

**Final Remedial Investigation/
Feasibility Study Work Plan**

Anacortes Port Log Yard
Anacortes, Washington
Ecology Agreed Order No. DE 10630

for

**Washington State Department of Ecology
on Behalf of Port of Anacortes**

August 11, 2015



GEOENGINEERS 
Earth Science + Technology

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File No. 5147-016-05

August 11, 2015

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym/ Abbreviation	Description
AET	Apparent Effects Threshold
ARI	Analytical Resources, Inc.
ARARs	Applicable or Relevant and Appropriate Requirements
ASTM	ASTM International
BT	bioaccumulation trigger
CAP	Cleanup Action Plan
COC	chemicals of concern
CSL	cleanup screening levels
DCAP	draft Cleanup Action Plan
DPS	Distinct Population Segment
DMMO	Dredged Material Management Office
DMMP	Dredged Material Management Program
DMMU	Dredged Material Management Unit
DNR	Washington Department of Natural Resources
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
HASP	Health and Safety Plan
HSP	Habitat Survey Plan
LAET	Lowest Apparent Effect Threshold
µg/kg	micrograms per kilogram
mg/kg	milligrams per kilogram
MLLW	mean lower low water
MTCA	Model Toxics Control Act
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PCSM	Preliminary Conceptual Site Model
PQL	practical quantitation limit

ng/kg	nanograms per kilograms
NMFS	National Marine Fisheries Service (now NOAA Fisheries)
QA/QC	Quality Assurance/Quality Control
RAOs	remedial action objectives
RCW	Revised Code of Washington
RI/FS	Remedial Investigation/Feasibility Study
SAP	Sampling and Analysis Plan
SCO	Sediment Cleanup Objectives
Site	Anacortes Port Log Yard
SMS	Sediment Management Standards
SVOCs	semi-volatile organic compounds
TEF	Toxicity Equivalency Factors
TEQ	toxicity equivalency (refers to concentration basis)
TOC	total organic carbon
TVS	total volatile solids
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WAC	Washington Administrative Code

1.0 INTRODUCTION

The Anacortes Port Log Yard (Site) is located in Anacortes, Washington (Figure 1). The Site is part of the Washington State Department of Ecology's (Ecology) Puget Sound Initiative and regional cleanup efforts on Fidalgo Island. The Site is listed on Ecology's Confirmed and Suspected Contaminated Sites List. The Facility Site ID No. is 21898438 and the Cleanup Site ID is 3604. This RI/FS Work Plan presents the activities that will be completed by the Port of Anacortes (Port), as required by the Agreed Order for the Site and Model Toxics Control Act (MTCA) to investigate and select of cleanup actions for identified contamination.

Ecology has issued Agreed Order No. DE 10630 (Order) pursuant to the authority of the MTCA, Revised Code of Washington (RCW) 70.105D.050(1). The effective date of the Order is November 18, 2014. The Port is the current entity bound by the Order.

Under the Order, the Port is required to complete a Remedial Investigation and Feasibility Study (RI/FS), per Washington Administrative Code (WAC) 173-340-350 and WAC 173-204-560 and a draft Cleanup Action Plan (DCAP) per WAC 173-340-350 through WAC 173-340-380 and WAC 173-204-560 through WAC 173-204-580, addressing in-water contamination and potential upland contamination (if warranted by the in-water analytical results). Completion of this RI/FS Work Plan is an initial requirement of the Order. Although the Order is issued under MTCA, the Sediment Management Standards (WAC 173-204) apply to investigation and cleanup for Site sediment.

The objectives of this RI/FS Work Plan include:

- Characterize the Site background, environmental setting and previous environmental investigations;
- Develop a Preliminary Conceptual Site Model (PCSM) for contamination;
- Identify appropriate preliminary contaminant screening levels consistent with the exposure pathways and receptors (both human and ecological) identified in the PCSM;
- Summarize existing environmental data with respect to preliminary screening levels to complete a preliminary delineation of the nature and extent of contamination;
- Identify data gaps in the existing data for characterization of the nature and extent of contamination;
- Identify the data need requirements, collection approach, procedures and methodology that will be utilized to obtain the required data to fill the identified data gaps and complete the RI;
- Describe the methodology that will be used to prepare the RI and FS; and
- Describe the public participation process, project management structure and expected schedule for completing the reporting requirements of the Order.

2.0 SITE BACKGROUND AND SETTING

2.1. Location and Property Description

The Site is generally located in the nearshore area northwest of 718 4th Street, Anacortes, Washington, at the northern terminus of T Avenue and is bound by the Guemes Channel to the north, Port of Anacortes – Pier 2 to the south and west, and Port owned properties and T Avenue to the east (Figure 2). As required by the Order, the Site is defined by the extent of contamination caused by the release of hazardous substances.

According to Skagit County records, the Site contains portions of the following property parcels as shown on Figure 2:

- P32902
- P32870
- P56524
- P32869
- P32868

2.2. Property Operational History

The Site was historically used for log handling from the mid-1960s to about 2004. Operations at the Site included log rafting and transfer of logs from the water (hauling out) to upland sorting and handling areas on Pier 2.

The Port purchased the Site in 1965 and established the area for use as a log handling and loading facility. According to Port records, portions of the Site were leased or operated by a number of different log handling businesses including: Washington Loggers Association (1966-1967); C. Itoh & Co., (1967-1975); Forest Sales, Inc., (1978-1986); and Frontier Industries, Inc., (1986-1997). The Port operated the log handling facility at the Site between 1997 and 2003. The Site has remained generally unchanged since 2003 except for storage of oil spill response booms for the refinery facilities in the area.

Historical aerial photographs from 1975 and 1992 show log rafting operations at the Site. Log rafting occurred adjacent to Pier 2 and logs were removed from the water between Pier 2 and the dock located on the east side of the Site. The 1975 aerial photo (Figure 3) shows the upland sorting and handling areas located on Pier 2 and the area south of the Site. The 1992 aerial photo (Figure 4) shows a smaller portion of Pier 2 used for upland storage and handling.

2.3. Environmental and Geologic Setting

The site consists of the intertidal and subtidal marine areas (Guemes Channel) located adjacent and east of Pier 2. The upper intertidal area is sloped toward the north whereas the lower intertidal and subtidal areas are relatively flat. The west side of the Site is bound by the Port's Pier 2 terminal. The terminal comprises an earth fill and a wharf at the northern most part of the facility. The slope of the earth fill is armored with rip rap. Several historical log mooring pile are located within the Site along the armored slope. The shoreline east of the Site includes a mixture of rip rap, remnant structures and natural rock outcroppings. The southern part of the site is a sloped gravel and sand beach. Some concrete debris and remnant structures are also located in the southern area of the Site.

The United States Geological Survey (USGS) map of the Bellingham Quadrangle (Lapen, 2000) was reviewed for geologic information in the vicinity of the Site. Mapped soils in the vicinity of the Site include both glacial and non-glacial processes that have occurred during the last 12,000 years. Native deposits likely consist of artificial fill and recessional marine (glaciomarine) drift from the Everson interstade of the Fraser glaciation. Bedrock outcroppings from the Lummi Formation are present along the shoreline.

2.4. Ecological Setting

The Site is on the Guemes Channel and Fidalgo Island (Figure 1). A small pocket beach is present. Properties located to the west and south of the Site have industrial use and properties located to the east have commercial and residential uses. Guemes Channel to the north provides juvenile and adult habitat for various marine fish, anadromous salmonids and invertebrate species of commercial and recreational value. The area also provides seasonal habitat for adult marine mammals, seabirds and other waterfowl of aesthetic value.

The following federally-listed species and/or their habitat are known to occur, or potentially occur, in the vicinity of the property based on the listings under Section 7 of the Endangered Species Act (ESA) from the United States Fish and Wildlife Service (USFWS) list for Skagit County (USFWS, 2012) and the National Marine Fisheries Service (NMFS, 2012a, b, c and d).

- Washington/Oregon/California Distinct Population Segment (DPS) marbled murrelet (*Brachyramphus marmoratus*)
- Puget Sound Coastal DPS bull trout (*Salvelinus confluentus*)
- Puget Sound evolutionarily significant unit (ESU) Chinook salmon (*Oncorhynchus tshawytscha*)
- Puget Sound DPS steelhead (*Oncorhynchus mykiss*)
- Southern Resident DPS orcas (*Orcinus orca*)
- Humpback whale (*Megaptera novaeangliae*)
- Eastern DPS Steller sea lion (*Eumetopias jubatus*)
- Puget Sound/Georgia Basin DPS bocaccio (*Sebastes paucispinis*)
- Puget Sound/Georgia Basin DPS yelloweye rockfish (*Sebastes ruberrimus*)
- Puget Sound/Georgia Basin DPS canary rockfish (*Sebastes pinniger*)

2.5. Current and Future Site Use

Since 2004 the Site area has been used for storage of oil spill response booms. The dock located on the eastern portion of the Site is owned by the Port and leased for commercial vessel moorage. The adjacent Pier 2 is used for bulk product export and manufacturing marine floats. Currently, public access to the Port's Pier 2 facility (including the beach area) is restricted with fencing, signage and guards to maintain security for the terminal. There is no public access to the beach area at the Site.

Future use of the former log haul out is likely to include continued storage of oil spill response booms. A portion of the shoreline and beach area will also continue to be used for deployment of marine floats (from the Pier 2 uplands) and spill response booms/equipment. The existing dock will continue to be used by the Port for moorage of commercial vessels. Public access to the former log haul out area will remain restricted during and after completion of the cleanup actions.

3.0 PREVIOUS INVESTIGATIONS

Following the closure of the facility for log handling and sorting in 2004, the Port conducted multiple environmental investigations to assess potential impacts to the Site from historical Site operations including:

- Pier 2 Log Haul Out Facility Due Diligence Report (Floyd Snider, 2004)
- Sediment Characterization Log Haul Out Site (GeoEngineers, 2008)
- 2008-2009 Sediment Characterization Report (GeoEngineers, 2010)
- Supplemental Sediment Characterization Report (GeoEngineers, 2011)

These investigations observed surface sediment containing up to 75 percent wood debris by volume within a matrix of silt and fine sand. Chemical analyses and biological testing was completed and found exceedances of Sediment Management Standards (SMS) criteria. A summary of each of the previous investigations of the Site is provided in the following sections.

The Port also completed a Dredged Material Characterization Report (GeoEngineers, 2013) at the adjacent Pier 2 berth located north of the Site. A summary of the sediment data collected for the Pier 2 Dredged Material Characterization Report is provided to inform possible conditions at the Site.

3.1. 2004 Due Diligence Report

In 2004 Floyd|Snider completed a limited environmental due diligence investigation for the intertidal area of the Site. This work was completed as part of the Port's closure of the Pier 2 log handling facility to evaluate the potential impacts resulting from historical log handling activities. The results of the field investigation found estimated wood debris, total organic carbon (TOC) and total volatile solids (TVS) values to exceed Ecology's recommended wood waste management guidelines.

In May 2004 Floyd|Snider completed eight hand-dug test pit explorations completed to approximately 2 feet below mudline to characterize near surface intertidal sediment. Test pit locations are presented on Figure 5. Wood debris was observed in the test pits ranging from an estimated 10 to 75 percent. The thickness of the wood debris ranged from approximately 11 inches to 2 feet with the highest wood content in the center of the intertidal area where log handling occurred. In July 2004 two surface sediment samples were collected from the upper 10 centimeters of sediment at test pit locations LP-1 and LP-2 (Figure 5). The two samples were submitted for laboratory analyses of Sediment Management Standards (SMS) chemicals of concern (COC) including metals, semivolatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), phthalates, phenols, polychlorinated biphenyls (PCBs), total solids, TVS, ammonia, TOC and grain size. Chemical analytical results were compared to the dry weight Sediment Cleanup Objectives (SCO) equivalent, the Lowest Apparent Effects Threshold (LAET), due to the high total organic carbon (TOC) content of the samples. The SMS chemicals were not detected at levels greater than SCO or LAET criteria.

3.2. 2008 Sediment Characterization Report

Ecology requested that the Port conduct chemical and biological toxicity testing to determine if the wood debris at the Site poses an environmental risk. GeoEngineers, Inc. (GeoEngineers) completed a sediment investigation to evaluate the potential toxicity of the surface sediment at the Site. The results of biological testing found sediment to exceed SMS criteria at the Site.

In August 2008, sediment samples were collected from two locations (S-1 and S-2) accessible during low tide conditions. Sample locations are presented on Figure 5. Samples were collected from the upper 10 centimeters of surface sediment and submitted to laboratories for chemical analyses and biological testing.

Chemical analyses for the sediment samples included metals, SVOCs, PAHs, PCBs, phthalates, phenols, total solids, TVS, total sulfides, ammonia, TOC and grain size. Zinc was detected at concentrations exceeding LAET but less than SMS Cleanup Screening Level (CSL) in both samples collected. All other SMS COCs were either not detected or were detected at concentrations less than the SQO/CSL or LAET criteria. There is no criterion for total sulfides in sediment, however high concentrations of total sulfides were measured in sediment samples at the Site and are notably outside the typical range for Puget Sound sediment.

Biological testing on the two samples included the 10-day amphipod bioassay, larval development bioassay and Microtox® porewater test. Biological testing results indicated the following:

- Sediment sample S-1 failed to meet the SMS SCO and CSL criteria for the acute amphipod toxicity test.
- Both sediment samples collected at the Site met the applicable SMS SCO and CSL criteria for the sand dollar larval development test.
- Both sediment samples collected at the site failed to meet the SCO criteria for the Microtox® porewater test. There are no established CSL criteria for the Microtox® test.

3.3. 2008-2009 Sediment Characterization Report

Ecology visited the Site in June 2009 and subsequently requested that the Port collect additional sediment samples to confirm the presence or absence of contaminants at the Site in response to Ecology's listing of the Site on the Confirmed or Suspected Contaminated Sites List. In response to Ecology's request GeoEngineers completed additional sediment investigation on behalf of the Port of Anacortes and prepared the Sediment Characterization Report to summarize data collected in 2008 and 2009.

GeoEngineers collected surface sediment samples in September 2009 from five locations (S-3 through S-7) selected in consultation with Ecology. All sample locations were accessible at low tide and are presented in Figure 5. Samples were collected from the upper 10 centimeters of sediment and submitted to laboratories for chemical analyses and biological testing.

Chemical analyses for the sediment samples included metals, SVOCs, PAHs, PCBs, phthalates, phenols, dioxins/furans (sample S-3 only), total solids, TVS, total sulfides, ammonia, TOC and grain size. Chemical analytical results are summarized as follows:

- Dioxins/furans were detected in sample S-3. There was no SCO or CSL established for dioxins/furans at the time of sampling and analysis.
- There is no SMS criterion for total sulfides in sediments, however high concentrations of total sulfides were measured in the sediment samples collected at the site (ranging from 1,720 milligrams per kilogram [mg/kg] to 3,440 mg/kg). These measured concentrations are notably outside of the typical range for Puget Sound sediment.
- All other SMS contaminants of concern were either not detected or were detected at concentrations less than the SCO/CSL or LAET criteria.

Biological testing on the two samples included the 10-day amphipod bioassay, larval development bioassay and Microtox® porewater test. Biological testing results indicated the following:

- All of the sediment samples (S-3 through S-7) met SCO and CSL criteria for the acute amphipod toxicity test.
- Sediment sample S-6 failed to meet SCO criteria for the larval development test.
- All of the sediment samples collected at the site failed to meet SCO criteria for the Microtox® porewater test. There are no established CSL criteria for the Microtox® test.

3.4. 2011 Supplemental Sediment Characterization Report

In response to Ecology requests for benthic abundance testing to further evaluate the toxicity of sediment with wood debris the Port collected additional samples and completed testing.

In October 2010 NewFields Laboratory of Port Gamble, Washington, collected surface sediment samples from five existing locations (S-2, S-3, S-4, S-5 and S-7) as shown on Figure 5. In addition, a reference sample was collected adjacent to the former Wyman's Marina as approved by Ecology for the benthic abundance testing given the proximity of the reference sample location and similarity in physical environment and habitat characteristics. Samples were collected from aboard a vessel using a grab sampler. The six samples were collected from depths ranging from 5 to 9 centimeters below the surface. Samples collected for benthic abundance testing were sieved through a 0.5 millimeter (mm) screen in the field.

The reference sample (LHO-REF) and its duplicate sample were submitted for chemical analysis to confirm that the reference sample does not contain chemical concentrations exceeding SMS criteria and is appropriate as a non-contaminated reference for the benthic abundance testing. The reference sample and its duplicate sample were analyzed for metals, SVOCs, PAHs, phthalates, phenols, PCBs and TOC. The chemical analytical results of the reference sample found:

- None of the COCs analyzed were detected at levels exceeding than the SCO and CSL criteria.
- The organic carbon normalized detection limits for 1,2,4-trichlorobenzene and hexachlorobenzene are elevated in sample LHO-REF. The elevated detection limit exceeds the SCO criteria.
- The dry weight detection limit for 2,4-dimethylphenol is elevated in sample LHO-REF. The elevated detection limit exceeds both the SCO and CSL criteria.

Based on the chemical analytical results the sample was determined to be non-contaminated and suitable for use as reference sediment for benthic abundance testing. Subsequently, the reference sample (LHO-REF) and sample S-2 were subjected to benthic abundance testing in accordance with Puget Sound Estuary Protocols (PSEP, 1987) and evaluated following guidance provided by SMS.

For the samples tested, the benthic invertebrate organisms retained on the 0.5 mm sieve were sorted into major taxonomic groups and identified to lowest possible taxon. The abundance of major taxonomic groups (crustacean, mollusc, and polychaete taxa) from sample S-2 was compared to those from the reference sample to determine compliance with SMS. A sample exceeds SCO when the test sediment has less than 50 percent of the reference sediment mean abundance for one of the major taxa and test sediment abundance is statistically different ($P \leq 0.05$) from the reference sediment abundance. The CSL criteria is exceeded if two of the major taxa have abundances less than 50 percent of the reference sediment and are statistically different from the reference sample.

Results of abundance at sample S-2 failed to meet CSL criteria with polychaete and mollusc abundances below 50 percent of the reference abundance (22 and 12 percent, respectively) and significantly different abundances compared to the reference.

3.5. Pier 2 Dredged Material Characterization Report

Separate from the sediment studies completed at the former log haul out facility, GeoEngineers completed a Dredged Material Characterization Report on behalf of the Port to characterize sediment at Pier 2 and Curtis Wharf for the purposes of maintenance dredging project. Sediment characterization activities were completed in accordance with Dredged Material Management Program (DMMP) requirements to evaluate disposal options for the dredged material. The results of the dredged material characterization are presented to preliminarily identify sediment quality conditions in the Guemes Channel farther offshore from the former log haul out and log storage area.

In November 2012 GeoEngineers collected sediment cores from three locations (P2-1-1, P2-1-2 and P2-1-3) within the Pier 2 berth area as shown on Figure 5. The sediment cores were completed to depths of 8.5 to 10 feet below mudline. Sediment from the three sample locations were composited to create samples that were representative of surface and subsurface dredged material management units (DMMUs), and the base of the dredge prism (referred to as Z-layer). The surface DMMU consisted of material from 0 to 4 feet below mudline and the subsurface DMMU consisted of material from 4 feet to the Z-layer at approximately 5 feet below mudline. These composite samples were submitted to a laboratory for conventional and chemical analyses required by DMMP including grain size, total solids, TVS, TOC, ammonia, total sulfides, metals, tributyltin in porewater, SVOCs, PAHs, phthalates, phenols, PCBs, pesticides and dioxins/furans. The chemical analytical results found:

- Tributyltin in porewater exceeded the DMMP screening level (SL) and bioaccumulation trigger (BT) in the surface DMMU composite sample.
- Each of the calculated dioxin and furan toxic equivalency (TEQ) concentrations for the surface DMMU, subsurface DMMU, and Z-Layer composite samples were less than the DMMP dispersive and non-dispersive disposal site management objective of 4 nanograms per kilograms (ng/kg) TEQ.
- Other chemicals either were not detected or were detected at concentrations less than the DMMP SL and BT levels in the surface DMMU, subsurface DMMU, and Z-Layer composite samples.

In response to the Pier 2 surface DMMU exceedances for tributyltin in porewater, the Port consulted with the Dredged Material Management Office (DMMO) to seek permission to utilize archived samples collected at each of the three individual sample locations within the DMMU for the purpose of isolating the tributyltin contamination within the failed DMMU. The Port recognized that the archive samples were outside of the DMMP's acceptable sample holding time for tributyltin analysis. The individual archived surface DMMU samples (0 to 4 feet below mudline) collected at sampling locations P2-1-1, P2-1-2 and P2-1-3 were analyzed for bulk and porewater tributyltin with the following results:

- Both the bulk and porewater tributyltin concentrations in the surface DMMU (0 to 4 feet below mudline) from sample locations P2-1-1 and P2-1-2 (the locations north of Pier 2) exceeded the DMMP SL and BT levels.
- Bulk and porewater tributyltin concentrations in the surface DMMU (0 to 4 feet below mudline) from sample location P2-1-3 (the location east of Pier 2) were detected at concentrations less than the DMMP SL and BT levels.

The DMMP issued a suitability determination for Pier 2 in March 2013 finding that the portion of the surface DMMU represented by sample locations at P2-1-1 and P2-1-2 was not suitable for open water disposal. The other dredged material characterized in the dredge prism was determined to be suitable for open water disposal. The Port subsequently decided to delay the Pier 2 dredging project with no future date specified at this time due to funding constraints.

4.0 PRELIMINARY CONCEPTUAL SITE MODEL

This section describes the Preliminary Conceptual Site Model (PCSM) for the Site. The PCSM is a tool to assist in determining how sediment may have become contaminated as the result of historical and ongoing activities and has been developed based on the following parameters:

- Physical conditions at the Site;
- Potential sources of contamination to different media;
- Findings from previous investigations; and
- Evaluation of the potential contaminant transport and exposure pathways.

The PCSM will be used to identify potential data gaps in the environmental characterization of the Site, develop an investigation approach to fill the identified data gaps, and evaluate potential remedial actions for contaminated media at the Site.

The PCSM is presented on Figure 6 as a typical cross-section representing the general range of conditions at the Site. The generalized cross-section was prepared to illustrate the PCSM for the range of physical conditions and potential contaminant transport and exposure pathways present. The following sections describe the specific elements of the PCSM.

4.1. Physical Conditions

The upland part of the Site is currently being used as storage for oil spill response equipment. To the east of the former log storage and handling facility is a Port-owned dock that is being used for moorage of commercial vessels. Offshore of the former log storing and handling area is the eastern portion of the Pier 2 vessel berth and mooring dolphins. Pier 2 is used primarily for bulk product exports and a portion is used by a marine float manufacturer.

Surface sediment located within the inlet at the former log haul out area consists of wood debris based on previous sediment investigations of the Site. The extent and depth of wood debris will be investigated as part of the RI. The Pier 2 berth located further to the north, has been dredged to approximately -45 feet mean lower low water (MLLW). Subsurface exploration of the upland portion of the Site has not been completed, but based on adjacent properties it is expected that upland soil consists of a layer of fill material overlying native deposits. It is also possible that some bedrock exists in the upland and/or in-water portions of the Site based on the geology at the adjacent properties.

4.2. Media of Potential Concern

The historical use of the Site as a log storage (log rafting) and handling facility consist of activities in the marine area of the Site. Sediment may have been contaminated by direct releases from log storage and handling. The upland portion of the Site was historically used for log sorting and handling on paved surfaces, and at this time there is no evidence suggesting that upland soil or groundwater is contaminated and effecting sediment or surface water. Therefore at this time, the only media of concern for the Site is sediment. Reevaluation of the media of potential concern will be made on review of the RI data.

4.3. Release and Transport Mechanisms

Release and transport mechanisms for contaminants to sediment at the Site are presented on Figure 6 and may include:

- Deposition of wood debris and hazardous substances to sediment due to historical log rafting and log hauling activities
- Re-suspension of wood debris and hazardous substances through bioturbation or marine disturbances (i.e., wave and current action, seismic disturbance, prop scour and vessel anchors, etc.)

Additional release and transport mechanisms may be present from activities adjacent to the historical log storage and handling operations. The environmental investigation as part of the RI will determine if additional release and transport mechanisms exist adjacent to the Site and would be incorporated into the conceptual site model in the RI Report.

4.4. Exposure Pathways and Potential Receptors

The only medium of potential concern is sediment in the marine area of the Site. The following are the potential exposure pathways and receptors for contaminants in sediment at the Site:

- Direct contact (dermal exposure) with sediment by human and ecological receptors;
- Incidental ingestion of sediment by human and ecological receptors;
- Exposure of benthic organisms, which may result in acute or chronic effects, to hazardous substances. This may also result in the uptake and bioaccumulation of contaminants in these organisms;

- Ingestion of contaminated benthic organisms as prey by higher trophic level organisms in the food chain (e.g., foraging fish, aquatic birds, marine mammals, etc.); and
- Human ingestion of marine organisms contaminated by hazardous substances.

5.0 EVALUATION OF EXISTING DATA

This section develops preliminary screening levels, compares existing data to these screening levels and identifies contaminants of potential concern (COPCs).

5.1. Screening Levels

Preliminary screening levels for sediment have been developed for contaminants detected in the identified media of concern based on the PCSM. Screening levels have been developed in this Work Plan for the purpose of evaluating existing data, identifying data gaps and to ensure that appropriate analytical method detection limits are utilized for the RI sampling and analysis. Consistent with Ecology's MTCA Cleanup Regulation (WAC 173-340) and Sediment Management Standard (WAC 173-204), the development of the screening levels identified potential exposure pathways for human and ecological receptors. Several of these pathways may not be appropriate for the cleanup evaluation, but were retained to ensure that detection limits would be adequate to assess nature and extent of contamination regardless of the exposure pathway.

Screening levels for sediment are presented in Tables 1 and 2 for protection of benthic organisms and protection of human health and higher trophic level ecological receptors, respectively. The toxicity equivalency factors (TEFs) used to calculate the TEQs for carcinogenic polycyclic aromatic hydrocarbons (cPAHs), dioxin-like PCBs, and dioxins/furans are presented in Table 3.

5.1.1. Screening Levels for Protection of Benthic Organisms

For this Work Plan, sediment screening levels for benthic invertebrate community health are the numeric Sediment Cleanup Objectives (SCO) from SMS (WAC 173-204-562) that correspond to sediment quality that will result in no adverse effects to the benthic community. Screening levels for protection of benthic organisms are presented in Table 1.

The SMS benthic community health-based sediment cleanup objective of WAC 173-204-562 provide numeric criteria for a broad range of chemicals. The benthic community health-based criteria for specific chemicals are based on either dry-weight or organic carbon-normalized concentrations. The analytical results for nonpolar organics are organic carbon normalized when the TOC concentration at a contaminated sediment site ranges from 0.5 to 3.5 percent (inclusive). The carbon normalized analytical results are then compared to the organic carbon-normalized SCO. Analytical results for nonpolar organics at contaminated sediment sites that include samples with TOC concentrations outside of the 0.5 to 3.5 percent range are screened against Marine Sediment Apparent Effects Threshold (AET) values on a dry-weight basis (Ecology's *Sediment Cleanup Users Manual II* guidance [SCUM II], Table 8-1; Ecology, 2015). SMS and AET screening level criteria for benthic community health are presented in Table 1. Because this Site contains deposits of wood debris, analytical results and screening will be completed on both an organic carbon-normalized basis, and separately on a dry-weight basis.

SMS does not include a screening level for total dioxin/furan TEQ and no regional background study of the area has been completed to date. A screening level (5 ng/kg) was provided by Ecology based on practical quantitation limit. Tributyltin does not have an established screening level protective of benthic organisms under SMS. A report on the evaluation of tributyltin relative to benthic toxicity (PSDDA/SMS, 2006) proposed regulatory criteria based on porewater concentrations, rather than bulk sediment, stating that the porewater concentration is conceptually equivalent to SMS SCO and CSL. These porewater concentrations will be used as the screening levels for tributyltin concentrations protective of benthic organisms, along with the bulk sediment criterion. The most recent agency clarification from the Sediment Annual Review Meeting (DMMP 2015) suggests that a bulk sediment criterion of 73 µg/kg may be equally effective at predicting adverse effects.

5.1.2. Screening Levels for Protection of Human Health and Higher Trophic Level Ecological Receptors

For this Work Plan, sediment screening levels have also been developed for protection of human health and protection of higher trophic level ecological receptors as presented in Table 2.

Screening levels for human health exposure to sediment via ingestion and dermal contact were developed utilizing equations and parameter values from Ecology's SCUM II guidance (Ecology, 2015). The preliminary sediment screening levels based on sediment ingestion and dermal contact shown in Table 2 represent the values for three potential receptors that were evaluated: a child exposed during beach play, an adult exposed during clam digging (subsistence harvesting), and an adult exposed during net fishing (subsistence harvesting). The intertidal area is defined as marine areas of the Site above -3 feet MLLW and the subtidal area are below -3 feet MLLW. Children exposed to sediment during beach play and adults exposed to sediment during clam digging are assumed to be exposed primarily to intertidal sediment (at elevations greater than -3 feet MLLW). Beach play may also take place in the subtidal area; however, because the subtidal sediments are underwater, the potential exposure to subtidal sediment is expected to be minimal relative to intertidal sediment. Likewise, the clam digging exposure scenario is expected to apply to intertidal sediment (at elevations greater than -3 feet MLLW). The net fishing potential exposure scenario relates to both intertidal and subtidal sediment. Beach play and clam digging exposure scenarios were considered in the development of preliminary screening levels to avoid potential data gaps during RI data collection. However, beach play and clam digging are not expected to be exposure pathways for this Site because the intertidal sediment is located within a secured and fenced area operated by the Port. The RI/FS Report will determine the exposure pathways for the Site and define cleanup levels based on the identified exposure pathways.

Because tissue data do not exist for the Site, site-specific biota-sediment accumulation factors (BSAFs) are not available to back-calculate risk-based sediment screening levels. A simplified approach (Option 1 within SCUM II - Section 9.2) where the SCO and CSL are established at background (natural and regional, respectively) or the practical quantitation limit (PQL) was selected to develop sediment screening levels based on bioaccumulation exposure for human health and higher trophic level organisms. For bioaccumulative chemicals such as dioxins/furans, dioxin-like PCBs, total PCBs, PAHs, arsenic, cadmium, lead, mercury and tributyltin, site-specific risk-based sediment screening levels presented in Table 2 are provided to evaluate human health and higher trophic level ecological receptors based on secondary exposure pathways. Sediment screening levels for human health and higher trophic level ecological receptors were chosen from lowest of bioaccumulative and direct contact pathways. The screening level for intertidal areas includes marine areas at elevations higher than -3 feet mean MLLW and the applicable direct contact pathways include beach play and clamming. The screening levels for subtidal areas include marine areas at elevations below -3 feet MLLW and the applicable direct contact pathway is net fishing.

Consistent with the SCUM II guidance, where the risk-based value is lower than natural background or PQL, the screening level defaults to the higher of natural background or PQL. Table 2 presents the natural background, PQL and the screening level selected for each chemical.

Tributyltin does not have a documented natural background concentration. The DMMP bioaccumulation triggers (BTs) were selected as the preliminary sediment screening level protective of higher trophic level ecological receptors for tributyltin (bulk and porewater) as presented in Table 2. The DMMP's BTs are set at a concentration that constitutes a "reason to believe" that the chemical would accumulate in the tissue of target organisms. Porewater was selected by the DMMP as the measurement basis for the tributyltin BT in 1996 (PSDDA/SMS, 1996); a change to bulk sediment as the measurement basis was recently proposed during the Sediment Management Annual Review Meeting (DMMP, 2015). Both porewater and bulk sediment will be analyzed for tributyltin as part of the RI, unless holding time exceedances preclude analysis of porewater in archived samples. In those cases, tributyltin will be analyzed and screened on a bulk sediment basis only.

5.1.3. Wood Debris and Biological Testing

In addition to screening of chemical constituents, bioassay testing may be used to directly screen sediment for adverse benthic community effects from chemicals and other potential environmental stressors such as wood debris. For evaluating sediment data for benthic invertebrate community health-based criteria, chemical results for compliance with benthic invertebrate community health standards in WAC 173-204-652 are superseded by bioassay test results. The requirements of WAC 173-204-561 for human health risk and WAC 173-204-564 for ecological receptor health are not superseded by bioassay test results.

There is no promulgated SMS criterion for wood debris in sediment, and therefore, delineation may rely, in part, on biological testing. For this investigation, Ecology, or the Port in consultation with Ecology, will determine where to conduct individual bioassays at this Site on a location-by-location basis after review of chemical analytical results. The following sections detail the RI study approach and how bioassay testing will be completed.

5.2. Comparison of Existing Data to Screening Levels

Existing pre-RI sediment data were compared to preliminary screening levels protective of benthic organisms and protective of human health and higher trophic level ecological receptors.

5.2.1. Sediment Chemical Analytical Results

Existing sediment chemical analytical data obtained during previous site investigations consists of surface sediment samples collected from 0 to 10 centimeters below mudline. Table 4 and Figure 7 present the existing data and highlight surface sediment samples with screening level exceedances. Lead, zinc, benzo(a)pyrene, cPAHs, total PCBs, and dioxin/furans were detected at concentrations greater than their respective screening levels in surface sediment at the Site.

Subsurface samples were collected and analyzed for the Pier 2 dredged material characterization work completed north of the Site. Table 5 presents analytical results of the composite and discrete subsurface samples that were analyzed for the dredged material characterization and Figure 7 highlights the discrete samples with screening level exceedances. Porewater and bulk tributyltin were detected at concentrations above respective screening levels in samples collected from samples comprised of sediment from 0 to 4 feet below mudline adjacent to the Pier 2 vessel berth.

5.2.2. Biological Testing

Existing biological testing has been completed for surface sediment during previous sediment investigations as described in Section 3.0. Figure 8 highlights the biological testing exceedances. Surface sediment at the Site has exceeded for the following bioassay tests and criteria:

- SCO exceedance for the larval development test.
- SCO exceedances for the Microtox® porewater test. There are no established CSL criteria for the Microtox® test.
- SCO and CSL exceedance for the benthic abundance test.

5.3. Contaminants of Potential Concern

The following compounds are considered COPCs at this Site:

Contaminant of Potential Concern	Rationale
Wood debris	Observed to be present in the surface sediment located at the former log haul out facility.
Lead	Exceeds preliminary screening level protective of human health and higher trophic level receptors at location S-4.
Zinc	Exceeds preliminary screening level protective of benthic organisms at locations S-1 and S-2.
Benzo(a)pyrene	Exceeds preliminary screening level protective of human health and higher trophic level receptors at locations S-1, S-2, S-3, S-5, S-6 and LHO-REF.
Total PCBs	Exceeds preliminary screening level protective of human health and higher trophic level receptors at location S-6.
Dioxins/furans	Exceeds preliminary screening levels protective of benthic organisms and protective of human health and higher trophic level receptors at location S-3. (Note S-3 is the only sample location analyzed for dioxins/furans).
Total cPAHs (TEQ)	Exceeds preliminary screening level protective of human health and higher trophic level receptors at locations S-1 through S-7 and LHO-REF.
Tributyltin (bulk and porewater)	Exceeds preliminary screening level protective of benthic organisms in porewater from samples collected for the Pier 2 berth dredged material characterization. Note that tributyltin may only be a COC for adjacent sites and there is not any known historical source due to historical operations at the Site.
Metals (arsenic, cadmium, chromium, copper, mercury, silver)	For consistency with SMS requirements.
SVOCs (including PAHs, phenols, phthalates, chlorinated organics and miscellaneous extractables)	For consistency with SMS requirements.

5.4. Identification of Data Gaps

To date only partial characterization of sediment quality at the Site has been completed. The previous sediment investigations primarily provide data for surface sediment within the direct vicinity of the former log sorting and handling location. Existing sediment data does not fully characterize the potential source area and the nature and extent of contamination at the Site. Specific data gaps include the following:

- Horizontal extent of contaminated sediment and wood debris in surface sediment;
- Horizontal and vertical extent of contaminated sediment and wood debris in subsurface sediment;
- Extent of tributyltin contamination near Pier 2 vessel berth;
- Bathymetric data adjacent to the upland portion of the Site; and
- Current marine habitat conditions at the Site.

6.0 REMEDIAL INVESTIGATION STUDY APPROACH

The RI will include sampling and analysis of sediment to delineate the nature and extent of contamination at the Site. In addition, bathymetric and habitat surveys will be completed as part of the RI. The approach for the tasks included in the RI are described in the following sections.

6.1. Bathymetric Survey

A topographic survey will be performed as part of RI to characterize current surface conditions at the Site. An existing multi-beam bathymetric survey completed in June 2014 will be used for the subtidal areas of the Site. This existing survey did not cover the complete intertidal and shoreline area. A topographic survey will be performed that includes the intertidal portions of the RI study area extending from the former log handling area extending to the east to the Wymans Marina habitat mitigation site. The survey will be completed by a professional surveyor registered in the State of Washington. The survey will be tied in to the existing bathymetric survey to create a comprehensive survey of the RI study area.

6.2. Habitat Survey

A habitat survey will be completed as part of the RI to determine the existing habitat at the Site. Specific details regarding field protocols and procedures that will be utilized to complete the habitat survey are presented in the Habitat Survey Plan (HSP) presented in Appendix A. The habitat survey will serve as a baseline for habitat conditions at the Site. The habitat survey will be used in the FS Report to identify where habitat improvements can be incorporated into potential remedial action alternatives. The habitat survey will also be used for permitting potential in-water construction activities. The habitat survey will, at a minimum, identify the location, areal extent and quality of the following:

- Eelgrass;
- Rock fish habitat;
- Near shore salmonid habitat;
- Forage fish spawning habitat;
- Shellfish beds; and
- Riparian habitat.

Other observed aquatic species and habitats (including upper trophic level species) will be noted during the habitat survey.

6.3. Sediment Investigation

The overall objectives of the sediment investigation described in this Work Plan include the following:

- Characterize the stratigraphy of surface and subsurface sediment at the Site including the nature and extent of wood debris;
- Characterize the nature and extent of hazardous substances in surface and subsurface sediment;
- Provide results from chemical analyses and parameters of wood debris to identify the need and locations for follow-up bioassay testing to evaluate compliance with SMS biological criteria;
- Use results of chemical analyses to identify locations for follow-up site-specific sediment/tissue sampling and analysis to support human health and ecological risk evaluation, if elected; and
- Determine if contamination extends to the upland portion of the Site.

The sediment investigation will identify the nature and extent of sediment contamination at the Site. The proposed sediment sample locations to initially be sampled are positioned to address identified data gaps and to provide comprehensive coverage of the Site. The Port worked with Ecology during development of this Work Plan to identify the sample locations for the RI. RI data gathering for this sediment investigation will follow a phased or tiered approach consisting of an initial sediment investigation and follow-up sediment investigation(s).

Initial Sediment Investigation:

1. Collect surface and subsurface sediment samples at locations and intervals identified in this Work Plan (see Figure 9).
2. Analyze the sample intervals identified for chemical constituents as described in this Work Plan (see Figure 10). Archive sample intervals that are not analyzed.
3. Review sediment chemical analytical results and compare to preliminary sediment screening levels presented in this Work Plan.

Follow-up Sediment Investigation:

4. Complete additional chemical analyses on archived sediment samples based on the results of initial sample analysis and comparison to the preliminary sediment screening levels. Determination of chemical analyses of the archived samples will be completed in collaboration with Ecology. This step may be iterative until the archived samples have filled potential data gaps relative to the preliminary sediment screening levels or a data gap has been identified.
5. OPTIONAL - If it appears that a paired tissue/sediment study would result in higher preliminary cleanup levels for protection of higher trophic ecological receptors than the current screening levels, then a paired tissue/sediment study may be proposed to Ecology for review and approval. If a paired tissue/sediment study is determined to be unnecessary, the preliminary cleanup level would default to the preliminary screening levels presented in this Work Plan. If a paired tissue/sediment study is elected the following steps will be completed:
 - a. If elected, plan and complete the paired tissue/sediment study. A proposed approach for the paired tissue/sediment study would be prepared and submitted to Ecology for review and approval.

- b. Use the results of the paired tissue/sediment study, preliminary screening levels, natural background, practical quantification limits, and/or initial sediment data results to derive site-specific preliminary cleanup levels protective of higher trophic ecological receptors for sediment at the Site. Development of preliminary cleanup levels will be completed with review and approval by Ecology.
 - c. Compare existing sediment chemical data to preliminary cleanup levels to determine data gaps.
6. Develop plans for filling identified data gaps including, but not limited to, determining locations for bioassay testing, additional sediment sample locations for chemical analyses and/or additional upland sample locations for chemical analyses. Submit plans to Ecology for review and approval prior to implementation of additional work to fill identified data gaps.

A summary of this phased approach for chemical analyses and biological testing to achieve the objectives of the RI is presented on Figure 11. Specific details regarding field protocols and quality assurance and control procedures that will be utilized to complete the sediment investigation are presented in the Sampling and Analysis Plan (SAP) presented in Appendix B. A Health and Safety Plan (HASP) is included in Appendix C and includes procedures for completing field work in a safe manner.

Ecology will be informed of all sediment sampling activities at the Site at least seven days prior to the sampling being performed and adequate space will be provided for an Ecology staff person aboard the sampling vessel(s) during sediment sampling activities. The detailed scope of the initial and follow-up phases of the sediment investigation are described in the following sections.

6.3.1. Initial Sediment Investigation

As part of the initial sediment investigation, sampling will be completed at 13 sample locations (LY-1 through LY-13). The proposed surface and subsurface sediment sampling locations are presented on Figure 9. Surface samples will be collected at each of the 13 locations and subsurface sediment cores will be completed and samples collected at nine sample locations (LY-3 through LY-11). A visual representation of the depths and chemicals for analysis and archival at each sampling location is provided on Figure 10.

Surface sediment samples will be obtained using a grab-type sampler (Van Veen or similar) for locations accessed by boat. Some surface sediment samples will be accessible by the upland during low tide conditions and these surface samples will be collected as grab samples using stainless steel spoons. Surface samples will be obtained from the upper 10 centimeters of sediment. Sediment cores will be obtained using vibracoring, hollow stem auger, sonic drilling, or other method(s) as determined to best meet the specific sampling objectives. Continuous cores will be advanced through the sediment to depths of approximately 10 feet below mudline. The objective of each core will be to encounter native material (or refusal at bedrock if encountered) and cores may be advanced deeper or shallower than 10 feet below mudline. Subsurface sediment samples will be collected continuously in 1-foot intervals and submitted to the laboratory for analysis or archival. The sediment type recovered in each surface grab sample and subsurface core will be classified in accordance with the Unified Soil Classification System and recorded on a log of exploration form.

The absence or presence of wood debris will also be recorded on a log of exploration form. If wood debris is present, the type or types of wood debris (i.e., saw dust, bark, chips, chunks, twigs, fibers, etc.), the estimated quantity (i.e., observed percent by volume) of each wood type, and the depth interval where the wood is observed will be recorded on a log of exploration form to further characterize the stratigraphy of surface and subsurface sediment. Additionally, the type or types of wood debris and estimated quantity present in each sample will be recorded. Sediment samples collected at selected locations will be analyzed for measures of wood debris to characterize the absence or presence of wood including TOC, TVS and porewater ammonia and sulfide.

The sediment sample collected from each sampling interval will be field screened by physical examination. The samples will also be evaluated for the potential presence of contamination using field screening techniques that include visual observation for the presence of contamination (i.e., staining, discoloration, etc.) and water sheen testing (i.e., petroleum sheen). The procedures for field screening are presented in the SAP.

Selected sediment samples obtained as part of this investigation will be submitted for a combination of the following analyses, which meet Ecology requirements previously provided for this investigation:

- Grain size by PSEP 1986 or ASTM International (ASTM)-Mod;
- TOC by PSEP 1986;
- TVS by PSEP 1986/ASTM D2974;
- Ammonia in porewater by United States Environmental Protection Agency (EPA) 350.1 M;
- Sulfides in porewater by SM 4500-S2;
- SMS metals by EPA Method 6000/7000 series;
- SMS SVOCs by EPA Method 8270/8270-SIM;
- PCBs by EPA Method 1668C;
- Dioxins and furans by EPA Method 1613;
- Tributyltin (bulk) by EPA Method 8270D-SIM/KRONE; and
- Tributyltin in porewater by EPA Method 8270D-SIM/KRONE.

Samples will be submitted to ARI Laboratory, an Ecology-certified laboratory for analysis. Samples not initially selected for analyses for preliminary hazardous substances from a specific location will be archived for potential future analysis based on the initial sample results to further characterize the nature and extent of contamination at the Site. Figure 10 presents the sample intervals and chemical analyses that will be completed as part of the initial sediment investigation. The objective of archiving sediment samples is to provide a cost effective approach in determining the nature and extent of chemical contamination at the Site. Analytical results from initial sediment sample analyses will be compared to the preliminary sediment screening levels provided in Tables 1 and 2. The results of the initial phase of chemical analysis will be used to inform follow-up sediment investigation and analysis of archived samples as part of the phased approach presented on Figure 11 and described in the subsequent section.

6.3.2. Follow-up Sediment Investigation

The following sections summarize the follow-up sediment investigation activities.

6.3.2.1. Chemical Analysis of Archived Samples

Upon receipt of chemical analytical results from the initial sediment investigation the Port will work with Ecology to determine additional samples to submit for specific chemical analyses. Additional chemical testing will be completed to define the vertical and horizontal extent of contamination at the Site based on comparison of the initial sediment investigation analytical data to the preliminary screening levels. Note that for additional testing of bioaccumulative chemicals, the Port may choose to develop preliminary cleanup levels before completing additional testing of archived samples as discussed in Section 6.3.2.2.

6.3.2.2. Development of Preliminary Cleanup Levels (OPTIONAL)

An evaluation will be completed to determine the need to conduct a site-specific paired tissue/sediment study to provide data for a Site-specific human health and ecological receptor risk evaluation. The paired tissue/sediment study would be completed if it appears that Site-specific preliminary cleanup levels for bioaccumulative chemicals would be greater than the preliminary screening levels included in this Work Plan. If the paired tissue/sediment study is not elected, analytical results will be compared to the preliminary screening levels for bioaccumulative chemicals for determining the vertical and horizontal extent of contamination at the Site.

If elected, the paired tissue/sediment study and subsequent evaluation would determine the risk from dioxins/furans, PAHs, PCBs, mercury, arsenic, cadmium, lead and/or tributyltin at the Site and will include congener data for dioxins/furans and PCBs. Analyses for these bioaccumulative chemicals in sediment are being performed as part of the initial sediment investigation. The results of these analyses would help determine the need for the paired sediment/tissue study and which COC to include.

If performed, the paired tissue/sediment study would consist of collecting sediment samples and tissue samples from selected organisms within the study area to evaluate bioaccumulation factors. A Work Plan addendum would be prepared to describe the scope and approach of sampling and analysis to support the tissue/sediment study. The addendum would identify the objectives and data to be collected for the study and is subject to Ecology approval. On approval of the addendum by Ecology, a subsequent field effort would be performed to collect sediment and tissue samples to evaluate bioaccumulation factors at the Site.

