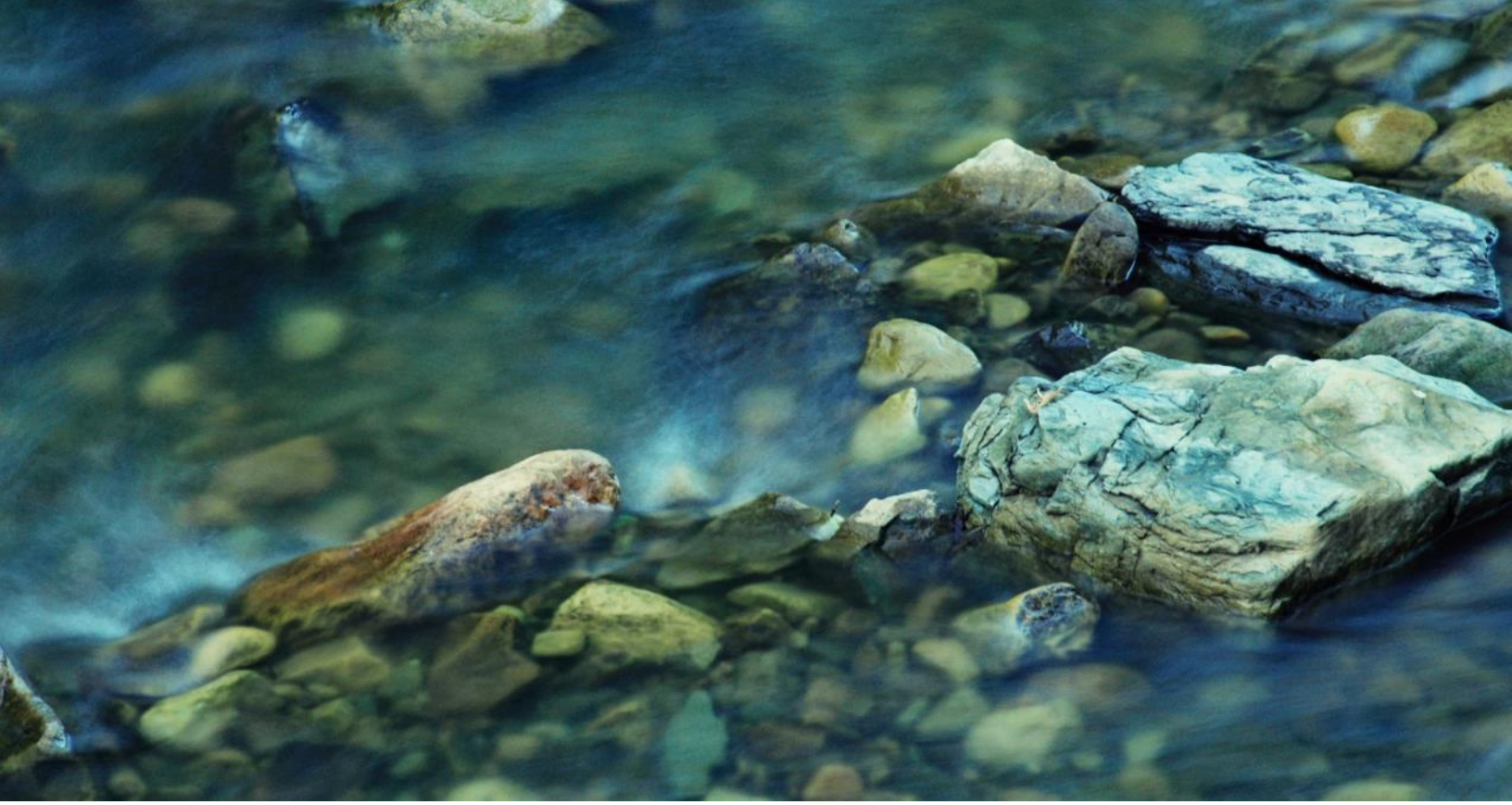

May 2020
Hylebos Wood Debris Site

ANCHOR QEA

Sampling and Quality Assurance Project Plan

Prepared for Hylebos Wood Debris Group and Washington State Department of Ecology

May 2020
Hylebos Wood Debris Site

Sampling and Quality Assurance Project Plan

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ABBREVIATIONS

CAP	Cleanup Action Plan
cm	centimeter
CMP	Compliance Monitoring Plan
DGT	diffuse gradient in thin films
DQO	data quality objective
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
GC	gas chromatography
MLLW	mean lower low water
NAD	North American Datum
NEBA	net environmental benefit analysis
PSEP	Puget Sound Estuary Program
QA/QC	quality assurance/quality control
RPD	relative percent difference
SMS	Sediment Management Standard
SQAPP	Sampling and Quality Assurance Project Plan
SQS	sediment quality standard
TVS	total volatile solids
WDG	Hylebos Wood Debris Group

1 Introduction

In 1997, as pre-remedial design investigations were underway in the Commencement Bay Nearshore/Tideflats Superfund Site, several wood product companies formed the Hylebos Wood Debris Group (WDG) to address in-water cleanup issues related to wood debris in the Head of Hylebos Waterway. In 1998, the WDG entered into an Agreed Order with the Washington State Department of Ecology (Ecology) to investigate potential wood debris impacts on water quality, sediment quality, and biota. In 2000, the WDG entered into a Consent Decree with Ecology to implement Ecology's Cleanup Action Plan (CAP) for the Hylebos Wood Debris Site, including the following:

- Mechanical dredging of woody debris and sediment exceeding cleanup levels
- Reuse and recycling of dredged woody debris to the extent possible
- Disposal of dredged materials that could not be reused or recycled at permitted disposal facilities, including the Commencement Bay open-water disposal site (for suitable materials), Blair Waterway Slip 1 nearshore confined disposal facility, and off-site upland landfills
- Installation of new log raft containment systems and replacement of breasting dolphins

The remedial actions specified in the CAP were performed by the WDG between 2001 and 2005. Construction and post-construction water and sediment quality monitoring verified that compliance monitoring objectives set forth in the CAP and described in more detail in the 2001 Ecology-approved Compliance Monitoring Plan (CMP) were successfully achieved. In addition to the Ecology-led WDG cleanup, Superfund remedial actions in the abutting Head of Hylebos and adjacent Mouth of Hylebos Waterway areas were performed between 2005 and 2009. Post-construction sediment quality monitoring is ongoing in the Superfund areas to verify compliance.

The 2000 CAP and 2001 CMP identified two localized areas within the Hylebos Wood Debris Site with relatively minor wood debris impacts on sediment quality and biota (e.g., only one of three sediment bioassays [the larval bioassay] exhibited minor toxicity), where no remedial action was conducted. The two localized areas will be characterized by performing a net environmental benefit analysis (NEBA) after benthic conditions in dredged areas of the abutting Head of Hylebos Waterway remedial action area have stabilized. Both the NEBA stations and stabilized Head of Hylebos dredge areas are depicted in Figure 1. Specifically, the NEBA will evaluate biological conditions in the Hylebos Wood Debris Site to determine the following: 1) whether current benthic assemblages are significantly different between NEBA and dredged areas; and 2) whether current biological conditions within the NEBA areas comply with sediment quality standard (SQS) biological criteria set forth in the CAP.

