July 2017
Shelton Harbor Sediment Cleanup Unit
Oakland Bay and Shelton Harbor Sediments Cleanup Site (Cleanup Site ID 13007)

ANCHOR QEA

Remedial Investigation/Feasibility Study Work Plan

Prepared for Simpson Timber Company and the Washington State Department of Ecology

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ABBREVIATIONS

AST	above-ground storage tank
cm	centimeter
CoC	chemical of concern
Corps	U.S. Army Corps of Engineers
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CSL	cleanup screening level
DCA	disproportionate cost analysis
DGT	diffusive gradients in thin films
DMMP	Dredged Material Management Program
DOH	Washington State Department of Health
DQO	data quality objective
Ecology	Washington State Department of Ecology
EIM	Environmental Information Management
FS	Feasibility Study
MTCA	Model Toxics Control Act
PQL	practical quantitation limit
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
SCO	sediment cleanup objective
SCU	Sediment Cleanup Unit
Simpson	Simpson Timber Company
SMS	Sediment Management Standards
SPI	sediment profile imaging
SPME	solid-phase microextraction
SQAPP	Sampling and Quality Assurance Project Plan
TEQ	toxic equivalents quotient
TVS	total volatile solids
WAC	Washington Administrative Code
Work Plan	Shelton Harbor Remedial Investigation/Feasibility Study Work Plan

1 Introduction

This Shelton Harbor Remedial Investigation/Feasibility Study (RI/FS) Work Plan (Work Plan) has been prepared in accordance with the Sediment Management Standards (SMS; Chapter 173-204 Washington Administrative Code [WAC]) and the Model Toxics Control Act (MTCA; Chapter 173-340 WAC). Simpson Timber Company (Simpson), along with other Potentially Liable Parties as appropriate, will implement this Work Plan to satisfy the requirements of Agreed Order DE 14091 between Simpson and the Washington State Department of Ecology (Ecology) for the Shelton Harbor Sediment Cleanup Unit (SCU) located within the Oakland Bay and Shelton Harbor Sediments Cleanup Site (Ecology Cleanup Site ID 13007). Ecology delineated the Shelton Harbor SCU in accordance with WAC 173-204-500(4)(a) to expedite cleanup of Shelton Harbor sediments located below the mean higher high water elevation, coordinated with habitat restoration activities planned within the SCU. Ecology and Simpson have the mutual objective of completing the RI/FS in 2018. The scope of work is defined in Section 4.

1.1 Shelton Harbor Environment

Like the rest of Puget Sound, the Shelton Harbor area was glaciated and carved out during the last ice age. Shelton Harbor, Oakland Bay, and Hammersley Inlet are likely the remnants of a subglacial channel formed during the most recent glacial retreat (Herrera 2010). Sediment entering Shelton Harbor is primarily from watershed inputs from Goldsborough Creek, along with smaller inputs from Shelton Creek and other sources. Sands transported through Goldsborough Creek deposit in the intertidal delta near the creek mouth, while finer sediment (silt and clay) is transported into deeper water areas of the Shelton Harbor SCU.

Both Goldsborough and Shelton Creeks are productive salmonid streams. In 2000, the U.S. Army Corps of Engineers (Corps), in conjunction with the Washington State Department of Fish and Wildlife, Simpson, and the Squaxin Island Tribe, removed a 33-foot-high dam in Goldsborough Creek, improving fish passage for Chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), and chum (*O. keta*) salmon, coastal cutthroat trout (*O. clarkii clarkii*), and bull trout (*Salvelinus confluentus*). Today, Goldsborough Creek is one of the only watersheds in Puget Sound with increasing salmon runs.

1.2 Harbor Development Timeline

The Shelton area economy was built around logging, farming, dairying, and ranching as well as oyster cultivation. Industrial development in Shelton Harbor began with sawmill operations in the late 1800s. Figures 1 to 5 present representative aerial photographs that depict changes in development of Shelton Harbor over the last 70 years. In general, waterfront industrial operations peaked in the 1950s and 1960s and have declined since that period like other areas of Puget Sound.

1.3 Historical Development

As described in the Agreed Order, several industrial facilities operating in Shelton Harbor may have historically released hazardous substances and/or wood debris to sediments, based on their scale, nature of operations, and years of operation. Each of these facilities is briefly summarized below. More detailed descriptions are provided in the *Summary of Existing Information and Data Gaps Technical Memorandum* (Herrera 2008). As discussed in Herrera (2010), historical sources of contamination to Shelton Harbor included wood debris, wood burning and hog fuel boiler burning, upland mill activities, wastewater discharges, and other operations. Transport pathways include currents and tidal fluctuations, aerial deposition, and stormwater runoff.

1.3.1 Simpson Timber Company

Since the mid-1800s, several timber industries have operated in Shelton Harbor. Through the early 1930s, three sawmills operated along the Shelton waterfront and a shingle mill operated at Eagle Point. By the early 1940s, Simpson acquired sawmills along with the shingle mill, redeveloping the Shelton waterfront into a combined sawmill and plywood/fiberboard manufacturing facility. In the mid-1940s, Simpson developed the waterfront north of Goldsborough Creek and built an insulating board plant, plywood plant, railroad roundhouse, and machine shops, as well as a railroad log dump (Figure 1). In the late 1940s, a wooden bulkhead log dump was constructed east of the Shelton Creek delta, and two above-ground petroleum storage tanks (ASTs) were installed northeast of this log dump (all ASTs in this area were removed in 1965). From the 1950s to the early 1960s, Simpson further expanded the facility on the north side of Goldsborough Creek, building planing mills, dry kilns, and other facilities.

In 1926, a wood-fired power plant was built to supply power to the sawmills south of Goldsborough Creek. From 1938 to 1963, this power plant was jointly owned and operated by Simpson and Rayonier (Section 1.3.2). After 1963, Simpson became sole owner of the power plant. The power plant's seven boilers burned hog fuel, which was generally made of bark, wood chips, and wood debris generated by the sawmills. Fuel oil was used to supplement the hog fuel as needed. Simpson built a new power plant in 1984 and subsequently decommissioned/demolished the original power plant. In 2015, Sierra Pacific Industries acquired and began operating the power plant.

1.3.2 Rayonier

From 1926 to 1957 Rayonier operated a pulp and paper sulfite mill on the south side of Shelton Harbor (Figure 1). The mill produced pulp for manufacturing rayon and other specialty cellulose products, with limited paper pulp production (Herrera 2008). The mill processes included pulp production (cooking), bleaching, screening, washing, and drying. Pulp was produced from wood chips supplied by Shelton sawmills or brought in by trucks or barges.

The calcium sulfite pulping process utilized by the Rayonier mill generated sulfite waste liquor as a byproduct. The liquor consisted of dissolved organic compounds, such as lignins and sugars, extracted from the wood chips by an acid-digestion pulping process. Prior to the early 1930s, spent sulfite liquor was discharged directly to Shelton Harbor and/or Hammersley Inlet (NewFields 2014). Rayonier attempted alternative methods of waste liquor disposal during the mid- to late 1930s, including the treatment of Shelton roads for dust control and the production of specialty products such as plywood adhesives and linoleum paste. In addition to the sulfite liquor waste, from 1927 to 1957 Rayonier discharged approximately 8 million gallons per day of untreated plant process wastewater to Shelton Harbor, as well as chlorine bleach wastewaters from a laboratory facility.

Between the early 1930s and early 1940s, Rayonier pumped waste liquor from the mill to Goose Lake (located in the northwest watershed of Shelton Harbor) via a 3-mile-long pipeline (NewFields 2014). Between the early 1930s and 1974, liquid and solid waste materials generated at Rayonier's former pulp mill and laboratory in Shelton were also disposed at Goose Lake. A remedial investigation (RI) of the Goose Lake Site was completed in 2012 (GeoEngineers 2012).

In 1945, Rayonier constructed a burn plant with a 320-foot-high stack on the hillside above the mill for incinerating spent liquor. Both the pulp mill and burn plant continued operation until 1957. Both facilities were demolished by the mid-1960s. In 1952, Rayonier dredged approximately 30,000 cubic yards of sediment from southwest Shelton Harbor and disposed of these materials in deeper water areas slightly offshore of the Shelton Harbor SCU.

1.3.3 Manke Lumber Company

The Manke Lumber Company purchased the pulp mill property from Rayonier in the 1960s and converted it into a sorting yard for logs brought in by trucks, which are then shipped out in rafts to Tacoma for processing (Figure 2).

1.3.4 Former Marine Railway/Shelton Yacht Club

The former Simpson marine railway facility located west of the marina included two sets of launching rails extending southeast into the harbor used to haul boats out of the water for maintenance and repair activities. The Shelton Yacht Club currently operates on the site. Investigations of this area in 2000 and 2005 detected elevated concentrations of copper and tributyltin immediately adjacent to the launching rails (Ecology 2000; Herrera 2010).

1.3.5 Evergreen Fuel Company

The former Evergreen Fuel Company petroleum bulk plant located northeast of the Shelton Yacht Club operated from 1913 until 2005. The site included nine ASTs and an overhead tanker truck fueling station that provided a range of petroleum products. In 2005, a RI of the upland and marine areas was completed pursuant to an Agreed Order between Ecology and Evergreen Marine Fuel

Company (Farralon and Anchor 2005). Cleanup activities were subsequently performed in 2006 and 2007, including removal of approximately 7,500 tons of petroleum-containing soil, groundwater treatment through enhanced aerobic bioremediation, and groundwater monitoring.

1.3.6 City of Shelton

Prior to 1950, pipes conveyed untreated sewage directly into Shelton Creek (Herrera 2008). Between 1950 and 1979, the City of Shelton operated a wastewater treatment plant that discharged into the northeast corner of the Shelton Harbor SCU. Since 1979, the City of Shelton has operated a wastewater treatment plant at Eagle Point that discharges through a deepwater outfall into Hammersley Inlet.

1.3.7 General Log Rafting, Booming, and Log Dumps

The Shelton Harbor SCU was historically utilized for extensive log rafting by a variety of entities, resulting in the release of wood debris from log dump and rafting areas (Figures 1 to 5). Log rafting operations have declined significantly over time, but continue to provide a vital element of the current Shelton economy.

1.4 Land Ownership

Current aquatic land ownership of the Shelton Harbor SCU is depicted on Figure 6. Primary aquatic landowners include Simpson, Manke Lumber Company, the Port of Shelton, and the City of Shelton. The Washington State Department of Natural Resources manages a relatively small parcel of state-owned aquatic land within the Shelton Yacht Club and Marina that is leased to the Port of Shelton.

1.5 Northern Habitat Restoration Project

In the early to mid-1900s, new armored shorelines were constructed in Shelton Harbor, along with boat and barge loading/unloading facilities. By the 1950s, the outlet of Goldsborough was confined between a railroad ferry dock on the north bank and a timber railway on the south bank (Figures 1 and 2). In approximately 1991, the ferry dock was removed by the Corps (Figure 3), after which Goldsborough Creek quickly migrated to the north into a former dredged area, creating an abrupt grade drop from the creek channel into a former dredged area within the delta (Figures 4 and 5). This grade change propagated an upstream channel incision in Lower Goldsborough Creek as it adjusted to its new base elevation, exposing buried pipelines, creating fish passage barriers, and degrading estuary and creek habitat.

The Squaxin Island Tribe, South Puget Sound Salmon Enhancement Group, and Simpson are currently designing and permitting a habitat restoration project within the northern portion of Shelton Harbor to address these habitat impacts, also facilitating greater salmon runs following removal of the Goldsborough Creek dam (in 2000; see Section 1.1). The habitat restoration project

will install engineered log jams and place clean fill in the Goldsborough Creek estuary to restore saltwater wetland habitat and enhance riparian areas (Figure 7). The cleanup of contaminated areas in northern Shelton Harbor will be designed to be compatible with the habitat plans for the northern harbor. Cleanup construction is anticipated to be coordinated with habitat construction to the extent practicable. However, cleanup will not be dependent on the restoration project. Cleanup plans for other areas of the Shelton Harbor SCU will be developed so that cleanup will be orchestrated with habitat restoration to ensure human health and environmental protection.

2 Summary of Existing Information

2.1 Previous Investigations

Several investigations of Shelton Harbor sediments have occurred beginning in the early 1970s. While historical information collected prior to 2005 will be considered in the RI/FS (e.g., Ecology 2000), more recent sediment sampling data collected from 2005 to present will be used in the RI/FS to characterize current environmental conditions, consistent with SMS guidance (Ecology 2017). Table 1 summarizes the surveys and the types of analyses conducted during this period. Figure 7 depicts existing sampling data for dioxins/furans and bioassays (2005 to present).

2.2 Chemicals of Concern

As discussed in Herrera (2010), recent sampling and analysis of sediments identified the following chemicals of concern (CoCs) in the Shelton Harbor SCU:

- Wood debris and degradation products (e.g., hydrogen sulfide and/or ammonia)
- Dioxins/furans
- Carcinogenic polynuclear aromatic hydrocarbons (cPAHs)

Using existing data summarized in Table 1, along with the additional site characterization data to be collected for the RI/FS, the full list of CoCs and/or indicator hazardous substances present in the Shelton Harbor SCU will be identified in the RI/FS, consistent with the requirements of SMS and MTCA, and following Ecology's current *Sediment Cleanup Users Manual II* guidance (Ecology 2017).

2.3 Extent of Wood Debris

Sediment investigations performed by Ecology in 2008 (Herrera 2010) included collection of cores at more than 20 stations within or immediately adjacent to the Shelton Harbor SCU. The vertical distribution of the visible percent wood content in these sediment cores is depicted on Figure 8. Based on these data, Herrera (2010) estimated that more than 240,000 cubic yards of wood debris has accumulated in the Shelton Harbor SCU. Relatively concentrated wood debris accumulations are present near historical sawmill and other operations. These existing core data, supplemented as necessary with additional core data to be collected during the RI, will be used to develop and evaluate sediment cleanup alternatives in the FS.

3 Remedial Investigation Data Quality Objectives

3.1 Remedial Investigation Approach

An RI will be prepared consistent with SMS and MTCA requirements. As discussed in WAC 173-204-550, an RI is intended to collect, develop, and evaluate sufficient information regarding a site or sediment cleanup unit for Ecology to establish sediment cleanup standards and inform selection of a cleanup action. The RI will include the following:

- General site information
- Site conditions
- Distributions of sediment CoCs and toxicity
- Sediment transport mechanisms
- Confirmed and suspected contaminant sources
- Recontamination potential
- Natural resources and habitat
- Screening-level human health and ecological risk assessments
- Proposed sediment cleanup standards
- Sediment management area and SCU boundaries

3.2 Data Collection Objectives and Design Rationale

The Shelton Harbor SCU and surrounding areas of the Oakland Bay site were sampled by Ecology in 2008 (Herrera 2010), providing most of the data needed for the RI/FS (Table 1). Data were also collected in 2005 to characterize sediment conditions at the Evergreen Fuel Company site (Farallon and Anchor 2005). Earlier (pre-2005) data are available for the former marine railway/Shelton Yacht Club area (Ecology 2000). Supplemental data were collected in 2011 by Ecology (2014) to evaluate recent natural recovery in Shelton Harbor and Oakland Bay. As described in this Work Plan, a final defined data collection effort will fill remaining RI data gaps. This section identifies the specific remaining data gaps and defines the RI activities that will be performed.

A systematic planning process is a key step in developing successful sampling and analysis programs to ensure the appropriate sampling, analyses, and data evaluations are conducted to meet program objectives. The U.S. Environmental Protection Agency's Guidance on Systematic Planning Using the Data Quality Objective Process (EPA 2006) is used in this Work Plan to guide data collection to support development of the RI. Specifically, the data quality objective (DQO) process is used to determine the type, quantity, and quality of data needed for the RI/FS. The DQO process is a seven-step procedure that establishes performance and acceptance criteria to ensure that data that are collected support the goals of the RI. The DQO process is depicted graphically in Figure 9.

The following four DQOs have been identified to complete the RI:

- DQO 1: Evaluate benthic conditions
- DQO 2: Evaluate potential bioaccumulation exposures to humans and wildlife
- DQO 3: Evaluate ongoing sources to sediments
- DQO 4: Evaluate recent natural recovery

Each of these DQOs are discussed below.

3.2.1 Evaluate Benthic Conditions

The evaluation of benthic conditions encompasses the presence of CoCs in surface sediments and the potential for associated biological impacts.

DQO 1: Evaluate Benthic Conditions

DQO Step	Description
Step 1: State the problem	Benthic conditions in the Shelton Harbor SCU are described by Ecology (2010), including areas with exceedances of sediment cleanup objective (SCO) and cleanup screening level (CSL) chemical and/or biological criteria based on sampling performed in 2008 (Figure 7). However, performance of the mussel (*Mytilus* sp.) larval, and polychaete (*Neanthes* sp.) bioassays across the study area was highly inconsistent, with widespread failures including in areas with an absence of SMS chemical exceedances and wood debris, as well as in samples collected from reference areas. Improved laboratory bioassay protocols for both the mussel larval and polychaete growth bioassays were recently developed and approved by Ecology and the Dredged Material Management Program (DMMP) that address the potential for entrainment of larvae by flocculent particulate material in tested sediments, and eliminating bias due to inorganic materials present in the gut of polychaetes being tested (Kendall et al. 2013). These potential laboratory artifacts may have resulted in false positive mussel larvae toxicity and reduced polychaete growth in earlier sediment bioassays performed on samples collected in 2008 from Shelton Harbor (Herrera 2010). Previously sampled stations with possible false positive mussel larval toxicity will be retested using the Ecology-approved bivalve larvae resuspension method to provide more reliable confirmatory bioassay data for comparison with SMS biological criteria. Similarly, previously sampled stations with possible false positive polychaete growth reductions will also be retested using the Ecology-approved ash-free dry weight endpoint to provide more reliable confirmatory bioassay data for comparison with SMS biological criteria. Additional stations will be sampled for bioassays as necessary to complete the RI. Shelton Harbor sediments contain wood debris that under certain circumstances may degrade into potentially toxic substances such as hydrogen sulfide and ammonia, which could contribute to toxicity in sediment bioassays. Log rafting operations in the Shelton Harbor SCU have declined significantly since the 2008 sampling (see Figures 1 to 5), which may have contributed to recent natural recovery. Additional data, as described below, are needed to evaluate current wood debris and sediment toxicity conditions in the RI.

DQO Step	Description
Step 2: Identify the goals of the study	Principal Study Questions • Are SMS benthic bioassay criteria exceeded in the Shelton Harbor SCU? • Are bioassay results correlated with concentrations of wood debris degradation products, including hydrogen sulfide and/or ammonia?
Step 3 Identify the information inputs	Existing Field Data/Reports • Existing data are summarized in Table 1 of this Work Plan New Data to Be Collected in the RI • Bivalve larval bioassays conducted using the Ecology-approved resuspension endpoint modified protocol at stations within the Shelton Harbor SCU where the mussel larval bioassay previously failed (possible false positive toxicity) during the 2008 testing by Herrera (2010) • Polychaete growth bioassays using the Ecology-approved ash free dry weight endpoint at stations within the Shelton Harbor SCU where the polychaete bioassay previously failed during the 2008 testing by Herrera (2010) • Full suite SMS bioassays at additional stations with relatively elevated levels of wood debris, as determined during initial sediment profile imaging (SPI) surveys • Porewater hydrogen sulfide and ammonia determinations, as well as conventional analyses (i.e., total volatile solids [TVS], sediment grain size, and total solids) at all stations where bioassays are performed • SPI and plan view images at all stations sampled for bioassays, and at representative locations to evaluate and delineate (to the extent practicable) wood debris deposits
Step 4: Define the boundaries of the study	Geographic Area • The study area for larval and polychaete growth bioassays, associated chemistry, and SPI surveys is the Shelton Harbor SCU • Because the planned land use of northern Shelton Harbor is habitat restoration/saltmarsh construction, which will involve raising the sediment elevations with addition of clean fill (Figure 7), it is likely that the cleanup alternatives to be considered in that area will be based on capping contaminated sediments; therefore, fewer additional data are needed in this area to support the RI Timeframe • Historical data from 2005 to present • Sampling to occur in July to September to optimize bioassay testing; this timing is necessary to address seasonal wood debris degradation rates, availability of healthy spawning stock for the larval testing, along with safety considerations (i.e., avoiding inclement weather conditions during the winter) Sample Type • Surficial sediment (i.e., top 10 centimeter [cm]) will be collected and analyzed for bioassays and associated chemical and conventional analyses • SPI and plan view images

DQO Step	Description
Step 5: Develop the analytical approach	The proposed sediment bioassay (larval and polychaete) and chemical data will provide comprehensive information on current benthic conditions and at previously sampled stations where the mussel larval and polychaete bioassays may have failed due to possible false positive toxicity, also reflecting source reductions (e.g., less log rafting) and natural recovery over the past 9 years. The new bivalve larval resuspension test and polychaete growth results will replace the older data at these retested stations. All data will be obtained using current Ecology-approved methods and evaluated per the SMS (i.e., bioassays will be evaluated relative to SCO and CSL bioassay criteria). Porewater sulfide and ammonia concentrations, along with TVS data, will be assessed relative to larval and polychaete bioassay results to evaluate possible causes of toxicity, and will also be compared with DMMP porewater toxicity benchmarks. SPI images will be evaluated to assess the presence and amount of wood debris. These data will be used to determine whether there are surface sediments within the Shelton Harbor SCU with greater amounts of wood debris compared with the bioassay stations sampled in 2008. Higher concentration wood debris deposits, if identified, will be tested using the full suite of SMS bioassays (i.e., amphipod, larval, and polychaete testing following current SMS procedures), as well as for concurrent TVS and porewater sulfide/ammonia analyses.
Step 6: Specify performance or acceptance criteria	Performance or acceptance criteria are described in the Sampling and Quality Assurance Project Plan (SQAPP; Appendix A of this Work Plan). The following quality control considerations will be addressed: • Field quality control samples • Laboratory quality control • Data quality indicators for chemical and bioassay laboratory analyses (precision, accuracy, representativeness, completeness, and comparability)

DQO Step	Description
Step 7: Develop the detailed plan for obtaining data	Sediment Profile Imaging • SPI with plan view photos will be performed at approximately 60 stations as shown on Figure 10; SPI images will be evaluated semi-quantitatively for the presence and amount of wood debris, as well as qualitatively for the presence of benthic invertebrates and grain size • Review of the SPI surveys with Ecology will determine the need for and locations of additional full suite sediment bioassays and/or sediment coring Full Suite Bioassays • If the SPI survey identifies higher concentration wood debris deposits (e.g., as determined from volumetric estimates of surficial wood debris, presence of sulfate-reducing bacteria such as *Beggiatoa sp.*, and methane gas accumulations) compared with the locations of the 2008 bioassays (Herrera 2010), full suite bioassays (i.e., amphipod, larval, and polychaete), porewater sulfide and ammonia analyses, and conventional chemical analyses (e.g., TVS) will be performed at those locations with the highest wood debris levels within the Shelton Harbor SCU (three to five stations assumed for planning purposes) Larval Bioassay Retest • The bivalve larval resuspension bioassay, porewater sulfide and ammonia concentrations, and conventional chemical analyses will be performed at six stations using the current SMS resuspension protocol for the larval bioassay; the stations are shown on Figure 10 and include SH-04, SH-14, SH-19, SH-21, SH-22, and SH-24 Polychaete Bioassay Retest • The polychaete growth bioassay, porewater sulfide and ammonia concentrations, and conventional chemical analyses will be performed at four stations using the current SMS protocol for the polychaete bioassay; the stations are shown on Figure 10 and include SH-13, SH-19, SH-22, and SH-28 Porewater Sulfide and Ammonia Analyses • At all bioassay test or retest stations discussed above, porewater sulfide concentrations will be analyzed using diffusive gradients in thin films (DGT) passive sampling methods deployed in situ. The DGT methodology (Rearick et al. 2005) has developed considerably over the past 10 years to more accurately characterize bioavailable free sulfide concentrations in sediment porewater, removing the influence of colloidal sulfide forms to provide a more direct comparison with toxicity benchmarks. Porewater ammonia concentrations will be analyzed using an electrochemical probe in the bioassay laboratory.

3.2.2 Evaluate Potential Bioaccumulation Exposures to Humans and Wildlife

Assessing potential exposures of CoCs in the Shelton Harbor SCU to humans and wildlife involves an evaluation of data for various potential exposure pathways. Screening-level human health and wildlife risk assessments have been performed by Ecology at other similar sediment cleanup sites in the Puget Sound (e.g., Port Angeles Harbor; Ecology & Environment and NewFields 2012), and reveal that risk-based sediment concentrations of the dioxin/furan toxic equivalents quotient (TEQ), cPAH TEQ, as well as other potentially bioaccumulative CoCs, are below natural and/or regional

background levels and/or practical quantitation limits (PQLs). In this situation, SMS cleanup levels default to background levels or PQLs, whichever is higher.

After reviewing the 2008 sediment data collected by Ecology, the Washington State Department of Health (DOH) performed health consultations to determine if bioaccumulative CoCs in the Oakland Bay Site are a health threat to people. One DOH consultation looked at potential health risks from direct contact or accidental ingestion of CoCs in sediments in Oakland Bay and Shelton Harbor (DOH 2010a), and the other focused on dioxins/furans in shellfish from Oakland Bay (DOH 2010b). DOH found the levels of these CoCs did not represent a health concern for residents, workers, or visitors. The sediment evaluation concluded that touching, breathing in, or accidentally eating sediment containing dioxins/furans and cPAHs from the Oakland Bay Site is unlikely to harm human health. DOH similarly concluded that eating shellfish from the Oakland Bay Site is unlikely to produce harmful health effects, even for people who eat a lot of these organisms.

Even though the DOH health consultations reveal a low bioaccumulative CoC risk in the Shelton Harbor SCU, SMS sediment cleanup levels for dioxin/furan TEQ and cPAH TEQ are based on lower threshold risk criteria (e.g., an allowable risk of one additional cancer per one million people). For these bioaccumulative CoCs, SMS sediment cleanup levels default to background levels or PQLs, whichever is higher.

DQO 2: Evaluate Potential Bioaccumulation Exposures to Humans and Wildlife

DQO Step	Description
Step 1: State the problem	Screening level human health and wildlife risk assessments have been performed by Ecology at other similar sediment cleanup sites in Puget Sound (e.g., Port Angeles Harbor; Ecology & Environment and NewFields 2012), and reveal that risk-based sediment concentrations of dioxin/furan TEQ and cPAH TEQ are below natural and/or regional background and PQLs. However, screening level risk assessments use default assumptions and provide conservative estimates of risk. DOH (2010a, 2010b) concluded that actual human health risks in the Oakland Bay and Shelton Harbor Site are low for these bioaccumulative CoCs. The extent to which alternative cleanup remedies may further reduce potential exposures to humans and wildlife and/or achieve background concentrations and/or PQLs will be used as lines-of-evidence in the evaluation of remedial alternatives in the RI/FS.
Step 2: Identify the goals of the study	Principal Study Questions • Are unacceptable risks to human health and wildlife (also considering tribal consultation) from bioaccumulative chemicals present in the Shelton Harbor SCU? • Do the risks differ from natural and/or regional background?

DQO Step	Description
Step 3 Identify the information inputs	Existing Field Data/Reports • Existing data are summarized in Section 3 of this Work Plan • Preliminary screening levels for human health and wildlife protection for dioxin/furan TEQ and cPAH TEQ have been developed by Ecology at other similar sites (e.g., Ecology & Environment and NewFields 2012) • Natural background concentrations and PQLs of dioxin/furan TEQ and cPAH TEQ have also been developed by Ecology for sediment cleanup sites in the Puget Sound, including the Shelton Harbor SCU • Draft regional background concentrations of dioxin/furan TEQ and cPAH TEQ are currently being developed by Ecology for south Puget Sound New Data to be Collected in the Remedial Investigation • No new data to be collected
Step 4: Define the boundaries of the study	Geographic Area • The study area for the assessment of potential bioaccumulative CoC exposure is the Shelton Harbor SCU Timeframe • Historical data from 2005 to present Sample Type • Natural background sediment concentrations of dioxin/furan TEQ and cPAH TEQ have been developed by Ecology for Puget Sound and draft regional background sediment concentrations of these CoCs are currently being developed by Ecology for south Puget Sound; no new data will be collected in the RI/FS to address this DQO
Step 5: Develop the analytical approach	Screening level human health and wildlife risk assessment developed by Ecology at other similar sites (e.g., Ecology & Environment and NewFields 2012) will be used along with background and PQL information to develop proposed sediment cleanup standards consistent with SMS requirements (Ecology 2017)
Step 6: Specify performance or acceptance criteria	Natural and draft regional background sediment concentrations for Puget Sound and analytical PQLs have been identified by Ecology; no new data will be collected in the RI/FS to address this DQO
Step 7: Develop the detailed plan for obtaining data	No new data will be collected in the RI/FS to address this DQO

3.2.3 Evaluate Ongoing Sources to Sediments

The RI/FS will evaluate spatial gradients of CoCs in surface sediments, focusing on areas that exceed cleanup levels at appropriate points of compliance as approved by Ecology. Because of locally elevated dioxin/furan TEQ levels reported in Ecology (2013) in the Shelton Creek drainage basin,

focused evaluation of the clinker deposit depicted in Figure 7 will be performed in the RI/FS to assess the potential for ongoing dioxin/furan TEQ inputs from this area and the need for further controls to minimize the potential for recontamination.

DQO 3: Evaluate Ongoing Sources to Sediments

DQO Step	Description
Step 1: State the problem	Shelton Harbor sediments have received hazardous substance releases from a variety of sources since commercial/industrial operations began, including upland and over-water operations; discharge of stormwater, sewage, and wastewater; nearshore burning; and direct discharge. Historical releases were of greater magnitude than ongoing sources, as evidenced by the higher subsurface chemical concentrations in many areas of the harbor (Herrera 2010). The RI/FS will identify ongoing sources that have the potential to result in sediment recontamination.
Step 2: Identify the goals of the study	Principal Study Question: • Would ongoing sources pose a recontamination risk to post-remedial sediments in the Shelton Harbor SCU?
Step 3 Identify the information inputs	Existing Field Data/Reports • Existing data are summarized in Section 3 of this Work Plan • Additional data to be considered include available sediment quality information for creek discharges (Ecology 2013) New Data to Be Collected in the Remedial Investigation • Porewater will be collected immediately downgradient of the clinker deposit and analyzed for dioxin/furan TEQ • Surface sediment will be collected in depositional areas of the Shelton Creek delta downstream of the clinker deposit and analyzed for dioxin/furan TEQ

DQO Step	Description
Step 4: Define the boundaries of the study	Geographic Area • The source evaluation process will encompass surface sediments within the Shelton Harbor SCU—if surface sediments exceed preliminary sediment cleanup levels developed in the RI/FS process, potential pathways to that area will be considered (e.g., nearshore bank soil erosion and/or stormwater), using available information • The approximate extent of the clinker deposit, including within the bed of Shelton Creek, will be surveyed based on initial visual reconnaissance and probing • Surface drainage pathways in and around the clinker deposit will be surveyed during wet weather events to evaluate the potential for erosion/direct discharges • Focused evaluation of ongoing dissolved-phase dioxin/furan TEQ releases will be performed in the clinker deposit located on the banks of Shelton Creek as generally depicted in Figure 10 Timeframe • Use surface sediment chemical data from 2005 to present to identify potential source areas; other data may be used to evaluate changes in sediment chemical concentrations over time • Characterize potential transport of dissolved-phase dioxin/furan TEQ from the clinker deposit to Shelton Creek during a representative wet weather period when groundwater and porewater discharges occur Sample Type • Surface sediment and porewater quality data
Step 5: Develop the analytical approach	Surface sediment areas where chemical concentrations exceed preliminary cleanup levels will be delineated. These will be considered source evaluation areas of potential concern. If subsurface data are available in or near a source evaluation area, those data will be reviewed to determine if there is a trend of decreasing concentrations of CoCs in newer sediment; such a trend would indicate a historical rather than an ongoing source. Ecology (2013) identified a localized clinker deposit on the left bank of Lower Shelton Creek with elevated dioxin/furan TEQ levels in surface soils, like those measured in sediments within the Shelton Harbor SCU (Figure 7). Depending on how strongly they are sequestered, dissolved-phase dioxin/furan TEQ could potentially be transported through the clinker deposit via groundwater and porewater. In situ passive sampling of porewater dioxin/furan TEQ levels using solid-phase microextraction (SPME) methods (ITRC 2011, EPA 2012) will be performed at the base on the delineated clinker deposit adjacent to Shelton Creek, and compared with local background concentrations to determine if further source controls in the clinker deposit area may be needed to ensure protection. These data, along with available sediment quality data, will be used as lines-of-evidence in the evaluation of remedial alternatives in the RI/FS.
Step 6: Specify performance or acceptance criteria	Performance or acceptance criteria will be described in the SQAPP (Appendix A of this Work Plan). The following quality control considerations will be addressed: • Field quality control samples • Laboratory quality control • Data quality indicators for laboratory analyses (precision, accuracy, representativeness, completeness, and comparability)

DQO Step	Description
Step 7: Develop the detailed plan for obtaining data	Clinker Deposit In situ Porewater • Four SPME fiber probes will be advanced at the base of the clinker deposit adjacent to Shelton Creek, as well as at two local background stations removed from clinker influence (preliminary SPME locations are depicted on Figure 10; final locations will be determined in the field based on the results of the initial reconnaissance survey). The SPME fiber probes will be screened over the top 2 feet of groundwater, and allowed to equilibrate for 2 months during the wet season (November 2017 to January 2018). Performance reference compounds will be spiked onto the SPME fibers to assess the degree to which equilibrium conditions are achieved, and to verify the accuracy of calculated porewater dioxin/furan TEQ levels (ITRC 2011, EPA 2012). Shelton Creek Delta Surface Sediment • A single surface sediment (0 to 10 cm) sample will be collected in a representative depositional area of the Shelton Creek delta downstream of the clinker deposit. The preliminary sampling locations is depicted on Figure 10; the final locations will be determined in the field based on the results of the initial reconnaissance survey). The sediment sample will be analyzed for dioxin/furan TEQ).

3.2.4 Evaluate Recent Natural Recovery

The RI/FS will further evaluate natural recovery rates in the Shelton Harbor SCU to support the evaluation of alternative cleanup remedies. In addition, existing core data discussed in Section 2.3 (see Figure 8), supplemented as necessary with additional core data to be collected during the RI, will be used to develop and evaluate sediment cleanup alternatives in the FS.