If the paired tissue/sediment study results in development of preliminary cleanup level concentrations lower than natural background, practical quantification limit or preliminary screening levels, the preliminary cleanup level would default to the natural background, practical quantification limit or preliminary screening level concentration. Development of preliminary cleanup levels for the Site will be completed in collaboration with Ecology and are subject to Ecology approval.

6.3.2.3. Identification of Data Gaps

Once the initial sediment investigation is completed and selected archived samples have been analyzed the data will be evaluated relative to the preliminary sediment screening levels or relative to the preliminary sediment cleanup levels developed from the paired tissue/sediment study (if elected) to identify data gaps in determining the nature and extent of contamination. Potential data gaps include:

- Horizontal and vertical extent of chemical contamination in surface and/or subsurface sediment;
- Locations for biological testing to determine toxicity of sediment with wood debris; and
- Extent of chemical contamination in upland portions of the Site if sample locations above MHHW (LY-1 and LY-2) are found to exceed screening levels.

The evaluation of the sediment analytical data and identification of data gaps will be subject to Ecology's review and approval.

6.3.2.4. Additional Sediment Investigation Activities

Based on the data gaps identified, additional sampling and testing will be completed. Additional sampling and analysis may include the following:

- Additional sampling and analysis of surface or subsurface sediment to define the nature and extent of wood debris and/or chemical contaminants.
- If elected or required by Ecology, collecting samples for bioassay testing to determine potential toxic effects of hazardous substances in sediment.
- If required based on initial chemical analytical results, complete sampling and analysis in upland areas of the Site.

An addendum to the Work Plan will be prepared and submitted to Ecology for review and approval to provide detailed plans for additional sediment investigation activities.

Biological testing may be required to be performed on surface sediment samples based on the results for parameters of wood debris and chemicals concentrations from the initial and follow-up sediment investigations to better define potential toxic effects of hazardous substances identified in sediment in accordance with WAC 173-204-562(4). Analytical results for parameters of wood debris and SMS chemicals will be used to identify locations where wood debris may have resulted in adverse biological effects in sediment. The Port will collaborate with Ecology to determine if bioassay testing is necessary. The samples for bioassay testing will be collected at the previous sample locations to the extent practical so that the results from previous chemical analyses can be utilized to characterize the sediment that is to undergo bioassay testing. Bioassay samples will be collected between August 15 and September 30, unless otherwise approved by Ecology, to understand the effects of site-specific low dissolved oxygen and higher water temperatures on sediment toxicity. Biological testing, if needed, will be performed by an Ecology-certified laboratory.

7.0 FEASIBILITY STUDY

The FS will utilize the results of the RI to establish proposed cleanup levels for future cleanup actions at the Site. The FS will develop and evaluate cleanup action alternatives for contaminated media so that appropriate cleanup actions may be selected. Specifically, the FS will:

- Establish cleanup levels, points of compliance and as necessary, establish remediation levels;
- Identify Applicable or Relevant and Appropriate Requirements (ARARs);
- Delineate media requiring remedial action;

- Develop remedial action objectives;
- Screen and evaluate separate upland and in-water cleanup alternatives in accordance with WAC 173-340-350(8) and WAC 173-204-560(4). Based on this evaluation, select a preferred alternative for upland and sediment cleanup in accordance with WAC 173-340-360 and WAC 173-204-570; and
- To the extent practicable, the integration of habitat restoration opportunities will be considered during the evaluation of remedial alternatives.

The following sections provide the details of the FS process that will be completed for the Site.

7.1. Establishment of Cleanup Levels, Points of Compliance and Remediation Levels

Cleanup standards, including cleanup levels and points of compliance will be developed for contaminated media in accordance with MTCA and/or SMS regulations. Exposure pathways and receptors will be identified as part of cleanup level development. As needed, remediation levels may also be established for specific cleanup alternatives.

Cleanup levels for sediment will be based on protection of human health, higher trophic ecological receptors, and benthic and aquatic species in accordance with the SMS. The point of compliance for sediment will be established and be protective of biologically active zones in sediment throughout the Site, consistent with SMS. The point of compliance may be deeper than biologically active zones, depending upon the contaminant types and concentrations detected, and the lateral and vertical extents of contamination determined during the remedial investigation.

7.2. Applicable or Relevant and Appropriate Requirements

In addition to the cleanup standards developed through the MTCA process, other regulatory requirements will be considered in the selection and implementation of the cleanup action. MTCA requires the cleanup standards to be “at least as stringent as all applicable state and federal laws” [WAC 173-340-700(6)(a)]. Besides establishing minimum requirements for cleanup standards, applicable state and federal laws may also impose certain technical and procedural requirements for performing cleanup actions. These requirements are described in WAC 173-340-710.

MTCA defines applicable state and federal laws to include legally applicable requirements and those requirements that are relevant and appropriate (ARARs). The primary ARARs will be the MTCA and SMS cleanup levels and regulations that address implementation of a cleanup under MTCA (173-340 WAC) and SMS (173-204 WAC). Other potential ARARs may include the following:

- Washington State Water Pollution Control Act (Chapter 90.48 RCW) and the implementing regulations: Water Quality Standards for Surface Waters of the State of Washington (Chapter 173-201A WAC).
- EPA National Recommended Water Quality Criteria – Section 304 Clean Water Act.
- EPA Water Quality Standards (National Toxics Rule) – 40 CFR 131. Minimum Standards for Construction and Maintenance of Wells (Chapter 173-160 RCW).
- The federal Clean Water Act, with respect to in-water work associated with dredging or sediment capping.

- Endangered Species Act, due to listing of Puget Sound chinook and of Coastal/Puget Sound bull trout.
- Washington Hazardous Waste Management Act and the implementing regulations: Dangerous Waste Regulations (Chapter 173-303 WAC), to the extent that any dangerous wastes are discovered or generated during the cleanup action.
- Washington's Shoreline Management Act with respect to construction cleanup activities conducted within 200 feet of the shoreline.
- Archaeological and Historical Preservation: The Archaeological and Historical Preservation Act (16 USCA 496a-1) would be applicable if any subject materials are discovered during Site grading and excavation activities.
- Archaeological Resources Protection Act, 16 USC 470aa; 43 CFR 7.
- Washington Clean Air Act (Chapter 70.94 WAC).
- Health and Safety: Site cleanup-related construction activities would need to be performed in accordance with the requirements of the Washington Industrial Safety and Health Act (RCW 49.17) and the federal Occupational Safety and Health Act (29 CFR 1910, 1926). These applicable regulations include requirements that workers are to be protected from exposure to contaminants and that excavations are to be properly shored.

The FS will identify additional ARARs that are applicable to the Site cleanup.

7.3. Identification of Media Requiring Remedial Action

The RI process will determine if soil, groundwater or sediment exceed cleanup levels and, if so, identify the locations of the exceedances. Based on any exceedances and the established points of compliance, the FS will identify the extent or volume of soil, groundwater or sediment that requires remedial action and define remedial action areas, as appropriate.

7.4. Development of Remedial Action Objectives

Remedial action objectives (RAOs) that define the goals of the cleanup that must be achieved to adequately protect human health and the environment will be developed for each medium and area identified as requiring remedial action. These RAOs will be action-specific and/or media-specific. Action-specific RAOs are based on actions required for environmental protection that are not intended to achieve a specific chemical criterion. Media-specific RAOs are based on developed cleanup levels. The RAOs will specify the contaminant of concern, the potential exposure pathways and receptors, and acceptable contaminant level or range of levels for each exposure pathway, as appropriate.

7.5. Development of Cleanup Alternatives

A reasonable number and type of cleanup alternatives will be developed for each medium of concern requiring cleanup. Initially, general remediation technologies will be identified for the purpose of meeting all applicable regulations for each medium. General remediation technologies consist of specific remedial action technologies and process options and will be considered and evaluated based on the media type, specific properties of contaminants and characteristics and complexity of the Site including consideration of specific Site conditions and physical constraints. The range of remedial technologies may include institutional controls, containment or other engineering controls, removal, *in situ* treatment and natural attenuation.

Specific remedial action technologies are the engineering components of a general remediation technology. Several specific technologies may be identified for each general remediation technology and multiple process options may exist within each specific technology. Specific remedial action technologies and representative process options will be selected for evaluation based on documented development or documented successful use for the particular medium and COPCs. Cleanup alternatives will be developed from the general and specific remedial technologies and process options consistent with Ecology requirements identified in WAC 173-340-370 and WAC 173-204-570 using best professional judgment and guidance documents, as appropriate. During the development of cleanup alternatives, both the current and planned future land use will be considered.

7.6. Evaluation of Cleanup Alternatives

Evaluation of cleanup action alternatives and the selection of preferred cleanup alternative will meet the requirements of WAC 173-340-360 and WAC 173-204-560. Consistent with MTCA, the alternatives will be evaluated with respect to compliance with threshold requirements, permanence, and restoration timeframe, and the results of the evaluation will be documented in the FS Report.

7.7. Habitat Restoration

Opportunities to perform remedial actions in an integrated manner with restoration of natural resources will be evaluated, including consideration of the logistics, cost-effectiveness, and environmental benefits associated with integrating cleanup and restoration actions. Restoration activities may include both primary and compensatory restoration.

8.0 PUBLIC PARTICIPATION

A Public Participation Plan (PPP) was prepared by Ecology for the project that summarizes the cleanup process to be conducted at the Site. The PPP is provided in Appendix D. The PPP will be provided to the public to present the opportunity for the public to learn about and provide input on the RI and remedial alternatives as required under MTCA (WAC) 173-340-600.

9.0 PROJECT MANAGEMENT

This section discusses the organizational structure and responsibilities designed to provide project control and quality assurance for the duration of the project.

9.1. Designated Project Coordinators

As specified in the Agreed Order the coordinators for the project are as follows:

- Susannah Edwards – Ecology
- Jenkins Dossen – Port of Anacortes

Each project coordinator will be responsible for overseeing the implementation of the work. Ecology's project coordinator is Ecology's designated representative for the Site. To the maximum extent possible, communications between the involved parties, and all documents, including reports, approvals, and other correspondence concerning the activities performed will be directed through the project coordinators. However all parties have direct access to Ecology to resolve issues or concerns.

9.2. Technical Project Manager

The Technical Project Manager for the activities that will be completed under this Work Plan is John Herzog. The Technical Project Manager has overall responsibility for executing the project in accordance with contractual requirements. The Technical Project Manager is also responsible for selecting project team members, assigning and coordinating project tasks, determining subcontractor participation, establishing and adhering to budgets and schedules, providing technical oversight, coordinating production and review of project deliverables, and is the primary technical representative.

9.3. Field Coordinators

The Field Coordinators for RI activities that will be completed under this Work Plan are Brian Tracy and/or Abhi Joshi. The Field Coordinator is responsible for the daily management of activities in the field and will be responsible for QA/QC oversight of the laboratory programs.

9.4. Quality Assurance Leader

The Quality Assurance (QA) Leader for the RI activities that will be completed under this Work Plan is Mark Lybeer. The QA Leader is responsible for coordinating QA/QC activities as they relate to chemical analytical data. The QA Leader will review laboratory QA/QC data to assure validity of data and conformance to QA/QC requirements and will provide a written QA/QC report.

9.5. Laboratory Management

The subcontracted laboratories conducting sample analyses for this project are required to obtain approval from the QA Leader before the initiation of sample analysis to assure that the laboratory QA plan complies with the project QA objectives. The Laboratory's QA Coordinator administers the Laboratory QA Plan and is responsible for QC. Analytical Resources, Inc. (ARI) of Tukwila, Washington will perform chemical analysis for this project. It is anticipated that Environ (formerly NewFields) of Port Gamble, Washington would be utilized if bioassay analysis is required for this project.

10.0 REPORTING AND SCHEDULE

10.1. Reporting

The following reports will be prepared under this Work Plan: Data Report Technical Memorandum; RI/FS Report; and Draft Cleanup Action Plan. Specific information on the content of these reports is described in the following sections.

10.1.1. Data Report Technical Memorandum

As required by the Agreed Order a Data Report Technical Memorandum will be developed to describe the analytical results of the RI field activities, the affected media, the extent of contamination, and identification of data gaps that need to be filled to complete the RI/FS with respect to definition of the nature and extent of contamination. The Data Report Technical Memorandum will be submitted to Ecology for review and will be utilized to determine if additional investigation is required to define the full nature and extent of contamination.

10.1.2. RI/FS Report

The RI/FS report will contain the results of the RI and provide information regarding the full extent and magnitude of contamination in media of concern identified. The FS will present and evaluate cleanup action alternatives to address the identified contamination. Based on the evaluation of alternatives, the FS will identify a preferred cleanup action alternative.

10.1.3. Draft Cleanup Action Plan

The draft Cleanup Action Plan (DCAP) will describe the proposed cleanup action alternatives to address contamination in impacted media. The DCAP will include a general description of the proposed cleanup actions including:

- A general description of the proposed cleanup action and restoration alternatives and the rationale for selection.
- A summary of the other alternatives evaluated in the RI/FS.
- A summary of applicable local, state, and federal laws pertinent to the proposed cleanup and restoration actions.
- Cleanup standards or remediation levels (if warranted) and rationale regarding their selection for each hazardous substance and for each medium of concern based on the results of the RI/FS.
- Descriptions of any institutional/engineering controls, if proposed.

A preliminary schedule for implementation of field construction work and subsequent maintenance and monitoring.

10.2. Schedule

The Agreed Order establishes the RI/FS schedule and reporting requirements for the project. The schedule for specific project milestones is provided in the following table. Ecology will be notified at the time unanticipated conditions or changed circumstances are discovered which might result in a schedule delay to implementation of the Work Plan. Any requests for a schedule extension will be undertaken as required by the Agreed Order. Any completion times that fall on a holiday or weekend will be extended to the next weekday.

PROJECT MILESTONES	SCHEDULE
Remedial Investigation/Feasibility Study (RI/FS) Work Plan Submittal	
Agreed Order Effective Date	November 18, 2014
Draft RI /FS Work Plan	Due to Ecology March 23, 2014 (as modified by Ecology on February 4, 2015).
Final RI/FS Work Plan	90 calendar days following receipt of Ecology's review comments on the Draft RI/FS Work Plan, and then will undergo a 30-day review period by Ecology.

PROJECT MILESTONES	SCHEDULE
Field RI	
Field RI	Commence within 60 calendar days of Ecology's approval of the Final RI/FS Work Plan. Separation mobilizations and field schedules may be required to complete the site investigation.
Data Report Technical Memorandum	60 calendar days following receipt of final validated data from all RI/FS analytical data.
Additional Field RI Activities (if needed)	The scope, schedule, and submittal requirements for additional field RI activities will be developed in consultation with Ecology. Plans for additional field RI activities will be submitted to Ecology for review and concurrence within 60 calendar days of Ecology's determination that additional RI activities are warranted.
RI/FS Report Submittal	
Draft RI/FS Report	180 calendar days following Ecology's approval of the Final RI/FS Work Plan. If Ecology review of the Data Report Technical Memorandum finds significant data gaps have not been filled, at Ecology's discretion, the Draft RI/FS Report submittal may be extended.
Final RI/FS Report	45 calendar days following Ecology comments on the Draft Final RI/FS. The Final RI/FS Report will undergo a 30-day public comment period. Ecology will complete a responsiveness summary to public comment on the Final RI/FS Report before approval of the document.
Draft Cleanup Action Plan (CAP) Submittal	
Preliminary Draft CAP	120 calendar days after the RI/FS Report is finalized.
Final Draft CAP	60 calendar days following Ecology's comments on the Preliminary Draft CAP. The Final Draft CAP will undergo a 30-day public comment review period.

11.0 LIMITATIONS

We have prepared this Remedial Investigation/Feasibility Study Work Plan for use by the Port of Anacortes during the RI/FS at the Anacortes Port Log Yard Site. Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted environmental science practices in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

12.0 REFERENCES

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United States Fish and Wildlife Service (USFWS), 2012. Section 7 of the Endangered Species Act (ESA) from USFWS list for Skagit County, Washington.

Table 1
Preliminary Sediment Screening Levels for Protection of Benthic Organisms
Anacortes Port Log Yard
Anacortes, Washington

Analyte	Criteria for Protection of Benthic Organisms						Sediment Screening Level for Protection of Benthic Organisms ³			
	Sediment Management Standard ¹ (SMS)			Apparent Effects Threshold (AET) Criteria ²						
	Sediment Quality Objectives (SQO)	Cleanup Screening Level (CSL)	Units	Lowest AET (LAET)	Second Lowest AET (2LAET)	Units	Organic Carbon (0.5% to 3.5%)	Units	Organic Carbon (<0.5% or >3.5%)	Units
Metals										
Arsenic	57	93	mg/kg	57	93	mg/kg	57	mg/kg	57	mg/kg
Cadmium	5.1	6.7		5.1	6.7		5.1			
Chromium	260	270		260	270		260			
Copper	390	390		390	390		390			
Lead	450	530		450	530		450			
Mercury	0.41	0.59		0.41	0.59		0.41			
Silver	6.1	6.1		6.1	6.1		6.1			
Zinc	410	960		410	960		410			
Low Molecular Weight Polycyclic Aromatic Hydrocarbons (LPAHs)										
Total LPAH	370	780	mg/kg OC	5.2	5.2	mg/kg	370	mg/kg OC	5.2	mg/kg
Naphthalene	99	170		2.1	2.1		99		2.1	
Acenaphthylene	66	66		1.3	1.3		66		1.3	
Acenaphthene	16	57		0.5	0.5		16		0.5	
Fluorene	23	79		0.54	0.54		23		0.54	
Phenanthrene	100	480		1.5	1.5		100		1.5	
Anthracene	220	1,200		0.96	0.96		220		0.96	
2-Methylnaphthalene	38	64		0.67	0.67		38		0.67	
High Molecular Weight Polycyclic Aromatic Hydrocarbons (HPAHs)										
Total HPAH	960	5,300	mg/kg OC	12	17	mg/kg	960	mg/kg OC	12	mg/kg
Fluoranthene	160	1,200		1.7	2.5		160		1.7	
Pyrene	1,000	1,400		2.6	3.3		1000		2.6	
Benzo(a)anthracene	110	270		1.3	1.6		110		1.3	
Chrysene	110	460		1.4	2.8		110		1.4	
Total benzofluoranthenes	230	450		3.2	3.6		230		3.2	
Benzo(a)pyrene	99	210		1.6	1.6		99		1.6	
Indeno(1,2,3-c,d)pyrene	34	88		0.60	0.69		34		0.60	
Dibenzo(a,h)anthracene	12	33		0.23	0.23		12		0.23	
Benzo(ghi)perylene	31	78		0.67	0.72		31		0.67	
Chlorinated Organic Compounds										
1,2-Dichlorobenzene	2.3	2.3	mg/kg OC	0.035	0.05	mg/kg	2.3	mg/kg OC	0.035	mg/kg
1,4-Dichlorobenzene	3.1	9		0.11	0.11		3.1		0.11	
1,2,4-Trichlorobenzene	0.81	1.8		0.031	0.051		0.81		0.031	
Hexachlorobenzene	0.38	2.3		0.022	0.07		0.38		0.022	
Phthalates										
Dimethyl phthalate	53	53	mg/kg OC	0.071	0.16	mg/kg	53	mg/kg OC	0.071	mg/kg
Diethyl phthalate	61	110		0.2	> 0.2		61		0.2	
Dibutyl phthalate	220	1,700		1.4	1.4		220		1.4	
Butyl benzyl phthalate	4.9	64		0.063	0.9		4.9		0.063	
Bis(2-ethylhexyl) phthalate	47	78		1.3	1.9		47		1.3	
Di-n-octyl phthalate	58	4,500		6.2	6.2		58		6.2	
Miscellaneous Extractables										
Dibenzofuran	15	58	mg/kg OC	0.54	0.54	mg/kg	15	mg/kg OC	0.54	mg/kg
Hexachlorobutadiene	3.9	6.2		0.011	0.12		3.9		0.011	
N-nitrosodiphenylamine	11	11		0.028	0.04		11		0.028	
Benzyl alcohol	57	73	µg/kg	57	73	µg/kg	57	µg/kg	57	µg/kg
Benzoic acid	650	650		650	650		650		650	
Polychlorinated Biphenyls (PCBs)										
Total PCBs (Total of Aroclors or congeners)	12	65	mg/kg OC	0.13	1	mg/kg	12	mg/kg OC	0.13	mg/kg
Phenols										
Phenol	420	1,200	µg/kg	420	1,200	µg/kg	420	µg/kg	420	µg/kg
2-Methylphenol	63	63		63	63		63		63	
4-Methylphenol	670	670		670	670		670		670	
2,4-Dimethylphenol	29	29		29	29		29		29	
Pentachlorophenol	360	690		360	690		360		360	
Dioxins and Furans (ng/kg)										
Total dioxins/furans - TEQ ⁴	--	--	ng/kg	--	--	ng/kg	5	ng/kg	5	ng/kg
Tributyltin										
Tributyltin, bulk	--	--	µg/kg	--	--	µg/kg	73	µg/kg	73	µg/kg
Interstitial Tributyltin, porewater	0.05	0.15	µg/L	--	--	µg/L	0.05	µg/L	0.05	µg/L

Notes:

¹ Sediment Management Standards (SMS) (Chapter 173-204 WAC).

² Apparent Effects Threshold (AET) Criteria from Table 8-1 of the Draft Sediment Cleanup Users Manual II (Ecology, 2015).

³ The organic carbon normalized SMS criteria are applicable to sediment with a total organic carbon (TOC) concentration ranging from 0.5 to 3.5 percent inclusive. Sediment with TOC concentrations outside of the 0.5 to 3.5 percent range are screened against the AET Screening Level on a dry weight basis (EPA, 1988).

⁴ Ecology-recommended PQL of 5 pptr (parts per trillion, dry-weight) toxicity equivalent (TEQ) concentration.

mg/kg = milligram per kilogram

mg/kg OC = milligram per kilogram normalized to organic carbon

µg/kg = microgram per kilogram

µg/L = microgram per liter

ng/kg = nanogram per kilogram

-- = Criteria not applicable or not available

Total LPAHs are the sum of naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene and anthracene; 2-methylnaphthalene is not included in the sum of LPAHs.

Total HPAHs are the sum of fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3-c-d)pyrene, dibenzo(a,h)anthracene and benzo(g,h,i)perylene.

Table 2
Preliminary Sediment Screening Levels for Protection of Human Health and Higher Trophic Level Ecological Receptors
Anacortes Port Log Yard
Anacortes, Washington

Analyte	Criteria for Protection of Human Health											Natural Background ³	PQL ⁴	Units	Sediment Screening Level for Protection of Human Health and Higher Trophic Level Ecological Receptors ⁵	
	Bioaccumulation via Consumption of Aquatic Organisms		Direct Contact via Beach Play ²			Direct Contact via Clamming ²			Direct Contact via Net Fishing ²							
	Natural Background or PQL ¹	Units	Carcinogenic (at 10 ⁻⁶ risk)	Non-Carcinogenic	Units	Carcinogenic (at 10 ⁻⁶ risk)	Non-Carcinogenic	Units	Carcinogenic (at 10 ⁻⁶ risk)	Non-Carcinogenic	Units				Intertidal Sediment (above -3 ft MLLW)	Subtidal Sediment (below -3 ft MLLW)
Metals																
Arsenic	11	mg/kg	5.3	190	mg/kg	0.78	140	mg/kg	2.9	520	mg/kg	11	5	mg/kg	11	11
Cadmium	0.8		--	640		--	470		--	1,700		1	0.2		1	1
Chromium	--		--	960,000		--	700,000		--	2,600,000		62	0.5		700,000	2,600,000
Copper	--		--	26,000		--	19,000		--	69,000		45	0.2		19,000	69,000
Lead	21		--	--		--	--		--	--		21	2		21	21
Mercury	0.2		--	190		--	140		--	520		0.2	0.05		0.2	0.2
Silver	--		--	3,200		--	2,300		--	8,700		0.2	0.3		2,300	8,700
Zinc	--		--	190,000		--	140,000		--	520,000		93	1		140,000	520,000
Low Molecular Weight Polycyclic Aromatic Hydrocarbons (LPAHs)																
Total LPAH	--	mg/kg	--	--	mg/kg	--	--	mg/kg	--	--	mg/kg	--	0.005	mg/kg	--	--
Naphthalene	--		--	9,900		--	3,800		--	29,000		--	0.005		3,800	29,000
Acenaphthylene	--		--	30,000		--	11,000		--	88,000		--	0.005		11,000	88,000
Acenaphthene	--		--	30,000		--	11,000		--	88,000		--	0.005		11,000	88,000
Fluorene	--		--	20,000		--	7,600		--	59,000		--	0.005		7,600	59,000
Phenanthrene	--		--	150,000		--	57,000		--	440,000		--	0.005		57,000	440,000
Anthracene	--		--	150,000		--	57,000		--	440,000		--	0.005		57,000	440,000
2-Methylnaphthalene	--		--	2,000		--	760		--	5,900		--	0.005		760	5,900
High Molecular Weight Polycyclic Aromatic Hydrocarbons (HPAHs)																
Total HPAH	--	mg/kg	--	--	mg/kg	--	--	mg/kg	--	--	mg/kg	--	0.005	mg/kg	--	--
Fluoranthene	--		--	20,000		--	7,600		--	5,900		--	0.005		5,900	5,900
Pyrene	--		--	15,000		--	5,700		--	44,000		--	0.005		5,700	44,000
Benzo(a)anthracene	--		8.5	--		0.65	--		5.0	--		--	0.005		0.65	5.0
Chrysene	--		85	--		6.5	--		50	--		--	0.005		6.5	50
Benzofluoranthenes (b, J, k)	--		8.5	--		0.65	--		5.0	--		--	0.005		0.65	5.0
Benzo(a)pyrene	--		0.85	--		0.065	--		0.50	--		--	0.005		0.065	0.50
Indeno(1,2,3-c,d)pyrene	--		8.5	--		0.65	--		5.0	--		--	0.005		0.65	5.0
Dibenzo(a,h)anthracene	--		8.5	--		0.65	--		5.0	--		--	0.005		0.65	5.0
Benzo(ghi)perylene	--		--	15,000		--	5,700		--	44,000		--	0.005		5,700	44,000
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs)																
Total cPAHs - TEQ	21	µg/kg	850	--	µg/kg	65	--	µg/kg	500	--	µg/kg	21	5	µg/kg	21	21
Chlorinated Organic Compounds																
1,2-Dichlorobenzene	--	mg/kg	--	45,000	mg/kg	--	17,000	mg/kg	--	130,000	mg/kg	--	0.2	mg/kg	17,000	130,000
1,4-Dichlorobenzene	--		1,100	35,000		88	13,000		680	100,000		--	0.2		88	680
1,2,4-Trichlorobenzene	--		210	4,900		16	1,900		130	15,000		--	0.2		16	130
Hexachlorobenzene	--		3.9	400		0.30	150		2.3	1,200		--	0.001		0.30	2.3
Phthalates																
Dimethyl phthalate	--	mg/kg	--	--	mg/kg	--	--	mg/kg	--	--	mg/kg	--	0.02	mg/kg	--	--
Diethyl phthalate	--		--	400,000		--	150,000		--	1,200,000		--	0.02		150,000	1,200,000
Dibutyl phthalate	--		--	49,000		--	19,000		--	150,000		--	0.02		19,000	150,000
Butyl benzyl phthalate	--		3,300	99,000		250	38,000		1,900	290,000		--	0.02		250	1,900
Bis(2-ethylhexyl) phthalate	--		440	9,900		34	3,800		260	29,000		--	0.05		34	260
Di-n-octyl phthalate	--		--	4,900		--	1,900		--	15,000		--	0.02		1,900	15,000

Analyte	Criteria for Protection of Human Health											Natural Background ³	PQL ⁴	Units	Sediment Screening Level for Protection of Human Health and Higher Trophic Level Ecological Receptors ⁵	
	Bioaccumulation via Consumption of Aquatic Organisms		Direct Contact via Beach Play ²			Direct Contact via Clamming ²			Direct Contact via Net Fishing ²							
	Natural Background or PQL ¹	Units	Carcinogenic (at 10 ⁻⁶ risk)	Non-Carcinogenic	Units	Carcinogenic (at 10 ⁻⁶ risk)	Non-Carcinogenic	Units	Carcinogenic (at 10 ⁻⁶ risk)	Non-Carcinogenic	Units				Intertidal Sediment (above -3 ft MLLW)	Subtidal Sediment (below -3 ft MLLW)
Miscellaneous Extractables																
Dibenzofuran	--	mg/kg	--	490	mg/kg	--	190	mg/kg	--	1,500	mg/kg	--	0.02	mg/kg	190	1,500
Hexachlorobutadiene	--		79	490		6.1	190		47	1,500		--	0.001		6.1	47
N-nitrosodiphenylamine	--		1,300	--		97	--		750	--		--	0.02		97	750
Benzyl alcohol	--	µg/kg	--	49,000,000	µg/kg	--	19,000,000	µg/kg	--	150,000,000	µg/kg	--	20	µg/kg	19,000,000	150,000,000
Benzoic acid	--		--	2,000,000,000		--	760,000,000		--	5,900,000,000		--	200		760,000,000	5,900,000,000
Polychlorinated Biphenyls (PCBs)																
Total Dioxin-Like PCBs - human health TEQ	2	ng/kg	100	730	ng/kg	13	490	ng/kg	55	2000	ng/kg	0.20	2	ng/kg	2	2
Total PCBs (Total for Aroclors or Congeners)	0.0035	mg/kg	3.1	9.9	mg/kg	0.24	3.8	mg/kg	1.8	29	mg/kg	0.0035	0.000002	mg/kg	0.0035	0.0035
Phenols																
Phenol	--	µg/kg	--	150,000,000	µg/kg	--	57,000,000	µg/kg	--	440,000,000	µg/kg	--	100	µg/kg	57,000,000	440,000,000
2-Methylphenol	--		--	25,000,000		--	9,500,000		--	73,000,000		--	20		9,500,000	73,000,000
4-Methylphenol	--		--	49,000,000		--	19,000,000		--	150,000,000		--	20		19,000,000	150,000,000
2,4-Dimethylphenol	--		--	9,900,000		--	3,800,000		--	29,000,000		--	25		3,800,000	29,000,000
Pentachlorophenol	--		15,000	2,500,000		1,200	950,000		9,200	7,300,000		--	100		1,200	9,200
Dioxins and Furans (ng/kg)																
Total dioxins/furans - human health TEQ	5	ng/kg	100	730	ng/kg	13	490	ng/kg	55	2,000	ng/kg	4	5 ⁶	ng/kg	5	5
Tributyltin																
Tributyltin, bulk	73 ⁷	µg/kg	--	150	µg/kg	--	57	µg/kg	--	440	µg/kg	--	3.86	µg/kg	73	73
Interstitial Tributyltin, porewater	0.15 ⁷	µg/L	--	--	µg/L	--	--	µg/L	--	--	µg/L	--	0.0052	µg/L	0.15	0.15

Notes:

¹ Bioaccumulative chemicals include arsenic, cadmium, lead, mercury, carcinogenic polycyclic aromatic hydrocarbons (cPAHs), dioxin-like polychlorinated biphenyls (PCBs), total PCBs, dioxins/furans and tributyltin. Currently site-specific human health and ecological risk-based sediment screening levels have not been developed for bioaccumulative chemicals. Therefore, sediment screening levels for these chemicals (with the exception of tributyltin) are based on the natural background or the practical quantification limit (PQL), whichever is higher.

² Sediment screening levels for the protection of human health via direct contact are calculated using equations and input parameters provided by Ecology in the Draft Sediment Cleanup Users Manual (SCUM) II guidance (Ecology, 2015).

³ Natural background concentrations are derived from the calculated values (90/90 UTL) from the Bold plus dataset and presented in Table 11-1 of Ecology's Draft SCUM II (Ecology, 2013) guidance document.

⁴ PQL values from Analytical Resources, Inc. of Tukwila, Washington.

⁵ The screening levels for bioaccumulative chemicals presented in this table are to provide a preliminary evaluation of human health and ecological risk for higher trophic level ecological receptors. Human health and higher trophic level ecological receptor screening levels are chosen from lowest of bioaccumulative and direct contact pathways. If the risk-based value is lower than natural background or PQL, the screening level defaults to the higher of natural background or PQL. The human health screening level for intertidal areas includes marine areas at elevations higher than -3 feet mean lower low water (MLLW) and the applicable direct contact pathways include beach play and clamming. The human health screening levels for subtidal areas include marine areas at elevations below -3 feet MLLW and the applicable direct contact pathway is net fishing.

⁶ Ecology-recommended PQL of 5 parts per trillion (ppt), dry-weight toxicity equivalent quotient (TEQ).

⁷ The bioaccumulative screening levels protective of higher trophic level ecological receptors is from the Dredged Material Management Program (DMMP) bioaccumulation triggers for bulk and porewater tributyltin. Measurement of tributyltin in interstitial water provides a more direct measure of potential bioavailability, and hence toxicity, than bulk sediment concentrations. Therefore porewater tributyltin will be preferred to bulk tributyltin concentrations.

mg/kg = milligram per kilogram

µg/kg = microgram per kilogram

µg/L = microgram per liter

ng/kg = nanogram per kilogram

-- = No criterion is currently available for this analyte

NA = Not applicable

Total LPAHs are the sum of naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene and anthracene; 2-methylnaphthalene is not included in the sum of LPAHs.

Total HPAHs are the sum of fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(a)fluoranthene, benzo(a)pyrene, indeno(1,2,3-c-d)pyrene, dibenzo(a,h)anthracene and benzo(g,h,i)perylene.

Table 3
Toxicity Equivalency Factors (TEF)
 Anacortes Port Log Yard
 Anacortes, Washington

Analyte	Human Health ¹	Mammals ¹	Birds ²	Fish ²
Dioxins				
2,3,7,8-TCDD	1	1	1	1
1,2,3,7,8-PeCDD	1	1	1	1
1,2,3,6,7,8-HxCDD	0.1	0.1	0.01	0.01
1,2,3,7,8,9-HxCDD	0.1	0.1	0.1	0.01
1,2,3,4,7,8-HxCDD	0.1	0.1	0.05	0.5
1,2,3,4,6,7,8-HpCDD	0.01	0.01	<0.001	0.001
Octa-dibenzodioxin	0.0003	0.0003	0.0001	<0.0001
Furans				
2,3,7,8-TCDF	0.1	0.1	1	0.05
1,2,3,7,8-PeCDF	0.03	0.03	0.1	0.05
2,3,4,7,8-PeCDF	0.3	0.3	1	0.5
1,2,3,6,7,8-HxCDF	0.1	0.1	0.1	0.1
1,2,3,7,8,9-HxCDF	0.1	0.1	0.1	0.1
1,2,3,4,7,8-HxCDF	0.1	0.1	0.1	0.1
2,3,4,6,7,8-HxCDF	0.1	0.1	0.1	0.1
1,2,3,4,6,7,8-HpCDF	0.01	0.01	0.01	0.01
1,2,3,4,7,8,9-HpCDF	0.01	0.01	0.01	0.01
Octa-dibenzofuran	0.0003	0.0003	0.0001	<0.0001
Carcinogenic polycyclic aromatic hydrocarbons (cPAHs)				
Benzo(a)anthracene	0.1	–	–	–
Chrysene	0.01	–	–	–
Benzo(b)fluoranthene	0.1	–	–	–
Benzo(k)fluoranthene	0.1	–	–	–
Benzo(a)pyrene	1	–	–	–
Indeno(1,2,3-cd)pyrene	0.1	–	–	–
Dibenz(a,h)anthracene	0.1	–	–	–
Dioxin-like polychlorinated biphenyls (PCBs)				
3,3',4,4'-Tetrachlorobiphenyl (PCB 77)	0.0001	0.0001	–	–
3,4,4',5'-Tetrachlorobiphenyl (PCB 81)	0.0003	0.0003	–	–
2,3,3',4,4'-Pentachlorobiphenyl (PCB 105)	0.00003	0.00003	–	–
2,3,4,4',5-Pentachlorobiphenyl (PCB 114)	0.00003	0.00003	–	–
2,3',4,4',5-Pentachlorobiphenyl (PCB 118)	0.00003	0.00003	–	–
2',3,4,4',5-Pentachlorobiphenyl (PCB 123)	0.00003	0.00003	–	–
3,3',4,4',5-Pentachlorobiphenyl (PCB 126)	0.1	0.1	–	–
2,3,3',4,4',5-Hexachlorobiphenyl (PCB 156)	0.00003	0.00003	–	–
2,3,3',4,4',5'-Hexachlorobiphenyl (PCB 157)	0.00003	0.00003	–	–
2,3',4,4',5,5'-Hexachlorobiphenyl (PCB 167)	0.00003	0.00003	–	–
2,3',4,4',5,5'-Hexachlorobiphenyl (PCB 169)	0.03	0.03	–	–
2,3,3',4,4',5,5'-Hexachlorobiphenyl (PCB 189)	0.00003	0.00003	–	–

Notes:

¹ Dioxin/Furan TEF source: The 2005 World Health Organization Reevaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-like Compounds (Van den Berg et al. 2006).

² Dioxin/Furan TEF Source: Framework for Application of the Toxicity Equivalence Methodology for Polychlorinated Dioxins, Furans and Biphenyls in Ecological Risk Assessment (EPA 2003).

Table 4
Existing Sediment Chemical Analytical Results
Anacortes Port Log Yard
Anacortes, Washington

Sample Location:		LP-1	LP-2	S-1	S-2	S-3	S-4	S-5	S-6	S-7	LHO-REF	LHO-REF	Preliminary Sediment Screening Levels Protective of Benthic Organisms		Preliminary Sediment Screening Levels Protective of Human Health and Higher Trophic Level Receptors	
Sample Identification		LP-1	LP-2	S-1	S-2	S-3	S-4	S-5	S-6	S-7	LHO-REF	DUP				
Sample Depth (feet):		Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Organic Carbon (0.5% to 3.5%)	Organic Carbon (<0.5% or >3.5%)	Intertidal Sediment (above -3 ft MLLW)	Subtidal Sediment (below -3 ft MLLW)
Sample Date:		7/13/2004	7/13/2004	08/28/2008	08/28/2008	09/01/2009	09/01/2009	09/01/2009	09/01/2009	09/01/2009	10/14/2010	10/14/2010				
Conventionals																
Total organic carbon	%	15	10.3	4.47	6.64	2.35	2.36	2.33	4.35	2.96	2.2	2.4	NE	NE	NE	NE
Metals																
Arsenic	mg/kg	10 U	10 U	4.52	5.3	10 U	10 U	10 U	10 U	9 U	10 U	11 U	57	57	11	11
Cadmium	mg/kg	0.5 U	0.5 U	0.698	0.642	0.6	0.7	1	1	0.9	1 U	1.1 U	5.1	5.1	1	1
Chromium	mg/kg	12	29	31.2	31.9	33	51	39	41	36.6	39	41	260	260	700,000	2,600,000
Copper	mg/kg	17.1	31.7	28.5	29.7	40.8	248	38.2	39.8	33.9	42	120	390	390	19,000	69,000
Lead	mg/kg	5 U	8	9.29	9.32	8	23	10	11	11	11	14	450	450	21	21
Mercury	mg/kg	0.1 U	0.09 U	0.033	0.037	0.07	0.06	0.08	0.08	0.07	0.1 U	0.11 U	0.41	0.41	0.2	0.2
Silver	mg/kg	0.8 U	0.8 U	0.15	0.1	0.6 U	0.7 U	0.7 U	0.7 U	0.6 U	1 U	1.1 U	6.1	6.1	2,300	8,700
Zinc	mg/kg	35	69	784	711	79	105	102	96	78	79	73	410	410	140,000	520,000
LPAH (TOC-normalized)																
2-Methylnaphthalene	mg/kg OC	NA	NA	NA	NA	0.85 U	0.85 U	0.86 U	NA	0.68 U	0.64 U	0.58 U	38	NE	NE	NE
Acenaphthene	mg/kg OC	NA	NA	NA	NA	0.85 U	0.85 U	0.52 J	NA	0.68 U	0.64 U	0.58 U	16	NE	NE	NE
Acenaphthylene	mg/kg OC	NA	NA	NA	NA	0.43 J	0.85 U	0.56 J	NA	0.68 U	0.64 U	0.58 U	66	NE	NE	NE
Anthracene	mg/kg OC	NA	NA	NA	NA	1.91	1.31	1.89	NA	0.57 J	1.82	3.38	220	NE	NE	NE
Fluorene	mg/kg OC	NA	NA	NA	NA	0.68 J	0.59 J	0.82 J	NA	0.68 U	0.64 U	0.67	23	NE	NE	NE
Naphthalene	mg/kg OC	NA	NA	NA	NA	0.85 U	0.85 U	0.86 U	NA	0.68 U	0.64 U	0.58 U	99	NE	NE	NE
Phenanthrene	mg/kg OC	NA	NA	NA	NA	5.11	7.20	8.15	NA	2.09	2.82	5.83	100	NE	NE	NE
Total LPAH	mg/kg OC	NA	NA	NA	NA	9.83	11.65	12.79	NA	5.37	7.18	11.63	370	NE	NE	NE
LPAH (dry weight)																
2-Methylnaphthalene	µg/kg	32 U	20 U	13	10 J	20 U	20 U	20 U	12	20 U	14 U	14 U	NE	670	760,000	5,900,000
Acenaphthene	µg/kg	32 U	28	8.8 J	7 J	20 U	20 U	12 J	14 J	20 U	14 U	14 U	NE	500	11,000,000	88,000,000
Acenaphthylene	µg/kg	32 U	20 U	13	69	10 J	20 U	13 J	15 J	20 U	14 U	14 U	NE	1,300	11,000,000	88,000,000
Anthracene	µg/kg	32 U	55	73	47	45	31	44	48	17 J	40	81	NE	960	57,000,000	440,000,000
Fluorene	µg/kg	32 U	27	18	19	16 J	14 J	19 J	26	20 U	14 U	16	NE	540	7,600,000	59,000,000
Naphthalene	µg/kg	32 U	20 U	16	10	20 U	20 U	20 U	20 U	20 U	14 U	14 U	NE	2,100	3,800,000	29,000,000
Phenanthrene	µg/kg	32 U	94	160	140	120	170	190	180	62	62	140	NE	1,500	57,000,000	440,000,000
Total LPAH	µg/kg	32 U	204	–	–	–	–	–	295 JT	–	–	–	NE	5,200	–	–
HPAH (TOC-normalized)																
Benzo(a)anthracene	mg/kg OC	NA	NA	NA	NA	3.49	2.20	3.61	NA	1.62	3.59	4.17	110	NE	NE	NE
Benzo(a)pyrene	mg/kg OC	NA	NA	NA	NA	3.06	2.12	3.95	NA	1.18	4.45	3.71	99	NE	NE	NE
Benzo(ghi)perylene	mg/kg OC	NA	NA	NA	NA	1.87	1.36	2.06	NA	0.47 J	2.50	2.13	31	NE	NE	NE
Benzo(a)fluoranthene (b, j, k)	mg/kg OC	NA	NA	NA	NA	9.36	7.63	12.02	NA	3.38	10.91	9.83	230	NE	NE	NE
Chrysene	mg/kg OC	NA	NA	NA	NA	6.38	4.24	6.44	NA	2.36	7.27	7.92	110	NE	NE	NE
Dibenzo(a,h)anthracene	mg/kg OC	NA	NA	NA	NA	0.68 J	0.85 U	0.86	NA	0.68 U	0.64 U	0.58 U	12	NE	NE	NE
Fluoranthene	mg/kg OC	NA	NA	NA	NA	19.57	19.07	32.19	NA	8.78	9.09	13.75	160	NE	NE	NE
Indeno(1,2,3-c,d)pyrene	mg/kg OC	NA	NA	NA	NA	1.57	1.14	1.93	NA	0.47 J	2.50	2.46	34	NE	NE	NE
Pyrene	mg/kg OC	NA	NA	NA	NA	8.51	5.51	9.01	NA	2.94	10.91	12.08	1000	NE	NE	NE
Total HPAH	mg/kg OC	NA	NA	NA	NA	54.51	44.11	72.06	NA	21.89	51.86	56.63	960	NE	NE	NE