Since the 2000 CAP, Ecology has developed improved laboratory protocols for larval and other bioassays that address the potential for entrainment of larvae by flocculent particulate material in

tested sediments, which can be particularly problematic in woody debris sediments. Laboratory artifacts associated with the earlier testing methods used to inform the CAP may have resulted in false positive larval toxicity results. As part of the NEBA, stations previously sampled by the WDG in April 1998 with possible false positive larval toxicity will be retested using the Ecology-approved bivalve larvae resuspension method to provide more reliable confirmatory bioassay data for comparison with SQS biological criteria.

1.1 Study Objectives

This Sampling and Quality Assurance Project Plan (SQAPP) describes proposed sediment quality characterization of the NEBA areas. Three NEBA stations were last characterized in April 1998 and will be retested to determine if they are in compliance with CAP performance standards. The proposed sediment characterization described in this SQAPP will provide comprehensive information on current benthic conditions at previously sampled stations where the larval bioassay may have failed due to possible false positive toxicity, also reflecting source reductions (e.g., less log rafting) and natural recovery over the past 10 years following completion of remedial dredging within the Head of Hylebos Waterway. All data will be obtained using current Ecology-approved methods and compared with SQS biological criteria set forth in the CAP.

1.2 Study Design

In late June 2020, the WDG will collect surface (0- to 10-centimeter [cm]) sediment samples from the following NEBA areas previously sampled in April 1998 that contained woody debris coverage (station HOW-B03 did not contain woody debris coverage; Figure 1):[1]

- HOW-B01
- HOW-B02
- HOW-B08

At each NEBA station, grab samples will be analyzed for the following:

- Visual determination of woody debris coverage
- Laboratory grain size (Puget Sound Estuary Program [PSEP] method)
- Total volatile solids (TVS)
- Porewater hydrogen sulfide (diffuse gradient in thin films [DGT] method)
- Amphipod bioassay
- Larval bioassay
- Polychaete bioassay

[1] The coordinates of the I998 sampling stations are likely accurate within approximately 30 feet, given positioning accuracies at that time. Since these stations are representative of the larger NEBA area, it is not necessary to precisely reoccupy these stations.

- Benthic enumeration (two additional replicate grabs will be collected within 15 feet of the initial sample location; field fines tests will be performed to ensure comparable reference selection)

Concurrently, the WDG will collect three surface samples from previously dredged reference areas near the NEBA areas (Figure 1). Like the NEBA samples, three replicate grab samples will be collected for benthic enumeration, and field sieving of fines will be performed to ensure appropriate reference selection. Visual determinations of woody debris coverage will be recorded for each sample. A representative reference area sample will be submitted for laboratory grain size and TVS analyses.

Bioassay reference sediment samples with grain size similar to surface sediment collected from HOW-B01, HOW-B02, and HOW-08 will be obtained from Carr Inlet (Ecology-approved bioassay reference area in south Puget Sound) and analyzed for grain size, amphipod bioassay, larval bioassay, and polychaete bioassay.

All NEBA data collected as described above will be interpreted using SQS biological criteria, incorporating recent refinements described in the 2019 update to the *Sediment Cleanup User's Manual (SCUM): Guidance for Implementing the Cleanup Provisions of the Sediment Management Standards, Chapter 173-204 WAC* (Ecology 2019). In addition to SQS biological criteria comparisons (i.e., based on abundance of major groups), benthic assemblage calculations will also include the following descriptive statistics:[2]

- Swartz's dominance index
- Mollusk richness
- Total richness

1.3 Document Organization

This SQAPP is organized as follows:

- Section 2 summarizes sampling and analysis methods.
- Section 3 includes quality assurance/quality control (QA/QC) procedures for the field collection and laboratory testing of samples.
- Section 4 summarizes documentation, recordkeeping, and reporting requirements.
- Section 5 describes data validation procedures to ensure that data are of acceptable quality.
- Section 6 provides a preliminary outline of the data report to be prepared.
- Section 7 lists references cited in this SQAPP.

[2] The primary benthic compliance metrics for this SQAPP are the SMS abundance criteria of major groups, which include molluscs, crustaceans, and polychaetes. The three additional benthic descriptive statistics listed will provide supporting information. Evaluation of successional stage requires additional data such as sediment profile imaging and is not a SQAPP requirement.

2 Data Generation and Acquisition

The section describes the type, quality, and quantity of data needed to evaluate compliance with the CAP.

2.1 Field Sampling Methods

This section describes the methodology for positioning, sample collection, processing, identification, documentation, equipment decontamination, and handling of investigation-derived waste for the field investigation.

2.1.1 Sampling Vessels and Field Equipment

An appropriately outfitted research vessel be used to collect surface sediment samples. Sediment will be collected from the research vessel using a modified powered Van Veen device.

2.1.2 Surface Sediment Collection and Processing

Surface sediment samples will be collected and processed as described in the following sections. At the NEBA stations, surface sediment will be collected for bioassays, benthic enumeration, hydrogen sulfide, visual assessment of surficial wood, and limited physical testing. Ex situ sulfide porewater measurements will also be performed at each NEBA station.

2.1.2.1 Surface Sediment Sample Collection Procedures

Surface sediment grab samples from the 0- to 10- cm biologically active zone will be collected for chemical analysis and toxicity bioassays using a Van Veen-type hydraulic power grab sampler, in accordance with PSEP (1997) protocols. The target locations and coordinates for each station are included in Figure 1 and Table 1, respectively. Samples will be collected in the following manner in accordance with the PSEP protocols:

- The vessel will maneuver to the proposed location.
- The sampler will be decontaminated.
- The sampler will be deployed to the bottom.
- The winch cable to the grab sampler will be drawn taut and vertical.
- Location coordinates of the cable hoist will be recorded by the location control person.
- The sediment sample will be retrieved aboard the vessel and evaluated against the following PSEP acceptability criteria:
  - Grab sampler is not overfilled (i.e., sediment surface is not against the top of the sampler)
  - Sediment surface is relatively flat, indicating minimal disturbance or winnowing
  - Overlying water is present, indicating minimal leakage
  - Overlying water has low turbidity, indicating minimal sample disturbance

  - Desired penetration depth of at least 10 cm is achieved
- Overlying water will be siphoned off.
- Observations (i.e., texture, odor, presence/absence of vegetation, debris, and any other distinguishing characteristics) will be recorded on the sample collection forms.
- A stainless-steel trowel or similar device will be used to collect the top 10 cm of sediment, taking care not to collect sediment in contact with the sides of the sampling device, and placed in a stainless-steel bowl.

Sediment samples that meet the above collection criteria will be processed as described below.