DQO 4: Evaluate Recent Natural Recovery

DQO Step	Description
Step 1: State the problem	As summarized above, historical releases of CoCs were of greater magnitude than ongoing sources, as evidenced by the higher subsurface chemical concentrations in many areas of the harbor (Herrera 2010). The RI/FS will evaluate natural recovery rates and the extent of subsurface contaminated sediment deposits in the Shelton Harbor SCU to support the evaluation of alternative cleanup remedies.
Step 2: Identify the goals of the study	Principal Study Questions: • What is the rate of natural recovery in the Shelton Harbor SCU? • What is the thickness of sediments with elevated CoC concentrations (including wood debris) in prospective sediment cleanup areas?
Step 3 Identify the information inputs	Existing Field Data/Reports • Existing data are summarized in Section 3 of this Work Plan New Data to Be Collected in the Remedial Investigation • Sediment cores will be collected in depositional areas of Shelton Harbor to characterize sedimentation rates, bioturbation depths, and recent recovery rates of dioxin/furan TEQ, cPAH TEQ, and wood debris (measured as TVS)

DQO Step	Description
Step 4: Define the boundaries of the study	Geographic Area • Focused evaluations of recent natural recovery of dioxin/furan TEQ, cPAH TEQ, and TVS levels will be performed in prospective depositional areas in the southern portion of Shelton Harbor, outside of the Goldsborough Creek delta • Supplemental cores will also be collected as needed in relatively concentrated wood debris accumulation areas (e.g., near historical sawmill operations) that have not been previously characterized (e.g., Figure 8) Timeframe • Evaluate overall recovery of dioxin/furan TEQ, cPAH TEQ, and TVS levels following peak waterfront industrial operations in the 1950s and 1960s Sample Type • Sediment core section data
Step 5: Develop the analytical approach	When located correctly, collecting cores from depositional areas and sectioning the cores for detailed radioisotope and CoC analyses can provide information on sedimentation rates, bioturbation/mixing depths, sediment stability, and source controls/natural recovery. For this Work Plan, three cores will be advanced in presumed depositional areas in the southern portion of the Shelton Harbor SCU across the gradient of higher to lower surface sediment dioxin/furan TEQ levels. The core sections will first be analyzed for two radioisotopes to characterize sedimentation rates, bioturbation/mixing depths, and sediment stability: • Lead-210 – a naturally occurring isotope with a half-life of 22 years • Cesium-137 – a marker of nuclear weapons releases in the early 1960s Based on the results of the initial radioisotope analyses, selected core sections will be analyzed for dioxin/furan TEQ, cPAH TEQ, and TVS to evaluate natural recovery of these CoCs over the past 50 to 60 years. These data will be used as lines-of-evidence in the evaluation of remedial alternatives in the RI/FS. As discussed in DQO 1, review of the initial SPI surveys with Ecology, along with comparisons with existing core data (Figure 8), will determine the need for and locations of additional sediment cores to refine wood debris thickness estimates.
Step 6: Specify performance or acceptance criteria	Performance or acceptance criteria will be described in the SQAPP (Appendix A of this Work Plan). The following quality control considerations will be addressed: • Field quality control samples • Laboratory quality control • Data quality indicators for laboratory analyses (precision, accuracy, representativeness, completeness, and comparability)

DQO Step	Description
Step 7: Develop the detailed plan for obtaining data	Natural Recovery Cores • Three cores will be advanced in presumed depositional areas in the southern portion of the Shelton Harbor SCU (stations SH-14, SH-19, and SH-22; Figure 10). Each core will be advanced to a target depth of 5 feet below mudline to attempt to penetrate into pre-1950 deposited sediment, and sectioned into 2-cm intervals. Selected intervals (seven per core assumed for planning purposes) will be analyzed for lead-210 and cesium-137 to characterize sedimentation rates, bioturbation/mixing depths, and sediment stability. Based on the results of the initial radioisotope analyses, selected core sections will be analyzed for dioxin/furan TEQ, cPAH TEQ, and TVS (for planning purposes, approximately nine samples will be analyzed). Wood Debris Thickness Cores • Review of the initial SPI surveys with Ecology, along with comparisons with existing core data (Figure 8), will determine the need for and locations of additional sediment cores to support the RI/FS

4 Feasibility Study Approach

Consistent with SMS and MTCA requirements, a Feasibility Study (FS) will be prepared, including collection, development, and evaluation of information to enable consideration of sediment cleanup alternatives and selection of a site-specific sediment cleanup standard to inform both Draft and Revised Cleanup Action Plans for the Shelton Harbor SCU. The FS will include an evaluation of alternative cleanup actions that protect human health and the environment by eliminating, reducing, or otherwise controlling risks posed through each exposure pathway and migration route of concern identified in the RI. The number and types of alternatives to be evaluated will consider the characteristics and complexity of Shelton Harbor SCU.

The cleanup alternatives may include establishment of sediment management areas, as defined in SMS regulations and guidance (Ecology 2017), with cleanup alternatives developed based on site physical characteristics and complexity, and in consideration of cost, technical feasibility, and net environmental impact. The FS will also include a MTCA disproportionate cost analysis (DCA).

The FS will consider multiple lines of evidence, described further in subsequent sections, which will include the following:

- Distribution of bioassay test failures and related chemical concentrations and wood debris
- Distribution of bioaccumulative compounds in sediment, and comparison of area-average concentrations across the Shelton Harbor SCU with natural background levels

Additionally, treatability testing with activated carbon will be performed at a representative location with relatively elevated dioxin/furan TEQ levels (station SH-19; see Figure 10) to measure the effect of activated carbon addition to reduce porewater concentrations of dioxin/furan TEQ and cPAH TEQ.

Overall, these analyses and the weight of evidence approach are performed to facilitate prioritization of areas for remedial actions, and/or consideration of remedial technologies.

4.1 Disproportionate Cost Analysis

The DCA described in the MTCA regulations (WAC 173-340-360[3][e]) will be used in the FS to evaluate which of the alternatives evaluated are protective to the maximum extent practicable. This analysis will involve comparing the costs and benefits of alternatives, including determining whether the incremental costs of an alternative are disproportionate to incremental benefits. The evaluation criteria for the DCA are specified in WAC 173-340-360(3)(f), and include protectiveness, permanence, cost, long-term effectiveness, management of short-term risks, implementability, and consideration of public concerns.

4.2 Data Collection Objectives and Design Rationale

Site characterization data collected since 2005, supplemented with the RI data collection effort discussed in Section 3, provide the information necessary to complete the FS, including delineation of sediment management areas, evaluation of natural recovery rates and recontamination potential, assessments of sediment stability, and development of schematic designs for enhanced natural recovery and capping alternatives. Geophysical surveys and sediment coring performed by Herrera (2010) provide information on the approximate thickness of recent contaminated sediment deposits to develop schematic designs for dredging alternatives. The combination of existing and new data is sufficient to complete the FS for the Shelton Harbor SCU. However, a focused data collection effort is proposed to provide additional lines of evidence to develop and evaluate remedial alternatives.

Surface sediment collected from a representative location with relatively higher sediment dioxin/furan TEQ levels (station SH-19; Figure 10) will be used for bench-scale testing of in situ treatment using activated carbon (Patmont et al. 2014). The sample will be mixed with 4 percent fine sand-sized activated carbon (dry weight basis) and stored on a shaker table for approximately 6 months to facilitate equilibration prior to testing. Both activated carbon-amended and unamended control samples will then be analyzed for total organic carbon, black carbon, bulk dioxin/furan TEQ and cPAH TEQ, and porewater dioxin/furan TEQ and cPAH TEQ using the SPME procedures summarized in DQO 3 (ITRC 2011, EPA 2012). The results of the treatability testing will be incorporated into the FS as appropriate.

5 Interim Actions

As discussed in Section 1.5, the Squaxin Island Tribe, South Puget Sound Salmon Enhancement Group, and Simpson have designed and are currently permitting a habitat restoration project within the northern portion of Shelton Harbor. The habitat restoration project will install engineered log jams and place clean fill in the Goldsborough Creek estuary to restore saltwater wetland habitat and enhance riparian areas. The habitat restoration project (generally depicted in Figure 7) will be implemented ahead of the final Cleanup Action Plan for the Shelton Harbor SCU. Therefore, an interim action plan will be developed for the proposed habitat restoration areas to ensure that a cleanup approach for those areas is in place in time to coordinate with the first phases of the restoration project. The RI will provide information to inform the interim cleanup elements that are needed to ensure that the habitat area will be protected from recontamination. At the same time, cleanup plans for other areas of the Shelton Harbor SCU will be developed so that cleanup will be orchestrated with future phases of habitat restoration to ensure human health and environmental protection.

5.1 Interim Action Work Plan

Following receipt of sediment sampling data from the RI (Figure 11), an Interim Action Work Plan, designed to be compatible with the habitat restoration, will be prepared for the northern portion of Shelton Harbor. This will include the clinker deposit and other areas of the Shelton Harbor SCU as appropriate that may be practicably and cost-effectively addressed prior to final cleanup actions. The Interim Action Work Plan will address the requirements of WAC 173-204-570.

6 Project Management and Schedule

6.1 Roles and Responsibilities

Clay Patmont of Anchor QEA will serve as overall Project Coordinator for the RI/FS. As such, he will be the primary contact for routine Ecology communications and required Ecology reporting, including monthly progress reports, schedule updates, and other project management tasks. Nathan Soccorsy of Anchor QEA will lead the field collection efforts described in DQOs 1 and 3.

6.2 Data Management

Data collected for this project will be validated and managed consistent with the SQAPP (Appendix A).

All data collected as part of this project will be submitted to Ecology's Environmental Information Management (EIM) database. An official project database will be maintained by Anchor QEA throughout the duration of this project, which will form the basis of RI/FS analyses, including generation of tables and graphics.

6.3 Deliverables

The following deliverables will be prepared:

- **Draft RI/FS SQAPP**. Following Ecology review of this Work Plan, procedures for quality assurance and quality control will be documented in the form of a SQAPP, to collect the new RI data described in Sections 3 and 4. The SQAPP will meet the requirements of WAC 173-340-350(7)(c)(iv), WAC 173-340-820, and guidance in the *Sediment Cleanup Users Manual II* (Ecology 2017). The SQAPP will include as an attachment a Health and Safety Plan meeting the requirements of WAC 173-340-350(7)(c)(iv) and WAC 173-340-810. Ecology will review the SQAPP. If requested by Ecology, comments submitted by Ecology will be incorporated into a revised document, which will be issued as the Final RI/FS SQAPP.
- **Draft Interim Action Work Plan**. The Draft Interim Action Work Plan shall meet the requirements of WAC 173-340-430(7), and shall describe the interim action to be taken in conjunction with the habitat restoration project being undertaken in northern Shelton Harbor by the Squaxin Island Tribe, South Puget Sound Salmon Enhancement Group, and Simpson, along with other complementary interim cleanup actions as appropriate. The proposed interim cleanup action shall not foreclose reasonable alternatives for the ultimate cleanup action for the SCU and shall meet the minimum requirements found in WAC 173-204-570(3)). Ecology's comments on the Draft Interim Action Work Plan, if provided, will be incorporated into the Final Interim Action Work Plan (below).
- **RI Data Memoranda (Data Memoranda)**. Data Memoranda will accompany the EIM data submittal(s). The Data Memoranda will contain a brief synopsis of deviations from the SQAPP,

and data validation reports. New data will be tabulated and provided in written form and uploaded to Ecology's EIM data management system (as provided in WAC 173-340-840[5]). The requirement for electronic submittal shall be complete when Ecology confirms all data are properly submitted into EIM. Ecology's comments on each Data Memorandum, if provided, will be incorporated into the RI/FS (below).

- **Final Interim Action Work Plan**. The Draft Interim Action Work Plan, described above, shall be revised to address Ecology's comments. The revised document will be submitted to Ecology for use in the public review process.
- **RI/FS Outline**. Prior to drafting the RI/FS Report (see below), an annotated outline of the RI/FS Report will be prepared that addresses MTCA and SMS requirements. Ecology's comments on the RI/FS Outline, if provided, will be incorporated into the RI/FS (below).
- **Agency Review Draft RI/FS Report (Agency Review RI/FS)**. The Agency Review RI/FS will integrate available data from prior studies in the Shelton Harbor SCU and additional data collected as per the SQAPP following the DQO process in this Work Plan. The RI/FS shall define the nature and extent of contamination pursuant to WAC 173-204-550 for developing and evaluating cleanup actions for the Shelton Harbor SCU. In evaluation of cleanup action alternatives, the RI/FS will follow the requirements of WAC 173-204-550 and -570.
- **Public Review Draft RI/FS Report**. The Agency Review RI/FS, described above, shall be revised to address Ecology's comments. The revised document will be submitted to Ecology for use in the public review process.
- **Draft Cleanup Action Plan**. The Draft Cleanup Action Plan shall describe final cleanup actions in the Shelton Harbor SCU. The proposed cleanup action shall meet the minimum requirements found in WAC 173-204-570, and the Draft Cleanup Action Plan shall be prepared consistent with the requirements and procedures in WAC 173-204-570. Ecology's comments on the Draft Cleanup Action Plan, if provided, will be incorporated into a Revised Cleanup Action Plan.
- **Revised Cleanup Action Plan**. The Draft Cleanup Action Plan, described above, shall be revised to address Ecology's comments. The Revised Cleanup Action Plan will be submitted to Ecology for use in developing the Public Review Draft Cleanup Action Plan.

6.4 Preliminary Schedule

A preliminary schedule has been developed for planning and coordination purposes and is depicted in Figure 11. This schedule shows the interrelated aspects of the planned Shelton Harbor SCU Interim Cleanup Actions and RI/FS processes.

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Table

Table 1
Recent Sediment Characterization Data Collected Near Shelton Harbor, 2005 to Present

Study Name[1]	Ecology EIM Study ID	Year Sampled	Sample Type	Sediment Collection Depths	Number of Samples[2]	Analyte Groups					
						Metals and TBT	PCBs	Pesticides[3]	SVOCs	Dioxins/ Furans	Bioassays
Evergreen Fuel Facility	Everfuel	2005	Sediment	0 to 10 cm	11	X	X		X		X
Oakland Bay Sediment Characterization of Intertidal and Subtidal Areas	OAKSED08	2008	Sediment	0 to 10 cm, 30 to 60 cm, and 60 to 90 cm	62	X	X	X	X	X	X
Shelton WWTP Outfall Baseline Sediment Monitoring	SHELTON WWTP	2010	Sediment	0 to 10 cm	3	X[4]	X		X	X	
Puget Sound Assessment and Monitoring Program	PSAMP_SP	2011	Sediment	0 to 2 cm and 2 to 10 cm	4	X	X	X	X		X
Budd Inlet and Oakland Bay Dioxin Study	BuddOakDioxins	2011	Sediment	0 to 2 cm and 2 to 10 cm	4					X	
Dioxin in Surface Water Sources to Oakland Bay	RCOO0012	2011	Creek Sediment	0 to 2 cm	9					X	

Notes:

1. Source: Ecology EIM System database.

2. Sample number reflects the number of sample IDs and includes reference samples as applicable; not all samples were analyzed for all analyte groups indicated.

3. Organochlorine pesticides.

4. Does not include TBT.

cm: centimeters

EIM: Environmental Information Management

PCB: polychlorinated biphenyl

SVOC: semivolatile organic compound

TBT: tributyltin

WWTP: wastewater treatment plant

Figures

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ANCHOR QEA

Figure 1
Aerial Photograph: 1951
Shelton Harbor RI/FS

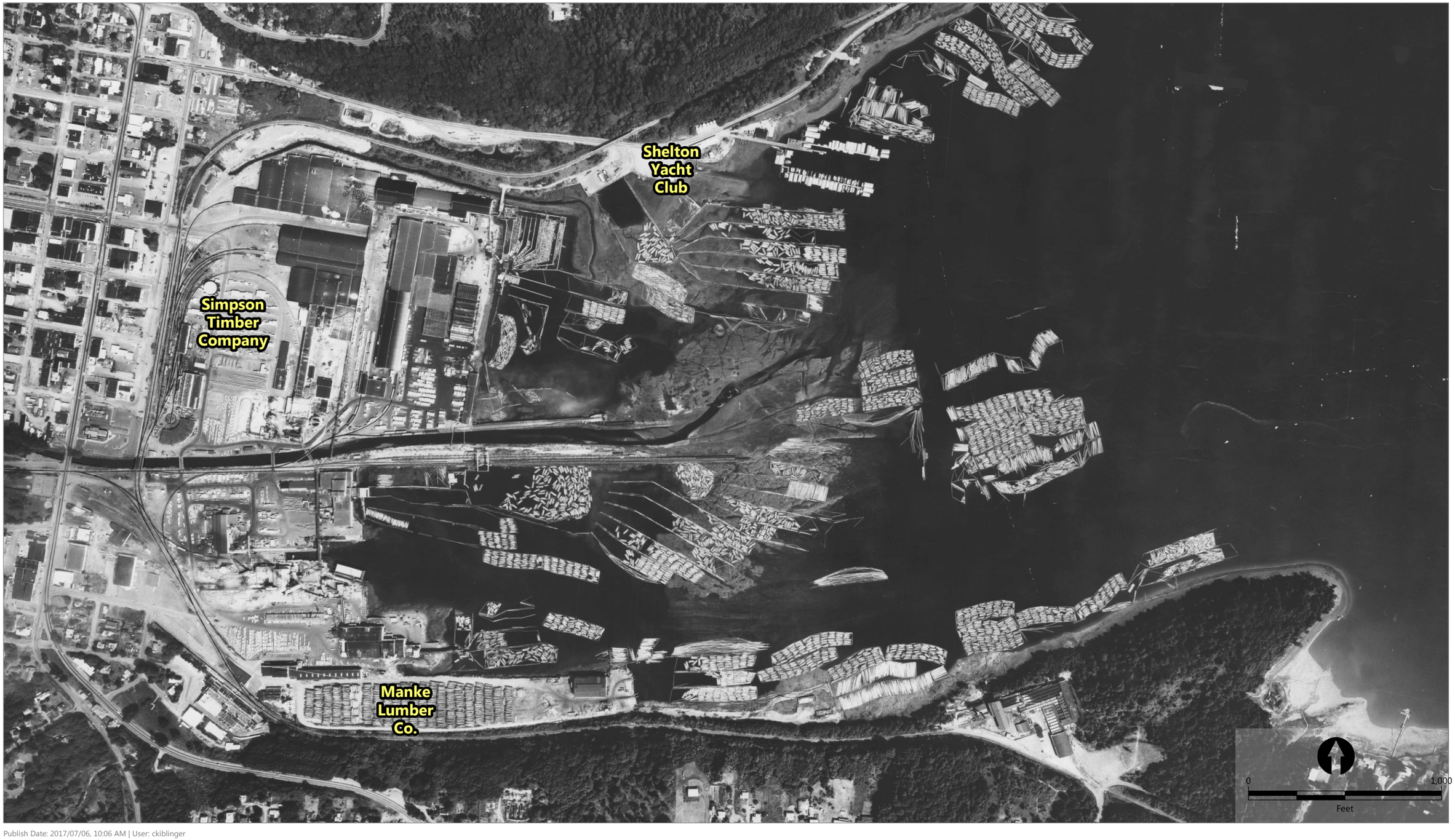

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Figure 2
Aerial Photograph: 1975
Shelton Harbor RI/FS

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Figure 3
Aerial Photograph: 1990
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Figure 4
Aerial Photograph: 2006
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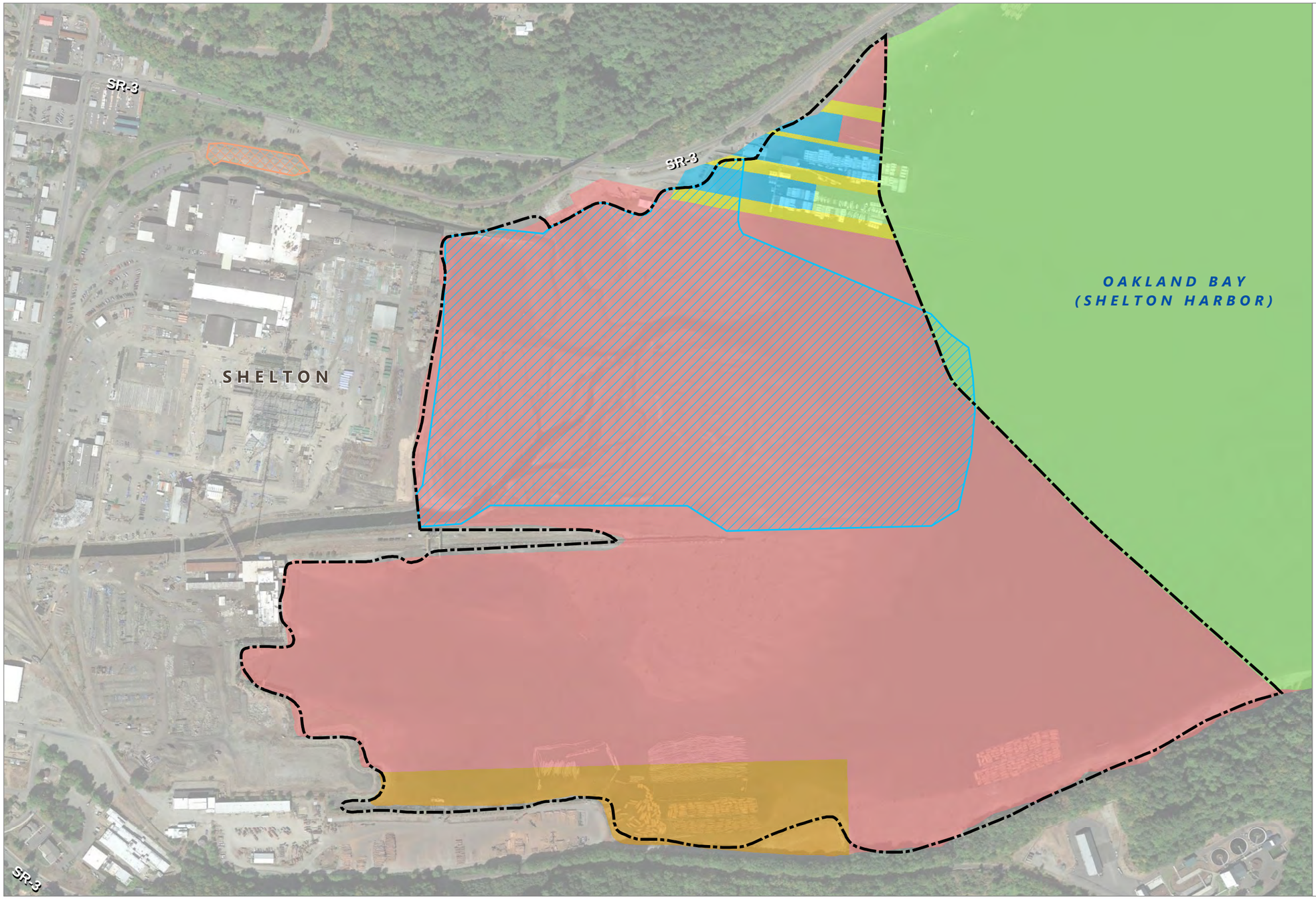
Figure 5
Aerial Photograph: 2016
Shelton Harbor RI/FS



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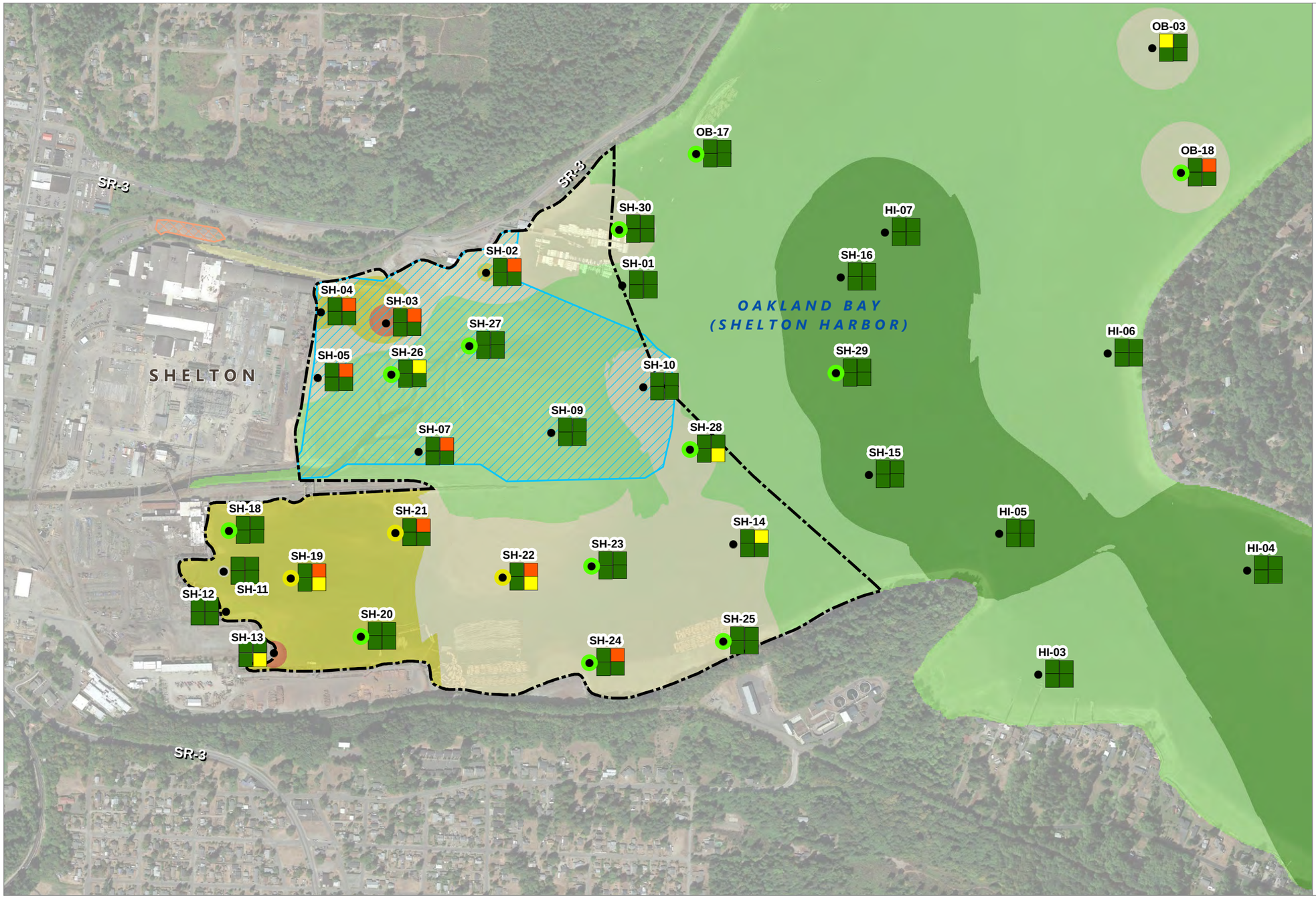
ANCHOR QEA

Figure 6
Current Aquatic Land Ownership
Shelton Harbor RI/FS



Northern Habitat Restoration Area
Clinker Deposit
Sediment Cleanup Unit Boundary
Sample Location

TVS Percent
Less than 15%
Greater than 15%

Dioxin/Furans TEQ (ng/kg dw)
< 4
4 – 25
25 – 50
50 – 100
> 100

Bioassay Results
Pass SCO Biological Criteria
Fail SCO/Pass CSL Biological Criteria
Fail CSL Biological Criteria

Amphipod	Larval
Microtox	Polychaete

NOTE:
1. Field reconnaissance will be conducted to evaluate the extents of the clinker deposit.

0 1,000
Feet

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ANCHOR QEA

Figure 7
Existing Surface Sediment Dioxin/Furan and Bioassay Data
Shelton Harbor RI/FS

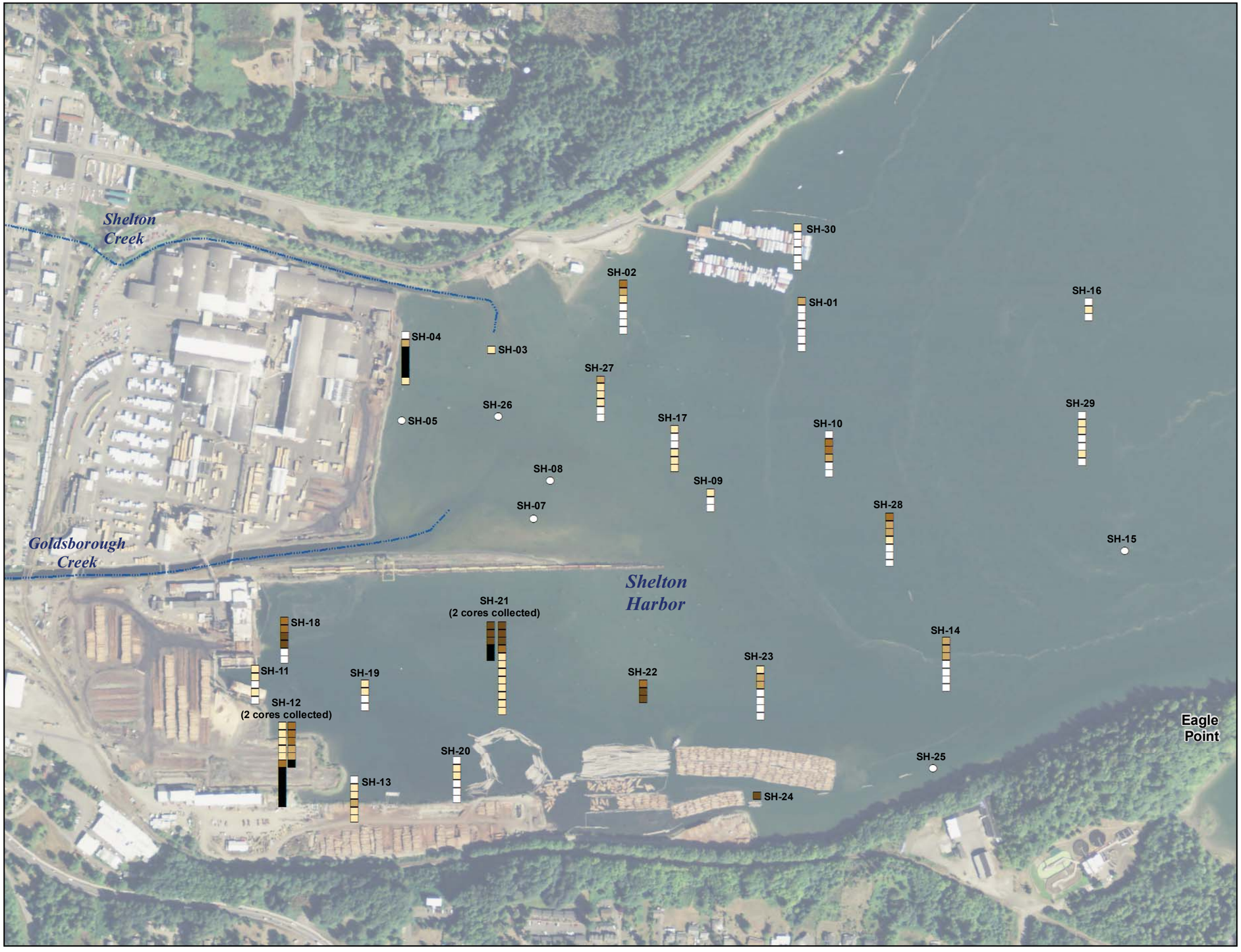

Figure 8

Visible percent wood content in Shelton Harbor sediment from Herrera (2010)

Legend

Total percent wood content

- Sample location - no wood found at any depth
- No wood at given depth
- 0.5 to 5%
- 5.1 to 10%
- 10.1 to 20%
- 20.1 to 50%
- > 50%

Collected sample depth (1-foot intervals)

- 0-1 foot
- 1-2 feet
- 2-3 feet
- 3-4 feet
- 4-5 feet
- 5-6 feet
- 6-7 feet
- 7-8 feet
- 8-9 feet
- 9-10 feet

Notes: Each station shown to the depth sampled; top box represents sample station location.

No surface grab or core collected at SH-06, due to high cobble content (not shown on map).

No cores collected at SH-03, SH-24, and SH-25; wood content reflects that found in surface grab sample.

Wood content based on visual inspection, provided in Appendix F.

N

0 250 500 1,000 Feet

HERRERA ENVIRONMENTAL CONSULTANTS

Aerial: USDA, 2009

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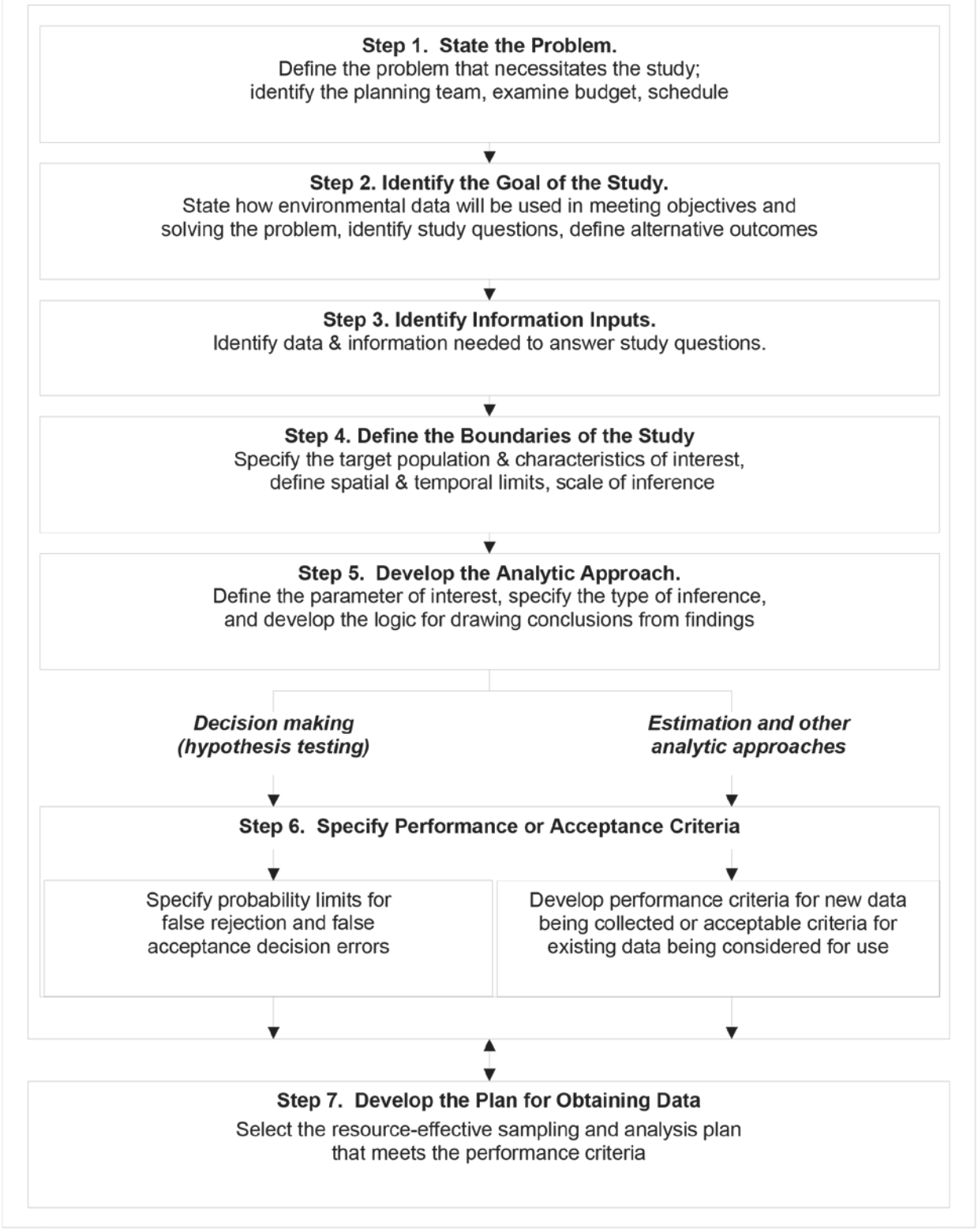

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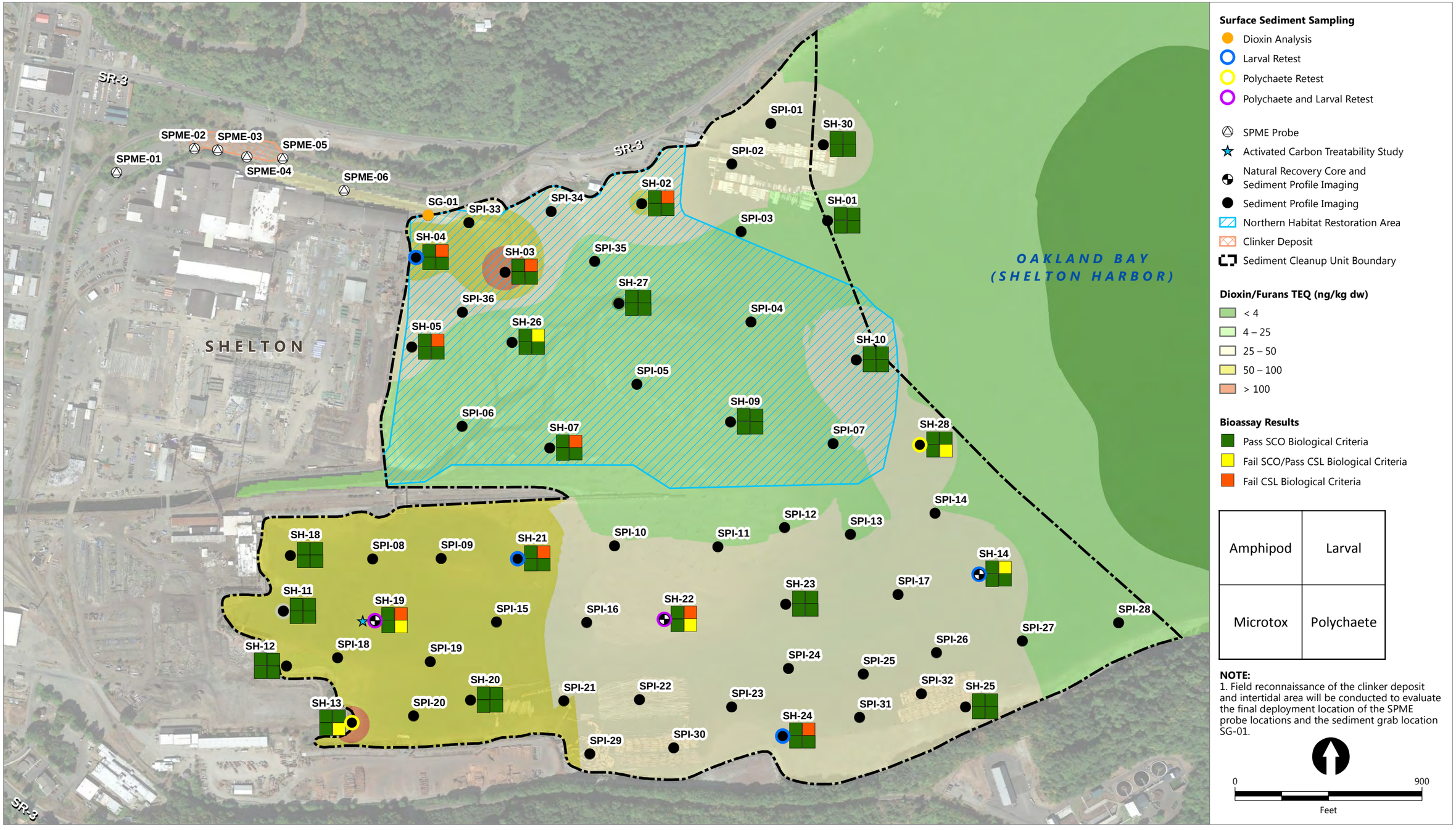
ANCHOR QEA

Figure 9
EPA's (2006) Data Quality Objective Process
Shelton Harbor RI/FS



Surface Sediment Sampling

- Dioxin Analysis
- Larval Retest
- Polychaete Retest
- Polychaete and Larval Retest

- SPME Probe
- Activated Carbon Treatability Study
- Natural Recovery Core and Sediment Profile Imaging
- Sediment Profile Imaging
- Northern Habitat Restoration Area
- Clinker Deposit
- Sediment Cleanup Unit Boundary

Dioxin/Furans TEQ (ng/kg dw)

- < 4
- 4 – 25
- 25 – 50
- 50 – 100
- > 100

Bioassay Results

- Pass SCO Biological Criteria
- Fail SCO/Pass CSL Biological Criteria
- Fail CSL Biological Criteria

Amphipod	Larval
Microtox	Polychaete

NOTE:
1. Field reconnaissance of the clinker deposit and intertidal area will be conducted to evaluate the final deployment location of the SPME probe locations and the sediment grab location SG-01.

