost traps will not continue to fish indefinitely, thereby harming local crab, shrimp, or fish. The date, time, and location of the trap will be recorded during both trap deployment and retrieval.

During the retrieval phase, captured organisms will be sorted by species into decontaminated bins filled with LDW water. All non-target species will be identified to the lowest practical taxa and their number estimated. More-sensitive species and life stages (i.e., juvenile salmonids, Pacific herring, smelt, juvenile tomcod) will be handled minimally and returned to the water as quickly as possible.

#### *3.2.2.2 Crab tissue processing*

Crabs will be inspected to ensure that their exoskeletons have not been cracked or damaged during the sampling process; damaged crabs will be discarded (EPA 2000). After crab traps have been retrieved, captured crabs will be rinsed with LDW water, and individual specimens will be grouped by target species and placed in clean holding trays to prevent contamination. Target crab specimens will be identified to species, measured to the nearest 1 mm, and weighed to the nearest 0.5 g. In keeping with EPA guidance, crab carapace width measurements will be made laterally across the carapace from tip of spine to tip of spine (EPA 2000). Crabs may be weighed and measured in the field or in the Windward laboratory at the discretion of the FC. Prior to processing, crabs will be placed on ice.

Crab carapace width measurements will be obtained using stainless steel calipers), and crabs will be individually weighed during processing. Individual specimens of the same species from a particular sampling area and gear deployment (i.e., a single trap) will be kept together in one large zip-lock bag with the date, time, effort number, species, and collection method recorded on the outside of the bag in indelible ink. All other pertinent information will be traceable through the field notebook and field collection forms (Appendix B). The bagged and iced crabs will be transported in coolers to Windward for temporary storage or directly to ARI for final processing. The edible meat and hepatopancreas will be removed from the crabs at ARI.

### 3.2.3 Clam samples

#### *3.2.3.1 Clam tissue and co-located sediment collection*

Clams will be collected for chemical analyses at low tide (Table 3-3). Two composite tissue samples (one for depurated clams and one for non-depurated clams), each consisting of at least 50 g of clam tissue (excluding shells), will be collected from each intertidal area. [10] Each composite sample will include at least 20 clams, if available. Consistent with 2004 tissue collection, only Eastern soft-shelled clams (*Mya arenaria)*

[10] A total of four (two depurated and two non-depurated) composite tissue samples will be collected from each of areas C2, C3, and C10.

with unbroken shells that are at least 2 cm wide (measured valve to valve) will be included in the composite samples if sufficient numbers of *Mya* are available.

**Table 3-3. LDW low tide predictions for August 24 through 28, 2007**

| DATE | TIME | LOW TIDE ELEVATION (ft MLLW) |
|---|---|---|
| August 24 | 8:49 a.m. | -0.11 |
| August 25 | 9:37 a.m. | -0.60 |
| August 26 | 10:20 a.m. | -0.93 |
| August 27 | 11:00 a.m. | -0.99 |
| August 28 | 11:39 a.m. | -0.72 |

At each of the numbered clam sampling areas, except areas C3 and C10, collection will take place as close as possible to the area where clams were collected in 2004 if clams are sufficiently abundant within these areas. If clams are not sufficiently abundant within the areas sampled in 2004, collection will take place following the catch-per-unit-effort (CPUE) method used in 2004 (Windward 2004b), radiating out from the 2004 collection area within a given numbered clam sampling area. The CPUE method will involve field crew members actively searching and collecting clams from areas within the intertidal area with the highest clam abundance, as evidenced by shows. The CPUE method will also be employed at the two new sampling locations (C11 and C12). At sampling area C11, sampling will begin at the beach access in Duwamish Waterway Park and will radiate outward from that point.

At sampling areas C2, C3, and C10, two samples of each type (i.e., depurated and non-depurated) will be collected at each beach to characterize these relatively large beaches. The two samples collected from each of these beaches in 2004 were collected in close proximity to each other, whereas in the 2007 sampling effort, samples will be collected farther apart to better characterize chemical concentrations in clams over the extent of the beach. At the northernmost collection location on each beach, collection will take place as close as possible to the area where clams were collected in 2004. The second sample will be collected beginning from the southernmost extent of the beach and progress northward until a sufficient number of clams are collected to create both depurated and non-depurated samples (i.e., 20 clams of each type, for a total of 40 clams).

In order to sample the location with elevated sediment arsenic concentrations in sampling area C12, clam collection will begin at 122° 18' 29.661" W 47° 31' 30.268" N, north of the medium-quality clam habitat and will progress southward. If samples cannot be collected north of 122° 18' 27.83" W, 47° 31' 26.74" N (the area with relatively elevated sediment arsenic concentrations), EPA and Ecology will be contacted to determine if the alternate location of RM 3.56 to RM 3.57 on the east bank should be sampled. If sufficient samples cannot be collected at the alternate location in a maximum effort of 4 hours, no samples will be collected from this location.

For each of the 12 sampling areas, the maximum level of effort per location is 4 hrs for the three-person crew, consistent with methods employed in 2004 (Windward 2004b).[11] If fewer than 40clams are obtained during the 4-hr period (i.e., fewer than 20 specimens for each of two composite tissue samples), the abundance of clams in a specific area would be considered inadequate for collecting the target clam tissue mass. In addition, it would be doubtful that an additional level of effort would increase the chance for success in these areas. In such cases, the clams obtained from those locations would be returned to the beaches, and no tissue samples would be collected from those locations.

At each of the holes where undamaged clams are collected, approximately 50 mL of the first shovelful of sediment will be collected for chemical analyses. No sediment will be collected from sampling locations where clams are not collected. A minimum of 40 50-mL sediment subsamples will be composited into each 2-L sediment sample per area (or proportionally less if fewer clams are collected). The volume of collected sediment will be estimated using a 50-mL beaker, and the sediment samples will be collected to a depth of 10 cm. A field duplicate sediment sample will be collected at one clam sample location selected in the field by the FC. The field duplicate sediment sample is described in greater detail in the 2004 benthic invertebrate QAPP (Windward 2004b).