2.1.2.2 Surface Sediment Sample Processing Procedures

Sediment grab processing will be conducted aboard the sampling vessel. All working surfaces and instruments will be thoroughly cleaned, decontaminated, and covered with aluminum foil to minimize outside contamination between sampling stations. Disposable gloves will be discarded after processing each station and replaced prior to handling decontaminated instruments or work surfaces. The steps for processing the samples are as follows:

- Place the grab on a stable surface. Remove any overlying water using a syphon hose or turkey baster. Following grab acceptance criteria listed in Section 2.1.2.1, determine whether the grab is acceptable.
- Visually assess the grab for the percentage of surficial wood. Then remove any large objects or debris from the sediment surface.
- To collect relatively undisturbed samples for benthic macroinvertebrate community analysis, two clean butyrate core tubes (13 inches long by 3.75 inches in diameter[3]) will be inserted into the sediment. The tubes will remain in the sediment until after bulk chemistry samples are collected, where applicable.
- At stations where porewater hydrogen sulfide characterization is required, the following procedure will be used:
  - Immediately after accepting the grab, collect approximately 0.5 gallon of sediment from the 0- to 10-cm interval and place directly into a plastic bag.
  - Immediately place the DGT piston into the bag containing the sediment.
  - Squeeze all head space from the bag, seal it, and place it into a Mylar bag[4] with oxygen-scavenging packets, and ensure the DGT piston is completely covered and placed into a cooler with ice.

[3] PSEP provides a range of sample volumes for benthic enumeration. Based on recent evaluations of other areas of the Hylebos Waterway, sieving the entire contents of the van Veen grab would result in many more individuals than are needed for abundance comparisons. The tubes will provide enough numbers for benthic enumeration within the range of PSEP sample volumes.

[4] The Mylar bags do not transmit light; the samples will be placed into an iced cooler.

  - Record the temperature of the sediment, the pH, and the salinity on the field form.
  - Agitate the bag every 3 hours from 7 a.m. to 10 p.m. to refresh the DGT surface over the 24-hour exposure duration.
  - After the exposure duration is complete, remove the DGT from the bag, rinse with distilled water, and place the DGT in foil and inside a labeled plastic bag.
  - Transport the bags to Anchor QEA's Portland, Oregon, laboratory for analysis.
- Prior to sampling, color photographs may be taken, and a sediment description of each grab will be recorded on a grab sampling log form. Record the description of the grab sample on the grab log form for the following parameters as appropriate and present:
  - Sample recovery (depth in inches or centimeters of recovery in the grab sampler)
  - Physical soil description of the grab in accordance with the Unified Soil Classification System (includes soil type, density/consistency of soil, moisture, and color)
  - Odor (e.g., hydrogen sulfide and petroleum)
  - Vegetation
  - Debris
  - Biological activity (e.g., detritus, shells, tubes, bioturbation, or live or dead organisms)
  - Presence of oil sheen
  - Any other distinguishing characteristics or features
- Using a clean spoon, place sample material from the desired grab depth (0 to 10 cm) into a clean stainless-steel bowl. To avoid cross contamination, take care to remove only sediment that has not come into contact with the sides or bottom of the grab. When sufficient material has been removed, the sample will be homogenized until a uniform color and consistency are achieved. The sample will then be packaged as follows:
  - Using a clean, stainless-steel spoon, completely fill pre-labeled sample containers as specified in Table 2. In addition to containers in Table 2, mass sample will be placed in bags for bioassay testing.
  - Immediately after filling the sample container with sediment, place the screw cap on the sample container and tighten. Bioassay bags[5] will be securely closed with zero head space.
  - Thoroughly check all sample containers for proper identification, analysis type, and lid tightness.
  - Pack each container carefully to prevent breakage and place inside a cooler with ice for storage at the proper temperature (4°±2°C for all samples).
- Remove core tubes from the sampler by carefully placing a gloved hand under the bottom of each tube to prevent the loss of sediment. Cap both ends of the tubes and label and store for

[5] Bags are now the standard method for packaging sediment samples for bioassay testing, eliminating headspace.

processing. Samples will be processed as soon as possible and no later than 24 hours following collection. The two core tubes from each station will be pooled to form one sample per station (for a total area of 0.016 square meter). Sediment from both tubes will be washed through a 1-millimeter stainless-steel sieve using site water. The material remaining in the sieve will be carefully spooned into pre-labeled sample containers. Any organisms remaining on the sieve will be removed with forceps and placed into the sample container. Samples will be preserved with a 5% buffered formalin solution and stored upright until delivery to the analytical laboratory.

Samples will be submitted for testing as presented in Table 3.

2.1.3 Horizontal Positioning and Vertical Control

Horizontal positioning will be determined using a differential global positioning system based on target coordinates shown in Table 1. The horizontal datum will be North American Datum (NAD) 83, Washington State Plane, North Zone. Measured station positions will be converted to latitudinal and longitudinal NAD 83 coordinates to the nearest 0.01 second. The accuracy of measured and recorded horizontal coordinates is typically less than 1 meter and will be within ±3 meters following Ecology guidance.

The vertical elevation of each sediment sample or probe location will be measured using a fathometer or lead line and converted to mean lower low water (MLLW), correcting for the tidal elevation. Tidal elevations will be determined after sample collection using data from the National Oceanic and Atmospheric Administration's Tacoma Station.

2.1.4 Sample Station Locations and Sample Identification

Figure 1 shows the locations of the proposed sampling locations. Tables 1 and 3 include listings of all station locations, sample identifiers, and analysis and/or testing required for each location. The sample identification schemes are described in Section 2.3.

2.1.5 Equipment Decontamination Procedures

Sample containers, instruments, working surfaces, technician protective gear, and other items that may come into contact with sediment sample material must meet high standards of cleanliness. All equipment and instruments used that are in direct contact with the sediment collected for analysis must be made of glass, stainless-steel, or high-density polyethylene, and will be cleaned prior to each day's use and between sampling or compositing events. Decontamination of all items will follow PSEP protocols. The decontamination procedure is as follows:

- Scrub until free of visible sediment and rinse with site water
- Pre-wash rinse with tap water

- Wash with solution of tap water and Alconox soap (brush)
- Rinse with tap water
- Rinse three times with distilled water
- Cover (no contact) all decontaminated items with aluminum foil
- Store in clean, closed container for next use if not used immediately

2.2 Sample Containers for Analysis

The contract laboratory will provide certified, pre-cleaned, U.S. Environmental Protection Agency (EPA)-approved containers for all chemistry samples. Sediment for bioassay testing will be placed in commercially available high-density polyethylene buckets that have been decontaminated as described in Section 2.1.5 and lined with clean, food-grade polyethylene bags and sealed airtight. Table 2 lists container size, holding times, and preservation for the categories of analytes. At a minimum, each sample container will be labeled with the following information:

- Project name and number
- Sample identifier
- Date and time of sample collection
- Initials of field personnel responsible for sample collection
- Analyses required
- Preservative type (if applicable)

2.3 Sample Identification

Each sample will be assigned a unique alphanumeric identifier using the following identification labels as a basis:

NEBA Stations:

- HOW-B01
- HOW-B02
- HOW-B08

Reference Stations:

- HOW-B09
- HOW-B10
- Ref-001

These identification labels will be appended with the collection date as follows:

- The remaining characters identify the sampling date (YYMMDD).