0 900
Feet

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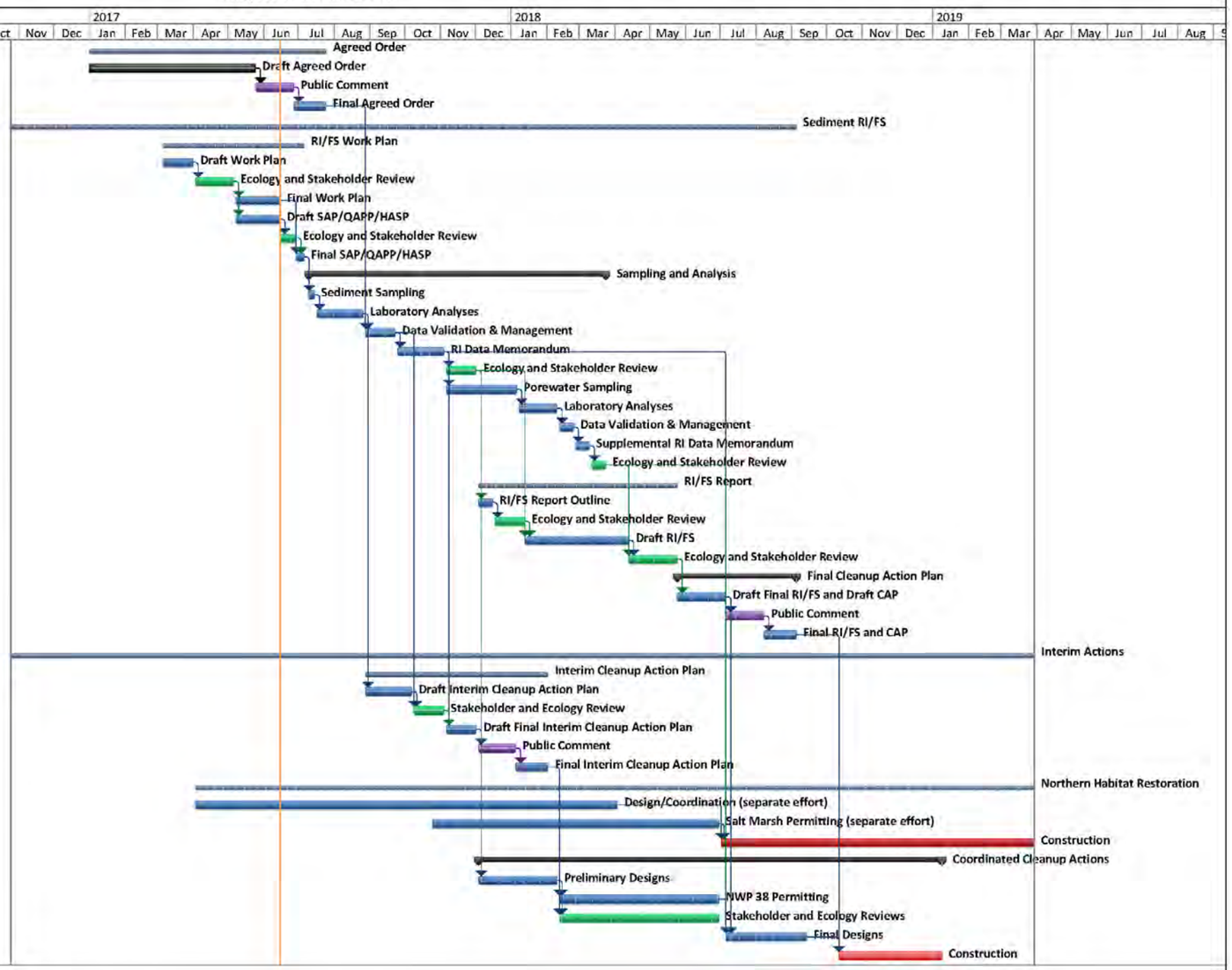
Figure 10
Proposed RI/FS Sampling Locations
Shelton Harbor RI/FS

Subject to Modification

ID	Task Name	Duration	Start	Finish
1	**Agreed Order**			
2	Draft Agreed Order	104 days	Sun 1/1/17	Wed 5/24/17
3	Public Comment	23 days	Thu 5/25/17	Mon 6/26/17
4	Final Agreed Order	20 days	Tue 6/27/17	Mon 7/24/17
5	**Sediment RI/FS**			
6	**RI/FS Work Plan**			
7	Draft Work Plan	20 days	Mon 3/6/17	Fri 3/31/17
8	Ecology and Stakeholder Review	25 days	Mon 4/3/17	Fri 5/5/17
9	Final Work Plan	28 days	Mon 5/8/17	Wed 6/14/17
10	Draft SAP/QAPP/HASP	28 days	Mon 5/8/17	Wed 6/14/17
11	Ecology and Stakeholder Review	10 days	Thu 6/15/17	Wed 6/28/17
12	Final SAP/QAPP/HASP	5 days	Thu 6/29/17	Wed 7/5/17
13	**Sampling and Analysis**	**185 days**	**Mon 7/10/17**	**Fri 3/23/18**
14	Sediment Sampling	5 days	Mon 7/10/17	Fri 7/14/17
15	Laboratory Analyses	30 days	Mon 7/17/17	Fri 8/25/17
16	Data Validation & Management	20 days	Mon 8/28/17	Fri 9/22/17
17	RI Data Memorandum	30 days	Mon 9/25/17	Fri 11/3/17
18	Ecology and Stakeholder Review	20 days	Mon 11/6/17	Fri 12/1/17
19	Porewater Sampling	45 days	Mon 11/6/17	Fri 1/5/18
20	Laboratory Analyses	25 days	Mon 1/8/18	Fri 2/9/18
21	Data Validation & Management	10 days	Mon 2/12/18	Fri 2/23/18
22	Supplemental RI Data Memorandum	10 days	Mon 2/26/18	Fri 3/9/18
23	Ecology and Stakeholder Review	10 days	Mon 3/12/18	Fri 3/23/18
24	**RI/FS Report**			
25	RI/FS Report Outline	10 days	Mon 12/4/17	Fri 12/15/17
26	Ecology and Stakeholder Review	20 days	Mon 12/18/17	Fri 1/12/18
27	Draft RI/FS	90 edays	Fri 1/12/18	Thu 4/12/18
28	Ecology and Stakeholder Review	30 days	Fri 4/13/18	Thu 5/24/18
29	**Final Cleanup Action Plan**	**73 days**	**Fri 5/25/18**	**Tue 9/4/18**
30	Draft Final RI/FS and Draft CAP	30 days	Fri 5/25/18	Thu 7/5/18
31	Public Comment	23 days	Fri 7/6/18	Tue 8/7/18
32	Final RI/FS and CAP	20 days	Wed 8/8/18	Tue 9/4/18
33	**Interim Actions**			
34	**Interim Cleanup Action Plan**			
35	Draft Interim Cleanup Action Plan	30 days	Mon 8/28/17	Fri 10/6/17
36	Stakeholder and Ecology Review	20 days	Mon 10/9/17	Fri 11/3/17
37	Draft Final Interim Cleanup Action Plan	20 days	Mon 11/6/17	Fri 12/1/17
38	Public Comment	24 days	Mon 12/4/17	Thu 1/4/18
39	Final Interim Cleanup Action Plan	20 days	Fri 1/5/18	Thu 2/1/18
40	**Northern Habitat Restoration**			
41	Design/Coordination (separate effort)	365 edays	Mon 4/3/17	Tue 4/3/18
42	Salt Marsh Permitting (separate effort)	178 days	Wed 10/25/17	Fri 6/29/18
43	Construction	195 days	Mon 7/2/18	Fri 3/29/19
44	**Coordinated Cleanup Actions**	**287 days**	**Mon 12/4/17**	**Tue 1/8/19**
45	Preliminary Designs	50 days	Mon 12/4/17	Fri 2/9/18
46	NWP 38 Permitting	100 days	Mon 2/12/18	Fri 6/29/18
47	Stakeholder and Ecology Reviews	100 days	Mon 2/12/18	Fri 6/29/18
48	Final Designs	50 days	Fri 7/6/18	Thu 9/13/18
49	Construction	63 days	Fri 10/12/18	Tue 1/8/19



Project: Shelton Harbor Master Sc
Date: Thu 6/15/17

Task — Summary — External Milestone — Inactive Summary — Manual Summary Rollup — Finish-only
Split — Project Summary — Inactive Task — Manual Task — Manual Summary — Deadline
Milestone — External Tasks — Inactive Milestone — Duration-only — Start-only — Progress

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Figure 11
Preliminary Schedule
Shelton Harbor RI/FS

July 2017
Shelton Harbor Sediment Cleanup Unit
Oakland Bay and Shelton Harbor Sediments Cleanup Site (Cleanup Site ID: 13007)

ANCHOR QEA

Sampling and Quality Assurance Project Plan

Prepared for Simpson Timber Company and the Washington State Department of Ecology

July 2017
Shelton Harbor Sediment Cleanup Unit
Oakland Bay and Shelton Harbor Sediments Cleanup Site (Cleanup Site ID: 13007)

Sampling and Quality Assurance Project Plan

Prepared for
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TABLES

FIGURES

ATTACHMENT

ABBREVIATIONS

µm	micrometer
AC	activated carbon
CCV	continuing calibration verifications
cm	centimeter
CoC	chemical of concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
DGPS	differential global positioning system
DGT	diffusive gradient thin film
DQO	data quality objective
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FC	Field Coordinator
f_e	fraction of equilibrium
GC/MS	gas chromatograph/mass spectrometer
H_2S	hydrogen sulfide
HDPE	high-density polyethylene
MLLW	mean lower low water
MS	matrix spike
MSD	matrix spike duplicate
MTCA	Model Toxics Control Act
NAD	North American Datum
PDMS	polydimethylsiloxane
PRC	performance reference compound
PSEP	Puget Sound Estuary Program
QA/QC	quality assurance/quality control
RI/FS	Remedial Investigation/Feasibility Study
RPD	relative percent difference
SCU	Sediment Cleanup Unit
Simpson	Simpson Timber Company
SMS	Sediment Management Standards
SPI	sediment profile imaging
SPME	solid-phase microextraction
SQAPP	Sampling and Quality Assurance Project Plan
TEQ	toxic equivalents quotient
TS	total solids
TVS	total volatile solids

WAC	Washington Administrative Code
Work Plan	Shelton Harbor Sediment Cleanup Unit Remedial Investigation/ Feasibility Study Work Plan

1 Introduction

In accordance with Agreed Order DE 14091, Simpson Timber Company (Simpson) and the Washington State Department of Ecology (Ecology) have agreed to perform a Remedial Investigation/Feasibility Study (RI/FS) for a Sediment Cleanup Unit (SCU) of Shelton Harbor, Washington (Figure 1). The Shelton Harbor SCU RI/FS Work Plan (Work Plan; Anchor QEA 2017; Exhibit B of the Agreed Order) describes the tasks required to complete the RI/FS process, including identifying data quality objectives (DQOs) and generally describing data collection activities. This Sampling and Quality Assurance Project Plan (SQAPP) describes data acquisition and has been prepared in accordance with the Sediment Management Standards (SMS; Chapter 173-204 Washington Administrative Code [WAC]) and the Model Toxics Control Act (MTCA; Chapter 173-340 WAC). The project-specific Health and Safety Plan is included as Attachment 1.

1.1 Objective

The Work Plan details geologic, historical development and land ownership of harbor and shoreline. In addition, a future habitat restoration project is currently being designed and permitted by the Squaxin Island Tribe, South Puget Sound Salmon Enhancement Group, and Simpson within the northern portion of Shelton Harbor. Recent existing high quality sediment investigation reports and results have been compiled and summarized in the Work Plan. While chemicals of concern (CoCs) and/or indicator hazardous substances will be identified in the RI/FS, the following chemicals of potential concern have been identified for the Shelton Harbor SCU:

- Wood debris and degradation products (e.g., hydrogen sulfide [H_2S] and/or ammonia)
- Dioxins/furans
- Carcinogenic polycyclic aromatic hydrocarbons (cPAHs)

A systematic planning process, DQOs, considered the historical information and planned restoration projects to determine the type, quantity, and quality of data needed for the RI/FS. The process identified the following four DQOs to complete the RI:

- DQO 1: Evaluate benthic conditions
- DQO 2: Evaluate potential bioaccumulation exposures to humans and wildlife
- DQO 3: Evaluate ongoing sources to sediments
- DQO 4: Evaluate recent natural recovery

As described in the Work Plan, no new data are required to address DQO 2. Accordingly, this SQAPP details the sample collection methods and analysis to address data acquisition for DQO 1, DQO 3, and DQO 4. Sufficient analytical data to evaluate potential bioaccumulation exposures to humans and wildlife as compared to natural background concentrations are available (Ecology 2017), and only additional data analysis and interpretation is required to address DQO 2.

To inform FS evaluations, treatability testing with activated carbon (AC) will be conducted with sediment collected from a location with relatively elevated dioxin/furan toxic equivalents quotient (TEQ) levels. The treatability test will measure the efficacy of AC treatment to reduce porewater concentrations of both dioxin/furan TEQ and cPAH TEQ.

The objective of this data collection is to provide the type, quality, and quantity of data needed for the RI/FS.

1.2 Document Organization

This SQAPP is organized as follows:

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

2 Data Generation and Acquisition

The section describes the type, quality, and quantity of data needed for the RI/FS.

2.1 Data Quality Objective 1: Evaluate Benthic Conditions

As identified through the Work Plan DQO process, additional data are required to characterize current sediment quality within the SCU. The sediment quality will be evaluated through bioassay testing, surface sediment porewater sulfide, and ammonia analysis, and for the presence of wood through sediment profile imaging (SPI). The following sections describe the methods for data acquisition technique.

2.1.1 Sediment Profile Imaging

The SPI survey is used to delineate the extent of wood debris deposits. SPI images will be collected at the locations shown in Figure 2 and summarized in Table 1. Additional information or locations may be added, in consultation with Ecology, based on the initial result observations to adequately characterize the extent of wood debris. All SPI images will undergo a preliminary review to estimate the plan view surficial and sectional wood content. Two replicate images (SPI and plan view) will be taken at each location.

The following qualitative metrics will be determined from the images:

Metric	Notes
Presence and amount of wood debris	Visual estimate of approximate wood debris amount and percent cover: • None = none • Trace = less than 5% • Low = 5% to 20% • Medium = 20% to 50% • High = greater than 50%
Presence of *Beggiatoa* sp. and/or methane	Presence of *Beggiatoa* sp. mats, or bubbles or voids indicative of methane
Debris	Visual estimate of approximate debris amount and percent cover: • None = none • Trace = less than 5% • Low = 5% to 20% • Medium = 20% to 50% • High = greater than 50%

At the end of each shift, the SPI data for each location will be reviewed to estimate wood content throughout the SCU in consultation with Ecology. If the estimated wood content is higher in areas

where bioassay testing has not been historically conducted, additional full suite bioassay locations may be selected.

2.1.2 Sediment Bioassay

Historical investigations resulted in inconsistent bioassay exceedances for larval development and polychaete growth tests, even in areas with no SMS chemical exceedances or wood debris, and even in reference tests (Figure 2; Table 2). In the period after the historical testing was conducted, Ecology has approved modified protocols for larval development and polychaete growth procedures that improve the testing methodology performance (Kendall et al. 2013). Larval and polychaete bioassay testing will be conducted where historical SMS exceedances have occurred (Table 2) using the updated methodology. If SPI reveals areas with higher wood debris content than the historical bioassay testing locations, full suite bioassays will be conducted at the additional locations as determined in consultation with Ecology.

At bioassay testing locations, bulk sediment conventional testing will be conducted in accordance with the methods and reporting limits included in Table 3 for the following: total volatile solids (TVS), total solids (TS), and grain size. Sediment porewater ammonia and H_2S will be measured at the bioassay laboratory at initiation of testing using an electrochemical probe. In addition, in situ dissolved H_2S concentrations will be measured using a diffusive gradient thin film (DGT) passive sampling method. Upon removal, the accumulated H_2S in the DGT gel will be measured using purge-and-trap followed by the colorimetric method (methylene blue; Teasdale et al. 1999; Table 3).

2.1.2.1 Larval Bioassay

Larval bioassay will be conducted at six locations using the mussel *Mytilus galloprovincialis* with the resuspension protocol (Kendall et al. 2013; Figure 2). The larval resuspension bioassay results will be used to reflect current sediment quality conditions in the RI/FS.

2.1.2.2 Polychaete Bioassay

Polychaete bioassays will be conducted at four locations using the juvenile *Neanthes arenaceodentata* with the current ash-free dry-weight and dry-weight protocols (Kendall et al. 2013; Figure 2). The polychaete bioassay results will be used to reflect current sediment quality conditions in the RI/FS.

2.1.2.3 Full Suite Bioassay

Full suite bioassays will be conducted if SPI results reveal locations where higher concentrations of wood debris deposits are present relative to the historical bioassay locations. Only the locations with the highest wood debris levels will have samples collected for a full suite bioassay.

Full suite bioassays will include the 10-day amphipod bioassay using *Eohaustorius estuarius*, the larval bioassay using the resuspension protocol, and the 20-day polychaete growth test described above.

2.2 Data Quality Objective 3: Evaluate Ongoing Sources to Sediments

The RI/FS will evaluate spatial gradients of CoCs in surface sediments, focusing on areas that exceed preliminary cleanup levels. Because of locally elevated dioxin/furan TEQ levels reported in Ecology (2013) in the Shelton Creek drainage basin, focused in situ passive sampling of porewater dioxin/furan TEQ of the clinker deposit depicted in Figure 2 will be performed in the RI/FS to assess the potential for transport of dissolved-phase dioxin/furans TEQ. The objective is to determine if contaminant transport from this area requires further controls to minimize the potential for recontamination, beyond bank stabilization actions already contemplated. In situ passive sampling will be conducted using solid-phase microextraction (SPME) methods (Table 4; ITRC 2011; EPA 2012) deployed at the base on the delineated clinker deposit adjacent to Shelton Creek, and compared with local background concentrations. In addition, a single surface sediment (0- to 10-centimeter [cm]) sample will be collected in a representative depositional area of the Shelton Creek delta downstream of the clinker deposit. The preliminary sampling location is depicted in Figure 2. These data, along with available sediment quality data, will be used as lines-of-evidence in the evaluation of remedial alternatives in the RI/FS.

Following field reconnaissance to determine the clinker deposit extents, SPME sampling devices will be deployed at a total of six locations for 2 months and allowed to equilibrate with the top 2 feet of sediment porewater. One sampler will be deployed at an upstream location to assess the background concentration of dioxins/furans TEQ. Four samplers will be deployed within the clinker deposit. One sampler will be deployed at a downstream location to assess downgradient effects of the clinker deposit. Prior to deployment, all SPME fibers will be spiked with performance reference compounds (PRCs), which are isotopically labeled versions of target compounds. PRCs are used to determine the fraction of equilibrium achieved (f_e) during deployment, which is a correction factor used to estimate the concentration of each chemical in the porewater.

Field reconnaissance of the intertidal Shelton Creek delta will also be conducted to field locate the single sampling location (SG-01; Figure 2) downstream of the clinker deposit.

2.3 Data Quality Objective 4: Evaluate Recent Natural Recovery

Historical releases of CoCs were of greater magnitude than ongoing sources, as evidenced by the higher subsurface chemical concentrations in many areas of the harbor (Herrera 2010). The RI/FS will evaluate natural recovery rates and the extent of subsurface contaminated sediment deposits in the Shelton Harbor SCU to support the evaluation of alternative cleanup remedies. Natural recovery will be evaluated by collecting sediment cores at three locations (Figure 2) to determine the rate of sedimentation and natural recovery within Shelton Harbor. Each subsurface core will be processed

into 2-cm intervals for radioisotope and chemical testing. Initially, core intervals selected based on visual examination of each core will be tested for the radioisotopes lead-210 and cesium-137 using the methods and reporting limits in Table 3, while the remaining mass will be archived at the chemical analytical laboratory. Additional core intervals will be analyzed as necessary based on initial testing results. The radioisotope testing results will then be used to estimate the sedimentation rates within Shelton Harbor. In consideration of the sedimentation rate, up to three archived sediment intervals from each core will be analyzed for dioxin/furan TEQ, cPAHs, and TVS to identify the rate of natural recovery over the last 50 to 60 years.

2.4 Feasibility Study Evaluations

Consistent with SMS and MTCA requirements, an FS will be performed to evaluate potential sediment cleanup alternatives and to select a site-specific sediment cleanup standard to inform both Draft and Revised Cleanup Action Plans for the Shelton Harbor SCU. To inform the FS, testing will be conducted to evaluate the efficacy of sediment AC amendment through bench-scale testing, and to refine the vertical extent of wood debris, through coring.

2.4.1 Bench-scale Activated Carbon Testing

To determine if in situ treatment is an effective remedial technology, a surface sediment location SH-19, which has relatively high dioxin/furan TEQ levels, will undergo treatability testing. One sample aliquot will be untreated while another aliquot will be amended with 4% by dry weight AC. Both samples will be thoroughly mixed and a representative sample analyzed for total organic carbon, black carbon, bulk dioxin/furan TEQ and cPAH TEQ. The AC-amended sample will equilibrate for 1 month prior to deploying SPME fibers into the sample. SPME fibers will be placed in both AC-treated and untreated test sediments and analyzed for dissolved-phase dioxin/furan and cPAH TEQ (Table 4). The samples will be allowed to equilibrate with mild agitation (potentially intermittent), on a on a shaker, for 6 months. To determine the composition of carbon in the sediment matrix, this station bulk sediment will be tested for black carbon (Table 3).

2.4.2 Extent of Wood Debris Sediment Coring

Additional cores will be advanced to delineate the extent of wood debris. These additional core locations will be determined upon review of the SPI results in consultation with Ecology. The 10-foot cores will be sectioned into intervals no greater than 2 feet, depending on lithology. The presence of wood debris will be estimated throughout the length of the core. Initially, the interval underlying the last identified presence of wood will be submitted for TS, grain size, and TVS analyses. All other intervals will be archived for testing.

2.5 Field Survey and Sampling Methods

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

2.5.1 Sampling Vessels and Field Equipment

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

An Ocean Imaging Systems 3731 SPI camera system provided and operated by NewFields, will be deployed from the research vessel for the collection of all images in Shelton Harbor.

2.5.2 Surface and Subsurface Sediment Collection

Surface and subsurface sediment will be collected and processed as described in the sections below. Surface sediment will be collected for bioassays and dioxin/furan TEQ analysis of potential source areas. In situ sulfide porewater measurements will also be performed at bioassay stations. Subsurface sediment will be collected to assess the natural recovery potential of the SCU.

2.5.2.1 Surface Sediment Sample Collection Procedures

Surface sediment grab samples from the 0- to 10-cm biologically active zone will be collected for chemical analysis and toxicity bioassays using a Van Veen-type hydraulic power grab sampler, in accordance with Puget Sound Estuary Program (PSEP) protocols (PSEP 1997). The target locations and coordinates for each station are included in Figure 2 and Table 2, respectively. Samples will be collected in the following manner in accordance with the PSEP protocols:

- The vessel will maneuver to the proposed location.
- The sampler will be decontaminated.
- The sampler will be deployed to the bottom.
- The winch cable to the grab sampler will be drawn taut and vertical.
- Location coordinates of the cable hoist will be recorded by the location control person.
- The sediment sample will be retrieved aboard the vessel and evaluated against the following PSEP acceptability criteria:
  - Grab sampler is not overfilled (i.e., sediment surface is not against the top of the sampler).
  - Sediment surface is relatively flat, indicating minimal disturbance or winnowing.
  - Overlying water is present, indicating minimal leakage.
  - Overlying water has low turbidity, indicating minimal sample disturbance.
  - Desired penetration depth of at least 10 cm is achieved.

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

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

2.5.2.2 Surface Sediment Sample Processing Procedures

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

- Place the grab on a stable surface. Remove any overlying water using a syphon hose or turkey baster. Following grab acceptance criteria listed in Section 2.5.2.1, determine whether the grab is acceptable.
- After noting their presence, remove any large objects or debris from the sediment surface.
- Prior to sampling, color photographs may be taken, and a sediment description of each grab will be recorded on a grab sampling log form. Record the description of the grab sample on the grab log form for the following parameters as appropriate and present:
  - Sample recovery (depth in inches or centimeters of recovery in the grab sampler)
  - Physical soil description of the grab in accordance with the Unified Soil Classification System (includes soil type, density/consistency of soil, moisture, and color)
  - Odor (e.g., H_2S and petroleum)
  - Note any vegetation
  - Debris
  - Biological activity (e.g., detritus, shells, tubes, bioturbation, or live or dead organisms)
  - Presence of oil sheen
  - Any other distinguishing characteristics or features
- Using a clean spoon, place sample material from the desired grab depth (0 to 10 cm) into a clean, stainless-steel bowl or high-density polyethylene (HDPE) bucket. To avoid cross contamination, take care to remove only sediment that has not come into contact with the sides or bottom of the grab. When sufficient material has been removed, the sample will be homogenized until a uniform color and consistency is achieved.

- Using a clean, stainless-steel spoon, completely fill pre-labeled sample containers as specified in Table 5. In addition to containers in Table 5, mass sample will be placed in bags for bioassay testing.
- Immediately after filling the sample container with sediment, place the screw cap on the sample container and tighten. Bioassay bags will be securely closed with zero head space.
- Thoroughly check all sample containers for proper identification, analysis type, and lid tightness.
- Pack each container carefully to prevent breakage and place inside a cooler with ice for storage at the proper temperature (4°±2°C for all samples).

Samples will be submitted for testing as presented in Table 2.

2.5.2.3 Sediment Core Collection Procedures

Subsurface cores will be collected, by either piston or vibracore, at three known locations (SH-19, SH-22, and SH-14) shown in Figure 2, and at other locations determined in consultation with Ecology. The target coordinates for each station are included in Table 2, but may be adjusted in the field based on accessibility. The subsurface core will use a rigid external tube with either polycarbonate liners or a dedicated aluminum tube. The subsurface core will be lowered to the bottom, where the unit will then be advanced either by slide or vibratory hammer. The target depth will be 5 feet below the mudline. The core will be driven to its maximum length or to refusal. Acceptance criteria for a sediment core sample are as follows:

- The core penetrated and retained material to project depth. If refusal is reached before project depth, an additional core will be attempted within a 10-foot radius of the original position. Relocations will be made along depth contours generally parallel to the shore.
- Recovery was at least 75% of the length of core penetration.
- Cored material did not extend out the top of the core tube or contact any part of the sampling apparatus at the top of the core tube.
- There were no obstructions in the cored material that might have blocked the subsequent entry of sediment into the core tube and resulted in incomplete core collection.
- If multiple core rejections (three attempts) require the core station to be relocated, the proposed station relocation will be documented and the actual coordinates will be recorded after sample collection is complete. Recovered cores will be cut, if necessary, placed on ice, and processed at the analytical laboratory, or equivalent.

The following procedure will be used to decontaminate core sample tubes prior to use:

- Rinse and pre-clean with tap water
- Wash and scrub in a solution of laboratory-grade, non-phosphate-based soap and tap water
- Rinse with tap water

- Rinse three times with distilled water
- Seal both ends of each core tube with aluminum foil

The core tube caps will be removed immediately prior to placement into the coring device. Care will be taken during sampling to avoid contact of the sample tube with potentially contaminated surfaces. Extra sample tubes will be available during sampling operations for uninterrupted sampling in the event of a potential core tube breakage or contamination. Core tubes suspected to have been accidentally contaminated will not be used. Logs and field notes of all core samples will be maintained as samples are collected and correlated to the sampling location map. The following information will be included in the logs:

- Elevation of each station sampled as measured from mean lower low water (MLLW)
- Location of each station as determined by differential global positioning system (DGPS)
- Date and time of collection of each sediment core sample
- Names of Field Coordinator (FC) and person(s) collecting and handling the sample
- Observations made during sample collection including complications and other details associated with the sampling effort
- The sample station identification
- Length and depth intervals of each core section and estimated recovery for each sediment sample as measured from MLLW
- Qualitative notation of apparent resistance of sediment column to coring
- Any deviation from the approved SQAPP

2.5.2.4 Sediment Core Processing Procedures

The core processing station will either be located at an upland location at the former sawmill or at the analytical laboratory. Transported cores will be handled consistent with ASTM International procedures (ASTM D 4220) and stored upright in the analytical laboratory refrigerators or on site until processed. Filled sample containers will be stored in coolers containing ice to maintain the samples at 4°C±2°C until delivery or shipping to the analytical laboratory.

All working surfaces and instruments will be thoroughly cleaned, decontaminated, and covered with aluminum foil to minimize outside contamination between sampling events. Disposable gloves will be discarded after processing each station and replaced prior to handling decontaminated instruments or work surfaces.

The steps for processing the samples are listed below:

1. Cut core longitudinally using a circular saw or power shears, taking care not to penetrate the sediment while cutting.
2. Use decontaminated utensils to split the core to expose the center of the two halves for sampling.

3. Photograph the entire length of the core.
4. Record the description of the core sample on the core log form for the following parameters as appropriate and present:
    a. Sample recovery (depth in feet of penetration and sample compaction)
    b. Physical soil description in accordance with the Unified Soil Classification System (includes soil type, density/consistency of soil, and color)
    c. Odor (e.g., H_2S or petroleum)
    d. Vegetation
    e. Debris
    f. Biological activity (e.g., detritus, shells, tubes, bioturbation, or live or dead organisms)
    g. Visual stratification, structure, and texture
    h. Presence of oil sheen
    i. Any other distinguishing characteristics or features
5. The radioisotope and natural recovery core will be split in half and sectioned into 2-cm intervals
    a. Sufficient mass will be placed into in radioisotope containers (Table 5)
    b. Using a clean spoon, sediment from each core interval will be placed into a cleaned, stainless-steel bowl, homogenized by hand, placed into containers described in Table 5, and either submitted for analysis or archived for potential future analysis.
6. Wood debris cores will be sectioned into intervals no greater than 2 feet depending on lithology and the presence of wood.
    a. Using a clean spoon, sample material from the core intervals will be placed into a cleaned, stainless-steel bowl, homogenized by hand, placed into containers described in Table 5, and either submitted for analysis or archived for potential future analysis.
    b. Initially, the interval underlying the last identified presence of wood will be submitted for testing. All other intervals will be archived.
7. Immediately after filling the sample container with sediment, place the screw cap on the sample container and tighten.
8. Thoroughly check all sample containers for proper identification, analysis type, and lid tightness.
9. Pack each container carefully to prevent breakage and place inside of a cooler with ice for storage at the proper temperature (4°±2°C for all samples).

2.5.3 Porewater Sulfide and Ammonia Sampling

For each bioassay location, freely dissolved porewater sulfide concentrations will be measured in situ using DGT samplers; porewater ammonia concentrations will be measured during the bioassay test. DGT samplers will be deployed from a vessel in a separate mobilization from the bioassay. The DGTs will be inserted into the surficial sediments with a custom apparatus outfitted with a video camera to ensure embedment. After a 48-hour equilibration period, the submersible camera will confirm that the DGT has remained embedded in the sediments and will be removed. Upon retrieval, the

sampling assembly will be extracted from the sediment, and the DGT sampler will be removed and flushed with deionized water and placed in a cool environment until analysis. The accumulated sulfide in the DGT gel will be measured using purge-and-trap followed by the colorimetric method (methylene blue) (Teasdale et al. 1999).

The accumulated sulfide measured in the DGT will be used to calculate porewater concentrations based on diffusive flux relationships. The flux to DGT equals the mass (*M*) accumulated by the binding gel divided by the area of the sampling window and the exposure time *t* as described in Equation 1.

Equation 1

$$F = M/(At)$$

where:

F	=	flux
M	=	mass
At	=	area of the sampling window and the exposure time

Porewater concentrations of sulfide can be calculated using Fick's first diffusion law (Equation 2).

Equation 2

$$C_{DGT} = \frac{F * \Delta g}{D} = \frac{M * \Delta g}{DAt}$$

where:

C	=	concentration
DGT	=	diffusive gradient thin sheet
F	=	flux
Δg	=	thickness of the diffusion layer
D	=	diffusion coefficient of sulfide in the diffusion layer
M	=	mass
At	=	area of the sampling window and the exposure time

2.5.4 In situ Solid-phase Microextraction Sampling

In situ SPME sampling has been recognized as a useful technology to monitor the time-integrated measurement of environmental contaminants in sediment porewater (Mayer et al. 2000; Fernandez et al. 2009; Lu et al. 2011). The SPME sampling device discussed herein consists of a glass fiber core

coated with polydimethylsiloxane (PDMS; a polymer sorbent) placed in a custom-designed T-shape insert PushPoint sampler for in situ SPME sampling. PDMS-coated fiber is the central element to this sampling method. The SPME fiber used in this study is 1,000-micrometer (µm)-diameter glass-core fibers coated with a 35-µm-thick PDMS polymer, which corresponds to approximately 115.5 microliters of PDMS per 1 meter of fiber. The fiber is manufactured by Polymicro Technologies of Phoenix, Arizona, and the fiber coating thickness is regularly measured for QC. The sampling device allows for deployment directly into the sediment to equilibrate fibers with sediment porewater while avoiding physically damaging the fibers.

Prior to deployment, individual SPME fibers are placed into the inner rod of the sampler. This inner rod is placed into a protective outer-casing with approximately 0.5-millimeter-thick slits cut at a spacing interval of 6 millimeters over the 2-foot length of the exposure area. These openings in the outer-casing allow sediment porewater to flow through and contact to the SPME fiber throughout the study. The inner-rod of the sampler has several partitions to prevent a vertical inflow of porewater inside the sampler during deployment.

The SPME sampling device is placed into sediment and left in place for approximately 2 months to allow dioxins/furans in sediment porewater to partition to the PDMS coating on the fiber. The dioxins/furans concentration that accumulates in the polymer sorbent at equilibrium is directly proportional to the dissolved dioxins/furans concentration in the porewater. A proportionality constant, a PDMS-water partition coefficient ($K_{PDMS\text{-}water}$), in conjunction with an estimate of the fraction of equilibrium achieved (f_e) can be used to estimate the concentration of each chemical in the porewater sampled from the concentration in the PDMS coating. After the deployment period, the SPME sampling devices will be retrieved from the sampling locations, and the SPME fibers will be submitted to analyze dioxins/furans.