#### *3.2.3.1 Clam tissue processing*

Two composite samples of 20 clams each randomly selected from each sampling area will be collected; one for a non-depurated sample and one for a depurated sample. All of the clams collected at a given sampling area will be rinsed in a decontaminated plastic bucket in several changes of site water until all visible sediment has been removed. Following rinsing, one-half of the clams from each sampling area will be randomly selected and placed together in one large zip-lock bag with the date, time, effort number, species, and collection method written on it. All other pertinent information will be traceable through the field notebook and field collection forms (Appendix B). The bagged clams will be placed in a cooler on wet ice and transported immediately to the Port of Seattle (POS) boathouse at Terminal 91 where field depuration will take place for 24 hours following modified American Society for Testing and Materials (ASTM) guidelines (ASTM 2001). At the POS boathouse, a label sealed in a zip-lock bag will be placed together with the clams in decontaminated plastic jars that are perforated on all sides to allow minimally interrupted water flow. Jars will be filled no more than two-thirds full with clams to minimize crowding, and then be placed within a nylon frame to exclude potential predators. The frame will be suspended in the water 3 to 5 ft beneath the boathouse for 24 hours. The boathouse is on a floating dock so clams will remain submerged for the duration of the 24 hours regardless of tides. Because the boathouse is located over deep water, clams will remain well above the sediment surface during depuration, minimizing potential

[11] Note that this level of effort applies to each of the two locations at sampling areas C2, C3, and C10.

exposure to sediment. During depuration, clams from different sampling areas will be separated to the extent possible to minimize potential cross contamination. After the depuration period, clams will be placed together in one large zip-lock bag with the date, time, effort number, species, and collection method written on it. All other pertinent information will be traceable through the field notebook and field collection forms (Appendix B). The bagged clams will be placed in a cooler on wet ice and transported in the cooler to Windward, whereupon they will be removed and processed as described below.

All non-depurated clams from a given location will be kept together in one large zip-lock bag stored in a cooler on ice with the date, time, effort number, species, and collection method recorded on the outside of the bag in indelible ink. All other pertinent information will be traceable through the field notebook and field collection forms (Appendix B). All clams will be transported to Windward for further processing.

Following rinsing for non-depurated clams and following depuration for depurated clams, clams will be measured to the nearest millimeter and weighed to the nearest 0.5 g and recorded on the Clam Collection Form (Appendix B) at the Windward laboratory prior to being packaged for shipment to the analytical laboratory. For shipment, clams will be placed together in one large zip-lock bag with the date, time, effort number, species, and collection method written on it. All other pertinent information will be traceable through the field notebook and field collection forms (Appendix B). The bagged clams will be placed in a cooler on wet ice and transported to Brooks-Rand. A label indicating the date, time, effort number, species, and collection method will be affixed to the cooler, and an ice pack will be attached inside the cooler. Clam samples will be shipped to the analytical laboratory within 24 hrs of processing or held at 4 (±2)°C until the next business day.

Removal of the clam tissue from the shell will be performed by Brooks Rand. The technicians will wear nitrile powder-free examination gloves; all sampling equipment will be stainless steel and will be cleaned between samples to avoid contaminating tissue specimens during handling.

### 3.2.3 Identification scheme for all locations and samples

#### *3.2.3.1 Fish and crab samples*

Unique alphanumeric identification (ID) numbers will be assigned to each individually wrapped fish and crab specimen in the field and recorded on the Target Species Tally Form. Organisms other than the targeted fish and crab species will be recorded on the Non-Target species Tally Form, but no specimen ID will be assigned. The first three characters will be “LDW” to identify the project area. The next two characters will be “07” to indicate that the sample was collected in 2007. The next two characters will identify the specific tissue sampling area (i.e., T1, T2, T3, or T4). The next character will identify the specific sampling subarea (i.e., A, B, C, D, E, F). The

next five characters will identify the collection method and effort number: TR representing trawl or CT representing crab trap followed by a three-digit number representing the effort number (numbered sequentially over all areas) (e.g., the 15th trawl after the start of sampling would be TR015). The next two characters will identify the individual species type: English sole (ES), starry flounder (SF), shiner surfperch (SS), Dungeness crab (DC), or slender crab (SC). The next identifier will be numeric and indicate the sequential number of the specimen captured. As an example, the 11th English sole captured in Area T1, Subarea C, in the 15th trawl would be identified as LDW-07-T1-C-TR015-ES-11. All relevant information for each individually wrapped and labeled target specimen, including specimen ID, length, weight, external abnormalities, sample date, time, and location number will be recorded on the Target Species Tally Form (Appendix B) and included as an appendix to the data report. All pertinent data associated with each individual fish or crab specimen will be traceable.

Fish and crab composite tissue samples will be identified using a similar convention, with the following differences. Effort number will not be indicated because specimens from multiple efforts may be included in each composite sample. Tissue type will be indicated as whole body (WB), skin-on fillet (FL), hepatopancreas (HP), or edible meat (EM); each sample for a given species and sampling area combination will be numbered sequentially following the letters "comp." If specimens from multiple subareas are included in the composite sample, the subarea designation will be replaced with "M." Corresponding hepatopancreas and edible meat samples will be assigned the same composite number. For example, the first Dungeness crab edible meat composite sample in Area T1, multiple subareas, would be identified as LDW-07-T1-M-DC-EM-comp1; and the corresponding hepatopancreas sample would be identified as LDW-07-T1-M-DC-HP-comp1. Information will be compiled regarding the specific numbers of fish or crabs from each subarea that were composited in each sample.

#### *3.2.3.2 Clam and co-located sediment samples*

For clams, the first three characters will be "LDW" to identify the project area. The next two characters will be "07" to identify the year. The next two characters will be the clam sampling location (i.e., C1 to C12); Locations C2, C3, and C10 will be followed by an a or b to differentiate the two samples per location; the last characters will numerically identify the individual clam at that location, beginning with "1." After all clams for a sampling location have been composited, the composite will be identified with "LDW" followed by the clam sampling location, the letters "comp" for composite, and the letters "dep" for depurated samples.

Co-located clam sediment samples will be identified with "LDW," followed by "07," the clam sampling location, and the letter "S" for "sediment." The sediment sample field duplicate will be followed by "FD."

### 3.2.4 Field equipment

The items needed in the field for each sampling method are identified in Table 3-4. The FC will check that all equipment is available and in working order each day before sampling personnel go into the field.