For example, sample "HOW-BO1-200428" represents a surface sediment grab collected at location HOW-BO1 on April 28, 2020.

2.4 Sample Transport and Chain-of-Custody Procedures

This section addresses the sampling program requirements for maintaining custody of the samples throughout the sample collection and shipping process and provides specific procedures for sample shipping.

2.4.1 Sample Custody Procedures

Samples are considered to be in one's custody if they are: 1) in the custodian's possession or view; 2) in a secured location (under lock) with restricted access; or 3) in a container that is secured with an official seal(s) such that the sample cannot be reached without breaking the seal(s).

Chain-of-custody procedures will be followed for all samples throughout the collection, handling, and analysis process. The principal document used to track possession and transfer of samples is the laboratory-provided chain-of-custody form. Each sample will be represented on a chain-of-custody form the day it is collected. All data entries will be made using indelible ink pen. Corrections will be made by drawing a single line through the error, writing in the correct information, then dating and initialing the change. Blank lines/spaces on the chain-of-custody form will be lined-out and dated and initialed by the individual maintaining custody.

A chain-of-custody form will accompany each cooler of samples to the analytical laboratories. 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. Copies of all chain-of-custody forms will be retained in the project files.

2.4.2 Sample Shipping and Receipt Requirements

All samples will be shipped or hand delivered to the analytical laboratory no later than the day after collection. If samples are collected on Friday, they may be held until the following Monday for shipment, provided that this does not adversely impact holding time requirements. Specific sample shipping procedures are as follows:

- Each cooler or container containing the samples for analysis will be shipped via overnight delivery to the appropriate analytical laboratory. In the event that Saturday delivery is required, the field coordinator will contact the analytical laboratory before 3 p.m. on Friday to ensure that the laboratory is aware of the number of coolers shipped and the airbill tracking numbers for those coolers. Following each shipment, the field coordinator will call the laboratory and verify the shipment from the day before has been received and is in good condition.

- Coolant ice will be sealed in separate double plastic bags and placed in the shipping containers.
- Individual sample containers will be placed in a sealable plastic bag, packed to prevent breakage, and transported in a sealed ice chest or other suitable container.
- Glass jars will be separated in the shipping container by shock-absorbent material (e.g., bubble wrap) to prevent breakage.
- The shipping containers will be clearly labeled with sufficient information (name of project, time and date container was sealed, person sealing the container, and consultant's office name and address) to enable positive identification.
- The shipping waybill number will be documented on all chain-of-custody forms accompanying the samples.
- A sealed envelope containing chain-of-custody forms will be enclosed in a plastic bag and taped to the inside lid of the cooler.
- A minimum of two signed and dated chain-of-custody seals will be placed on adjacent sides of each cooler prior to shipping.
- Each cooler will be wrapped securely with strapping tape, labeled "Glass – Fragile" and "This End Up," and will be clearly labeled with the laboratory's shipping address and the consultant's return address.

Upon transfer of sample possession to the analytical laboratory, the persons transferring custody of the sample container will sign the chain-of-custody form. Upon receipt of samples at the laboratory, the shipping container seal will be broken and the receiver will record the condition of the samples on a sample receipt form. Chain-of-custody forms will be used internally in the laboratory to track sample handling and final disposition.

2.5 Waste Management

Sediments with visible evidence of chemical contamination (e.g., oily droplets, sheen, paint chips, or sandblast grit) will not be returned to the water. Instead, they will be retained on board the vessel for appropriate disposal on shore. Sediment without visible evidence of chemical contamination will be washed overboard at the collection site prior to moving to the next sampling station.

All disposable sampling materials and personnel protective equipment used in sample processing, such as disposable coveralls, gloves, and paper towels, will be placed in heavy-duty garbage bags or other appropriate containers for appropriate disposal.

2.6 Inadvertent Discovery Plan

While unlikely in the marine environment, there is potential for inadvertent discovery of cultural resources while collecting field samples. Examples of cultural resources include the following:

- An accumulation of shell, burned rocks, or other food-related materials
- Bones or small pieces of bone
- An area of charcoal or very dark stained soil with artifacts
- Stone tools or waste flakes (i.e., an arrowhead, or stone chips)
- Clusters of tin cans or bottles, or logging or agricultural equipment, that appears to be older than 50 years
- Buried railroad tracks, decking, or other industrial materials

If such items are discovered while processing samples, assume the material is a cultural resource. Stop work and immediately contact the field coordinator and Anchor QEA's staff archeologist, Barbara Bundy, Ph.D., Registered Professional Archeologist, for further instructions.

3 Field and Laboratory Quality Assurance and Quality Control

Field and laboratory activities must be conducted in such a manner that results meet specified quality objectives and are fully defensible. Guidance for QA/QC is derived from the protocols developed for the Dredged Material Management Program (DMMO 2016), Sediment Management Standards (Ecology 2019), Model Toxics Control Act (Chapter 173-340 WAC), EPA Test Methods (EPA 1986), National Functional Guidelines (EPA 2017a, 2017b), and the cited methods.

3.1 Field Quality Assurance and Quality Control

Field QA procedures will consist of following acceptable practices for collecting and handling samples. Adherence to these procedures will be complemented by periodic and routine equipment inspection.

Field QA samples will include the collection of additional sample volume to ensure that the laboratory has sufficient sample volume to run the program-required analytical QA/QC samples for analysis, as specified in Table 4. Additional sample volume to meet this requirement will be collected at a frequency of 1 in 20 samples processed.

Field QA samples will also include field duplicates and equipment blanks. All field QA samples will be documented in the field logbook and verified by the QA/QC manager or a designee.

Field QA samples will be collected along with environmental samples. Field QA samples are useful in identifying possible problems resulting from sample collection or sample processing in the field.

3.1.1 Field Duplicates

A field duplicate is a duplicate sample collected in the field to assess sampling homogenization precision. Field duplicates will be collected for bulk sediment chemistry at a frequency of one duplicate per one per sampling event or 1 in 20 samples processed, whichever is more frequent.[6] Field duplicate precision will be screened against a relative percent difference of 50%. No data will be qualified based solely on field duplicate precision.

3.1.2 Equipment Blanks

An equipment blank consists of distilled or deionized water collected from the equipment used to collect and homogenize sediment samples, to assess the potential for field contamination. Equipment blanks will be collected at a frequency of one per collection method per event. If target analytes are detected in the equipment blank at levels above the reporting limits, concentrations will

[6] Including DGT samples.

be compared to sediment concentrations and sample data may be qualified if sediment results are within five times the concentration in the blank.

3.2 Analytical Laboratory Quality Assurance and Quality Control

Laboratory QC procedures, where applicable, include initial and continuing instrument calibrations, laboratory control samples, matrix spikes, matrix spike duplicates, surrogate spikes (for organic analyses), and method blanks. QA/QC sample frequencies are provided in Table 4. A summary of the analytical data quality objectives is provided in Table 5.