Sample Location:		LP-1	LP-2	S-1	S-2	S-3	S-4	S-5	S-6	S-7	LHO-REF	LHO-REF	Preliminary Sediment Screening Levels Protective of Benthic Organisms		Preliminary Sediment Screening Levels Protective of Human Health and Higher Trophic Level Receptors	
Sample Identification		LP-1	LP-2	S-1	S-2	S-3	S-4	S-5	S-6	S-7	LHO-REF	DUP				
Sample Depth (feet):		Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Organic Carbon (0.5% to 3.5%)	Organic Carbon (<0.5% or >3.5%)	Intertidal Sediment (above -3 ft MLLW)	Subtidal Sediment (below -3 ft MLLW)
Sample Date:		7/13/2004	7/13/2004	08/28/2008	08/28/2008	09/01/2009	09/01/2009	09/01/2009	09/01/2009	09/01/2009	10/14/2010	10/14/2010				
HPAH (dry weight)																
Benzo(a)anthracene	µg/kg	32 U	40	140	320	82	52	84	94	48	79	100	NE	1,300	650	5,000
Benzo(a)pyrene	µg/kg	32	38	100	330	72	50	92	100	35	98	89	NE	1,600	65	500
Benzo(ghi)perylene	µg/kg	32 U	20 U	54	150	44	32	48	44	14 J	55	51	NE	670	5,700,000	44,000,000
Benzofluoranthenes (b, j, k)	µg/kg	82	125	--	--	--	--	--	320	--	--	--	NE	3,200	650	5,000
Chrysene	µg/kg	38	73	280	430	150	100	150	160	70	160	190	NE	1,400	6,500	50,000
Dibenzo(a,h)anthracene	µg/kg	32 U	20 U	19	44	16 J	20 U	20	20 U	20 U	14 U	14 U	NE	230	650	5,000
Fluoranthene	µg/kg	110	320	490	560	460	450	750	630	260	200	330	NE	1,700	5,900,000	5,900,000
Indeno(1,2,3-c,d)pyrene	µg/kg	32 U	20 U	66	160	37	27	45	44	14 J	55	59	NE	600	650	5,000
Pyrene	µg/kg	48	130	310	790	200	130	210	170	87	240	290	NE	2,600	5,700,000	44,000,000
Total HPAH	µg/kg	310	930	--	--	--	--	--	1582 T	--	--	--	NE	12,000	--	--
cPAHs																
Total cPAHs TEQ	µg/kg	45.4 T	57.2 T	149.4 T	426.5 T	109.0 T	77.9 T	136.4 T	148.4 T	52.9 T	137.7 T	131.1 T	NE	NE	21	21
Chlorinated Hydrocarbons (TOC-normalized)																
1,2,4-Trichlorobenzene	mg/kg OC	NA	NA	NA	NA	0.26 U	0.26 U	0.26 U	NA	0.20 U	1.59 U	1.46 U	0.81	NE	NE	NE
1,2-Dichlorobenzene	mg/kg OC	NA	NA	NA	NA	0.26 U	0.26 U	0.26 U	NA	0.20 U	1.59 U	1.46 U	2.3	NE	NE	NE
1,4-Dichlorobenzene	mg/kg OC	NA	NA	NA	NA	0.26 U	0.26 U	0.26 U	NA	0.20 U	1.59 U	1.46 U	3.1	NE	NE	NE
Hexachlorobenzene	mg/kg OC	NA	NA	NA	NA	0.26 U	0.26 U	0.26 U	NA	0.20 U	1.59 U	1.46 U	0.38	NE	NE	NE
Chlorinated Hydrocarbons																
1,2,4-Trichlorobenzene	µg/kg	32 U	20 U	3.1 U	2.8 U	6 U	6.2 U	6 U	6.1 U	6 U	35 U	35 U	NE	31	16,000	130,000
1,2-Dichlorobenzene	µg/kg	32 U	20 U	3.5 U	3.1 U	6 U	6.2 U	6 U	6.1 U	6 U	35 U	35 U	NE	35	17,000,000	130,000,000
1,4-Dichlorobenzene	µg/kg	32 U	20 U	3.5 U	3.1 U	6 U	6.2 U	6 U	6.1 U	6 U	35 U	35 U	NE	110	88,000	680,000
Hexachlorobenzene	µg/kg	32 U	20 U	1.5 U	1.3 U	6 U	6.2 U	6 U	6.1 U	6 U	35 U	35 U	NE	22	300	2,300
Phthalates (TOC-normalized)																
Bis(2-ethylhexyl) phthalate	mg/kg OC	NA	NA	NA	NA	4.26	28.81	16.74	NA	3.72	2.23	1.46 U	47	NE	NE	NE
Butyl benzyl phthalate	mg/kg OC	NA	NA	NA	NA	0.64 U	0.68 U	0.64 U	NA	0.51 U	1.59 U	1.46 U	4.9	NE	NE	NE
Dibutyl phthalate	mg/kg OC	NA	NA	NA	NA	0.85 U	0.85 U	0.86 U	NA	0.68 U	1.59 U	1.46 U	220	NE	NE	NE
Diethyl phthalate	mg/kg OC	NA	NA	NA	NA	0.85 U	0.85 U	0.86 U	NA	0.68 U	7.73 U	7.50 U	61	NE	NE	NE
Dimethyl phthalate	mg/kg OC	NA	NA	NA	NA	2.85	0.85 U	0.86 U	NA	0.68 U	1.59 U	1.46 U	53	NE	NE	NE
Di-n-octyl phthalate	mg/kg OC	NA	NA	NA	NA	0.85 U	0.85 U	0.86 U	NA	4.39	1.59 U	1.46 U	58	NE	NE	NE
Phthalates (dry weight)																
Bis(2-ethylhexyl) phthalate	µg/kg	32 U	25	75	44	100	680	390	150	110	49	35 U	NE	1,300	34,000	260,000
Butyl benzyl phthalate	µg/kg	32 U	20 U	3.8 U	3.4 U	15 U	16 U	15 U	20	15 U	35 U	35 U	NE	63	250,000	1,900,000
Dibutyl phthalate	µg/kg	32 U	20 U	22	26 U	20 U	20 U	20 U	20 U	20 U	35 U	35 U	NE	1,400	19,000,000	150,000,000
Diethyl phthalate	µg/kg	32 U	20 U	10 J	1.4 U	20 U	20 U	20 U	20 U	20 U	170 U	180 U	NE	200	150,000,000	1,200,000,000
Dimethyl phthalate	µg/kg	32 U	20 U	5.9 J	10 J	67	20 U	20 U	20 U	20 U	35 U	35 U	NE	71	--	--
Di-n-octyl phthalate	µg/kg	32 U	20 U	2 U	1.8 U	20 U	20 U	20 U	20 U	130	35 U	35 U	NE	6,200	1,900,000	15,000,000
Miscellaneous Extractables (TOC-normalized)																
Dibenzofuran	mg/kg OC	NA	NA	NA	NA	0.85 U	0.42 J	0.52 J	NA	0.68 U	1.59 U	1.46 U	15	NE	NE	NE
Hexachlorobutadiene	mg/kg OC	NA	NA	NA	NA	0.26 U	0.26 U	0.26 U	NA	0.20 U	1.59 U	1.46 U	3.9	NE	NE	NE
N-Nitrosodiphenylamine	mg/kg OC	NA	NA	NA	NA	0.26 U	0.26 U	0.26 U	NA	0.20 U	1.59 U	1.46 U	11	NE	NE	NE
Miscellaneous Extractables (dry weight)																
Benzoic acid	µg/kg	320 U	200 U	120 J	110 U	200 U	200 U	200 U	200 U	200 U	35 U	35 U	650	650	760,000,000	5,900,000,000
Benzyl alcohol	µg/kg	32 U	20 U	2.5 U	2.3 U	30 U	31 U	30 U	30 U	30 U	35 U	35 U	57	57	19,000,000	150,000,000

Sample Location:		LP-1	LP-2	S-1	S-2	S-3	S-4	S-5	S-6	S-7	LHO-REF	LHO-REF	Preliminary Sediment Screening Levels Protective of Benthic Organisms		Preliminary Sediment Screening Levels Protective of Human Health and Higher Trophic Level Receptors	
Sample Identification		LP-1	LP-2	S-1	S-2	S-3	S-4	S-5	S-6	S-7	LHO-REF	DUP				
Sample Depth (feet):		Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Organic Carbon (0.5% to 3.5%)	Organic Carbon (<0.5% or >3.5%)	Intertidal Sediment (above -3 ft MLLW)	Subtidal Sediment (below -3 ft MLLW)
Sample Date:		7/13/2004	7/13/2004	08/28/2008	08/28/2008	09/01/2009	09/01/2009	09/01/2009	09/01/2009	09/01/2009	10/14/2010	10/14/2010				
Dibenzofuran	µg/kg	32 U	20 U	9 J	7.3 J	20 U	10 J	12 J	20	20 U	35 U	35 U	NE	540	190,000	1,500,000
Hexachlorobutadiene	µg/kg	32 U	20 U	3 U	2.7 U	6 U	6.2 U	6 U	6.1 U	6 U	35 U	35 U	NE	11	6,100	47,000
N-Nitrosodiphenylamine	µg/kg	32 U	20 U	1.9 U	1.7 U	6 U	6.2 U	6 U	6.1 U	6 U	35 U	35 U	NE	28	97,000	750,000
Phenols (dry weight)																
2,4-Dimethylphenol	µg/kg	32 U	20 U	6.5 U	5.8 U	6.6	6.2 U	6 U	6.1 U	6 U	870 U	880 U	29	29	3,800,000	29,000,000
2-Methylphenol	µg/kg	32 U	20 U	1.8 U	1.6 U	6 U	6.2 U	6 U	6.1 U	6 U	35 U	35 U	63	63	9,500,000	73,000,000
4-Methylphenol	µg/kg	32 U	70	130	26	48	47	82	66	55	35 U	35 U	670	670	19,000,000	150,000,000
Pentachlorophenol	µg/kg	160 U	99 U	32 J	22 U	30 U	31 U	30 U	71	30 U	170 U	180 U	360	360	1,200	9,200
Phenol	µg/kg	32 U	20 U	12	2.2 U	20 U	20 U	15	20 U	20 U	240	35 U	420	420	57,000,000	440,000,000
PCBs (TOC-normalized)																
Aroclor 1016	mg/kg OC	NA	NA	NA	NA	0.17 U	0.17 U	0.17 U	NA	0.14 U	4.55 U	4.58 U	NE	NE	NE	NE
Aroclor 1221	mg/kg OC	NA	NA	NA	NA	0.17 U	0.17 U	0.17 U	NA	0.14 U	4.55 U	4.58 U	NE	NE	NE	NE
Aroclor 1232	mg/kg OC	NA	NA	NA	NA	0.17 U	0.17 U	0.17 U	NA	0.14 U	4.55 U	4.58 U	NE	NE	NE	NE
Aroclor 1242	mg/kg OC	NA	NA	NA	NA	0.17 U	0.17 U	0.17 U	NA	0.14 U	4.55 U	4.58 U	NE	NE	NE	NE
Aroclor 1248	mg/kg OC	NA	NA	NA	NA	0.17 U	0.17 U	0.17 U	NA	0.14 U	4.55 U	4.58 U	NE	NE	NE	NE
Aroclor 1254	mg/kg OC	NA	NA	NA	NA	0.17 U	0.17 U	0.17 U	NA	0.14 U	4.55 U	4.58 U	NE	NE	NE	NE
Aroclor 1260	mg/kg OC	NA	NA	NA	NA	0.17 U	0.17 U	0.17 U	NA	0.14 U	4.55 U	4.58 U	NE	NE	NE	NE
Aroclor 1262	mg/kg OC	NA	NA	NA	NA	0.17 U	0.17 U	0.17 U	NA	0.14 U	4.55 U	4.58 U	NE	NE	NE	NE
Aroclor 1268	mg/kg OC	NA	NA	NA	NA	0.17 U	0.17 U	0.17 U	NA	0.14 U	4.55 U	4.58 U	NE	NE	NE	NE
Total PCBs	mg/kg OC	NA	NA	NA	NA	0.17 UT	0.17 UT	0.17 UT	NA	0.14 UT	4.55 UT	4.58 UT	12	NE	NE	NE
PCBs (dry weight)																
Aroclor 1016	µg/kg	16 U	16 U	6.8 U	3.8 U	3.9 U	4 U	4 U	4 U	4 U	100 U	110 U	NE	NE	NE	NE
Aroclor 1221	µg/kg	16 U	16 U	14 U	7.2 U	3.9 U	4 U	4 U	4 U	4 U	100 U	110 U	NE	NE	NE	NE
Aroclor 1232	µg/kg	16 U	16 U	12 U	2.2 U	3.9 U	4 U	4 U	4 U	4 U	100 U	110 U	NE	NE	NE	NE
Aroclor 1242	µg/kg	16 U	16 U	6.4 U	4.3 U	3.9 U	4 U	4 U	4 U	4 U	100 U	110 U	NE	NE	NE	NE
Aroclor 1248	µg/kg	16 U	16 U	4.7 U	4.9 U	3.9 U	4 U	4 U	4 U	4 U	100 U	110 U	NE	NE	NE	NE
Aroclor 1254	µg/kg	16 U	16 U	5.3 U	7.5 U	3.9 U	4 U	4 U	4 U	4 U	100 U	110 U	NE	NE	NE	NE
Aroclor 1260	µg/kg	16 U	16 U	3.5 U	3.4 U	3.9 U	4 U	4 U	4 U	4 U	100 U	110 U	NE	NE	NE	NE
Aroclor 1262	µg/kg	-	-	-	-	3.9 U	4 U	4 U	4.6 J	4 U	-	-	NE	NE	NE	NE
Aroclor 1268	µg/kg	-	-	-	-	3.9 U	4 U	4 U	4 U	4 U	-	-	NE	NE	NE	NE
Total PCBs	µg/kg	16 UT	16 UT	14 UT	7.5 UT	3.9 UT	4 UT	4 UT	4.6 T	4 UT	100 UT	110 UT	NE	130	3.5	3.5
Dioxins/Furans (dry weight)																
1,2,3,4,6,7,8-HpCDD	ng/kg	-	-	-	-	258	-	-	-	-	-	-	NE	NE	NE	NE
1,2,3,4,6,7,8-HpCDF	ng/kg	-	-	-	-	23.8	-	-	-	-	-	-	NE	NE	NE	NE
1,2,3,4,7,8,9-HpCDF	ng/kg	-	-	-	-	1.59	-	-	-	-	-	-	NE	NE	NE	NE
1,2,3,4,7,8-HxCDD	ng/kg	-	-	-	-	2	-	-	-	-	-	-	NE	NE	NE	NE
1,2,3,4,7,8-HxCDF	ng/kg	-	-	-	-	1.43	-	-	-	-	-	-	NE	NE	NE	NE
1,2,3,6,7,8-HxCDD	ng/kg	-	-	-	-	13.4	-	-	-	-	-	-	NE	NE	NE	NE
1,2,3,6,7,8-HxCDF	ng/kg	-	-	-	-	1.04	-	-	-	-	-	-	NE	NE	NE	NE
1,2,3,7,8,9-HxCDD	ng/kg	-	-	-	-	6.4	-	-	-	-	-	-	NE	NE	NE	NE
1,2,3,7,8,9-HxCDF	ng/kg	-	-	-	-	0.619	-	-	-	-	-	-	NE	NE	NE	NE
1,2,3,7,8-PeCDD	ng/kg	-	-	-	-	1.38	-	-	-	-	-	-	NE	NE	NE	NE
1,2,3,7,8-PeCDF	ng/kg	-	-	-	-	0.578	-	-	-	-	-	-	NE	NE	NE	NE
2,3,4,6,7,8-HxCDF	ng/kg	-	-	-	-	1.44	-	-	-	-	-	-	NE	NE	NE	NE

Sample Location:		LP-1	LP-2	S-1	S-2	S-3	S-4	S-5	S-6	S-7	LH0-REF	LH0-REF	Preliminary Sediment Screening Levels Protective of Benthic Organisms		Preliminary Sediment Screening Levels Protective of Human Health and Higher Trophic Level Receptors	
Sample Identification		LP-1	LP-2	S-1	S-2	S-3	S-4	S-5	S-6	S-7	LH0-REF	DUP				
Sample Depth (feet):		Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Surface (0-10 cm)	Organic Carbon (0.5% to 3.5%)	Organic Carbon (<0.5% or >3.5%)	Intertidal Sediment (above -3 ft MLLW)	Subtidal Sediment (below -3 ft MLLW)
Sample Date:		7/13/2004	7/13/2004	08/28/2008	08/28/2008	09/01/2009	09/01/2009	09/01/2009	09/01/2009	09/01/2009	10/14/2010	10/14/2010				
2,3,4,7,8-PeCDF	ng/kg	–	–	–	–	0.916	–	–	–	–	–	–	NE	NE	NE	NE
2,3,7,8-TCDD	ng/kg	–	–	–	–	0.341 U	–	–	–	–	–	–	NE	NE	NE	NE
2,3,7,8-TCDF	ng/kg	–	–	–	–	1.22	–	–	–	–	–	–	NE	NE	NE	NE
OCDD	ng/kg	–	–	–	–	2210	–	–	–	–	–	–	NE	NE	NE	NE
OCDF	ng/kg	–	–	–	–	80.3	–	–	–	–	–	–	NE	NE	NE	NE
Total Dioxin/Furan TEQ (ND=0.5DL)	ng/kg	–	–	–	–	8.1 T	–	–	–	–	–	–	5 ^a	5 ^a	5 ^a	5 ^a

Notes:

- ^aScreening level based on the practical quantification limit.
- TOC = total organic carbon
- TEQ = toxicity equivalent
- LPAH = low molecular weight polycyclic aromatic hydrocarbon
- HPAH = high molecular weight polycyclic aromatic hydrocarbon
- cPAH = carcinogenic polycyclic aromatic hydrocarbon
- PCB = polychlorinated biphenyl
- = not tested
- NE = not established
- NA = not applicable because TOC outside of range for comparison to TOC-normalized screening levels
- mg/kg = milligram per kilogram
- µg/L = microgram per liter
- µg/kg = microgram per kilogram
- ng/kg = nanogram per kilogram
- U = The analyte is not detected at or above the reported concentration.
- J = Estimated concentration
- Orange shading indicates exceedance of screening level protective of benthic organisms
- Blue shading indicates exceedance of screening level protective of human health and higher trophic level ecological receptors
- Red shading indicates exceedance of screening levels protective of benthic organisms and protective of human health and higher trophic level ecological receptors.
- Gray shading indicates a non-detect that exceeds any screening level

Table 5
Pier 2 Dredged Material Characterization Analytical Results
Anacortes Port Log Yard
Anacortes, Washington

Sample Identification	P2-1-A-COMP	P2-1-B-COMP	P2-1-Z-COMP	P2-1-A	P2-2-A	P2-3-A	Preliminary Sediment Screening Levels Protective of Benthic Organisms		Preliminary Sediment Screening Levels Protective of Human Health and Higher Trophic Level Receptors	
Sample Location	3 Locations	3 Locations	All	P2-1-1	P2-1-2	P2-1-3				
Sample Date	11/16/2012	11/16/2012	11/16/2012	11/14/2012	11/15/2012	11/16/2012				
Sample Type	Surface Layer Composite	Subsurface Layer Composite	Z-Layer Composite	Surface Layer Discrete	Surface Layer Discrete	Surface Layer Discrete	Organic Carbon (0.5% to 3.5%)	Organic Carbon (<0.5% or >3.5%)	Intertidal Sediment (above -3 ft MLLW)	Subtidal Sediment (below -3 ft MLLW)
Conventionals										
Gravel (%)	1.2	0.3	0.2	--	--	--	NE	NE	NE	NE
Very coarse sand (%)	1.3	0.3	0.3	--	--	--	NE	NE	NE	NE
Coarse sand (%)	1.6	0.5	0.6	--	--	--	NE	NE	NE	NE
Medium sand (%)	9	7.2	8.4	--	--	--	NE	NE	NE	NE
Fine sand (%)	15.3	21.8	31.3	--	--	--	NE	NE	NE	NE
Very fine sand (%)	12.6	20.9	12.8	--	--	--	NE	NE	NE	NE
Coarse silt (%)	18.8	22.2	13.4	--	--	--	NE	NE	NE	NE
Medium silt (%)	16.5	12.8	11.5	--	--	--	NE	NE	NE	NE
Fine silt (%)	9.5	6.3	8.9	--	--	--	NE	NE	NE	NE
Very fine silt (%)	6.1	3.3	5.5	--	--	--	NE	NE	NE	NE
Clay (%)	8.3	4.5	7	--	--	--	NE	NE	NE	NE
Total solids (%)	79.4	80.5	82.1	--	--	--	NE	NE	NE	NE
Total volatile solids (%)	1.83	1.37	1.14	--	--	--	NE	NE	NE	NE
Total organic carbon (%)	0.21	0.125	0.145	--	--	--	NE	NE	NE	NE
Ammonia (mg/kg)	2.24	0.87	0.93	--	--	--	NE	NE	NE	NE
Total sulfides (mg/kg)	94	1.24 U	1.21 U	--	--	--	NE	NE	NE	NE
Metals (mg/kg)										
Antimony	6 J	6 J	6 J	--	--	--	NE	NE	NE	NE
Arsenic	6 U	6 U	6 U	--	--	--	57	57	11	11
Cadmium	0.3	0.3	0.2 U	--	--	--	5.1	5.1	1	1
Chromium	26.5 J	19 J	19.9 J	--	--	--	260	260	700,000	2,600,000
Copper	22.2	16.2	14.5	--	--	--	390	390	19,000	69,000
Lead	4	2 U	4	--	--	--	450	450	21	21
Mercury	0.03 U	0.03 U	0.02 U	--	--	--	0.41	0.41	0.2	0.2
Selenium	0.6 U	0.6 U	0.6 U	--	--	--	NE	NE	NE	NE
Silver	0.4 U	0.4 U	0.3 U	--	--	--	6.1	6.1	2,300	8,700
Zinc	48	32	30	--	--	--	410	410	140,000	520,000
Organometallic Compounds										
Tributyltin ion (interstitial water; µg/L)	0.38	--	--	4.9 ¹ J	0.45 ¹ J	0.02 ¹ J	0.05	0.05	0.15	0.15
Tributyltin ion (bulk; µg/kg)	--	3.7	2.9 J	280 ¹ J	91 ¹ J	10 ¹ J	NE	NE	73	73
Organics (µg/kg)										
Total LPAH	35 J	0	0	--	--	--	NE	5,200	NE	NE
Naphthalene	17 J	18 U	19 U	--	--	--	NE	2,100	3,800,000	29,000,000
Acenaphthylene	19 U	18 U	19 U	--	--	--	NE	1,300	11,000,000	88,000,000
Acenaphthene	19 U	18 U	19 U	--	--	--	NE	500	11,000,000	88,000,000
Fluorene	19 U	18 U	19 U	--	--	--	NE	540	7,600,000	59,000,000
Phenanthrene	18 J	18 U	19 U	--	--	--	NE	1,500	57,000,000	440,000,000
Anthracene	19 U	18 U	19 U	--	--	--	NE	960	57,000,000	440,000,000
2-Methylnaphthalene	19 U	18 U	19 U	--	--	--	NE	670	760,000	5,900,000
Total HPAH	539	10 J	0	--	--	--	NE	12,000	NE	NE
Fluoranthene	26	18 U	19 U	--	--	--	NE	1,700	5,900,000	5,900,000
Pyrene	250	10 J	19 U	--	--	--	NE	2,600	5,700,000	44,000,000
Benz(a)anthracene	15 J	18 U	19 U	--	--	--	NE	1,300	650	5,000
Chrysene	30	18 U	19 U	--	--	--	NE	1,400	6,500	50,000
Benzofluoranthenes (b, j ,k)	100	37 U	37 U	--	--	--	NE	3,200	650	5,000
Benzo(a)pyrene	58	18 U	19 U	--	--	--	NE	1,600	65	500
Indeno(1,2,3-c,d)pyrene	19	18 U	19 U	--	--	--	NE	600	650	5,000
Dibenz(a,h)anthracene	15	18 U	19 U	--	--	--	NE	230	650	5,000
Benzo(g,h,i)perylene	26	18 U	19 U	--	--	--	NE	670	5,700,000	44,000,000
Chlorinated Hydrocarbons (µg/kg)										
1,4-Dichlorobenzene	3.2 J	4.6 U	4.6 U	--	--	--	NE	110	88,000	680,000
1,2-Dichlorobenzene	4.7 U	4.6 U	4.6 U	--	--	--	NE	35	17,000,000	130,000,000
1,2,4-Trichlorobenzene	4.7 U	4.6 U	4.6 U	--	--	--	NE	31	16,000	130,000
Hexachlorobenzene (HCB)	4.7 U	4.6 U	4.6 U	--	--	--	NE	22	300	2,300
Phthalates (µg/kg)										
Dimethyl phthalate	4.7 U	4.6 U	4.6 U	--	--	--	NE	71	NE	NE
Diethyl phthalate	47 U	4.6 U	4.6 U	--	--	--	NE	200	150,000,000	1,200,000,000
Di-n-butyl phthalate	19 U	18 U	19 U	--	--	--	NE	1,400	19,000,000	150,000,000
Butyl benzyl phthalate	4.7 U	4.6 U	4.6 U	--	--	--	NE	63	250,000	1,900,000
Bis(2-ethylhexyl) phthalate	34 U	24 U	27 U	--	--	--	NE	1,300	34,000	260,000
Di-n-octyl phthalate	19 U	18 U	19 U	--	--	--	NE	6,200	1,900,000	15,000,000
Phenols (µg/kg)										
Phenol	19 U	18 U	19 U	--	--	--	420	420	57,000,000	440,000,000
2-Methylphenol	4.7 U	4.6 U	4.6 U	--	--	--	63	63	9,500,000	73,000,000
4-Methylphenol	38 U	37 U	37 U	--	--	--	670	670	19,000,000	150,000,000
2,4-Dimethylphenol	19 U	18 U	19 U	--	--	--	29	29	3,800,000	29,000,000
Pentachlorophenol	47 U	46 U	46 U	--	--	--	400	360	1,200	9,200

Sample Identification	P2-1-A-COMP	P2-1-B-COMP	P2-1-Z-COMP	P2-1-A	P2-2-A	P2-3-A	Preliminary Sediment Screening Levels Protective of Benthic Organisms		Preliminary Sediment Screening Levels Protective of Human Health and Higher Trophic Level Receptors	
Sample Location	3 Locations	3 Locations	All	P2-1-1	P2-1-2	P2-1-3				
Sample Date	11/16/2012	11/16/2012	11/16/2012	11/14/2012	11/15/2012	11/16/2012				
Sample Type	Surface Layer Composite	Subsurface Layer Composite	Z-Layer Composite	Surface Layer Discrete	Surface Layer Discrete	Surface Layer Discrete	Organic Carbon (0.5% to 3.5%)	Organic Carbon (<0.5% or >3.5%)	Intertidal Sediment (above -3 ft MLLW)	Subtidal Sediment (below -3 ft MLLW)
Miscellaneous Extractables (µg/kg)										
Benzyl alcohol	19 U	18 U	19 U	--	--	--	57	57	19,000,000	150,000,000
Benzoic acid	380 U	370 U	370 U	--	--	--	650	650	760,000,000	5,900,000,000
Dibenzofuran	19 U	18 U	19 U	--	--	--	NE	540	190,000	1,500,000
Hexachlorobutadiene	4.7 U	4.6 U	4.6 U	--	--	--	NE	11	6,100	47,000
N-nitrosodiphenylamine	19 U	18 U	19 U	--	--	--	NE	28	97,000	750,000
Pesticides (µg/kg)										
4,4'-DDD	0.97 U	0.96 U	0.96 U	--	--	--	NE	NE	NE	NE
4,4'-DDE	0.97 U	0.96 U	0.96 U	--	--	--	NE	NE	NE	NE
4,4'-DDT	0.97 U	0.96 U	0.96 U	--	--	--	NE	NE	NE	NE
DDT	0.97 U	0.96 U	0.96 U	--	--	--	NE	NE	NE	NE
Aldrin	0.48 U	0.48 U	0.48 U	--	--	--	NE	NE	NE	NE
Total Chlordane ²	0.97 U	0.96 U	0.96 U	--	--	--	NE	NE	NE	NE
Dieldrin	0.97 U	0.96 U	0.96 U	--	--	--	NE	NE	NE	NE
Heptachlor	0.48 U	0.48 U	0.48 U	--	--	--	NE	NE	NE	NE
Polychlorinated biphenyls (µg/kg)										
Total PCBs	3.8 U	3.8 U	3.8 U	--	--	--	NE	130	3.5	3.5
Dioxins & Furans (ng/kg)										
2,3,7,8-tetrachloro-p-dibenzodioxin toxicity equivalents (TEQ)	0.219	0.081	0.093	--	--	--	5 ^a	5 ^a	5 ^a	5 ^a

Notes:

¹Sample analyzed outside of the holding time of 7 days in consultation with the DMMP. The positive results and reporting limits for all target analytes were qualified as estimated (J) in these samples.

²Total chlordane based on the sum of detected concentration of cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor, and oxychlordane.

^aScreening level based on the practical quantification limit.

J = Estimated Concentration

mg/kg = milligram per kilogram

µg/L = microgram per liter

µg/kg = microgram per kilogram

NE = not established

ng/kg = nanogram per kilogram

MLLW = Mean Lower Low Water

U = The analyte is not detected at or above the reported concentration.

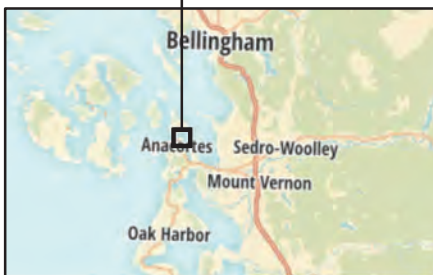
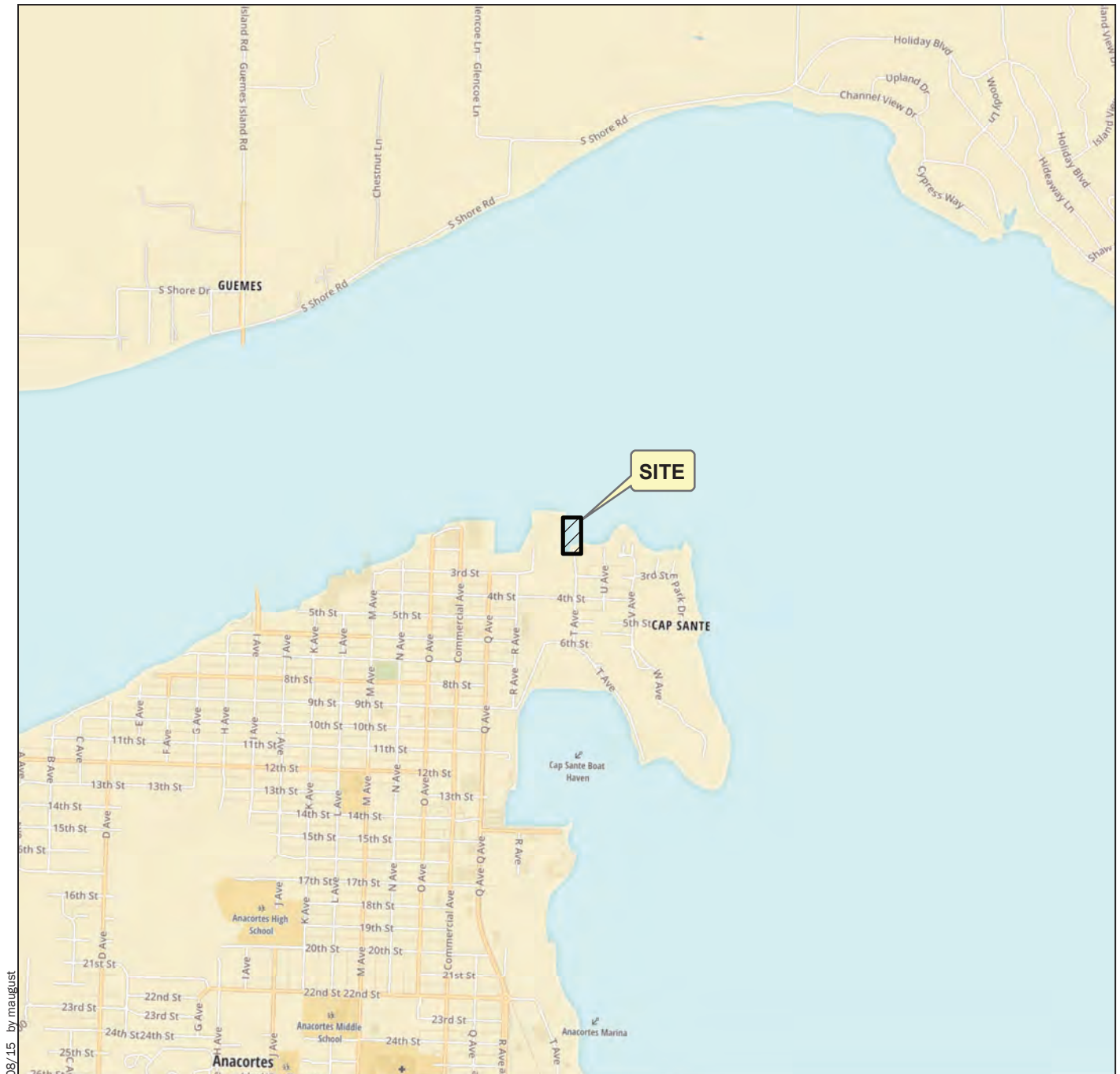
Y = The analyte is not detected at or above the reported concentration. The reporting limit is raised due to chromatographic interference. The Y flag is equivalent to the U flag with a raised reporting limit.

Orange shading indicates exceedance of screening level protective of benthic organisms

Blue shading indicates exceedance of screening level protective of human health and higher trophic level ecological receptors

Red shading indicates exceedance of screening levels protective of benthic organisms and protective of human health and higher trophic level ecological receptors

Gray shading indicates a non-detect that exceeds a screening level



Vicinity Map

Anacortes Port Log Yard
Anacortes, Washington



Figure 1

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Mapbox Open Street Map, 2015

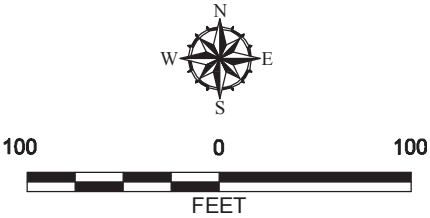
Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

P:\5\5147016\05\514701605 Fig 2 PROPERTY MAP.DWG\TAB:Fig 2 MODIFIED BY THICHAUD ON JUN 09, 2015 - 14:48



Legend

- Skagit County Parcel Boundaries
- P32868 Skagit County Parcel ID
- Inner/Outer Harbor Boundaries
- Remedial Investigation Study Area
- Outfall
- Stormdrain



Notes

- 1. The locations of all features shown are approximate.
 - 2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document.
- GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
- Reference: Base map source Port of Anacortes, 2007. Bathymetry from David Evans and Associates Inc. (DEA) survey dated June 26, 2014.

Property Map	
Anacortes Port Log Yard Anacortes, Washington	
GEOENGINEERS	Figure 2



Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.



Data Source: Port of Anacortes

1975 Aerial Photograph

Anacortes Port Log Yard
Anacortes, Washington

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Figure 3



Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.



Data Source: Port of Anacortes

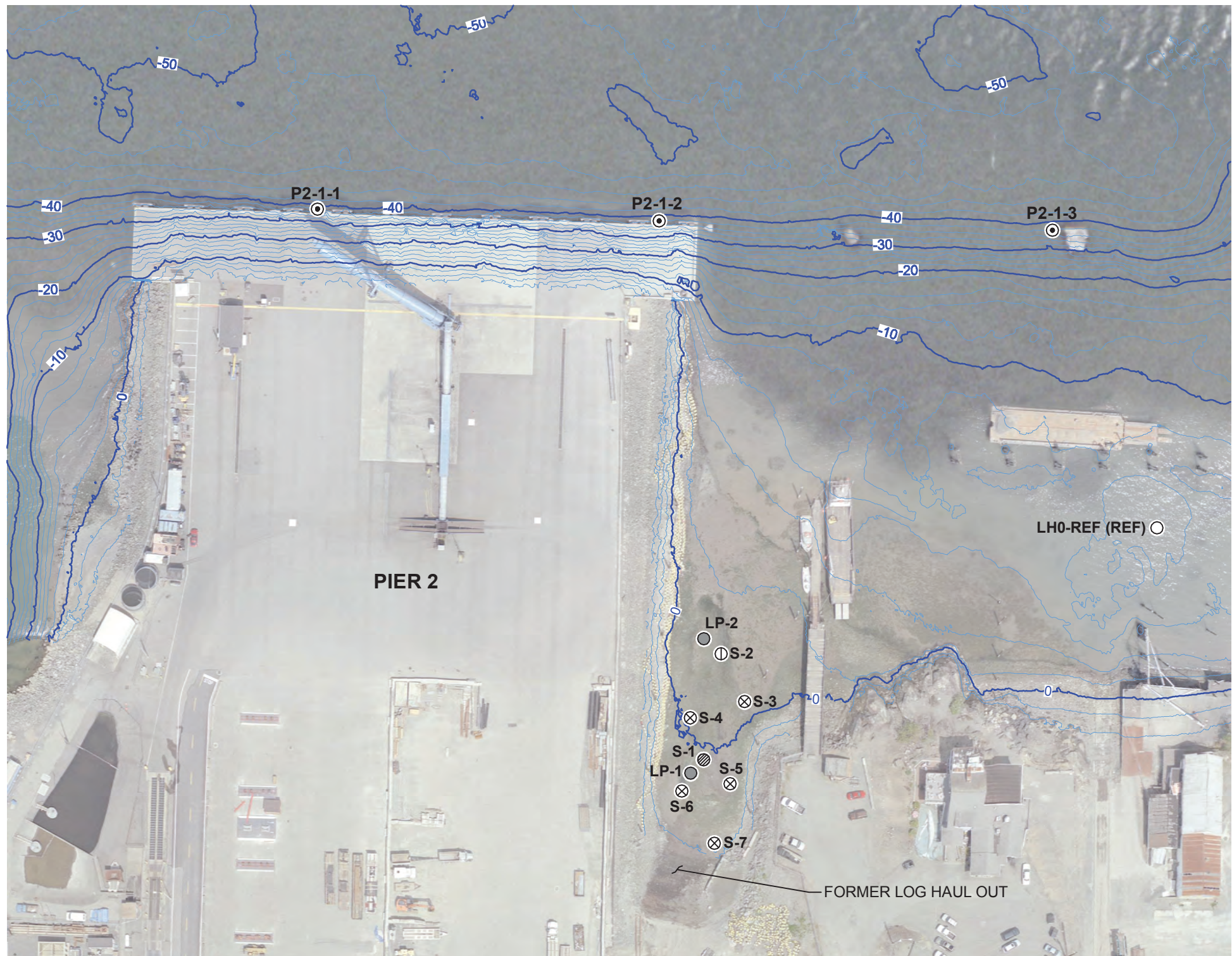
1992 Aerial Photograph

Anacortes Port Log Yard
Anacortes, Washington

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Figure 4

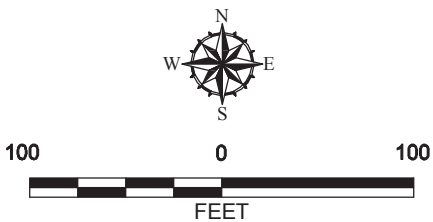
P:\15\147016\05\1514701605 Fig 5 WITHOUT RESULTS.DWG\TAB:Fig 5 MODIFIED BY THICHAUD ON JUN 09, 2015 - 14:51



- Legend**
- P2-1-3 ○ Sample Location (2012)
 - LH0-REF (REF) ○ Sample Location (2010)
 - S-2 ○ Sample Location (2008 & 2010)
 - S-4 ⊗ Sample Location (2009)
 - S-1 ⊗ Sample Location (2008)
 - LP-1 ● Approximate Sample Location (2004)
 - 10 — Bathymetric Contour

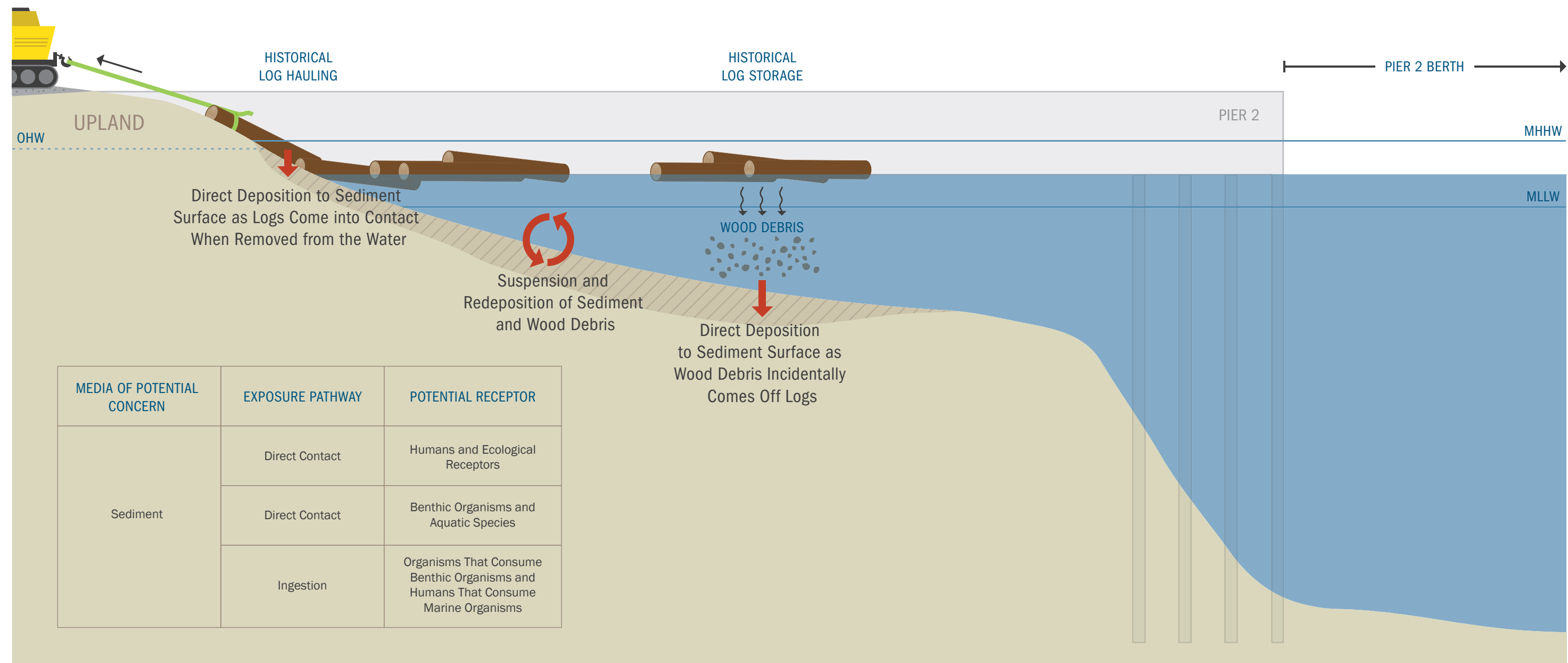
Notes

1. The locations of all features shown are approximate.
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- Reference: Base map source Port of Anacortes, 2007.
Bathymetry from David Evans and Associates Inc. (DEA) survey dated June 26, 2014.



Previous Sediment Investigation Sampling Locations	
Anacortes Port Log Yard Anacortes, Washington	
GEOENGINEERS 	Figure 5

\\sea\projects\5147016\05\514701605 Fig 6 Preliminary Conceptual Site Model for Site Contamination.ai Date Exported: 06/05/15 by spride



-  Potential Contaminant Transport Pathway
-  Wood Debris
- MHHW** Mean Higher High Water
- MLLW** Mean Lower Low Water
- OHW** Ordinary High Water

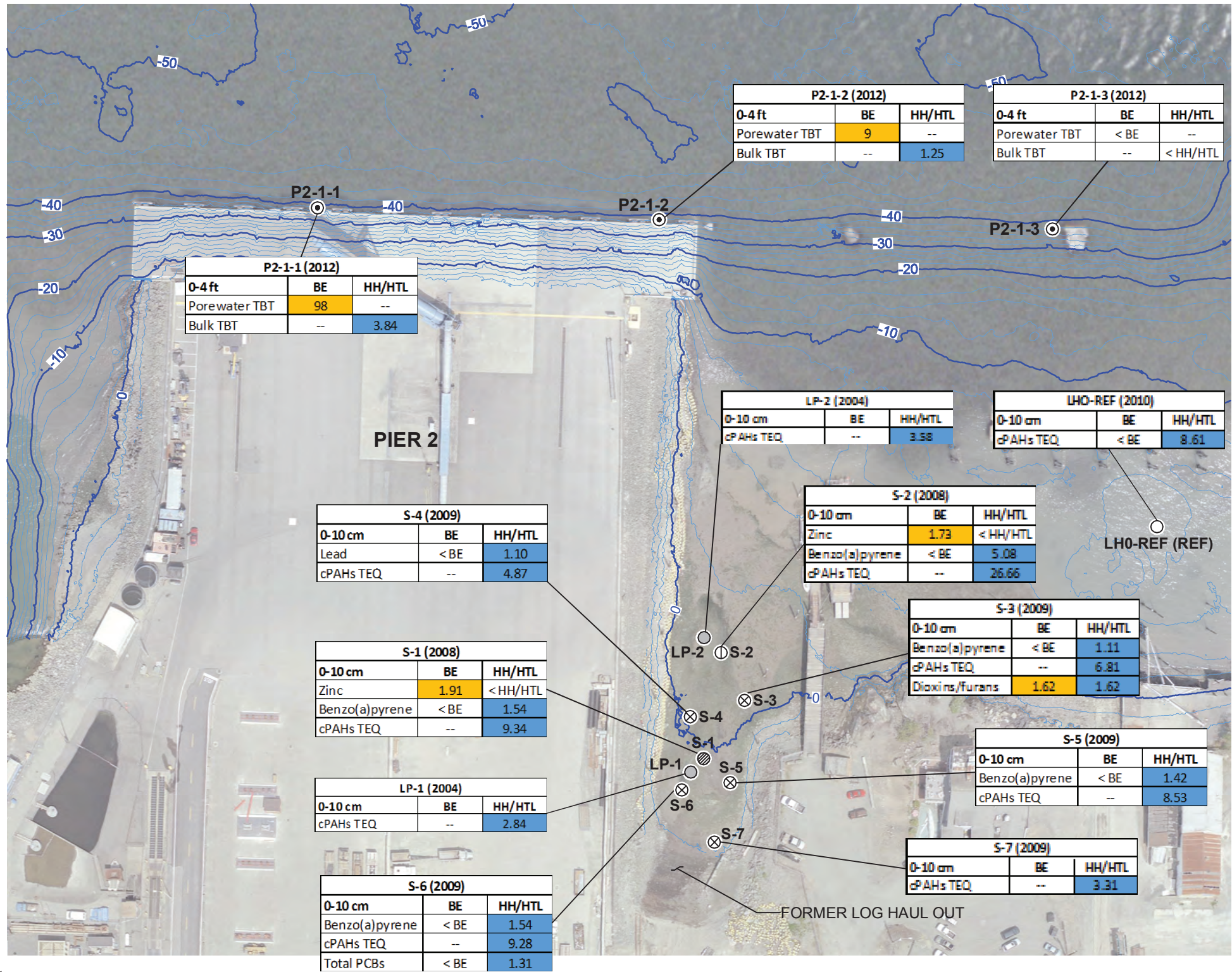
**Preliminary Conceptual Site Model
for Site Contamination**

Anacortes Port Log Yard
Anacortes, Washington



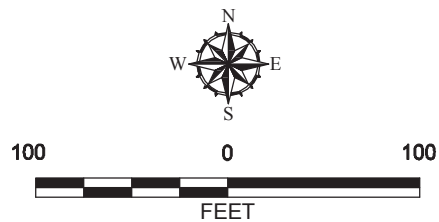
Figure 6

P:\15\15147016\05\1514701605 Fig 7 ANALYTICAL RESULTS.DWG\TAB:Fig 7 MODIFIED BY TMCHAUD ON JUN 09, 2015 - 14:54



Notes

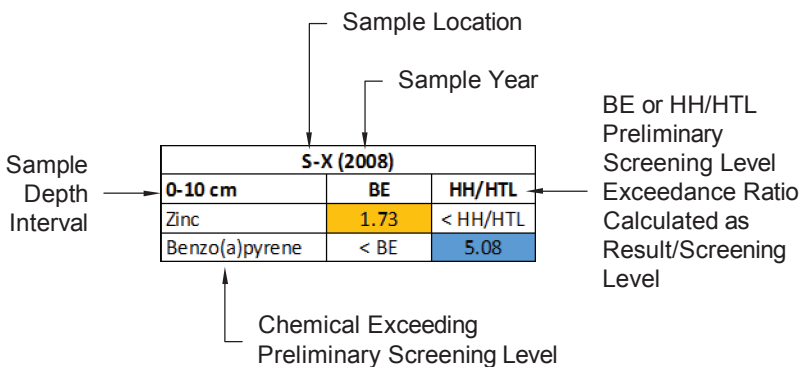
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- Reference: Base map source Port of Anacortes, 2007.
Bathymetry from David Evans and Associates Inc. (DEA) survey dated June 26, 2014.