**Table 3-4. Field equipment for fish, crab, and clam tissue collection**

| Field Equipment | Fish Collection | Crab Collection | Clam Collection |
|---|---|---|---|
| 2004 QAPPs and QAPP addendum | X | X | X |
| Health and safety plan | X | X | X |
| Key personnel contact information list | X | X | X |
| Field collection forms | X | X | X |
| Field notebooks (Rite in the Rain®) | X | X | X |
| Chain-of-custody forms | X | X | X |
| Pens, pencils, Sharpies® | X | X | X |
| Tide tables | X | X | X |
| Study area maps | X | X | X |
| Fish identification guides | X | X | X |
| GPS (with extra batteries) | X | X | X |
| Digital camera | X | X | X |
| Cellular phone | X | X | X |
| Marine radio | X | X | |
| Alconox® detergent | X | X | X |
| Distilled water | X | X | X |
| Garden sprayer (for distilled water) | X | X | X |
| Scrub brushes | X | X | X |
| Paper towels | X | X | X |
| Garbage bags | X | X | X |
| Buckets (5 and 2 gallon) | X | X | X |
| Coolers | X | X | X |
| perforated plastic jars | | | X |
| Ice (wet and dry) | X | X | X |
| Heavy-duty aluminum foil | X | X | X |
| Zip-lock freezer bags (assorted sizes) | X | X | X |
| Plastic bins for specimen sorting | X | X | |
| Dip nets | X | | |
| Calipers | X | X | X |
| Measuring boards | X | X | |
| Scales | X | X | |
| Ladner 30-in. crab traps (complete with floats, line, bait bags/jars, and weights) | | X | |
| Bait for crab/fish traps | | X | |
| Pike pole (for dislodging nets hung on | X | X | |

| Field Equipment | Fish Collection | Crab Collection | Clam Collection |
|---|---|---|---|
| underwater debris and trap retrieval) | | | |
| High-rise otter trawl | X | | |
| Cutting board | | X | |
| Knife | | X | |
| High-rise otter trawl net | X | X | |
| Shovel | | | X |
| Stainless steel bowls and spoons | | | X |
| 50-mL (or larger) beaker | | | X |
| 2-L glass or plastic sediment sample jars | | | X |
| Powder-free nitrile exam gloves | X | X | X |
| Rubber work gloves | X | X | X |
| Rubber boots | X | X | X |
| Rain gear | X | X | X |
| Waders | | X | X |
| Personal flotation devices | X | X | |
| Hard hats | X | | |
| Head lamps | X | X | |
| First aid kit | X | X | X |
| Duct tape | X | X | X |

GPS – global positioning system

QAPP – quality assurance project plan

## 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 analyses. Additional details are presented in Sections 3.3.1 and 3.3.5 of the 2004 QAPPs (Windward 2004b, c).

### 3.3.1 Sample handling procedures

#### *3.3.1.1 Fish and crab samples*

Samples will be handled per Sections 3.2.1.2 and 3.2.2.2 of this QAPP addendum. Specimens will be stored frozen at ARI until they are homogenized and composited. During the compositing and homogenization process, fish and crab specimens from each trawl, trap, or sampling location will be kept separate from one another and processed one at a time to ensure that individual specimens are tracked properly. Each individual of the target species will be re-weighed using an analytical scale accurate to 0.5 g. Total fish length will be re-measured as the length from the anterior-most part of the fish to the tip of the longest caudal fin ray (when the lobes of the caudal fin are compressed dorsoventrally). In keeping with EPA guidance, crab carapace width measurements will be made laterally across the carapace from tip of spine to tip of spine (EPA 2000). Tissue dissection and homogenization will be performed by

qualified laboratory technicians following ARI's standard operating procedures (SOP) under Windward's oversight. ARI will follow the same procedures as those used in 2005 to ensure that comparable data are generated between sampling events. All equipment used for fish processing must be completely disassembled and cleaned prior to initial use and after each sample to ensure that no cross-contamination will occur, in accordance with the laboratory's SOP.

For fillet samples, partially thawed whole fish will be filleted with the skin on. A lengthwise cut will be made along the dorsal region adjacent to the spine using a solvent-rinsed scalpel or pre-cleaned razor blade. The muscle tissue will be carefully separated from the ribs until the entire muscle fillet has been removed, including all tissue behind the gill flap to the tail fin (as much as is reasonably possible). Care must be taken to not puncture any internal organs during this process.

The crab samples will be partially thawed before processing. The hepatopancreas tissue and edible-meat tissue will be dissected and separated into respective samples using surgical scalpels, forceps, shears, picks, and/or razor blades. The shell will be removed from the belly of the crab by pulling up on the back end of the shell, thereby exposing the crab's internal organs. The hepatopancreas tissue, which is yellow, will be removed, ensuring separation from all other tissue (e.g., white, spongy gill tissue). All edible-meat tissue will be removed from the crab's upper body and legs, as much as is reasonably possible.

Tissue samples will be homogenized using a blender, chopper, and/or meat grinder. The tissue may be cut with solvent-rinsed knives or razor blades into smaller pieces (i.e., 3-in. slices) prior to chopping or blending to ensure that the tissue is homogenized into a creamy paste with no discernable bits remaining (e.g., no large pieces of bones or fins). Whole fish will be homogenized as composite samples or as individual fish, depending on the size of the fish. Large fish may need to be homogenized individually and then the individual homogenates combined to form the composite sample. Smaller fish may be composited prior to homogenization. The composited, homogenized tissue sub-sample selected for extraction or analysis must be representative of the entire fish composite sample.

#### *3.3.1.2 Clam and co-located sediment samples*

Sediment and clam tissue samples for chemical analyses will be placed in appropriately sized, certified-clean, wide-mouth glass jars and capped with Teflon®-lined lids. 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. Each jar will be sealed, labeled, and stored under appropriate conditions, as outlined in Section 3.4.2.1 of the 2004 benthic invertebrate QAPP (Windward 2004b).

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 damaged from water and sediment.

Clam specimens and sediment samples will be processed per Section 3.2.3 of this QAPP addendum. The sediment samples will be composited and homogenized in the field, and a single jar will be submitted to Brooks Rand for chemical analysis. The clam tissue samples will be processed, composited, and homogenized by qualified laboratory personnel at Brooks Rand according to the laboratory's SOPs. The whole-body clam tissue will be removed from the shells prior to homogenization using a stainless steel spatula or knife. If the clams are processed fresh (i.e., refrigerated, not frozen), any excess liquid will be discarded. If the clams were frozen prior to processing, the excess liquid will be collected as part of the sample because some cells may have lysed and released material from the tissues. Care should be taken to remove all tissue from the shell, including the entire mantle. Once removed from the shell, all tissue will be homogenized using a blender or chopper. It may be necessary to cut or cube some of the tissues before blending or chopping. All equipment must be cleaned before use and between samples in accordance with the laboratory's SOPs.