An analyst will review the results of the QC samples from each sample group immediately after a sample group has been analyzed. The QC sample results will then be evaluated to determine if control limits have been exceeded. If control limits are exceeded in the sample group, the QA/QC manager will be contacted immediately, and corrective action (e.g., method modifications followed by reprocessing the affected samples) will be initiated prior to processing a subsequent group of samples.

3.2.1 Laboratory Instrument Calibration and Frequency

An initial calibration will be performed on each laboratory instrument to be used prior to the start of the project, after each major interruption to the analytical instrument, and when any ongoing calibration does not meet method control criteria. Calibration verification will be analyzed following each initial calibration and will meet method criteria prior to analyses of samples. Continuing calibration verifications will be analyzed at method-required frequencies to track instrument performance.

The frequency of continuing calibration verifications varies with method. For gas chromatograph/mass spectrometer methods, one will be analyzed every 12 hours. For gas chromatography, metals, and inorganic methods, one will be analyzed for every 10 field samples analyzed and at the end of each run. If the continuing calibration is out of control, the analysis will be terminated until the source of the control failure is eliminated or reduced to meet control specifications, which may include analyzing a new initial calibration. Any project samples analyzed while the instrument calibration was out of control will be reanalyzed.

Instrument blanks or continuing calibration blanks provide information on the stability of the baseline established. Continuing calibration blanks will be analyzed with each continuing calibration verification for each type of applicable analysis.

3.2.2 Laboratory Duplicates

Analytical laboratory duplicates provide information on the precision of the analysis and are useful in assessing potential sample heterogeneity and matrix effects. Analytical duplicates are subsamples of the original sample that are prepared and analyzed as a separate sample.

3.2.3 Matrix Spikes and Matrix Spike Duplicates

Analyses of matrix spike samples provide information on the extraction efficiency of the method on the sample matrix, as well as any interferences introduced by the sample matrix. By performing matrix spike duplicate analyses, information on the precision of the method is also provided.

3.2.4 Method Blanks

Method blanks are prepared and analyzed in the same manner as project samples to assess possible laboratory contamination at all stages of sample preparation and analysis. The method blank for all analyses must be less than the method reporting limit of any single target analyte/compound. If a laboratory method blank exceeds this criterion for any analyte/compound, and the concentration of the analyte/compound in any of the samples is less than five times the concentration found in the blank (10 times for common contaminants), analyses must stop and the source of contamination must be eliminated or reduced. Affected samples should be prepared again and reanalyzed, if possible.

3.2.5 Laboratory Control Samples

Laboratory control samples are analyzed to assess possible laboratory bias at all stages of sample preparation and analysis. The laboratory control sample is a matrix-dependent spiked sample prepared at the time of sample extraction along with the preparation of the sample, matrix spike, and method blank. The laboratory control sample will provide information on the precision of the analytical process, and when analyzed in duplicate, will provide accuracy information as well.

3.3 Bioassay Laboratory Quality Control

Sediment toxicity tests will incorporate standard QA/QC procedures to ensure that the test results are valid. Standard QA/QC procedures include the use of negative controls, positive controls, reference sediment samples, replicates, and measurements of water quality during testing. Bioassay results will be interpreted in accordance with Table 6.

3.3.1 Negative Controls

The negative control to be used for both sediment toxicity tests will be a clean control, which consists of clean, inert material and the same seawater used in testing sediment toxicity. For the tests

to be used in this study, the negative control[7] will be the amphipod collection site sediment, which will most likely be clean sand. The negative control for the bivalve larval test will be a seawater control.

3.3.2 Positive Controls

An appropriate reference toxicant will be run with each batch of test sediments as a positive control to establish the relative sensitivity of the test organisms. The positive control for sediment tests is typically conducted with diluent seawater and without sediment. The 50% lethal or effective concentration must be within the 95% confidence interval of responses expected for the toxicant used.[8]

3.3.3 Reference Sediment

Reference sediment will also be included with each bioassay, tested concurrently with test sediments to provide data that can be used to separate toxicant effects from unrelated effects, such as those of sediment grain size. Reference sediment samples should be collected from an area documented to be free from chemical contamination and should represent the range of important natural, physical, and chemical characteristics of the test sediments (e.g., sediment grain size and total organic carbon). For this study, reference sediment samples will be collected from Carr Inlet in Puget Sound, Washington (PSEP 1995). All bioassays have performance standards for reference sediments as mentioned earlier. Failure to meet these standards may result in the requirement to retest.

3.3.4 Replicates

Five replicate chambers for each test sediment, reference sediment, and negative control treatments will be run for each bioassay. A water quality replicate will also be run for each treatment.

3.3.5 Water Quality Monitoring

Water quality monitoring will be conducted for the amphipod, larval, and juvenile polychaete bioassays and reference toxicant tests. This monitoring consists of daily measurements in the water quality replicate of salinity, temperature, pH, and dissolved oxygen for the amphipod and larval tests. These measurements will be made every 3 days for the juvenile polychaete bioassay, except dissolved oxygen, which will be measured daily. Ammonia and sulfides in the overlying water will be determined at test initiation and termination for all three tests. Monitoring will be conducted for all test and reference sediments and negative controls (including seawater controls). Measurements for

[7] Sand collected from the clean source of the amphipods, typically in the Mukilteo area.

[8] LC_{50} is the lethal concentration of toxicant killing 50% of exposed organisms. EC_{50} is the concentration of test substance in dilution water that is calculated to affect 50% of a test population during continuous exposure over a specified time period.

each treatment will be made on a separate test chamber that is set up identically to the other replicates within the treatment group, including the addition of test organisms.

3.4 Benthic Invertebrate Community Analysis

Benthic invertebrate community evaluations will be performed by EcoAnalysts in Port Gamble, Washington. Upon receipt at the laboratory, samples will be processed in accordance with the laboratory standard operating procedure. Organisms will be subsequently sorted into major phyla and then identified to the lowest practicable taxonomic level and enumerated.

Community metrics, including total abundance, diversity, species richness, and evenness, will be calculated for each station. In addition, the Bray-Curtis similarity index and multi-dimensional scaling plots will be used to evaluate similarities in benthic communities between sampling stations.

3.4.1 Benthic Invertebrate Enumeration QA/QC

Benthic enumeration and identification will be conducted by experienced taxonomists. The QA/QC procedures include a 20% re-sort of every sample. If more than five organisms are found during the re-sort, the entire sample will be re-sorted to recover missed organisms, and the process will be repeated until QC requirements are met. In addition, one voucher specimen from each species will be verified by an outside taxonomist.

4 Documentation, Recordkeeping, and Reporting Requirements

This section describes field and laboratory documentation, recordkeeping, and data report requirements.

4.1 Documentation and Records

This project will require central project files, to be maintained at Anchor QEA.