2.5.5 Sampling Schedule and Platform

Sampling will occur after approval of this SQAPP by Ecology, and is anticipated to occur in summer 2017. It is anticipated that mobilization, field sampling, sample processing, and demobilization will require approximately 6 days.

Collection of subsurface sediment cores and surface sediment grab samples will be conducted by a qualified contractor and overseen by Anchor QEA from a vessel properly equipped to deploy and recover a vibracorer and power grab, and to provide the required navigation. The vibracore equipment is hydraulically driven, low-frequency, spring-loaded, and mounted on a sampling platform to ensure a vertical drive into the sediment. The vibracore is equipped with a piston device fitted into the upper portion of the core barrel to assist in recovery of soft surface material. The vibracore is also equipped with an inverse fathometer that displays real-time penetration within the wheelhouse to monitor penetration progress and determine refusal depth.

The collection of surface sediment grab samples for bioassay analysis will be conducted by Marine Sampling Systems at seven locations in the harbor. Surface sediment samples will be collected using a hydraulically operated power grab. The vessel will be operated by a licensed captain and will conform to U.S. Coast Guard regulations. The vessel captain and crew have extensive experience in subsurface core and surface grab collection in Puget Sound.

2.5.6 Horizontal Positioning and Vertical Control

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

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

2.5.7 Sample Station Locations and Sample Identification

Figure 2 shows the locations of the proposed core and bioassay sampling locations, respectively. Collectively, Tables 1 and 2 include listings of all station locations, sample identifiers, and analysis and/or testing required for each location. The sample identification schemes are described in Section 2.5.10.

2.5.8 Equipment Decontamination Procedures

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

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

2.5.9 Sample Containers for Analysis

The contract laboratory will provide certified, pre-cleaned, U.S. Environmental Protection Agency (EPA)-approved containers for all chemistry samples. Sediment for bioassay testing will be placed in commercially available HDPE buckets that have been decontaminated as described in Section 2.5.8 and lined with clean food-grade polyethylene bags and sealed airtight. Table 5 lists container size, holding times, and preservation for the categories of analytes. At a minimum, each sample container will be labelled with the following information:

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

2.5.10 Sample Identification

Each sample will be assigned a unique alphanumeric identifier using the following format:

- The first two characters identify the site (i.e., SH for Shelton Harbor).
- The next two characters identify the location (i.e., 01, 02, 03, and so on).
- The next characters identify the collection method:
  - SG for surface sediment grab
  - SC for sediment core, followed by depth interval in feet (i.e., "00-04" for the top 4 feet of the core)
  - SPME for solid-phase microextraction
  - GEO for geochronology samples
  - B for bioassay samples
- The remaining characters identify the sampling date (YYMMDD).

Sample "SH-04-SG-170710" represents a surface sediment grab collected at location SH-04 on July 10, 2017.

Sample "SH-22-SC-04-05-170715" represents the 4- to 5-foot depth interval from a sediment core collected at location SH-22 on July 15, 2017.

Field duplicate will be identified by adding 100 to the location ID. Sample "SH-128-SG-170710" is the field duplicate of sample "SH-28-SG-170710."

2.5.11 Sample Transport and Chain-of-Custody Procedures

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

2.5.12 Sample Custody Procedures

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

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

A chain-of-custody form will accompany each cooler of samples to the analytical laboratories. Each person who has custody of the samples will sign the chain-of-custody form and ensure that the samples are not left unattended unless properly secured. Copies of all chain-of-custody forms will be retained in the project files.

2.5.13 Sample Shipping and Receipt Requirements

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

- Each cooler or container containing the samples for analysis will be shipped via overnight delivery to the appropriate analytical laboratory. In the event that Saturday delivery is required, the FC will contact the analytical laboratory before 3 p.m. on Friday to ensure that the laboratory is aware of the number of coolers shipped and the airbill tracking numbers for those coolers. Following each shipment, the FC will call the laboratory and verify the shipment from the day before has been received and is in good condition.
- Coolant ice will be sealed in separate double plastic bags and placed in the shipping containers.
- Individual sample containers will be placed in a sealable plastic bag, packed to prevent breakage, and transported in a sealed ice chest or other suitable container.

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

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

2.5.14 Waste Management

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

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

Sediment remaining after core processing and sampling will be collected in 55-gallon drums and consolidated. The 55-gallon drum area will be located in a secure area and labeled appropriately. After core processing is completed, a composite sample will be collected and analyzed to obtain representative data for sediment disposal profiling.

2.6 Inadvertent Discovery Plan

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

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

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

3 Field and Laboratory Quality Assurance and Quality Control

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

3.1 Field Quality Assurance and Quality Control

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

Field QA samples will include the collection of additional sample volume to ensure that the laboratory has sufficient sample volume to run the program-required analytical QA/QC samples for analysis, as specified in Table 6. Additional sample volume to meet this requirement will be collected at a frequency of 1 in 20 samples processed except for DGTs, which cannot be reliably duplicated in the field.

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

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

3.1.1 Field Duplicates

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

3.1.2 Equipment Blanks

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

3.2 Analytical Laboratory Quality Assurance and Quality Control

Laboratory QC procedures, where applicable, include initial and continuing instrument calibrations, laboratory control samples, matrix spikes (MS), matrix spike duplicates (MSD), surrogate spikes (for organic analyses), and method blanks. QA/QC sample frequencies are provided in Table 6. A summary of the analytical data quality objectives is provided in Table 7.

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

3.2.1 Laboratory Instrument Calibration and Frequency

An initial calibration will be performed on each laboratory instrument to be used prior to the start of project, after each major interruption to the analytical instrument, and when any ongoing calibration does not meet method control criteria. Calibration verification will be analyzed following each initial calibration and will meet method criteria prior to analyses of samples. Continuing calibration verifications (CCV) will be analyzed at method-required frequencies to track instrument performance. The frequency of CCVs varies with method. For gas chromatograph/mass spectrometer (GC/MS) methods, one will be analyzed every 12 hours. For GC, metals, and inorganic methods, one will be analyzed for every 10 field samples analyzed and at the end of each run. If the continuing calibration is out of control, the analysis will be terminated until the source of the control failure is eliminated or reduced to meet control specifications, which may include analyzing a new initial calibration. Any project samples analyzed while the instrument calibration was out of control will be re-analyzed.

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

3.2.2 Laboratory Duplicates

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

3.2.3 Matrix Spikes and Matrix Spike Duplicates

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

3.2.4 Method Blanks

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

3.2.5 Laboratory Control Samples

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

3.3 Bioassay Laboratory Quality Control

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

3.3.1 Negative Controls

The negative control to be used for both sediment toxicity tests will be a clean control, which consists of clean, inert material and the same seawater used in testing sediment toxicity. For the tests to be used in this study, the negative control will be the amphipod collection site sediment, which will most likely be clean sand. The negative control for the bivalve larval test will be a seawater control.

3.3.2 Positive Controls

An appropriate reference toxicant will be run with each batch of test sediments as a positive control to establish the relative sensitivity of the test organisms. The positive control for sediment tests is

typically conducted with diluent seawater and without sediment. The LC_{50} or the EC_{50} must be within the 95% confidence interval of responses expected for the toxicant used[1].

3.3.3 Reference Sediment

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

3.3.4 Replicates

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

3.3.5 Water Quality Monitoring

Water quality monitoring will be conducted for the amphipod, larval, and juvenile polychaete bioassays and reference toxicant tests. This monitoring consists of daily measurements in the water quality replicate of salinity, temperature, pH, and dissolved oxygen for the amphipod and larval tests. These measurements will be made every 3 days for the juvenile polychaete bioassay, except dissolved oxygen, which will be measured daily. Ammonia and sulfides in the overlying water will be determined at test initiation and termination for all three tests. Monitoring will be conducted for all test and reference sediments and negative controls (including seawater controls). Measurements for each treatment will be made on a separate test chamber that is set up identically to the other replicates within the treatment group, including the addition of test organisms.

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

4 Documentation, Recordkeeping, and Reporting Requirements

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

4.1 Documentation and Records

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

4.1.1 Field Records

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

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

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

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

4.1.2 Analytical Laboratory Data Deliverable

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

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

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

4.1.3 Bioassay Laboratory Data Deliverable

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

required to report results that include all information recommended by the applicable protocols described in Section 2.1 for QA review, as follows:

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

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

4.2 Data Reduction

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

4.3 Data Management

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

Laboratory data will be provided to the data manager in the EQuIS electronic format. The laboratory data that are provided electronically and loaded into the database will undergo a 10% check against the laboratory hard copy data. Data will be validated or reviewed manually and qualifiers, if assigned, will be entered manually. The accuracy of all manually entered data will be verified by a second party.

5 Data Validation and Usability

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

5.1 Data Review, Validation, and Verification

Stage 2B data validations (EPA 2009) will be performed on most data, and Stage 4 data validations will be performed on the dioxin/furan data. During the validation process, analytical data will be evaluated for method QC and laboratory QC compliance, and their validity and applicability for program purposes will be determined. Based on the findings of the validation process, data validation qualifiers may be assigned. The validated project data, including qualifiers, will be entered into the project database, thus enabling this information to be retained or retrieved, as needed.

5.2 Validation and Verification Methods

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

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

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

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

Data packages will be checked for completeness immediately upon receipt from the laboratory to ensure that data and QA/QC information requested are present. Data quality will be assessed for all data by a reviewer using this SQAPP and National Functional Guidelines (EPA 2016, 2017a, 2017b), by considering the following:

- Laboratory sample receipt
- Holding times

- Instrument performance checks
- Initial calibrations
- Continuing calibrations
- Method blanks
- Surrogate recoveries
- Internal standard results
- Detection limits
- Quantitation limits
- Dual-column confirmation results
- Laboratory control samples
- MS/MSD samples
- Laboratory replicates

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

5.3 Reconciliation with User Requirements

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

6 References

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Tables

Table 1
Sediment Profile Imaging Locations

Sample Location	Latitude	Longitude
SPI-1	47.21461	-123.08505
SPI-2	47.21406	-123.08578
SPI-3	47.21317	-123.08556
SPI-4	47.21198	-123.08532
SPI-5	47.21111	-123.08749
SPI-6	47.21049	-123.09085
SPI-7	47.21041	-123.08366
SPI-8	47.20871	-123.09251
SPI-9	47.20874	-123.09118
SPI-10	47.20897	-123.08783
SPI-11	47.20900	-123.08583
SPI-12	47.20928	-123.08455
SPI-13	47.20922	-123.08327
SPI-14	47.20953	-123.08165
SPI-15	47.20792	-123.09007
SPI-16	47.20795	-123.08832
SPI-17	47.20844	-123.08231
SPI-18	47.20739	-123.09313
SPI-19	47.20737	-123.09133
SPI-20	47.20665	-123.09162
SPI-21	47.20691	-123.08872
SPI-22	47.20696	-123.08726
SPI-23	47.20689	-123.08547
SPI-24	47.20742	-123.08439
SPI-25	47.20738	-123.08294
SPI-26	47.20769	-123.08154
SPI-27	47.20788	-123.07988
SPI-28	47.20815	-123.07803
SPI-29	47.20622	-123.08819
SPI-30	47.20633	-123.08657
SPI-31	47.20681	-123.08299
SPI-32	47.20714	-123.08181
SPI-33	47.21318	-123.09083
SPI-34	47.21336	-123.08924
SPI-35	47.21272	-123.08838
SPI-36	47.21200	-123.09091
SH-01	47.21335	-123.08389
SH-02	47.21350	-123.08750
SH-03	47.21254	-123.09011
SH-04	47.21270	-123.09184
SH-05	47.21152	-123.09187
SH-07	47.21024	-123.08914
SH-09	47.21065	-123.08565
SH-10	47.21152	-123.08326
SH-11	47.20798	-123.09420
SH-12	47.20726	-123.09411
SH-13	47.20654	-123.09281
SH-14	47.20874	-123.08076
SH-18	47.20872	-123.09410
SH-19	47.20789	-123.09243
SH-20	47.20688	-123.09053
SH-21	47.20877	-123.08970
SH-22	47.20802	-123.08683
SH-23	47.20827	-123.08448
SH-24	47.20653	-123.08447
SH-25	47.20698	-123.08094
SH-26	47.21162	-123.08993
SH-27	47.21218	-123.08789
SH-28	47.21042	-123.08198
SH-30	47.21435	-123.08402

Note:

1. Horizontal datum: Washington State Plane North, North American Datum 1983, U.S. Feet.

Table 2
Physical and Chemical Testing Locations

Sample Location[a]	Latitude	Longitude	Sediment									Bioassays[c]		In situ SPME	Ex Situ Treatability Testing SPME	
			Total Organic Carbon	Black Carbon	Total Volatile Solids	PAHs	Dioxin/ Furan	Radio-isotope	Porewater Ammonia	Porewater Sulfide	Archive[b]	Larval	Polychaete	Dioxin/ Furan	cPAHs	Dioxin/ Furan
SG-01	47.21	-123.09	--	--	--	--	X	--	--	--	X	--	--	--	--	--
SH-04	47.21	-123.09	--	--	X	--	--	--	X	X	X	X	--	--	--	--
SH-13	47.21	-123.09	--	--	X	--	--	--	X	X	X	--	X	--	--	--
SH-14	47.21	-123.08	--	--	X	--	--	X	X	X	X	X	--	--	--	--
SH-19	47.21	-123.09	X	X	X	X	X	X	X	X	--	X	X	--	X	X
SH-21	47.21	-123.09	--	--	X	--	--	--	X	X	X	X	--	--	--	--
SH-22	47.21	-123.09	--	--	X	--	--	X	X	X	X	X	X	--	--	--
SH-24	47.21	-123.08	--	--	X	--	--	--	X	X	X	X	--	--	--	--
SH-28	47.21	-123.08	--	--	X	--	--	--	X	X	X	--	X	--	--	--
SPME-1	47.21	-123.10	--	--	--	--	X	--	--	--	--	--	--	X	--	--
SPME-2	47.21	-123.10	--	--	--	--	X	--	--	--	--	--	--	X	--	--
SPME-3	47.21	-123.10	--	--	--	--	X	--	--	--	--	--	--	X	--	--
SPME-4	47.21	-123.10	--	--	--	--	X	--	--	--	--	--	--	X	--	--
SPME-5	47.21	-123.09	--	--	--	--	X	--	--	--	--	--	--	X	--	--
SPME-6	47.21	-123.09	--	--	--	--	X	--	--	--	--	--	--	X	--	--

Notes:

1. Horizontal datum: Washington State Plane North, North American Datum 1983, U.S. Feet.

a. Subsurface cores will be collected at locations determined in consultation with the Washington State Department of Ecology (Ecology), to determine the extent of wood debris. These cores will be sectioned into intervals no greater than 2 feet depending on lithology and the presence of wood. The interval underlying the last identified presence of wood will be submitted for total solids, and total volatile solids analyses. All other intervals will be archived.

b. Bulk sediments will be archived for dioxin/furan and PAH testing at bioassay stations, if necessary.

c. Full suite bioassays may be conducted at additional locations as determined in consultation with Ecology. Bulk sediments will be archived for testing at bioassay stations not currently identified in this table.

cPAHs: carcinogenic polycyclic aromatic hydrocarbons as defined in Washington Administrative Code 173-340-200

PAHs: polycyclic aromatic hydrocarbons

SPME: solid-phase microextraction

Table 3

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

Parameter	Method	Target Reporting Limit
Conventionals (%)		
Total organic carbon	Plumb, 1981	0.10
Black carbon	Grossman and Ghosh, 2009	0.10
Total volatile solids/loss on ignition	ASTM D2974	0.10
Total solids	SM 2540G	0.10
Grain size	ASTM D422	0.10
Radioisotope (piC/g dw)		
Cesium-137	HASL-300(Ga-01-R)	0.1
Lead-210	ORNL 7.2.3	0.1
Polycyclic aromatic hydrocarbons (µg/kg)		
2-Methylnaphthalene	EPA 8270D SIM	0.5
Acenaphthene	EPA 8270D SIM	0.5
Acenaphthylene	EPA 8270D SIM	0.5
Anthracene	EPA 8270D SIM	0.5
Benzo(a)anthracene	EPA 8270D SIM	0.5
Benzo(a)pyrene	EPA 8270D SIM	0.5
Benzo(b)fluoranthene	EPA 8270D SIM	0.5
Benzo(e)pyrene	EPA 8270D SIM	0.5
Benzo(g,h,i)perylene	EPA 8270D SIM	0.5
Benzo(k)fluoranthene	EPA 8270D SIM	0.5
Chrysene	EPA 8270D SIM	0.5
Dibenzo(a,h)anthracene	EPA 8270D SIM	0.5
Fluoranthene	EPA 8270D SIM	0.5
Fluorene	EPA 8270D SIM	0.5
Indeno(1,2,3-c,d)pyrene	EPA 8270D SIM	0.5
Naphthalene	EPA 8270D SIM	0.5
Perylene	EPA 8270D SIM	0.5
Phenanthrene	EPA 8270D SIM	0.5
Pyrene	EPA 8270D SIM	0.5
Dioxin/Furans (ng/kg)		
Dioxins		
2,3,7,8-TCDD	EPA 1613B	0.5
1,2,3,7,8-PeCDD	EPA 1613B	2.5
1,2,3,4,7,8-HxCDD	EPA 1613B	2.5
1,2,3,6,7,8-HxCDD	EPA 1613B	2.5
1,2,3,7,8,9-HxCDD	EPA 1613B	2.5
1,2,3,4,6,7,8-HpCDD	EPA 1613B	2.5
OCDD	EPA 1613B	5
Furans		
2,3,7,8-TCDF	EPA 1613B	0.5
1,2,3,7,8-PeCDF	EPA 1613B	2.5
2,3,4,7,8,-PeCDF	EPA 1613B	2.5
1,2,3,4,7,8-HxCDF	EPA 1613B	2.5
1,2,3,6,7,8-HxCDF	EPA 1613B	2.5
1,2,3,7,8,9-HxCDF	EPA 1613B	2.5
2,3,4,6,7,8-HxCDF	EPA 1613B	2.5
1,2,3,4,6,7,8-HpCDF	EPA 1613B	2.5
1,2,3,4,7,8,9-HpCDF	EPA 1613B	2.5
OCDF	EPA 1613B	5
Porewater Conventionals (mg/L)		
DGT Sulfide	AVS EPA 1991	TBD

Notes:

%: percent

µg/kg: microgram per kilogram

DGT: diffusive gradients in thin films technique

mg/L: milligram per liter

NA: not applicable

ng/kg: nanogram per kilogram

piC/g dw: picocurie per gram dry weight

Table 4

Parameters for Analysis, Methods, and Target Quantitation Limits in Solid-phase Microextraction Fibers

Parameter	Method	Target Reporting Limit
Polycyclic aromatic hydrocarbons (ng/fiber)		
2-Methylnaphthalene	HRPAH/MMCARB429	2
Acenaphthene	HRPAH/MMCARB429	2
Acenaphthylene	HRPAH/MMCARB429	2
Anthracene	HRPAH/MMCARB429	2
Benzo(a)anthracene	HRPAH/MMCARB429	2
Benzo(a)pyrene	HRPAH/MMCARB429	2
Benzo(b)fluoranthene	HRPAH/MMCARB429	2
Benzo(e)pyrene	HRPAH/MMCARB429	2
Benzo(g,h,i)perylene	HRPAH/MMCARB429	2
Benzo(k)fluoranthene	HRPAH/MMCARB429	2
Chrysene	HRPAH/MMCARB429	2
Dibenzo(a,h)anthracene	HRPAH/MMCARB429	2
Fluoranthene	HRPAH/MMCARB429	2
Fluorene	HRPAH/MMCARB429	2
Indeno(1,2,3-c,d)pyrene	HRPAH/MMCARB429	2
Naphthalene	HRPAH/MMCARB429	2
Perylene	HRPAH/MMCARB429	2
Phenanthrene	HRPAH/MMCARB429	2
Pyrene	HRPAH/MMCARB429	2
Dioxin/Furans (ng/fiber)		
Dioxins		
2,3,7,8-TCDD	EPA 1613B	0.5
1,2,3,7,8-PeCDD	EPA 1613B	2.5
1,2,3,4,7,8-HxCDD	EPA 1613B	2.5
1,2,3,6,7,8-HxCDD	EPA 1613B	2.5
1,2,3,7,8,9-HxCDD	EPA 1613B	2.5
1,2,3,4,6,7,8-HpCDD	EPA 1613B	2.5
OCDD	EPA 1613B	5
Furans		
2,3,7,8-TCDF	EPA 1613B	0.5
1,2,3,7,8-PeCDF	EPA 1613B	2.5
2,3,4,7,8,-PeCDF	EPA 1613B	2.5
1,2,3,4,7,8-HxCDF	EPA 1613B	2.5
1,2,3,6,7,8-HxCDF	EPA 1613B	2.5
1,2,3,7,8,9-HxCDF	EPA 1613B	2.5
2,3,4,6,7,8-HxCDF	EPA 1613B	2.5
1,2,3,4,6,7,8-HpCDF	EPA 1613B	2.5
1,2,3,4,7,8,9-HpCDF	EPA 1613B	2.5
OCDF	EPA 1613B	5

Notes:

HRPAH/MMCARB429: high-resolution polycyclic aromatic hydrocarbon/modified method California Air Resources Board 429

NA: not applicable

ng/fiber: nanogram per solid-phase microextraction fiber

Table 5
Guidelines for Sample Handling and Storage

Parameter	Sample Size	Container Size and Type[1]	Holding Time	Preservative
Total solids	50 g	8-oz glass	14 days	Cool/4 °C
			6 months	Freeze -18 °C
Total organic carbon	50 g	from TS/TVS container	14 days	Cool/4 °C
			6 months	Freeze -18 °C
Total volatile solids/ loss on ignition	100 g	8-oz glass	14 days	Cool/4 °C
			6 months	Freeze -18 °C
Grain size	150 g	16-oz HDPE	6 months	Cool/4 °C
Black carbon	10 g	4-oz glass	14 days	Cool/4 °C, store in dark
Cesium-137	100 g	4-oz glass or HDPE	6 months	Ambient
Lead-210				
Polycyclic aromatic hydrocarbons	150 g	8-oz glass	14 days until extraction	Cool/4 °C
			1 year until extraction	Freeze -18°C
			40 days after extraction	Cool/4 °C
Dioxin/furans	150 g	8-oz amber glass	None	Cool/4 °C
DGT sediment	NA	DGT apparatus	7 days	Cool/4 °C
Polycyclic aromatic hydrocarbons by solid-phase microextraction	450 g	16-oz glass	Porewater extraction in 28 days; 24 hours to extraction after flocculation	Cool/4 °C
			1 year until extraction	Freeze -18°C
			40 days after extraction	Cool/4 °C
Dioxin/furans by solid-phase microextraction	450 g	16-oz glass	None	Cool/4 °C
			None	Freeze -18°C
			40 days after extraction	Cool/4 °C

Notes:

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

DGT: diffusive gradients in thin films technique

g: gram

HDPE: high-density polyethylene

NA: not applicable

oz: ounce

TS: total solids

TVS: total volatile solids

Table 6

Laboratory Quality Assurance/Quality Control Analysis Summary

Analysis Type	Initial Calibration	Ongoing Calibration	Replicates	Matrix Spikes	LCS/Blank Spike	Matrix Spike Duplicates	Method Blanks	Surrogate Spikes
Total solids	Daily or each batch[1]	NA	1 per 20 samples	NA	NA	NA	NA	NA
Total organic carbon	Daily or each batch	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	Each batch	NA
Grain size	Daily or each batch[1]	NA	1 per 20 samples	NA	NA	NA	NA	NA
Black carbon	Daily or each batch	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	Each batch	NA
Radioisotopes	Daily or each batch	NA	NA	1 per 20 samples	1 per 20 samples	1 per 20 samples	Each batch	NA
Polycyclic aromatic hydrocarbons	As needed[3]	Every 12 hours	NA	1 per 20 samples	1 per 20 samples	1 per 20 samples	Each batch	Each sample
Dioxin/furans	As needed[3]	Every 12 hours	1 per 20 samples	NA[4]	1 per 20 samples	NA[4]	Each batch	Each sample
DGT sulfide	Daily or each batch	1 per 10 samples	NA	NA	NA	NA	Each batch	NA
Solid-phase microextraction	As needed[3]	Every 12 hours	NA	NA[4]	1 per 20 samples	NA[4]	Each batch	Each sample

Notes:

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

2. A matrix spike duplicate may be analyzed in lieu of a sample replicate.

3. Initial calibrations are considered valid until the ongoing continuing calibration no longer meets method specifications. At that point, a new initial calibration is performed.

4. Isotope dilution required by the method.

LCS: laboratory control sample

NA: not applicable

Table 7
Data Quality Objectives

Parameter	Precision (Percentage)	Accuracy[1] (Percentage)	Completeness (Percentage)
Total organic carbon	± 30 RPD	75 – 125 R	95
Total solids	± 20 RPD	NA	95
Grain size	± 20 RPD	NA	95
Black carbon	± 30 RPD	75 – 125 R	95
Radioisotopes	± 35 RPD	70 – 130 R	95
Polycyclic aromatic hydrocarbons	± 35 RPD	50 – 150 R	95
Dioxin/furans	± 35 RPD	50 – 150 R	95
Solid-phase microextraction	± 35 RPD	50 – 150 R	95

Notes:

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

NA: not applicable

R: recovery

RPD: relative percent difference

Figures

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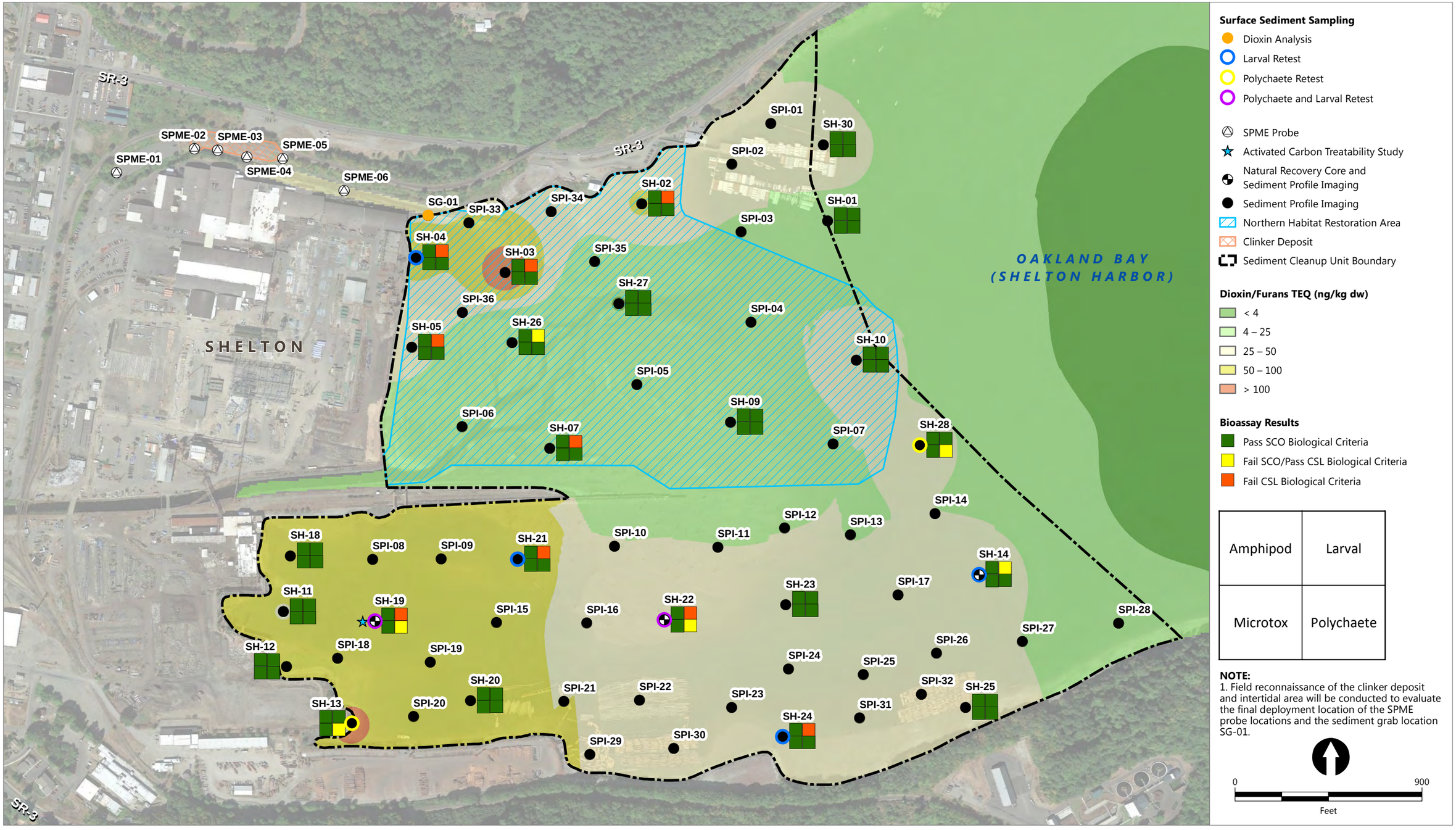
ANCHOR QEA

Figure 1
Vicinity Map
Sampling and Quality Assurance Project Plan
Shelton Harbor Sediment Cleanup Unit



Surface Sediment Sampling

- Dioxin Analysis
- Larval Retest
- Polychaete Retest
- Polychaete and Larval Retest
- SPME Probe
- Activated Carbon Treatability Study
- Natural Recovery Core and Sediment Profile Imaging
- Sediment Profile Imaging
- Northern Habitat Restoration Area
- Clinker Deposit
- Sediment Cleanup Unit Boundary

Dioxin/Furans TEQ (ng/kg dw)

- < 4
- 4 – 25
- 25 – 50
- 50 – 100
- > 100

Bioassay Results

- Pass SCO Biological Criteria
- Fail SCO/Pass CSL Biological Criteria
- Fail CSL Biological Criteria

Amphipod	Larval
Microtox	Polychaete

NOTE:
1. Field reconnaissance of the clinker deposit and intertidal area will be conducted to evaluate the final deployment location of the SPME probe locations and the sediment grab location SG-01.

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Feet

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ANCHOR QEA

Figure 2
Proposed RI/FS Sampling Locations
Sampling and Quality Assurance Project Plan
Shelton Harbor Sediment Cleanup Unit

Attachment 1
Health and Safety Plan

July 2017
Shelton Harbor Sediment Cleanup Unit
Oakland Bay and Selton Harbor Sediments Cleanup Site (Cleanup ID 13007)

ANCHOR QEA

Health and Safety Plan

Prepared for Simpson Timber Company and the Washington State Department of Ecology

July 2017
Shelton Harbor Sediment Cleanup Unit
Oakland Bay and Shelton Harbor Sediments Cleanup Site (Cleanup Site ID 13007)

Health and Safety Plan

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Certification Page

Clay Patmont

Project Manager

Anchor QEA, LLC

Date: July 7, 2017

Nathan Soccorsy

Field Lead

Anchor QEA, LLC

Date: July 7, 2017

The information in this Health and Safety Plan has been designed for the Work Plan presently contemplated by Anchor QEA, LLC (Anchor QEA). Therefore, this document may not be appropriate if the work is not performed by or using the methods presently contemplated by Anchor QEA. In addition, as the work is performed, conditions different from those anticipated may be encountered and this document may have to be modified. Therefore, Anchor QEA only intends this plan to address currently anticipated activities and conditions and makes no representations or warranties as to the adequacy of the Health and Safety Plan for all conditions encountered.

Health and Safety Plan Acknowledgement Form

Project Number: 110008-01.01

Project Name: Shelton Harbor Sediment Cleanup Unit

My signature below certifies that I have read and understand the policies and procedures specified in this Health and Safety Plan (HASP). For non-Anchor QEA employees, this HASP may include company-specific appendices to this plan developed by entities other than Anchor QEA. Non-affiliated personnel may be required to sign the Liability Waiver following this Acknowledgement Form.

Date	Name (print)	Signature	Company

Date	Name (print)	Signature	Company

Liability Waiver

Release from Liability, Waiver of Claims, and Indemnification

This liability release, waiver, and indemnification is required for participation in our field trips and site tours. Each participant must sign his/her own form.

In return for receiving permission from **Anchor QEA, LLC** (**"Anchor QEA"**), a Washington State Limited Liability Company, to participate in the field trip that is to take place at _____ (location) on _____ (date) (collectively, the **"Activities"**), the undersigned participant (**"Participant"**), acting through and/or with the consent of his/her parent or legal guardian (if Participant is a minor or the subject of a guardianship), hereby agrees as follows:

1. I fully recognize the dangers of participating in the Activities, and I voluntarily assume all risks associated with my participation in the Activities. I understand that the dangers that I may encounter at the site(s) where the Activities take place (in each case, a **"Site"**) include, by way of example only and without limitation: exposure to contaminants; exposure to aerosol vapors; wild animals, poisonous snakes, and harmful insects; poisonous vegetation; drowning, sea sickness, and boating accidents; falling from steep slopes, cliffs, or narrow trails; landslides; rough terrain; lightning; wildfire; extremes of temperatures; and storms. I realize that there is also a risk of my becoming seriously ill or injured in an area remote from medical care and that Anchor QEA cannot guarantee the availability of emergency medical services or emergency transportation to medical facilities.
2. I agree that neither Anchor QEA nor any of its agents, representatives, partners, contractors, consultants, or employees: (a) shall have any liability for any defect or dangerous natural or artificial condition relating to any Site or any of the Activities; or (b) have made or are making any representation or warranty, expressed or implied, regarding: (i) the conditions of any Site; (ii) the safety of the Activities or any of the equipment to be used in connection with the Activities; (iii) any means of transportation to or from any Site; or (iv) any other aspect of any Site or any of the Activities.
3. I agree to take the responsibility to familiarize myself with the rules and regulations applicable to the Sites and the Activities, and to ensure that I have been properly instructed in and understand the use of any equipment I am to use in the Activities. I realize that my participation in the Activities may require sustained strenuous physical activity. I am in good health, and am not aware of any physical or medical condition that might endanger myself or other participants in the Activities.
4. Acting for myself and my heirs, executors, personal representatives, and assigns, I forever release and discharge Anchor QEA and its agents, representatives, partners, contractors, consultants, or employees, and the successors and assigns of each of them (in each case, a **"Released Party"**), of and from all claims, losses, damages, costs, expenses, and other liabilities, including (but not

limited to) reasonable attorneys' fees (in each case, a **"Claim"**), whether known or unknown, foreseen or unforeseen, relating to property damage or the death, injury, pain, or mental trauma of myself or any other person, and resulting, directly or indirectly, from my participation in the Activities or my travel to or from any Site. Without limiting the above, I agree not to sue any of the Released Parties for any such Claims, to waive any such Claims that I may have at any time against any of the Released Parties, and to indemnify and defend each of the Released Parties against, and to hold each of the Released Parties harmless of and from any Claims resulting from my acts or omissions during the Activities or while at any Site.

5. I have read and understand the policies and procedures specified in the Health and Safety Plan (HASP) for this Site. This HASP may include company-specific appendices developed by entities other than Anchor QEA.

The undersigned Participant acknowledges and agrees that he/she has carefully read this Release from Liability, Waiver of Claims, and Indemnification and fully understands all of its contents, and their legal effect, and agrees that this Release from Liability, Waiver of Claims, and Indemnification (of which I have been given a copy to keep, with any attachments) is contractually binding, and is being signed by the undersigned Participant of his/her own free will.

Signature: _____ Date: _____

Printed Name: _____ Email: _____

Street Address: _____

(street address — no PO Boxes)

City: _____ State: _____ Zip: _____

Phone Number: _____

Emergency Contact Name: _____

Emergency Contact's Phone Number: _____

Consent and Release for Publications of Photographs

I, the undersigned, hereby grant Anchor QEA permission to take photographs of me, and irrevocably consent to and authorize the use and reproduction by Anchor QEA, or anyone duly authorized by Anchor QEA, of any and all such photographs, for any legitimate purposes, including for advertising, trade, and editorial purposes, at any time in the future in all media now known or hereafter developed, throughout the world. I also consent to the use of my name in connection with such photographs.

I hereby release, indemnify, and hold harmless Anchor QEA and its agents, representatives, partners, contractors, consultants, or employees from any and all claims that may result at any time by reason of

the use of my image and name, including, without limitation, claims of privacy. My heirs, executors, administrators, and assigns shall be bound by this consent and release. I am over the age of 18 years.