The analysis of total and inorganic arsenic and total solids will be performed by Brooks Rand for both sediment and tissue samples. Following tissue sample compositing and homogenization, a sub-sample of the tissue homogenates will be sent under chain-of-custody procedures to ARI for lipids analysis. Sample mass shipped to ARI will be sufficient to ensure sufficient archived tissue is available to allow for potential future cPAH analysis. Remaining sample mass beyond that used for analysis will be archived frozen at the laboratories.

### 3.3.2 Sample tracking and custody procedures

At each laboratory, a unique identifier will be assigned to each sample (using either the 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 or initials of individuals responsible for performing the analyses; dates of sample extraction, preparation, and analysis; and the types of analyses being performed.

Sample labels will contain the project number, name(s) of sampling personnel, date, time, specimen ID, and comments. The specimens included in each composite sample will be tracked using the Composite Sample Form (Appendix B). This form will include the project number, the composite sample ID, the sample ID of each specimen included in the composite sample, collection date and time, and the weight of each specimen.

The analytical laboratory will assign a unique sample identifier to each sample (using either the 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 or initials of the individuals responsible for performing the analyses, dates of sample extraction, preparation and analysis, and the type of analysis being performed.

Custody procedures will be used for all samples throughout the collection, transport, and analytical process, and for all data and data documentation, whether in hard-copy or electronic formats. Custody procedures will be initiated during sample collection. A chain-of-custody form will accompany samples to the analytical laboratory. Each person who has custody of the samples will sign the chain-of-custody form and ensure that the samples are not left unattended unless properly secured.

## 3.4 ANALYTICAL METHODS

After field collection and initial processing at Windward, fish and crab specimens will be sent to ARI for filleting (fish) or extraction of hepatopancreas tissue and edible meat (crabs), compositing, homogenization, and chemical analysis; clam tissue specimens and sediment composite samples will be shipped to Brooks Rand, where they will be shucked and homogenized. Sub-samples of selected fish and crab sample homogenates will be shipped frozen from ARI to Axys for PCB congener analysis. All sample processing will be conducted at the laboratories following their SOPs. Chemical analyses will take place at different laboratories depending on the analyte (Table 3-5). This section provides a brief summary of the analytical methods. See the 2004 QAPPs (Windward 2004b) for details involving QA / QC; instrument and equipment testing, inspection, maintenance, and calibration; non-direct measurement; and data management.

**Table 3-5. Procedures to be conducted at each analytical laboratory**

| ARI | BROOKS RAND | AXYS |
|---|---|---|
| Fish and crab processing and homogenization | Clam processing and homogenization | PCB congener analysis of a subset of fish and crab samples |
| Analysis for PCB Aroclors in fish, crab, and clam samples | Analysis for total arsenic in clams and sediment | |
| Analysis for total solids in fish and crab samples | Analysis for inorganic arsenic in clams | |
| Analysis for lipids (all tissue samples) | Analysis for total solids in clams and sediment | |
| Potential cPAH analysis (clams) | | |
| Sample archiving | | |

Homogenates may be frozen; however, frozen homogenates from individual fish must be re-homogenized before compositing for analysis (if required). Any remaining homogenates or whole fish will be archived frozen for at least 1 year after collection.

All fish and crab composite tissue samples will be analyzed for PCBs as Aroclors, lipids, and percent solids (Table 3-6). In addition, three whole-body English sole samples, three shiner surfperch samples, three crab edible-meat samples, and one crab

hepatopancreas sample[12] will be analyzed for PCB congeners. The specific samples selected for PCB congener analysis will be determined based on the PCB Aroclor data.

### Table 3-6. Numbers of composite tissue samples to be analyzed for each analyte group

| Analyte | English Sole | | Shiner Surfperch | Dungeness Crab | | Clams | Total Number of Samples |
|---|---|---|---|---|---|---|---|
| | WB | Fillet | WB | EM | HP | WB | |
| PCB congeners | 3 | 0 | 3 | 3 | 1[a] | 0 | 8 |
| PCBs as Aroclors | 21 | 10 | 22 | 10 | 4[a] | 12 | 79 |
| Total arsenic | 0 | 0 | 0 | 0 | 0 | 30 | 30 |
| Inorganic arsenic | 0 | 0 | 0 | 0 | 0 | 30 | 30 |
| Lipids | 21 | 10 | 22 | 10 | 4[a] | 30 | 97 |
| Total solids | 21 | 10 | 22 | 10 | 4[a] | 30 | 97 |
| cPAH | 0 | 0 | 0 | 0 | 0 | 0[b] | 0 |

[a] Composited from all crabs used in the three edible meat samples; however, if sufficient tissue mass is available from the crabs collected for edible meat samples, three hepatopancreas samples will be created, one per edible meat sample.

[b] Subsamples of clam tissue will be archived for potential cPAH analysis.

EM – edible meat

HP – hepatopancreas

PCB – polychlorinated biphenyl

WB – whole body

All composite clam tissue samples will be analyzed for total arsenic, inorganic arsenic, and total solids by Brooks Rand. The remaining clam tissue will be sent from Brooks Rand to ARI for lipids and PCB Aroclor analysis. Both depurated and non-depurated clam samples from locations C2-1, C6, C7, C8, C9, and C10-1 will be analyzed for PCBs as Aroclors. Clam tissue will also be archived for potential cPAH analysis. The laboratories will store the remaining tissue homogenates and sediment samples frozen. The co-located sediment samples (15 total) for clam samples will be analyzed for total solids and total arsenic by Brooks Rand. Analytical methods, minimum required sample mass, and laboratory sample handling requirements for all target analytes in tissue are presented in Table 3-7; requirements for all target analytes in sediment are presented in Table 3-8.

[12] Note that three hepatopancreas samples will be analyzed if three rather than one hepatopancreas samples are also analyzed for Aroclors (See Table 3-1 for further explanation).