4.1.1 Field Records

Documentation will consist of a daily field log and sample collection forms. The daily field log is intended to provide sufficient data and observations to enable readers to reconstruct events that occurred during the sampling period. Examples of information to be recorded are field personnel, weather conditions, complications encountered, field communications, and other general details associated with the sampling effort. At a minimum, the following information will be included in this log:

- Names of the field coordinator and person(s) collecting and logging the sample
- Sample station number
- Date and collection time of each sediment sample
- Observations made during sample collection including weather conditions, complications, communications, and other details associated with the sampling effort
- Qualitative notation of apparent resistance of sediment column to sampling, including notes on debris
- Any deviations from the approved SQAPP

In addition to maintaining a daily field log, sample collection forms will be completed for each sample. The sample collection forms will include standard entries for station identifiers, station coordinates, date and time of sample location, type of samples collected, type of analyses for each sample, and specific information pertaining to the matrix being collected. For sediment core samples, the collection form will include information regarding penetration of the sampler and physical characteristics of the sediment such as texture, color, odor, stratification, and sheens.

The field forms will be on water-resistant, durable paper for adverse field conditions. All data entries will be made using indelible, waterproof blue or black ink pen. Corrections will be made by drawing a single line through the error, writing in the correct information, then dating and initialing the change. Each form will be marked with the project name, number, and date. The field forms will be scanned into Anchor QEA's project file directory as convenient during the sampling event or upon completion of each sampling event.

4.1.2 Analytical Laboratory Data Deliverable

Data packages will be checked for completeness immediately upon receipt from the laboratory to ensure that data and QA/QC information requested are present. The analytical laboratory will be required, where applicable, to report the following:

- **Project Narrative**. This summary, in the form of a cover letter, will include a discussion of any problems encountered during analyses. This summary should include (but not be limited to) QA/QC, sample shipment, sample storage, and analytical difficulties. Any problems encountered, actual or perceived, and their resolutions will be documented in as much detail as appropriate.
- **Chain-of-Custody Records**. Legible copies of the chain-of-custody forms will be provided as part of the data package. This documentation will include the time of receipt and condition of each sample received by the laboratory. Additional internal tracking of sample custody by the laboratory will also be documented on a sample receipt form. The form must include sample shipping container temperatures measured at the time of sample receipt.
- **Sample Results**. The data package will summarize the results for each sample analyzed. The summary will include the following information when applicable:
  - Field sample identification code and the corresponding laboratory identification code
  - Sample matrix
  - Date of sample preparation/extraction
  - Date and time of analysis
  - Mass and/or volume used for preparation and analysis
  - Final dilution or concentration factors for the sample
  - Identification of the instrument used for analysis
  - Method detection limits and method reporting limits accounting for sample-specific factors (e.g., dilution and total solids)
  - Analytical results with reporting units identified
  - Data qualifiers and their definitions
  - An electronic data deliverable with data in a format specified in advance by Anchor QEA
- **QA/QC Summaries**. This section will contain the results of the laboratory QA/QC procedures. Each QA/QC sample analysis will be documented with the same information required for the sample results. No recovery or blank corrections will be made by the laboratory. The required summaries are as follows (additional information may be requested):
  - Calibration Data Summary. This summary will report the concentrations of the initial calibration and daily calibration standards and the date and time of analysis. The response factor, percent relative standard deviation, percent difference, and retention time for each analyte will be listed, as appropriate. Calibration results for standards will be documented to indicate instrument sensitivity.

  - Internal Standard Area Summary. The stability of internal standard areas will be reported.
- **Method Blank Analysis**. The method blank analysis associated with each sample and the concentration of all compounds of interest identified in these blanks will be reported.
- **Surrogate Spike Recovery**. All surrogate spike recoveries for organic analyses will be reported. The name and concentration of all compounds added, percent recoveries, and range of acceptable recoveries will be provided.
- **Matrix Spike Recovery**. Matrix spike recovery data for all applicable analyses will be reported. The names and concentrations of compounds added, percent recoveries, and range of acceptable recoveries will be listed. The percent recoveries and relative percent difference (RPD) values for matrix spike duplicate analyses will be reported.
- **Matrix Duplicate**. The RPD values for matrix duplicate analyses will be reported.
- **Laboratory Control Sample**. Laboratory control sample recovery data will be reported. The names and concentrations of compounds added, percent recoveries, and range of acceptable recoveries will be included. The percent recoveries and RPD values for laboratory control sample duplicate analyses will be included.
- **Relative Retention Time**. Relative retention times of each analyte detected in the samples for both primary and conformational analyses will be reported.
- **Original Data**. Legible copies of the original data generated by the laboratory will include the following information:
  - Sample extraction, preparation, and cleanup logs including methods used
  - Instrument analysis logs for all instruments used on days of calibration and sample analyses
  - Calculation worksheets as applicable
  - Ion chromatograms for all samples, standards, blanks, calibrations, spikes, replicates, and reference materials
  - Copies of full scan chromatograms and quantitation reports for gas chromatography (GC) and/or GC/mass spectrometer analyses of samples, standards, blanks, calibrations, spikes, replicates, and reference materials
  - Enhanced spectra of detected compounds with associated best-match spectra for each sample

4.1.3 Bioassay Laboratory Data Deliverable

The laboratory conducting the bioassay tests will be responsible for internal checks on data reporting and will correct errors identified during the QA review. The bioassay laboratory for this study will be

required to report results that include all information recommended by the applicable protocols described in Section 4.1.2 for QA review, as follows:

- A description of any deviations from the methodology or problems with the process and procedures of analyses
- Test methods used for bioassay testing and statistical analyses
- Results for survival, growth, reburial, abnormalities, water quality parameters, reference toxicant, and statistical analyses
- Original data sheets for water quality, survival, growth, reburial, abnormalities, reference toxicant, and statistical analyses
- Chain-of-custody records

Close contact with the laboratory will be maintained to resolve any QA/QC problems in a timely manner.

4.2 Data Reduction

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

4.3 Data Management

Field data sheets will be checked for completeness and accuracy by the field coordinator prior to delivery to the data manager. All data generated in the field will be documented and provided to the office data manager, who is responsible for entering the data into the database. All manually entered data will be checked by a second party. Field documentation will be filed in the main project file after data entry and checking are complete.

Laboratory data will be provided to the data manager in the EQuIS electronic format. The laboratory data that are provided electronically and loaded into the database will undergo a 10% check against the laboratory hard copy data. Data will be validated or reviewed manually and qualifiers, if assigned, will be entered manually. The accuracy of all manually entered data will be verified by a second party. Validated data (see Section 5) will be uploaded onto Ecology's EIM database.

5 Data Validation and Usability

This section describes the processes that will be used to review project data quality.

5.1 Data Review, Validation, and Verification

Stage 2B data validations (EPA 2009) will be performed. During the validation process, analytical data will be evaluated for method QC and laboratory QC compliance, and their validity and applicability for program purposes will be determined. Based on the findings of the validation process, data validation qualifiers may be assigned. The validated project data, including qualifiers, will be entered into the project database, thus enabling this information to be retained or retrieved, as needed.