Legend

- P2-1-3** ⊙ Sample Location (2012)
- LH0-REF (REF)** ○ Sample Location (2010)
- S-2** ⊙ Sample Location (2008 & 2010)
- S-4** ⊗ Sample Location (2009)
- S-1** ⊗ Sample Location (2008)
- LP-1** ● Approximate Sample Location (2004)
- -10 — Bathymetric Contour

Chemical Testing



Notes:

1. Orange shading indicates exceedance of BE.
2. Blue Shading indicated exceedance of HH/HTL.
3. BE = Preliminary screening levels protective of benthic organisms.
4. HH/HTL = Preliminary screening levels protective of human health and higher trophic levels receptors.
5. Only chemical compounds that exceed preliminary screening levels are presented on this figure.

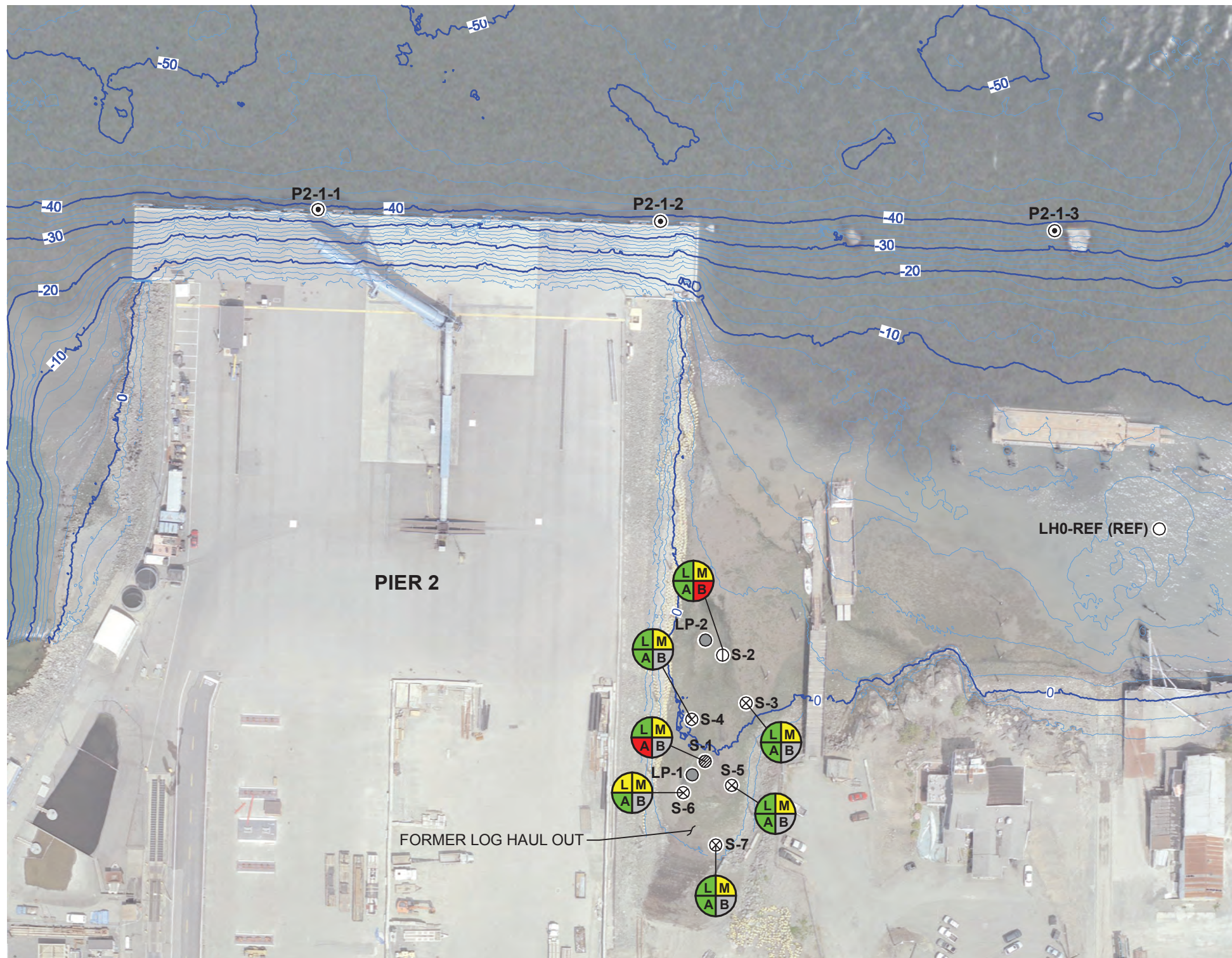
Existing Sediment Chemical Analytical Results

Anacortes Port Log Yard
Anacortes, Washington

GEOENGINEERS

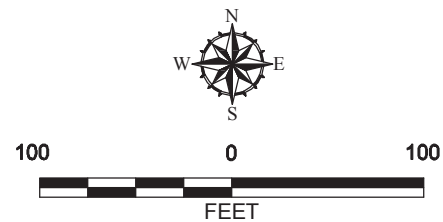
Figure 7

P:\15\147016\05\15\14701605 Fig 8 EXISTING SEDIMENT BIOLOGICAL TESTING RESULTS.DWG\TAB:Fig 8 MODIFIED BY THICHAUD ON JUN 09, 2015 - 14:58



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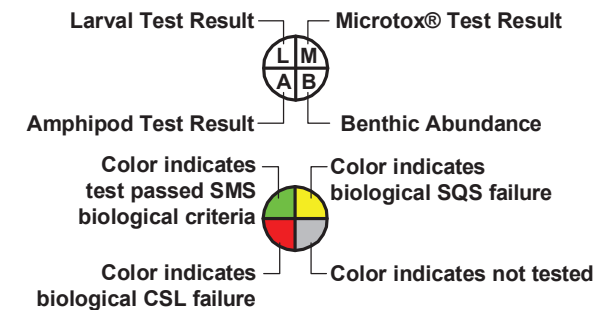
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Bathymetry from David Evans and Associates Inc. (DEA) survey dated June 26, 2014.



Legend

- P2-1-3 Sample Location (2012)
- LH0-REF (REF) Sample Location (2010)
- S-2 Sample Location (2008 & 2010)
- S-4 Sample Location (2009)
- S-1 Sample Location (2008)
- LP-1 Approximate Sample Location (2004)
- 10 Bathymetric Contour

Biological Toxicity Testing



Existing Sediment Biological Testing Results

Anacortes Port Log Yard
Anacortes, Washington

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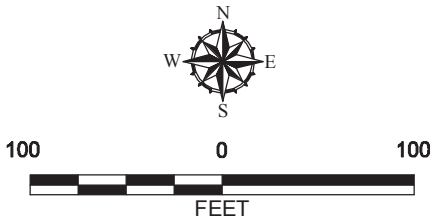
Figure 8

P:\15\147016\05\15\14701605 Fig 9.DWG\TAB:Fig 9 MODIFIED BY TMICHAUD ON JUN 09, 2015 - 15:05



Legend

- LY-1 Proposed Surface Sample Location
- LY-3 Proposed Surface Sample and Sediment Core Location
- P2-1-3 Sample Location (2012)
- LH0-REF (REF) Sample Location (2010)
- S-2 Sample Location (2008 & 2010)
- S-4 Sample Location (2009)
- S-1 Sample Location (2008)
- LP-1 Approximate Sample Location (2004)
- 10 Bathymetric Contour
- MHHW Mean Higher High Water
- Remedial Investigation Study Area



Notes

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- Reference: Base map source Port of Anacortes, 2007. Bathymetry from David Evans and Associates Inc. (DEA) survey dated June 26, 2014.

Proposed Sediment Sampling Locations	
Anacortes Port Log Yard Anacortes, Washington	
	Figure 9

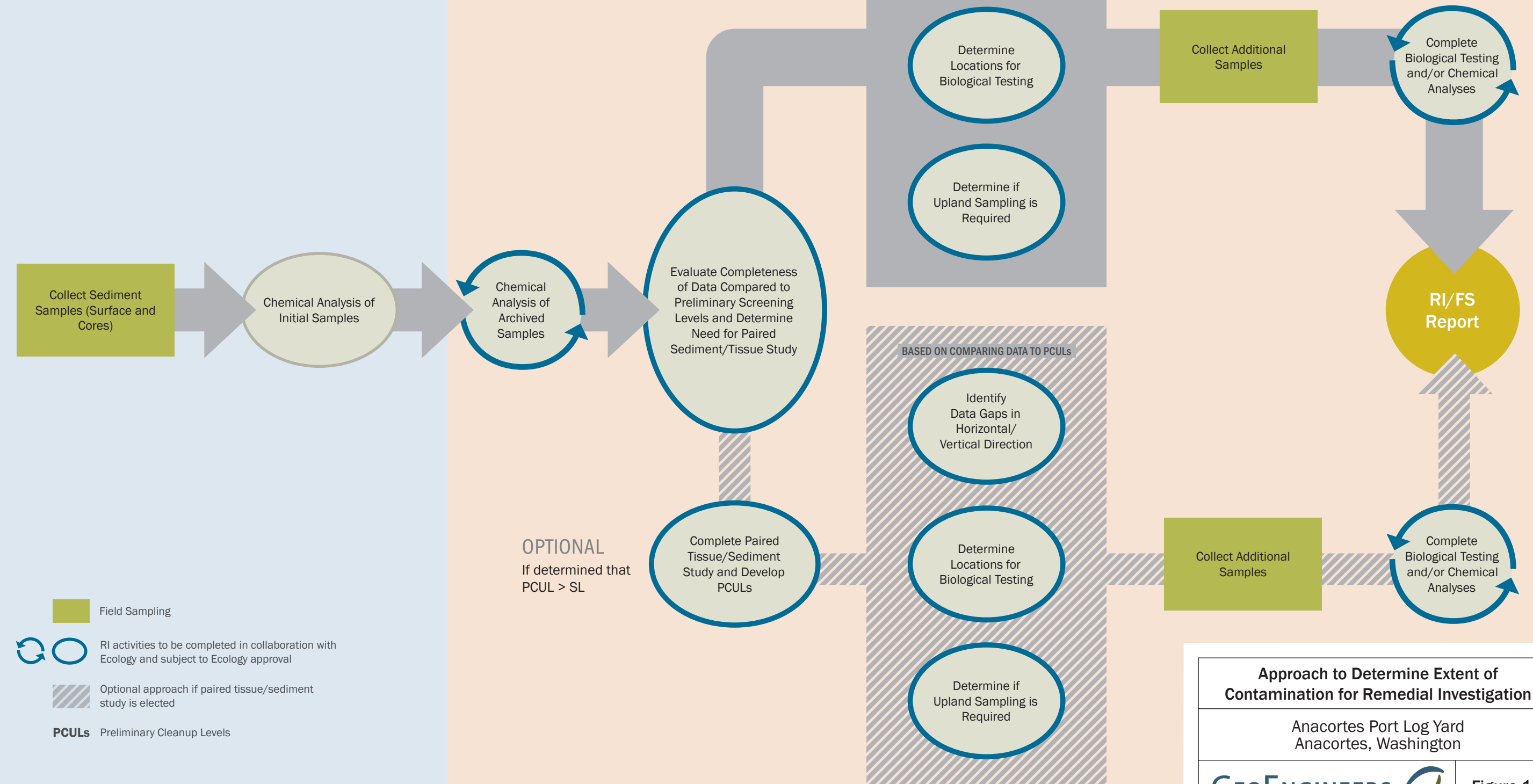
\\sea\projects\5\54701605\05_54701605 Fig 11 Approach to Determine Extent of Contamination for Remedial Investigation.indd Date Exported: 06/05/15 by spride

INITIAL SEDIMENT INVESTIGATION

As Specified in RI/FS Work Plan

FOLLOW-UP SEDIMENT INVESTIGATION

To be documented in RI/FS Work Plan Addendum(s)



Approach to Determine Extent of Contamination for Remedial Investigation

Anacortes Port Log Yard
Anacortes, Washington

GEOENGINEERS

Figure 11

APPENDIX A

Habitat Survey Plan

Habitat Survey Plan

Anacortes Port Log Yard
Anacortes, Washington
Ecology Agreed Order No. DE 10630

for

**Washington State Department of Ecology
on Behalf of Port of Anacortes**

August 11, 2015



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600 Stewart Street, Suite 1700
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Habitat Survey Plan
Anacortes Port Log Yard
Anacortes, Washington
Ecology Agreed Order No. DE 10630

File No. 5147-016-05

August 11, 2015

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Figure 2. Site Plan

INTRODUCTION

This Habitat Survey Plan (HSP) has been prepared for habitat surveying activities that will be completed as part of Remedial Investigation (RI) for the Anacortes Port Log Yard (Site) located in Anacortes, Washington (Figure 1). The Site is a cleanup site included in the Washington State Department of Ecology's (Ecology) Puget Sound Initiative and is being addressed through an Ecology-issued Agreed Order No. DE 106320. This Habitat Survey Plan supports the Remedial Investigation/Feasibility Study Work Plan (Work Plan; GeoEngineers, 2015) that details the overall approach to investigate the Site and evaluate cleanup alternatives.

The purpose of the survey is to characterize the beach, intertidal and subtidal habitats at the Site including the presence/absence, general distribution and extent of suitable forage fish spawning habitat, shellfish beds and eelgrass/macroalgae at the Site. The habitat survey will serve as a baseline for habitat conditions at the Site and will be used in the Feasibility Study Report to identify the location and type of habitat improvements that could potentially be incorporated into remedial action alternatives for the Site. The habitat survey will also be used for permitting for in-water construction activities that may be required to implement remedial actions. The habitat survey will, at a minimum, identify the location, areal extent and quality of the following:

- Eelgrass/macroalgae;
- Rock fish habitat¹;
- Nearshore salmonid habitat;
- Forage fish spawning habitat²;
- Shellfish beds; and
- Riparian habitat.

Other observed aquatic species and habitats (including upper trophic level species) will be noted during the habitat survey. Specific details regarding field protocols and procedures that will be utilized to complete the habitat survey are presented in the following sections. Procedures for completing the field work in a safe manner is presented in the Health and Safety Plan (HASP) included as Appendix D of the Work Plan.

¹ Juvenile rockfish settlement habitats are located in nearshore area with substrates such as sand, rock and/or cobble that also support kelp (families Chordaceae, Alariaceae, Lessoniaceae, Costariaceae, and Laminariceae) that enable forage opportunities and behavioral and physiological changes needed for juveniles to occupy deeper adult habitats and provide refuge from predators (79 FR 68041).

² The surf smelt potential spawning/spawn incubation zone spans the upper third of the tidal extent, from approximately +7 feet (MLLW, tidal datum) up to extreme high water. Spawning substrate is generally a sand-gravel mix, ranging from 1-7 mm diameter (Schaefer 1936, Penttila 1978). The spawning habitat of Pacific sand lance is similar to surf smelt, occurring between +5 feet and mean higher high water (MHHW; Penttila 1995).

HABITAT SURVEY PROCEDURES

The habitat survey will evaluate the existing habitat in the area of the Site that may be subject to remedial action. The work to be performed includes a survey of the beach, intertidal and subtidal areas of the Site. As described in the following sections, the beach and intertidal portion of the survey will be performed by a GeoEngineers, Inc. (Geoengineers) biologist on foot, while the subtidal portion of the survey will be performed using underwater video. Demarcation of the boundary between the intertidal and subtidal zone will be determined based on actual field conditions. In accordance with the Washington State Department of Fish and Wildlife (WDFW) Eelgrass/Macroalgae Habitat Interim Survey Guidelines (WDFW, 2008), the habitat survey will be performed between June 1 and September 30, 2015.

The location of the Site is shown relative to surrounding features on Figure 2.

Beach and Intertidal Survey

The beach and intertidal portions of the Site will be surveyed during a daytime low tide event by a GeoEngineers' biologist along a minimum of five transects approximately equally spaced along the length of the shoreline within the study area (Figure 2). Each transect will extend from above the approximate ordinary high water mark (OHWM) to the lowest elevation feasible based on the tide level at the time the survey is performed. Additional transects will be performed as necessary to provide additional spatial coverage for evaluating the beach and intertidal habitat characteristics. Predicted tide elevations for Guemes Channel will be reviewed prior to performing the survey to identify favorable low tide levels between the months of June and September 2015.

Field procedures for performing the survey along each transect for the beach and intertidal portion of the Site is as follows:

1. Perform all health and safety procedures and checks before beginning work.
2. Establish a secure pin (10-inch metal stake or equivalent) or anchor (minimum 10 pounds) at the upland limit of each transect line.
3. Attach a 200-foot long "rag tape" (or equivalent) to the secured pin/anchor located at the upland end of each transect line and extend the tape waterward to the lowest accessible shoreline elevation.
4. Establish a secure pin (10-inch metal stake or equivalent) or anchor (minimum 10 pounds) at the waterward limit of each transect line and collect the global positioning system (GPS) coordinates for both the upland and waterward ends of each transect line using a Trimble GPS unit (or similar).
5. Starting from the upland portion of the transect, walk the length of the transect to document the types of substrates, organisms and habitats observed including:
 - a. Characteristics of the habitat substrate (i.e., percent cover of riprap, boulder, cobble, gravel, sand, silt/clay, debris, wood, pilings, etc.).
 - b. Spatial extent of different substrate types (i.e., approximate boundaries of different substrate types as measured along the length of the transect line, in feet from start of each transect).
 - c. Spatial extent of different observed habitat types and species (i.e., approximate boundaries of habitat types and species as observed along the length of each transect).

- i. For eelgrass and macroalgae, record the observed extent (in feet) from the start of the transect line in general accordance with the WDFW Eelgrass/Macroalgae Habitat Interim Survey Guidelines. Note that the full waterward extent of eelgrass and macroalgae may not be documented by the intertidal habitat survey as it may extend beyond the accessible limit of the shoreline at low tide.
 - d. Presence of other organisms (i.e., approximate location or boundaries of other observed upland or marine species).
 - e. Presence of other site features including structures, significant substrate or habitat transitions, presence of debris and debris type, pilings, etc.
6. Record the time and tidal stage that the aquatic habitat survey was completed along the established transect.

In addition, photographs of the observed substrate/habitat biological characteristics will be obtained. If eelgrass or macroalgae beds are observed during the beach/intertidal survey, the perimeter of the observed bed(s) will be surveyed using a GPS to document the spatial extent.

Subtidal Survey

For portions of the study area (Figure 2) not accessible from land, the area will be surveyed using underwater video. The primary goal of the subtidal survey is to identify the locations and extent of eelgrass beds and macroalgae as well as to identify other habitat within the study area. Procedures for performing the underwater video survey are discussed below.

Underwater Video

In conjunction with the beach/intertidal survey, an underwater video survey will be performed during a daytime high-tide event to identify the location of eelgrass beds, macroalgae and other habitat. Underwater video footage will be collected by towing the submersible camera along evenly spaced transects (approximately 25 feet apart) within the study area (Figure 2). Each transect will extend from the northern limit of the study area to an elevation of approximately 2 feet mean lower low water (MLLW; approximate northern extent of the beach/intertidal survey). Equipment used to acquire the imagery will include a research vessel, Trimble Pro XH GPS (or similar), submersible camera, and data acquisition software. An integrated GPS tracker overlay system will be used to embed the GPS coordinates of the submersible camera onto the video imagery. Additional transects will be performed as necessary to provide additional spatial coverage to further evaluate subtidal habitat characteristics.

Field procedures for performing the survey along each transect for the beach and intertidal portion of the Site is as follows:

1. Perform all health and safety procedures and checks before beginning work.
2. Tow the underwater camera along evenly spaced transect lines within the study area.
 - a. Planned transects will be preloaded into a GPS unit.
 - b. Upland visual markers (i.e., dock, buildings, wooden piles, etc.) will be used to verify the location of the transect lines.

3. Starting at the corner of the study area, the underwater camera will be towed along the length of the transect line. At the end of the transect line, the boat towing the underwater camera will circle around to the next adjacent transect line. Subtidal transects will be completed to document the types of substrates, organisms and habitats observed, including:
 - a. Characteristics of the habitat substrate (i.e., percent cover of riprap, boulder, cobble, gravel, sand, silt/clay, debris, wood, pilings, etc.).
 - b. Spatial extent of different observed habitat types, species and substrate types (i.e., approximate boundaries of different habitat types and/or substrate types as measured by the GPS tracker overlay).
 - i. For eelgrass and macroalgae, record the observed extent (in feet) from the start of the transect line in general accordance with the WDFW Eelgrass/Macroalgae Habitat Interim Survey Guidelines.
 - c. Presence of other organisms (i.e., approximate location or boundaries of other observed species).
 - d. Presence of other site features including structures, significant substrate or habitat transitions, presence of debris and debris type, pilings, etc.

REPORTING

After completion of the beach/intertidal and subtidal habitat surveys, a Habitat Assessment Report will be prepared summarizing observed substrate/habitat and biological characteristics within the study area. The Habitat Assessment Report will be submitted to Ecology for review concurrently with the Data Report Technical Memorandum. The Habitat Assessment Report will include a review of WDFW Priority Habitats and Species database as well as other existing reputable sources of habitat data/information within approximately 200-300 feet of the study area boundary. In addition, the location and extent of eelgrass, macroalgae and other identified habitat within the study area will be presented in plan view.

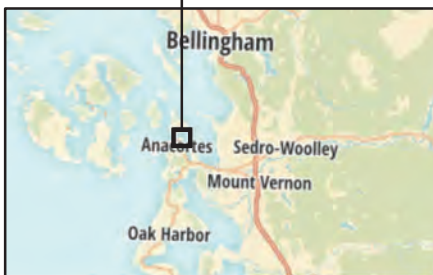
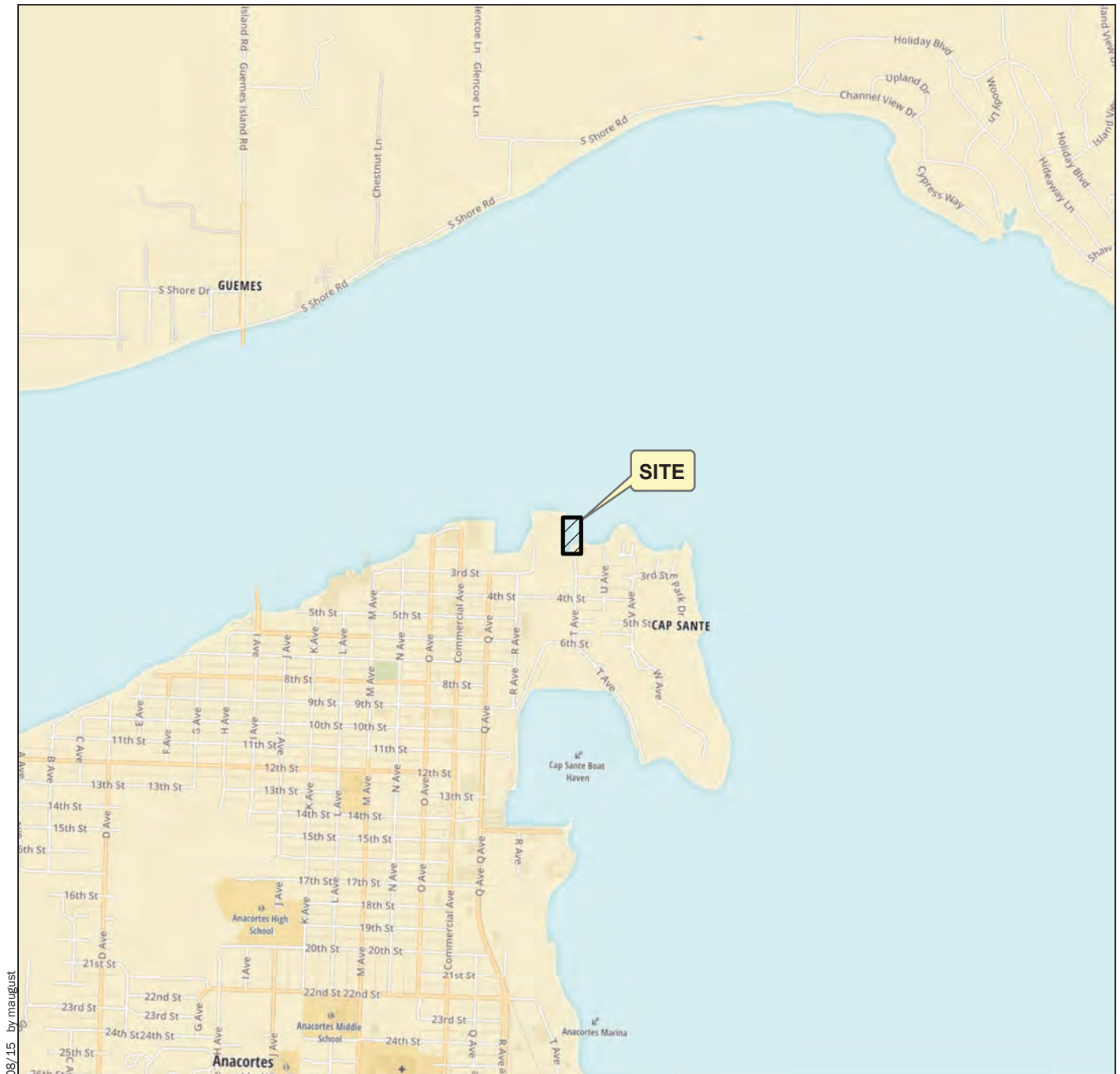
REFERENCES

- 79 FR 68041-68087. 50 CFR Part 226. Endangered and Threatened Species; Designation of Critical Habitat for the Puget Sound/Georgia Basin Distinct Population Segments of Yelloweye Rockfish, Canary Rockfish and Bocaccio. Final Rule. Federal Register, Vol. 79, No. 219.
- GeoEngineers, Inc., "Final Remedial Investigation/Feasibility Study Work Plan, Anacortes Port Log Yard, Anacortes, Washington, Ecology Agreed Order No. DE 10630", prepared for Washington State Department of Ecology on Behalf of Port of Anacortes, GEI File No. 5147-016-05, dated August 11, 2015.
- Penttila, D. 1995. Investigations of the spawning habitat of the Pacific sand lance (*Ammodytes hexapterus*), in Puget Sound. Pages 855-859 in Puget Sound Research-95 Conference Proceedings, Vol. 2. Puget Sound Water Quality Authority, Olympia, Washington.

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Schaefer, M.B. 1936. Contribution to the life history of the surf smelt, *Hypomesus pretiosus*, in Puget Sound. Biol. Rep. 35 B. Washington Department of Fisheries, Olympia, Washington. 45 p. + illustrations.

WDFW, 2008. Eelgrass / Macroalgae Habitat Interim Survey Guidelines. Revised 6/16/2008.



Vicinity Map

Anacortes Port Log Yard
Anacortes, Washington



Figure 1

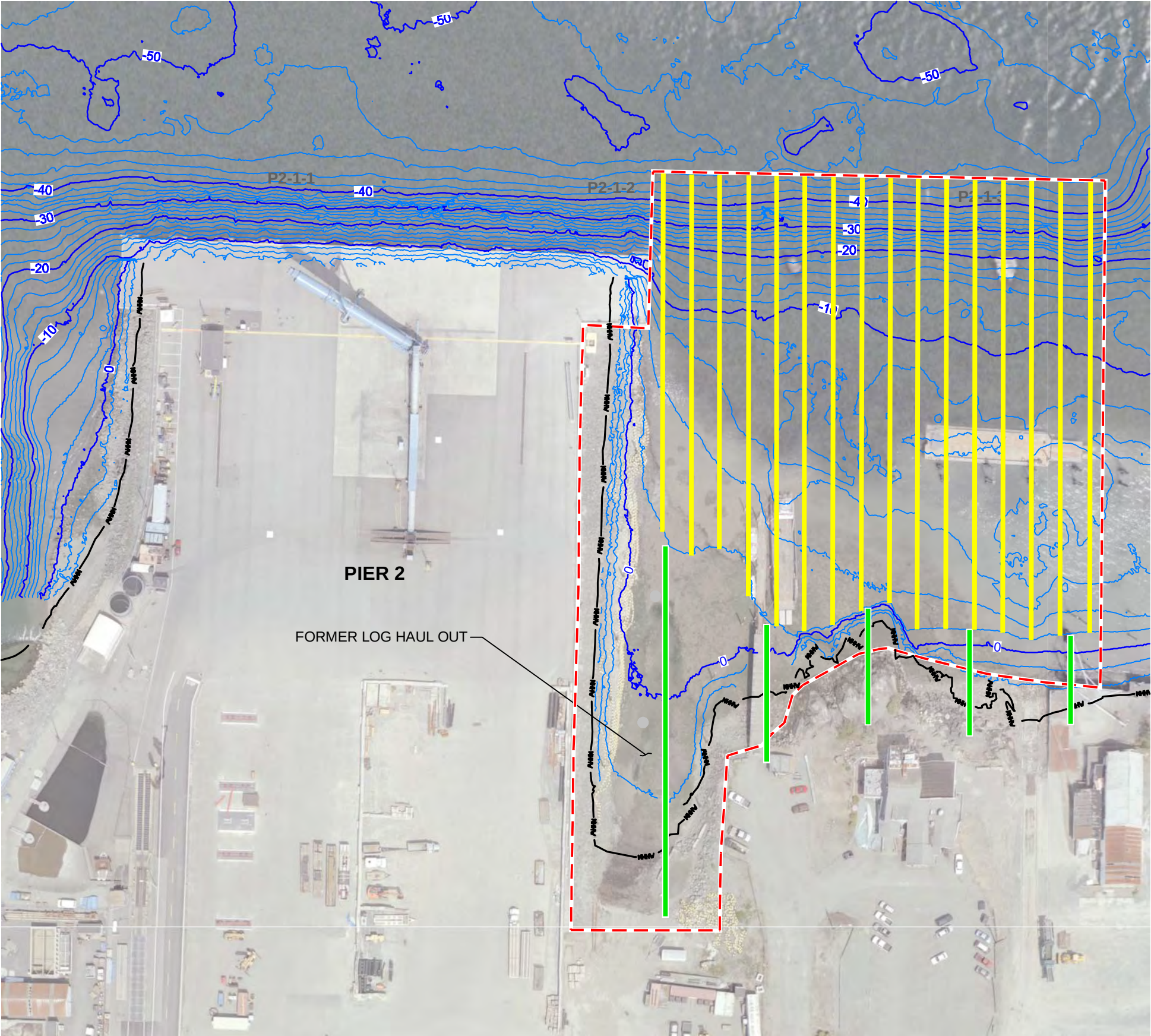
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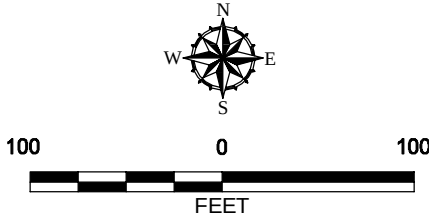
Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

P:\15147016\05\HABITAT PLAN\1514701605 FIG 2 SITE PLAN.DWG\TAB: LAYOUT MODIFIED BY THICHAUD ON JUN 10, 2015 - 10:15



Legend

- 10 Bathymetric Contour
- MHHW Mean Higher High Water
- Remedial Investigation Study Area
- Proposed Beach/Intertidal Survey Transect
- Proposed Subtidal Survey Transect



Notes

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- Reference: Base map source Port of Anacortes, 2007. Bathymetry from David Evans and Associates Inc. (DEA) survey dated June 26, 2014.

Site Plan	
Anacortes Port Log Yard Anacortes, Washington	
	Figure 2

APPENDIX B

Sampling and Analysis Plan

Sampling and Analysis Plan

Anacortes Port Log Yard
Anacortes, Washington
Ecology Agreed Order No. DE 10630

for

**Washington State Department of Ecology
on Behalf of Port of Anacortes**

August 11, 2015



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600 Stewart Street, Suite 1700
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Sampling and Analysis Plan
Anacortes Port Log Yard
Anacortes, Washington
Ecology Agreed Order No. DE 10630

File No. 5147-016-05

August 11, 2015

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1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) has been prepared for sampling and analytical activities that will be completed as part of Remedial Investigation (RI) activities for the Anacortes Port Log Yard (Site). The Site is a cleanup site included in the Washington State Department of Ecology's (Ecology) Puget Sound Initiative and is being addressed through an Ecology issued Agreed Order No. DE 106320. This site-specific SAP has been prepared as required by the Agreed Order in accordance with sediment sampling requirements in WAC 173-340-820 and under the Sediment Management Standards (SMS; Chapter 173-204 WAC). This SAP supports the Remedial Investigation/Feasibility Study (RI/FS) Work Plan that details the overall approach to investigate the Site and evaluate cleanup alternatives.

This SAP serves as the primary guide for the integration of quality assurance (QA) and quality control (QC) functions for sediment sampling completed as part of the RI for the Site. This SAP presents the objectives, procedures, organization, function activities, and specific quality assurance/quality control (QA/QC) activities designed to achieve the data quality objectives (DQOs) established for the project. Environmental measurements will be conducted to produce data that are scientifically valid, of known and acceptable quality, and meet established objectives. QA/QC procedures will be implemented so that the precision, accuracy, representativeness, completeness, and comparability (PARCC) of the data generated meet the specified DQOs to the maximum extent possible.

The QA/QC portions of this SAP were prepared following the United States Environmental Protection Agency (EPA) Requirements for Quality Assurance Project Plans (USEPA, 2001), Guidance for Quality Assurance Project Plans (USEPA, 2002), EPA's Contract Laboratory Program (USEPA, 2004) and Washington State Department of Ecology's (Ecology's) Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies (Ecology, 2004).

2.0 PROJECT AND TASK DESCRIPTION

2.1. Project Description and Objectives

The RI will include sampling and analysis of sediment to delineate the nature and extent of contamination at the Site. The overall objectives of the sediment investigation described in this Work Plan include the following:

- Characterize the stratigraphy of surface and subsurface sediment at the Site including the nature and extent of wood debris;
- Characterize the nature and extent of hazardous substances in surface and subsurface sediment;
- Provide results from chemical analyses and parameters of wood debris to identify the need and locations for follow-up bioassay testing to evaluate compliance with SMS biological criteria;
- Use results of chemical analyses to identify locations for follow-up site-specific sediment/tissue sampling and analysis to support human health and ecological risk evaluation, if elected; and
- Determine if contamination extends to the upland portion of the Site.

RI data gathering for this sediment investigation will follow a phased or tiered approach consisting of an initial sediment investigation and follow-up sediment investigation(s) as described in detail in the RI/FS

Work Plan. As part of the initial sediment investigation, sampling will be completed at 13 sample locations at the coordinates listed in Table B-1. The RI/FS Work Plan details the sample locations and chemical analyses that will be completed for the RI.

2.2. Task Description

2.2.1. Physical and Chemical Testing

Selected sediment samples will be submitted for analysis for hazardous substances based on proximity to specific past Site activities and previous sample results. Proposed sampling locations and chemical analyses are presented in the RI/FS Work Plan. Selected sediment samples obtained as part of this investigation will be submitted to Analytical Resources, Inc. (ARI) in Tukwila, Washington for a combination of the following analyses:

- Grain Size by PSEP 1986 or ASTM-Mod;
- TOC by PSEP 1986/EPA 9060 M;
- TVS by PSEP 1986/ASTM D2974;
- Ammonia in porewater by EPA 350.1 M;
- Sulfides in porewater by SM 4500-S2;
- SMS Metals by EPA Method 6000/7000 series;
- SMS SVOCs by EPA Method 8270/8270-SIM;
- PCBs by EPA Method 1668C;
- Dioxins and furans by EPA Method 1613;
- Tributyltin (bulk) by EPA Method 8270D-SIM/KRONE; and
- Tributyltin in porewater by EPA Method 8270D-SIM/KRONE.

Samples not initially selected for analyses for hazardous substances from a specific location will be archived for potential future analysis based on the initial sample results to adequately characterize the nature and extent of contamination. The extraction of porewater from sediment samples for analysis will be performed by the laboratory (tributyltin ion) in accordance with Dredged Material Management Program (DMMP) procedures (DMMP, 1998).

2.2.2. Biological Testing

As part of the follow-up sediment investigation, biological testing may be performed on surface sediment samples based on the results for chemicals and parameters of wood debris to better define potential toxic effects of hazardous substances identified in the Site. Sample locations that are proposed for further bioassay testing to determine the Site specific toxicity will be identified in an addendum to the RI/FS Work Plan and submitted to Ecology for review and approval prior to sampling. A subsequent field effort will be performed to collect surface sediment samples for bioassay testing. The samples for bioassay testing will be collected at the previous sample locations to the extent practical so that the results from previous chemical analyses can be utilized to characterize the sediment that is to undergo bioassay testing. Bioassay samples will be collected between August 15 and September 30 to understand the effects of site-specific low dissolved oxygen and higher water temperatures conditions relative to sediment toxicity.

If bioassay testing is elected or required by Ecology, both acute and chronic bioassay tests will be performed to characterize toxicity of whole sediment. Field collection and processing methods, bioassay specific QA/QC, and data reporting procedures will be followed in accordance with Puget Sound Protocols and Guidelines (PSEP, 1995). Bioassay testing for marine evaluations will include:

- 10-day amphipod mortality test (acute toxicity);
- 20-day juvenile infaunal growth test (chronic toxicity); and
- Sediment larval test (acute toxicity) using the resuspension method.

Biological testing will be in compliance with PSEP (1995), Ecology's *Sediment Cleanup Users Manual II* (Ecology, 2015), and with appropriate modifications as specified by the Sediment Management Annual Review Meeting (SMARM). If bioassay tests fail, ammonia reference toxicant tests may be conducted if elevated ammonia concentrations are identified in porewater. General biological testing procedures and specific procedures for each sediment bioassay are summarized in the following sections.

2.2.2.1. Bioassay Species

The recommended species for the 10-day amphipod mortality test may include:

- *Eohaustorius estuarius* – most commonly used species; can be considered for use over grain size distributions ranging from 100 percent sand to 0.6 percent sand, as long as the clay fraction is less than 20 percent, and in interstitial salinities ranging from 2 parts per thousand (ppt) to 28 ppt.
- *Ampelisca abdita* – recommended if test sediment contains greater than 20 percent clay.
- *Rhepoxynius abronius* – alternative species for use in coarser-grained sediments (i.e., fines less than 60 percent).

The recommended species for the 20-day juvenile infaunal growth test include:

- *Neanthes arenaceodentata* (Los Angeles karyotype).

The recommended species for the larval test include:

- Bivalve: *Mytilus galloprovincialis*; and
- Echinoderm: *Dendraster excentricus*.

Bioassay species will be selected by the testing laboratory based on sediment material type and composition and/or seasonal availability.

2.2.2.2. Reference Sediments

Bioassay testing requires that test sediments be matched and run with appropriate reference sediment to factor out sediment grain-size effects on bioassay organisms. Reference sediment will be collected from Carr Inlet or other Ecology approved reference sediment area. One or more reference samples will be collected from the reference area to match the grain size of reference sediment to the grain size of samples collected for bioassays from the Site. The location coordinates of the reference sediment sampling location will be recorded. Reference sediment samples will be collected and processed using the same methods as the test sediment samples.

2.2.2.3. Bioassay Laboratory Protocols

Sediment samples for bioassays will be stored at 4 °C with no headspace. Bioassay testing, will commence within 14 days after collection of the first sediment sample in the sediment composite to be analyzed. Any retesting will occur within 56 days after collection of the first sediment sample in the composite. Any retest performed outside the initial 14-day period will be reanalyzed for sulfides and ammonia at the time of the retest.

Chain-of-custody procedures will be maintained by the laboratory throughout biological testing.

2.2.2.4. Bioassay Specific Procedures

The following summarize the specific bioassay procedures that will be completed for biological testing:

- **Amphipod 10-day Survival Bioassay:** The amphipod mortality test will be run for a 10-day exposure period, followed by counting of the surviving animals. Daily emergence data and the number of amphipods failing to rebury at the end of the test will be recorded.
- **Juvenile Infaunal Growth Bioassay:** The sediment juvenile infaunal bioassay will be run for a 20-day exposure period, followed by counting and weighing of the surviving animals (PSEP, 1995). At the end of the test, mean individual growth rate is calculated for each replicate exposure as the difference between final and initial weights divided by the exposure duration. Results will be reported on an ash-free dry-weight (AFDW) basis using the protocol specified in the clarification paper identifying refinements in the juvenile infaunal growth bioassay (i.e., *Neanthes*) endpoint measurement developed as part of the SMARM (DMMP, 2013).
- **Larval Development Bioassay:** The sediment larval bioassay has a variable endpoint that is determined by the developmental stage of organisms in a sacrificial seawater control (PSEP, 1995). At the end of the test, larvae from each test sediment replicate exposure are examined to quantify abnormality and mortality. If a bivalve species is used for the larval development bioassay (i.e., *Mytilus galloprovincialis*), the larval resuspension protocol specified in the clarification paper identifying refinements in the bivalve development bioassay endpoint measurement developed as part of the SMARM will be used (DMMP, 2013).

2.2.2.5. Polycyclic Aromatic Hydrocarbon Toxicity

The toxicity of certain PAHs in sediment can be significantly increased if those PAHs are exposed to UV light (Ahrens and Hickey 2002). When certain polycyclic aromatic hydrocarbons (PAHs) are exposed to ultraviolet (UV) radiation, the toxicity to benthic and water column organisms may be an order of magnitude greater than organisms exposed to the same concentrations/mixtures of PAHs in the absence of UV. The overall effect is decreased individual fitness and potentially detrimental population-level effects. To account for this potential effect, bioassay analysis will be performed in the presence of full spectrum ultraviolet (UV) following the SCUM II guidance for conducting bioassays on sediment containing photo-activated PAHs if SQS has been exceeded for any photo-activated PAH or if the sum of PAHs exceed the SCO by more than 25 percent.

2.2.3. Sediment/Tissue Study

As detailed in the RI/FS Work Plan, an evaluation will be completed to determine the need to conduct a Site-specific paired tissue/sediment study to provide data for a Site-specific human health and ecological receptor risk evaluation. The paired tissue/sediment study would be completed if it appears that site-specific preliminary cleanup levels for bioaccumulative chemicals would be greater than the preliminary screening levels.

If elected, the paired tissue/sediment study and subsequent evaluation would determine the risk from dioxins/furans, PAHs, PCBs, mercury, arsenic, cadmium, lead and/or tributyltin at this Site and will include congener data for dioxins/furans and PCBs. Note that other bioaccumulative chemicals of concern, aside from those mentioned above may be identified and evaluated in human and/or ecological risk assessments based on data collected during the initial data results and following procedures outlined in WAC 173-204-564(2)(c)(iii). Analyses for these bioaccumulative chemicals in sediment are being performed as part of the initial sediment investigation. The results of these analyses would help determine the need for the paired sediment/tissue study and which chemicals of concern to include.

If performed, the paired sediment/tissue study would consist of collecting sediment samples and tissue samples from selected organisms within the study area to evaluate bioaccumulation factors. A RI/FS Work Plan addendum would be prepared to describe the scope and approach of sampling and analysis to support the tissue/sediment study. The addendum would identify the objectives and data to be collected for the study and is subject to Ecology approval. On approval of the addendum by Ecology, a subsequent field effort would be performed to collect sediment and tissue samples to evaluate bioaccumulation factors at the Site.

3.0 DATA QUALITY OBJECTIVES

This section presents data quality objectives for chemical and biological testing that are required for completion of the RI. The Data Quality Objectives (DQOs) for this RI is to collect environmental sampling data of known, acceptable, and documentable quality. The specific objectives established for the project are:

- Implement the procedures outlined herein for field sampling, sample custody, equipment operation and calibration, laboratory analysis, and data reporting to ensure consistency and thoroughness of data generated.
- Achieve the level of QA/QC required to produce scientifically valid analytical data of known and documented quality. This will be accomplished by establishing criteria for data precision, accuracy, representativeness, completeness, and comparability, and by evaluating project data against these criteria.

3.1. Chemical Quality Objectives

The sampling design, field procedures, useable laboratory procedures, and QC procedures established for this project were developed to provide defensible data. Specific data quality factors that may affect data usability include quantitative factors (precision, bias, accuracy, completeness, and reporting limits) and qualitative factors such as representativeness and comparability. The specific DQOs associated with these data quality factors are discussed below. Method-specific DQOs for chemical laboratory analyses are presented in Tables B-2 through B-4.

3.1.1. Analytical Detection Limits

Analytical methods have quantitative limitations at a given statistical level of confidence that are often expressed as the method detection limit (MDL). Although results reported near the MDL provide insight for sediment conditions, quality assurance dictates that analytical methods achieve a consistently reliable

level of detection known as the practical quantitation limit (PQL), which is typically demonstrated with the lowest point of a linear calibration. The contract laboratory will provide numerical results for all analytes and report them as detected above the PQL or undetected at the PQL.

The PQLs for COPC provided by the Ecology-certified laboratory contract laboratory (ARI) are presented in Table B-5 for sediment. The PQLs presented in Table B-5 are considered target reporting limits (TRLs) because several factors may influence final reporting limits. First, moisture and other physical conditions of sediment affect detection limits. Second, analytical procedures may require sample dilutions or other practices to quantify a particular analyte at concentrations above the range of the instrument. The effect is that other analytes could be reported as undetected but at a value higher than a specified TRL. Data users must be aware that high non-detect values, although correctly reported, can bias statistical summaries and careful interpretation is required to correctly characterize subsurface conditions.

3.1.2. Precision

Precision is the measure of mutual agreement among replicate or duplicate measurements of an analyte from the same sample and applies to field duplicate or split samples, replicate analyses, and duplicate spiked environmental samples (matrix spike duplicates). The closer the measured values are to each other, the more precise the measurement process. Precision error may affect data usefulness. Good precision is indicative of relative consistency and comparability between different samples. Precision will be expressed as the relative percent difference (RPD) for spike sample and field duplicate comparisons of various matrices. The RPD is calculated as:

$$\text{Where } RPD(\%) = \frac{|D_1 - D_2|}{(D_1 + D_2)/2} \times 100,$$

D_1 = Concentration of analyte in primary sample.
 D_2 = Concentration of analyte in duplicate sample.

The calculation applies to split samples, replicate analyses, duplicate spiked environmental samples (matrix spike duplicates), and laboratory control duplicates. The RPD will be calculated for samples and compared to the applicable criteria. Precision can also be expressed as the percent difference (%D) between replicate analyses. Project RPD goals for all analyses are presented in Table B-2, unless the primary and duplicate sample results are less than 5 times the MRL, in which case RPD goals will not apply for data quality assessment purposes.

3.1.3. Accuracy

Accuracy is a measure of bias in the analytical process. The closer the measurement value is to the true value, the greater the accuracy. Accuracy is typically evaluated by adding a known spike concentration of a target or surrogate compound to a sample prior to analysis. The detected concentration or percent recovery (%R) of the spiked compound reported in the sample provides a quantitative measure of analytical accuracy. Since most environmental data collected represent single points spatially and temporally rather than an average of values, accuracy is generally more important than precision in assessing the data. In general, if %R values are low, non-detect results may be reported for compounds of interest when in fact these compounds are present (i.e., false negative results), and results for detected compounds may be biased low. The reverse is true when %R values are high. In this case, non-detect values are considered accurate, whereas detected values may be higher than true values.