## Table 3-7. Analytical methods and sample handling requirements for tissue samples

| Analyte | Method | Reference | Sample Holding Time[a] | Container | Minimum Sample Mass (g)[b] | Preservative |
|---|---|---|---|---|---|---|
| PCB congeners[c] | HRGC/HRMS | EPA 1668 | 1 year to extract, 1 year to analyze | aluminum foil and zip-lock bag (whole fish and crabs) glass jar (homogenate) | 25 | freeze/-20° C |
| PCBs as Aroclors | GC/ECD | EPA 8082 | 1 year to extract, 40 days to analyze | aluminum foil and zip-lock bag (whole fish and crabs) glass jar (homogenate) | 10 | freeze/-20° C |
| Total arsenic | ICP-MS | EPA 6020 | 6 months | glass jar (clam specimens and sample homogenate) | 5 | freeze/-20° C |
| Inorganic arsenic | HG-AFS | EPA 1632 | 6 months | glass jar (clam specimens and sample homogenate) | 5 | freeze/-20° C |
| Lipids | DCM extraction gravimetric | NOAA (1993) | 1 year | glass jar or aluminum foil and zip-lock bag (clam specimens and whole fish or crabs) glass jar (homogenate) | 5 | freeze/-20° C |
| Total solids | Oven-dried | NOAA (1993) or PSEP (1997) | 6 months | glass jar or aluminum foil and zip-lock bag (clam specimens and whole fish or crabs) glass jar (homogenate) | 10 | freeze/-20° C |
| cPAH[c] | GC/MS | EPA 8270-SIM | 1 year to extract, 40 days to analyze | glass jar (clam specimens and sample homogenate) | 10 | freeze/-20° C |

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

[b] One sample per 20 should have approximately three times the minimum required sample mass for the analysis of laboratory QC samples. The actual sample mass used for analysis is selected at the discretion of the laboratory. RLs may increase proportionally if less sample mass is used for analysis.

[c] Tissue samples are being archived for potential analysis of PCB congeners and cPAHs.

C – centigrade

DCM – dichloromethane

EPA – US Environmental Protection Agency

GC/ECD – gas chromatography/electron capture detector

GC/MS – gas chromatography/mass spectrometry

HRGC/HRMS – high resolution gas chromatography/high resolution mass spectrometry

HG-AFS – hydride generation atomic fluorescence spectrometry

ICP-MS – inductively coupled plasma mass spectrometry

NOAA – National Oceanic and Atmospheric Administration

PCB – polychlorinated biphenyl

PSEP – Puget Sound Estuary Program

SIM – selected ion monitoring

## Table 3-8. Laboratory analytical methods and sample handling requirements for sediment samples

| Parameter | Method | Reference | Container | Sample Holding Time[a] | Preservative |
|---|---|---|---|---|---|
| Total arsenic | ICP-MS | EPA 6020 | glass jar | 6 months[b] | cool/4°C |
| Total solids | oven-dried | PSEP (1986) | | 14 days | cool/4°C |

[a] All samples will be archived frozen at the laboratory until the Windward PM authorizes their disposal.

[b] Frozen sediment has a maximum holding time of 1 year.

C – centigrade

EPA – US Environmental Protection Agency

ICP-MS – inductively coupled plasma mass spectrometry

PSEP – Puget Sound Estuary Program

The parameters used to assess data quality are precision, accuracy, representativeness, comparability, completeness, and sensitivity. Table 3-9 lists specific data quality indicators (DQIs) for tissue analyses. Table 3-10 lists specific DQIs for sediment analyses. Interferences in individual samples may result in an increase in the reported quantitation limits. To achieve the required low quantitation limits, some modifications to the methods may be necessary. Composite samples for analysis should weigh at least 50 g. The remaining homogenate will be archived frozen at ARI. Table 3-11 summarizes the QC procedures to be performed by the laboratory.

## Table 3-9. Data quality indicators for tissue analyses

| Parameter | Units | Precision | Accuracy | Completeness | Reporting Limits |
|---|---|---|---|---|---|
| PCBs as congeners | ng/kg ww | ±50% | 38 – 150% | 95% | 0.76 – 4.7 |
| PCBs as Aroclors | µg/kg ww | ±50% | 38 – 150% | 95% | 20 |
| Total arsenic | mg/kg ww | ±30% | 60 – 130% | 95% | 0.05 |
| Inorganic arsenic | mg/kg ww | ±25% | 75 – 125% | 95% | 0.003 |
| Lipids | % ww | ±30% | na | 95% | 0.1 |
| Total solids | % ww | ±20% | na | 95% | 0.1 |
| cPAHs | µg/kg ww | ±50% | 20 – 130% | 95% | 5 |

cPAHs – carcinogenic polycyclic aromatic hydrocarbons

na – not applicable

PCB – polychlorinated biphenyl

ww – wet weight

## Table 3-10. Data quality indicators for sediment analyses

| Parameter | Units | Precision | Accuracy | Completeness | Reporting Limit |
|---|---|---|---|---|---|
| Arsenic | mg/kg dw | ±30% | 70-130% | 95% | 0.012 |
| Total solids | % ww | ±20% | na | 95% | 0.1 |

dw – dry weight

ww – wet weight

**Table 3-11. Laboratory quality control sample analysis summary**

| Analysis Type | Initial Calibration | Second Source Initial Calibration Verification | Continuing Calibration Verification | Laboratory Control Sample or Standard Reference Material | Matrix Spike | Matrix Spike Duplicate or Lab Replicate | Method Blank | Surrogate Spikes |
|---|---|---|---|---|---|---|---|---|
| PCB Congeners | prior to analysis | after initial calibration | Prior to 12-hr analytical batch | one per prep batch | na | one laboratory replicate per 20 samples | one per prep batch | each sample |
| PCB Aroclors | prior to analysis | after initial calibration | every 20 injections or 12 hrs, whichever is more frequent | one per prep batch | one per prep batch or SDG | one per prep batch or SDG | one per prep batch | each sample |
| Arsenic (total and inorganic) | daily, prior to analysis | after initial calibration | every 10 samples | one per prep batch | one per prep batch | one per prep batch | one1 per prep batch | na |
| Total solids and lipids | na | na | na | na | na | one lab replicate per 20 samples | na | na |
| cPAH | prior to analysis | after initial calibration | Prior to 12-hr analytical batch | one per prep batch | one per prep batch or SDG | one per prep batch or SDG | one per prep batch | each sample |

Note: A batch is a group of samples of the same matrix analyzed or prepared at the same time, not to exceed 20 samples.

cPAH – carcinogenic polycyclic aromatic hydrocarbons SDG – sample delivery group

na – not applicable

PCB – polychlorinated biphenyl

# 4.0 Assessment and Oversight

Details of compliance assessment and response actions are presented in the 2004 fish and crab QAPP (Windward 2004c).