5.2 Validation and Verification Methods

Data validation includes signed entries by the field and laboratory technicians on field data forms and laboratory datasheets, respectively, review for completeness and accuracy by the field coordinator and laboratory manager, review by the QA/QC manager (or designee) for outliers and omissions, and the use of QC criteria to accept or reject specific data. All data will be entered into the project database.

All laboratory data will be reviewed and verified to determine whether data quality objectives (DQOs) have been met and that appropriate corrective actions have been taken, when necessary. The project QA/QC manager or designee will be responsible for the final review of all data generated from analyses of samples.

The first level of review will take place in the laboratory as the data are generated. The laboratory manager or designee will be responsible for ensuring that the data generated meet minimum QA/QC requirements and that the instruments were operating under acceptable conditions during generation of data. DQOs will also be assessed at this point by comparing the results of QC measurements with pre-established criteria as a measure of data acceptability.

The analysts and/or laboratory department manager will prepare a preliminary QC checklist for each analytical parameter and for each sample delivery group as soon as analysis of a sample delivery group has been completed. Any deviations from the DQOs listed on the checklist will be brought to the attention of the laboratory manager to determine whether corrective action is needed, and to determine the impact on the reporting schedule.

Data packages will be checked for completeness immediately upon receipt from the laboratory to ensure that data and QA/QC information requested are present. Data quality will be assessed for all

data by a reviewer using this SQAPP and National Functional Guidelines (EPA 2016, 2017a, 2017b), by considering the following:

- Laboratory sample receipt
- Holding times
- Instrument performance checks
- Initial calibrations
- Continuing calibrations
- Method blanks
- Surrogate recoveries
- Internal standard results
- Detection limits
- Quantitation limits
- Dual-column confirmation results
- Laboratory control samples
- Matrix spike and matrix spike duplicate samples
- Laboratory replicates

The data will be validated in accordance with the project-specific DQOs, analytical method criteria, and the laboratory's internal performance standards based on their Standard Operating Procedures.

5.3 Reconciliation with User Requirements

The QA/QC manager will review data after each survey to determine if DQOs have been met. If data do not meet the project's specifications, the QA/QC manager will review the errors and determine if the problem is due to calibration/maintenance, sampling techniques, or other factors, and will suggest corrective action as necessary. It is expected that any problem would be able to be corrected by retraining, revision of techniques, or replacement of supplies or equipment; if not, the DQOs will be reviewed for feasibility. If specific DQOs are not achievable, the QA/QC manager will recommend appropriate modifications.

6 Data Report

Following data validation and uploading data onto Ecology's EIM database, a brief data report will be prepared for Ecology review. The preliminary outline of the data report is as follows:

- Introduction
  - Study Objectives
  - Study Design
  - Document Organization
- Field Sampling and Processing
  - SQAPP Deviations *(if any)*
- Physical and Chemical Analyses
  - Data Quality Assessment
  - Grain Size Comparisons
  - Wood Debris Coverage and TVS Concentrations
  - Porewater Sulfide Concentrations
- Bioassays
  - Data Quality Assessment
  - Sediment Management Standard (SMS) Comparisons
- Benthic Abundance
  - Data Quality Assessment
  - SMS Comparisons
  - Other Benthic Community Metrics
- Summary
  - Weight-of-Evidence Evaluation
  - Consent Decree Requirements
- References

Ecology's comments on the draft report (*if any*) will be addressed in the final submittal.

7 References

DMMO (Dredged Material Management Office), 2016. *Dredged Material Evaluation and Disposal Procedures (User Manual).* Prepared by U.S. Army Corps of Engineers, Seattle District; U.S. Environmental Protection Agency, Region 10; Washington Department of Natural Resources; and Washington State Department of Ecology. August 2016.

Ecology (Washington State Department of Ecology), 2019. *Sediment Cleanup User's Manual. Guidance for Implementing the Cleanup Provisions of the Sediment Management Standards, Chapter 173-204 WAC.* Publication No. 12-09-057. Revised December 2019.

EPA (U.S. Environmental Protection Agency), 1986. *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.* U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. EPA 530/SW-846.

EPA, 2009. *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use.* U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. EPA 540-R-08-005. January 2009.

EPA, 2012. *Guidelines for Using Passive Samplers to Monitor Organic Contaminants at Superfund Sediment Sites.* Office of Solid Waste and Emergency Response Directive 9200.1-110FS. December 2012.

EPA, 2016. *National Functional Guidelines for High Resolution Superfund Methods Data Review.* EPA 542-B-16-001. April 2016.

EPA, 2017a. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Methods Data Review.* U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. EPA 540-R-2017-001. September 2017.

EPA, 2017b. *USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review.* U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. EPA 540-R-2017-002. January 2017.

PSEP (Puget Sound Estuary Program), 1997. *Recommended Guidelines for Sampling Marine Sediment, Water Column, and Tissue in Puget Sound.* Prepared for the U.S. Environmental Protection Agency, Region 10; and the Puget Sound Water Quality Authority. Puget Sound Water Quality Authority, Olympia, Washington.

Tables

Table 1
Sampling Locations and Types

Location ID	X	Y	Sample Type	Grain Size	Total Volatile Solids	Porewater Hydrogen Sulfide (DGT)	Bioassay (3 test suite)	Benthic Enumeration[1]
HOW-B08	1177819.467	709456.0087	NEBA	X	X	X	X	X
HOW-B01	1178524.328	708806.7029		X	X	X	X	X
HOW-B02	1178309.051	708716.4252		X	X	X	X	X
Ref-001	1177772.592	709032.3977	Reference	X	X	--	--	X
HOW-B09	1178015.648	709619.2029		X	X	--	--	X
HOW-B10	1177706.62	709646.9808		X	X	--	--	X

Notes:

1. Two additional replicates will be collected within 15 feet of the target station for enumeration.

Datum: North American Datum 1983, Washington State Plane South

NEBA: net enviromental benefit analysis

DGT: diffusive gradients in thin films

Table 2
Guidelines for Sample Handling and Storage

Parameter	Sample Size	Container Size and Type[1]	Holding Time	Preservative
Total solids	50 g	8-oz glass	14 days	Cool/4 °C
			6 months	Freeze -18 °C
Total volatile solids/ loss on ignition	300 g	8-oz glass	14 days	Cool/4 °C
			6 months	Freeze -18 °C
DGT sediment	~ 300 g	Mylar bag with DGT disc	7 days	Cool/4 °C
Sediment Biossay	4- to 6-liters	bioassay bags	56 days	Cool/4 °C

Notes:

1. All sample containers will have lids with Teflon inserts.

DGT: diffusive gradients in thin films

g: gram

oz: ounce

Table 3

Parameters for Analysis, Methods, and Target Quantitation Limits in Sediments and Porewaters

Parameter	Method	Target Reporting Limit
Conventionals (%)		
Total volatile solids/loss on ignition	ASTM D2974	0.10
Total solids	SM 2540G	0.10
Grain size	ASTM D422	0.10
Porewater Conventionals (mg/L)		
DGT Sulfide	Optical Densitometry	TBD

Notes:

DGT: diffusive gradients in thin films

mg/L: milligram per liter

Table 4

Laboratory Quality Assurance/Quality Control Analysis Summary

Analysis Type	Initial Calibration	Ongoing Calibration	Replicates	Matrix Spikes	LCS/Blank Spike	Matrix Spike Duplicates	Method Blanks	Surrogate Spikes
Total solids	Daily or each batch[1]	NA	1 per 20 samples	NA	NA	NA	NA	NA
Total volatile solids	Daily or each batch	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	Each batch	NA
Grain size	Daily or each batch[1]	NA	1 per 20 samples	NA	NA	NA	NA	NA

Notes:

1. Calibration and certification of drying ovens and weighing scales are conducted bi-annually

LCS: laboratory control sample

NA: not applicable

Table 5
Data Quality Objectives

Parameter	Precision (Percentage)	Accuracy[1] (Percentage)	Completeness (Percentage)
Total volatile solids	± 30 RPD	75 – 125 R	95
Total solids	± 20 RPD	NA	95
Grain size	± 20 RPD	NA	95

Notes:

1. Laboratory control sample and matrix spike/matrix spike duplicate percent recovery

NA: not applicable

R: recovery

RPD: relative percent difference

Table 6
Bioassay Intepretative Criteria

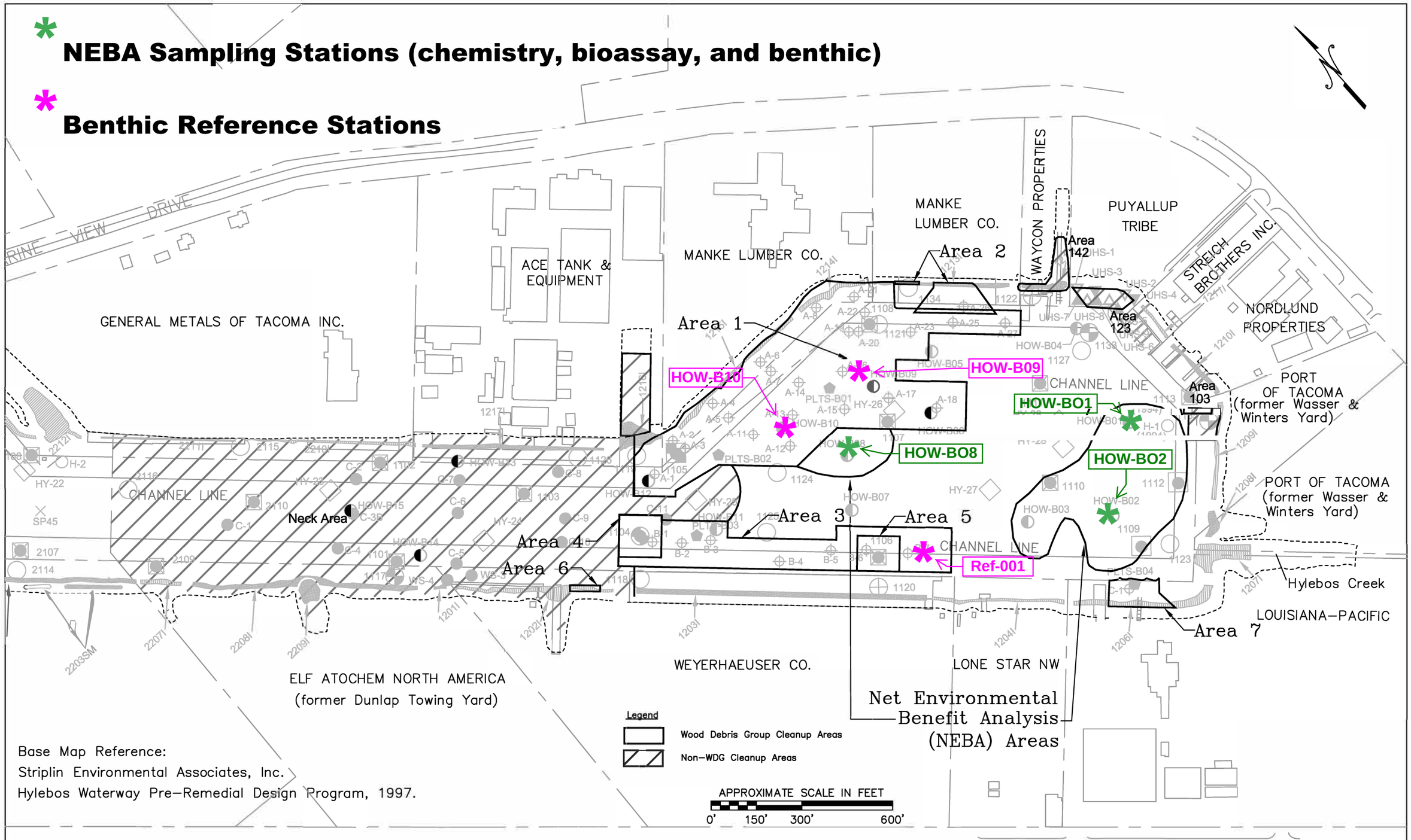
Bioassay	Negative Control Performance Standard	Reference Sediment Performance Standard	SMS SCO/SQS Evaluation Guidelines	SMS CSL Evaluation Guidelines
Amphipod Mortality	$M_C \leq 10\%$	$M_R \leq 25\%$	$M_T > 25\%$ and M_T vs. M_R SD ($p \leq 0.05$)	M_T-$M_R \geq 30\%$ and M_T vs. M_R SD ($p \leq 0.05$)
Larval Development	N_C / I ≥ 0.70	N_R / $N_C \geq 0.65$	$(N_R - N_T) / N_C > 0.15$ and N_T /Nc vs. N_R/Nc SD ($p \leq 0.10$)	$(N_R - N_T)$/Nc > 0.30 and (N_T/Nc) vs. N_R /Nc SD ($p \leq 0.10$)
Neanthes Growth	$M_C \leq 10\%$ and $MIG_C \geq 0.38$ mg/individual/day (or case-by-case)	$MIG_R / MIG_C \geq 0.80$	$MIG_T / MIG_R < 0.70$ and MIG_T vs. MIG_R SD ($p \leq 0.05$)	$MIG_T / MIG_R < 0.50$ and MIG_T vs. MIG_R SD ($p \leq 0.05$)

Notes:
C: negative control
CSL: cleanup screening level
I: initial count
M: mortality
mg: milligrams
MIG: mean individual growth rate (mg/individual/day)
N: normal larvae
R: reference sediment
SCO: sediment cleanup objective
SD: statistically significant difference
SMS: sediment management standard
SQS: sediment quality standard
T: test sediment

Figure

* **NEBA Sampling Stations (chemistry, bioassay, and benthic)**

* **Benthic Reference Stations**



Hylebos Waterway
Wood Debris Program
Cleanup Areas

Figure 1
NEBA Sampling Stations

03/01/00 HYLEBOS2000\CSR_8-1a.dwg xref: base1.dwg, samp_upd2.dwg, points.dwg