For this project, accuracy will be expressed as the %R of a known surrogate spike, matrix spike, or laboratory control sample (blank spike), concentration:

$$\text{Recovery (\%R)} = \frac{\text{Spiked Result} - \text{Unspiked Result}}{\text{Known Spike Concentration}} \times 100$$

Accuracy (%R) criteria for surrogate spikes, matrix spikes, and laboratory control samples (blank spikes) are presented in Tables B-2 through B-4.

3.1.4. Representativeness, Completeness, and Comparability

Representativeness expresses the degree to which data accurately and precisely represent the actual site conditions. Representativeness of the data will be evaluated by:

- Comparing actual sampling procedures to those specified in this SAP.
- Reviewing analytical results for field duplicates to determine the variability in the analytical results.
- Invalidating non-representative data or identifying data to be classified as questionable or qualitative in nature. Only representative data will be used in subsequent data reduction, validation, and reporting activities.

Completeness establishes whether a sufficient amount of valid measurements were obtained to meet project objectives. The number of samples and results expected establishes the comparative basis for completeness. The completeness goal is 90 percent useable data for the samples/analyses planned. If the completeness goal is not achieved, an evaluation will be performed to determine if the data are adequate to meet study objectives.

Comparability expresses the confidence with which one set of data can be compared to another. Although numeric goals do not exist for comparability, a statement on comparability will be prepared to assess overall usefulness of data sets generated during the project, following the evaluation of precision and accuracy.

3.1.5. Holding Times

Holding times are defined as the time between sample collection and extraction, sample collection and analysis, or sample extraction and analysis. Recommended holding times are presented in Table B-6.

3.1.6. Quality Control Blank Samples

According to the National Functional Guidelines for Organic Data Review (USEPA, 2008), “The purpose of laboratory (or field) blank analysis is to assess the existence and magnitude of contamination resulting from laboratory (or field) activities. The criteria for evaluation of blanks apply to any blank associated with the samples (e.g., method blanks, instrument blanks, trip blanks, and equipment blanks).” Trip blanks are placed with samples during shipment; method blanks are created during sample preparation and follow samples throughout the analysis process.

Analytical results for QC blanks will be interpreted in general accordance with EPA’s National Functional Guidelines for Organic (USEPA, 2008) and Inorganic Data (USEPA, 2004) Review and professional judgment. QC blank samples are discussed further in Section 4.13.

3.2. Biological Testing Data Quality Objectives

Sediment toxicity testing 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, lab replicates, and measurements of water quality during testing. Performance standards for control and reference sediment toxicity tests are summarized in Table B-12.

3.2.1. Negative Controls

Negative control sediment is used in bioassays to check laboratory performance. Negative control sediment are clean sediments in which the test organism normally lives and which are expected to produce low mortality, and thus are collected from the organism collection site for the bioassay.

In the amphipod and juvenile infaunal bioassay tests, control mortality over the exposure period should be less than or equal to 10 percent and consistent with other requirements provided in WAC 173-204-562, Table IV for *Neanthes* 20 day growth. This represents a generally accepted level of mortality of test organisms under control conditions, where the bioassay (in terms of test organism health) is still considered a valid measure of effects of the test treatments. If control mortality is greater than 10 percent, the bioassay test will generally have to be repeated. For the sediment larval test, the performance standard for the seawater negative control combined endpoint (mortality + abnormality) is 30 percent.

3.2.2. Reference Sediment

Bioassay reference sediment that closely match the grain-size characteristics of the Site material test sediment will be used for test comparison and interpretations. The reference sediment will be used to account for physical effects of the test sediment. The collection area will be determined based on sample physical characteristics. The reference sample will be analyzed for total solids, total volatile solids, total organic carbon and grain size.

The wet-sieving protocol will be used in the location of the appropriate reference station. Wet-sieving will be conducted using a 63-micron (#230) sieve and graduated cylinder; 100 mL of sediment is placed in the sieve and washed until the water runs clear. The volume of sand and gravel remaining is then washed into the graduated cylinder and measured as the coarse fraction. The fines are determined by subtracting the coarse fraction from 100.

3.2.3. Replication

Eight laboratory replicates of test sediment, reference sediment, and negative controls will be run for each marine water bioassay (per ASTM and EPA guidance).

3.2.4. Positive Controls

A positive control will be run for each bioassay. Positive controls are chemicals known to be toxic to the test organism and provide an indication of the sensitivity of the particular organisms used in a bioassay. Positive control charts will be requested from the laboratory for the twelve prior tests performed at a minimum.

3.2.5. Water Quality Monitoring

Water quality monitoring will be conducted for the amphipod, larval, and juvenile polychaete bioassays and reference toxicant tests. This consists of daily measurements in each test replicate of salinity, temperature,

pH, and dissolved oxygen (DO) for the amphipod and larval tests. These measurements will be made every three days for the juvenile polychaete bioassay, with the exception of DO, 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).

3.2.6. Interpretation

Test interpretation consists of endpoint comparisons of test sediments to the measurements observed in the controls and in reference sediments on an absolute percentage basis, as well as statistical comparison between the test and reference endpoints, where appropriate. Test interpretation will follow the requirements of WAC 173-204-562, Table IV.

4.0 DATA GENERATION AND ACQUISITION

The data generation and acquisition elements of the SAP (as detailed below) address aspects of the project design and implementation including the appropriate methods for sampling, measurement and analysis, data collection or generation, data handling, and how QC activities are employed and properly documented.

The information presented herein applies directly to the selection of sampling locations and field sampling methodology. Sampling methods including field documentation, sampling and decontamination procedures, are also discussed below.

4.1. Sample Process Design

Details of the sampling activities (i.e., sample locations, frequency, laboratory analysis, and rationale) that will be used during the RI are presented in the RI/FS Work Plan.

4.2. Sampling Methods

The RI will identify the nature and extent of sediment contamination at the Site. This sediment investigation includes collection of surface and subsurface sediment samples as the initial phase of sampling and the RI/FS Work Plan specifies samples for initial chemical analysis and archiving. The proposed sediment investigation sampling locations, approach and rationale are described in RI/FS Work Plan.

The collection of samples for bioassay testing and/or paired sediment/tissue analyses to evaluate human health and ecological risk are not being performed as part of initial sampling activities. Additional sampling activities for bioassay testing and/or paired sediment tissue analysis may be performed based on the results of the initial phase of sampling and analysis to better define potential toxic effects of hazardous substances identified in sediment. The Port will collaborate with Ecology to determine if bioassay testing and/or paired sediment tissue analysis is necessary. Based upon the results of the initial sampling and existing data. If required, sampling and testing for bioassays and/or paired sediment/tissue analyses will be described in addendums to this SAP. The addendums to this SAP will be submitted to Ecology for review and approval prior to initiation of sampling for potential bioassays and paired sediment/tissue testing.

Subsurface sediment cores will be obtained using vibracoring, hollow stem auger, sonic drilling, or other method(s) as determined to best meet the specific sampling objectives. Continuous cores will be advanced through the sediment to depths of approximately 10 feet below mudline. The objective of each core will be

to encounter native material (or refusal at bedrock if encountered) and cores may be advanced deeper or shallower than 10 feet below mudline. Subsurface sediment samples will be collected continuously in 1-foot intervals and submitted to the laboratory for analysis or archival.

The sediment type recovered in each grab sample and core interval will be classified in accordance with the Unified Soil Classification System and observed and tested in the field for the presence of contamination. The absence or presence of wood debris will be recorded on a log of exploration form (i.e., field form). If wood debris is present, the type or types of wood debris (i.e., saw dust, bark, chips, chunks, twigs, fibers, etc.), the estimated quantity (i.e., observed percent by volume) of each wood type, and the depth interval where the wood is observed will be recorded on a log of exploration form and photographed to further characterize the stratigraphy present. Additionally, the type or types of wood debris and estimated quantity present in each sample will be recorded on the log of exploration. Field observation and testing will consist of visual observation for the presence of contamination (i.e., staining, discoloration, etc.) and water sheen testing. Observations of sediment conditions and field testing results for each exploration will be included on the log of exploration.

4.3. Sample Collection Methods

4.3.1. Surface Sediment Collection and Processing

Surface sediment samples will be obtained using a grab-type sampler (Van Veen or similar) or as grab samples using stainless steel spoons. Surface samples will be obtained from the upper 10 centimeters of sediment. Sampling equipment must be decontaminated and inspected before sampling. The procedures for collecting surface sediment samples are as follows:

1. Maneuver the sampling vessel to the proposed sampling location, steady the vessel, and verify location control using a GPS. If sample is collected from the upland at low tide use a handheld GPS to identify the proposed sampling location.
2. Record the location of the sample.
3. If collecting the sample from a sampling vessel, deploy the sampler through the water column to the mudline. If collecting the sample from upland during low tide, use a stainless steel spoon to collect the sediment from the top 10 cm and place in stainless steel bowl(s) and skip ahead to Step 7 below.
4. Examine the sample for the following sediment acceptance criteria (only applicable for samples collected using Van Veen (or similar sampling device from vessel):
 - The sampler jaw is closed.
 - The sampler is not overfilled so that the sediment surface is pressing against the top of the sampler.
 - Minimal leakage has occurred, as evidenced by overlying water on the sediment surface.
 - Minimal sample disturbance has occurred, as evidenced by limited turbidity in the water overlying the sample.
 - A penetration of greater than 10 cm has been achieved. Greater than 10 cm shall be the target penetration depth in order to sample sediment that has not come into contact with the side or bottom of the sampler.
 - If any of the sediment acceptance criteria are not achieved, the sample will be rejected and the location resampled. If the proposed sampling location cannot be achieved after four deployments, the Project Manager shall be notified. Ecology will be contacted prior to additional sampling to provide required review and approval of an appropriate alternative location.

5. Siphon off the water overlying the surface of the sediment while taking care to not disturb the surface of the sediment.
6. Sediment samples for porewater analysis (ammonia, sulfide and tributyltin ion) will be collected immediately after the sediment sample overlying water is siphoned, prior to any additional observation, testing, photography, classification or homogenization of the sample material, by carefully placing relatively undisturbed sediment removed directly from the Van Veen sampler with a stainless steel spoon directly into a sample jar. The sample jar will be filled completely to eliminate headspace. Porewater extraction will be conducted at the laboratory.
7. Visually classify sediment in accordance with ASTM International (ASTM) D 2488 methods and the Unified Soil Classification System (ASTM D 2487) and record on the field form. In addition to the visual classification, sediment samples shall be observed and field screened. Qualitative descriptive parameters including biota, debris, and presence of staining shall also be recorded.
8. The visual absence or presence of wood debris in the surface sediment sample will also be recorded on the field form. If wood debris is present, the type or types of wood debris (i.e., saw dust, bark, chips, chunks, twigs, fibers, etc.), the estimated quantity (i.e., observed percent by volume) of each type of wood debris, and the depth interval where the wood is observed will be recorded on the field form.
9. Photograph the sediment sample. Include in the camera's field of view, and a sheet of paper or whiteboard with the sample name written in large print; use care not to touch the sediment with the paper/whiteboard or with hands contaminated with whiteboard ink.
10. To avoid cross-contamination, a clean hands/dirty hands approach to use of whiteboard pens and erasers and lab pens will be utilized during all sample collection activities where subsequent chemical analyses will be carried out on the samples collected. Gloves that have been in contact with lab pens and whiteboard pens will not be used for sample handling.
11. Collect the upper 10 cm of sediment from the sampler using a decontaminated stainless steel spoon. Do not collect sediment that has been in contact with the sides of the sampler.
12. Place the sediment into a decontaminated stainless steel homogenization bowl. Cover the container with a new sheet of aluminum foil and dispose after use. If sufficient sample volume was not collected, repeat the sampling process until sufficient volume is achieved. Successive deployments should be within an approximate 10-foot radius of the initial deployment.
13. Homogenize the sediment (from one deployment if adequate sediment volume was achieved, or from multiple deployments if multiple deployments were required) in the stainless steel bowl using the stainless steel spoon until the sediment appears generally uniform in color and texture.
14. Distribute the sample to designated sample containers and ensure that the samples are properly labeled and tightly closed. Sample containers will be filled to minimize headspace.
15. Clean the exterior of the sample containers and store them in a cooler with ice.
16. Decontaminate all equipment as described in Section 4.5.
17. Double check that field collection forms are completely filled out.

4.3.2. Subsurface Sediment Sample Collection and Processing

Subsurface sediment cores will be obtained using vibracoring, hollow stem auger, sonic drilling, or other method(s) as determined to best meet the specific sampling objectives. Continuous cores will be advanced

through the sediment to depths of approximately 10 feet below mudline. The objective of each core will be to encounter native material (or refusal at bedrock if encountered) and cores may be advanced deeper or shallower than 10 feet below mudline. Subsurface sediment samples will be collected continuously in 1-foot intervals and submitted to the laboratory for analysis or archival. If additional volume is needed than is available in the 1-foot interval then additional cores may be completed to obtain more volume or, if necessary, intervals may be combined to provide adequate sample volume.

The procedures for collecting subsurface sediment samples are as follows:

1. Maneuver the sampling vessel to the proposed sampling location, steady the vessel, and verify location control using the GPS.
2. Record the location of the sample.
3. Record the sampling time and depth to mudline below the water surface using the lead-line.
4. Drive the sampler into the sediment surface to the target depth or until refusal.
5. Collect a continuous core to the specified target depth or until refusal.
6. For each core interval, record the penetration depth on the field form.
7. Extract the core barrel, extract and cap the liner, and examine the core relative to the following acceptance criteria:
 - Overlying water is present and the surface is intact.
 - Calculated linear compaction is not greater than 25 percent.
 - The core tube appears intact without obstructions or blockage.
 - If any of the sediment acceptance criteria are not achieved, the sample will be rejected and the location resampled. If the proposed sampling location cannot be achieved after four deployments, notify the Project Manager. Ecology will be contacted for required review and approval of an appropriate alternative location.
 - If the core meets the acceptance criteria then proceed with core processing. If core processing is not performed in the field, the cores will be labeled and kept at approximately 4° C during storage and shipment.
8. Open the core with a decontaminated core-opening device.
9. Visually classify sediment in accordance with ASTM D 2488 methods and the Unified Soil Classification System (ASTM D 2487) and record on the field form. In addition to the visual classification, sediment samples shall be observed and field screened. Qualitative descriptive parameters including biota, debris, and presence of product/staining shall also be recorded.
10. The visual absence or presence of wood debris in the sediment core will also be recorded on the field form. If wood debris is present, the type or types of wood debris (i.e., saw dust, bark, chips, chunks, twigs, fibers, etc.), the estimated quantity (i.e., observed percent by volume) of each type of wood debris, and the depth interval where the wood is observed will be recorded on the field form and a photograph obtained representing and supporting the quantity estimated. Fine sawdust generated by sawmills may be indistinguishable from other sediment, so care will be taken to attempt to identify finer fractions of wood debris in samples.
11. Photograph the sample. Include in the camera's field of view a sheet of paper or whiteboard with the sample name written in large black print; use care not to touch the sediment with the paper/whiteboard

or with gloved hands in contact with whiteboards, pens or with whiteboard ink. It is likely several photos will be necessary to record the entire length of the core sample. Include the depth interval on the paper/whiteboard.

12. Collect sediment from the liner using a decontaminated stainless steel spoon. Do not collect sediment that has been in contact with the sides of the core liner, or the core-opening device. Place the sediment into a decontaminated stainless steel homogenization bowl. Cover the container with a new sheet of aluminum foil and dispose after use.
13. Homogenize the sediment in the stainless steel bowl using the stainless steel spoon until the sediment appears generally uniform in color and texture.
14. Distribute the sample to appropriate sample containers and ensure that the samples are properly labeled and tightly closed.
15. Clean the exterior of the sample containers and immediately store them in a cooler with ice.
16. Decontaminate all equipment as described in Section 4.5.
17. Double check that field collection forms are completely filled out.

If adequate sample volume cannot be obtained in a particular interval(s) in cores, an adjacent core will be attempted within a 10-foot radius of the original core.

4.4. Positioning

Station positions will be determined in latitude and longitude referenced to North American Datum of 1983 (NAD83) using a GPS unit. The accuracy of measured and recorded horizontal coordinates will be within 2 meters. Coordinates for the proposed sample locations are provided in Table B-1.

Vertical elevations of the mudline at each sampling location will be based on measured water depth (i.e., depth to mudline) and tidal elevation at the time of sampling. Depths below mudline for the core sample will be measured directly based on penetration depth of the sampler and will be determined within approximately 0.1 foot to the extent practical. Vertical elevations will be referenced to mean lower low water (MLLW).

4.5. Sampling Equipment and Decontamination Procedures

Samples will be collected using grab sampling equipment, coring/drilling equipment and hand tools including stainless steel spoons and stainless steel mixing bowls. Reusable sampling equipment that is used to process the samples and comes in contact with the sediment (i.e., spoons, bowls, measuring devices, etc.) will be decontaminated before each use. Decontamination procedures for this equipment will consist of the following:

1. Seawater rinse over equipment to dislodge and remove any sediment (deionized water will be used for the samples collected on land);
2. Washing with a brush and non-phosphate detergent solution (e.g., Liqui-Nox and distilled water);
3. Deionized water rinse;
4. Hexane (certified ACS HPLC Grade $\geq 99.5\%$) or acetone (certified ACS HPLC Grade $\geq 99.5\%$) rinse;

5. Deionized water rinse; and
6. Wrapping or covering the decontaminated equipment with aluminum foil.

Due to relatively low contaminant levels observed within the study area based on the results of previous environmental studies and added health and safety concerns with the use of solvents, solvents will only be used if high levels of contamination are observed.

Field personnel will limit cross-contamination by changing gloves between sampling locations.

4.6. Field Observation and Testing

Sediment samples will be observed and tested in the field for evidence of possible contamination. Field results will be recorded on the field forms and the results will be used as evidence of possible contamination. Field testing and observation results can also be used to aid in the selection of additional sediment samples to be submitted for chemical analysis. Field observation and testing will not reduce or remove the samples required for the initial investigation, but may add additional samples based upon results obtained for follow-up analysis as part of archived samples. The following screening methods will be used:

- Visual and olfactory observation; and
- Water sheen testing.

Field testing and observation results are site- and location-specific. The results may vary with temperature, moisture content, sediment type and chemical constituent. All field testing and observation results will be documented on the field log and reported.

4.6.1. Visual and Olfactory Observation

The sediment will be observed for debris (i.e., wood, etc.), unusual color and staining and/or odor indicative of possible contamination.

4.6.2. Water Sheen Testing

This is a qualitative field testing method that can help identify the presence or absence of petroleum hydrocarbons. A portion of the sediment sample (about a tablespoon) will be placed in a small pan containing distilled water and the water surface will be observed for signs of sheen. The following sheen classifications will be used:

Classification	Identifier	Description
No Sheen	(NS)	No visible sheen on the water surface
Slight Sheen	(SS)	Light, colorless, dull sheen; spread is irregular, not rapid; sheen dissipates rapidly
Moderate Sheen	(MS)	Light to heavy sheen; may have some color/iridescence; spread is irregular to flowing, may be rapid; few remaining areas of no sheen on the water surface
Heavy Sheen	(HS)	Heavy sheen with color/iridescence; spread is rapid; entire water surface may be covered with sheen

4.7. Water Quality Measurements

Water quality measurements including dissolved oxygen (DO), temperature, acidity (pH), electric conductivity (EC) and salinity will be obtained during sample collection (if water column is present) using a water quality meter (Horiba U-50 series or similar). Measurements will be obtained within one foot of the air/water surface interface, water/sediment interface and at the pycnocline (if the water is deep enough and one exists at the time of sampling). If there is no water column present during sample collection (i.e., sediment sample collected from the upland during low tide), a representative water quality measurement will be obtained from the dock located on the eastern portion of the Site.

All field testing and observation results will be documented on the field log and reported.

4.8. Sample Containers and Labeling

The Field Coordinator will establish field protocol to manage field sample collection, handling, and documentation. Sediment samples will be placed in appropriate laboratory-prepared containers. Sample containers and preservatives are listed in Table B-6.

Sample containers will be labeled with the following information at the time of sample collection:

- Project name and number
- Type of sample preservative used (where applicable)
- Sample name, which will include a reference to date and sampling depth (if applicable)
- Date and time of collection

The sample collection activities will be noted in the field log books. The Field Coordinator will monitor consistency between sample containers/labels, field log books, and COC forms.

4.9. Chain of Custody

The Chain of Custody (COC) record will contain the same information as is contained on the sample labels and serve as documentation of sample handling during delivery or shipment. One copy of this custody record will remain with the shipped samples, and one copy will be retained by the Field Staff who originally sampled and relinquished the samples. The sampler's copy will be maintained in the project file.

The samples relinquished to the Laboratory will be subject to transfer-of-custody and shipment procedures, as follows:

- The samples shipped to the Laboratory will be accompanied by a COC record documenting which samples are present in the cooler. When transferring possession of samples, the individuals relinquishing and receiving the samples will sign, date, and note the times of the sample transfer on the record. This custody record will document transfer of sample custody from the sampler to other persons, including the Laboratory.
- The samples will be properly packed for shipment and dispatched to the Laboratory for analysis, with a separate, signed COC enclosed in each sample cooler. If a GeoEngineers representative is not the person delivering the sample coolers to the Laboratory, sample shipping containers will be custody-sealed before being delivered to the Laboratory. The preferred procedure for custody sealing includes

use of a custody signed seal placed across filament tape that is wrapped around the cooler at least twice. The custody seal should then be folded over and attached to itself in such a way as the package can only be accessed by cutting the filament tape or breaking the seal.

- Samples will be shipped and analyzed within the established hold times that are listed in Table B-6.

The Laboratory will utilize an established system for sample check-in, sample tracking, laboratory analyses assignment and performance, and sample check-out. The system will allow management review of the laboratory data before the issuance of laboratory reports. The management review will be accomplished on two levels: review of raw data for each analysis, and review of the final results to check for consistency or agreement of the results between parameters. Computers are routinely used for this purpose to take advantage of fast retrieval of information.

Upon receipt of samples accompanied by a COC form identifying the analytical parameters to be performed, the Laboratory Coordinator or a delegate will conduct the following:

- Log in the samples and assign Laboratory identification numbers. For each sample, a record will be generated containing the sample station number, sample description, analytical requirements, pricing information, and report format description.
- Enter these data into the Laboratory computer system.
- Prepare an analysis assignment sheet, noting the analytical parameters to be run and providing spaces for resulting analytical data.
- Assign the samples a position in the Laboratory workload backlog.
- Retain the COC form upon completion of data generation.

4.10. Field Documentation

The field staff will be responsible for documenting field sampling activities in an all-weather (e.g. “Rite-in-the-Rain”) field notebook and on field logs, and by producing a draft technical field report at the end of each day of sampling. The field staff will also be responsible for implementing field QA/QC procedures in accordance with the methods outlined in this SAP and general good practice sampling protocols. These procedures include recording and documenting relevant and appropriate information regarding project activities, sampling methods and data collected during performance of field activities at each sample location.

The following general guidelines should be followed in documenting fieldwork:

- Documentation will be maintained in a dedicated field notebook and on field forms.
- Notebook documentation will be completed in waterproof ink or permanent marker and written errors will be crossed out with a single line.

Field notebooks will include records of pertinent activities related to specific sampling tasks. They will be bound books with sequentially numbered pages. The books will remain in the custody of the Field Coordinator until project completion, after which, the books will be kept in the project files. The field notebook and forms will be maintained on a real-time basis and will include, where applicable and appropriate, the following information:

- Date, time of specific activities and weather conditions.
- Names of all personnel on the site, including visitors.
- Specific details regarding sampling activities, including sampling locations, type of sampling, depth, and sample numbers.
- Specific problems and resolutions.
- Identification numbers of monitoring instruments used that day.
- Chain-of-custody details, including sample identification numbers.

A draft field report will be prepared upon completion of field sampling activities each day. Field data that was recorded in the notebooks and field forms will be used to complete the field report. The field report will be used to document construction, sampling, and monitoring activities, sampling and Site personnel, and weather conditions, as well as decisions, corrective actions, and/or modifications to the project plans and procedures discussed in this report. The draft field report will be finalized following review by the Field Coordinator and/or Technical Project Manager and kept in the project files.

4.11. Sample Preservation, Container and Hold Times

Samples for fixed laboratory analysis will be prepared, containerized, and preserved in the field in accordance with the guidelines described in Table B-6. Samples will be kept on ice in coolers from the time of collection until delivery to the Laboratory. The samples will be preserved and hand delivered by the Field Staff, Field Coordinator, Technical Project Manager or courier to the laboratory. Alternatively, samples may be packaged and shipped to the laboratory. Samples will be kept at 0° to 6°C during delivery to the Laboratory and in refrigerated coolers while at the Laboratory until analyzed.

4.12. Analytical Methods

Laboratory analytical methods for the chemical analysis of sediment samples collected during this investigation will include total organic carbon, total volatile solids, metals, semi volatile organic compounds (SVOCs), PCB congeners, dioxins/furans, bulk tributyltin, porewater sulfides, porewater ammonia, and porewater tributyltin ion. Samples and QC samples shall be analyzed following the analytical methods listed in Table B-5, using laboratory instruments prescribed in the methods. The analytical methods must meet the technical acceptance criteria specified by the method prior to the analysis of environmental samples. Samples that are not analyzed initially (i.e., placed on “hold”) will be stored at the laboratory for up to 6 months, and will be disposed of by the laboratory following this period. Samples to be analyzed initially will be analyzed within proper holding times, which are listed in Table B-6.

The laboratory is required to comply with their current written standard operating procedures. All laboratory personnel will be responsible for reporting problems that may compromise the quality of the data to the laboratory project manager. A narrative describing the anomaly, the steps taken to identify and correct it and the treatment of the relevant sample batch (i.e., recalculation, reanalysis, re-extraction) will be submitted with the data package.

4.13. Quality Control

Quality control activities that will be implemented for each sampling, analysis or measurement technique are summarized in Table B-2 through B-13. Formulas for calculating QC statistics are provided in Section 3.1.

The Laboratory will maintain and implement documented QA/QC procedures. The laboratory QA/QC program will provide the following:

- Procedures that must be followed for certifying the precision and accuracy of the analytical data generated by the Laboratory.
- Documentation of each phase of sample handling, data acquisition, data transfer, report preparation, and report review.
- Accurate and secure storage and retrieval of samples and data.
- Detailed instructions for performing analyses and other activities affecting the quality of analytical data generated by the Laboratory.
- Appropriate management-level review and approval of procedures, revisions to procedures, and control of procedures in such a way so that laboratory personnel that require specific procedures have access to them.

A summary of method reporting limits (MRLs) and method detection limits (MDLs) for the Target Analytes are listed in Table B-5.

4.13.1. Field Quality Control

Field QC samples serve as a control and check mechanism to monitor the consistency of sampling methods and the potential influence of off-Site factors on project samples. Examples of off-Site factors include airborne VOCs and contaminants that may be present in potable water used during drilling activities.

4.13.1.1. Field Duplicates

In addition to replicate analyses performed in the laboratory, field duplicates also serve as measures for precision. Field duplicates measure the precision and consistency of laboratory analytical procedures and methods, as well as the consistency of the sampling techniques used by field personnel. Under ideal field conditions, field duplicates, are created by thoroughly mixing a volume of the sample matrix, placing aliquots of the mixed sample in separate containers, and identifying one of the aliquots as the primary sample and the other as the duplicate sample. One field duplicate will be collected for every twenty sediment samples.

4.13.1.2. Trip Blanks

Trip blanks consist of samples of reagent water that accompany samples to be analyzed for VOCs during sample storage in coolers and transport to the laboratory. They are used to assess potential contamination of samples during collection and transport due to the presence of VOCs in ambient air. Trip blanks will be analyzed on a one per cooler basis containing samples for VOC analysis.

4.13.2. Laboratory Quality Control

Laboratory QC procedures will be evaluated through a formal data quality assessment process. The analytical laboratory will follow standard analytical method procedures that include specified QC monitoring requirements. These requirements will vary by method, but generally include:

- Method blanks
- Internal standards
- Instrument calibrations
- Matrix spike/matrix spike duplicates (MS/MSD)
- Laboratory control samples/laboratory control sample duplicates (LC S/LCSD)
- Laboratory replicates or duplicates
- Surrogate spikes

4.13.2.1. Laboratory Blanks

Laboratory procedures utilize several types of blanks, but the most commonly used blanks for QC monitoring are method blanks. Method blanks are laboratory QC samples that consist of either a soil-like material having undergone a contaminant destruction process, or reagent (contaminant-free) water. Method blanks are extracted and analyzed with each batch of environmental samples undergoing analysis. Method blanks are particularly useful during volatiles analysis since VOCs can be transported in the laboratory through the vapor phase. If a substance is detected in a method blank, then one (or more) of the following occurred:

- Sample containers, measurement equipment, and/or analytical instruments were not properly cleaned and contained contaminants.
- Reagents used in the process were contaminated with a substance(s) of interest.
- Volatile substances in ambient laboratory air with high solubility or affinities toward the sample matrix contaminated the samples during preparation or analysis.

It is difficult to determine which of the above scenarios took place if blank contamination occurs. However, it is assumed that the conditions that affected the blanks also likely affected the project samples. If target analytes are detected in method blanks, data validation guidelines assist in determining which substances in project samples are considered “real,” and which ones are attributable to the analytical process. Furthermore, the guidelines state, “...there may be instances where little or no contamination was present in the associated blank, but qualification of the sample is deemed necessary. Contamination introduced through dilution water is one example” (USEPA, 2008).

For EPA Method 1668C, method blank contamination for individual PCB congeners is greater than two times the minimum level (Table 2 of the method) or one-third the regulatory compliance limit, whichever is greater; or if any potentially interfering compound is found in the blank at the minimum level for each PCB congener listed in Table 2 of the method (assuming a response factor of 1 relative to the quantitation listed at that level of chlorination for a potentially interfering compound; i.e., a compound not listed in this Method), analysis of samples must be halted until the sample batch is re-extracted and the extracts re-analyzed, and the blank associated with the sample batch shows no evidence of contamination at these

levels. All samples must be associated with an uncontaminated Method blank before the results for those samples may be reported or used for permitting or regulatory compliance purposes. If re-analysis options have been exhausted, congeners within three times the blank congener concentration will be appropriately flagged and not included in the PCB total.

4.13.2.2. Calibrations

Several types of instrument calibrations are used, depending on the analytical method, to assess the linearity of the calibration curve and assure that the sample results reflect accurate and precise measurements. The main calibrations used are initial calibrations, daily calibrations, and continuing calibration verification.

4.13.2.3. Matrix Spike/Matrix Spike Duplicates (MS/MSD)

MS/MSD samples are used to assess influences or interferences caused by the physical or chemical properties of the sample itself. For example, extreme pH can affect the results for SVOCs. Or, the presence of a particular compound may interfere with accurate quantitation of another analyte. MS/MSD data is reviewed in combination with other QC monitoring data to determine matrix effects. In some cases, matrix effects cannot be determined due to dilution and/or high levels of related substances in the sample. A matrix spike is evaluated by spiking a project sample with a known amount of one or more of the target analytes, ideally at a concentration that is 5 to 10 times higher than the sample result. A percent recovery is then calculated by subtracting the un-spiked sample result from the spiked sample result, dividing by the known concentration of the spike, and multiplying by 100.

MS/MSD samples will be analyzed at a frequency of one MS/MSD per sample set or batch. The samples for the MS/MSD analyses should be collected from a boring or sampling location that is believed to have only low-level contamination. A sample from an area of low-level contamination is needed because the objective of MS/MSD analyses is to determine the presence of matrix interferences, which can best be achieved with low levels of contaminants. Additional sample volume will be collected for the MS/MSD analyses as required by the laboratory.

4.13.2.4. Laboratory Control Sample/ Laboratory Control Sample Duplicates (LCS/LCSD)

Also known as blank spikes, laboratory control samples (LCS) are similar to MS samples in that a known amount of one or more of the target analytes are spiked into a prepared sample medium, and a percent recovery of the spiked substances is calculated. The primary difference between LCS and MS samples is that the LCS uses a contaminant-free sample medium. For example, reagent water is typically used for LCS water analyses. The purpose of an LCS is to help assess the overall accuracy and precision of the analytical process including sample preparation, instrument performance, and analyst performance.

4.13.2.5. Laboratory Replicates/Duplicates

Laboratories utilize MS/MSDs, LCS/LCSDs, and/or replicates to assess precision. Replicates are a second analysis of a field-collected environmental sample. Replicates can be split at varying stages of the sample preparation and analysis process; they most commonly consist of a second analysis on the extracted media.

4.13.2.6. Surrogate Spikes

Surrogate spikes are used to verify proper extraction procedures and the accuracy of the analytical instrument. Surrogates are substances with characteristics similar to the target analytes. A known concentration of surrogate is added to the project sample and passed through the instrument, and percent recovery is calculated. Each surrogate used has acceptance limits (i.e., an acceptable range) for percent

recovery. If a surrogate recovery is low, sample results may be biased low and depending on the recovery value, a possibility of false negatives may exist. Conversely, when recoveries are above the specified acceptance limits, a possibility of false positives exist, although non-detect results are considered accurate.

4.14. Instrument/Equipment Testing, Inspection, and Maintenance

4.14.1. Field Instrumentation

Field instruments are not expected to be necessary for sediment sampling collection. If field instruments are used calibration and calibration checks will be performed to facilitate accurate and reliable field measurements. The calibration of the instruments will be checked and adjusted as necessary in general accordance with manufacturers' recommendations. Methods and frequency of calibration checks and instrument maintenance will be based on the type of instrument, stability characteristics, required accuracy, intended use, and environmental conditions. The basic calibration check frequencies are described below.

4.14.2. Laboratory Instrumentation

For chemical analytical testing, calibration procedures will be performed in general accordance with the analytical methods used and the laboratory's Standard Operating Procedures (SOPs). Calibration documentation will be retained at the laboratory for a period of 6 months.

4.15. Laboratory Data Reporting and Deliverables

Laboratories will report data in formatted hardcopy and electronic form to the Technical Project Manager and QA Leader. Upon completion of analyses, the laboratory will prepare electronic deliverables for data packages in accordance with the specifications in the agreed-upon *Special Conditions for Lab Analysis* document. The laboratory will provide electronic data deliverables (EDDs) within 2 business days after GeoEngineers' receipt of printed-copy analytical results, including the appropriate QC documentation. GeoEngineers will establish EDD requirements with the contract laboratory.

Analytical laboratory measurements will be recorded in standard formats that display, at a minimum, the client/field sample identification, the laboratory sample identification, reporting units, analytical methods, analytes tested, analytical results, extraction and analysis dates, quantitation limits, and data qualifiers. Each sample delivery group will be accompanied by sample receipt forms and a case narrative identifying data quality issues.

5.0 DATA REDUCTION AND ASSESSMENT PROCEDURES

This section describes the process for generating and checking data, as well as the process for producing reports for field and analytical laboratory data.

5.1. Data Reduction

Data reduction involves the conversion or transcription of field and analytical data to a useable format. The laboratory personnel will reduce the analytical data for review by the QA Leader and Technical Project Manager. This will involve both hard-copy forms and EDDs. Both forms of data will be compared with each other to verify that the data are reliable and error-free.

5.2. Review of Field Documentation and Laboratory Receipt Information

Documentation of field sampling data will be reviewed periodically for conformance with project QC requirements described in this SAP. At a minimum, field documentation will be checked for proper documentation of the following:

- Sample collection information (date, time, location, matrices, etc.);
- Field instruments used and calibration data;
- Sample collection protocol;
- Sample containers, preservation, and volume;
- Field QC samples collected at the frequency specified;
- Chain-of-custody protocols; and
- Sample shipment information.

Sample receipt forms provided by the laboratory will be reviewed for QC exceptions. The final laboratory data package will describe (in the case narrative) the effects that any identified QC exceptions have on data quality. The laboratory will review transcribed sample collection and receipt information for correctness prior to delivering the final data package.

5.3. Data Verification/Validation

Project decisions, conclusions, and recommendations will be based upon verified (validated) data. The purpose of data verification is to ensure that data used for subsequent evaluations and calculations are scientifically valid, of known and documented quality, and legally defensible. Field data verification will be used to eliminate data not collected or documented in accordance with the protocols specified in the RI/FS Work Plan and this SAP. Laboratory data verification will be used to eliminate data not obtained using prescribed laboratory procedures.

The QA Leader will validate data collected during the supplemental investigation to ensure that the data are valid and usable. Data will be validated in general conformance with EPA functional guidelines for data validation (USEPA, 2004, 2005, and 2008). At a minimum, the following items will be reviewed to verify the data as applicable:

- Documentation that a final review of the data was completed by the Laboratory QA Coordinator;
- Documentation of analytical and QC methodology;
- Documentation of sample preservation and transport;
- Sample receipt forms and case narratives; and
- The following QC parameters:
 - Holding times and sample preservation
 - Method blanks
 - MS/MSDs
 - LCS/LCSDs
 - Surrogate spikes
 - Duplicates/replicates

When sample analytical data are received from the analytical laboratory, they will undergo a QC review by the QA Leader. The accuracy and precision achieved will be compared to the laboratory's analytical control limits. Example control limits are presented in Tables B-2 through B-4. Calculations of RPDs will follow standard statistical conventions and formulas as presented in in this SAP. Additional specifications and professional judgment by the QA Leader may be incorporated when appropriate data from specific matrices and field samples are available.

A data quality assessment will be prepared to document the overall quality of the data relative to the DQOs. The major components of the data quality assessment are as follows:

- **Data Validation Summary.** Summarizes the data validation results for all sample delivery groups by analytical method. The summary identifies any systematic problems, data generation trends, general conditions of the data, and reasons for any data qualification.
- **QC Sample Evaluation.** Evaluates the results of QC sample analyses, and presents conclusions based on these results regarding the validity of the project data.
- **Assessment of DQOs.** An assessment of the quality of data measured and generated in terms of accuracy, precision, and completeness relative to objectives established for the project.
- **Summary of Data Usability.** Summarizes the usability of data, based on the assessment performed in the three preceding steps.

The data quality assessment will help to achieve an acceptable level of confidence in the decisions that are to be made based upon the project data. The project analytical data will be submitted to Ecology's Environmental Information Management (EIM) system after the data quality assessment is completed.

5.4. TOC Normalized Data

In general, chemistry concentrations will be reported on a dry-weight basis. For polar organic chemicals, converted to TOC-normalized concentrations to allow direct comparison to the preliminary screening levels (Table B-5) when the corresponding TOC concentration in the sample ranges from 0.5 to 3.5 percent to allow direct comparison to the preliminary screening levels presented in Table B-5. Dry-weight values will be reported in cases where TOC values are either very high (> 3.5%) or very low (< 0.5%) for comparison to the preliminary screening levels (Table B-5).

5.5. Calculating Chemical Sums

The following guidelines will be used to calculate chemical sums:

- Total PAHs represents the sum of the detected concentrations of the following compounds: 1-methylnaphthalene, 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benzo[a]anthracene, benzo[a]pyrene, benzo[g,h,i]perylene, chrysene, dibenz[a,h]anthracene, fluoranthene, fluorene, indeno[1,2,3-c,d] pyrene, naphthalene phenanthrene, pyrene, and total benzofluoranthenes [b, j, k] (WAC 173-204-563(2)(h)).
- Total low molecular weight PAHs (LPAHs) represents the sum of the detected concentrations of the following compounds: acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, and phenanthrene, (WAC 173-204-562(2)(i)).

- Total high molecular weight PAHs (HPAHs) represents the sum of the detected concentrations of the following compounds: benz[a]anthracene, benzo[a]pyrene, benzo[g,h,i]perylene, chrysene, dibenzo[a,h]anthracene, fluoranthene, indeno[1,2,3-c,d]pyrene, pyrene, and total benzofluoranthenes, (WAC 173-204-562(2)(j)).
- Total benzofluoranthenes represents the sum of detected concentrations of the b, j, and k isomers of benzofluoranthenes (WAC 173-204-562(2)(k)). In some cases, the testing laboratory may report the total benzofluoranthenes concentration rather than concentrations of individual compounds since they may not be able to resolve all three isomers.
- Total PCBs represent the sum of the detected concentrations of Aroclors® 1016, 1221, 1232, 1242, 1248, 1254 and 1260.
- Total carcinogenic PAHs (cPAHs) will be calculated using the toxicity equivalence (TEQ) approach in accordance with WAC 173-340-708(8)(e). Total cPAH TEQs will be calculated using TEF values referenced from MTCA Table 708.2 (WAC 173-340-900). For non-detect results, one-half the PQL will be used in the TEQ calculations.
- Total dioxin/furans and dioxin-like PCB congeners will be calculated using the TEQ approach in accordance with WAC 173-340-708(8)(d). Total dioxin/furan TEQs will be calculated using the 2005 World Health Organization (WHO) toxicity equivalency factor (TEF) values to characterize the toxicity of these mixtures. The TEFs and minimum individual cPAHs that should be included in the TEQ calculations are listed in Table 3 of the Work Plan.

For the summation of chemical totals, non-detects represent any “U” qualified data, which may be data reported at the PQL, the MDL, or the RL. For the calculations, no distinction is made between these different types of detection limits, and any “U” qualified data are treated as “non-detects”. The following guidelines will be used for reporting and summing non-detects for total PAHs, LPAHs, HPAHs, benzofluoranthenes and PCBs for comparing site data to benthic criteria:

- When all chemicals in a group are non-detect, only the single highest individual chemical quantitation limit in a group will be reported and appropriately qualified.
- If some concentrations were detected and others are not, only the detected concentrations are included in the sum.

For calculating TEQ sums total cPAH, dioxin and furan, and dioxin-like PCB congener TEQs, the Ecology recommended Kaplan-Meier (KM) method for estimating the TEQ sums when non-detected congeners are present within a sample will be used. As an alternative, estimating the TEQ sum may be calculated using a substitution at one-half the detection limit (i.e., $n=1/2$). However, using this alternative may result in generated sums that are estimates with unknown bias and precision. Therefore, such values will be qualified appropriately as estimates with a “K” qualifier to indicate the variable accuracy of the estimated sums. In addition, these estimates will be bounded by reporting sums using a substitution of the detection limit at $n=0$ and $n=1$.

Estimated values between the method detection limit and the laboratory reporting limit (i.e. “J” qualified results) will be included in the summation at face value and the sum will also be qualified as estimated with a “J” qualifier. Results that are qualified as estimates with “J” qualifiers through data validation, will also be handled in the same manner.

6.0 PROJECT MANAGEMENT AND ORGANIZATION

The project management and organization elements of the SAP as detailed below address the basic area of project management including the roles and responsibilities of the participants, the project description, quality objectives and criteria, special training/certification and documents and records.

6.1. Project Organization and Responsibilities

Key individuals and positions providing quality assurance (QA) and quality control (QC) are summarized in the following table. A description of the responsibilities, lines of authority and communication for the key individuals and positions providing QA and QC is presented in Sections 6.1.1 through 6.1.8. This element of the plan ensures that the each key project participant has a defined role.

Project Role	Name Organization	Telephone Email Address
Port of Anacortes Project Manager	Jenkins Dossen Port of Anacortes	360.299.1814 Jenkins@portofanacortes.com 100 Commercial Ave. Anacortes, WA 98221
Technical Project Manager	John Herzog GeoEngineers	206.406.6431 jherzog@geoengineers.com 600 Stewart Street, Suite 1700 Seattle, Washington 98101
Task Manager/Field Coordinator	Brian Tracy GeoEngineers	206.239.3250 btracy@geoengineers.com 600 Stewart Street, Suite 1700 Seattle, Washington 98101
Health and Safety Manger	Wayne Adams GeoEngineers	253.722.2793 wadams@geoengineers.com 1101 Fawcett Avenue, Suite 200 Tacoma, Washington 98402
Quality Assurance Leader	Mark Lybeer GeoEngineers	206.278.2674 mlybeer@geoengineers.com 600 Stewart Street, Suite 1700 Seattle, Washington 98101
Laboratory Project Manager	Cheronne Oreiro Analytical Resources, Inc.	206.695.6214 cheronneo@arilabs.com 4611 S. 134 th Place, Suite 100 Tukwila, WA 98168-3240

6.1.1. Port of Anacortes Project Manager

The Port of Anacortes (Port) Project Manager's duties consist of implementing the project approach and tasks, overseeing the project team members during performance of project tasks.

6.1.2. Technical Project Manager

The Technical Project Manager is responsible for fulfilling contractual and administrative control of the project. The Technical Project Manager's duties include defining the project approach and tasks, selecting project team members and establishing budgets and schedules.

The Technical Project Manager's duties also include implementing the project approach and tasks, overseeing project team members during performance of project tasks, adhering to and communicating the status of budgets and schedules to the Port Project Manager, providing technical oversight, and providing overall production and review of project deliverables. The Technical Project Manager shall maintain the official, approved RI/FS Work Plan/SAP and shall be responsible for distributing updated documents to the recipients listed in Section 6.1.

6.1.3. Task Manager

The individual task managers are responsible for the daily management of project tasks including providing technical direction to the field staff, produces task specific documents including the SAP, Remedial Investigation/Feasibility Study Work Plan, and Health and Safety Plan (HASP), develops schedules and allocates resources for field tasks, coordinates data collection activities to be consistent with information requirements, supervises the compilation of field data and laboratory analytical results, assures that data are correctly and completely reported, implements and oversees field sampling in accordance with project plan and supervises field personnel. Additionally, the Task Manager coordinates work with on-site subcontractors, verifies that appropriate sampling, testing, and measurement procedures are followed, coordinates the transfer of field data, sample tracking forms, and log books to the Project Manager for data reduction and validation, and participates in QA corrective actions as required.

6.1.4. Field Coordinator

The Field Coordinator will lead the field sampling effort for the project, serving as the direct point of contact between the Task Manager, analytical laboratory and subcontractors; and ensures that the appropriate sampling containers, chain-of-custody (COC) forms and field sampling gear including personal protective equipment (PPE) are available. The Field Coordinator is to ensure that data collection activities are consistent with information requirements and to assure that field information is correctly and completely reported for the entire duration of the project. The Field Coordinator will also coordinate appropriate sampling, testing, and measurement procedures and schedule sample delivery/shipment with the analytical laboratory. The Field Coordinator will transfer field data and sample tracking forms to the project file and data reduction and validation and participate in QA corrective actions as required.

6.1.5. Technical/Field Staff

Technical/Field Staff have the primary responsibility for duties involve field data collection and documentation. Technical/Field Staff are responsible for:

- Understanding and following the Remedial Investigation/Feasibility Study Work Plan and SAP.
- Checking all equipment and supplies in advance of field operations.
- Ensuring that samples are properly collected, preserved, labeled, packaged, and shipped.
- Ensuring that all field data are carefully recorded in accordance with the Remedial Investigation/Feasibility Study Work Plan and SAP.
- Following chain-of-custody procedures and standard operating procedures when they are required.