# 5.0 Data Validation and Usability

Data are not considered final until validated. Data validation will be conducted following EPA guidance (EPA 2004, 1999, 1995a). The project QA / QC coordinator is responsible for ensuring that all analyses performed by the laboratory are correct, properly documented, and complete and that they satisfy the DQIs specified in Tables 3-8, 3-9, and 3-10.

Independent third-party data review and summary validation of the analytical chemistry data will be conducted by LDC. A minimum of 10% or a single sample delivery group will undergo full data validation; all PCB congener results will undergo full-level validation. If no discrepancies are found between reported results and raw data in the set that undergoes full data validation, then validation can proceed as a summary validation on the rest of the data using all of the QC forms submitted in the laboratory data package. As part of the summary validation, all

summary forms for calibrations, instrument performance, and internal standard summaries will be reviewed.

All discrepancies and requests for additional, corrected data will be discussed with the laboratories prior to issuing the formal data validation report. LDC will prepare a data validation report that summarizes QC results, qualifiers, and possible data limitations. This data validation report will be appended to the data report. Only validated data with appropriate qualifiers will be released for general use.

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

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# APPENDIX A. HEALTH AND SAFETY PLAN

# APPENDIX A: HEALTH AND SAFETY PLAN

**Title and Approval Page:**
**LDW Fish, Crab and Clam Tissue 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 addendum to which it is attached.

Kathy Godtfredsen
Project Manager

Date

Tad Deshler
Corporate Health and Safety Manager

Date

Thai Do
Field Coordinator/Health and Safety Officer

Date

## A.1.0 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 herein are based on generally recognized health and safety practices. Any changes or revisions to this plan will be made by a written amendment that 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 and visitors.

This HSP addresses all activities associated with collection and handling of biological specimens from the Lower Duwamish Waterway (LDW) for preparation of tissue samples for chemical analyses. 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 Windward Corporate Health and Safety Manager (HSM) and the Windward Project Manager (PM).

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 preliminary 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.

## A.2.0 Site Description and Project Scope

### A.2.1 Site Description

The sampling area is in the LDW (see Figures 3-1 and 3-2 in the QAPP addendum). The QAPP addendum 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 biological specimens from a boat using a high-rise-trawl
- collection of biological specimens from a boat using crab traps
- collection of biological specimens and sediment samples in the intertidal zones using a shovel
- sample handling, processing, and shipping

Additional details on the sampling design and sampling methods are provided in Section 3.0.

## A.3.0 Health and Safety Personnel

Key health and safety personnel and their responsibilities are described below. These individuals are responsible for the implementation of this HSP and will be responsible for informing all individuals assigned to work on the site, or visit the site, of the contents of this plan and ensuring that each person signs the Site Safety Plan Acknowledgment Form. By signing the Safety Plan Acknowledgment Form, individuals recognize the site health and safety hazards, known or suspected, and will adhere to the protocols required to minimize exposure to such hazards.

**Project Manager:** The 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 Field Coordinator (FC) and Health and Safety Officer (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 addendum.

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 will 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.4.0 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 high-rise trawl, shrimp and crab traps, and beach seine will be used to collect tissue samples as described in Section 3.2 of the QAPP. Appropriate seining protocols will be used in the deployment and hauling of the seine to ensure safety of the field personnel. Before sampling activities begin, there will be a training session for all field personnel for the equipment that will be onboard the sampling vessel.

### A.4.1.3 Falling overboard

Some of the sampling activities will be conducted 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, hypothermia, or frostbite are not anticipated. The sampling will occur during the time of year when extreme weather conditions are not expected to occur.

#### 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.

#### A.4.1.7 Vessel traffic

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. As practical, the field boat will stay out of the navigation channel.

### A.4.2 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.4.2.1 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 —** Incidental ingestion of sediment or surface water 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 onboard the boat should prevent the occurrence of water splashing or spilling during sample collection and handling activities.

#### A.4.2.2 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 the 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 the compounds into the body. Field procedures require immediate washing of sediments from exposed skin.

**Polychlorinated biphenyls —** 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.4.3 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-1 presents the activity hazard analysis for the following activities:

- Tissue sampling from boat
- Tissue and sediment sampling from shore

**Table A-1. Activity hazard analysis**

| ACTIVITY | HAZARD | CONTROL |
|---|---|---|
| Sampling from a boat and shore | Falling overboard | Use care in boarding/departing from vessel. Deploy and recover the net or traps 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 pots, or seek help. |

## A.5.0 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 will encompass the area where sample collection and handling activities are performed. Work zones will be identified for each sampling gear type. The FC / HSO will delineate the work zone as a particular area on-board the collection vessels (for high-rise trawl and traps) or on the beach (for beach seining). 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 zones. 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 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.6.0 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.7.0 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 onboard 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.

New personnel or visitors will be informed of PPE requirements during their initial site briefing (see Section A3.0).

### 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 lab coats
- chemical-resistant steel-toed boots
- chemical-resistant gloves
- safety glasses

### 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 or waders
- 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 onboard. Equipment will be checked daily to ensure its readiness for use.

## A.8.0 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 will 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.9.0 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:**

- Do not walk 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 the following decontamination procedures, as appropriate, before eating lunch, taking a break, or before leaving the work location:

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

Sampling equipment will be decontaminated as described in Section 3.3.2 of the QAPP. In summary, to minimize sample contamination, the following practices will be followed:

- Caught fish will only be placed on clean surfaces, such as aluminum foil (dull side touching the fish).
- Ice chests will be scrubbed with Alconox® detergent and rinsed with deionized water prior to any sampling activities.
- Samples will be placed in re-sealable, waterproof plastic bags to avoid contamination from melting ice.
- Sampling equipment will be free from contaminants such as oils, grease, and fuels.
- All utensils or equipment used directly in handling fish (e.g., such as measuring boards) will be scrubbed with Alconox® detergent and rinsed with deionized water, and stored in aluminum foil until use.