Signature: _____ Date: _____

Printed Name: _____

Consent and Signature of Parent or Guardian

(if Participant is under 18 years of age or the subject of a guardianship)

As the parent or guardian of _____ , the Participant described in the foregoing Release from Liability, Waiver of Claims, and Indemnification with respect to taking part in the Activities which are described above, I hereby acknowledge that I have read and understood such Release from Liability, Waiver of Claims, and Indemnification, and Consent and Release for Publications of Photographs, and I hereby agree, individually and on behalf of my child or ward, to all of the terms of such Release from Liability, Waiver of Claims, and Indemnification, and Consent and Release for Publications of Photographs; and hereby give my permission to my child or ward to participate in such Activities.

Signature: _____ Date: _____

Printed Name: _____ Email: _____

Street Address: _____

(street address — no PO Boxes)

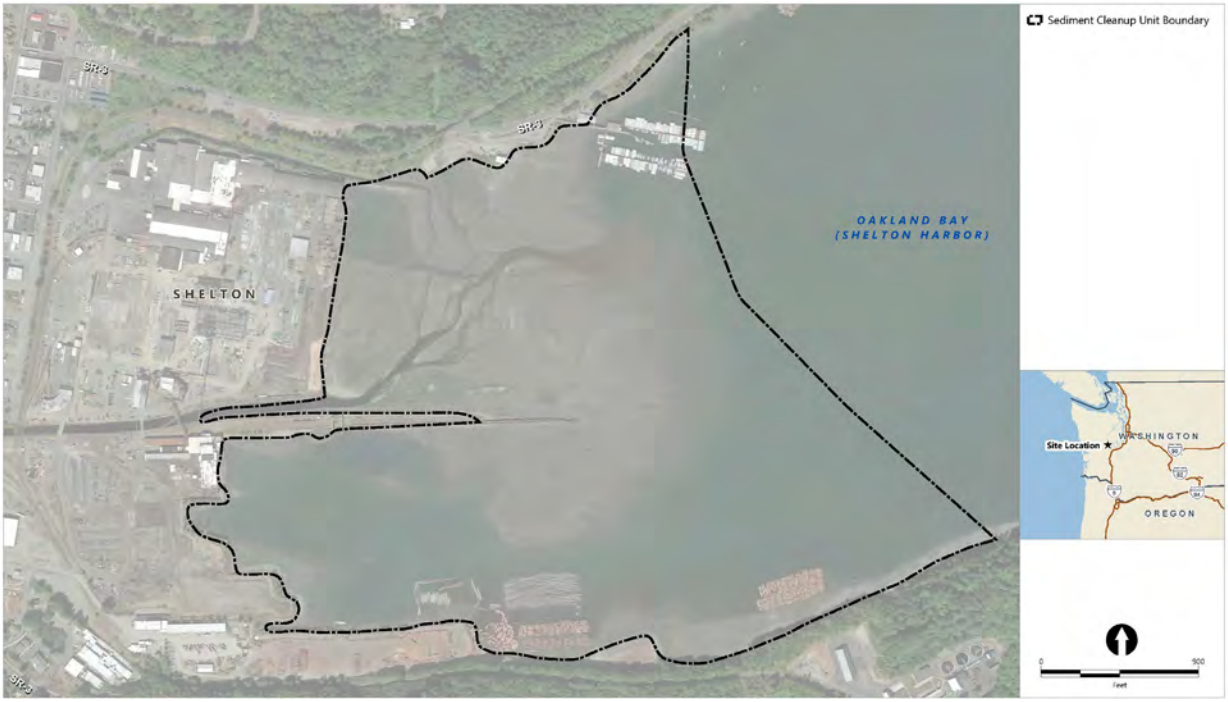
City: _____ State: _____ Zip: _____

Phone Number: _____

Site Emergency Procedures

Site Map

Figure A
General Site Location Overview



Emergency Contact Information

Table A
Site Emergency Form and Emergency Phone Numbers*

Category	Information
Possible Chemicals of Concern	Dioxin/furans and carcinogenic polycyclic aromatic hydrocarbons (cPAHs)
Minimum Level of Protection	Modified Level D
Site(s) Location Address	Former Simpson Timber Mill Site
Emergency Phone Numbers	
Ambulance	911
Fire	911
Police	911
Poison Control	(800) 222-1222

Category	Information	
Client Contact	Dave McEntee	Office: (253) 779-6405 Cell: (253) 280-1187
Project Manager (PM)	Clay Patmont	Office: (206) 903-3324 Cell: (206) 300-1543
Field Lead (FL)	Nathan Soccorsy	Office: (206) 903-3385 Cell: (480) 272-2805
Corporate Health and Safety Manager (CHSM)	David Templeton	Office: (206) 287-9130 Cell: (206) 910-4279
State Emergency Response System	1-800-258-5990	
EPA Emergency Response Team,[1] Region 10	1-201-321-6600	

Notes:

* In the event of any emergency, contact the PM and FL.

1. For local resources, please visit: http://www2.epa.gov/emergency-response/emergency-response-my-community. The National Response Center hotline is 1-800-424-8802.

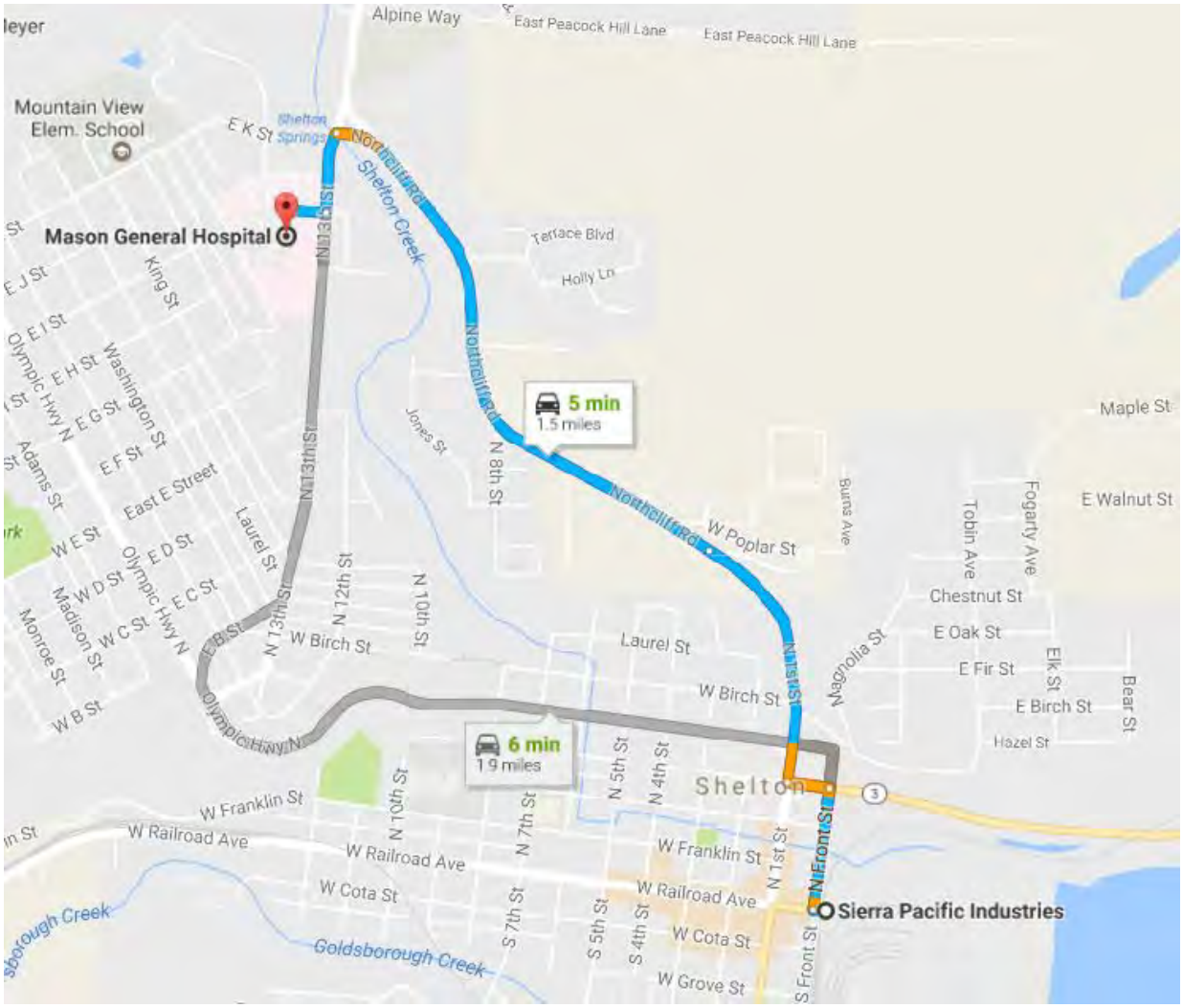
Table B
Hospital Information

Category	Information
Hospital Name	Mason General Hospital
Address	901 Mountain View Drive
City, State	Shelton, Washington
Phone	(360) 426-1611
Emergency Phone	911

Hospital Route Map and Driving Directions

1. Leaving the site, turn right onto North Front Street and continue for 0.2 mile.
2. Turn left onto East Pine Street and continue for 302 feet.
3. Turn right at the first cross street onto North 1st Street and continue for 0.4 mile.
4. Continue straight onto Northcliff Road for 0.8 mile.
5. Turn left onto North 13th Street and continue for 0.1 mile.
6. Turn right onto North 13th Loop Road; the hospital is on your right.

Figure B
Hospital Route Map



WorkCare Incident Intervention

Anchor QEA has an additional Incident Intervention resource from WorkCare to help answer questions, alleviate uncertainty and stress in a potential injury situation, and maintain the health and safety of our employees. Incident Intervention is an injury and illness management tool that provides employees with 24 hours a day/7 days a week (24/7) immediate telephone access to a member of WorkCare's clinical staff of nurses and physicians who intervene at the time of a workplace injury or illness. Contact information is provided below:

- **Access WorkCare 24/7 from anywhere using the toll-free number: 1-888-449-7787**

At the time of a workplace injury or illness, the employee, manager or another employee at the scene notifies WorkCare using the toll-free number listed above. The caller provides information on the type of incident, possible cause, and the scope of the situation. With the details of the incident recorded, an experienced nurse or physician provides the following:

- Responsive evaluation of the incident
- Direction on the appropriate course of action
- Consultation with the employee's treating physician to design a quality care treatment plan that meets the needs of the employee and Anchor QEA

All employees are encouraged to use this service should a workplace injury or illness occur.

Key Safety Personnel

The following people share responsibility for health and safety at the site. See Section 4 of this Health and Safety Plan (HASP) for a description of the role and responsibility of each.

Client Contact: Dave McEntee	Office: (253) 779-6405 Cell: (253) 906-1187
Project Manager (PM): Clay Patmont	Office: (206) 903-3324 Cell: (206) 300-1543
Field Lead (FL): Nathan Soccorsy	Office: (206) 903-3385 Cell: (480) 272-2805
Corporate Health and Safety Manager (CHSM): David Templeton	Office: (206) 287-9130 Cell: (206) 910-4279

Emergency Response Procedures

In the event of an emergency, immediate action must be taken by the first person to recognize the event. Use the following steps as a guideline:

- Survey the situation to ensure that it is safe for you and the victim. Do not endanger your own life. Do not enter an area to rescue someone who has been overcome unless properly equipped and trained. Ensure that all protocols are followed. If applicable, review Safety Data Sheets (SDS) to evaluate response actions for chemical exposures.
- Call the appropriate emergency number (911, if available) or direct someone else to do this immediately (see Table A). Explain the physical injury, chemical exposure, fire, or release and location of the incident.
- Have someone retrieve the nearest first aid kit (containing appropriate items for the particular work scope) and Automated External Defibrillator (AED), if available. Note: Only use an AED if you have been properly trained and are currently certified to do so.
- Decontaminate the victim without delaying life-saving procedures (see Section 8).

- Administer first aid and cardiopulmonary resuscitation (CPR), if properly trained, until emergency responders arrive.
- Notify the Project Manager (PM), Field Lead (FL), and owner.
- Complete the appropriate incident investigation reports.
- In the event that evacuation is required, the FL must perform a head count to verify that all Anchor QEA personnel are accounted for.

First Aid and CPR Guidelines

Personnel qualified and currently certified in basic first aid and/or CPR procedures may perform these procedures as necessary. Personnel qualified and currently certified in basic first aid and/or CPR are protected under Good Samaritan policies as long as they only perform the basic tasks that they were taught. Do not perform first aid and/or CPR tasks if you have not been trained in first aid and/or CPR.

Injury Management/Incident Notification

Observe the following injury management/incident notification procedures and practices:

Injury Management

- Once a personal injury incident is discovered, the first action will be to ensure that the injured party receives appropriate medical attention.
- If it is safe to do so, the nearest site personnel will immediately assist a person who shows signs of medical distress or who is involved in an accident.
- Call 911 or the appropriate emergency number and render first aid as soon as possible.
- Escort the injured person to the occupational clinic or hospital or arrange for an ambulance.
- Proceed immediately to Notification Requirements, below.

Notification Requirements

- Directly after caring for an injured person, summon the FL. The FL will immediately contact the PM or other designated individual to alert them of the medical emergency. The FL will advise them of the following:
  - Location of the victim at the work site
  - Nature of the emergency
  - Whether the victim is conscious
  - Specific conditions contributing to the injury, if known
- Contact the PM (if not contacted previously) and owner immediately.
- The PM will contact upper line management, including the Corporate Health and Safety Manager (CHSM).
- The CHSM will facilitate the incident investigation.

All client requirements pertinent to personal injury incident reporting will also be adhered to.

Incident Other Than Personal Injury

All incidents including, but not limited to, fire, explosion, property damage, or environmental release will be responded to in accordance with the site-specific HASP. In general, this includes securing the site appropriate to the incident, turning control over to the emergency responders, or securing the site and summoning appropriate remedial personnel or equipment. Anchor QEA will immediately notify the client of any major incident, fire, equipment or property damage, or environmental incident with a preliminary report. A full report will be provided within 72 hours.

Near-miss Reporting

All near-miss incidents (i.e., those that could have reasonably led to an injury, environmental release, or other incident) must be reported to the FL and/or PM immediately so action can be taken to ensure that such conditions that led to the near-miss incident are readily corrected in order to prevent future occurrences.

Spills and Releases of Hazardous Materials

When required, notify the National Response Center and local state agencies. The following information should be provided to the National Response Center:

- Name and telephone number
- Name and address of facility
- Time and type of incident
- Name and quantity of materials involved, if known
- Extent of injuries
- Possible hazards to human health or the environment outside of the facility

The emergency telephone number for the National Response Center is 1-800-424-8802. If hazardous waste is released or produced through control of the incident, ensure that:

- Waste is collected and contained
- Containers of waste are removed or isolated from the immediate site of the emergency
- Treatment or storage of the recovered waste, contaminated soil or surface water, or any other material that results from the incident or its control is provided
- No waste that is incompatible with released material is treated or stored in the facility until cleanup procedures are completed

Ensure that all emergency equipment used is decontaminated, recharged, and fit for its intended use before operations are resumed.

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APPENDICES

ABBREVIATIONS

° C	degrees Celsius
° F	degrees Fahrenheit
ACGIH	American Conference of Governmental Industrial Hygienists
AED	Automated External Defibrillator
ANSI	American National Standards Institute
APR	Air-Purifying Respirator
ASTM	ASTM International
CFR	Code of Federal Regulations
CHSM	Corporate Health and Safety Manager
City	City of Shelton
COC	chemical of concern
CPR	Cardiopulmonary resuscitation
CRZ	Contamination Reduction Zone
dbA	A-weighted decibel
dB	decibel
DPT	Direct Push Technology
EPA	U.S. Environmental Protection Agency
eV	electron volts
EZ	Exclusion Zone/Hot Zone
FL	Field Lead
GFCI	Ground-fault Circuit Interrupter
HASP	Health and Safety Plan
HAZMAT	Hazardous Materials
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	High Efficiency Particulate Air
HMIS	Hazardous Material Information System
IP	Ionization Potential
JSA	Job Safety Analysis
kV	kilovolts
LEL	Lower Explosive Limit
mg/m^3	milligrams per cubic meter
MHR	Maximum Heart Rate
MLLW	mean lower low water
NEC	National Electrical Code
NFPA	National Fire Protection Association
NIOSH	National Institute for Occupational Safety and Health
NPL	National Priority List
NRR	Noise Reduction Rating
O_2	oxygen

OEL	Occupational Exposure Limit
OSHA	Occupational Safety and Health Act or Administration
OVM	Organic Vapor Monitor
PAHs	polycyclic aromatic hydrocarbon
PEL	Permissible Exposure Limit
PFD	personal flotation device
PID	Photoionization Detector
PM	Project Manager
Port	Port of Shelton
PPE	Personal Protective Equipment
ppm	parts per million
PVC	Polyvinyl Chloride
QLFT	Qualitative Fit Test
REL	Recommended Exposure Limits
RCRA	Resource Conservation and Recovery Act
SDS	Safety Data Sheets
Simpson	Simpson Timber Company
STEL	Short Term Exposure Limit
SZ	Support Zone/Clean Zone
TLV	Threshold Limit Value
TSD	Treatment, Storage, and Disposal Facility
TWA	time-weighted average
TWIC	Transportation Worker Identification Credential
USCG	U.S. Coast Guard
VOC	Volatile Organic Compound
WBGT	Wet Bulb Globe Temperature

1 Introduction

This Health and Safety Plan (HASP) was prepared on behalf of Simpson Timber Company (Simpson) and presents health and safety requirements and procedures that will be followed by Anchor QEA, LLC, personnel and at a minimum by Anchor QEA subcontractors during work activities at Shelton Harbor Sediment Cleanup Unit at the Former Simpson Timber Mill Site (the site). This HASP was developed in accordance with Title 29 of the Code of Federal Regulations (CFR), Part 1910.120(b), and will be used in conjunction with Anchor QEA's Corporate Health and Safety Program. See Section 1.1 for HASP modification procedures.

The provisions of this HASP are mandatory for all Anchor QEA personnel assigned to the project. A copy of this HASP must be maintained on site and available for employee review at all times. Anchor QEA subcontractors are also expected to follow the provisions of this HASP unless they have their own HASP that covers their specific activities related to this project. Any subcontractor HASPs must include the requirements set forth in this HASP, at a minimum. All visitors to the work site must also abide by the requirements of this HASP and will attend a pre-work briefing where the contents of this HASP will be presented and discussed.

Personnel assigned to work at the project site will be required to read this plan and must sign the Health and Safety Plan Acknowledgement Form to confirm that they understand and agree to abide by the provisions of this HASP.

Subcontractors are ultimately responsible for the health and safety of their employees. Subcontractors may mandate health and safety protection measures for their employees beyond the minimum requirements specified in this HASP.

The objectives of this HASP are to identify potential physical, chemical, and biological hazards associated with field activities; establish safe working conditions and protective measures to control those hazards; define emergency procedures; and describe the responsibilities, training requirements, and medical monitoring requirements for site personnel.

This HASP prescribes the procedures that must be followed during specific site activities. Significant operational changes that could affect the health and safety of personnel, the community, or the environment will not be made without the prior approval of the Project Manager (PM) and the Corporate Health and Safety Manager (CHSM).

Issuance of this approved HASP documents that the workplace has been evaluated for hazards. A hazard assessment was performed, and the adequacy of the personal protective equipment (PPE) selected was evaluated as required by 29 CFR 1910.132(d) – Personal Protective Equipment, General Requirements (General Industry); 29 CFR 1910.134 – Respiratory Protection; 29 CFR 1926.28 – Personal Protective Equipment (Construction Industry); and 29 CFR 1926.55 – Gases, Vapors, Fumes,

Dusts and Mist, and is duly noted by the signature(s) and date appearing on the certification page of this document.

1.1 Health and Safety Plan Modifications

This HASP will be modified by amendment, if necessary, to address changing field conditions or additional work tasks not already described in this document. Modifications will be proposed by the Field Lead (FL) using the Modification to Health and Safety Plan form included in Appendix A. Modifications will be reviewed by the CHSM or authorized representative and approved by the PM.

2 Site Description and Background Information

2.1 Site Description

The site is located in south Mason County, Washington. It is bounded to the west by Oakland Bay and to the north, south, and east by the City of Shelton (City). Simpson's operations along the western portion of the site included saw mills, log rafting, machine shops, and power plant operations. Rayonier operated a pulp and paper mill along the south end of the site until the 1960s, when Manke Lumber Company purchased the land to use as a log sorting yard. The northeast corner of the site is owned by the City and the Port of Shelton (Port). The City leases its land to the Port to operate the Shelton Yacht Club and Marina.

2.2 Site Background Information

Simpson has operated in Shelton Harbor since the mid-1800s. In 1926, a wood-fired power plant was built to supply power to the sawmills south of Goldsborough Creek. From 1938 to 1963, this power plant was jointly owned and operated by Simpson and Rayonier. Through the early 1930s, three sawmills operated along the Shelton waterfront and a shingle mill operated at Eagle Point. By the 1940s, Simpson acquired sawmills and the shingle mill, redeveloped the Shelton waterfront to build a combined sawmill and plywood/fiberboard manufacturing facility, an insulating board plant, plywood plant, railroad roundhouse, and machine shops, as well as a railroad log dump. From the 1950s to the early 1960s, Simpson further expanded the facility on the north side of Goldsborough Creek, building planing mills, dry kilns, and other facilities.

Rayonier operated a pulp and paper sulfite mill on the south side of Shelton Harbor from 1926 to 1957. The mill produced pulp for manufacturing rayon and other specialty cellulose products, with limited paper pulp production (Herrera 2008). The mill processes included pulp production (cooking), bleaching, screening, washing, and drying. Pulp was produced from wood chips supplied by Shelton sawmills or brought in by trucks or barges. The Manke Lumber Company purchased the pulp mill property from Rayonier in the 1960s and converted it into a sorting yard for logs brought in by trucks, which were then shipped out in rafts to Tacoma for processing.

The Shelton Yacht Club and Marina, owned by the Port, and the City jointly own the northeast corner of the site. The City operated at the northeast corner of the Shelton Harbor Sediment Cleanup Unit since 1974. A former marine railway in this area was used to haul boats out of the water for maintenance and repair activities. A remedial investigation of the area was completed in 2005, including characterization of metal, tributyltin, total petroleum hydrocarbon, and polycyclic aromatic hydrocarbon (PAH) concentrations in surface sediment within this area (Farralon and Anchor 2005).

3 Scope of Work

This plan addresses health and safety issues associated with the following field tasks:

- Surface and subsurface sediment sampling
- Sediment profile imaging
- In situ passive sampler deployment and retrieval
- Equipment decontamination

4 Authority and Responsibilities of Key Personnel

This section describes the authority and responsibilities of key Anchor QEA project personnel. The names and contact information for the following key safety personnel are listed in the Emergency Site Procedures section at the beginning of this HASP. Should key site personnel change during the course of the project, a new list will be established and posted immediately at the site. The emergency phone number for the site is **911** and should be used for all medical, fire, and police emergencies.

4.1 Project Manager

The PM provides overall direction for the project. The PM is responsible for ensuring that the project meets the client's objectives in a safe and timely manner. The PM is responsible for providing qualified staff for the project and adequate resources and budget for the health and safety staff to carry out their responsibilities during the field work. The PM will be in regular contact with the FL and CHSM to ensure that appropriate health and safety procedures are implemented into each project task.

The PM has authority to direct response operations; the PM assumes total control over project activities but may assign responsibility for aspects of the project to others. In addition, the PM performs the following tasks:

- Oversees the preparation and organization of background review of the project, the Work Plan, and the field team
- Ensures that the team obtains permission for site access and coordinates activities with appropriate officials
- Briefs the FL and field personnel on specific assignments
- Together with the FL, sees that health and safety requirements are met
- Consults with the CHSM regarding unsafe conditions, incidents, or changes in site conditions or the Sampling and Analysis Plan

4.2 Field Lead

The FL reports to the PM, has authority to direct response operations, and assumes control over on-site activities. The FL will direct field activities, will coordinate the technical and health and safety components of the field program, and is responsible in general for enforcing this site-specific HASP and Corporate Health and Safety Program requirements. The FL will be the primary point of contact for all field personnel and visitors and has direct responsibility for implementation and administration of this HASP. The FL and any other member of the field team have **STOP WORK AUTHORITY**—the authority to stop or suspend work in the event of an emergency, if conditions arise that pose an unacceptable health and safety risk to the field team or environment, or if

conditions arise that warrant modifications to this HASP. It is critical that both the FL and PM communicate regularly to proactively identify and address any safety-related concerns that may arise. The following include, but are not necessarily limited to, the functions of the FL related to this HASP:

- Conduct and document daily safety meetings, or designate an alternate FL in his or her absence.
- Execute the Work Plan and schedule.
- Conduct periodic field health and safety inspections to ensure compliance with this HASP.
- Oversee implementation of safety procedures.
- Implement site personnel protection levels.
- Enforce site control measures to help ensure that only authorized personnel are allowed on site.
- Notify, when necessary, local public emergency officials (all personnel on site may conduct this task as needed).
- Follow-up on incident reports to the PM.
- Periodically inspect protective clothing and equipment for adequacy and safety compliance.
- Ensure that protective clothing and equipment are properly stored and maintained.
- Perform or oversee air monitoring (if required) in accordance with this HASP.
- Maintain and oversee operation of monitoring equipment and interpretation of data from the monitoring equipment.
- Monitor site personnel for signs of stress, including heat stress, overexertion, cold exposure, and fatigue.
- Require participants to use the "buddy" system in performing tasks.
- Provide (via implementation of this HASP) emergency procedures, evacuation routes, and telephone numbers for the local hospital, poison control center, fire department, and police department.
- Communicate incidents promptly to the PM.
- Maintain communication with the CHSM on-site activities.
- If applicable, ensure that decontamination and disposal procedures are followed.
- Maintain the availability of required safety equipment.
- Advise appropriate health services and medical personnel of potential exposures.
- Notify emergency response personnel in the event of an emergency and coordinate emergency medical care.

The FL will record health-and-safety-related details of the project in the field logbook. At a minimum, each day's entries must include the following information:

- Project name or location
- Names of all on-site personnel

- Level of PPE worn and any other specifics regarding PPE
- Weather conditions
- Type of field work being performed

The FL will have completed the required Occupational Safety and Health Administration (OSHA) 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training and annual updates, the 8-hour Supervisor training, medical monitoring clearance, and current first aid and cardiopulmonary resuscitation (CPR) training. Other certifications or training may be stipulated based on client or site requirements.

4.3 Corporate Health and Safety Manager

The CHSM (or designee) will be responsible for managing on-site health and safety activities and will provide support to the PM and FL on health and safety-related issues. The following are specific duties of the CHSM:

- Provide technical input into the design and implementation of this HASP.
- Advise on the potential for occupational exposure to project hazards, along with appropriate methods and/or controls to eliminate site hazards.
- Ensure that a hazard assessment has been performed and that the adequacy of the PPE selected was evaluated as required by 29 CFR 1910.132(d), 29 CFR 1910.134, 29 CFR 1926.25, and 29 CFR 1926.55, and is duly noted by the signatures and date appearing on the Certification Page of this document.
- Consult with the FL on matters relating to suspending site activities in the event of an emergency.
- Verify that all on-site Anchor QEA personnel and subcontractors have read and signed the HASP Acknowledgement Form.
- Verify that corrective actions resulting from deficiencies identified by audit and observations are implemented and effective.

The CHSM or designee will have completed the required OSHA 40-hour HAZWOPER training and annual updates as well as the 8-hour Supervisor training, and will have medical monitoring clearance. In addition, the CHSM or designee will have current training in first aid and CPR.

4.4 Project Field Team

All project field team members will attend a project-specific meeting conducted by the FL concerning safety issues and project work task review before beginning work on site. All field team members, including subcontractors, must be familiar with and comply with this HASP. The field team has the responsibility to immediately report any potentially unsafe or hazardous conditions to the FL, and all members of the field team have **STOP WORK AUTHORITY**—the authority to stop or

suspend work if conditions arise that pose an unacceptable health and safety risk to the field team or environment, or if conditions arise that warrant modifications to this HASP. It is critical that all field team members proactively communicate with the FL to identify potential unsafe conditions. The field team reports to the FL for on-site activities and is responsible for the following:

- Reviewing and maintaining a working knowledge of this HASP
- Safe completion of on-site tasks required to fulfill the Work Plan
- Compliance with the HASP
- Attendance and participation in daily safety meetings
- Notification to the FL of existing or potential safety conditions at the site
- Reporting all incidents to the FL
- Demonstrating safety and health-conscious conduct

Per OSHA 1910.120(e)(3)(i),[1] newly assigned HAZWOPER 40-hour trained field team members must have at least 3 days of field work supervised by an experienced FL (preferably an individual with HAZWOPER Supervisor training). It is the responsibility of the PM to identify such "short service" personnel and ensure that their supervised field experience occurs (or has occurred) and is documented in the project field notes and on the Daily Safety Briefing form (Appendix A).

[1] "General site workers (such as equipment operators, general laborers and supervisory personnel) engaged in hazardous substance removal or other activities which expose or potentially expose workers to hazardous substances and health hazards shall receive a minimum of 40 hours of instruction off the site, and a minimum of three days actual field experience under the direct supervision of a trained experienced supervisor."

5 Project-specific Requirements

This section provides activity-specific levels of protection and air monitoring requirements to be used on this site based on the Sampling and Analysis Plan and the chemicals of concern (COCs).

5.1 Activity-specific Level of Protection Requirements

Refer to Section 10 for general requirements for PPE. Level D is the minimum acceptable level for most sites. An upgrade to Modified Level D occurs when there is a possibility that contaminated media can come in contact with the skin or work uniform. An upgrade to Level C occurs when there is a potential for exposure to airborne COCs (i.e., if the results of air monitoring reveal that action levels have been exceeded). Hearing protection must be worn when there are high noise levels. Site personnel must maintain proficiency in the use and care of PPE that is to be worn.

Table 5-1 describes the specific means of protection needed for each identified work activity.

5.2 Project Air Monitoring Requirements

Given the expected low volatile chemical concentrations, and that the sample media will be water-saturated sediment, air monitoring is not required during this project. If evidence of contamination is discovered during sampling, work will stop and air monitoring measures will be assessed.

Table 5-1
Project Job Tasks and Required PPE

Job Tasks		PPE Requirements
• Loading and unloading sample coolers, boat equipment, and other general non-sampling activities on a boat • Operation of sampling vessel and equipment from inside boat house • Operation of sampling equipment but with no anticipated direct contact with sediments or decontamination chemicals	☒	Standard work uniform/coveralls
	☒	Work boots with safety toe conforming to ASTM International (ASTM) F2412-05/ASTM F2413-05
	☐	Traffic safety vest
	☐	Chemical-resistant clothing <u>check appropriate garments</u>: ☐ One-piece coverall ☐ Hooded one- or two-piece chemical splash suit ☐ Disposable chemical coveralls ☐ Chemical-resistant hood and apron ☐ Bib-style overalls and jacket with hood **Fabric Type**: Tyvek NOTE: Thick rain pants and coveralls may be substituted for coated Tyvek if sediments are not obviously contaminated with polycyclic aromatic hydrocarbons (PAHs) or related petroleum products. Rain slickers cannot be effectively decontaminated of tar/petroleum contamination.
	☐	Disposable inner gloves (latex or equivalent "surgical")
	☒	Disposable chemical-resistant outer gloves **Material Type**: Nitrile
	☒	Chemical-resistant boots with safety toe conforming to ASTM F2412-05/ASTM F2413-05 or disposable boot covers for safety toe/work boots **Material Type**: Rubber or leather
	☐	Puncture-resistant shanks in safety shoes conforming to ASTM F2412-05/ASTM F2413-05
	☐	Metatarsal guards conforming to ASTM F2412-05/ASTM F2413-05
	☐	Sleeves to be duct-taped over gloves and pants to be duct-taped over boots
	☐	Splash-proof safety goggles
	☒	Safety glasses
	☒	Hard hat
	☐	Hard hat with face shield
	☒	Hearing protectors (**REQUIRED** if site noise levels are greater than 85 decibels [dB] based on an 8-hour time-weighted average [TWA]). **Type**: Ear plugs
	☐	Two-way radio communication (intrinsically safe, if explosive atmosphere is a potential)
	☐	Long cotton underwear

Job Tasks		PPE Requirements
	☒	High-visibility, U.S. Coast Guard (USCG)-approved personal flotation device (PFD) (if working on any water vessel or without fall protection within 10 feet of water)
	☐	USCG-approved float coat and bib-overalls (e.g., full two-piece "Mustang" survival suit or similar) or one-piece survival suit if combined air and water temperature is below 90° F
	☐	Half-face Air-Purifying Respirator (APR) (OSHA/NIOSH-approved)
	☐	Full-face APR (OSHA/NIOSH-approved)
	☐	**Type of Cartridges to be Used**: ☐ **OV or** ☐ **OV/HEPA (if samples are dry)**
• Direct Push Sampling • Sampling and characterizing sediments • Installation and retrieval of passive samplers into soils	☒	Standard work uniform/coveralls
	☒	Work boots with safety toe conforming to ASTM F2412-05/ASTM F2413-05
	☐	Traffic safety vest
	☐	Chemical-resistant clothing <u>check appropriate garments</u>: ☐ One-piece coverall ☐ Hooded one- or two-piece chemical splash suit ☐ Disposable chemical coveralls ☐ Chemical-resistant hood and apron ☐ Bib-style overalls and jacket with hood **Fabric Type**: Tyvek NOTE: Thick rain pants and coveralls may be substituted for coated Tyvek if sediments are not obviously contaminated with PAHs or related petroleum products. Rain slickers cannot be effectively decontaminated of tar/petroleum contamination.
	☐	Disposable inner gloves (latex or equivalent "surgical")
	☒	Disposable chemical-resistant outer gloves **Material Type**: Nitrile
	☐	Chemical-resistant boots with safety toe and steel shank conforming to ASTM F2412-05/ASTM F2413-05 or disposable boot covers for safety toe/work boots **Material Type**: Rubber or leather
	☐	Puncture-resistant shanks in safety shoes conforming to ASTM F2412-05/ASTM F2413-05
	☐	Metatarsal guards conforming to ASTM F2412-05/ASTM F2413-05
	☐	Sleeves to be duct-taped over gloves and pants to be duct-taped over boots
	☒	Splash-proof safety goggles

Job Tasks		PPE Requirements
	☒	Safety glasses
	☒	Hard hat
	☐	Hard hat with face shield
	☒	Hearing protectors (**REQUIRED** if site noise levels are greater than 85 dB based on an 8-hour TWA). **Type:** Ear plugs
	☐	Two-way radio communication (intrinsically safe, if explosive atmosphere is a potential)
	☐	Long cotton underwear
	☒	High-visibility, USCG-approved PFD (if working on any water vessel or without fall protection within 10 feet of water)
	☐	USCG-approved float coat and bib-overalls (e.g., full two-piece "Mustang" survival suit or similar) or one-piece survival suit if combined air and water temperature is below 90° F
	☐	Half-face APR (OSHA/NIOSH-approved)
	☐	Full-face APR (OSHA/NIOSH-approved)
	☐	**Type of Cartridges to be Used:** ☐ **OV or** ☐ **OV/HEPA (if samples are dry)**

6 Risk Analysis and Control

The following sections discuss the potential health and safety hazards associated with the field tasks described in the Sampling and Analysis Plan. Controls of these hazards are addressed through the mechanical and physical control measures, use of PPE, monitoring, training, decontamination, emergency response, and safety procedures.

Significant changes in the Sampling and Analysis Plan covered by this HASP must be communicated to the PM and CHSM, and a modification to this HASP must be created as needed (see Section 1.1). Any task conducted beyond those identified in the Sampling and Analysis Plan and this HASP must be evaluated using the Job Safety Analysis (JSA) process prior to conducting the work.

6.1 Job Safety Analysis

Anchor QEA work tasks have been evaluated for their hazards, and JSA documents have been developed that detail the chemical, physical, and biological hazards associated with these tasks, along with the control measures (e.g., engineering controls, administrative controls, and/or PPE) that will be used to ensure that these tasks are conducted in a safe manner.

The PM and FL are responsible for identifying work tasks and project site conditions that are beyond the previously developed JSA documents and for communicating such information to the CHSM. The CHSM will provide support, as needed, to the PM and/or the FL, who will have primary responsibility to develop project-specific JSAs.

The contents of the JSA documents shall be communicated to project personnel during the site orientation meeting and during daily safety meetings when conducting work where the specific JSAs are applicable.