6.1.6. Quality Assurance Leader

The Quality Assurance Leader will provide oversight required for the completion of sample analyses for the project and verify, in conjunction with the laboratory manager, that the analytical work is proceeding in accordance with internal laboratory standard practices and the QA/QC guidelines for the project. This person will also oversee completion of data validation activities completed for this project. The Quality Assurance Leader maintains independence from the individual(s) generating the data.

6.1.7. Health and Safety Manager

The Health and Safety Manager will oversee implementation of health and safety programs and verify that work on the project proceeds in accordance with the site-specific HASP.

6.1.8. Laboratory Project Manager

The Laboratory Project Manager will fulfill the analytical requirements of this project including being responsible for sample analyses using appropriate analytical laboratory methods. The specific procedures to be used for COC transfer, internal calibrations, laboratory analyses, reporting, preventive instrument maintenance, and corrective action will follow standard protocols.

7.0 REFERENCES

Dredged Material Management Program (DMMP), 2013, "Bioassay Endpoint Refinements: Bivalve larval and Neanthes Growth Bioassay. Prepared by David Kendall, (U.S. Army Corps of Engineers) and Russ McMillan, (Washington State Department of Ecology) for the DMMP agencies and SMS Program, and Bill Gardiner, Brian Hester, and Jack D Word (Newfields, LLC)," dated June 5, 2013.

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Washington State Department of Ecology (Ecology), 2008, "Sediment Sampling and Analysis Plan Appendix, Guidance on the Development of Sediment Sampling and Analysis Plans Meeting the Requirements of the Sediment Management Standards (Chapter 173-204 WAC)," Ecology Publication No. 03-09-043, Sediment Source Control Standards User Manual, Washington Department of Ecology Sediment Management Unit, Revised February 2008.

Table B-1
Proposed Sampling Location Coordinates
Anacortes Port Log Yard
Anacortes, Washington

Sample Location	Northing	Easting	Latitude	Longitude
LY-1	559608.6318	1210617.098	48.3114	-122.3625
LY-2	559609.0724	1210710.276	48.3114	-122.3624
LY-3	559707.8508	1210662.121	48.3115	-122.3624
LY-4	559816.8874	1210661.04	48.3116	-122.3624
LY-5	559961.5924	1210664.707	48.3117	-122.3624
LY-6	560080.2847	1210669.564	48.3119	-122.3624
LY-7	560185.0163	1210804.291	48.312	-122.3622
LY-8	559907.3682	1210729.217	48.3117	-122.3623
LY-9	559867.1419	1210770.342	48.3116	-122.3623
LY-10	559917.0895	1210804.871	48.3117	-122.3622
LY-11	559871.982	1210887.132	48.3117	-122.3621
LY-12	559973.3579	1210924.766	48.3118	-122.3621
LY-13	559899.7282	1211030.099	48.3117	-122.3619

Table B-2
Measurement Quality Objectives - Conventionals, Metals, SVOCs, and Tributyltin Ion
Anacortes Port Log Yard
Anacortes, Washington

Laboratory Analysis	Laboratory Control Sample¹ (LCS) (% Recovery)	Matrix Spike¹ (MS) (% Recovery)	Surrogate Standard² (SS) (% Recovery)	MS Duplicate Samples or Lab Duplicate RPD Limits³ (%)
Total Organic Carbon	75 - 125	75 - 125	--	--
Total Volatile Solids	--	--	--	±20
Sulfides	75 - 125	75 - 125	--	±20
Ammonia ⁴	75 - 125	75 - 125	--	±20
Metals ⁴	80 - 120	75 - 125	--	≤20
SMS SVOCs	30 - 160	30 - 160	30 - 160	≤30
Bulk Tributyltin	30 - 160	30 - 160	30 - 160	≤30
Porewater Tributyltin Ion	30 - 160	30 - 160	30 - 160	≤30

Notes:

¹ Percent recovery limits are expressed as ranges based on laboratory control limits. Limits will vary for individual analytes.

² Individual surrogate recoveries are compound-specific.

³ RPD control limits are only applicable if the primary and duplicate sample concentrations are greater than 5 times the method reporting limit (MRL). For results less than 5 times the MRL, the difference between the primary and duplicate samples must be less than 2 times the MRL.

⁴ The identified quality control criteria for ammonia and sulfide applies to both porewater and bulk analyses.

-- indicates that the measurement quality objective is not applicable for the laboratory method.

SMS = Sediment Management Standards

SVOCs = Semivolatile organic compounds

PCBs = Polychlorinated biphenyls

RPD = Relative percent difference

MS = Matrix spike

Table B-3
Measurement Quality Objectives - Dioxins and Furans
Anacortes Port Log Yard
Anacortes, Washington

Laboratory Analysis	Initial Precision and Recovery		Ongoing Precision and Recovery (%)	Initial Calibration (%)	Calibration Verification (%)	Labeled Compound (% Recovery)	
	RSD (%)	Recovery (%)				Warning Limit	Control Limit
Native Compound							
2,3,7,8-TCDD	28	83 - 129	67 - 158	20	78 - 129	-	-
2,3,7,8-TCDF	20	87 - 137	75 - 158	20	84 - 120	-	-
1,2,3,7,8-PeCDD	15	76 - 132	70 - 142	20	78 - 130	-	-
1,2,3,7,8-PeCDF	15	86 - 124	80 - 134	20	82 - 120	-	-
2,3,4,7,8-PeCDF	17	72 - 150	68 - 160	20	82 - 122	-	-
1,2,3,4,7,8-HxCDD	19	78 - 152	70 - 164	20	78 - 128	-	-
1,2,3,6,7,8-HxCDD	15	84 - 124	76 - 134	20	78 - 128	-	-
1,2,3,7,8,9-HxCDD	22	74 - 142	64 - 162	20	82 - 122	-	-
1,2,3,4,7,8-HxCDF	17	82 - 118	72 - 134	20	90 - 112	-	-
1,2,3,6,7,8-HxCDF	13	92 - 120	84 - 130	20	88 - 114	-	-
1,2,3,7,8,9-HxCDF	13	84 - 122	78 - 130	20	90 - 112	-	-
2,3,4,6,7,8-HxCDF	15	74 - 148	70 - 156	20	88 - 114	-	-
1,2,3,4,6,7,8-HpCDD	15	76 - 130	70 - 140	20	86 - 116	-	-
1,2,3,4,6,7,8-HpCDF	13	90 - 112	82 - 122	20	90 - 110	-	-
1,2,3,4,7,8,9-HpCDF	16	86 - 126	78 - 138	20	86 - 116	-	-
OCDD	19	89 - 127	78 - 144	20	79 - 126	-	-
OCDF	27	74 - 146	63 - 170	20	63 - 159	-	-
Labeled Compounds							
13C ₁₂ -2,3,7,8-TCDD	37	28 - 134	20 - 175	35	82 - 121	40 - 120	25 - 164
13C ₁₂ -2,3,7,8-TCDF	35	31 - 113	22 - 152	35	71 - 140	40 - 120	24 - 169
13C ₁₂ -1,2,3,7,8-PeCDD	39	27 - 184	21 - 227	35	62 - 160	40 - 120	25 - 181
13C ₁₂ -1,2,3,7,8-PeCDF	34	27 - 156	21 -192	35	76 - 130	40 - 120	24 - 185
13C ₁₂ -2,3,4,7,8-PeCDF	38	16 - 279	13 - 328	35	77 - 130	40 - 120	21 - 178
13C ₁₂ -1,2,3,4,7,8-HxCDD	41	29 - 147	21 - 193	35	85 - 117	40 - 120	32 - 141
13C ₁₂ -1,2,3,6,7,8-HxCDD	38	34 - 122	25 - 163	35	85 - 118	40 - 120	28 - 130
13C ₁₂ -1,2,3,4,7,8-HxCDF	43	27 - 152	19 - 202	35	76 - 131	40 - 120	26 - 152
13C ₁₂ -1,2,3,6,7,8-HxCDF	35	30 - 122	21 - 159	35	70 - 143	40 - 120	26 - 123
13C ₁₂ -1,2,3,7,8,9-HxCDF	40	24 - 157	17 - 205	35	74 - 135	40 - 120	29 - 147
13C ₁₂ -2,3,4,6,7,8-HxCDF	37	29 - 136	22 - 176	35	73 - 137	40 - 120	28 - 136
13C ₁₂ -1,2,3,4,6,7,8-HpCDD	35	34 - 129	26 - 166	35	72 - 138	40 - 120	23 - 140
13C ₁₂ -1,2,3,4,6,7,8-HpCDF	41	32 - 110	21 - 158	35	78 - 129	40 - 120	28 - 143
13C ₁₂ -1,2,3,4,7,8,9-HpCDF	40	28 - 141	20 - 186	35	77 - 129	40 - 120	26 - 138
13C ₁₂ -OCDD	48	21 - 138	13 - 199	35	48 - 208	25 - 120	17 - 157
Cleanup Standard							
37Cl ₄ -2,3,7,8-TCDD	36	39 - 154	31 - 191	35	79 - 127	40 - 120	35 - 197

Notes:

– indicates that the measurement quality objective is not applicable for the laboratory method.

RSD = Relative standard deviation

Table B-4
Measurement Quality Objectives - PCB Congeners
Anacortes Port Log Yard
Anacortes, Washington

Laboratory Analysis	Test Concentration ^{1,2,3} (ng/ml)	Calibration Verification (%)	Initial Precision and Recovery		Ongoing Precision and Recovery (%)	Surrogate Standard (% Recovery in Sample)
			RSD (%)	Recovery (%)		
Compound						
PCB-1	50	72-125	25	70-130	60-135	-
PCB-3	50	72-125	25	70-130	60-135	-
PCB-4	50	72-125	25	70-130	60-135	-
PCB-15	50	72-125	25	70-130	60-135	-
PCB-19	50	72-125	25	70-130	60-135	-
PCB-37	50	72-125	25	70-130	60-135	-
PCB-54	50	72-125	25	70-130	60-135	-
PCB-77	50	72-125	25	70-130	60-135	-
PCB-81	50	72-125	25	70-130	60-135	-
PCB-104	50	72-125	25	70-130	60-135	-
PCB-105	50	72-125	25	70-130	60-135	-
PCB-114	50	72-125	25	70-130	60-135	-
PCB-118	50	72-125	25	70-130	60-135	-
PCB-123	50	72-125	25	70-130	60-135	-
PCB-126	50	72-125	25	70-130	60-135	-
PCB-155	50	72-125	25	70-130	60-135	-
PCB-156	50	72-125	25	70-130	60-135	-
PCB-157	50	72-125	25	70-130	60-135	-
PCB-167	50	72-125	25	70-130	60-135	-
PCB-169	50	72-125	25	70-130	60-135	-
PCB-188	50	72-125	25	70-130	60-135	-
PCB-189	50	72-125	25	70-130	60-135	-
PCB-202	50	72-125	25	70-130	60-135	-
PCB-205	50	72-125	25	70-130	60-135	-
PCB-206	50	72-125	25	70-130	60-135	-
PCB-208	50	72-125	25	70-130	60-135	-
PCB-209	50	72-125	25	70-130	60-135	-
Surrogate Compounds						
13C-PCB-1	100	50-145	70	20-135	15-145	5-145
13C-PCB-3	100	50-145	70	20-135	15-145	5-145
13C-PCB-4	100	50-145	70	20-135	15-145	5-145
13C-PCB-15	100	50-145	70	20-135	15-145	5-145
13C-PCB-19	100	50-145	70	20-135	15-145	5-145
13C-PCB-28	100	50-145	70	20-135	15-145	5-145
13C-PCB-37	100	50-145	70	20-135	15-145	5-145
13C-PCB-54	100	50-145	70	20-135	15-145	5-145
13C-PCB-77	100	50-145	50	45-135	40-145	10-145
13C-PCB-81	100	50-145	50	45-135	40-145	10-145
13C-PCB-104	100	50-145	50	45-135	40-145	10-145
13C-PCB-105	100	50-145	50	45-135	40-145	10-145
13C-PCB-111	100	50-145	50	45-135	40-145	10-145
13C-PCB-114	100	50-145	50	45-135	40-145	10-145
13C-PCB-118	100	50-145	50	45-135	40-145	10-145
13C-PCB-123	100	50-145	50	45-135	40-145	10-145
13C-PCB-126	100	50-145	50	45-135	40-145	10-145
13C-PCB-155	100	50-145	50	45-135	40-145	10-145
13C-PCB-156	100	50-145	50	45-135	40-145	10-145
13C-PCB-157	100	50-145	50	45-135	40-145	10-145
13C-PCB-167	100	50-145	50	45-135	40-145	10-145
13C-PCB-169	100	50-145	50	45-135	40-145	10-145
13C-PCB-178	100	50-145	50	45-135	40-145	10-145
13C-PCB-188	100	50-145	50	45-135	40-145	10-145
13C-PCB-189	100	50-145	50	45-135	40-145	10-145
13C-PCB-202	100	50-145	50	45-135	40-145	10-145
13C-PCB-205	100	50-145	50	45-135	40-145	10-145
13C-PCB-206	100	50-145	50	45-135	40-145	10-145
13C-PCB-208	100	50-145	50	45-135	40-145	10-145
13C-PCB-209	100	50-145	50	45-135	40-145	10-145
Cleanup Surrogate Compounds						
13C-PCB-28	100	65-135	70	20-135	15-145	5-145
13C-PCB-111	100	75-125	50	45-135	40-145	10-145
13C-PCB-178	100	75-125	50	45-135	40-145	10-145

Notes:

¹ Concentration of Congeners and Surrogates in Calibration Verification Standard #3 (CS3)

Table B-5
Method Analysis and Target Reporting Limits for Sediment
Anacortes Port Log Yard
Anacortes, Washington

Analysis	CAS Number ¹	Method	Practical Quantification Limit (PQL ²)	Preliminary Sediment Screening Levels ³			
				Protection of Benthic Organisms		Protection of Human Health and Higher Trophic Ecological Receptors	
				Apparent Effects Threshold (AET) Criteria ⁴	Sediment Management Standard (SMS) ⁵	Intertidal Sediment (above - 3 ft MLLW)	Subtidal Sediment (below -3 ft MLLW)
Conventionals							
Grain Size (%)	--	PSEP 1986 or ASTM-Mod	--	--	--	--	--
Total solids (%)	--	SM2540G	0.1				
Total volatile solids (%)	--	PSEP 1986/ ASTM D2974	0.1	--	--	--	--
Total Organic Carbon (%)	--	EPA 9060 M	0.1	--	--	--	--
Porewater Ammonia (mg/L)	--	EPA 350.1 M	0.01				
Porewater Sulfide (mg/L)	--	SM4500-S2	0.05				
Metals			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Arsenic	7440-38-2	EPA 6010/6020	5	57	57	11	11
Cadmium	7440-43-9	EPA 6010/6020	0.2	5.1	5.1	1	1
Chromium	7440-47-3	EPA 6010/6020	0.5	260	260	700,000	2,600,000
Copper	7440-50-8	EPA 6010/6020	0.2	390	390	19,000	69,000
Lead	7439-92-1	EPA 6010/6020	2	450	450	21	21
Mercury	7439-97-6	EPA 7470A/ 7471A	0.05	0.41	0.41	0.2	0.2
Silver	7440-22-4	EPA 6010/6020	0.3	6.1	6.1	2,300	8,700
Zinc	7440-66-6	EPA 6010/6020	1	410	410	140,000	520,000
Polycyclic Aromatic Hydrocarbons (PAHs)			µg/kg	µg/kg	mg/kg OC	µg/kg	µg/kg
Total LPAH	--	--	5	5200	370	--	--
Naphthalene	91-20-3	EPA 8270-SIM	5	2100	99	3,800,000	29,000,000
Acenaphthylene	208-96-8	EPA 8270-SIM	5	1300	66	11,000,000	88,000,000
Acenaphthene	83-32-9	EPA 8270-SIM	5	500	16	11,000,000	88,000,000
Fluorene	86-73-7	EPA 8270-SIM	5	540	23	7,600,000	59,000,000
Phenanthrene	85-01-8	EPA 8270-SIM	5	1500	100	57,000,000	440,000,000
Anthracene	120-12-7	EPA 8270-SIM	5	960	220	57,000,000	440,000,000
2-Methylnaphthalene	91-57-6	EPA 8270-SIM	5	670	38	760,000	5,900,000
Total HPAH	--	--	5	12000	960	--	--
Fluoranthene	206-44-0	EPA 8270-SIM	5	1700	160	5,900,000	5,900,000
Pyrene	129-00-0	EPA 8270-SIM	5	2600	1000	5,700,000	44,000,000
Benz(a)anthracene	56-55-3	EPA 8270-SIM	5	1300	110	650	5,000
Chrysene	218-01-9	EPA 8270-SIM	5	1400	110	6,500	50,000
Benzofluoranthenes (b, j ,k)	205-99-2/ 205-82-3/ 207-08-9	EPA 8270-SIM	5	3200	230	650	5,000
Benzo(a)pyrene	50-32-8	EPA 8270-SIM	5	1600	99	65	500
Indeno(1,2,3-c,d)pyrene	193-39-5	EPA 8270-SIM	5	600	34	650	5,000
Dibenz(a,h)anthracene	53-70-3	EPA 8270-SIM	5	230	12	650	5,000
Benzo(g,h,i)perylene	191-24-2	EPA 8270-SIM	5	670	31	5,700,000	44,000,000
Total cPAHs	--	--	5	NE	NE	16	16
Chlorinated Hydrocarbons			µg/kg	µg/kg	mg/kg OC	µg/kg	µg/kg
1,4-Dichlorobenzene	106-46-7	EPA 8270/8270-SIM	5	35	2.3	88,000	680,000
1,3-Dichlorobenzene	541-73-1	EPA 8270/8270-SIM	5	>0.17	NE	NE	NE
1,2-Dichlorobenzene	95-50-1	EPA 8270/8270-SIM	5	110	3.1	17,000,000	130,000,000
1,2,4-Trichlorobenzene	120-82-1	EPA 8270/8270-SIM	5	31	0.81	16,000	130,000
Hexachlorobenzene (HCB)	118-74-1	EPA 8081B	1	22	0.38	300	2,300
Phthalates			µg/kg	µg/kg	mg/kg OC	µg/kg	µg/kg
Dimethyl phthalate	131-11-3	EPA 8270	20	71	53	--	--
Diethyl phthalate	84-66-2	EPA 8270	20	200	61	150,000,000	1,200,000,000
Di-n-butyl phthalate	84-74-2	EPA 8270	20	1400	220	19,000,000	150,000,000
Butyl benzyl phthalate	85-68-7	EPA 8270/8270-SIM	5	63	4.9	250,000	1,900,000
Bis(2-ethylhexyl) phthalate	117-81-7	EPA 8270	50	1300	47	34,000	260,000
Di-n-octyl phthalate	117-84-0	EPA 8270	20	6200	58	1,900,000	15,000,000
Miscellaneous Extractables			µg/kg	µg/kg	mg/kg OC	µg/kg	µg/kg
Dibenzofuran	132-64-9	EPA 8270/8270-SIM	5	540	15	190,000	1,500,000
Hexachlorobutadiene	87-68-3	EPA 8081B	1	11	3.9	6,100	47,000
N-Nitrosodiphenylamine	86-30-6	EPA 8270/8270-SIM	5	28	11	97,000	750,000
			µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Benzyl alcohol	100-51-6	EPA 8270	20	57	57	19,000,000	150,000,000
Benzoic acid	65-85-0	EPA 8270	200	650	650	760,000,000	5,900,000,000
Phenols			µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Phenol	108-95-2	EPA 8270	100	420	420	57,000,000	440,000,000
2-Methylphenol	95-48-7	EPA 8270	20	63	63	9,500,000	73,000,000
4-Methylphenol	106-44-5	EPA 8270	20	670	670	19,000,000	150,000,000
2,4-Dimethylphenol	105-67-9	EPA 8270/8270-SIM	25	29	29	3,800,000	29,000,000
Pentachlorophenol	87-86-5	EPA 8270	100	360	360	1,200	9,200
Polychlorinated Biphenyl (PCB) Congeners			ng/kg	ng/kg	mg/kg OC	ng/kg	ng/kg
PCB-1	2051-60-7	EPA 1668C	2	NE	NE	NE	NE
PCB-2	2051-61-8	EPA 1668C	2	NE	NE	NE	NE
PCB-3	2051-62-9	EPA 1668C	2	NE	NE	NE	NE
PCB-4	13029-08-8	EPA 1668C	2	NE	NE	NE	NE
PCB-5	16605-91-7	EPA 1668C	2	NE	NE	NE	NE
PCB-6	25569-80-6	EPA 1668C	2	NE	NE	NE	NE
PCB-7	33284-50-3	EPA 1668C	2	NE	NE	NE	NE
PCB-8	34883-43-7	EPA 1668C	2	NE	NE	NE	NE
PCB-9	34883-39-1	EPA 1668C	2	NE	NE	NE	NE
PCB-10	33146-45-1	EPA 1668C	2	NE	NE	NE	NE

Analysis	CAS Number ¹	Method	Practical Quantification Limit (PQL ²)	Preliminary Sediment Screening Levels ³			
				Protection of Benthic Organisms		Protection of Human Health and Higher Trophic Ecological Receptors	
				Apparent Effects Threshold (AET) Criteria ⁴	Sediment Management Standard (SMS) ⁵	Intertidal Sediment (above - 3 ft MLLW)	Subtidal Sediment (below -3 ft MLLW)
PCB-11	2050-67-1	EPA 1668C	2	NE	NE	NE	NE
PCB-12	2974-92-7	EPA 1668C	2	NE	NE	NE	NE
PCB-13	2974-90-5	EPA 1668C	2	NE	NE	NE	NE
PCB-14	34883-41-5	EPA 1668C	2	NE	NE	NE	NE
PCB-15	2050-68-2	EPA 1668C	2	NE	NE	NE	NE
PCB-16	38444-78-9	EPA 1668C	2	NE	NE	NE	NE
PCB-17	37680-66-3	EPA 1668C	2	NE	NE	NE	NE
PCB-18	37680-65-2	EPA 1668C	2	NE	NE	NE	NE
PCB-19	38444-73-4	EPA 1668C	2	NE	NE	NE	NE
PCB-20	38444-84-7	EPA 1668C	2	NE	NE	NE	NE
PCB-21	55702-46-0	EPA 1668C	2	NE	NE	NE	NE
PCB-22	38444-85-8	EPA 1668C	2	NE	NE	NE	NE
PCB-23	55720-44-0	EPA 1668C	2	NE	NE	NE	NE
PCB-24	55702-45-9	EPA 1668C	2	NE	NE	NE	NE
PCB-25	55712-37-3	EPA 1668C	2	NE	NE	NE	NE
PCB-26	38444-81-4	EPA 1668C	2	NE	NE	NE	NE
PCB-27	38444-76-7	EPA 1668C	2	NE	NE	NE	NE
PCB-28	7012-37-5	EPA 1668C	2	NE	NE	NE	NE
PCB-29	15862-07-4	EPA 1668C	2	NE	NE	NE	NE
PCB-30	35693-92-6	EPA 1668C	2	NE	NE	NE	NE
PCB-31	16606-02-3	EPA 1668C	2	NE	NE	NE	NE
PCB-32	38444-77-8	EPA 1668C	2	NE	NE	NE	NE
PCB-33	38444-86-9	EPA 1668C	2	NE	NE	NE	NE
PCB-34	37680-68-5	EPA 1668C	2	NE	NE	NE	NE
PCB-35	37680-69-6	EPA 1668C	2	NE	NE	NE	NE
PCB-36	38444-87-0	EPA 1668C	2	NE	NE	NE	NE
PCB-37	38444-90-5	EPA 1668C	2	NE	NE	NE	NE
PCB-38	53555-66-1	EPA 1668C	2	NE	NE	NE	NE
PCB-39	38444-88-1	EPA 1668C	2	NE	NE	NE	NE
PCB-40	38444-93-8	EPA 1668C	2	NE	NE	NE	NE
PCB-41	52663-59-9	EPA 1668C	2	NE	NE	NE	NE
PCB-42	36559-22-5	EPA 1668C	2	NE	NE	NE	NE
PCB-43	70362-46-8	EPA 1668C	2	NE	NE	NE	NE
PCB-44	41464-39-5	EPA 1668C	2	NE	NE	NE	NE
PCB-45	70362-45-7	EPA 1668C	2	NE	NE	NE	NE
PCB-46	41464-47-5	EPA 1668C	2	NE	NE	NE	NE
PCB-47	2437-79-8	EPA 1668C	2	NE	NE	NE	NE
PCB-48	70362-47-9	EPA 1668C	2	NE	NE	NE	NE
PCB-49	41464-40-8	EPA 1668C	2	NE	NE	NE	NE
PCB-50	62796-65-0	EPA 1668C	2	NE	NE	NE	NE
PCB-51	68194-04-7	EPA 1668C	2	NE	NE	NE	NE
PCB-52	35693-99-3	EPA 1668C	2	NE	NE	NE	NE
PCB-53	41464-41-9	EPA 1668C	2	NE	NE	NE	NE
PCB-54	15968-05-5	EPA 1668C	2	NE	NE	NE	NE
PCB-55	74338-24-2	EPA 1668C	2	NE	NE	NE	NE
PCB-56	41464-43-1	EPA 1668C	2	NE	NE	NE	NE
PCB-57	70424-67-8	EPA 1668C	2	NE	NE	NE	NE
PCB-58	41464-49-7	EPA 1668C	2	NE	NE	NE	NE
PCB-59	74472-33-6	EPA 1668C	2	NE	NE	NE	NE
PCB-60	33025-41-1	EPA 1668C	2	NE	NE	NE	NE
PCB-61	33284-53-6	EPA 1668C	2	NE	NE	NE	NE
PCB-62	54230-22-7	EPA 1668C	2	NE	NE	NE	NE
PCB-63	74472-34-7	EPA 1668C	2	NE	NE	NE	NE
PCB-64	52663-58-8	EPA 1668C	2	NE	NE	NE	NE
PCB-65	33284-54-7	EPA 1668C	2	NE	NE	NE	NE
PCB-66	32598-10-0	EPA 1668C	2	NE	NE	NE	NE
PCB-67	73575-53-8	EPA 1668C	2	NE	NE	NE	NE
PCB-68	73575-52-7	EPA 1668C	2	NE	NE	NE	NE
PCB-69	60233-24-1	EPA 1668C	2	NE	NE	NE	NE
PCB-70	32598-11-1	EPA 1668C	2	NE	NE	NE	NE
PCB-71	41464-46-4	EPA 1668C	2	NE	NE	NE	NE
PCB-72	41464-42-0	EPA 1668C	2	NE	NE	NE	NE
PCB-73	74338-23-1	EPA 1668C	2	NE	NE	NE	NE
PCB-74	32690-93-0	EPA 1668C	2	NE	NE	NE	NE
PCB-75	32598-12-2	EPA 1668C	2	NE	NE	NE	NE
PCB-76	70362-48-0	EPA 1668C	2	NE	NE	NE	NE
PCB-78	70362-49-1	EPA 1668C	2	NE	NE	NE	NE
PCB-79	41464-48-6	EPA 1668C	2	NE	NE	NE	NE
PCB-80	33284-52-5	EPA 1668C	2	NE	NE	NE	NE
PCB-82	52663-62-4	EPA 1668C	2	NE	NE	NE	NE
PCB-83	60145-20-2	EPA 1668C	2	NE	NE	NE	NE
PCB-84	52663-60-2	EPA 1668C	2	NE	NE	NE	NE
PCB-85	65510-45-4	EPA 1668C	2	NE	NE	NE	NE
PCB-86	55312-69-1	EPA 1668C	2	NE	NE	NE	NE
PCB-87	38380-02-8	EPA 1668C	2	NE	NE	NE	NE
PCB-88	55215-17-3	EPA 1668C	2	NE	NE	NE	NE
PCB-89	73575-57-2	EPA 1668C	2	NE	NE	NE	NE
PCB-90	68194-07-0	EPA 1668C	2	NE	NE	NE	NE
PCB-91	68194-05-8	EPA 1668C	2	NE	NE	NE	NE
PCB-92	52663-61-3	EPA 1668C	2	NE	NE	NE	NE
PCB-93	73575-56-1	EPA 1668C	2	NE	NE	NE	NE
PCB-94	73575-55-0	EPA 1668C	2	NE	NE	NE	NE
PCB-95	38379-99-6	EPA 1668C	2	NE	NE	NE	NE

Analysis	CAS Number ¹	Method	Practical Quantification Limit (PQL ²)	Preliminary Sediment Screening Levels ³			
				Protection of Benthic Organisms		Protection of Human Health and Higher Trophic Ecological Receptors	
				Apparent Effects Threshold (AET) Criteria ⁴	Sediment Management Standard (SMS) ⁵	Intertidal Sediment (above - 3 ft MLLW)	Subtidal Sediment (below -3 ft MLLW)
PCB-96	73575-54-9	EPA 1668C	2	NE	NE	NE	NE
PCB-97	41464-51-1	EPA 1668C	2	NE	NE	NE	NE
PCB-98	60233-25-2	EPA 1668C	2	NE	NE	NE	NE
PCB-99	38380-01-7	EPA 1668C	2	NE	NE	NE	NE
PCB-100	39485-83-1	EPA 1668C	2	NE	NE	NE	NE
PCB-101	37680-73-2	EPA 1668C	2	NE	NE	NE	NE
PCB-102	68194-06-9	EPA 1668C	2	NE	NE	NE	NE
PCB-103	60145-21-3	EPA 1668C	2	NE	NE	NE	NE
PCB-104	56558-16-8	EPA 1668C	2	NE	NE	NE	NE
PCB-106	70424-69-0	EPA 1668C	2	NE	NE	NE	NE
PCB-107	70424-68-9	EPA 1668C	2	NE	NE	NE	NE
PCB-108	70362-41-3	EPA 1668C	2	NE	NE	NE	NE
PCB-109	74472-35-8	EPA 1668C	2	NE	NE	NE	NE
PCB-110	38380-03-9	EPA 1668C	2	NE	NE	NE	NE
PCB-111	39635-32-0	EPA 1668C	2	NE	NE	NE	NE
PCB-112	74472-36-9	EPA 1668C	2	NE	NE	NE	NE
PCB-113	68194-10-5	EPA 1668C	2	NE	NE	NE	NE
PCB-115	74472-38-1	EPA 1668C	2	NE	NE	NE	NE
PCB-116	18259-05-7	EPA 1668C	2	NE	NE	NE	NE
PCB-117	68194-11-6	EPA 1668C	2	NE	NE	NE	NE
PCB-119	56558-17-9	EPA 1668C	2	NE	NE	NE	NE
PCB-120	68194-12-7	EPA 1668C	2	NE	NE	NE	NE
PCB-121	56558-18-0	EPA 1668C	2	NE	NE	NE	NE
PCB-122	76842-07-4	EPA 1668C	2	NE	NE	NE	NE
PCB-124	70424-70-3	EPA 1668C	2	NE	NE	NE	NE
PCB-125	74472-39-2	EPA 1668C	2	NE	NE	NE	NE
PCB-127	39635-33-1	EPA 1668C	2	NE	NE	NE	NE
PCB-128	38380-07-3	EPA 1668C	2	NE	NE	NE	NE
PCB-129	55215-18-4	EPA 1668C	2	NE	NE	NE	NE
PCB-130	52663-66-8	EPA 1668C	2	NE	NE	NE	NE
PCB-131	61798-70-7	EPA 1668C	2	NE	NE	NE	NE
PCB-132	38380-05-1	EPA 1668C	2	NE	NE	NE	NE
PCB-133	35694-04-3	EPA 1668C	2	NE	NE	NE	NE
PCB-134	52704-70-8	EPA 1668C	2	NE	NE	NE	NE
PCB-135	52744-13-5	EPA 1668C	2	NE	NE	NE	NE
PCB-136	38411-22-2	EPA 1668C	2	NE	NE	NE	NE
PCB-137	35694-06-5	EPA 1668C	2	NE	NE	NE	NE
PCB-138	35065-28-2	EPA 1668C	2	NE	NE	NE	NE
PCB-139	56030-56-9	EPA 1668C	2	NE	NE	NE	NE
PCB-140	59291-64-4	EPA 1668C	2	NE	NE	NE	NE
PCB-141	52712-04-6	EPA 1668C	2	NE	NE	NE	NE
PCB-142	41411-61-4	EPA 1668C	2	NE	NE	NE	NE
PCB-143	68194-15-0	EPA 1668C	2	NE	NE	NE	NE
PCB-144	68194-14-9	EPA 1668C	2	NE	NE	NE	NE
PCB-145	74472-40-5	EPA 1668C	2	NE	NE	NE	NE
PCB-146	51908-16-8	EPA 1668C	2	NE	NE	NE	NE
PCB-147	68194-13-8	EPA 1668C	2	NE	NE	NE	NE
PCB-148	74472-41-6	EPA 1668C	2	NE	NE	NE	NE
PCB-149	38380-04-0	EPA 1668C	2	NE	NE	NE	NE
PCB-150	68194-08-1	EPA 1668C	2	NE	NE	NE	NE
PCB-151	52663-63-5	EPA 1668C	2	NE	NE	NE	NE
PCB-152	68194-09-2	EPA 1668C	2	NE	NE	NE	NE
PCB-153	35065-27-1	EPA 1668C	2	NE	NE	NE	NE
PCB-154	60145-22-4	EPA 1668C	2	NE	NE	NE	NE
PCB-155	33979-03-2	EPA 1668C	2	NE	NE	NE	NE
PCB-158	74472-42-7	EPA 1668C	2	NE	NE	NE	NE
PCB-159	39635-35-3	EPA 1668C	2	NE	NE	NE	NE
PCB-160	41411-62-5	EPA 1668C	2	NE	NE	NE	NE
PCB-161	74472-43-8	EPA 1668C	2	NE	NE	NE	NE
PCB-162	39635-34-2	EPA 1668C	2	NE	NE	NE	NE
PCB-163	74472-44-9	EPA 1668C	2	NE	NE	NE	NE
PCB-164	74472-45-0	EPA 1668C	2	NE	NE	NE	NE
PCB-165	74472-46-1	EPA 1668C	2	NE	NE	NE	NE
PCB-166	41411-63-6	EPA 1668C	2	NE	NE	NE	NE
PCB-168	59291-65-5	EPA 1668C	2	NE	NE	NE	NE
PCB-170	35065-30-6	EPA 1668C	2	NE	NE	NE	NE
PCB-171	52663-71-5	EPA 1668C	2	NE	NE	NE	NE
PCB-172	52663-74-8	EPA 1668C	2	NE	NE	NE	NE
PCB-173	68194-16-1	EPA 1668C	2	NE	NE	NE	NE
PCB-174	38411-25-5	EPA 1668C	2	NE	NE	NE	NE
PCB-175	40186-70-7	EPA 1668C	2	NE	NE	NE	NE
PCB-176	52663-65-7	EPA 1668C	2	NE	NE	NE	NE
PCB-177	52663-70-4	EPA 1668C	2	NE	NE	NE	NE
PCB-178	52663-67-9	EPA 1668C	2	NE	NE	NE	NE
PCB-179	52663-64-6	EPA 1668C	2	NE	NE	NE	NE
PCB-180	35065-29-3	EPA 1668C	2	NE	NE	NE	NE
PCB-181	74472-47-2	EPA 1668C	2	NE	NE	NE	NE
PCB-182	60145-23-5	EPA 1668C	2	NE	NE	NE	NE
PCB-183	52663-69-1	EPA 1668C	2	NE	NE	NE	NE
PCB-184	74472-48-3	EPA 1668C	2	NE	NE	NE	NE
PCB-185	52712-05-7	EPA 1668C	2	NE	NE	NE	NE
PCB-186	74472-49-4	EPA 1668C	2	NE	NE	NE	NE
PCB-187	52663-68-0	EPA 1668C	2	NE	NE	NE	NE

Analysis	CAS Number ¹	Method	Practical Quantification Limit (PQL ²)	Preliminary Sediment Screening Levels ³			
				Protection of Benthic Organisms		Protection of Human Health and Higher Trophic Ecological Receptors	
				Apparent Effects Threshold (AET) Criteria ⁴	Sediment Management Standard (SMS) ⁵	Intertidal Sediment (above - 3 ft MLLW)	Subtidal Sediment (below -3 ft MLLW)
PCB-188	74487-85-7	EPA 1668C	2	NE	NE	NE	NE
PCB-190	41411-64-7	EPA 1668C	2	NE	NE	NE	NE
PCB-191	74472-50-7	EPA 1668C	2	NE	NE	NE	NE
PCB-192	74472-51-8	EPA 1668C	2	NE	NE	NE	NE
PCB-193	69782-91-8	EPA 1668C	2	NE	NE	NE	NE
PCB-194	35694-08-7	EPA 1668C	2	NE	NE	NE	NE
PCB-195	52663-78-2	EPA 1668C	2	NE	NE	NE	NE
PCB-196	42740-50-1	EPA 1668C	2	NE	NE	NE	NE
PCB-197	33091-17-7	EPA 1668C	2	NE	NE	NE	NE
PCB-198	68194-17-2	EPA 1668C	2	NE	NE	NE	NE
PCB-199	52663-75-9	EPA 1668C	2	NE	NE	NE	NE
PCB-200	52663-73-7	EPA 1668C	2	NE	NE	NE	NE
PCB-201	40186-71-8	EPA 1668C	2	NE	NE	NE	NE
PCB-202	2136-99-4	EPA 1668C	2	NE	NE	NE	NE
PCB-203	52663-76-0	EPA 1668C	2	NE	NE	NE	NE
PCB-204	74472-52-9	EPA 1668C	2	NE	NE	NE	NE
PCB-205	74472-53-0	EPA 1668C	2	NE	NE	NE	NE
PCB-206	40186-72-9	EPA 1668C	2	NE	NE	NE	NE
PCB-207	52663-79-3	EPA 1668C	2	NE	NE	NE	NE
PCB-208	52663-77-1	EPA 1668C	2	NE	NE	NE	NE
PCB-209	2051-24-3	EPA 1668C	2	NE	NE	NE	NE
Total PCBs	--	EPA 1668C	2	130,000	12 (mg/kg OC)	3.5	3.5
Dioxin-Like Polychlorinated Biphenyls (PCBs)			ng/kg	ng/kg	ng/kg	ng/kg	ng/kg
3,3',4,4'-Tetrachlorobiphenyl (PCB 77)	32598-13-3	EPA 1668C	2	NE	NE	NE	NE
3,4,4'5,-Tetrachlorobiphenyl (PCB 81)	70362-50-4	EPA 1668C	2	NE	NE	NE	NE
2,3,3',4,4'-Pentachlorobiphenyl (PCB 105)	32598-14-4	EPA 1668C	2	NE	NE	NE	NE
2,3,4,4',5-Pentachlorobiphenyl (PCB 114)	74472-37-0	EPA 1668C	2	NE	NE	NE	NE
2,3',4,4',5-Pentachlorobiphenyl (PCB 118)	31508-00-6	EPA 1668C	2	NE	NE	NE	NE
2',3,4,4',5-Pentachlorobephenyl (PCB 123)	65510-44-3	EPA 1668C	2	NE	NE	NE	NE
3,3',4,4',5-Pentachlorobiphenyl (PCB 126)	57465-28-8	EPA 1668C	2	NE	NE	NE	NE
2,3,3',4,4',5-Hexachlorobiphenyl (PCB 156)	38380-08-4	EPA 1668C	2	NE	NE	NE	NE
2,3,3',4,4',5'-Hexachlorobiphenyl (PCB 157)	69782-90-7	EPA 1668C	2	NE	NE	NE	NE
2,3',4,4',5,5'-Hexachlorobiphenyl (PCB 167)	52663-72-6	EPA 1668C	2	NE	NE	NE	NE
2,3',4,4',5,5'-Hexachlorobiphenyl (PCB 169)	32774-16-6	EPA 1668C	2	NE	NE	NE	NE
2,3,3',4,4',5,5'-Hexachlorobiphenyl (PCB 189)	39635-31-9	EPA 1668C	2	NE	NE	NE	NE
Total Dioxin-like PCB Congener TEQ	--	EPA 1668C	2	NE	NE	2	2
Dioxins & Furans			ng/kg	ng/kg	ng/kg	ng/kg	ng/kg
2,3,7,8-TCDD	1746-01-6	EPA 1613	0.5	NE	NE	NE	NE
1,2,3,7,8-PeCDD	40321-76-4	EPA 1613	2.5	NE	NE	NE	NE
1,2,3,4,7,8-HxCDD	39227-28-6	EPA 1613	2.5	NE	NE	NE	NE
1,2,3,6,7,8-HxCDD	57653-85-7	EPA 1613	2.5	NE	NE	NE	NE
1,2,3,7,8,9-HxCDD	19408-74-3	EPA 1613	2.5	NE	NE	NE	NE
1,2,3,4,6,7,8-HpCDD	35822-46-9	EPA 1613	2.5	NE	NE	NE	NE
OCDD	3268-87-9	EPA 1613	5	NE	NE	NE	NE
2,3,7,8-TCDF	51207-31-9	EPA 1613	0.5	NE	NE	NE	NE
1,2,3,7,8-PeCDF	57117-41-6	EPA 1613	2.5	NE	NE	NE	NE
2,3,4,7,8-PeCDF	57117-31-4	EPA 1613	2.5	NE	NE	NE	NE
1,2,3,4,7,8-HxCDF	70648-26-9	EPA 1613	2.5	NE	NE	NE	NE
1,2,3,6,7,8-HxCDF	57117-44-9	EPA 1613	2.5	NE	NE	NE	NE
1,2,3,7,8,9-HxCDF	72918-21-9	EPA 1613	2.5	NE	NE	NE	NE
2,3,4,6,7,8-HxCDF	60851-34-5	EPA 1613	2.5	NE	NE	NE	NE
1,2,3,4,6,7,8-HpCDF	67562-39-4	EPA 1613	2.5	NE	NE	NE	NE
1,2,3,4,7,8,9-HPCDF	55673-89-7	EPA 1613	2.5	NE	NE	NE	NE
OCDF	39001-02-0	EPA 1613	5	NE	NE	NE	NE
Total Dioxins/Furans TEQ	--	EPA 1613	5	5	5	5	5
Tributyltin			µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Bulk Tributyltin	813-19-4	EPA 8270D-SIM/ Krone	3.86	NE	NE	73	73
			µg/L	µg/L	µg/L	µg/L	µg/L
Porewater Tributyltin Ion	36643-28-4	EPA 8270D-SIM/ Krone	0.0052	NE	0.05	0.15	0.15

Notes:

- ¹ Chemical abstract service registry number.
- ² Practical Quantitation Limit (PQL) values from ARI of Tukwila, Washington and Frontier Analytical Laboratory of El Dorado Hills, California.
- ³ Development and selection of preliminary screening levels is presented in the Work Plan.
- ⁴ Apparent Effects Threshold (AET) Criteria from Table 8-1 of the Draft Sediment Cleanup Users Manual II (Ecology, 2013). Lowest of LAET and 2 LAET is used.
- ⁵ Sediment Management Standards (SMS) (Chapter 173-204 WAC). Lowest of Sediment Quality Objective (SQO) and Cleanup Screening Level (CSL) is used.
- ⁶ Ecology-recommended PQL of 5 ppt (parts per trillion, dry-weight) toxicity equivalent quotient (TEQ).
- = No criteria is currently available for this analyte
- SL = screening level
- BL = bioaccumulation level
- ML = maximum level
- NE = Screening level not established
- mg/kg = milligram per kilogram
- µg/L = microgram per liter
- µg/kg = microgram per kilogram
- ng/kg = nanogram per kilogram
- mg/kg OC = milligram per kilogram normalized to organic carbon

Table B-6
Test Methods, Sample Size, Containers, Preservation and Holding Times
Anacortes Port Log Yard
Anacortes, Washington

Parameter	Method	Minimum Sample Size (dry wt)	Container Size and Type	Sample Preservation Technique	Holding Time for Indicated Preservation Technique
Grain size	PSEP 1986 or ASTM-Mod	300 g	16-oz HDPE or Ziploc	Not Applicable	6 months
Total volatile solids	PSEP 1986/ ASTM D2974	20 g	4-oz WM-Glass	Cool ≤ 6 °C	14 days
				Freeze -18 °C	6 months
Total organic carbon	PSEP 1986/ EPA 9060 M	10 g	From Total Volatile Solids Container	Cool ≤6 °C	14 days
				Freeze -18 °C	6 months
Total Metals (As, Cd, Cr, Cu, Pb, Ag and Zn)	EPA 6010/6020	20 g	4-oz WM Glass	Cool ≤ 6 °C	6 months
				Freeze -18 °C	2 years
Mercury	EPA 7470A/7471A	2 g	From Metals Container	Cool ≤ 6 °C	28 days
SVOCs (Including PAHs)	EPA 8270/8270-SIM	150 g	16-oz WM-Glass	Cool <6 °C	14 days until extraction
				Cool <6 °C	40 days after extraction
				Freeze -18 °C	1 year until extraction
Bulk Tributyltin	EPA 8270D-SIM/Krone	100 g	16oz WM-Glass (can share w/ SVOC)	Cool <6 °C	14 days until extraction
				Cool <6 °C	40 days after extraction
				Freeze -18 °C	1 year until extraction
PCB Congeners	EPA 1668C	100 g	8-oz WM Amber Glass	Cool <6 °C/Store<-10 °C	1 year until extraction
Dioxins and Furans	EPA 1613	100 g	8-oz WM Amber Glass	Cool <4 °C/Store<-10 °C	1 year until extraction
Porewater Tributyltin Ion	EPA 8270D-SIM/Krone	1200g/150 mL	Two 32-oz WM Glass	Cool <6 °C	7 days until extraction 40 days after extraction
Porewater Sulfide	SM4500-S2	1200g/150 mL	Two 32-oz WM Glass	Cool <6 °C/Zinc Acetate	7 days until extraction 7 days after extrction
Porewater Ammonia	EPA 350.1 M	600g/75mL	One 32-oz WM Glass	Cool <6 °C/Sulfuric Acid	7 days until extraction 28 days after extrction
Bioassay	PSEP 1995	5 L	5 x 1L WM-Glass or Polyethylene	Cool, 4 °C, nitrogen atmosphere	8 weeks

Notes:
PSEP = Puget Sound Estuary Program
ASTM = American Society for Testing and Materials
HDPE = High-density polyethylene
g = gram
mL = milliliter
L = liter
oz = ounce
WM = wide mouth
EPA = Environmental Protection Agency
SVOCs = Semivolatile Organic Compounds
PCBs = Polychlorinated Biphenyls
SIM = Selected Ion Mode

Table B-7
Quality Control Procedures and Acceptance Criteria for Organic Analysis^{1,2,3}
Anacortes Port Log Yard
Anacortes, Washington

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Instrument Quality Assurance/Quality Control			
Initial Calibration	Before sample analysis and when continuing calibration does not meet method requirements. See reference method(s) in Table A-6.	See reference method(s) in Table A-6.	Laboratory to recalibrate and reanalyze affect samples.
Continuing Calibration	Method-specific. See reference method(s) in Table A-6.	Method-specific. See reference method(s) in Table A-6.	Laboratory to recalibrate if correlation coefficient or response factor does not meet requirements.
Method Quality Assurance/Quality Control			
Holding Times	All samples.	See Table A-6	Laboratory to qualify results if holding times are exceeded. Data validator will use professional judgment to qualify results as estimated or reject data.
Method Detection Limits (MDL)	Update method detection limit studies annually.	See reference method(s) in Table A-6.	Revise detection limits.
Method Blanks	One per sample batch or every 20 samples, whichever is more frequent, or when there is a change in reagents.	Analyte concentration ≤ PQL. Control limits are not applicable if sample concentrations are < MDL.	Laboratory to eliminate or greatly reduce laboratory contamination due to glassware, or reagents, or analytical system. Re-digest and reanalyze affected samples.
Analytical Laboratory Duplicates and Matrix Spike Duplicates	One duplicate analysis with every sample batch or every 20 samples, whichever is more frequent. Use analytical replicates when samples are expected to contain target analytes. Use matrix spike duplicates when samples are not expected to contain target analytes.	Compound and matrix specific. Use intra-laboratory control chart results if sufficient data are available to generate control charts. Otherwise use analytical method default criteria.	Laboratory to re-digest and reanalyze samples if analytical problems are suspected, or to qualify the data if sample homogeneity problems are suspected and the project manager is consulted.
Matrix Spikes	One per sample batch or every 20 samples, whichever is more frequent. Spiked with the same analytes at the same concentration as the laboratory control sample.	Compound and matrix specific, recovery should not exceed method or performance -based intra-laboratory control chart limits.	Laboratory to re-digest and reanalyze samples if analytical problems suspected. Matrix interferences should be assessed and explained in case narrative accompanying the data package.
Surrogate Spikes	Added to every organics sample as specified in analytical protocol.	Compound specific, recovery should not exceed the control limits specified in the method or performance-based intra- laboratory control limits.	Follow corrective actions specified in analytical method.
Laboratory Control Samples	One per analytical batch or every 20 samples, whichever is more frequent.	Compound specific, recovery should not exceed performance- based intra-laboratory control limits.	Laboratory to correct problem to verify the analysis can be performed in a clean matrix with acceptable precision and recovery; then re-extract and reanalyze affected samples.
Certified or Standard Reference Material	Project specific requirement or at project manager’s discretion.	Compound specific, recovery should be within accepted control or advisory limits.	Laboratory to re-extract and reanalyze samples if analytical problems suspected, or to qualify the data after consultation.
Field Quality Assurance/Quality Control			
Field Duplicates	One per every ten sediment samples	Project, matrix, and compound specific	Modify field sample homogenization procedures.
Field Blanks	At project manager’s discretion	Analyte concentration ≤ PQL	Compare to method blank results to rule out laboratory contamination. Modify sample collection and equipment decontamination procedures. Qualify associated data.