## A.10.0 Disposal of Contaminated Materials

Contaminated materials that may be generated during field activities include PPE 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 or unwanted specimens collected for tissue samples will be returned to the water.

## A.11.0 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 and visitors must read this HSP and be familiar with its contents before beginning work

or providing oversight. They must acknowledge reading the HSP by signing the HSP review form contained in Attachment A1. The form will be kept in the project files.

The boat captain and FC / HSO will also be required to have the US Coast Guard Auxiliary Boating Safely certification. The boat captain 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 procedures
- 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 logbook.

### A.11.3 FIRST AID AND CPR

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

## A.12.0 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 following 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 as a result of 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.13.0 Reporting and Record Keeping

Each member of the field crew will sign the HSP review form (see Attachment 1). 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.14.0 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 and a map 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 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 Windward PM as soon as possible after initiating an emergency response action. The Windward PM 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-2 lists the names and phone numbers for emergency response services and individuals.

**Table A-2. Emergency response contacts**

| CONTACT | TELEPHONE NUMBER |
|---|---|
| Emergency Numbers | |
| Ambulance | 911 |
| Police | 911 |
| Fire | 911 |
| Harborview Medical Center | (206) 323-3074 |
| Emergency Responders | |
| U.S. 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 |
| US Environmental Protection Agency | 1-800-424-8802 |
| Washington State Department of Ecology – Northwest Region Spill Response<br>(24-hour emergency line) | (206) 649-7000 |
| Emergency Contacts | |
| ***Windward Project Manager*** | |
| Kathy Godtfredsen | (206) 812-5413 |
| ***Windward Corporate Health and Safety Manager*** | |
| Tad Deshler | (206) 812-5406 |
| ***Field Coordinator/Health and Safety Officer*** | Site cellular telephone: |
| Thai Do | (206) 353-9346 |

### 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 injured individual(s), 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(s).
- 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 pickup.
- 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.14.11.

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 BOATING HAZARDS

Emergency responses to boating hazards are described in Table A-3.

## Table A-3. Potential boat 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 life rafts, rescue boat, or swimming) and meet at a designated area. The field manager will take roll call to make sure everyone evacuated safely. Emergency meeting places will be determined in the field during the daily safety briefings. |
| Medical emergency/ personal injury | At least one person with current first aid-CPR training will be onboard the vessel at all times. This person will attempt to assess the nature and critical path 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 | Immediately throw the person in the water a life ring. 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 field manager will take a roll call to make sure everyone is present. |
| Hydraulic oil spill or leak | If the leak/spill is small, immediately apply absorbent pads to control the leak and continue work. If the leak/spill is uncontainable, stop work, call 911 immediately, and wait for assistance. The vessel operator will assess the personal safety hazard associated with the leak/spill and begin evacuation procedures if necessary. |
| 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 field manager 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. 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. Field manager and vessel operator will assess damage and potential hazards. If necessary, vessel will be evacuated and secured until repairs can be made. |

### A.14.11 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 as follows:

- Dock the vessel at 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.

## 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 |
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| Signature | Date |
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# APPENDIX B. FIELD COLLECTION FORMS

This appendix contains the following forms that will be used, as necessary, during this study:

- Protocol Modification Form
- Target Species Tally Form
- Non-Target Species Tally Form
- Clam Collection Form
- Surface Sediment Collection Form
- Specimen Label
- Composite Sample Form

# PROTOCOL MODIFICATION FORM

Project Name and Number: **LDW RI – Fish and crab chemistry (04-08-06-22)**

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 Manager: Date:

QA Manager: Date:

# TARGET SPECIES TALLY FORM

**Project Name: LDW RI – Fish and crab chemistry** **Project #: 04-08-06-22**

**Species sampled:** **Field crew initials:**

**Comments:**

| COLLECTION DATE | COLLECTION TIME | LOCATION ID | COLLECTION METHOD | SPECIMEN ID # | LENGTH (mm) | WEIGHT (g) | GENDER | COMMENTS |
|---|---|---|---|---|---|---|---|---|
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# NON-TARGET SPECIES TALLY FORM

**Project Name: LDW RI – Fish and crab chemistry** **Project #: 04-08-06-22**

**Field crew initials:**

**Comments:**

| COLLECTION DATE | COLLECTION TIME | LOCATION ID | COLLECTION METHOD | SPECIES | LENGTH RANGE (mm) | TOTAL WEIGHT (g ww) | COUNT | COMMENTS |
|---|---|---|---|---|---|---|---|---|
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# CLAM COLLECTION FORM

**Project Name: LDW RI – Fish and crab chemistry** **Project #: 04-08-06-22**

**Collection date:** **Begin/end time:**

**Sampling method:** **Station ID:**

**Weather:** **(X):**

**Field crew initials:** **(Y):**

| CLAM SPECIES | SPECIMEN ID | LENGTH (MM) | WEIGHT (G WW) |
|---|---|---|---|
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**Comments:**

# SURFACE SEDIMENT COLLECTION FORM

**Project Name:** LDW RI – Fish and crab chemistry **Project #.:** 04-08-06-22

**Date:** _____ **Weather:** _____

**Sampling Method:** _____ **Crew:** _____

| **GRAB DATA** | **Location ID:** | | | |
|---|---|---|---|---|
| **Latitude:** | | **Longitude:** | | |
| **Grab time** | **Bottom depth (m)** | **Penetration depth (cm)** | **Acceptable grab (Y/N)** | **Comments:** |
| | | | | |
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| | | | | |
| **SAMPLE DATA** | **Sample ID:** | | | |
| **Sediment type:** | **Sediment color:** | **Sediment odor:** | | **Comments:** (i.e. organic matter, wood debris, shell fragments, field duplicate, rinsate blank, etc.) |
| cobble | brown surface | none | $H_2S$ | |
| gravel | drab olive | slight | petroleum | |
| sand: C M F | brown | moderate | other: | |
| silt | gray | strong | | |
| clay | black | | | |

| **GRAB DATA** | **Location ID:** | | | |
|---|---|---|---|---|
| **Latitude:** | | **Longitude:** | | |
| **Grab time** | **Bottom depth (m)** | **Penetration depth (cm)** | **Acceptable grab (Y/N)** | **Comments:** |
| | | | | |
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| **SAMPLE DATA** | **Sample ID:** | | | |
| **Sediment type:** | **Sediment color:** | **Sediment odor:** | | **Comments:** (i.e. organic matter, wood debris, shell fragments, field duplicate, rinsate blank, etc.) |
| cobble | brown surface | none | $H_2S$ | |
| gravel | drab olive | slight | petroleum | |
| sand: C M F | brown | moderate | other: | |
| silt | gray | strong | | |
| clay | black | | | |