JSA documents applicable to this project are located in Appendix B and include the following field tasks:

- General field activities
- Sediment sampling
- General boating activities
- Decontamination activities
- Motor vehicle operation
- Sample and laboratory glassware handling
- Investigation-derived waste management

6.1.1 Augmented Job Safety Analysis Process

If significant work tasks are identified during the course of the project that were not previously addressed in the JSA documentation supplied in Appendix B, then a task-specific JSA document must

be developed at the project site prior to conducting the work. The PM and/or FL shall develop this document(s) with input from the CHSM, as needed, and this HASP will be modified to include the JSA document (see Section 1.1 for HASP modification procedures). Project personnel shall be trained on the contents of the developed task-specific JSA prior to its implementation. A copy of the task-specific JSA form used in this process is supplied in Appendix B of this HASP.

6.2 Exposure Routes

Possible routes of exposure to the chemicals potentially encountered on this project include inhalation, dermal contact, and ingestion of dust, mist, gas, vapor, or liquid. Exposure will be minimized by using safe work practices and by wearing the appropriate PPE. A further discussion of PPE requirements is presented in Section 10.

6.2.1 Inhalation

Inhalation of particulates, dust, mist, gas, or vapor during field activities is possible. Whenever possible, work activities will be oriented so that personnel are upwind of the sampling location. An organic vapor monitor (OVM) may be used to monitor ambient air and the breathing zone within the work area for organic compounds. Section 5.2 describes potential OVM action levels and response procedures.

6.2.2 Dermal Contact

Dermal contact with potentially contaminated soil, sediment, or groundwater during field activities is possible. Direct contact will be minimized by using appropriate PPE and decontamination procedures.

6.2.3 Ingestion

Direct ingestion of contaminants can occur by inhaling airborne dust, mist, or vapors, or by swallowing contaminants trapped in the upper respiratory tract. Indirect ingestion can occur by introducing the contaminants into the mouth by way of food, tobacco, fingers, or other carriers. Although ingestion of contaminants can occur, proper hygiene, decontamination, and contamination reduction procedures should reduce the probability of this route of exposure.

6.3 Chemicals of Concern Profile

Table 6-1 provides a summary profile for the COCs for this project. As available, this profile is based on recent site history and site characterization information. For more detailed and specific information, always refer to the Safety Data Sheet (SDS) or equivalent information for the chemical (see Appendix C).

Table 6-1
Chemicals of Concern Profile

Chemical	Exposure Routes	Symptoms	Target Organs	OSHA PEL	Odor Threshold (ppm)	LEL (%)	Ionization Potential (eV)
Dioxin/furan	Inhalation, skin and/or eye contact, ingestion	Irritation of eyes; allergic dermatitis, chloracne; porphyria; gastrointestinal disturbance; possible reproductive, teratogenic effects In Animals: liver, kidney damage; hemorrhage (potential occupational carcinogen)	Eyes, skin, liver, kidneys, reproductive system	None	N/A	N/A	N/A
Carcinogenic polycyclic aromatic hydrocarbons (cPAHs)	Inhalation, skin and/or eye contact, ingestion	Dermatitis, bronchitis (potential occupational carcinogen)	Respiratory system, skin, bladder, kidneys	0.2 mg/m^3	Varies	Varies	Varies

Notes:
eV: electron volts
LEL: Lower Explosive Limit
mg/m^3: milligram per cubic meter
N/A: not applicable
OSHA: Occupational Safety and Health Administration
PEL: Permissible Exposure Limit
ppm: parts per million

7 Site Control and Communications

The primary purposes for site controls are to establish the hazardous area perimeter, reduce migration of contaminants into clean areas, and prevent unauthorized access or exposure to hazardous materials by site personnel and the public. Site control is especially important in emergency situations.

7.1 General Site Control Safety Procedures

The following standard safe work practices apply to all Anchor QEA site personnel and subcontractors and shall be discussed in the safety briefing prior to initiating work on the site:

- Eating, drinking, chewing gum or tobacco, and smoking are prohibited on site except in designated areas.
- Hands and faces must be washed upon leaving the work area and before eating, drinking, chewing gum or tobacco, and smoking.
- A buddy system will be used. Radio, cell phone, or hand signals will be established to maintain communication.
- During site operations, each worker will consider himself/herself as a safety backup to his/her partner.
- Visual contact will be maintained between buddies on site when performing potentially hazardous duties.
- No personnel will be admitted to the site without the proper safety equipment, training, and (if required) medical surveillance certification.
- All personnel must comply with established safety procedures. Any staff member who does not comply with safety policy as established in this HASP may be subject to corrective action, potentially including but not limited to, being reprimanded or immediate dismissal.
- Proper decontamination procedures must be followed before leaving a contaminated work area.

7.2 Work Area Access Control

If work is performed in public areas, the following precautions shall be taken to protect both the site personnel and the public. Access control to the work area will be accomplished using a combination of the following devices and/or methods:

- Fences and/or barricades
- Traffic control devices and/or use of flaggers
- Caution tape
- Other methods to keep the site secure and provide a visual barrier to help keep unauthorized personnel from entering the site and active work areas

7.3 Hazardous Waste Site Work Control Procedures

To prevent contamination from migrating from personnel and equipment, work areas will be clearly specified as an Exclusion Zone/Hot Zone (EZ), Contamination Reduction Zone (CRZ), or Support Zone/Clean Zone (SZ) prior to beginning operations. Each work area will be clearly identified using signs or physical barriers. At the end of each workday, the site should be secured and/or guarded to prevent unauthorized entry.

Site work zones will include:

- **Exclusion Zone/Hot Zone (EZ).** The EZ will be the "hot zone" or contaminated area inside the site perimeter (or sample collection area of boat). The EZ is the defined area where potential respiratory and/or health hazards exist. All personnel entering the EZ must use the required PPE, as set forth in this HASP, and meet the appropriate training and medical clearance. Entry to and exit from this zone will be made through a designated point. Appropriate warning signs to identify the EZ should be posted (e.g., DANGER, AUTHORIZED PERSONNEL ONLY, PROTECTIVE EQUIPMENT REQUIRED BEYOND THIS POINT). Personnel and equipment decontamination must be performed upon exiting the EZ.
- **Contamination Reduction Zone (CRZ).** The CRZ, also known as the "warm zone," is a transitional zone between the EZ and the SZ (also known as the "cold zone" or "clean zone"). The CRZ provides a location for removal and decontamination of PPE and tools leaving the EZ. A separate decontamination area will be established for heavy equipment. All personnel and equipment must exit via the CRZ. If the CRZ is compromised at any time, a new CRZ will be established.
- **Support Zone/Clean Zone (SZ).** This uncontaminated zone will be the area outside the EZ and CRZ and within the geographic perimeters of the site (including boat and processing areas). The SZ is used for support personnel; staging materials; parking vehicles; office, laboratory, and sanitation facilities; and receiving deliveries. Personnel entering this zone may include delivery personnel, visitors, security guards, and others who will not necessarily be permitted in the EZ or CRZ.

A log of all personnel visiting, entering, or working on the site shall be maintained by the FL. No visitor will be allowed in the EZ without showing proof of training and medical certification, per 29 CFR 1910.120(e),(f) (and 29 CFR 1926.1101(k)(9),(m) if appropriate). Visitors will attend a site orientation given by the FL and sign the HASP.

7.4 Site-specific Work Zone Requirements

This section contains guidelines for maintaining safe conditions when working from a boat, in a roadway, or at an excavation site.

7.4.1 Sediment Sampling Work Zones

This subsection contains guidelines concerning health and safety aboard marine sampling vessels. The vessel captain, onshore coring operator, and the FL will delineate the boundaries of the work zones aboard the vessel and will inform the field team of the arrangement. The purpose of the zones is to limit the migration of sample material out of the zones and to restrict access to active work areas.

Two work zones will be observed aboard the vessel. One will encompass the "moonhole" of the vessel where the samplers will be deployed and recovered. Only the coring team may enter this zone unless assistance is required by other personnel. The second work zone will be a sample processing area on the vessel. The contractor team will deliver sediment core tubes to this zone and open them. Anchor QEA personnel will log and process the sediment cores either on the boat or on shore.

Both the collection and processing areas on the vessel and onshore will have a SZ outside the CRZ to stage clean equipment, don PPE, take rest breaks, or perform any other site activities that do not involve potentially contaminated materials.

7.4.1.1 Vessel Decontamination Area

A station will be set up for decontaminating sample processing equipment and personnel gear such as boots or PPE. The station will have the buckets, brushes, soapy water, rinse water, or wipes necessary to perform decontamination operations. Plastic bags will be provided for expendable and disposable materials. Decontamination fluids will be stored in sealable containers and will be properly disposed of.

7.4.1.2 Access Control

Security and control of access to the sampling vessel and onshore area will be the responsibility of the captain and FL. Additional security measures may be placed into effect by the client, or as required by national security threat levels determined by the federal government. Access to the vessel and onshore areas will only be granted to necessary project personnel and authorized visitors. Any security or access control problems will be reported to the client or appropriate authorities.

7.4.1.3 Safety Equipment

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

- U.S. Coast Guard (USCG)-approved personal flotation devices (PFDs)
- First aid kit adequate for the number of personnel
- Emergency eyewash

Anchor QEA and/or subconsultants will provide this equipment, which must be at the location(s) where field activities are being performed. Equipment will be checked daily to ensure its readiness for use.

7.5 Field Communications

Communications between all Anchor QEA employees and subcontractors at the work site can be verbal and/or non-verbal. Verbal communication can be affected by the on-site background noise and various PPE. See Table 7-1 for a list of the types of communication methods and equipment to use, depending on site conditions. Communication equipment must be checked daily to ensure proper operation. All project personnel must be initially briefed on the communication methods prior to starting work; communication methods should be reviewed in daily safety meetings.

Table 7-1
Field Communication Methods

Type of Communication	Communication Device	Signal
Emergency notification	On-site Telephone or Cellular Telephone	Initiate phone call using applicable emergency numbers
Emergency notification among site personnel	Two-way Radio	Initiate radio communication with Code Red message
Hailing site personnel for non-emergency	Compressed Air Horn	One long blast, one short blast
Hailing site personnel for emergency evacuation	Compressed Air Horn	Three long, continuous blasts
Hailing site personnel for distress, need help	Visual	Arms waved in circle over head
Hailing site personnel for emergency evacuation	Visual	Arms waved in criss-cross over head
Contaminated air/strong odor	Visual	Hands clutching throat
Break, lunch, end of day	Visual	Two hands together, break apart

8 Decontamination Procedures and Practices

8.1 Minimization of Contamination

The following measures will be observed to prevent or minimize exposure to potentially contaminated materials:

Personnel

- Do not walk through spilled materials.
- Do not handle, touch, or smell sample media directly.
- Make sure PPE has no cuts or tears prior to use.
- Protect and cover any skin injuries.
- Stay upwind of airborne dusts and vapors.
- Do not eat, drink, chew tobacco, or smoke in the work zones.

Sampling Equipment and Vehicles/Vessels

- Use care to avoid getting sampled media on the outside of sample containers.
- If necessary, bag sample containers before filling with sampled media.
- Place clean equipment on a plastic sheet to avoid direct contact with contaminated media.
- Keep contaminated equipment and tools separate from clean equipment and tools.
- Fill sample containers over a plastic tub to contain spillage.
- Clean up spilled material immediately to avoid tracking around the vehicle/vessel.

8.2 Decontamination Equipment

All vehicles, vessels, and equipment that have entered potentially contaminated areas will be visually inspected and, if necessary, decontaminated prior to leaving the area. If the level of vehicle contamination is low, decontamination may be limited to rinsing tires and wheel wells with an appropriate detergent and water. If the vehicle is significantly contaminated, steam cleaning or pressure washing may be required. Tools will be cleaned in the same manner. Rinsate from all decontamination activities will be collected for proper disposal. Decontamination of equipment and tools will take place within the CRZ.

The following supplies will be available to perform decontamination activities:

- Wash and rinse buckets
- Tap water and phosphate-free detergent
- Scrub brushes
- Distilled/deionized water
- Deck pump with pressurized freshwater hose (aboard the vessel)
- Pressure washer/steam cleaner, if appropriate
- Paper towels and plastic garbage bags

8.3 Personnel Decontamination

The FL will ensure that all site personnel are familiar with personnel decontamination procedures as listed below. All personnel wearing PPE in a work area (EZ) must undergo decontamination prior to entering the SZ. Personnel will perform the following decontamination procedures:

- Wash and rinse outer gloves and boots in portable buckets to remove gross contamination.
- If suit is heavily soiled, rinse it off.
- Remove outer gloves; inspect and discard if damaged. Leave inner gloves on. Personnel will remove their outer garment and gloves, dispose of them, and properly label container or drum. Personnel will then decontaminate their hard hats and boots with an aqueous solution of detergent or other appropriate cleaning solution. These items then will be hand-carried to the next station. Remove inner gloves.
- Thoroughly wash hands and face before leaving CRZ.
- Sanitize respirators and place in a clean plastic bag.

8.4 Sampling and Processing Equipment Decontamination

To prevent sample cross-contamination, sampling and processing equipment in contact with soil, sediment, or water samples will undergo the following decontamination procedures when work is completed in the CRZ and prior to additional use:

1. Rinse with potable water and wash with scrub brush.
2. Wash with phosphate-free detergent (Alconox®).
3. Visually inspect the sampler and repeat the scrub and rinse step, if necessary. If scrubbing and rinsing with Alconox® is insufficient to remove visually observable tar-related contamination on equipment, the equipment will be scrubbed and rinsed using hexane (or similar type solution) until all visual signs of contamination are absent.
4. Rinse external sampling equipment with potable water three times prior to use. Rinse homogenizing equipment once with potable water and three times with distilled water prior to and between sample processing.

8.5 Handling of Investigation-derived Waste

All remaining soil or sediment, fluids used for decontamination of sampling equipment, and sample collection disposable wastes (e.g., gloves, paper towels, foil, or others) will be placed into appropriate containers and staged on site for disposal.

8.5.1 Disposable PPE

Disposable PPE may include Tyvek suits, inner latex gloves, and respirator cartridges. Dispose of PPE according to the requirements of the client and state and federal agencies.

8.5.2 Non-disposable PPE

Non-disposable PPE may include respirators and boots and gloves. When decontaminating respirators, observe the following practices and procedures:

- Wipe out the respirator with a disinfecting pad prior to donning.
- Decontaminate the respirator on site at the close of each day with an approved sanitizing solution.

When decontaminating boots and gloves, observe the following practices and procedures:

- Decontaminate the boots or gloves outside with a solution of detergent and water; rinse with water prior to leaving the site.
- Protect the boots or gloves from exposure by covering with disposable covers such as plastic to minimize required decontamination activities.

8.6 Sanitizing of Personal Protective Equipment

Respirators, reusable protective clothing, and other personal articles must not only be decontaminated before being reused, but also sanitized. The insides of masks and clothing become soiled due to exhalation, body oils, and perspiration. Manufacturer's instructions should be used to sanitize respirator masks. If practical, reusable protective clothing should be machine-washed after a thorough decontamination; otherwise, it must be cleaned by hand.

8.7 Emergency Personnel Decontamination

Personnel with medical problems or injuries may also require decontamination. There is the possibility that the decontamination may aggravate or cause more serious health effects. If prompt lifesaving, first aid, and medical treatment are required, decontamination procedures will be omitted. In either case, a member of the site management team will accompany contaminated personnel to the medical facility to advise on matters involving decontamination.

8.8 Containment of Decontamination Fluids

As necessary, spill control measures will be used to contain contaminated runoff that may enter into clean areas. Use plastic sheeting, hay bales, or install a spill control system to prevent spills and contain contaminated water.

9 Health and Safety Training and Informational Programs

This section describes the health and safety training and informational programs with which Anchor QEA project site personnel must comply. All certifications required in this section will be kept on internal file.

9.1 Initial Project Site Orientation

Work on all Anchor QEA project sites requires participation in an initial health and safety orientation presented by the PM or FL that will consist of, at a minimum, the following topics:

- A review of the contents of this HASP, including the Sampling and Analysis Plan and associated site hazards and control methods and procedures.
- Provisions of this plan are mandatory for all Anchor QEA personnel assigned to the project.
- Anchor QEA subcontractors are also expected to follow the provisions of this plan unless they have their own HASP that covers their specific activities related to this project and includes the minimum requirements of this HASP.
- All visitors to the work site will also be required to abide by the requirements of this plan.
- Personnel assigned to perform work at the project site, working under the provisions of this HASP, will be required to read the plan and must sign the Health and Safety Plan Acknowledgement Form to confirm that they understand and agree to abide by the provisions of this plan. Personnel not directly affiliated with the project (i.e., visitors) may also be required to sign the Liability Waiver.

9.2 Daily Safety Meetings

Daily safety meetings ("tailgate meetings") make accident prevention a top priority for everyone and reinforce awareness of important accident-prevention techniques. The following daily safety meeting procedures and practices are required:

- Daily safety meetings will be held each morning prior to conducting site activities.
- The Daily Safety Briefing form in Appendix A will be used to document each meeting.
- Copies of the completed Daily Safety Briefing forms will be maintained on site during the course of the project.

9.3 Hazardous Waste Operations Training

Personnel working on project sites that present a potential exposure to hazardous wastes or other hazardous substances shall be trained in accordance with the requirements of the 29 CFR 1910.120 (HAZWOPER) regulation. Training requirements will consist of the following:

- Field personnel must complete a minimum of 40 hours of hazardous waste activity instruction.
- Field personnel must complete a minimum of 3 days of supervised field instruction.

- Field personnel assigned to the site will also have received 8 hours of refresher training if the time lapse since their previous training has exceeded 1 year.
- On-site managers and supervisors directly responsible for employees engaged in hazardous waste operations will receive an additional 8 hours of supervisory training.
- Field personnel shall be current in first aid/CPR training offered by the American Red Cross or equivalent.
- Other training may be required depending on the task to be performed (e.g., confined space, excavation/trenching, underground storage tank removal, fall protection, respiratory protection, and hazard communication).

9.4 Transportation Worker Identification Credential (TWIC)

All Anchor QEA field personnel will maintain current TWIC status, pursuant to the Maritime Transportation Security Act of 2002, unless this requirement is waived specifically in writing by relevant property owners.

9.5 Asbestos Awareness Training

Field personnel working on project sites that present a potential exposure to asbestos shall receive asbestos awareness training in accordance with 29 CFR 1926.1101(k)(9)(vii), which shall address the following:

- The health effects associated with asbestos exposure.
- The relationship between smoking and asbestos in producing lung cancer.
- The nature of operations that could result in exposure to asbestos, the importance of necessary protective controls to minimize exposure including, as applicable, engineering controls, work practices, respirators, housekeeping procedures, hygiene facilities, protective clothing, decontamination procedures, emergency procedures, and waste disposal procedures.
- The purpose, proper use, fitting instructions, and limitation of respirators.
- The appropriate work practices to be used for the selected job tasks.
- Medical surveillance program requirements.

9.6 Hazard Communication Program

The purpose of hazard communication (Employee Right-to-Know) is to ensure that the hazards of all chemicals located at the field project site are communicated to all Anchor QEA personnel and subcontractors according to 29 CFR 1926.59. Refer to the Anchor QEA Hazard Communication Program document for additional information.

Every container of hazardous materials must be labeled by the manufacturer, who must also provide a SDS upon initial order of the product and upon request thereafter. The actual format may differ

from company to company (e.g., National Fire Protection Association [NFPA], Hazardous Material Information System [HMIS], or other), but the labels must contain similar types of information. Maintain manufacturer labels if possible. The label may use words or symbols to communicate the following:

- Introduction
- Hazard(s) identification
- Composition/information on ingredients
- First-aid measures
- Fire-fighting measures
- Accidental release response measures
- Handling and storage
- Exposure controls/personal protection
- Physical and chemical properties
- Stability and reactivity properties
- Toxicological properties
- Ecological properties
- Disposal considerations
- Transport considerations
- Regulatory information
- Other information, including at a minimum, label preparation or last revision date

SDS for all chemicals brought onto the site or anticipated to be used on site shall be provided in Appendix C of this HASP. These SDS shall be readily available for reference by site personnel and emergency response personnel.

Hazardous materials received without proper labels shall be set aside and not distributed for use until properly labeled.

If a hazardous chemical is transferred into a portable container (approved safety can), even if for immediate use only, the contents (e.g., acetone or gasoline) of the portable container must be identified.

10 General PPE Requirements

The minimum level of PPE should be selected according to the hazards that may be encountered during site activities in accordance with established U.S. Environmental Protection Agency (EPA) levels of protection (D and C). Only PPE that meets American National Standards Institute (ANSI) standards shall be worn. Site personnel must maintain proficiency in the use and care of PPE. Damaged or defective PPE must be replaced and may not be used. Anchor QEA will provide all necessary PPE for its employees as described in this HASP.

Refer to Section 5 for site-specific job task and level-of-protection requirements.

10.1 Minimum Requirements – Level D Protection

The minimum level of protection on project sites will be Level D protection, which consists of the following equipment:

- Standard work uniform/coveralls
- Work boots with safety toe conforming to ASTM International (ASTM) F2412-05/ASTM F2413-05
- Approved safety glasses or goggles (meets ANSI Z87.1 – 2010 requirements for eye protection)
- Hard hat (meets ANSI Z89.1 – 1986 requirements for head protection)
- Traffic safety vest
- Hearing protection when there are high noise levels

Level D protection will be used only when:

- The atmosphere contains no known hazards
- Work functions preclude splashes, immersions, or the potential for unexpected inhalation of, or contact with, hazardous concentrations of chemicals
- Atmospheric concentrations of contaminants are less than the Permissible Exposure Limit (PEL) and/or Threshold Limit Value (TLV)

10.1.1 Modified Level D Protection Requirements

Depending on the Sampling and Analysis Plan and the potential hazards to be encountered, Level D protection shall be modified to include additional protective equipment such as USCG-approved PFDs, face shields/goggles, chemical-resistant clothing, and disposable gloves of varying materials depending on the chemical substances involved. An upgrade to Modified Level D occurs when there is a possibility that contaminated media can contact the skin or work uniform, or if unique, site-specific hazards exist.

11 General Air Monitoring Requirements

11.1 General Requirements

No air monitoring is considered necessary at this Site. However, air monitoring shall be conducted when the possibility of hazardous atmospheres, chemical volatilization, or contaminated airborne dust exists (e.g., from intrusive activities involving contaminated soils or groundwater, developing new monitoring wells, working with wells containing known COCs, confined space entry, or others), if identified.

Air movers or other engineering controls shall be used to exhaust or dilute solvent vapors emanating from monitoring wells or hazardous atmospheres in confined spaces prior to the use of respiratory protection devices.

Site-specific air monitoring action levels are provided in Section 5.2.

11.2 Real-time Air Monitoring Equipment

As applicable, organic vapor concentrations shall be monitored in the field with either a photoionization detector (PID) or flame ionization detector (FID). Flammable vapors and/or gasses are monitored with an oxygen/lower-explosive level (O_2/LEL) real-time instrument. Organic vapor measurements are usually taken in the breathing zone of the worker while O_2/LEL measurements are taken at the point of operation (e.g., monitoring well head or auger point).

As applicable, airborne dust/particulate concentrations shall be measured using a real-time aerosol monitor (using a scattered light photometric sensing cell) when there are visible signs of potentially contaminated airborne dust. Both area and personal air monitoring readings are to be taken to characterize site activities.

As applicable, colorimetric detector tubes shall be used to monitor specific COCs such as benzene or vinyl chloride if there is a possibility that they may be present in elevated concentrations based upon the background of the project site, the Sampling and Analysis Plan, and conditions discovered at the site.

As applicable, other real-time air monitoring equipment, such as hydrogen cyanide meters, may be utilized depending upon the Sampling and Analysis Plan and COCs.

Air monitoring results shall be documented on the Daily Air Monitoring Record form (see Appendix A) or in the field logbook.

11.3 Time-integrated Air Monitoring Equipment

Some Anchor QEA projects may require the use of time-integrated air monitoring equipment to determine employee exposures to COCs. Time-integrated air monitoring would be required if there is the possibility that employees would be exposed to concentrations of a COC that approach or exceed an established exposure limit.

Typical time-integrated sampling methods will usually involve the use of personal sampling pumps and associated filter and/or charcoal sampling media, or the use of diffusion-based sampling media. Exposed sampling media is normally sent to an accredited laboratory for analysis.

Contact the CHSM for consultation and assistance with the performance of time-integrated air monitoring activities.

11.4 Equipment Calibration and Maintenance

Calibration and maintenance of air monitoring equipment shall follow manufacturer specifications and must be documented. Recalibration and adjustment of air monitoring equipment shall be completed as site conditions and equipment operation warrant. Record all air monitoring equipment calibration and adjustment information on the Daily Air Monitoring Record form (see Appendix A) and in the field logbook.

11.5 Air Monitoring Action Levels

Air monitoring action levels have been developed that stipulate the chemical concentrations in the breathing zone that require an upgrade in level of PPE.

Air monitoring action levels are typically set at one-half of the OSHA PEL, NIOSH Recommended Exposure Limit (REL), or the American Conference of Governmental Industrial Hygienists (ACGIH) TLVs. The rationale for establishing action levels is based on the available data that characterize COCs in site media.

Air monitoring measurements shall generally be taken in the breathing zone of the worker most likely to have the highest exposure. Transient peaks will not automatically trigger action. Action will be taken when levels are consistently exceeded in a 5-minute period. Similarly, if chemical odors are detected that are a nuisance, bothersome, or irritating, an upgrade in respiratory protection can provide an extra level of comfort or protection when conducting site activities.

11.6 Air Monitoring Frequency Guidelines

In general, conduct periodic air monitoring when:

- It is possible that an immediately dangerous to life or health condition or a flammable atmosphere has developed (e.g., confined space entry or intrusive activities)

- There is an indication that exposures may have risen over established action levels, PELs, or published exposure levels since the last monitoring. Look for a possible rise in exposures associated with the following situations:
  - *Change in site area* – Work begins on a different section of the site.
  - *Change in on-site activity* – One operation ends and another begins.
  - *Change in contaminants* – Handling contaminants other than those first identified.
  - Visible signs of particulate exposure from intrusive activities such as drilling, boring, or excavation.
  - Perceptible chemical odors or symptoms of exposure.
  - Handling leaking drums or containers.
  - Working with obvious liquid contamination (e.g., a spill or lagoon).
  - Conduct air monitoring when the possibility of volatilization exists (such as with a new monitoring well or a well containing known COCs).

12 Health and Safety Procedures and Practices

In addition to the task-specific JSAs listed in Section 6.1 and presented in Appendix B, this section lists the health and safety procedures and practices applicable to this project. For additional information, consult with the PM.

12.1 Physical Hazards and Controls

12.1.1 General Site Activities

Observe the following general procedures and practices to prevent physical hazards:

- Legible and understandable precautionary labels shall be affixed prominently to containers of potentially contaminated soil, sediment, water, and clothing.
- No food or beverages shall be present or consumed in areas that have the potential to contain COCs and/or contaminated materials or equipment.
- No tobacco products or cosmetics shall be present or used in areas that have the potential to contain COCs and/or contaminated materials or equipment.
- An emergency eyewash unit shall be located immediately adjacent to employees who handle hazardous or corrosive materials, including decontamination fluids. All operations involving the potential for eye injury or splash must have approved eyewash units locally available capable of delivering at least 0.4 gallons per minute for at least 15 minutes.
- Personnel working within 10 feet of bodies of water shall wear USCG-approved PFDs.
- Certain project sites may have newly finished work (e.g., concrete, paving, framing, habitat reconstruction, or sediment caps) that may be damaged by unnecessary contact, or that could cause dangerous conditions for personnel (e.g., slipping, sinking, or tripping). Personnel working in or around these areas shall communicate with the PM, FL, and property owner as needed to prevent damaging new work or entering dangerous conditions.
- Generally, all on-site activities will be conducted during daylight hours. If work after dusk is planned or becomes necessary due to an emergency, adequate lighting must be provided.
- Hazardous work, such as handling hazardous materials and heavy loads and operating equipment, should not be conducted during severe storms.
- All temporary electrical power must have a Ground-fault Circuit Interrupter (GFCI) as part of its circuit if the circuit is not part of permanent wiring. All equipment must be suitable and approved for the class of hazard present.

12.1.2 Slips, Trips, and Falls

Observe the following procedures and practices to prevent slips, trips, and falls:

- Inspect each work area for slip, trip, and fall potential prior to each work task.

- Slip, trip, and fall hazards identified must be communicated to all personnel. Hazards identified shall be corrected or labeled with warning signs to be avoided.
- All personnel must be aware of their surroundings and maintain constant communication with each other at all times.

12.1.3 Ergonomic Considerations

Certain field tasks may involve workers in fixed positions (e.g., observing subcontractor work) or performing repetitive motions over a period of time (e.g., sediment sample processing). It is important that workers self-monitor for ergonomic fatigue (e.g., soreness, tightness, stiffness, or pain in muscles) and make adjustments to work tasks, body positions, or work areas so that ergonomic stressors are minimized. Suggestions for decreasing the likelihood of ergonomic stress include the following:

- Limit fixed positions. Periodically vary standing and sitting positions, take frequent short walks, and modify observation locations when possible.
- Minimize extreme postures. Conduct work tasks using comfortable postures (particularly if the tasks are repetitive), and use tools or structures to minimize the need to hold or work with materials or access the work area.
- Limit contact stress. Be aware of soft tissue resting on hard surfaces, and limit these occurrences (e.g., use comfortable footwear, and use tools to hold materials).
- Contact the Field Mobilization Team in advance for prolonged field efforts that involve a field trailer. This group can set up field staff with a monitor, mouse, and keyboard so they are not working solely on laptops.
- Take breaks from work tasks, particularly repetitive ones.
- Consider performing stretching exercises before and during work activities, if those tasks are anticipated to be long in duration and/or strenuous.

12.1.4 Sediment Core Sampling

Sediment samples will be collected using a “Mud Mole” or vibracore sampling equipment operated from a boat. Please see Sections 12.1.12 and 12.1.13 for additional safety information regarding working on or near the water.

All operations involving the use of powered sediment coring rigs will follow generally accepted drilling/coring practices. One person will be assigned the responsibility of Lead Driller/Corer. Additional personnel will assist with equipment as needed. The Lead Driller/Corer will be responsible for operating the drilling/coring rig and ensuring safety.

General rules associated with drilling/coring rig operations will be as follows:

- While drilling, all non-essential personnel shall remain at a distance that is past the radius of any moving parts.
- All operators and team members will be familiar with the rig operations and will have received practical training.
- All personnel will be instructed in the use of the emergency kill switch/shutdown on the drill rig.
- No loose-fitting clothing, jewelry, or free long hair is permitted near the drilling rig or moving machinery parts.
- A first aid kit and fire extinguisher will be available at all times.
- No drilling will occur during impending electrical storms or tornadoes, or when rain, ice, snow, or wind conditions create undue potential hazards.
- Never allow "horsing around" within the vicinity of the drill rig and tool and supply storage areas, even when the drill rig is shut down.

12.1.5 Underground/Overhead Utility Line Contact Prevention

Observe the following underground/overhead utility line contact prevention procedures and practices:

- Prior to conducting work, the PM or FL shall ensure that all existing underground or overhead utilities in the work area are located per the state or local mark-out methods. Documentation of utility mark-out shall be completed using the Utility Contact Prevention Checklist form (see Appendix A). No excavation work is to be performed until all utility mark-outs are verified.
- The PM or FL shall conduct a site survey to search for signs of other buried or overhead utilities. The results of such surveys shall be documented on the Utility Mark-out documentation form.
- The property owner or facility operator shall be consulted on the issue of underground utilities. As-built drawings shall be reviewed, when available, to verify that underground utility locations are consistent with the utility location mark-outs. All knowledge of past and present utilities must be evaluated prior to conducting work.
- If on-site subsurface utility locations are in question, a private locating service shall be contacted to verify locations. If the investigation calls for boreholes in an area not covered by the municipal One-Call system, then a private utility locate firm shall be contacted to determine the location of other underground utilities.
- The PM shall have documented verbal contact and an agreement with the fiber optic company for all work within 50 feet of any fiber optic cables.
- **Only non-destructive excavation, such as hand digging or hydro excavation, is permitted within 3 feet of underground high voltage, product, or gas lines.** Once the line

is exposed, heavy equipment can be used, but must remain at least 3 feet from the exposed line.

- Elevated superstructures (e.g., drill rig, backhoe, scaffolding, ladders, and cranes) shall remain a distance of 10 feet away from utility lines and 20 feet away from power lines. Distance from utility lines may be adjusted by the FL depending on actual voltage of the lines.
- Overhead utility locations shall be marked with warning tape or flags where equipment has the potential for contacting overhead utilities.

Table 12-1 shows the minimum clearances required for energized overhead electrical lines.

Table 12-1
Overhead Utility Clearance Requirements

Minimum Clearance from Energized Overhead Electric Lines	
Nominal System Voltage	**Minimum Required Clearance**
0 to 50 kV	10 feet
51 to 100 kV	12 feet
101 to 200 kV	15 feet
201 to 300 kV	20 feet
301 to 500 kV	25 feet
501 to 750 kV	35 feet
751 to 1000 kV	45 feet

Notes:
kV: kilovolts
Whenever equipment operations must be performed closer than 20 feet from overhead power lines, the Field Leader (FL) must be notified. When clearance to proceed is received from the FL, the electric utility company must be contacted to turn the power off or physically insulate (protect) the lines if the operation must be performed closer to the power line than is allowed in this table. For voltages not listed on this table, add 0.4 inches per kV to obtain the safe distance between equipment and power lines.

12.1.6 Heavy Equipment Operations

Observe the following heavy equipment operations procedures and practices:

- Wear leather gloves while attaching support members to protect against pinching injuries.
- While working from elevated levels greater than 6 feet, ensure that all employees have fall protection that meets OSHA and ANSI Z3591 standards.
- Do not stand under loads that are being raised or lowered with cranes or aerial lifts.
- The subcontractor or Anchor QEA equipment operator must conduct pre-operational inspections of all equipment. In addition, daily inspections will be conducted on the equipment prior to site activities.
- Maintain the appropriate distance from overhead utilities (see Table 12-1):

- Always stay out of the swing radius of all heavy equipment. Always use a spotter during movement of equipment. The spotter and others, as appropriate, shall maintain constant communication with the operator.
- All operators must have adequate training and be qualified to operate the particular heavy equipment unit.
- Conduct a site evaluation to determine proper positioning for the unit. Make sure the surface is level. Cordon off holes, drop-offs, bumps, or weak ground surfaces.
- When using a crane, do not use hands when the load is being lifted or lowered. Use non-conductive tag line to help direct and position the load.
- Never climb a raised platform or stand on the mid-rail or top-rail.
- Tools should always be hung or put into a belt whenever possible

12.1.7 Drilling with Direct Push Technology (DPT)

General rules associated with direct push intrusive activities are as follows:

- Maintain all equipment in a safe condition.
- Keep all guards in place during use.
- Before Direct Push Technology (DPT) sampling is started, ensure that everyone who operates the rig has had adequate training and is thoroughly familiar with the DPT rig, its controls, capabilities, and operating manual.
- Set-up on stable and level terrain.
- Outriggers shall be extended per the manufacturer's specifications.
- Do not place outriggers on underground structures such as vaults, manholes, stormwater inlets, catch basins, or well boxes.
- Use proper dunnage, cribbage, plates, or wooden blocks between outriggers and supporting surfaces.
- The Driller and helper must be present during all active operations and TEST THE TWO KILL SWITCHES DURING EACH STARTUP.
- The DPT rig helper and other site personnel must know the location of the two emergency shutoff switches.
- The area around the drilling operation must be cordoned off/barricaded.
- When hazardous conditions are deemed present, the operation must be shut down.
- Team members shall not wear loose clothing, free long hair, jewelry, or equipment that might become caught in moving machinery. Secure PPE close to the body to avoid getting caught in moving parts.
- Unauthorized personnel must be kept clear of the DPT rig.
- Shut down, lock, and tag out the DPT rig to make repairs or adjustments or to lubricate fittings. Release all pressure on the hydraulic systems, the drilling fluid system, and the air pressure systems of the drill rig prior to performing maintenance.

- Identify and understand parts of the equipment that may cause crushing, pinching, rotating, or similar injuries.
- Neatly stack pipe, rods, or similar on racks or sills to prevent spreading, rolling, or sliding.
- Wear proper work gloves when the possibility of pinching or other injury may be caused by moving or handling large or heavy objects.
- Establish a system of responsibility for the operator and helpers to follow during the series of various activities, such as connecting and disconnecting sections and inserting and removing the sections.
- Never reach behind or around rotating equipment for any reason.
- Clean equipment only when the DPT rig is in neutral and the equipment has stopped.
- Don't place hands, feet, and/or limbs into or through openings of equipment frames or structures that were not intended to be used in such a fashion.