Table B-8
Quality Control Procedures and Acceptance Criteria for Metals Analysis^{1,2,3}
Anacortes Port Log Yard
Anacortes, Washington

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Instrument Quality Assurance/Quality Control			
Initial Calibration	Daily.	Correlation coefficient ≥0.995.	Laboratory to optimize and recalibrate the instrument and reanalyze any affected samples.
Initial Calibration Verification	Immediately after initial calibration.	90-110% recovery for ICP-AES, ICP-MS and GFAA (80-120% for Mercury), or method based.	Laboratory to resolve discrepancy prior to sample analysis.
Continuing Calibration Verification a	After every 10 samples or every 2 hours, whichever is more frequent, and after the last sample.	90-110% recovery for ICP-AES and GFAA, 85-115% for ICP-MS (80-120% for mercury).	Laboratory to recalibrate and reanalyze affected samples.
Initial and Continuing Calibration Blanks	Immediately after initial calibration, then 10% of samples or every 2 hours, whichever is more frequent, and after the last sample.	Analyte concentration ≤ PQL.	Laboratory to recalibrate and reanalyze affected samples
ICP Interelement Interference Check Samples	At the beginning and end of each analytical sequence or twice per 8- hour shift, whichever is more frequent.	80-120% of the true value.	Laboratory to correct problem, recalibrate, and reanalyze affected samples.
Method Quality Assurance/Quality Control			
Holding Times	All samples.	See Table A-6.	Laboratory to qualify results if holding times are exceeded. Data validator will use professional judgment to qualify results as estimated or reject data.
Method Detection Limits (MDL)	Update method detection limit studies annually.	See reference method(s) in Table A-6.	Revise detection limits.
Method Blanks	With every sample batch or every 20 samples, whichever is more frequent.	Analyte concentration ≤ PQL. Control limits are not applicable if sample concentrations are < MDL	Laboratory to re-digest and reanalyze samples.
Analytical (Laboratory) Duplicates or Matrix Spike Duplicates	One duplicate analysis with every sample batch or every 20 samples, whichever is more frequent; Use analytical replicates when samples are expected to contain target analytes. Use matrix spike replicates when samples are not expected to contain target analytes.	Analyte and matrix specific. Use intra- laboratory control chart limits if sufficient data are available to generate control charts; otherwise use analytical method default criteria.	Laboratory to re-digest and reanalyze samples if analytical problems are suspected, or to qualify the data if sample homogeneity problems are suspected and the project manager is consulted.
Matrix Spikes	With every sample batch or every 20 samples, whichever is more frequent.	75-125% recovery applied when the sample concentration is ≤4 times the spiked concentration for a particular analyte.	Laboratory may be able to correct or minimize problem, or qualify and accept data.
Field Quality Assurance/Quality Control			
Field Duplicates	One per every ten sediment samples	Project, matrix, and compound specific	Modify field sample homogenization procedures.
Field Blanks	At project manager’s discretion	Analyte concentration ≤ PQL	Compare to method blank results to rule out laboratory contamination. Modify sample collection and equipment decontamination procedures. Qualify associated data.

Table B-9
Quality Control Procedures and Acceptance Criteria for Conventional Analysis^{1,2}
Anacortes Port Log Yard
Anacortes, Washington

Analyte	Initial Calibration	Continuing Calibration	Calibration Blanks	Laboratory Control Samples	Matrix Spikes	Laboratory Duplicates	Method Blank
Ammonia	Correlation coefficient ≥ 0.995	90 -110% recovery	Analyte concentration $\leq$ PQL	80 -120% recovery	75 -125% recovery	20% RSD	Analyte concentration $\leq$ PQL
Grain size	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	20% RSD	Not applicable
Total organic carbon	Correlation coefficient ≥ 0.995	90-110% recovery	Analyte concentration $\leq$ PQL	80-120% recovery	75-125% recovery	20% RSD	Analyte concentration $\leq$ PQL
Total sulfides	Correlation coefficient ≥ 0.990	85 -115% recovery	Not applicable	65 -135% recovery	65 -135% recovery	20% RSD	Analyte concentration $\leq$ PQL
Total solids	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	20% RSD	Analyte concentration $\leq$ PQL

Notes:

¹ The control limits provided above are suggested limits only. They are based on EPA control limits for metals analyses (Table A-8), and an attempt has been made to take into consideration the expected analytical accuracy using PSEP methodology. The corrective action indicated for metals in Table A-7 will be applied to the conventional analytes using professional judgment.

² As applicable, the QA/QC procedures indicated in this table will be completed at the same frequency as for metals analyses (see Table A-7).

PQL = practical quantification limit

RSD - relative standard deviation

Table B-10
Quality Control Procedures and Acceptance Criteria for PCDD/PCDF Analysis^{1,2,3}
Anacortes Port Log Yard
Anacortes, Washington

Quality Control Procedure	Frequency	Acceptance Criteria	Laboratory Corrective Action
Ongoing Precision and Recovery	One per sample batch or every 20 samples, whichever is more frequent.	Recovery within limits presented in Table B-3.	1. Check calculation. 2. Re-extract and reanalyze batch.
Stable-isotope- labeled compounds	Spiked into each sample for every target analyte	Recovery within limits presented in Table B-3.	1. Check calculations. 2. Qualify all associated results as estimated. 3. Alternatively, use of secondary ions that meet appropriate theoretical criteria is allowed if interferences are suspect. This alternative must be approved by Ecology.
		Ion abundance ratios must be within the criteria specified by the method.	
Sample target analyte Ion abundance ratios	All detected analytes for all samples.	Ion abundance ratios must be within the criteria specified by the method.	1. Reanalyze specific samples. 2. Reject all affected results outside the criteria. 3. Alternatively, use of secondary ions that meet appropriate theoretical criteria is allowed if interferences are suspect. This alternative must be approved by Ecology.
Method blank	One per sample batch or every 20 samples, whichever is more frequent.	Detection ≤ minimum level as specified by the method.	1. If the method blank results are greater than the reporting limit, halt analysis, find the source of contamination, and reanalyze batch. 2. Report project samples as non- detected for results ≤ to the reported method blank values.
GC/MS Tune	At the beginning of each 12 hour shift; must start and end each analytical sequence	>10,000 resolving power at m/z304.9825. Exact mass of 380.9760 within 5 ppm of theoretical values.	1. Re-analyze affected samples. 2. Reject all data not meeting method 1613B requirements.
Initial Calibration	Initially and when continuing calibration fails	Five point curve for all analytes. RSD must meet Table B-3 requirements for all target compounds and labeled compounds. Signal to noise ratio (S/N)>10. Ion abundance (IA) ratios within method specified limits.	
Window Defining/Column Performance Mix	Before every initial and continuing calibration	Valley < 25% for all peaks near 2378-TCDD/F peaks.	
Continuing Calibration	Must start and end each analytical sequence.	%Difference must use the limits for target compounds & labeled compounds as specified by the method. S/N>10. IA ratios within method specified limits.	
Confirmation of 2,3,7,8-TCDF	For all primary column detections of 2,3,7,8-TCDF.	Confirmation presence of 2,3,7,8-TCDF in accordance with method 1613B requirements.	Failure to verify presence of 2,3,7,8- TCDF by second column confirmation or use of an alternative primary column that meets resolution criteria requires qualification of associated 2,3,7,8- TCDF results as non-detected at the associated value
Sample data not achieving target reporting limits or method performance in presence of possibly interfering compounds	Not applicable	Not applicable	Rather than simply diluting an extract to reduce interferences, the lab should perform additional cleanup techniques identified in the method to insure minimal matrix effects and background interference. Thereafter, the lab can dilute the extract. If reanalysis is required, the laboratory shall report both initial and re-analysis results.
Sediment Reference Material	One per analytical project.	Results must be within 20% of the 95% confidence interval.	1. Extraction and analysis should be evaluated by the lab and re-analysis performed of the entire sample batch once performance criteria can be met. 2. If analysis accompanies several batches with acceptable RM results, then the laboratory can narrate possible reason for RM outliers.

Notes:

- ¹ Instrument and method QA/QC to monitor the performance of the instrument and sample preparation procedures are the responsibility of the analytical laboratory. When an instrument or method control limit is exceeded, the laboratory is responsible for correcting the problem and reanalyzing the samples.
- ² Instrument and method QA/QC results reported in the final data package should always meet control limits with a very small number of exceptions that apply to difficult analytes as specified by EPA CLP. If instrument and method QA/QC procedures meet control limits, laboratory procedures are deemed to be adequate.
- ³ Matrix and field QA/QC procedures monitor matrix effects, field procedures, and variability. Although poor analytical procedures may also result in poor spike recovery or duplicate results, the laboratory is not held responsible for meeting control limits for these QA/QC samples.

MDL = method detection limit
PQL = practical quantification limit

Table B-11**Quality Control Procedures and Acceptance Criteria for Tributyltin (TBT) Analysis**

Anacortes Port Log Yard

Anacortes, Washington

Quality Control Procedure	Frequency	Acceptance Criteria	Corrective Action
Laboratory Control Sample (LCS) ¹	One per sample batch or every 20 samples, whichever is more frequent.	Recovery 50 – 150%	1. Check calculations 2. Reanalyze (matrix or injection problems) 3. If still out, re-extract and reanalyze LCS and associated samples (if available); If not available flag data.
Matrix spike (MS) and matrix spike duplicate (MSD) ¹	One MS/MSD pair per analytical batch or every 20 samples, whichever is more frequent.	Recovery 50 – 150% and relative percent difference (RPD) ≤ 30%	1. Evaluate for supportable matrix effect. 2. If no interference, re- extract and reanalyze MS/MSD once (if available). 3. If still out, report both sets of data.
Surrogate spike ¹ (Triphenyltin recommended)	One per sample.	Recovery 50 – 150%	1. Check calculations. 2. Evaluate for supportable matrix effect 3. If no interference is evident, re-extract and reanalyze affected sample(s) (if available) and flag any outliers.
Method blank ²	One per sample batch or every 20 samples, whichever is more frequent.	Target analyte < 3x the reporting limit (RL)	1. Flag if target > 3x RL but less than 0.075 ppb.³ 2. Rerun batch and ID contamination source if target >0.075 ppb.

Notes:

¹ All QC samples should be run using the same sample handling as is used on the environmental samples.

² Method blank can include centrifugation step or, alternatively a centrifugation blank can be run separately from the analytical method blank.

³ 0.075 ppb tributyltin (TBT) is used here as a benchmark for evaluating blank performance because it represents a concentration that is one-half the interstitial water screening level (0.15 ppb) that is being used by the DMMP agencies to determine the need for bioaccumulation testing.

Table B-12
Biological Toxicity Test and Performance Standards
Anacortes Port Log Yard
Anacortes, Washington

Test Species	Frequency of Water Quality Monitoring		Control Limits			Control Samples			Performance Standards ¹
	Temperature, Salinity, Dissolved Oxygen, pH	Sulfides/ Ammonia	Temp (° C)	Salinity (ppt)	Dissolved Oxygen (% Saturation)	Negative Control	Positive Control	Reference Sediment	
Amphipod Mortality Test (Acute Toxicity)									
<i>Eohaustorius estuarius</i>	Daily	Beginning/End	15±1	Ambient (same as interstitial)	NA ²	Clean sediment	Reference toxicant in seawater	Yes	Mean mortality in control sediment <10 percent and mean mortality in reference sediment <25 percent.
<i>Ampelisca abdita</i>	Daily	Beginning/End	20±1	28±1	NA ²	Clean sediment	Reference toxicant in seawater	Yes	Mean mortality in control sediment <10 percent and mean mortality in reference sediment <25 percent.
<i>Rhepoxynius abronius</i>	Daily	Beginning/End	15±1	28±1	NA ²	Clean sediment	Reference toxicant in seawater	Yes	Mean mortality in control sediment <10 percent and mean mortality in reference sediment <25 percent.
Sediment Larval Test (Acute Toxicity)									
Mussel (<i>Mytilus sp.</i>) ³	Daily	Beginning/End	16±1	28±1	>60 ⁴	Clean seawater	Reference toxicant in seawater	Yes	Mean normal survivorship in seawater control >70 at time final.
Sand dollar (<i>Dendraster excentricus</i>)	Daily	Beginning/End	15±1	28±1	>60 ⁴	Clean seawater	Reference toxicant in seawater	Yes	Mean normal survivorship in seawater control >70 at time final.
Juvenile Infaunal Growth Test (Chronic Toxicity)									
<i>Neanthes arenaceodentata</i>	Every third day	Beginning/End (optional)	20±1	28±2	NA ²	Clean sediment	Reference toxicant	Yes	Mean mortality in control sediment <10 %, Mean individual growth rate > 0.72 mg/ind/day and test failed when growth rate < 0.38 mg/ind/day. Mean individual growth rate in reference sediment ≥80 percent of mean individual growth rate in control sediment.

Notes:

¹ Performance standards in WAC 173-204-315(2). Subject to QA1 and QA2 review - See MyEIM Bioassay Sediment Quality Value Groups for specific performance standards recommendations.

² Continuous aeration is required by the protocol, so the dissolved oxygen concentration should not be cause for concern.

³ PSEP (1995) and the SMS refer only to the use of *Mytilus edulis* in this test. However, it may be more accurate to refer to the test organisms used as members of the *Mytilus edulis* sibling species complex. Recent taxonomic studies of west coast mussels (McDonald and Koehn 1988; McDonald et al. 1991; Geller et al. 1993) indicate that the mussels in Washington state are either *M. trossulus* (a more northerly species) or *M. galloprovincialis* (a more southerly species). The mussel species being used by most biological laboratories in the northwest is *M. galloprovincialis*. *M. edulis* does not occur locally and is therefore unlikely to be used in toxicity tests. This does not constitute a change in test organisms, but an acknowledgment that the organisms may have been previously misidentified.

⁴ Aeration should be initiated if the dissolved oxygen concentration declines below 60 percent of saturation.

NA - not applicable

ppt - parts per thousand

Table B-13
Quality Control Samples - Type and Frequency
Anacortes Port Log Yard
Anacortes, Washington

Parameter	Field QC		Laboratory QC			
	Field Duplicates	Trip Blanks	Method Blanks	LCS/OPR	MS / MSD	Lab Duplicates
Metals	1/10 sediment samples	NA	1/batch	1/batch	1 set/batch	1/batch
SMS SVOCs	1/10 sediment samples	NA	1/batch	1/batch	1 set/batch ¹	NA
PCB Congeners	1/10 sediment samples	NA	1/batch	1/batch	NA	NA
Dioxins/furans	1/10 sediment samples	NA	1/batch	1/batch	NA	NA
Ammonia ²	1/10 sediment samples	NA	1/batch	1/batch	1/batch	1/batch
Sulfides ²	1/10 sediment samples	NA	1/batch	NA	NA	1/batch
Bulk Tributyltin	1/10 sediment samples	NA	1/batch	1/batch	1 set/batch ¹	NA
Porewater Tributyltin Ion	1/10 sediment samples	NA	1/batch	NA	NA	1/batch

Notes:

¹ Matrix specific QC is not method required for most organic analyses. MS/MSDs must be specifically requested and appropriate volume must be provided for the laboratory to perform QC. An analytical lot or batch is defined as a group of samples taken through a preparation procedure and sharing a method blank, LCS, and MS/MSD (or MS and lab duplicate). No more than 20 field samples can be contained in one batch.

² The identified quality control samples for ammonia and sulfide applies to both porewater and bulk analyses.

QC = Quality control

LCS = Laboratory control sample

MS = Matrix spike sample

MSD = Matrix spike duplicate sample

OPR = Ongoing precision and recovery

SMS = Sediment Management Standards

SVOCs = Semivolatile organic compounds

PCBs = Polychlorinated biphenyls

NA = not applicable

APPENDIX C

Health and Safety Plan

Health and Safety Plan (HASP)

Anacortes Port Log Yard
Anacortes, Washington
Ecology Agreed Order No. DE 10630

August 11, 2015



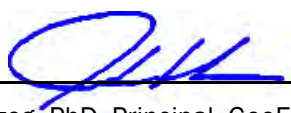
Plaza 600 Building
600 Stewart Street, Suite 1700
Seattle, Washington 98101
206.278.2674

Health and Safety Plan
Anacortes Port Log Yard
Anacortes, Washington
Ecology Agreed Order No. DE 10630

File No. 5147-016-05

August 11, 2015

Approved By:

Signature:  Date: August 11, 2015

John M. Herzog, PhD, Principal, GeoEngineers

Signature:  Date: August 11, 2015

Brian J. Tracy, PE, Task Manager/Field Coordinator, GeoEngineers

Signature: Wayne Adams Date: August 11, 2015

Wayne D. Adams, Health & Safety Program Manager, GeoEngineers

ARJ:BJT:JMH:ch

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ATTACHMENTS

Attachment C1. Boat, Over Water and Near Water Safety Program

GEOENGINEERS, INC.
HEALTH AND SAFETY PLAN
LOG HAUL OUT FACILITY SITE SEDIMENT SAMPLING
FILE NO. 5147-016-05

This HASP is to be used in conjunction with the GeoEngineers Safety Program Manual. Together, the written safety programs and this HASP constitute the site safety plan for this site. This plan is to be used by GeoEngineers personnel on this site and must be available on-site. If the work entails potential exposures to other substances or unusual situations, additional safety and health information will be included, and the plan will need to be approved by the GeoEngineers Health and Safety Manager. All plans are to be used in conjunction with current standards and policies outlined in the GeoEngineers Health and Safety Program Manual.

Liability Clause: If requested by subcontractors, this site safety plan may be provided for informational purposes only. In this case, Form 3 shall be signed by the subcontractor. Please be advised that this Site Safety Plan is intended for use by GeoEngineers Employees only. Nothing herein shall be construed as granting rights to GeoEngineers' subcontractors or any other contractors working on this site to use or legally rely on this Site Safety Plan. GeoEngineers specifically disclaims any responsibility for the health and safety of any person not employed by them.

1.0 GENERAL PROJECT INFORMATION

Project Name:	<u>Anacortes Port Log Yard</u>
Project Number:	<u>5147-016-05</u>
Type of Project:	<u>Sediment sampling (grab samples and coring)</u>
Start/Completion:	<u>TBD</u>
Subcontractors:	<u>TBD</u>

2.0 SAMPLING AND ANALYSIS PLAN

The RI will include sampling and analysis of sediment to delineate the nature and extent of contamination at the Site. The overall objectives of the sediment investigation described in this Work Plan include the following:

- Characterize the stratigraphy of surface and subsurface sediment at the Site including the nature and extent of wood debris;
- Characterize the nature and extent of hazardous substances in surface and subsurface sediment;
- Provide results from chemical analyses and parameters of wood debris to identify the need and locations for follow-up bioassay testing to evaluate compliance with SMS biological criteria;

- Use results of chemical analyses to identify locations for follow-up site-specific sediment/tissue sampling and analysis to support human health and ecological risk evaluation, if elected; and
- Determine if contamination extends to the upland portion of the Site.

RI data gathering for this sediment investigation will follow a phased or tiered approach consisting of an initial sediment investigation and follow-up sediment investigation(s) as described in detail in the RI/FS Work Plan. As part of the initial sediment investigation, sampling will be completed at 13 sample locations at the coordinates listed in Table A-1. The RI/FS Work Plan details the sample locations and chemical analyses that will be completed for the RI.

2.1 List of Field Activities

☒ Site reconnaissance	☐ Field Screening of Soil Samples
☒ Sediment coring	☐ Vapor Measurements
☒ Hand digging	☐ Groundwater Sampling
☒ Surveying	☐ Groundwater Depth and Free Product Measurement
☒ Drilling and Soil Sampling	☐ Product Sample Collection
☐ Monitoring Well Installation	☐ Soil Stockpile Testing
☐ Monitoring Well Development	☐ Remedial Excavation
☒ Sediment Sample Collection	☐ Underground Storage Tank (UST) Removal Monitoring
☐ Remediation System Monitoring	☐ Recovery of Free Product

3.0 LIST OF FIELD PERSONNEL AND TRAINING

Anticipated field personnel include the following:

- Nate Solomon
- Hannah McDonough
- Brian Tracy
- Abhijit Joshi
- Robert Trahan

Field personnel will have appropriate training and up to date certifications.

Name of Employee	Level of HAZWOPER Training (24-/40-hr)	Date of 8-Hr Refresher Training	First Aid/ CPR	Date of Respirator Fit Test
Nate Solomon	40-hr	6/10/2013	--	6/10/2014
Hannah McDonough	40-hr	1/23/2015	1/12/2013	2/13/2014
Brian Tracy	40-hr	1/7/2014	5/10/2011	4/19/2013
Abhijit Joshi	40-hr	10/15/2012	3/22/2011	6/7/2013
Robert Trahan	40-hr	9/7/2012	4/18/2013	4/11/2013

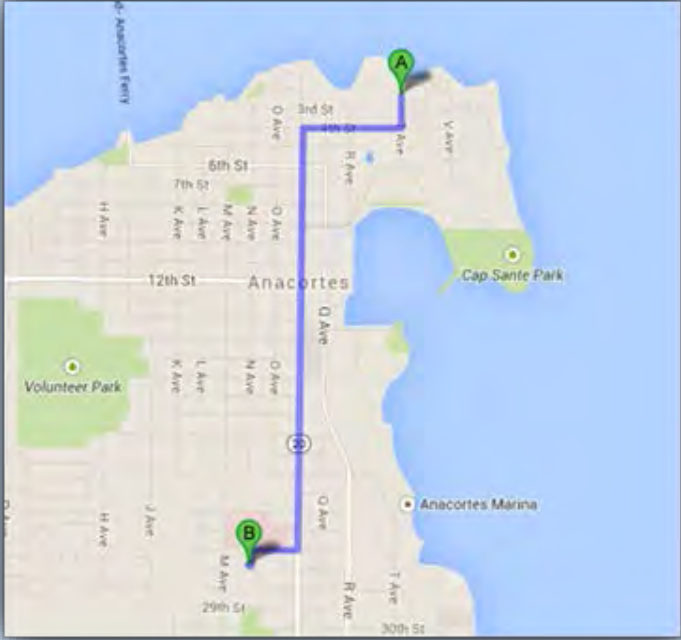
4.0 CHAIN OF COMMAND

- Establish and identify the chain of command;
- Identify the site safety and health supervisor and other personnel responsible for employee safety and health;
- Specify the overall responsibilities of supervisors and employees (this is in HAZWOPER written program);
- Include the name and title of the person with responsibility and authority to direct all hazardous waste operations;
- Include a site safety and health supervisor responsible for developing and implementing the HASP and verifying compliance;
- Identify the functions and responsibilities of all personnel needed for hazardous waste operations and emergency response;
- Identify site specific lines of authority, responsibility, and communication.

Chain of Command	Title	Name	Telephone Numbers
1	Principal in Charge	John Herzog	206.297.0708
2	Project Manager	Brian Tracy	206.239.3250
3	HAZWOPER Supervisor	Brian Tracy	206.239.3250
4	Field Engineer/Geologist	TBD	TBD
5	Site Safety and Health Supervisor*	TBD	TBD
6	Client Assigned Site Supervisor	TBD	TBD
7	Health and Safety Program Manager	Wayne Adams	253.722.2793
N/A	Subcontractor(s)	N/A	N/A
N/A	Current Owner	Port of Anacortes	360.293.3134

* **Site Safety and Health Supervisor** – The individual present at a hazardous waste site responsible to the employer and who has the authority and knowledge necessary to establish the site-specific health and safety plan and verify compliance with applicable safety and health requirements.

5.0 EMERGENCY INFORMATION

Hospital Name	Island Hospital
Hospital Address	1211 24th Street Anacortes, WA 98221
Phone Number (Hospital ER)	(360) 299-1300
Driving Distance	1.8 Miles
Driving Directions	1. Head south on T Ave toward 3rd St 2. Take the 1st right onto 4th St About 1 min 3. Take the 3rd left onto Commercial Ave 4. Turn right onto 26th St Destination will be on the left
Driving Map	

Ambulance:

Poison Control:

Police:

Fire:

Location of Nearest Telephone:

Nearest Fire Extinguisher:

Nearest First-Aid Kit:

9-1-1

Seattle (800) 222-1222; Other (800) 732-6985

9-1-1

9-1-1

Cell phones are carried by field personnel.

Located in the GeoEngineers vehicle on-site.

Located in the GeoEngineers vehicle on-site.

5.1 Standard Emergency Procedures

Get help

- send another worker to phone 9-1-1 (if necessary)
- as soon as feasible, notify GeoEngineers' Project Manager

Reduce risk to injured person

- turn off equipment
- move person from injury location (if in life-threatening situation only)
- keep person warm
- perform CPR (if necessary)

Transport injured person to medical treatment facility (if necessary)

- by ambulance (if necessary) or GeoEngineers vehicle
- stay with person at medical facility
- keep GeoEngineers manager apprised of situation and notify Human Resources Manager of situation

6.0 HAZARD ANALYSIS

A hazard assessment will be completed at every site prior to beginning field activities. Updates will be included in the daily log. Anticipated physical and chemical hazards at the Site are summarized in the following sections.

- Identification and evaluation of on-site safety and health hazards;
- A safety and health risk (hazard) analysis for each site task and operation that is identified in the comprehensive work plan.

6.1 Physical Hazards

☒	Sediment Coring,
☒	Near-Water Work (see attached Boat, Over Water and Near Water Safety Program)
☒	Hand digging tools (e.g. shovel, etc.)
☐	Trackhoe
☐	Crane
☐	Front End Loader
☐	Excavations/trenching (1:1 slopes for Type B soil)
☐	Shored/braced excavation if greater than 4 feet of depth
☐	Overhead hazards/power lines
☒	Tripping/puncture hazards (debris on-site, steep slopes or pits)
☐	Unusual traffic hazard – Street traffic
☒	Heat/Cold, Humidity
☐	Utilities/ utility locate

- Utility checklist will be completed as required for the location to preventing drilling or digging into utilities.
- Work areas will be marked with reflective cones, barricades and/or caution tape. High-visibility vests will be worn by on-site personnel to ensure they can be seen by vehicle and equipment operators.
- Field personnel will be aware at all times of the location and motion of heavy equipment in the area of work to ensure a safe distance between personnel and the equipment. Personnel will be visible to the operator at all times and will remain out of the swing and/or direction of the equipment apparatus. Personnel will approach operating heavy equipment only when they are certain the operator has indicated that it is safe to do so through hand signal or other acceptable means.
- Heavy equipment and/or vehicles used on this Site will not work within 20 feet of overhead utility lines without first ensuring that the lines are not energized. This distance may be reduced to 10 feet depending on the client and the use of a safety watch.
- Personnel will avoid tripping hazards, steep slopes, pits and other hazardous encumbrances. If it becomes necessary to work within 6 feet of the edge of a pit, slope or other potentially hazardous area, appropriate fall protection measures will be implemented by the Site Safety and Health Supervisor in accordance with OSHA/DOSH regulations and the GeoEngineers Health and Safety Program.
- Cold stress control measures will be implemented according to the GeoEngineers Health and Safety Program to prevent frost nip (superficial freezing of the skin), frost bite (deep tissue freezing), or hypothermia (lowering of the core body temperature). Heated break areas and warm beverages shall be available during periods of cold weather.
- Heat stress control measures required for this site will be implemented according to GeoEngineers Health and Safety Program with water provided on-site.
- Excessive levels of noise (exceeding 85 dB) are anticipated during drilling. Personnel potentially exposed will wear ear plugs or muffs with a noise reduction rating (NRR) of at least 25 dB whenever it becomes difficult to carry on a conversation 3 feet away from a co-worker or whenever noise levels become bothersome. (Increasing the distance from the source will decrease the noise level noticeably.)

6.2 Engineering Controls

☐ Trench shoring (1:1 slope for Type B Soils)
☒ Location work spaces upwind/wind direction monitoring
☐ Other soil covers (as needed)
☐ Other (specify) _____

6.3 Chemical Hazards

CHEMICAL HAZARDS (POTENTIALLY PRESENT AT SITE)

Substance	Pathways
Metals	Sediment
Semi-Volatile Organic Compounds (SVOC)	Sediment
Polycyclic aromatic hydrocarbons (PAHs)	Sediment
Polychlorinated Biphenyls (PCBs)	Sediment

Substance	Pathways
Dioxins and Furans	Sediment
Tributyltin	Sediment
Acids and Solvents	Equipment Decontamination

Chemical hazards that may be potentially encountered at the Site are summarized in the following table.

SUMMARY OF ANTICIPATED CHEMICAL HAZARDS, EXPOSURE ROUTES AND EXPOSURE LIMITS

COMPOUND/ DESCRIPTION	EXPOSURE LIMITS/IDLH	EXPOSURE ROUTES	SYMPTOMS/HEALTH EFFECTS
Nitric Acid	REL 5.0 mg/m ³ PEL 5.0 mg/m ³	inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, mucous membrane; delayed pulmonary edema, pneumonitis, bronchitis; dental erosion
Hexane	REL 180 mg/m ³ PEL 1800 mg/m ³	inhalation, ingestion, skin and/or eye contact	irritation eyes, nose; nausea, headache; peripheral neuropathy: numb extremities, muscle weak; dermatitis; dizziness; chemical pneumonitis (aspiration liquid)
Acetone	REL 590 mg/m ³ PEL 2400 mg/m ³	inhalation, ingestion, skin and/or eye contact	irritation eyes, nose, throat; headache, dizziness, central nervous system depression; dermatitis
Arsenic	PEL 0.05 mg/m ³ IDLH 5.0 mg/m ³	Inhalation, skin absorption, skin and eye contact, ingestion	Ulceration of nasal septum; dermatitis; GI disturbances; peripheral neuropathy; respiratory irritation; hyperpigmentation of skin
Copper	PEL 1 mg/m ³ IDLH 100 mg/m ³	Inhalation, ingestion, skin and eye contact	Irritated eyes, nose, pharynx; nasal septum perforation; metallic taste; dermatitis
Chromium	PEL 1 mg/m ³ IDLH 250 mg/m ³	Inhalation, ingestion, skin and eye contact	Irritated eyes, skin, respiratory system
Lead	PEL 0.05 mg/m ³ IDLH 100 mg/m ³	Inhalation, ingestion, skin and eye contact	Lassitude; insomnia; facial pallor; abnormalities; weight loss, malnutrition, constipation, abdominal pain; colic; anemia; gingival lead line; tremors; paralysis of the wrist and ankles; encephalopathy; kidney disease; irritated eyes; hypertension
Mercury	PEL 0.05 mg/m ³ IDLH 10 mg/m ³	Inhalation, skin absorption, skin and eye contact, ingestion	Irritated eyes, skin; cough, chest pain, dyspnea, bronchitis, pneumonia; tremors, insomnia, irritability, indecision, headache, lassitude; stomatitis, salivation; GI disturbances, abnormalities, low weight; proteinuria

COMPOUND/ DESCRIPTION	EXPOSURE LIMITS/IDLH	EXPOSURE ROUTES	SYMPTOMS/HEALTH EFFECTS
Nickel	IDLH 10 mg/m ³	Inhalation, skin and eye contact	Sensitization dermatitis, allergic asthma, pneumonitis; [potential occupational carcinogen]
Zinc	TLV/PEL none Treat as particles not otherwise specified and maintain levels below 3 mg/m ³ respirable and 10 mg/m ³ inhalable	Inhalation	Metal fume fever (usually onsets at 77-600 mg zinc/m ³)
Polycyclic aromatic hydrocarbons (PAH)	PEL 0.2 mg/m ³ TLV 0.2 mg/m ³ REL 0.1 mg/m ³ IDLH 80 mg/m ³	Inhalation, ingestion, skin and/or eye contact	Dermatitis, bronchitis, potential carcinogen
PCBs (as Arochlor 1254)—colorless to pale-yellow viscous liquid with a mild, hydrocarbon odor	PEL 0.5 mg/m ³ TLV 0.5 mg/m ³ REL 0.001 mg/m ³ IDLH 5.0 mg/m ³	Inhalation (dusts or mists), skin absorption, ingestion, skin and/or eye contact	Irritated eyes, chloracne, liver damage, reproductive effects, potential carcinogen
Dioxins/furans	See below	See below	See below

Notes:

IDLH = immediately dangerous to life or health

OSHA = Occupational Safety and Health Administration

ACGIH = American Conference of Governmental Industrial Hygienists

mg/m³ = milligrams per cubic meter

TWA = time-weighted average (over 8 hrs)

PEL = permissible exposure limit

TLV = threshold limit value (over 10 hrs)

STEL = short-term exposure limit (15 min)

ppm = parts per million

6.3.1 Dioxins/Furans

Generally, dioxin exposures to humans are associated with increased risk of severe skin lesions such as chloracne and hyperpigmentation, altered liver function and lipid metabolism, general weakness associated with drastic weight loss, changes in activities of various liver enzymes, depression of the immune system, and endocrine- and nervous-system abnormalities. It is a potent teratogenic and fetotoxic chemical in animals. A very potent promoter in rat liver cancers, 2,3,7,8-tetrachlorodibenzo-pdioxin (2,3,7,8-TCDD) causes cancers of the liver and other organs in animals. Populations occupationally or accidentally exposed to chemicals contaminated with dioxin have increased incidences of soft-tissue sarcoma and non-Hodgkin's lymphoma.

Dioxin-contaminated soil may result in dioxins occurring in a food chain. This is especially important for the general population. It has been estimated that about 98% of exposure to dioxins is through the oral route. Exposure as a vapor is normally negligible because of the low vapor pressure typical of these compounds. In the 1980s, a concentration level of 1 ppb 2,3,7,8-TCDD in soil was specified as "a level of concern," based on cancer effects. However, recent studies indicate that end points other than cancer (such as those listed above)

are also of concern based on a projected intake from 1 ppb 2,3,7,8-TCDD in soil. Human studies have shown alteration in delayed-type hypersensitivity after exposure to dioxins. NIOSH recommends respiratory protection at the “lowest feasible level.” Very little human toxicity data from exposure to tetrachlorodibenzodioxins (TCDDs) and/or polychlorinated dibenzodioxins (PCDDs) are available. Health-effect data obtained from occupational settings in humans are based on exposure to chemicals contaminated with dioxins. It produces a variety of toxic effects in animals and is considered one of the most toxic chemicals known. Most of the available toxicity data are from high-dose oral exposures to animals (including tumor production, immunological dysfunction, and teratogenesis).

Very little dermal and inhalation exposure data are available in the literature. It is important for field personnel to remember that although dioxins are toxic and carcinogenic, most of the information is based on exposure to high doses of liquid product. These products are not very volatile, so the major concern is on skin protection and inhalation/ingestion of soil particles. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends a 20 ppm threshold limit value (TLV) for 1,4-dioxane (an example of numerous dioxin compounds), lists it as being absorbed through the skin, and lists it as potentially carcinogenic as well as toxic to liver and kidneys. This is typical of health effects for dioxin/furan compounds. Care should be taken especially in sampling product from drums and wells known to contain detectable levels of dioxins. Emphasis will be on working outside in well-ventilated areas using proper PPE (as discussed later in this plan). There is significant variability in dioxin lethality in animals. The signs and symptoms of dioxin poisoning in humans, however, are analogous to those observed in animals.

6.4 Biological Hazards and Procedures

Y/N	Hazard	Procedures
N	Poison Ivy or other vegetation	Hard hat, gloves and long sleeve shirt
N	Insects or snakes	Hard hat, gloves and long sleeve shirt
N	Used hypodermic needles or other infectious hazards	Do not pick up or contact
Y	Others: Bird Droppings	Hard hat, gloves and long sleeve shirt

6.5 Documentation of Hazards

Update in Daily Report. Include evaluation of:

- Physical Hazards (excavations and shoring, equipment, traffic, tripping, heat stress, cold stress and others)
- Chemical Hazards (odors, spills, free product, airborne particulates and others present)
- Biological Hazards (snakes, spiders, other animals, discarded needles, poison ivy, pollen, bees/wasps and others present)

7.0 AIR MONITORING PLAN

Air monitoring is not expected to be required because contaminants of concern have low volatility. If volatile odors are observed, air monitoring will be initiated as described below.

Check instrumentation to be used:

☒ Photoionization Detector (PID)

☐ Other (i.e., detector tubes): _____

Check monitoring frequency/locations and type (specify: work space, borehole, breathing zone):

☒ 15 minutes - Continuous during soil disturbance activities or handling samples

☐ 15 minutes

☐ 30 minutes

☒ Hourly (in breathing zone during drilling and/or sampling)

If drilling or excavation activities generate visible dust, the Site Safety and Health Supervisor will be notified immediately to assess the need for air monitoring and lab analysis for inhalable and respirable particulates.

AIR MONITORING ACTION LEVELS

Contaminant	Activity	Monitoring Device	Frequency of Monitoring Breathing Zone	Action Level	Action
Organic Vapors	Environmental Remedial Actions	PID	Start of shift; prior to excavation entry; every 30 to 60 minutes and in event of odors	Background to 5 ppm in breathing zone	Use Level D or Modified Level D PPE.
Organic Vapors	Environmental Remedial Actions	PID	Start of shift; prior to excavation entry; every 30 to 60 minutes and in event of odors	5 to 25 ppm in breathing zone	Upgrade to Level C PPE.
Organic Vapors	Environmental Remedial Actions	PID	Start of shift; prior to excavation entry; every 30 to 60 minutes	> 25 ppm in breathing zone	Stop work and evacuate the area. Contact Health and Safety Manager for guidance.
Combustible Atmosphere	Environmental Remedial Actions	PID	Start of shift; prior to excavation entry; every 30 to 60 minutes	>10% LEL or >1,000 ppm	Depends on contaminant. The PEL is usually exceeded before the lower explosive limit (LEL).

Contaminant	Activity	Monitoring Device	Frequency of Monitoring Breathing Zone	Action Level	Action
Combustible Atmosphere	Environmental Remedial Actions	PID or 4-gas meter	Start of shift; prior to excavation entry; every 30 to 60 minutes	>10% LEL or >1,000 ppm	Stop work and evacuate the Site. Contact Health and Safety Manager for guidance.
Oxygen Deficient/ Enriched Atmosphere	Environmental Remedial Actions Confined Spaces	Oxygen meter or 4-gas meter	Start of shift; prior to excavation entry; every 30 to 60 minutes	<19.5>23.5%	Continue work if inside range. If outside range, evacuate area and contact Health and Safety Manager.

7.1 Respirator Selection, Use and Maintenance

If respirators are required, site personnel shall be trained before use on the proper use, maintenance and limitations of respirators. Additionally, they must be medically qualified to wear a respiratory protection in accordance with 29 CFR 1910.134. Site personnel who will use a tight-fitting respirator must have passed a qualitative or quantitative fit test conducted in accordance with an OSHA-accepted fit test protocol. Fit testing must be repeated annually or whenever a new type of respirator is used. Respirators will be stored in a protective container.

7.2 Respirator Cartridges

If site personnel are required to wear air-purifying respirators, the appropriate cartridges shall be selected to protect personnel from known or anticipated site contaminants. The respirator/cartridge combination shall be certified and approved by the National Institute for Occupational Safety and Health (NIOSH). A cartridge change-out schedule shall be developed based on known site contaminants, anticipated contaminant concentrations and data supplied by the cartridge manufacturer related to the absorption capacity of the cartridge for specific contaminants. Site personnel shall be made aware of the cartridge change-out schedule prior to the initiation of site activities. Site personnel shall also be instructed to change respirator cartridges if they detect increased resistance during inhalation or detect vapor breakthrough by smell, taste or feel, although breakthrough is not an acceptable method of determining the change-out schedule.

7.3 Respirator Inspection and Cleaning

The Site Safety and Health Supervisor shall periodically (weekly) inspect respirators at the project site. Site personnel shall inspect respirators prior to each use in accordance with the manufacturer's instructions. In addition, site personnel wearing a tight-fitting respirator shall perform a positive and negative pressure user seal check each time the respirator is donned, to ensure proper fit and function. User seal checks shall be performed in accordance with the GeoEngineers respiratory protection program or the respirator manufacturer's instructions.

8.0 SITE CONTROL PLAN

Work zones will be considered to be within 10 feet of the coring device. Employees should work upwind of the machinery if possible. To the extent practicable, use the buddy system. Do not approach heavy equipment unless you are sure the operator sees you and has indicated it is safe to approach. All personnel from GeoEngineers and subcontractor(s) should be made aware of safety features during each morning's safety tailgate meeting (coring device shutoff switch, location of fire extinguishers, cell phone numbers etc.). For medical assistance, see Section 5.1 above.

A contamination reduction zone should be established for personnel before leaving the Facility or before breaking for lunches etc. The zone should consist of garbage bags into which used PPE should be disposed. Personnel should wash hands at the Facility before eating or leaving the Facility.

8.1 Traffic or Vehicle Access Control Plan

Explorations will be completed on board research vessel. Outside personal will not be allowed on board.

8.2 Site Work Zones

Hot zone/exclusion, contamination and decontamination zones: On the vessel and within 10 feet of the sediment sample processing area.

A contamination reduction zone will be established just outside the exclusion zone for the decontamination of sampling equipment. Care will be taken to prevent the spread of contamination. Equipment and personnel decontamination are discussed in the following sections, and the following types of equipment will be available to perform these activities:

- Scrub brushes;
- Spray rinse applicator;
- Plastic garbage bags; and
- Container of Alconox/water solution and Alconox powder.

Method of delineation/ excluding non-site personnel

<u> X </u>	Fence
<u> </u>	Survey Tape
<u> X </u>	Traffic Cones
<u> X </u>	Other – verbal communication

8.3 Buddy System

Personnel on-site should use the buddy system (pairs), particularly whenever communication is restricted. If only one GeoEngineers employee is on-site, a buddy system can be arranged with subcontractor/ contractor personnel.

8.4 Site Communication Plan

Positive communications (within sight and hearing distance or via radio) should be maintained between pairs on-site, with the pair remaining in proximity to assist each other in case of emergencies. The team should

prearrange hand signals or other emergency signals for communication when voice communication becomes impaired (including cases of lack of radios or radio breakdown). In these instances, you should consider suspending work until communication can be restored; if not, the following are some examples for communication:

1. Hand gripping throat: Out of air, can't breathe.
2. Gripping partner's wrist or placing both hands around waist: Leave area immediately, no debate.
3. Hands on top of head: Need assistance.
4. Thumbs up: Okay, I'm all right: or I understand.
5. Thumbs down: No, negative.

8.5 Decontamination Procedures

Decontamination consists of removing outer protective Tyvek clothing and washing soiled boots and gloves using bucket and brush provided on-site in the contamination reduction zone. Inner gloves and respirator will then be removed, hands and face will be washed in either a portable wash station or a bathroom facility in the support zone. Employees will perform decontamination procedures and wash prior to eating, drinking or leaving the Site.

Reusable sampling equipment that is used to process the samples and comes in contact with the sediment (i.e., spoons, bowls, measuring devices, etc.) will be decontaminated before each use. Decontamination procedures for this equipment will consist of the following:

1. Seawater rinse over equipment to dislodge and remove any sediment (deionized water will be used for the samples collected on land);
2. Washing with a brush and non-phosphate detergent solution (e.g., Liqui-Nox and distilled water);
3. Deionized water rinse;
4. Nitric acid (10 % reagent grade nitric acid and distilled water solution);
5. Deionized water rinse;
6. Hexane (certified ACS HPLC Grade $\geq 99.5\%$) or acetone (certified ACS HPLC Grade $\geq 99.5\%$) rinse;
7. Deionized water rinse; and
8. Wrapping or covering the decontaminated equipment with aluminum foil.

These measures include changing out disposable gloves between each sampling location, using fresh paper towels at each sample location, and maintaining a clean work area. Rubber gloves are to be used for decontaminating reusable field equipment with nitric acid and solvents.

8.6 Waste Disposal or Storage

Used PPE, disposable field equipment will be discarded in local trash.

8.7 Sampling, Managing and Handling Drums and Containers

Drums and containers used during the cleanup shall meet the appropriate Department of Transportation (DOT), OSHA and U.S. Environmental Protection Agency (EPA) regulations for the waste that they contain. Site operations shall be organized to minimize the amount of drum or container movement. When practicable, drums and containers shall be inspected and their integrity shall be ensured before they are moved. Unlabeled drums and containers shall be considered to contain hazardous substances and handled accordingly until the contents are positively identified and labeled. Before drums or containers are moved, all employees involved in the transfer operation shall be warned of the potential hazards associated with the contents.