# SPECIMEN LABEL

| WINDWARD ENVIRONMENTAL LLC<br>200 WEST MERCER STREET, SUITE 401, SEATTLE, WA 98119<br>TEL: (206) 378-1364 FAX: (206) 217-0089 | |
|---|---|
| Project #: **04-08-06-22** | Sampler initials: |
| Sample date: | Sample time: |
| Species: | |
| Sample ID#: | |
| Comments: | |

# COMPOSITE SAMPLE FORM

**Project Name: LDW RI – Fish and crab chemistry** **Project #: 04-08-06-22**

**Date Composited:** **Composited By:**

| COMPOSITE SAMPLE ID # | SPECIMEN ID # | COLLECTION DATE | COLLECTION TIME | WEIGHT (g ww) |
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**Comments:**

# APPENDIX C. DATA MANAGEMENT

# Appendix C. Data Management

## C.1 Laboratory Replicate Samples

Chemical concentrations obtained from the analysis of laboratory duplicate or replicate samples (two or more analyses on the same sample) are averaged for a closer representation of the "true" concentration as compared to the results of a single analysis. Averaging rules are dependent on whether the individual results are detected concentrations or reporting limits (RLs) for undetected analytes. If all concentrations are detects for a given parameter, the values are simply averaged arithmetically. If all concentrations are undetected for a given parameter, the minimum RL is reported. If the concentrations are a mixture of detected concentrations and RLs, any two or more detected concentrations are averaged arithmetically and RLs are ignored. If there is a single detected concentration and one or more RLs, the detected concentration is reported. The latter two rules are applied regardless of whether the RLs are higher or lower than the detected concentration.

## C.2 Location Averaging

Chemical concentrations for a single location where more than one sample is obtained are calculated as the average concentration of a surface sediment sample and the assoicated field duplicate sample. These types of samples are also called field splits (PSEP 1997), and are collected at a single location using the same homogenized sediment. The sample and the field duplicate sample are submitted to the laboratory as individual samples, and they are analyzed separately. The averaging rules used for location averaging are the same as for laboratory replicate samples described above. A sampling location with averaged chemical concentrations is presented as a single "sample" in the data report text and data tables.

## C.3 Significant Figures and Rounding

The laboratories report results with different numbers of significant figures depending on the instrument, parameter, and the concentration relative to the reporting limit (RL). The reported (or assessed) precision of each observation is explicitly stored in the project database as a record of the number of significant figures assigned by the laboratory. The tracking of significant figures becomes important when calculating averages and performing other data summaries.

When a calculation involves addition, such as totaling polychlorinated biphenyls (PCBs) or polycyclic aromatic hydrocarbons (PAHs), the calculation can only be as precise as the least precise number that went into the calculation. For example (assuming two significant figures):

> 210 + 19 = 229, but this would be reported as 230 because the trailing zero in the number 210 is not significant.

When a calculation involves multiplication or division, such as when organic carbon normalizing is used, all significant figures are carried through the calculation, and then the total result is rounded at the end of the calculation to reflect the value used in the calculation with the fewest significant figures. For example:

> 59.9 x 1.2 = 71.88, to be reported as 72 because there are two significant figures in the number 1.2.

When rounding, if the number following the last significant figure is less than 5, the digit is left unchanged. If the number following the last significant figure is equal to or greater than 5, the digit is increased by 1.

## C.4 DILUTIONS

All analyte concentrations within the calibration range of the instrument in the lowest analytical dilution are selected as the final result. Any analyte concentrations that exceed the calibration range and are qualified as estimated by the laboratory as an exceedance (E-qualified) are rejected by the data validator. The values for these analytes are selected from the analysis of the sample dilution in which the analyte concentration is within the calibration range of the instrument. In cases where the result from the lowest analytical dilution is qualified by the laboratory or the validator, the validator uses best professional judgment to determine whether or not the qualification warrants the selection of the result from another analytical dilution as the final result.

## C.5 CALCULATING TOTALS

Total PCBs are calculated, in accordance with the methods of the Washington State Sediment Management Standards (SMS), using only detected values for seven Aroclor mixtures.[1] For individual samples in which none of the seven Aroclor mixtures is detected, total PCBs are given a value equal to the highest RL of the seven Aroclors and assigned a U-qualifier indicating the lack of detected concentrations.

## C.6 CALCULATION OF PCB CONGENER TEQS

PCB congener toxic equivalents (TEQs) are calculated using the World Health Organization (WHO) consensus toxic equivalency factor (TEF) values (Van den Berg et al. 2006) for mammals as presented in Table C-1. The TEQ is calculated as the sum of each congener concentration multiplied by the corresponding TEF value. When the congener concentration is reported as non-detected, then the TEF is multiplied by zero, half the RL or the full RL, depending on the calculation method specified.

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

**Table C-1. PCB congener TEF values for mammals**

| PCB Congener Number | TEF Value (unitless) |
|---|---|
| 77 | 0.0001 |
| 81 | 0.0003 |
| 105 | 0.00003 |
| 114 | 0.00003 |
| 118 | 0.00003 |
| 123 | 0.00003 |
| 126 | 0.1 |
| 156 | 0.00003 |
| 157 | 0.00003 |
| 167 | 0.00003 |
| 169 | 0.03 |
| 189 | 0.00003 |

## C.7 References

PSEP. 1997. Recommended guidelines for sampling marine sediment, water column, and tissue in Puget Sound. Final report. Prepared for the US Environmental Protection Agency, Seattle, WA. Puget Sound Water Quality Action Team, Olympia, WA.

Van den Berg M, Birnbaum LS, Denison M, De Vito M, Farland W, Feeley M, Fiedler H, Hakansson H, Hanberg A, Haws L, Rose M, Safe S, Schrenk D, Tohyama C, Tritscher A, Tuomisto J, Tysklind M, Walker N, Peterson RE. 2006. The 2005 World Health Organization reevaluation of human and mammalian toxic equivalency factors for dioxins and dioxin-like compounds. Tox Sci 93(2):223-241.