12.1.8 Hand and Power Tools

Observe the following procedures and practices when working with hand and power tools:

- Keep hand tools sharp, clean, oiled, dressed, and not abused.
- Worn tools are dangerous. For example, the "teeth" in a pipe wrench can slip if worn smooth, an adjustable wrench will slip if the jaws are sprung, and hammerheads can fly off loose handles.
- Tools subject to impact (e.g., chisels, star drills, and caulking irons) tend to "mushroom." Keep them dressed to avoid flying spalls, and use tool holders.
- Do not force tools beyond their capacity.
- Flying objects can result from operating almost any power tool, so always warn people in the vicinity and use proper eye protection.
- Each power tool should be examined before use for damaged parts, loose fittings, and frayed or cut electric cords. Tag and return defective tools for repairs. Ensure that there is adequate lighting, inspect tools for proper lubrication, and relocate tools or material that could "vibrate into trouble."
- Compressed air must be shut off or the electric cord unplugged before making tool adjustments. Air must be "bled down" before replacement or disconnection.
- Proper guards or shields must be installed on all power tools before issue. Do not use improper tools or tools without guards in place.
- Replace all guards before startup. Remove cranks, keys, or wrenches used in service work.

12.1.9 Motor Vehicle Operation

All drivers are required to have a valid driver's license, and all vehicles must have appropriate state vehicle registration and inspection stickers. **Anchor QEA prohibits the use of hand-held wireless devices while driving any vehicle for business use at any time, for personal use during business**

hours, and as defined by law. Additionally, site-specific motor vehicle requirements must be followed, if any.

When driving to, from, and within the job site, be aware of potential hazards including:

- Vehicle accidents
- Distractions
- Fatigue
- Weather and road conditions

To mitigate these hazards, observe the following procedures and practices regarding motor vehicle operation:

- Before leaving, inspect fuel and fluid levels and air pressure in tires, and adjust mirrors and seat positions appropriately.
- Wear a seat belt at all times and make sure that clothing will not interfere with driving.
- Plan your travel route and check maps for directions or discuss with colleagues.
- Clean windows and mirrors as needed throughout the trip.
- Wear sunglasses as needed.
- Fill up when the fuel level is low (not near empty).
- Follow a vehicle maintenance schedule to reduce the possibility of a breakdown while driving.
- Stop driving the vehicle, regardless of the speed (e.g., even 5 miles per hour) or location (e.g., a private road), when the potential of being distracted by conversation exists.
- Using hand-held communication devices (e.g., cell phones) while operating any motor vehicle is prohibited.
- Get adequate rest prior to driving.
- Periodically change your seat position, stretch, open the window, or turn on the radio to stay alert.
- Pull over and rest if you are experiencing drowsiness.
- Check road and weather conditions prior to driving.
- Be prepared to adjust your driving plans if conditions change.
- Travel in daylight hours, if possible.
- Give yourself plenty of time to allow for slowdowns due to construction, accidents, or other unforeseen circumstances.
- Use lights at night and lights and wipers during inclement weather.

12.1.10 Vehicular Traffic

Observe the following procedures and practices regarding vehicular traffic:

- Wear a traffic safety vest when vehicle hazards exist.
- Use cones, flags, barricades, and caution tape to define the work area.

- Use a vehicle to block the work area (if conditions allow).
- Engage a police detail for high-traffic situations.
- Always use a spotter in tight or congested areas for material deliveries.
- As necessary, develop traffic control plans and train personnel as flaggers in accordance with the U.S. Department of Transportation Manual of Uniform Traffic Control Devices and/or local requirements.

12.1.11 Working Near Railways

When working near railways or in rail yards, observe the following procedures and practices:

- Plan work activities well ahead of time, including coordination with the railway owner(s) and operator(s).
- Always assume work near railways requires a permit from the owner/operator.
- Maintain emergency rail yard and owner/operator contact information at the field location.
- Become cognizant of train signals such as horns and lights, in order to understand potential train activity.
- Follow all owner/operator required procedures.
- Plan work activities to minimize time spent adjacent to tracks.
- Expect movement from on-track equipment at any time.
- Before approaching a track, look in both directions. Make sure it's safe to get on or cross the track.
- Never cross a track in front of oncoming traffic.
- When on-track equipment is approaching, stay at least 30 feet from the track while the equipment is passing.
- Watch for protruding structures on passing equipment as well as other hazards.
- Do not stage or store equipment unattended within 30 feet of tracks.
- When rail traffic is approaching, move away from the track, and warn your coworkers of approaching rail traffic.
- Never sit, walk, step, stand, or lie down on rails, including other track components such as switch points, frogs, guard rails, derails, and wheel stops.
- Do not lean on, climb on, or go under any on-track equipment unless your job requires it, in which case do so only after all required safety procedures have been put in place.
- Do not walk between on-track equipment unless they are separated by at least 50 feet.
- Keep at least 30 feet from the end of standing trains, cars, or locomotives. This will allow you time to react safely to any movement of the equipment.
- Avoid being trapped between on-track equipment passing on adjacent tracks.

12.1.12 Boating Operations

The following precautions shall be followed when conducting boating trailer and launch activities:

- Follow the trailer and boat manufacturers' instructions for securing the boat to the trailer.
- Follow the trailer manufacturer's instructions for securing the trailer to the towing vehicle.
- Prohibit site personnel from moving into trailer/vehicle pinch points without advising the vehicle operator.
- Use experienced operators when backing trailers on boat ramps.
- Wear proper work gloves when the possibility of pinching or other injury may be caused by moving or handling large or heavy objects.
- Maintain all equipment in a safe condition.
- Launch boats one at a time to avoid collisions.
- Use a spotter for vehicles backing boats to the launch area.
- Understand and review hand signals.
- Wear boots with non-slip soles when launching boats.
- Wear USCG-approved PFDs when working within 10 feet of the water.
- Keep ropes and lines coiled and stowed to eliminate trip hazards.
- Maintain three-point contact on dock/pier or boat ladders.
- Ensure that drain plugs are in place, as present.

The following precautions shall be followed when conducting boating operations:

- Maintain a current boater's license(s) as required.
- Wear USCG-approved PFDs for work activities within 10 feet of the water.
- Obtain and review information regarding dams that may be present in work areas, particularly with regard to "no boating" zones and safety buoys, cables, and warning signage.
- Maintain boat anchorage devices commensurate with anticipate currents, distance to shore, and water depths.
- Provide a floating ring buoy in the immediate boat launch/landing areas with at least 60 feet (18.3 meters) of line for a vessel less than 65 feet (19.8 meters) in length, or 90 feet (27.4 meters) of line for a vessel 65 feet (19.8 meters) or greater in length (see http://www.uscg.mil/d13/cfvs/CheckLists/Regs/28.115.pdf for more information).
- Step into the center of the boat.
- Keep your weight low when moving on the boat.
- Move slowly and deliberately.
- Steer directly across other boat wakes at a 90-degree angle to avoid capsizing.
- Steer the boat facing forward.
- Watch for floating objects in the water.

- Right-of-way is yielded to vessels on your boat's right, or starboard, and vessels with limited ability to maneuver such as any wind-propelled vessel.

The following precautions shall be followed when working on a boat:

- Observe proper lifting techniques.
- Obey lifting limits (see Section 12.1.15)
- Use mechanical lifting equipment (i.e., pulleys or winches) to move large or awkward loads.
- Wear USCG-approved PFDs for work activities within 10 feet of the water.

The safety-related items listed in Table 12-2 shall be available when conducting boating operations.

Table 12-2
Safety Equipment Specific to In-water Work

Additional Safety Equipment for Sampling Vessel per U.S. Coast Guard (USCG) Requirements:
• Proper vessel registration, numbering, and documentation (registered with state, certificate of vessel registration number displayed, and carrying a valid certificate of number) • USCG-approved personal flotation devices (PFDs; or life jackets) for every person on the sampling vessel (Type II PFD required, Type I PFD preferred as it will turn most unconscious wearers face up in the water) • Appropriate, non-expired, visual distress devices for day and night use from the following: • Three hand-held red flares (day and night), or • One hand-held red flare and two parachute flares (day and night), or • One hand-held orange smoke signal, two floating orange smoke signals (day), and one electric distress light (night only) • Alternate means of propulsion (oars or paddles) • Dewatering device (pump or bailer) • Properly maintained and inspected USCG-approved fire extinguishers (no fixed system = (2) B-1 or (1) B-2 type extinguishers; fixed system = (1) B-1 type extinguisher) • Proper ventilation of gasoline-powered vessels • Sound-producing device (whistle, bell, or horn) • VHF 2-way radio • Proper navigational light display • Throwable life ring with attached line (any vessel larger than 16 feet is required to carry one Type IV [throwable] PFD)

Additional Safety Equipment for Sampling Vessel per U.S. Coast Guard (USCG) Requirements:	
Additional USCG Recommended Equipment Includes:	
• Extra visual distress signals • Primary and spare anchor • Heaving line • Fenders • First aid kit • Flashlight • Mirror • Searchlight • Sunburn lotion • Tool kit • Spare fuel	• Boat hook • Spare propeller • Mooring line • Food and water • Binoculars • Spare batteries • Sunglasses • Marine hardware • Extra clothing • Spare parts • Pertinent navigational chart(s) and compass

12.1.13 Working Over or Near Water

12.1.13.1 Personal Flotation Devices

PFDs are not required where employees are continuously protected from the hazard of drowning by railings, nets, safety belts, or other applicable provisions.

Type III, Type V, or better USCG-approved high-visibility PFD shall be provided and properly worn by all personnel in the following circumstances:

- On or within 10 feet of water
- On floating pipelines, pontoons, rafts, or stages
- On structures extending over or next to the water, except where guard rails or safety nets are provided for employees
- Working alone at night where there are drowning hazards, regardless of other safeguards provided
- In skiffs, small boats, or launches, unless in an enclosed cabin or cockpit
- Whenever there is a drowning hazard

The following precautions shall be followed when using PFDs:

- Prior to and after each use, the buoyant work vests or life preservers shall be inspected for defects that would alter their strength or buoyancy. Defective devices or devices with less than 13 pounds buoyancy shall be removed from service.
- All PFDs shall be equipped with reflective tape as specified in 46 CFR 25.25-15.
- Thirty-inch USCG-approved ring buoys with at least 150 feet of 600-pound capacity line shall be provided and readily available for emergency rescue operations. The distance between ring buoys shall not exceed 200 feet.

- PFD lights conforming to 46 CFR 161.012 shall be required whenever there is a potential need for life rings to be used after dark. Onshore installations, at least one life ring, and every third one thereafter, shall have a PFD light attached. PFD lights on life rings are required only in locations where adequate general lighting (e.g., floodlights or light stanchions) is not provided.

12.1.13.2 Cold Water Work

When the combined air and water temperature is below 90° F, field personnel working on or near water shall wear either a float coat and bib overalls (e.g., a full two-piece "Mustang" survival suit or similar) or a one-piece survival suit. Suits or float coats shall be USCG approved. If extremely cold or severe weather conditions are forecast, work activities should be postponed. Work activities will be continually reviewed and adjustments made if wearing a survival suit during work activities potentially poses a hazard due to warm air temperatures, or limited mobility or agility. In addition, proximity of water work to shore and scope/duration/timing of work activities will be considered when stipulating the above requirement. Overall, if water craft will be used during work, or work will be conducted near water, it is imperative that site-specific conditions are considered and evaluated so that proper safeguards and procedures are in place prior to beginning work.

In addition to considering the use of apparel appropriate for anticipated air, weather, and water conditions, field teams shall identify any procedures necessary for cold-water "man-overboard" scenarios. These procedures should be identified in the site-specific HASP, described in the JSA used for boating activities and, if prudent, practiced before work.

12.1.13.3 Work Near Dams

Work near dams should be avoided unless necessary to complete the required work scope. In the event that working near dams is required, the following shall be considered:

- Obtain safety procedures from the dam owner/operator prior to beginning work.
- Follow required safety procedures including no boating offsets and fall protection procedures.
- Obtain dam operation (i.e., spillway use and trash rack locations) schedules and plan work activities to the extent practicable during periods of no or low dam activity.

12.1.14 Noise

Excessive noise is hazardous not only because of its potential to damage hearing, but also because of its potential to disrupt communications and instructions. The following procedures and practices shall be followed to prevent noise-related hazards:

- All employees will have access to ear protection with a Noise Reduction Rating of not less than 30.

- Ear protection must be worn in any environment where site personnel must raise their voices to be heard while standing at a distance of 3 feet or less.
- Ear protection must be worn by any personnel observing or operating concrete cutting or sawing equipment, pile driving, or other loud noise-generating activities.

Hearing protection is required for site personnel operating or working near noisy equipment or operations, where the noise level is greater than 85 A-weighted decibels (dbA) (time-weighted average [TWA]), as well as personnel working around heavy equipment. The FL will determine the need and appropriate testing procedures, (i.e., sound level meter and/or dosimeter) for noise measurement.

When needed, a sound level meter will be used to measure noise levels at selected locations in the work area and on the site perimeter. When used, noise monitoring equipment must be calibrated before and after each shift.

If continuous noise levels are found to exceed 85 dbA at any location within the work area, warning signs will be posted. Site personnel and visitors will be notified that hearing protection is required. Appropriate hearing protection (i.e., ear plugs or ear muffs) will be worn whenever personnel or visitors are working in that location. A supply of ear plugs will be maintained on site.

Action levels in Table 12-3 will trigger the use of appropriate hearing protection (plugs or muffs). Hearing protection must be able to attenuate noise below 90 dbA (8-hour TWA). Each hearing protection or device has a Noise Reduction Rating (NRR) assigned by EPA. The calculation for a hearing protection device's effectiveness is:

Equation 1

Noise reading $dbA - (NNR - 7db) < 90dbA$

where:

dbA = A-weighted decibel

NRR = Noise Reduction Rating

Table 12-3
Noise Exposure Action Levels

Instrument	Measurement	Action
Type I or Type II	> 80 dbA to 85 dbA	Hearing protection recommended. Limit work duration to 8-hour shifts.
	> 85 dbA to 90 dbA	Hearing protection required. Limit work duration to 8-hour shifts.

Instrument	Measurement	Action
Sound Level Meter or Dosimeter	> 90 dbA to 115 dbA	Hearing protection required. Investigate use of engineering controls. Limit work duration to 8-hour shifts.
	> 115 dbA	Stop work. Consult CHSM.

Notes:
CHSM: Corporate Health and Safety Manager
dBA: A-weighted decibel

12.1.15 Lifting and Material Handling

Observe the following procedures and practices for lifting and material handling:

- Use leather gloves when handling metal, wire rope, sharp debris, or transporting materials (e.g., wood, piping, or drums).
- The size, shape, and weight of the object to be lifted must first be considered. No individual employee is permitted to lift any object that weighs more than 60 pounds. Multiple employees or mechanical lifting devices are required for objects heavier than the 60-pound limit.
- Plan a lift before doing it. Bend at the knees and lift with the legs; maintain the natural curves of the back; do not use back muscles.
- Check the planned route for clearance.
- Use the buddy system when lifting heavy or awkward objects.
- Do not twist your body while lifting.
- Know the capacity of any handling device (e.g., crane, forklift, chain fall, or come-along) that you intend to use.
- Use tag lines to control loads.
- Ensure that your body, material, tools, and equipment are safe from such unexpected movement as falling, slipping, rolling, tripping, bowing, or any other uncontrolled motion.
- Trucks (i.e., flat beds) hauling equipment or materials must not be moved once rigging has been released.
- Chock all material and equipment (such as pipe, drums, tanks, reels, trailers, and wagons) as necessary to prevent rolling.
- Tie down all light, large-surface-area material that might be moved by the wind.
- When working at heights, secure tools, equipment, and wrenches against falling.
- Do not store materials or tools on ducts, lighting fixtures, beam flanges, hung ceilings, or similar elevated locations.
- Fuel-powered tools used inside buildings or enclosures shall be vented and checked for excessive noise.

12.1.16 Fire Control

Observe the following fire control procedures and practices:

- Smoke only in designated areas.
- Keep flammable liquids in closed containers.
- Keep the work site clean; avoid accumulating combustible debris such as paper.
- Obtain and follow property owner hot work safety procedures when welding or performing other activities requiring an open flame.
- Isolate flammable and combustible materials from ignition sources.
- Ensure fire safety integrity of equipment installations according to National Electrical Code (NEC) specifications.

12.1.17 Cleaning Equipment

Observe the following procedures and practices when cleaning equipment:

- Wear appropriate PPE to avoid skin and eye contact with isopropyl alcohol, Alconox®, or other cleaning materials.
- Stand upwind to minimize any potential inhalation exposure.
- Dispose of spent cleaning solutions and rinses accordingly.

12.2 Environmental Hazards and Controls

12.2.1 Fatigue Management

Because Anchor QEA personnel may be working during both daytime and nighttime hours several days per week, depending on the activity, it is important that all personnel are aware of the hazards related to fatigue. Fatigue can be defined as an increasing difficulty in performing physical or mental activities. Signs of fatigue may include tiredness, changes in behavior, loss of energy, and reduced ability to concentrate. Fatigued site personnel may have a reduced ability to recognize or avoid risks on the work site, which may lead to an increase in the number and severity of injuries and other incidents. Fatigue can occur at any time when working and may cause safety concerns due to decreased manual dexterity, reaction time, and alertness.

Fatigue results from insufficient rest and sleep between activities. Contributing factors to fatigue may include the following:

- The time of day that work takes place
- The length of time spent at work and in work-related duties
- The type and duration of a work task and the environment (e.g., weather conditions and ambient noise) in which it is performed
- The quantity and quality of rest obtained prior to, during, and after a work period

- Non-work activities
- Individual factors such as sleeping disorders, medications, or emotional state

Personnel suffering from fatigue may exhibit both physical and mental effects, such as the following:

- Slower movements
- Poor coordination
- Slower response time to interaction
- Bloodshot eyes
- Slumped or weary appearance
- Nodding off
- Distractedness or poor concentration
- Inability to complete tasks
- Fixed gaze
- Appearing depressed, irritable, frustrated, or disinterested

Employees are strongly encouraged to get sufficient pre-work rest, maintain sufficient nutritional intake during work (i.e., eat and drink at regular intervals), and communicate with team members and leaders if their level of fatigue elevates.

Use the following procedures to help detect and address fatigue-related issues:

- Periodically observe and query coworkers for signs or symptoms of fatigue.
- Site personnel that express concern over their level of fatigue, or that are observed to be fatigued such that elevated worker risk is evident, will be relieved or their work tasks adjusted so that they may rest sufficiently.
- Work schedules will consider fatigue factors and optimize continuous periods available for uninterrupted sleep. The employee is responsible for reporting to work properly rested and fit for duty. In case of an emergency or operational difficulties (e.g., limited access due to water levels or boat repairs), work hours may require adjustment.
- Maintain a routine exercise program and regular sleep schedule as much as possible over the course of the work.
- Avoid heavy meals or caffeine and minimize or eliminate the consumption of alcohol and nicotine before sleeping.

12.2.2 Heat Stress

Observe the following general procedures and practices regarding heat stress:

- Increase the number of rest breaks and/or rotate site personnel in shorter work shifts.
- Watch for signs and symptoms of heat stress and fatigue (see Section 12.2.2.1).
- During hot months, plan work for early morning or evening.

- Use ice vests when necessary.
- Rest in cool, dry areas.
- Ensure that employees have access to potable drinking water and shade.
- During conditions exceeding 95° F, ensure that the following additional procedures are adhered to:
  - Establish effective communication by voice, observation, or electronic means.
  - Observe employees for alertness and signs or symptoms of heat illness.
  - Designate one or more employees on each work site as authorized to call for emergency medical services.
  - Remind employees to drink water throughout the shift.
  - Conduct pre-shift meetings before beginning work to review the high heat procedures, encourage drinking water, and remind employees of their right to take a cool-down rest when necessary.

12.2.2.1 Signs, Symptoms, and Treatment

The FL will be trained in heat stress prevention, including the following, prior to supervising employees:

- Procedures to prevent heat illness.
- Procedures to follow when an employee exhibits symptoms consistent with possible heat illness, including emergency response procedures.

The information provided below addresses these training requirements.

Adverse climatic conditions are important considerations in planning and conducting site operations. High ambient temperature can result in health effects ranging from transient heat fatigue, physical discomfort, reduced efficiency, personal illness, and increased accident probability to serious illness or death. Heat stress is of particular concern when chemical protective garments are worn because they prevent evaporative body cooling. Wearing PPE places employees at considerable risk of developing heat stress.

Heat stress is caused by a number of interacting factors, including environmental conditions, clothing, workload, and the individual characteristics of the worker. Because heat stress is probably one of the most common (and potentially serious) illnesses, regular monitoring and other preventive precautions are vital.

Heat Rash. Heat rash can be caused by continuous exposure to hot and humid air and skin abrasion from sweat-soaked clothing, rubber boots, or impermeable waders. The condition is characterized by a localized red skin rash and reduced sweating. Heat rash reduces the ability to tolerate heat. To treat, keep skin hygienically clean and allow it to dry thoroughly after using chemical protective

clothing. Take measures to prevent heat rash by changing clothes often to maximize use of dry garments, or taking frequent breaks to allow doffing of equipment and drying of skin.

Heat Cramps. Heat cramps are caused by profuse perspiration with inadequate electrolytic fluid replacement. This often robs the larger muscle groups (stomach and quadriceps) of blood, which can cause painful muscle spasms and pain in the extremities and abdomen. To treat, move the employee to a cool place and give sips of water or an electrolytic drink. Watch for signs of heat exhaustion or heat stroke.

Heat Exhaustion. Heat exhaustion is a mild form of shock caused by increased stress on various organs to meet increased demand to cool the body. Onset is gradual and symptoms should subside within 1 hour. Symptoms include a weak pulse; shallow breathing; pale, cool, moist skin; profuse sweating; dizziness; and fatigue. To treat, move the employee to a cool place and remove as much clothing as possible. Give sips of water or electrolytic solution and fan the person continuously to remove heat by convection. Do not allow the affected person to become chilled. Treat for shock if necessary.

Heat Stroke. Heat stroke is the most severe form of heat stress; the body must be cooled immediately to prevent severe injury and/or death. ***This is a medical emergency!*** Symptoms include red, hot, dry skin; a body temperature of 105° F or higher; no perspiration; nausea; dizziness and confusion; and a strong, rapid pulse. Because heat stroke is a true medical emergency, transport the patient to a medical facility immediately. Prior to transport, remove as much clothing as possible and wrap the patient in a sheet soaked with water. Fan the patient vigorously while transporting to help reduce body temperature. If available, apply cold packs under the arms, around the neck, or any other place where they can cool large surface blood vessels. If transportation to a medical facility is delayed, reduce body temperature by immersing the patient in a cool-water bath (however, be careful not to over-chill the patient once body temperature is reduced below 102° F). If this is not possible, keep the patient wrapped in a sheet and continuously douse with water and fan.

12.2.2.2 Prevention

The implementation of preventative measures is the most effective way to limit the effects of heat-related illnesses. During periods of high heat, adequate liquids must be provided to replace lost body fluids. Replacement fluids can be a 0.1% saltwater solution, a commercial mix such as Gatorade, or a combination of these with fresh water. The replacement fluid temperature should be kept cool, 50° F to 60° F, and should be placed close to the work area. Employees must be encouraged to drink more than the amount required to satisfy thirst. Employees should also be encouraged to salt their foods more heavily during hot times of the year.

Cooling devices such as vortex tubes or cooling vests can be worn beneath impermeable clothing. If cooling devices are worn, only physiological monitoring will be used to determine work activity.

All site personnel are to rest when any symptoms of heat stress are noticed. Rest breaks are to be taken in a cool, shaded rest area. Employees shall remove chemical protective garments during rest periods and will not be assigned other tasks.

All employees shall be informed of the importance of adequate rest and proper diet, including the harmful effects of excessive alcohol and caffeine consumption.

12.2.2.3 Monitoring

Heat stress monitoring should be performed when employees are working in environments exceeding 90° F ambient air temperature. If employees are wearing impermeable clothing, this monitoring should begin at 77° F. There are two general types of monitoring that the health and safety representative can designate to be used: wet bulb globe temperature (WBGT), and physiological. The Heat Stress Monitoring Record form (see Appendix A) will be used to record the results of heat stress monitoring.

Note that some states such as Washington and California have specific regulatory standards for protection of employees from heat stress-related injuries.

Wet Bulb Globe Temperature (WBGT). The WBGT index is the simplest and most suitable technique to measure the environmental factors that most nearly correlate with core body temperature and other physiological responses to heat. When WBGT exceeds 25° C (77° F), the work regiment in Table 12-4 should be followed.

Table 12-4
Permissible Heat Exposure Threshold Limit Values

Work/Rest Regimen	Workload		
	Light	Moderate	Heavy
Continuous work	86° F (30.0° C)	80° F (26.7° C)	77° F (25.0° C)
75% work, 25% rest each hour	87° F (30.6° C)	82° F (28.0° C)	78° F (25.9° C)
50% work, 50% rest, each hour	89° F (31.4° C)	85° F (29.4° C)	82° F (27.9° C)
25% work, 75% rest, each hour	90° F (32.2° C)	88° F (31.1° C)	86° F (30.0° C)
These TLVs assume that nearly all acclimated, fully-clothed site personnel with adequate water and salt intake should be able to function effectively under the given working conditions without exceeding a deep body temperature of 100.4° F (38° C).			

(From OSHA Technical Manual, Section III: Chapter 4 - Heat Stress)

The TLVs denoted in Table 12-4 apply to physically fit and acclimatized individuals wearing light, summer clothing. If heavier clothing that impedes sweat or has a higher insulation value is required, the permissible heat exposure TLVs should be adjusted based on the WBGT Correction Factors in Table 12-5.

Table 12-5
WBGT Correction Factors

Clothing Type	WBGT Correction
Summer lightweight working clothing	0° F (0° C)
Cotton coveralls	-3.6° F (-2° C)
Winter work clothing	-7.2° F (-4° C)
Water barrier, permeable	-10.8° F (-6° C)
Fully encapsulating	-14.4° F (-10° C)

Physiological. Physiological monitoring can be used in lieu of, or in addition to, WBGT. This monitoring can be self-performed once the health and safety representative demonstrates appropriate techniques to affected employees. Because individuals vary in their susceptibility to heat, this type of monitoring has its advantages. The following two parameters are to be monitored at the beginning of each rest period:

- **Heart Rate** – The maximum heart rate (MHR) is the amount of work (beats) per minute a healthy person's heart can be expected to safely deliver. Each individual will count his/her radial (wrist) pulse for 1 minute as early as possible during each rest period. If the heart rate of any individual exceeds 75% of his/her calculated MHR (MHR = 200 - age) at the beginning of the rest period, then the work cycle will be decreased by one-third. The rest period will remain the same. An individual is not permitted to return to work until his/her sustained heart rate is below 75% of his/her calculated MHR.
- **Temperature** – Each individual will measure his/her temperature with a thermometer for 1 minute as early as possible in the first rest period. If the temperature exceeds 99.6° F at the beginning of the rest period, then the work cycle will be decreased by one-third. The rest period will remain the same. An individual is not permitted to return to work if his/her temperature exceeds 100.4° F.

12.2.2.4 Training

Employees potentially exposed to heat stress conditions will be instructed on the contents of this procedure. This training can be conducted during daily tailgate safety meetings.

12.2.3 Insects/Spiders

Observe the following general procedures and practices regarding insects/spiders:

- Tuck pants into socks.
- Wear long sleeves.
- Use insect repellent.

- Avoid contact by always looking ahead to where you will be walking, standing, sitting, leaning, grabbing, lifting, or reaching.
- Check for signs of insect/spider bites, such as redness, swelling, and flu-like symptoms.

The most dangerous spiders to humans in North America are black widows and brown spiders (also known as brown recluse or fiddleback spiders). A guide to identifying these spiders is presented in Table 12-6.

Table 12-6
North American Hazardous Spider Identification Guide

Hazardous Spider Identification Guide	
Black Widow Spider • Abdomen usually shows hourglass marking • Female is 3 to 4 centimeters in diameter • Have been found in well casings and flush-mount covers • Not aggressive, but more likely to bite if guarding eggs • Light, local swelling and reddening are early signs of a bite, followed by intense muscular pain, rigidity of the abdomen and legs, difficulty breathing, and nausea • If bitten, see a physician as soon as possible	
Brown Spiders (aka Brown Recluse or Fiddleback) • Found in the central and southern United States, although in some other areas, as well • 1/4-to-1/2-inch-long body, and size of a silver dollar • Hide in baseboards, ceiling cracks, and undisturbed piles of material • Bite may either go unnoticed or may be followed by a severe localized reaction, including scabbing, necrosis of the affected tissue, and very slow healing • If bitten, see a physician as soon as possible	

12.2.4 Bees and Wasps

Many encounters with bees and wasps occur when nests built in well casings or excavation areas are disturbed. Before opening a well casing, take a few moments to observe whether or not insects are entering or exiting. If they are flying to and from the casing, avoid it if possible. If you must be in an area where disturbing a nest is likely, be sure to wear long pants and a long-sleeved shirt. Stinging insects fly around the top of their target, so if you get into trouble, pull a portion of your shirt over your head and run away.

If you get stung, look for a stinger and, if present, remove it as soon as possible. Several over-the-counter products or a simple cold compress can be used to alleviate the pain of the sting. If the sting is followed by severe symptoms, or if it occurs in the neck or the mouth, seek medical attention immediately because swelling could cause suffocation.

If you need to destroy a nest, consult with the PM and project FL first. Commercially available stinging insect control aerosols are very effective, but could potentially contaminate the well. Once the nest is destroyed, fine mesh may be applied over the exit and entry points of a well casing to prevent re-infestation.

12.2.5 Mosquitoes

Mosquitoes in the United States have been known to carry West Nile virus, Zika virus, St. Louis encephalitis, and Dengue fever. Avoid mosquito bites by doing the following:

- Apply insect repellent containing DEET (N,N-diethyl-meta-toluamide) when outdoors. DEET is very effective, but could potentially contaminate samples.
- Read and follow the product directions whenever you use insect repellent.
- Wear long-sleeved clothes and long pants treated with repellent to further reduce your risk, or stay indoors during peak mosquito feeding hours (dusk until dawn).
- Limit the number of places available for mosquitoes to lay their eggs by eliminating standing water sources from around the work area.
- If you need to destroy a nest, consult with the PM and project FL first.
- Check to see if there is an organized mosquito control program near the project site. If no program exists, work with the local government officials to establish a program.

12.2.6 Bird Droppings

Large populations of roosting birds may present a disease risk. The most serious health risks arise from disease organisms that grow in the accumulations of bird droppings, feathers, and debris under a roost—especially if roosts have been active for years. Among the fungal diseases associated with bird droppings, the two most common are Histoplasmosis and Cryptococcosis.

If you are working in an area where large quantities of droppings are present, follow certain precautions to minimize the risk from disease organisms in the droppings:

- Wear a respirator that can filter particles as small as 0.3 microns, such as a HEPA filter.
- Wear disposable protective gloves, hat, coveralls, and boots if you will be in close contact.
- Wash or shower at the work site after cleanup, if possible.
- If allowable, modify the structure or use methods to prevent birds from re-establishing the roost.

12.2.7 Poisonous Plants

Poisonous plants include poison ivy, poison oak, and poison sumac as shown in Table 12-7. Observe the following procedures and practices regarding poisonous plants:

- Avoid entering areas infested with poisonous plants.
- Immediately wash any areas that come into contact with poisonous plants.
- Use PPE when there is a possibility of contact with poisonous plants.

Table 12-7
North American Hazardous Plant Identification Guide

Hazardous Plant Identification Guide		
Poison Ivy • Grows in the West, Midwest, Texas, and the East Coast • Several forms—vine, trailing shrub, or shrub • Three leaflets (can vary from three to nine) • Leaves are green in summer and red in fall • Yellow or green flowers • White berries		
Poison Oak • Grows in the East (New Jersey to Texas) and Pacific Coast • 6-foot tall shrubs or long vines • Oak-like leaves in clusters of three • Yellow berries		
Poison Sumac • Grows in boggy areas, especially in the Southwest and Northern United States • Shrub up to 15 feet tall • Seven to 13 smooth-edged leaflets • Glossy pale yellow or cream-colored berries		

If you have been exposed to poison ivy, oak, or sumac, act quickly because the toxin in the plants penetrates the skin within minutes. If possible, stay outdoors until you complete the first two steps:

1. Cleanse the exposed skin with generous amounts of isopropyl alcohol.
2. Wash the skin with water.
3. Take a regular shower with soap and warm water. Do not use soap until this point because it will pick up the toxin from the surface and move it around.
4. Wash clothes, tools, and anything else that may have been in contact with the toxin with alcohol and water. Be sure to wear hand protection during that process.

Signs and symptoms of exposure include redness and swelling that appears 12 to 48 hours after exposure. Blistering and itching will follow. If you have had a severe reaction in the past, you should see a physician right away. Over-the-counter products that are available to alleviate symptoms include Cortaid®, Lanacort®, baking soda, Aveeno® oatmeal baths, and calamine lotion.

12.2.8 The Public at Large

The community residents around worksites may pose their own specific hazards. These conditions may include the following:

- Unintentional disruption of work
- Benign or malicious trespass
- Criminal intent

Scenarios may include the following:

- Pedestrians, cyclists, or motorists disregarding site boundaries due to distraction or willful disobedience.
- Public use of private site facilities for shelter, relief, and other reasons with no ill-intention.
- Public use of private site facilities for mischievous or criminal activity, such as loitering, vandalism, or theft.
- Encounters with community members who are disgruntled with the project activity.
- Encounters with criminal activities on or near a project site.

If any of the above are anticipated to be likely, take the following precautions as appropriate:

- Verify that the site is adequately marked and barricaded to limit unintentional disruptions of the work by the public.
- Review the site for attractive nuisances (e.g., hazards or conditions that are likely to attract children), and mitigate those.
- Secure all equipment and site facilities to prevent unauthorized access or use.
- Remove valuable items from the site or adequately secure them on site to limit the temptation for potential criminals.
- Have contact information for the client's or owner's public relations office while on site, and direct disgruntled community members to that office. If necessary, vacate the site to relieve the situation and notify the PM or FL.
- Work in pairs when uncertain of the public safety situation at a site. In questionable situations, postpone work as necessary until a plan of action can be developed to verify a safe working environment.

12.2.9 Personal Health and Safety

In addition to hazards associated with chemicals of concern, equipment, operations or site conditions discussed above, there may be additional personal safety issues to consider at a site, including those related to one or multiple protected classes, such as race, gender, religion, ability, sexual orientation, or gender identity. These conditions may involve the following, perpetrated by the public or those associated with the work:

- Malicious disruption of work
- Harassment, including unwanted comments, gestures, or actions
- Threats of violence, either implied (using derogatory language) or explicit
- Assault

It is critical that the work environment be discussed within the project team to evaluate risks, ways to avoid those risks, and communication protocols. Anchor QEA requires that work be performed in teams.

Specifically, if any of the above are anticipated, take the following precautions as appropriate:

- Alert the PM, FL, CHSM, and/or Human Resources Department of potential issue(s).
- Formulate a plan of action to verify and maintain a safe working environment prior to field work, which may include the following:
  - Working in pairs and/or within a certain physical distance of other work groups.
  - Coordinated check-ins (calls to or from the office or visual check-ins with other field members).
- Whenever possible, schedule work only within daylight hours (which fluctuate seasonally) or on weekends when questionable scenarios may be more minimal.
  - If night work is required, maintain a minimum of two field personnel at all times, and potentially increase the total number of personnel.
  - If working in high-risk areas, discuss the possibility of hiring security if work needs to be performed at night, in low light, or near potentially dangerous areas (e.g., abandoned buildings, public displays of hostility, discrimination, or gang-related activity).
- Maintain a field phone with active GPS and non-locking 911 capability at all times while out in the field.
- If a need arises for a change in field work (e.g., additional sampling or moving to an area that was not planned) or travel plans (e.g., dead battery or flat tire), immediately alert the FL and PM as to the event.

In addition, practice active awareness of your environment. Discuss personal health and safety concerns at the daily tailgate meeting. If you feel unsafe based on the potential behavior of others,

immediately bring it up to field team coworkers. If the issue is not resolved to your satisfaction, alert the PM, FL, CHSM, and/or Human Resources Department to assist in resolving any potential issue(s).

13 Medical Surveillance Program

This section describes the medical surveillance program that Anchor QEA field personnel must comply with when working on sites where there is a potential for exposure to hazardous wastes or other hazardous substances.