Drums or containers and suitable quantities of proper absorbent shall be kept available and used where spills, leaks or rupture may occur. Where major spills may occur, a spill containment program shall be implemented to contain and isolate the entire volume of the hazardous substance being transferred. Fire extinguishing equipment shall be on hand and ready for use to control incipient fires.

8.8 Spill Containment Plans (Drum and Container Handling)

Drums will be fitted with secure lids to limit the potential for spills. A spill containment plan will be prepared if required by the client.

8.9 Sanitation

Washrooms are present in nearby retail facilities.

8.10 Lighting

Field work will be generally conducted during daylight hours; artificial lighting is not anticipated to be necessary.

9.0 PERSONAL PROTECTIVE EQUIPMENT

PPE will consist of standard Level D equipment. Additionally, waders will be used by field personnel if wet conditions/soft sediment conditions are observed.

Air monitoring will be conducted to determine the level of respiratory protection.

- Level D PPE unless a higher level of protection is required will be worn at all times on the site. Potentially exposed personnel will wash gloves, hands, face and other pertinent items to prevent hand-to-mouth contact. This will be done prior to hand-to-mouth activities including eating, smoking, etc.
- Adequate personnel and equipment decontamination will be used to decrease potential ingestion and inhalation.

Check applicable personal protection gear to be used:

- ☒ Hardhat (if overhead hazards, or client requests)
- ☒ Steel-toed boots (if crushing hazards are a potential or if client requests)
- ☒ Safety glasses (if dust, particles, or other hazards are present or client requests)
- ☒ Hearing protection (if it is difficult to carry on a conversation 3 feet away)
- ☒ Rubber boots and/or waders (if wet conditions or soft sediment observed)
- ☒ Life Jackets (for work near/over water)

Gloves (specify):

- ☒ Nitrile
- ☒ Latex
- ☐ Liners
- ☐ Leather
- ☒ Other (specify) Rubber

Protective clothing:

- ☐ Tyvek (if dry conditions are encountered, Tyvek is sufficient)
- ☐ Saranex (personnel shall use Saranex if liquids are handled or splash may be an issue)
- ☒ Cotton
- ☒ Rain gear (as needed)
- ☒ Layered warm clothing (as needed)

Inhalation hazard protection:

- ☒ Level D
- ☐ Level C (respirators with organic vapor/HEPA or P100 filters)

9.1 Personal Protective Equipment Inspections

PPE clothing ensembles designated for use during site activities shall be selected to provide protection against known or anticipated hazards. However, no protective garment, glove or boot is entirely chemical-resistant, nor does any PPE provide protection against all types of hazards. To obtain optimum performance from PPE, site personnel shall be trained in the proper use and inspection of PPE. This training shall include the following:

- Inspect PPE before and during use for imperfect seams, non-uniform coatings, tears, poorly functioning closures or other defects. If the integrity of the PPE is compromised in any manner, proceed to the contamination reduction zone and replace the PPE.
- Inspect PPE during use for visible signs of chemical permeation such as swelling, discoloration, stiffness, brittleness, cracks, tears or other signs of punctures. If the integrity of the PPE is compromised in any manner, proceed to the contamination reduction zone and replace the PPE.
- Disposable PPE should not be reused after breaks unless it has been properly decontaminated.

10.0 ADDITIONAL ELEMENTS

10.1 Cold Stress Prevention

Working in cold environments presents many hazards to site personnel and can result in frost nip (superficial freezing of the skin), frost bite (deep tissue freezing), or hypothermia (lowering of the core body temperature).

The combination of wind and cold temperatures increases the degree of cold stress experienced by site personnel. Site personnel shall be trained on the signs and symptoms of cold-related illnesses, how the human body adapts to cold environments, and how to prevent the onset of cold-related illnesses. Heated break areas and warm beverages shall be provided during periods of cold weather.

10.2 Heat Stress Prevention

State and federal OSHA regulations provide specific requirements for handling employee exposure to heat stress. GeoEngineers' program complies with these requirements and will be implemented in all areas where heat stress is identified as a potential health issue.

General requirements for preventing heat stress apply to outdoor work environments from May 1 through September 30, annually, only when employees are exposed to outdoor heat at or above an applicable temperature listed in the table below. To determine which temperature applies to each worksite, select the temperature associated with the general type of clothing or personal protective equipment (PPE) each employee is required to wear.

HEAT STRESS

Type of Clothing	Outdoor Temperature Action Levels
Non-breathing clothes including vapor barrier clothing or PPE such as chemical resistant suits	52°
Double-layer woven clothes including coveralls, jackets and sweatshirts	77°
All other clothing	89°

Keeping workers hydrated in a hot outdoor environment requires that more water be provided than at other times of the year. GeoEngineers is prepared to supply at least one quart of drinking water per employee per hour. When employee exposure is at or above an applicable temperature listed in Table 1, Project Managers shall ensure that:

- A sufficient quantity of drinking water is readily accessible to employees at all times; and
- All employees have the opportunity to drink at least one quart of drinking water per hour.

10.3 Emergency Response

Indicate what site-specific procedures you will implement.

- Personnel on-site should use the "buddy system" (pairs).

- Visual contact should be maintained between “pairs” on-site, with the team remaining in proximity to assist each other in case of emergencies.
- If any member of the field crew experiences any adverse exposure symptoms while on-site, the entire field crew should immediately halt work and act according to the instructions provided by the Site Safety and Health Supervisor.
- Wind indicators visible to all on-site personnel should be provided by the Site Safety and Health Supervisor to indicate possible routes for upwind escape. Alternatively, the Site Safety and Health Supervisor may ask on-site personnel to observe the wind direction periodically during site activities.
- The discovery of any condition that would suggest the existence of a situation more hazardous than anticipated should result in the evacuation of the field team, contact of the PM, and reevaluation of the hazard and the level of protection required.
- If an accident occurs, the Site Safety and Health Supervisor and the injured person are to complete, within 24 hours, an Accident Report for submittal to the PM, the Health and Safety Program Manager and Human Resources. The PM should ensure that follow-up action is taken to correct the situation that caused the accident or exposure.

10.4 Boat, Over Water and Near Water Safety Program

See the Boat, Over Water and Near Water Safety Program, included as Attachment A.

11.0 PERSONNEL MEDICAL SURVEILLANCE

GeoEngineers employees are not in a medical surveillance program because they do not fall into the category of “Employees Covered” in OSHA 1910.120(f)(2), which states a medical surveillance program is required for the following employees:

- All employees who are or may be exposed to hazardous substances or health hazards at or above the permissible exposure limits or, if there is no permissible exposure limit, above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more a year;
- All employees who wear a respirator for 30 days or more a year or as required by state and federal regulations;
- All employees who are injured, become ill or develop signs or symptoms due to possible overexposure involving hazardous substances or health hazards from an emergency response or hazardous waste operation; and Members of HAZMAT teams.

12.0 DOCUMENTATION TO BE COMPLETED FOR HAZWOPER PROJECTS

The following forms shall be completed:

- Form 1. Health and Safety Pre-Entry Briefing
- Form 2. Site Safety Plan – GeoEngineers’ Employee Acknowledgment
- Form 3. Subcontractor and Site Visitor Site Safety Form

In addition, the following forms are required for Hazardous Waste Operations and Emergency Response (HAZWOPER) projects:

- Conditional forms available at GeoEngineers office: Accident Report
- Field Log

The Field Log is to contain the following information:

- Updates on hazard assessments, field decisions, conversations with subcontractors, client or other parties, etc.
- Air monitoring/calibration results, including: personnel, locations monitored, activity at the time of monitoring, etc.
- Actions taken.
- Action level for upgrading PPE and rationale.
- Meteorological conditions (temperature, wind direction, wind speed, humidity, rain, snow, etc.).

FORM 1
HEALTH AND SAFETY PRE-ENTRY BRIEFING
ANACORTES PORT LOG YARD
FILE NO. 5147-016-05

Inform employees, contractors and subcontractors or their representatives about:

- The nature, level and degree of exposure to hazardous substances they're likely to encounter;
- All site-related emergency response procedures; and
- Any identified potential fire, explosion, health, safety or other hazards.

Conduct briefings for employees, contractors and subcontractors, or their representatives as follows:

- A pre-entry briefing before any site activity is started; and
- Additional briefings, as needed, to make sure that the Site-specific HASP is followed.

Make sure all employees working on the Site are informed of any risks identified and trained on how to protect themselves and other workers against the Site hazards and risks

Update all information to reflect current sight activities and hazards.

All personnel participating in this project must receive initial health and safety orientation. Thereafter, brief tailgate safety meetings will be held as deemed necessary by the Site Safety and Health Supervisor.

The orientation and the tailgate safety meetings shall include a discussion of emergency response, Site communications and site hazards.

Company Employee

<u>Date</u>	<u>Topics</u>	<u>Attendee</u>	<u>Name Initials</u>

FORM 2
SITE SAFETY PLAN – GEOENGINEERS’ EMPLOYEE ACKNOWLEDGMENT
ANACORTES PORT LOG YARD
FILE NO. 5147-016-05

(All GeoEngineers' Site workers shall complete this form, which should remain attached to the Safety Plan and filed with other project documentation).

I hereby verify that a copy of the current Safety Plan has been provided by GeoEngineers, Inc., for my review and personal use. I have read the document completely and acknowledge an understanding of the safety procedures and protocol for my responsibilities on Site. I agree to comply with all required, specified safety regulations and procedures.

Print Name Signature

Date[illegible]

FORM 3
SUBCONTRACTOR AND SITE VISITOR SITE SAFETY FORM
ANACORTES PORT LOG YARD
FILE NO. 5147-016-05

I verify that a copy of the current Site Safety Plan has been provided by GeoEngineers, Inc. to inform me of the hazardous substances on Site and to provide safety procedures and protocols that will be used by GeoEngineers' staff at the Site. By signing below, I agree that the safety of my employees is the responsibility of the undersigned company.

Print Name Signature

FirmDate[illegible]

ATTACHMENT 1
Boat, Over Water and Near Water Safety Program

BOAT, OVER WATER AND NEAR WATER SAFETY PROGRAM

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Personnel Working Over or Near Water	C1-9

GENERAL

Use of a boat for work requires safe boating practices, good equipment, and training. These procedures are not meant to replace the safety manuals that are provided by the U.S. Coast Guard. Instead they should highlight some of the areas of concern and address specific GeoEngineers, Inc. work procedures. While working near water over waist deep or while on a boat, use a Coast Guard approved flotation device. Remember that being submersed in water increases the chance of hypothermia. Have a dry set of clothes and work with a buddy if you are working around water. If an employee is required to work in the water, they will wear appropriate gear including a wet suit or dry suit if necessary for safe accomplishment of the task.

The US Coast Guard's Federal Requirements state, "All recreational boats must carry one wearable PFD (Type I, II, III, or Type V) for each person aboard... [and that] any boat 16ft and longer (except canoes and kayaks) must also carry one throwable Type IV PFD."

GeoEngineers' Insurance for working over water is covered under the USL&H policy (worker's comp over water) and is not specific to the individuals participating. For work in arctic waters an additional site safety plan will be created to address the additional hazards of working in extremely cold waters.

For work on barges or boats or areas near water that have an OSHA standard height and strength guardrail, PFDs are not required while working behind the guardrail. The access to the barge or near water area also requires that the gangway be protected by guardrails. If employees are not wearing PFDs, there cannot be a risk of falling in the water. Fall protection rules can be utilized on projects where employees are not within 6 feet of a leading edge and there is no risk of falling in the water.

REGULATORY REFERENCES

When working near water, over water or on a barge, OSHA has authority. The U.S. Coast Guard has authority 12 miles off shore and until international waters.

Life Jackets--Employees wear Coast Guard Approved vests that meet the water conditions (See PFD section) they can wear the self-inflating vests.

This safety program is based on the following state and federal regulations:

- OSHA 1926.106 Working over or near water; 1926.605 Marine operations and equipment; Access to vessels 1915.74 and Access to barges and river towboats 1918.26 (Idaho, Missouri)
- WAC 296-800-160 Personal Protective Equipment for PFD
- OR-OSHA 1926 (Oregon)
- AAC Title 8 (Alaska)
- HIOSH Title 12 (Hawaii)
- Cal/OSHA Title 8 (California)

PROCEDURES FOR USING BOATS

Two people will be involved with the use of the boat. The boat operator should always plan a course of travel which is the safest and minimizes the distance to the shore. As a general courtesy, the boat should be cleaned up by the user after each day.

Maneuvering a Boat

- To move boat from dock, move stern away then bow (but not into waves or wind)
- Try not to depend on fendering, slow down
- Communicate with other person in boat when:
 - increase or decrease speed
 - dramatically change direction
 - approach pilings so hands can come inside boat

Right-of-Way

- Watch out for ferry traffic– large vessels have right of way and cannot stop
 - Don't cut them off, they move much faster than they appear to. If the boat breaks down in a ferry lane, use radio, flares, and wave and make sure they see you until help arrives.
- Larger vessel has right of way over smaller
- With boats of similar size, sailboat has right of way
- When lights are visible, green has the right of way over red

Load Limits

Cargo should be evenly distributed and there should be a safe amount of freeboard which depends on water conditions. When loading up the boat for travel that goes beyond the protection of the pier, the employee should drive to the end of the pier and check wave conditions before entering.

Engine Use

When using an outboard motor, the boat operator will use the tether kill switch. This will hook to the employee's wrist and turn off the engine if the employee were to be launched into the water.

Personal Floatation Device (PFD)

Type 1 PFDs will be worn in the boats at all times. PFD will be the correct size for the wearer and will be securely fastened. The PFD should be inspected for damage prior to each use.

In water with PFD – to reduce water from lowering body temperature:

- One person: cross arms pull knees up
- Two persons: huddle together

Chance of swimming 100 yards is not very good, so the best strategy is to stay with the boat. The boat should always be closer to shore than this distance during transport and the employee would be close enough to swim to shore.

Throwing Lines

- Make first two coils larger
- Kneel in boat
- Shoulder pointed to victim
- Throw over their head

Water on Board

- A five gallon bucket will always be available on the boat to bale water that comes inside the boat.

Towing

- Take time to set up
- Look at lines
- Stay in step with waves
- For logs, may want to tow from bow. use timber hitch, shackle to weigh down
- Don't overstress lines
- Don't shock load lines
- Sea anchor – can use to slow down tow, make more controllable. For some situations, a sea anchor is not necessary and could make things worse.

Safety and Signals

- Horn blasts: five short blasts signals danger
- Lights: Employees will not be traveling between terminals in the dark. If it becomes dark while working, the operator will moor the boat at that terminal for the night. A flashlight will be available in the waterproof box stored in the workboat.

BARGE OR PLATFORM PROCEDURES

Any work within six feet of a leading edge will require a life jacket if water is below the leading edge. Railings must be present if a leading edge is above a hard surface. Refer to GeoEngineers' Fall Protection Program for additional details.

Employees shall not be permitted to walk along the sides of covered lighters or barges with coamings more than 5 feet high, unless there is a 3-foot clear walkway, or a grab rail, or a taut hand line is provided. (Coaming is any vertical surface on a ship designed to deflect or prevent entry of water. It usually refers to raised section of deck plating around an opening, such as a hatch. Coamings also provide a frame onto which to fit a hatch cover.)

Employees shall not be permitted to walk over deck loads from rail to coaming unless there is a safe passage. If it is necessary to stand at the outboard or inboard edge of the deck load where less than 24 inches of bulwark, rail, coaming, or other protection exists, all employees shall be provided with a suitable means of protection against falling from the deck load.

The employer shall ensure that there is in the vicinity of each barge in use at least one U.S. Coast Guard-approved 30-inch life ring with not less than 90 feet of line attached, and at least one portable or permanent ladder which will reach the top of the apron to the surface of the water. If the above equipment is not available at the pier, the employer shall furnish it during the time that he is working the barge.

Whenever practicable, a gangway of not less than 20 inches walking surface of adequate strength, maintained in safe repair and safely secured shall be used. If a gangway is not practicable, a substantial straight ladder, extending at least 36 inches above the upper landing surface and adequately secured against shifting or slipping shall be provided. When conditions are such that neither a gangway nor a straight ladder can be used, a Jacob's ladder meeting the requirements of paragraphs (d)(1) and (2) of this section may be used.

Cranes/Hoists/Cables

Employees need to use caution when working in areas where cranes, hoists and cables are in use. Refer to the GeoEngineers' Drilling and Rigging Safety Program.

WORKING NEAR WATER PROCEDURES

- GeoEngineers' employees working over or near water, where the danger of drowning exists, shall be provided with U.S. Coast Guard-approved life jacket or buoyant work vests.
- Prior to and after each use, the buoyant work vests or life preservers shall be inspected for defects which would alter their strength or buoyancy. Defective units shall not be used.
- Ring buoys with at least 90 feet of line shall be provided and readily available for emergency rescue operations. Distance between ring buoys shall not exceed 200 feet.
- At least one lifesaving skiff shall be immediately available at locations where employees are working over or adjacent to water.

EMERGENCY PROCEDURES

The following topics are items that are important for handling an emergency. The boat operator should know these procedures and follow them at all times.

Communication

The Marine Radio will be with the boat operator at all times. Before entering the boat, the operator will call in to the Dispatcher and notify them of the location and destination of the boat. Each time an employee enters or exits the boat, this will be recorded by the Dispatcher. This contact should occur at departure and arrival for long transits.

Engine Problems

In the event of engine problems, contact the Dispatcher and notify them of the situation immediately. Depending on the situation, a rescue could be dispatched by the Coast Guard, another employee or a contractor. If a repair is made in the interim while waiting for the tow, call the Dispatcher again and notify them of the situation.

Spare plugs will be in the waterproof kit for offshore engine problems only. The boat operator will be required to take a spare tank and line for fuel, thus eliminating the need for spare line.

Distress Flares

Are located in the waterproof boxes that the boat operator needs to ensure are on the boat before each travel session. Boat operators should also make sure that they are familiar with the operation of these flares.

Person Overboard/Rescue

Boat operators should be familiar with in water rescue techniques. The Coast Guard recommends that people not try to swim long distances to shore but wait for a rescue. This is because of hypothermia. Please see the section on Personal Floatation Devices. Access back into the boat will be from the stern. The engine will be turned off while the employee re-enters the boat.

Fire

Each workboat will be equipped with a 5pound ABC fire extinguisher located near the bow. The fire extinguisher should be checked each time the boat is used to ensure that it is ready to operate.

Work Related Injuries

Work related injuries that are not threatening to the safety of the persons on board should be reported to the Supervisor as soon as possible. Any work related injury that impairs operation of the boat should be called in to the GeoEngineers' office immediately. The office will call for the Coast Guard and or the Fire Dept. in the event of a serious injury.

WEATHER/TIDES

If the visibility is very low due to fog, the operator will not take the boat out.

Fog

In fog employees will stay within sight of the shoreline and/or head in and tie up. Whereas the MTC class instructed employees to drop anchor and use horn alert those nearby, employees are not likely to be caught unexpected in dense fog and should not go out if visibility is not sufficient for travel. Remember, ferry boats can't pick you up on radar and can't stop quickly.

Rough Water

- Look for lee, can be another boat
- Head into swells, throttle up when approaching, throttle down when dropping down
- Check wave conditions before taking the boat out
- Head in at 45 degree angle at times, depending on wave size

Tides

Tidal changes in the Puget Sound and northern areas can be significant. Employees should always be aware of the tide changes and plan their work accordingly. There have been several instances where work under the docks became dangerous due to changing tides and lack of planning.

LIST OF SUPPLIES

In addition to the list of supplies generated in the training at the Maritime Training Center, the U.S. Coast Guard identified the following items to be critical for safe boating.

Items to be stored with the boat at all times:

- Oars and oarlocks
- Anchor
- Bucket for baling water
- Fire Extinguisher
- One spare fuel tank and line

Items that will be brought onto the boat when in use:

- Marine radio
- Watertight box with: first aid kit, flashlight, flares
- Personal Floatation Device(s)
- Carry a knife with serrated edge
- Tide book
- Spare plugs and wrench

PERSONAL FLOATATION DEVICE (PFD) SPECIFICATIONS

Personal Flotation Device (PFD) use applies to terminals and piers and employees working near other bodies of water. It also applies to all activities conducted by GeoEngineers employees at these facilities, including construction, maintenance, inspections, tours and operations. Type 1 PFDs will be worn in the boats at all times. PFD will be the correct size for the wearer and will be securely fastened. The PFD should be inspected for damage prior to each use. Boats longer than 16 feet must carry at least one Type I, II, III, or V PFD for each person on board.

In addition, at least one Type IV (throwable device) must be carried. This is important, you may not use a Type IV “flotation cushion” as your sole PFD in your small rowboat or sailing dingy. Note: If a Type V device is used to count toward requirements, it must be worn. Federal regulations require PFDs on canoes and kayaks of any size; they are not required on racing shells, rowing skulls, or racing kayaks. State laws may vary.

PFDs are required for:

- Any employee in a boat/skiff/barge,
- Any employee is working on top of, or beyond the bull rail (a railing for docking the boat), or
- Employees working near water where the danger of drowning exists.

PFDs are not specifically required when:

- Employees are not exposed to the danger of drowning when:
 - Employees are working behind standard height and strength guardrails.
 - Employees are working inside operating cabs or stations that eliminate the possibility of accidentally falling into the water.
 - Employees are wearing an approved safety harness with a lifeline attached that prevents the possibility of accidentally falling into the water.
 - Working behind a guardrail of standard height and strength or other stable restraint.
 - A single person is working more than 6 feet from the edge.
 - Working over shallow water (less than chest deep) where floatation would not be achieved (other protective measures required).

Provide your employees with PFDs approved by the United States Coast Guard for use on commercial or merchant vessels. The following are appropriate or allowable United States Coast Guard-approved PFDs:

Type of PFD	General Description
Type I	Off-Shore Life Jacket-effective for all waters or where rescue may be delayed.
Type II	Near-Shore Buoyant Vest- intended for calm, inland water or where there is a good chance of quick rescue.
Type III	Flotation aid- good for calm, inland water, or where there is a good chance of rescue.
Type V	Flotation aids such as boardsailing vests, deck suits, work vests and inflatable PFD's marked for commercial use.

Off-Shore Life Jacket (Type I PFD)

Best for open, rough or remote water, where rescue may be slow coming.

- Advantages:
 - Floats person the best.
 - Turns most unconscious wearers face-up in water.
 - Highly visible color.
- Disadvantages:
 - Bulky.

Near-Shore Buoyant Vest (Type II PFD)

Good for calm, inland water, or where there is good chance for fast rescue.

■ Advantages

- Turns some unconscious wearers face-up in water.
- Less bulky, more comfortable than Off-Shore Life Jacket (Type I PFD).
- Compromise between Type I PFD performance and wearer comfort.

■ Disadvantages

- May be uncomfortable wearing for extended periods.
- Will not turn as many people face-up as a Type I PFD will.
- In rough water, a wearer's face may often be covered by waves.
- Not for extended survival in rough water.

Flotation Aid (Type III PFD)

Good for calm, inland water, or where there is good chance of fast rescue.

■ Advantages

- Generally the most comfortable type for continuous wear.
- Freedom of movement for water skiing, small boat sailing, fishing, etc.
- Available in many styles, including vests and flotation coats.

■ Disadvantages

- Not for rough water.
- Wearer may have to tilt head back to avoid face-down position in water.

Inflatable PFD's come in Types I, II, and III. Although the different "Types" of inflatable PFD's are intended for use in the same areas as inherently buoyant types of PFD's, the characteristics of inflatable PFD's are different. Inflatable PFD's are not inherently buoyant and will not float without inflation. For Types I, II, and III inflatables, the lower the Type number, the better the PFD's performance (e.g., Type I is better than Type II).

Although inflatable PFD's are considered one of the most comfortable PFD's to wear when it's hot, inflatable PFD's require regular maintenance and are not recommended for children or individuals who can't swim. Inflatable PFD's are not for use where water impact is expected as when waterskiing, riding personal watercraft, or whitewater paddling.

TRAINING

Personnel Using Boats

Each state is specific boat training requirements. In addition the U.S. Coast Guard can also be contacted for local training opportunities. All GeoEngineers employees operating a boat should have documented training.

The topics are copied from the Basic Use section of these Policy and Procedure Training materials provided by Maritime Training Center (MTC) are available from the Health and Safety Program Manager to use as a guide for additional training.

- Boat safety
- Boat operations, maneuvering (hands on)
- Towing
- Communications
- Emergency situations
- Rescue (hands on)
- Use of ropes (hands on)

Personnel Working Over or Near Water

GeoEngineers employees working over or near water should be trained in the contents of the Boat, Over Water and Near Water Safety Program. At the start of each project in which working over or near water presents a danger of drowning employees should have a tailgate safety meeting and discuss the following:

- The danger of drowning where it exists.
- Use of U.S. Coast Guard-approved life jacket or buoyant work vests.
- Life jacket or buoyant work vests inspections.
- Location of ring buoys for emergency rescue operations.
- Location of a lifesaving skiff for rescue if needed.

APPENDIX D

Public Participation Plan

Site Cleanup:

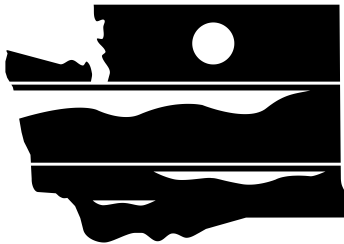
ANACORTES PORT LOG YARD

718 4th Street
Anacortes, Skagit County, Washington

DRAFT PUBLIC PARTICIPATION PLAN

Prepared by:

Washington State Department of Ecology



DEPARTMENT OF
ECOLOGY
State of Washington

September 2014

This plan is for you!

This Public Participation Plan (Plan) is prepared for the Anacortes Port Log Yard Site cleanup as part of the requirements of the Model Toxics Control Act (MTCA). The Plan provides information about MTCA cleanup actions and requirements for public involvement, and identifies how the Washington State Department of Ecology (Ecology) will support public involvement throughout the cleanup. The Plan is intended to encourage coordinated and effective public involvement tailored to the community's needs at the Anacortes Port Log Yard Site.

For additional copies of this document, please contact:

Washington State Department of Ecology
Susannah Edwards, Site Manager
Toxics Cleanup Program
PO Box 47600
Olympia, WA 98504-7600
(360) 407-6798
Email: Susannah.edwards@ecy.wa.gov

Accommodation Requests:

To request ADA accommodation including materials in a format for the visually impaired, call Ecology at (360) 407-7170. Persons with impaired hearing may call Washington Relay Service at 711. Persons with speech disability may call TTY at 877-833-6341.

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1.0: Introduction and Overview of the Public Participation Plan

This Public Participation Plan (Plan) explains how you can become involved in improving the health of your community. It describes public participation opportunities that will be available during this review period for a site on the Fidalgo Bay waterfront – the Anacortes Port Log Yard Site (Site). The Site is generally located at 718 4th Street in Anacortes, Washington. These opportunities are part of a collaborative effort by the Washington State Department of Ecology (Ecology) and Port of Anacortes (Port) to decide on cleanup actions for the Site. Current draft documents for review include:

- Agreed Order - a legal document between Ecology and the Port in which the Port agrees to provide remedial action at the Site where there has been a release or threatened release of hazardous substances.

Cleanup actions, and the public participation process that helps guide them, are established in Washington's Model Toxics Control Act (MTCA).¹ Under MTCA, Ecology is responsible for providing timely information and meaningful chances for the public to learn about and comment on important cleanup decisions before they are made. The goals of the public participation process are:

- To promote understanding of the cleanup process so that the public has the necessary information to participate.
- To encourage involvement through a variety of public participation opportunities.

This Plan provides a framework for open dialogue about the cleanup among community members, Ecology, and other interested parties. It outlines basic MTCA requirements for community involvement activities that will help ensure that this exchange of information takes place during the investigation and cleanup. These requirements include:

- Notifying the public about available reports and studies about the site.
- Notifying the public about review and comment opportunities during specific phases of the cleanup investigation.
- Providing appropriate public participation opportunities to learn about cleanup documents, and if community interest exists, holding meetings to solicit input and identify community concerns.

¹ The Model Toxics Control Act (MTCA) is the hazardous waste cleanup law for the State of Washington. The full text of the law can be found in Revised Code of Washington (RCW), Chapter 70.105D. The legal requirements and criteria for public notice and participation during MTCA cleanup investigations can be found in Washington Administrative Code (WAC), Section 173-340-600.

- Considering public comments received during public comment periods.

In addition to these basic requirements, the Plan may include additional site-specific activities to meet the needs of your community. Based upon the type of proposed cleanup action, the level of public concern, and the risks posed by the site, Ecology may decide that more public involvement opportunities are appropriate.

These opportunities form the basis for the public participation process. The intent of this Plan is to:

- Provide complete and current information to all interested parties.
- Let you know when there are opportunities to provide input.
- Provide opportunities to listen to and address community concerns.

Part of the Puget Sound Initiative

The Site is one of several waterfront sites in Fidalgo and Padilla Bays and is part of a larger cleanup effort called the Puget Sound Initiative (PSI). Washington State established the Puget Sound Initiative to protect and restore Puget Sound. The PSI includes cleaning up 50-60 contaminated sites within one-half mile of the Sound. These sites are grouped in several bays around the Sound for “baywide” cleanup efforts. As other sites in Fidalgo and Padilla Bays move forward into investigation and cleanup, information about them will be provided to the community as well as people and groups who are interested.

Roles and Responsibilities

Ecology will lead public involvement activities. Ecology maintains overall responsibility and approval authority for the activities outlined in this plan. Ecology and Port of Anacortes are responsible for cleanup at the Site. Ecology will oversee all future cleanup activities and ensure that contamination on the Site is cleaned up to concentrations that are established in state regulations and that protect human health and the environment.

Organization of this Public Participation Plan

The sections that follow in this Plan provide:

- Section 2: Background information about the Anacortes Port Log Yard Site.
- Section 3: An overview of the local community that this plan is intended to engage.
- Section 4: Public involvement opportunities in this cleanup.

This Plan addresses current conditions at the Site, but it is intended to be a dynamic working document that will be reviewed at each phase of the cleanup and updated as needed. Ecology and the Port of Anacortes urge the public to become involved in the cleanup process.

2.0: Site Background

Site Description and Location

The Site is generally located at 718 4th Street in Anacortes, Skagit County, Washington, on Fidalgo Bay (see Figure 1). Acquired by the Port in 1965, the Site is at the northern terminus of T Avenue and bound by Guemes Channel to the North. Further investigations will sample upland and in-water areas.



Figure 1: The Anacortes Port Log Yard Site is shown in the above map, located at 718 4th Street in Anacortes, WA.

General Site History and Contaminants

The Site is owned by the Port of Anacortes (Port) and was historically used for log handling from the mid-1960's to about 2004. Operations included log rafting and the transfer of logs from water to upland sorting and handling areas on Pier 2. From 1978 to 1979 the Port leased the area to Forest Sales, Inc. for similar uses.

Following the closure of the facility in 2004, the Port led an investigation to assess potential impacts from decades of log handling activities. The investigation found surface sediments containing up to 75 percent wood debris by volume within a matrix of silt and fine sand.

In addition to wood waste, the investigation found levels of organic carbon and volatile solids above recommended levels.

Further investigations from 2008 to 2010 found that sediment samples failed to meet Ecology's regulatory levels: the Sediment Cleanup Objective and Cleanup Screening Levels criteria for benthic invertebrate community health (i.e., living in or near marine sediments). These investigations also indicated the site may contain dioxins/furans at levels that exceed human health risk based sediment cleanup levels.

The Cleanup Process

Washington State's cleanup process and key opportunities for you to provide input are outlined in Figure 2 on page 12. The general cleanup process includes the following steps:

- Remedial Investigation (RI) – investigates the site for types, locations, and amounts of contaminants.
- Feasibility Study (FS) – identifies cleanup options for those contaminants.
- Cleanup Action Plan (CAP) – selects the preferred cleanup option and explains how cleanup will be conducted.

Each of these steps is generally documented in reports and plans that will be available for public review. Public comment periods of at least 30 calendar days are usually conducted for the following documents:

- Draft RI report
- Draft FS report
- DCAP

These comment periods may be conducted separately or combined.

Steps in the cleanup process and related documents are described in greater detail in the following subsections.

Interim Actions

Interim actions may be completed during the cleanup if required by Ecology. An interim action partially addresses the cleanup of a site, and may be conducted if:

- It is technically necessary to reduce a significant threat to human health or the environment.
- It corrects a problem that may become substantially worse or cost substantially more to fix if delayed.
- It is needed to complete another cleanup activity, such as design of a cleanup plan.

The forthcoming RI/FS work plan will evaluate whether an Interim Action is appropriate for the Site.

Overview of Agreed Order

The proposed agreement, called an Agreed Order, is a legal document between Ecology and the Port which agrees to provide remedial action at the Site where there has been a release or threatened release of hazardous substances.

The Agreed Order describes the studies that the Potentially Liable Persons, the Port, agree to perform on the Site. The Agreed Order provides guidance on the following studies and documents:

- **Draft Remedial Investigation/Feasibility Study (RI/FS)** – This document explains the work needed to look for, identify, and analyze contamination at the Site.
- **Draft Final Cleanup Action Plan (DCAP)** – This document uses RI/FS information to identify a preferred cleanup action at the Site and sets a schedule to remove and treat the contamination.

3.0: Community Profile

Community Profile

Anacortes is Skagit County's second largest city and its largest seaport. It is the principal city on Fidalgo Island. The current population is approximately 16,048 people (about 7,680 households)² situated within about 12 square miles. Located on Fidalgo Bay, Anacortes has 12.5 miles of saltwater shoreline which support three Port of Anacortes marine terminals, a shipyard, several yacht and mid-size boat building and sales operations, and four private marinas. In addition to the City's modern educational and health care facilities, four freshwater lakes and 3,300 acres of city-owned forestland and parks create a rural character in the community. The City's 2006 labor workforce was more than 7,000, predominantly employed in manufacturing, accommodations/food service, retail, and health care.³

Key Community Concerns

An important part of this Plan is to identify key community concerns for the cleanup site. Many factors are likely to raise community questions, such as the amount of contamination, how much contamination has been cleaned up and what remains, and future use of the Site. Community concerns often change over time as new information is learned and questions are answered. Identifying site-specific community concerns at each stage of the cleanup process helps ensure that they are adequately addressed. On-going key community concerns will be identified for the Anacortes Port Log Yard Site through public comments and other opportunities, as detailed in Section 4.

² US Census Bureau, State & County QuickFacts, *available at* <http://quickfacts.census.gov/qfd/states/53/5301990.html> (Accessed 07/29/14).

³ Anacortes Chamber of Commerce web site, *available at* <http://www.anacortes.org/uploads/Community%20Profile.pdf> (Accessed 07/29/14).

4.0: Public Participation Opportunities

Ecology and Port of Anacortes invite you to share your comments and participate in the cleanup in your community. As we work to meet our goals, we will evaluate whether this public participation process is successful. This section describes the public participation opportunities for the Site.

Measuring Success

We want this public participation process to succeed. Success can be measured, at least in part, in the following ways:

- Number of written comments submitted that reflect understanding of the cleanup process and the site.
- Direct, in-person feedback about the site cleanup or public participation processes, if public meetings are held.
- Periodic updates to this Plan to reflect community concerns and responses.

If we are successful, this process will increase:

- Community awareness about plans for cleanup and opportunities for public involvement.
- Public participation throughout the cleanup.
- Community understanding regarding how their input will be considered in the decision-making process.

Activities and Information Sources

Ecology Contacts

Ecology is the lead contact for questions about the cleanup in your community. The Ecology staff person identified in this section is familiar with the cleanup process and activities at the Site. For more information about public involvement or the technical aspects of the cleanup, please visit our website at <https://fortress.wa.gov/ecy/gsp/Sitepage.aspx?csid=3604>, or contact:

Susannah Edwards, Site Manager
Department of Ecology
Toxics Cleanup Program
PO Box 47600
Olympia, WA 98504-7600
Phone: (360) 407-6798
Email: Susannah.edwards@ecy.wa.gov

Ecology's Webpage

Ecology has created a webpage to provide convenient access to information. Documents such as the Agreed Order are posted as they are issued during the investigation and cleanup process. Visitors to the webpage can find out about public comment periods and possible meetings; download, print, and read information; and submit comments via email. The webpage also provides links to detailed information about the MTCA cleanup process. The Anacortes Port Log Yard Site webpage is available at the following address:

<https://fortress.wa.gov/ecy/gsp/Sitepage.aspx?csid=3604>

Information Centers/Document Repositories

The most comprehensive source of information about the Site is the information center or document repository. Two repositories provide access to the complete list of site-related documents. All Site investigation and cleanup activity reports will be kept in print at those two locations and will be available for your review. They can also be requested on compact disk (CD). Document repositories are updated before public comment periods to include the relevant documents for review. Documents remain at the repositories throughout the investigation and cleanup. For the Site, the document repositories are:

- **Anacortes Public Library**
1220 10th Street
Phone: (360) 293-1910
Web:
<http://library.cityofanacortes.org/client/default>
- **Department of Ecology Headquarters**
300 Desmond Drive
Lacey, WA 98503
By appointment. Please contact Carol Dorn
at (360) 407-7224 or Carol.Dorn@ecy.gov.

Look for document covers much like the illustration on the right.



Public Comment Periods

Public comment periods provide opportunities for you to review and comment on major documents when they are available, such as the draft Consent Decree, draft RI, draft FS, DCAP and draft Public Participation Plan. The typical public comment period is 30 calendar days.

Notice of Public Comment Periods

Notices for each public comment period will be provided by local newspaper and by mail. These notices indicate the timeframe and subject of the comment period, and explain how you can submit your comments.

For the Anacortes Port Log Yard Site, a newspaper notice will be posted in American Anacortes, Skagit Valley Herald, and the Clamdigger.

Notices are also sent by regular mail to the local community and interested parties. The local community typically includes all residential and business addresses within one-quarter mile of the site, as well as potentially interested parties such as public health entities, environmental groups, and business associations.

Fact Sheets

One common format for public comment notification is a fact sheet. Like the newspaper notice, fact sheets explain the timeframe and purpose of the comment period, but also provide background and a summary of the document(s) under review. Future fact sheets will be prepared at key milestones in the cleanup process.

MTCA Site Register

Ecology produces an electronic newsletter called the MTCA Site Register. This semi-monthly publication provides updates of the cleanup activities occurring throughout the state, including public meeting dates, public comment periods, and cleanup-related reports. Individuals who would like to receive the MTCA Site Register can sign up three ways:

- Call (360) 407-6848
- Send an email request to spre461@ecy.wa.gov
- Register online at http://www.ecy.wa.gov/programs/tcp/pub_inv/pub_inv2.html

Mailing Lists

Ecology maintains both email and regular mail distribution lists throughout the cleanup process. The lists are created from carrier route delineations for addresses within one-quarter mile of the Site; potentially interested parties; public meeting sign-in sheets; and requests made in person or by regular mail or email. You may request to be on a mailing list by contacting the Ecology staff person listed earlier in this section.

Optional Public Meetings

A public meeting will be held during a comment period if requested by ten or more people, or if Ecology decides it would be useful. Public meetings provide additional opportunity to learn about the investigation or cleanup, and to enhance informed comment. If you are interested in a public meeting about the Site, please contact the Ecology staff listed earlier in this section.

Submitting Comments

You may submit comments by regular mail or email during public comment periods to the Ecology Project Manager listed earlier in this section.

Response to Comments

Ecology will review all comments submitted during public comment periods, and will modify documents as necessary. You will receive notice by regular mail or email that Ecology has received your comments, along with a general explanation about how the comments were addressed and where the revised document can be found.

Other

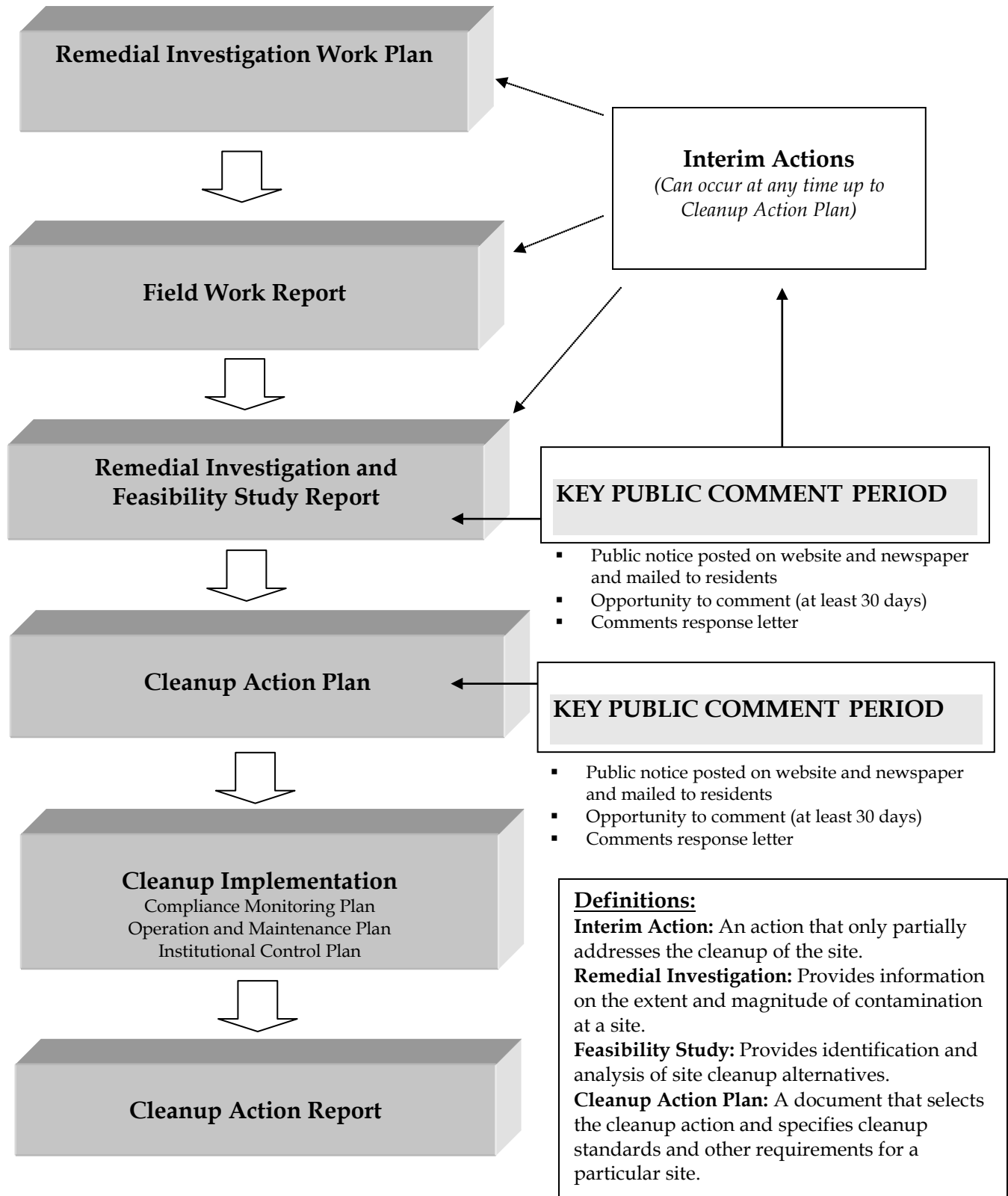
Ecology is committed to the public participation process and will consider additional means for delivering information and receiving comments, including combining public comment periods for other actions (such as those associated with the State Environmental Policy Act).

Public Participation Grants

You are eligible to apply for a Public Participation Grant from Ecology approximately every two years to provide funding for additional public participation activities. Those additional activities will not reduce the scope of the activities defined by this Plan. Activities conducted under this Plan would coordinate with the additional activities defined under the grant.

Visit www.ecy.wa.gov/programs/swfa/grants/ppg.html for more information about Ecology's Public Participation Grants.

Figure 2: Washington State Cleanup Process



Glossary

Cleanup: The implementation of a cleanup action or interim action.

Cleanup Action: Any remedial action except interim actions, taken at a site to eliminate, render less toxic, stabilize, contain, immobilize, isolate, treat, destroy, or remove a hazardous substance that complies with MTCA cleanup requirements, including but not limited to: complying with cleanup standards, utilizing permanent solutions to the maximum extent practicable, and including adequate monitoring to ensure the effectiveness of the cleanup action.

Cleanup Action Plan: A document that selects the cleanup action and specifies cleanup standards and other requirements for a particular site. The cleanup action plan, which follows the remedial investigation/feasibility study report, is subject to a public comment period. After completion of a comment period on the cleanup action plan, Ecology finalizes the cleanup action plan.

Cleanup Level: The concentration (or amount) of a hazardous substance in soil, water, air, or sediment that protects human health and the environment under specified exposure conditions. Cleanup levels are part of a uniform standard established in state regulations, such as MTCA.

Cleanup Process: The process for identifying, investigating, and cleaning up hazardous waste sites.

Contaminant: Any hazardous substance that does not occur naturally or occurs at greater than natural background levels.

Feasibility Study: Provides identification and analysis of site cleanup alternatives and is usually completed within a year. The entire Remedial Investigation/Feasibility Study (RI/FS) process takes about two years and is followed by the cleanup action plan. Remedial action evaluating sufficient site information to enable the selection of a cleanup action plan.

Hazardous Site List: A list of ranked sites that require further remedial action. These sites are published in the Site Register.

Interim Action: Any remedial action that partially addresses the cleanup of a site. It is an action that is technically necessary to reduce a threat to human health or the environment by eliminating or substantially reducing one or more pathways for exposure to a hazardous substance at a facility; an action that corrects a problem that may become substantially worse or cost substantially more to address if the action is delayed; an action needed to provide for completion of a site hazard assessment, state remedial investigation/feasibility study, or design of a cleanup action.

Model Toxics Control Act: Refers to RCW 70.105D. Voters approved it in November 1988. The implementing regulation is WAC 173-340 and was amended in 2001.

Public Notice: At a minimum, adequate notice mailed to all persons who have made a timely request of Ecology and to persons residing in the potentially affected vicinity of the proposed action; mailed to appropriate news media; published in the local (city or county) newspaper of largest circulation; and the opportunity for interested persons to comment.

Public Participation Plan: A plan prepared under the authority of WAC 173-340-600 to encourage coordinated and effective public involvement tailored to the public's needs at a particular site.

Release: Any intentional or unintentional entry of any hazardous substance into the environment, including, but not limited to, the abandonment or disposal of containers of hazardous substances.

Remedial Action: Any action to identify, eliminate, or minimize any threat posed by hazardous substances to human health or the environment, including any investigative and monitoring activities of any release or threatened release of a hazardous substance, and any health assessments or health effects studies conducted in order to determine the risk or potential risk to human health.

Remedial Investigation: Any remedial action that provides information on the extent and magnitude of contamination at a site. This usually takes 12 to 18 months and is followed by the feasibility study. The purpose of the Remedial Investigation/Feasibility Study is to collect and develop sufficient site information to enable the selection of a cleanup action.

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