13.1 General Requirements

Anchor QEA employees shall be enrolled in a medical surveillance program in compliance with OSHA standards (29 CFR 1910.120(f)) under the following circumstances.

If they are involved with any of the following operations:

- *Cleanup operations* required by a governmental body, whether federal, state, local, or other involving hazardous substances that are conducted at uncontrolled hazardous waste sites (including, but not limited to, the EPA's National Priority List [NPL] sites, state priority list sites, sites recommended for the EPA NPL, and initial investigation of government-identified sites that are conducted before the presence or absence of hazardous substances has been ascertained)
- *Corrective actions* involving cleanup operations at sites covered by the Resource Conservation and Recovery Act of 1976 (RCRA) as amended (42 United States Code 6901 et seq)
- *Voluntary cleanup operations* at sites recognized by federal, state, local, or other governmental bodies as uncontrolled hazardous waste sites
- *Operations involving hazardous wastes* that are conducted at treatment, storage, and disposal (TSD) facilities regulated by 40 CFR 264 and 40 CFR 265 pursuant to RCRA or by agencies under agreement with the EPA to implement RCRA regulations
- *Emergency response operations* for releases of, or substantial threats of releases of, hazardous substances without regard to the location of the hazard

And, if they meet the following criteria:

- Are or may be exposed to hazardous substances or health hazards at or above the established PEL, above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more per year

In addition, employees are required to be enrolled in the medical surveillance program if they meet any of the following conditions:

- Wear a respirator for 30 days or more per year
- 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 operations

- Are members of a Hazardous Materials (HAZMAT) team

Anchor QEA employees required to be enrolled in a medical surveillance program under 29 CFR 1910.120(f) shall have medical examinations and consultations made available to them by Anchor QEA on the following schedule:

- Prior to assignment
- At least once every 12 months unless the attending physician believes a longer interval (not greater than biennially) is appropriate
- At termination of employment or reassignment to an area where the employee would not be covered if the employee has not had an examination within the last 6 months
- As soon as possible upon notification that the employee has developed signs or symptoms indicating possible overexposure to hazardous substances or health hazards, or that the employee has been injured or exposed above the PEL or published exposure levels in an emergency situation
- At more frequent times, if the examining physician determines that an increased frequency of examination is medically necessary

The content of medical examinations or consultations made available to employees shall be determined by the attending physician but shall include, at a minimum, a medical and work history with special emphasis on symptoms related to the handling of hazardous substances and health hazards, and to fitness for duty including the ability to wear any required PPE under conditions (i.e., temperature extremes) that may be expected at the work site.

The attending physician shall provide Anchor QEA with a written opinion for each examined employee that contains the following information:

- Whether the employee has any detected medical conditions that would place the employee at an increased risk of impairment of the employee's health from hazardous waste operations work, emergency response, or respirator use
- Any recommended limitations on the employee's assigned work
- A statement that the employee has been informed of the results of the medical examination and any medical conditions that require further examination or treatment

The written opinion obtained by Anchor QEA shall not reveal specific findings or diagnoses unrelated to occupational exposures. Medical surveillance and other employee-related medical records shall be retained for at least the duration of employment plus 30 years.

13.2 Team Self Monitoring

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

- Headaches
- Dizziness
- Nausea
- Blurred vision
- Cramps
- Irritation of eyes, skin, or respiratory system
- Skin chafing from damp or wet clothing
- Changes in complexion or skin color
- Changes in apparent motor coordination
- Increased frequency of minor mistakes
- Excessive salivation or changes in papillary response
- Changes in speech ability or speech pattern
- Symptoms of heat stress or heat exhaustion
- Symptoms of hypothermia

If any of these conditions develop, the affected person will be moved from the immediate work location and evaluated. If further assistance is needed, personnel at the local hospital will be notified, and an ambulance will be summoned if the condition is thought to be serious. If the condition is the result of sample collection or processing activities, procedures and/or PPE will be modified to address the problem.

14 References

Farallon (Farallon Consulting) and Anchor (Anchor Environmental), 2005. Final Remedial Investigation Report – Evergreen Fuel Facility, 661 East Pine Street, Shelton, Washington. Prepared by Farallon and Anchor for CC Cole and Sons, Inc., D.B.A. Evergreen Fuel Company and Chevron Corporation. November 2005.

Herrera (Herrera Environmental Consultants), 2008. Summary of Existing Information and Identification of Data Gaps Technical Memorandum, Oakland Bay, Shelton, Washington. Prepared by Herrera Environmental Consultants, Inc. for Ecology. May 2008.

Appendix A
Health and Safety Logs and Forms

Daily Air Monitoring Record

Project Name: _____ **Date:** _____

Project Number: _____ **Location:** _____

Temperature: _____

Conditions: _____

COC	Instrument	S/N	Calibration Date	Calibration Gas/Method	Calibration by
Organic vapors					
Particulates					
O_2					
Other:					
Other:					
Other:					

Time	Location/Description	Organic Vapor (ppm)	O2%	CG %LEL	Other	Other

Notes:

Completed by:

Printed Name _____ Signature _____ Date _____

Daily Safety Briefing Form

Date: _____

Project No: _____

Project Name: _____

Person Conducting Meeting: _____ **Health & Safety Officer:** _____ **Project Manager:** _____

TOPICS COVERED:

- ☐ Emergency Procedures and Evacuation Route
- ☐ Directions to Hospital
- ☐ HASP Review and Location
- ☐ Safety Equipment Location
- ☐ Proper Safety Equipment Use
- ☐ Employee Right-to-Know/ SDS Location
- ☐ Fire Extinguisher Location
- ☐ Eye Wash Station Location
- ☐ Buddy System
- ☐ Self and Coworker Monitoring
- ☐ Lines of Authority
- ☐ Communication
- ☐ Site Security
- ☐ Vessel Safety Protocols
- ☐ Work Zones
- ☐ Vehicle Safety and Driving/ Road Conditions
- ☐ Equipment Safety and Operation
- ☐ Proper Use of PPE
- ☐ Decontamination Procedures
- ☐ Near Miss Reporting Procedures
- ☐ Lifting Techniques
- ☐ Slips, Trips, and Falls
- ☐ Hazard Exposure Routes
- ☐ Heat and Cold Stress
- ☐ Overhead and Underfoot Hazards
- ☐ Chemical Hazards
- ☐ Flammable Hazards
- ☐ Biological Hazards
- ☐ Eating/Drinking/Smoking
- ☐ Reviewed Prior Lessons Learned
- ☐ Field Team Medical Conditions for Emergency Purposes (Confidential): _____
- ☐ Other: _____

Weather Conditions: _____

Daily Work Scope: _____

Site-specific Hazards: _____

Safety Comments: _____

Attendees

Printed Name	Signature

Employee Exposure/Injury Incident/Spill Report

Employee Name: _____ **Date:** _____

Project Name/No: _____ **Time:** _____

Type of Occurrence: ☐ employee exposure ☐ injury incident ☐ spill

Site Name and Location: _____

Site Weather: *(clear, rain, snow, etc.)* _____

Nature of Illness/Injury: _____

Symptoms: _____

Action Taken: ☐ rest ☐ first aid ☐ medical

Transported By: _____ **Witnessed By:** _____

Hospital Name: _____

Treatment: _____

Describe in detail how this exposure/injury incident/spill occurred: *(if a spill, list the name of the compounds, quantities, and method of cleanup/containment)* _____

_____

_____

_____

_____

_____

What was the person doing at the time of the accident/incident?: _____

_____

List personal protective equipment worn: _____

_____

What immediate action was taken to prevent recurrence?: _____

_____

Employee:

Printed Name	Signature	Date

Supervisor:

Printed Name	Signature	Date

Site Safety Representative:

Printed Name	Signature	Date

NOTE: Use additional page(s) if necessary.

Field Safety Equipment Checklist

The following is a list of safety-related gear that may be appropriate depending on the type of work being conducted. The purpose of this checklist is twofold: 1) ensure that all field crew members think about appropriate safety gear needs before heading to the worksite; and 2) provide an extensive list of gear to consider in order to serve as a reminder of potential safety gear needs during a field effort.

☐ **Safety Briefing Log or Notebook**

Personal Protective Gear

- ☐ Rain pants and jacket
- ☐ Hard hats
- ☐ Boots (steel-toed, if appropriate)
- ☐ Safety glasses
- ☐ Ear protection
- ☐ Nitrile gloves (inner and outer pair)
- ☐ Tyvek overalls
- ☐ H_2S sensor
- ☐ Flashlight
- ☐ EpiPen (inquire if any field staff use one)
- ☐ Other:

Warm Weather Safety Gear

- ☐ Sunscreen
- ☐ Water
- ☐ Hat
- ☐ Light clothes

Cold Weather Safety Gear

- ☐ Warm clothes (preferably synthetics)
- ☐ Hat
- ☐ Gloves
- ☐ Boot warmers
- ☐ Thermos of warm drink/soup

Communications

- ☐ Notify office staff of day's field plan
- ☐ Walkie Talkies
- ☐ Cell phones
- ☐ Satellite phone (if appropriate)
- ☐ Contact numbers (e.g., for other field crew members, the PM, or others to notify that you are accessing site)

General Gear for Work Near Water

- ☐ Life jacket
- ☐ Boots or waders (hip or chest)
- ☐ Throwline

Boat Safety Gear

U.S. Coast Guard Required Gear:

- ☐ 1. Personal flotation device (PFD), preferably life jacket, for each occupant
- ☐ 2. Fire extinguisher (filled to operable range)
- ☐ 3. Flares (unexpired)
- ☐ 4. Horn
- ☐ 5. Navigation lights

- ☐ First aid kit
- ☐ Bowline and stern line
- ☐ Anchor and anchor line
- ☐ Paddle
- ☐ Spare propeller and linchpin
- ☐ Appropriate personal protective gear (boots or waders) to step onto shore if necessary
- ☐ Drain plug (and spare)
- ☐ Boat fuel and oil
- ☐ Weather radio (if appropriate)
- ☐ Weather, tides, and currents forecasts
- ☐ Warm clothes/blanket in dry bag

Modification to Health and Safety Plan

Date: _____

Project No: _____

Project Name: _____

Modification: _____

_____

_____

_____

_____

Reason for Modification: _____

_____

_____

_____

_____

_____

Site Personnel Briefed

Name: _____ **Date:** _____

Name: _____ **Date:** _____

Name: _____ **Date:** _____

Name: _____ **Date:** _____

Name: _____ **Date:** _____

Name: _____ **Date:** _____

Name: _____ **Date:** _____

Name: _____ **Date:** _____

Name: _____ **Date:** _____

Name: _____ **Date:** _____

Approvals

Field Lead: _____ _____ _____
Printed Name | Signature | Date

Project Manager: _____ _____ _____
Printed Name | Signature | Date

Heat Stress Monitoring Record

Date: ______________________________

Project No: ______________________________

Project Name: ______________________________

Location: ______________________________

Employee Name	Monitoring Results												
	Initial Reading Time:	First Work Period Time:		Second Work Period Time:		Third Work Period Time:		Fourth Work Period Time:		Fifth Work Period Time:		Sixth Work Period Time:	
	WBGT (°F):	WBGT (°F):		WBGT (°F):		WBGT (°F):		WBGT (°F):		WBGT (°F):		WBGT (°F):	
	Air Temp (°F):	Air Temp (°F):		Air Temp (°F):		Air Temp (°F):		Air Temp (°F):		Air Temp (°F):		Air Temp (°F):	
	Initial Temp:	Initial Temp:	Final Temp:	Initial Temp:	Final Temp:	Initial Temp:	Final Temp:	Initial Temp:	Final Temp:	Initial Temp:	Final Temp:	Initial Temp:	Final Temp:
	Initial H.R.:	Initial H.R.:	Final H.R.:	Initial H.R.:	Final H.R.:	Initial H.R.:	Final H.R.:	Initial H.R.:	Final H.R.:	Initial H.R.:	Final H.R.:	Initial H.R.:	Final H.R.:
	Initial Temp:	Initial Temp:	Final Temp:	Initial Temp:	Final Temp:	Initial Temp:	Final Temp:	Initial Temp:	Final Temp:	Initial Temp:	Final Temp:	Initial Temp:	Final Temp:
	Initial H.R.:	Initial H.R.:	Final H.R.:	Initial H.R.:	Final H.R.:	Initial H.R.:	Final H.R.:	Initial H.R.:	Final H.R.:	Initial H.R.:	Final H.R.:	Initial H.R.:	Final H.R.:
	Initial Temp:	Initial Temp:	Final Temp:	Initial Temp:	Final Temp:	Initial Temp:	Final Temp:	Initial Temp:	Final Temp:	Initial Temp:	Final Temp:	Initial Temp:	Final Temp:
	Initial H.R.:	Initial H.R.:	Final H.R.:	Initial H.R.:	Final H.R.:	Initial H.R.:	Final H.R.:	Initial H.R.:	Final H.R.:	Initial H.R.:	Final H.R.:	Initial H.R.:	Final H.R.:
	Initial Temp:	Initial Temp:	Final Temp:	Initial Temp:	Final Temp:	Initial Temp:	Final Temp:	Initial Temp:	Final Temp:	Initial Temp:	Final Temp:	Initial Temp:	Final Temp:
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	Initial H.R.:	Initial H.R.:	Final H.R.:	Initial H.R.:	Final H.R.:	Initial H.R.:	Final H.R.:	Initial H.R.:	Final H.R.:	Initial H.R.:	Final H.R.:	Initial H.R.:	Final H.R.:

Notes:

Completed by:

______________________ ______________________ ______________

Printed Name Signature Date

Utility Contact Prevention Checklist

NOTE: Utility mark-out requirements vary from state to state; consult state authorities before beginning work.

Purpose: This form is intended to help the Field Lead confirm that underground or overhead utilities are identified to the extent practicable and consistent with applicable regulations **PRIOR** to site work.

INVESTIGATIONS MUST NOT OCCUR UNTIL MULTIPLE LINES OF EVIDENCE INDICATE THAT SUBSURFACE OR OVERHEAD UTILITIES ARE NOT PRESENT IN THE WORK AREA

Project Name/No: _____ **Date:** _____

Field Lead: _____ **Project Address:** _____

Project Manager: _____ **Health & Safety Officer:** _____

Emergency Contact Information for One Call: _____

Duration/Summary of Work to be Performed: _____

_____

_____

Consideration	Check		Explanation	Initial
Has the state One Call been contacted?	☐ Yes	☐ No		
Has the property owner or client been contacted for local knowledge of utilities, as applicable?	☐ Yes	☐ No		
Does the property owner or client have specific utility contact prevention procedures and, if so, have they been completed?	☐ Yes	☐ No		
Are any as-built drawings available? If so, do they show any utilities?	☐ Yes	☐ No		
Has a visual inspection of the work area(s) been completed?	☐ Yes	☐ No		
Has the potential presence of in-water utilities been assessed (shore markers, streets dead-ending at water's edge, etc.)	☐ Yes	☐ No		
Is evidence of electrical utilities present? (electric meters on structures, conduits, overhead lines, light poles, etc.)	☐ Yes	☐ No		
Is evidence of water/sewer utilities present? (water meter, hydrants, restrooms, grates in ground, etc.)	☐ Yes	☐ No		
Is evidence of telecommunications utilities present? (fiber optic warning signs, conduits from utility poles, wall-mounted boxes, etc.)	☐ Yes	☐ No		
Is other evidence of utilities present? (unknown ground markings, manholes or valve covers, "Call Before You Dig" signs, linear asphalt or concrete repair characteristics, liner subsidence of ground surface, pin flags or stakes, etc.)	☐ Yes	☐ No		

Utility Contact Prevention Checklist

NOTE: Utility mark-out requirements vary from state to state; consult state authorities before beginning work.

Consideration	Check		Explanation	Initial
Has a private locating service been contacted?	☐ Yes	☐ No		
Were any utilities identified and marked out through a private locating service? If so, duplicate mark-outs on site drawings.	☐ Yes	☐ No		
Are there any fiber optic cables, fuel lines, or high-pressure lines within 50 feet of work locations?	☐ Yes	☐ No		
If fiber optic cables, fuel lines, or high-pressure lines are within 50 feet, has an agreement with the utility owner been established?	☐ Yes	☐ No		
Can a test borehole be advanced by hand digging, probing, post-hole digging, and/or air knifing to 5 feet below ground surface (bgs)?	☐ Yes	☐ No		
If hand digging, probing, post-hole digging, and/or air knifing to 5 feet bgs is not possible, can a non-invasive geophysical investigation be conducted? If not, why?	☐ Yes	☐ No		
Other considerations:				

NOTE: Please fill in second page and attach additional reports, drawings, or other information, as necessary.

Confirmation Number: _____

Contact Name: _____ **Organization:** _____

Contact Date: _____ **Contact Time:** _____

Response: _____

_____

_____

_____

Completed by:

_____ _____ _____

Printed Name Signature Date

Contractor:

_____ _____ _____

Printed Name Signature Date

Appendix B
Job Safety Analysis (JSA) Documents

Job Safety Analysis

Field Activities

Project Name: Shelton Harbor Sediment Cleanup Unit	**Project Number:** 110008-01.01	**JSA Number:** 001	**Issue Date:** April 19, 2017
Location: Shelton, Washington	**Contractor:** Anchor QEA, LLC	**Analysis by:** Eli Patmont	**Analysis Date:** April 19, 2017
Work Operation: Field activities	**Superintendent/Competent Person:** Nathan Soccorsy	**Revised by:** Nathan Soccorsy	**Revised Date:** June 12, 2017
Required Personal Protective Equipment (PPE): • Modified Level D – Long pants, long sleeves, and/or Tyvek coveralls if handling potentially contaminated media, and steel-toed footwear conforming to ASTM International (ASTM) F2412-05/ASTM F2413-05 • Safety glasses/splash goggles, hard hat, nitrile outer gloves • U.S. Coast Guard-approved personal flotation device (PFD; see cold stress section for cold-weather PFD information)		**Reviewed by:** Nora Kochie	**Reviewed Date:** July 6, 2017
		Approved by: Nathan Soccorsy	**Approved Date:** July 6, 2017

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
If boating		• Follow the Job Safety Analysis (JSA) for boating activities.	
Outdoor, physical activity	Slips, trips, and falls	• Be aware of potentially slippery surfaces and tripping hazards. Use handrails where available. Wear footwear that has sufficient traction. • Maintain good housekeeping practices. Clean up all spills immediately. • Be aware of weather effects on the work area, including wet and/or frozen ground. • Jumping, running, and horseplay are prohibited. • Keep all areas clean and free of debris to prevent any trips and falls. • Be aware of and limit loose clothing or untied shoelaces that may contribute to slips, trip, and falls • Notify the field team members of any unsafe conditions.	• Routinely inspect work area for unsafe conditions.
	Heat stress	• Adjust work schedules, as necessary, to avoid the hottest part of the day. • Take rest breaks as warranted. • Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods. • Maintain body fluids at normal levels. • Train workers to recognize the symptoms of heat-related illness.	• Monitor workers' physical conditions. • Monitor outside temperature versus worker activity.

Job Safety Analysis

Field Activities

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Outdoor, physical activity (continued)	Rain/snow	• Wear appropriate PPE (rain gear). • Be aware of slip hazards, puddles, and electrical hazards when working in wet conditions. • If extremely cold conditions are forecast, consider additional precautions or postponing work activity.	• Inspect PPE daily prior to use. • Routinely inspect work area for deteriorating conditions.
	Sunshine	• Have sunscreen available for ultraviolet protection. • Have abundant water available to prevent dehydration. • Consider wearing wide-brimmed headwear and light-colored, lightweight, sun-blocking clothing.	• Ensure that sunscreen and water are available.
	Lightning	• Do not begin or continue work until lightning subsides for at least 20 minutes. Disconnect and do not use or touch electronic equipment. • Immediately head for shore if on the water and lightning is observed. If not able to get to shore, disconnect and do not use or touch the major electronic equipment, including the radio, throughout the duration of the storm.	• Obtain weather forecast and updates as needed.
	High winds	• Wear goggles or safety glasses if dust or debris are visible.	• Ensure that goggles or safety glasses are available.
	Noise exposure	• Wear hearing protection in high noise environments or when working around heavy machinery or equipment (action level of 85 decibels averaged over an 8-hour day).	• Ensure that hearing protection is available.

Training Requirements:

- All personnel working on hazardous waste sites must receive appropriate training as required by 29 Code of Federal Regulations (CFR) 1910.120(e), including but not limited to initial 40-hour, 8-hour supervisor, and annual 8-hour refresher trainings.
- Medical clearance must be received on an annual basis as required by 29 CFR 1910.120(f).
- If boating is involved, and a professional captained vessel is not in use, boat operators must take the appropriate state boater safety courses.
- All assigned employees are required to familiarize themselves with the contents of this JSA before starting a work activity and review it with their supervisor during their daily safety meeting.

Job Safety Analysis

Sediment Sampling

Project Name: Shelton Harbor Sediment Cleanup Unit	**Project Number:** 110008-01.01	**JSA Number:** 002	**Issue Date:** April 19, 2017
Location: Shelton, Washington	**Contractor:** Anchor QEA, LLC	**Analysis by:** Eli Patmont	**Analysis Date:** April 19, 2017
Work Operation: Sediment sampling	**Superintendent/Competent Person:** Nathan Soccorsy	**Revised by:** Nathan Soccorsy	**Revised Date:** June 12, 2017
Required Personal Protective Equipment (PPE): • Modified Level D – Long pants, long sleeves, and/or Tyvek coveralls if handling potentially contaminated media, and steel-toed footwear conforming to ASTM International (ASTM) F2412-05/ASTM F2413-05 • Safety glasses/splash goggles, hard hat, nitrile outer gloves • U.S. Coast Guard-approved personal flotation device (PFD; see cold stress section for cold-weather PFD information)		**Reviewed by:** Nora Kochie	**Reviewed Date:** July 6, 2017
		Approved by: Nathan Soccorsy	**Approved Date:** July 6, 2017

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
If boating		• Follow the Job Safety Analysis (JSA) for boating activities.	
If using glassware		• Follow the JSA for handling glassware.	
Sediment sample retrieval and processing	Injury from hand and power tool operation (e.g., spatula or drill)	• Be aware of sharp edges on hand tools (e.g., spatulas, knives, drill bits, and saw blades). • Be aware of electrical connections and water hazards when working with electric- or battery-operated tools. • Ensure that all tools are working properly; repair or replace defective tools. Repair when unplugged and off. • Keep guards on power tools when not in use.	• Inspect tools to ensure that they are in good working order. • Inspect electrical connections (if applicable). • Inspect tools periodically to ensure dry and clean operation.
	Noise exposure	• Wear hearing protection in high noise environments or when working around heavy machinery or equipment (action level of 85 decibels averaged over an 8-hour day).	• Ensure that hearing protection is available.

Job Safety Analysis

Sediment Sampling

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Sediment sample retrieval and processing (continued)	Slips, trips, and falls	• Be aware of potentially slippery surfaces, including boat decks, riprap, muddy or algae-covered rocks, shoreline plants/seaweed, thick mud, and tripping hazards. Use handrails where available. Wear footwear that has sufficient traction. • Maintain good housekeeping practices. Clean up all spills immediately. • Be aware of weather effects on the work area, including wet and/or frozen ground. • Jumping, running, and horseplay are prohibited. • Be cautious when entering or exiting the vessel, and load/unload items onto/off of the pier or shore once boarded. • Keep all areas clean and free of debris to prevent any trips and falls. • Notify the field team members of any unsafe conditions.	• Routinely inspect work area for unsafe conditions.
	Ingestion of contaminants, skin/eye contact with contaminants	• Wear appropriate PPE to prevent/reduce exposure. • Contact 911, as necessary; perform CPR if breathing stops. • Move exposed person away from source of contamination, and rinse mouth. If exposure to skin occurs, promptly wash contaminated skin using soap or mild detergent and water. Rinse eyes with large amounts of water. • Follow decontamination procedures as outlined in the Health and Safety Plan (HASP).	• Ensure that decontamination procedures are on hand and are reviewed. • Ensure that PPE and rinsing water are available.
	Muscle strain or injuries from improper lifting	• Use proper lifting techniques or ask for assistance with heavy objects. • If boating, avoid carrying objects directly onto or off the boat; rather, load/unload objects while on the boat to/from the pier/shore.	• Evaluate weight and center of gravity of heavier items prior to lifting or moving.
	Pinch points	• If boating, secure any unsecured objects on deck; they may shift on deck quickly in wave, current, or engine acceleration conditions. • Maintain a safe distance from closing mechanisms and moving parts on sampling gear. • Avoid placing hands or self between boat and dock/piles.	
	Wading	• Be aware of potentially slippery surfaces and tripping hazards such as fallen brush, logs, rocks, and other debris. Wear footwear that has sufficient traction. • Be aware of water depth and potential drop-offs. • Be aware of existing and projected river flows. • Wear knee or chest waders as appropriate for traction and to protect against cold water. • Keep extra dry clothes on hand, including socks. • Consider carrying a walking staff for balance. • Always wear a PFD, even if water looks shallow or slow; drop-offs occur and water is often moving faster than it looks.	• Inspect work area for tripping hazards visible from streambank. • Inspect waders for leaks. • Check depths and flows before wading. • Ensure that change of dry clothes is available if wading in cold weather or cold water conditions.

Job Safety Analysis

Sediment Sampling

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Working outdoors	Heat stress	• Adjust work schedules, as necessary, to avoid the hottest part of the day. • Take rest breaks as warranted. • Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods. • Maintain body fluids at normal levels. • Train workers to recognize the symptoms of heat-related illness.	• Monitor workers' physical conditions. • Monitor outside temperature versus worker activity.
	Rain/snow	• Wear appropriate PPE (rain gear). • Be aware of slip hazards, puddles, and electrical hazards when working in wet conditions. • If extremely cold conditions are forecast, consider additional precautions or postponing work activity.	• Inspect PPE daily prior to use. • Routinely inspect work area for deteriorating conditions.
	Sunshine	• Have sunscreen available for ultraviolet protection. • Have abundant water available to prevent dehydration. • Consider wearing wide-brimmed headwear and light-colored, lightweight, sun-blocking clothing.	• Ensure that sunscreen and water are available.
	Lightning	• Do not begin or continue work until lightning subsides for 20 minutes. Disconnect and do not use or touch electronic equipment. • Immediately head for shore if on the water and lightning is observed. If not able to get to shore, disconnect and do not use or touch the major electronic equipment, including the radio, throughout the duration of the storm.	• Obtain weather forecast and updates as needed.
	High winds	• Wear goggles or safety glasses if dust or debris are visible.	• Ensure that goggles or safety glasses are available.

Training Requirements:

- All personnel working on hazardous waste sites must receive appropriate training as required by 29 Code of Federal Regulations (CFR) 1910.120(e), including but not limited to initial 40-hour, 8-hour supervisor, and annual 8-hour refresher trainings.
- Medical clearance must be received on an annual basis as required by 29 CFR 1910.120(f).
- If boating is involved, and a professional captained vessel is not in use, boat operators must take the appropriate state boater safety courses.

Job Safety Analysis

Sediment Sampling

- All assigned employees are required to familiarize themselves with the contents of this JSA before starting a work activity and review it with their supervisor during their daily safety meeting.

Job Safety Analysis

General Boating Activities

Project Name: Shelton Harbor Sediment Cleanup Unit	**Project Number:** 110008-01.01	**JSA Number:** 003	**Issue Date:** April 19, 2017
Location: Shelton, Washington	**Contractor:** Anchor QEA, LLC	**Analysis by:** Eli Patmont	**Analysis Date:** April 19, 2017
Work Operation: General boating activities	**Superintendent/Competent Person:** Nathan Soccorsy	**Revised by:** Nathan Soccorsy	**Revised Date:** June 12, 2017
Required Personal Protective Equipment (PPE): • Modified Level D – Long pants, long sleeves, and/or Tyvek coveralls if handling potentially contaminated media, and steel-toed footwear conforming to ASTM International (ASTM) F2412-05/ASTM F2413-05 • Safety glasses/splash goggles, hard hat, nitrile outer gloves • U.S. Coast Guard-approved personal flotation device (PFD; see cold stress section for cold-weather PFD information)		**Reviewed by:** Nora Kochie	**Reviewed Date:** July 6, 2017
		Approved by: Nathan Soccorsy	**Approved Date:** July 6, 2017

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Walking on deck	Pinch points	• Secure any unsecured objects on deck; they may shift quickly in wave, current, or engine acceleration conditions. • Maintain a safe distance from closing mechanisms and moving parts, such as on sampling gear. • Avoid placing your hands or yourself between the boat and the dock or piles.	
	Slips, trips, and falls	• Be aware of potentially slippery surfaces, including boat decks, riprap, muddy or algae-covered rocks, shoreline plants or seaweed, thick mud, and tripping hazards. Use handrails where available. Wear footwear that has sufficient traction. • Maintain good housekeeping practices. Clean up all spills immediately. • Be aware of weather effects on the work area, including wet and/or frozen ground. • Jumping, running, and horseplay are prohibited. • Be cautious when entering or exiting the vessel, and load/unload items onto/off of the pier or shore once boarded. • Keep all areas clean and free of debris to prevent any trips and falls. • Notify the field team members of any unsafe conditions. • Keep rope lines neatly coiled and stowed. Avoid stepping on or over lines.	• Routinely inspect work area for unsafe conditions.

Job Safety Analysis

General Boating Activities

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
	Exceeding boat capacity	• Keep the number of passengers and equipment as posted on boat placards within limits at all times. If conditions warrant, reduce capacity to maintain boat stability.	• Ensure that field team is aware of limits and adheres accordingly.
Walking on deck (continued)	Noise exposure	• Wear hearing protection in high noise environments or when working around heavy machinery or equipment (action level of 85 decibels averaged over an 8-hour day).	• Ensure that hearing protection is available.
Working outdoors	Heat stress	• Adjust work schedules, as necessary, to avoid the hottest part of the day. • Take rest breaks as warranted. • Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods. • Maintain body fluids at normal levels. • Train workers to recognize the symptoms of heat-related illness.	• Monitor workers' physical conditions. • Monitor outside temperature versus worker activity.
	Rain/snow	• Wear appropriate PPE (rain gear). • Be aware of slip hazards, puddles, and electrical hazards when working in wet conditions. • If extremely cold conditions are forecast, consider additional precautions or postponing work activity.	• Inspect PPE daily prior to use. • Routinely inspect work area for deteriorating conditions.
	Sunshine	• Have sunscreen available for ultraviolet protection. • Have abundant water available to prevent dehydration. • Consider wearing wide-brimmed headwear and light-colored, lightweight, sun-blocking clothing.	• Ensure that sunscreen and water are onboard.
	Fog	• Wait for fog to lift for adequate visibility.	
	Lightning	• Do not begin or continue work until lightning subsides for at least 20 minutes. Disconnect and do not use or touch electronic equipment. • Immediately head for shore if on the water and lightning is observed. • If not able to get to shore, disconnect and do not use or touch the major electronic equipment, including the radio, throughout the duration of the storm.	• Obtain weather forecast and updates as needed.
	High river flows or high waves	• Be aware of waves and forecasts and recent rainfall in your watershed.	• Have forecast available.
Working outdoors (continued)	High winds	• Wear goggles or safety glasses if dust or debris are visible. • Stow or secure loads or equipment that could be moved by wind, particularly when underway.	• Ensure that goggles or safety glasses are onboard.

Job Safety Analysis

General Boating Activities

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Vessel emergencies	Man overboard	• Shout "man overboard," throw flotation device, keep engine away from person, and call 911 or USCG if needed.	• Ensure that floatation devices are available. • Ensure that team wears PFDs.
	Fire, abandon ship	• Be prepared to abandon ship in case of major fire or other emergency. Only the captain can order abandon ship. • Communicate intent to abandon to all personnel; notify USCG and nearby vessels. • Call 911 when able to do so; notify project safety personnel when time permits.	• Ensure that fire extinguisher is available, current, and in working order. • Review abandon ship procedures with field team prior to work.
Navigation	Boat traffic	• Maintain a safe operating distance from shoreline and other vessels.	• Be aware of on-water surroundings.
Motor vehicle operation and trailering	Boat not secured properly	• Ensure that latches, straps, antennas, and onboard gear are secure. Ensure that motor is up and lights are plugged in for driving. • Follow Job Safety Analysis (JSA) for motor vehicle operation.	• Inspect around entire boat before driving.

Training Requirements:

- All personnel working on hazardous waste sites must receive appropriate training as required by 29 Code of Federal Regulations (CFR) 1910.120(e), including but not limited to initial 40-hour, 8-hour supervisor, and annual 8-hour refresher trainings.
- Medical clearance must be received on an annual basis as required by 29 CFR 1910.120(f).
- If professional captained vessel is not in use, boat operators must take appropriate state boater safety courses.
- All assigned employees are required to familiarize themselves with the contents of this JSA before starting a work activity and review it with their supervisor during their daily safety meeting.

Job Safety Analysis

Decontamination Activities

Project Name: Shelton Harbor Sediment Cleanup Unit	**Project Number:** 110008-01.01	**JSA Number:** 004	**Issue Date:** April 19, 2017
Location: Shelton, Washington	**Contractor:** Anchor QEA, LLC	**Analysis by:** Eli Patmont	**Analysis Date:** April 19, 2017
Work Operation: Decontamination activities	**Superintendent/Competent Person:** Nathan Soccorsy	**Revised by:** Nathan Soccorsy	**Revised Date:** June 12, 2017
Required Personal Protective Equipment (PPE): • Modified Level D – Long pants, long sleeves, and/or Tyvek coveralls if handling potentially contaminated media, and steel-toed footwear conforming to ASTM International (ASTM) F2412-05/ASTM F2413-05 • Safety glasses/splash goggles, hard hat, nitrile outer gloves • U.S. Coast Guard-approved personal flotation device (PFD; see cold stress section for cold-weather PFD information)		**Reviewed by:** Nora Kochie	**Reviewed Date:** July 6, 2017
		Approved by: Nathan Soccorsy	**Approved Date:** July 6, 2017

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
If boating		• Follow the Job Safety Analysis (JSA) for boating activities.	
Decontamination area set up	Vehicle, heavy equipment traffic, or boat traffic in work area	• Wear safety vest and hard hat PPE. • Be alert when working around heavy equipment and/or other boats, especially if wearing hearing protection.	• Ensure that safety vests are available for staff and visitors.
	Muscle strain or injuries from improper lifting	• Use proper lifting techniques or ask for assistance with heavy objects. • If boating, avoid carrying objects directly onto or off of the boat; rather, load/unload objects while on the boat to/from the pier/shore.	• Evaluate weight and center of gravity of heavier items prior to lifting or moving.
Decontamination activities	Injury from hand and power tool operation (e.g., spatula or drill)	• Be aware of sharp edges on hand tools (e.g., spatulas, knives, drill bits, and saw blades). • Be aware of electrical connections and water hazards when working with electric- or battery-operated tools. • Ensure that all tools are working properly; repair or replace defective tools. Repair when unplugged and off. • Keep guards on power tools when not in use.	• Inspect tools to ensure that they are in good working order. • Inspect electrical connections (if applicable). • Inspect tools periodically to ensure dry and clean operation.

Job Safety Analysis

Decontamination Activities

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
	Noise exposure	• Wear hearing protection in high noise environments or when working around heavy machinery or equipment (action level of 85 decibels averaged over an 8-hour day).	• Ensure that hearing protection is available.
	Slips, trips, and falls	• Be aware of potentially slippery surfaces and tripping hazards. Use handrails where available. Wear footwear that has sufficient traction. • Maintain good housekeeping practices. Clean up all spills immediately. • Be aware of weather effects on the work area, including wet and/or frozen ground. • Jumping, running, and horseplay are prohibited. • Keep all areas clean and free of debris to prevent any trips and falls. • Notify the field team members of any unsafe conditions.	• Routinely inspect work area for unsafe conditions.
	Ingestion of contaminants, skin/eye contact with contaminants	• Wear appropriate PPE to prevent/reduce exposure. • Contact 911, as necessary; perform CPR if breathing stops. • Move exposed person away from source of contamination, and rinse mouth. If exposure to skin occurs, promptly wash contaminated skin using soap or mild detergent and water. Rinse eyes with large amounts of water. • Follow decontamination procedures as outlined in the Health and Safety Plan (HASP).	• Ensure that decontamination procedures are on hand and are reviewed. • Ensure that PPE and rinsing water are available.
Working outdoors	Heat stress	• Adjust work schedules, as necessary, to avoid the hottest part of the day. • Take rest breaks as warranted. • Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods. • Maintain body fluids at normal levels. • Train workers to recognize the symptoms of heat-related illness.	• Monitor workers' physical conditions. • Monitor outside temperature versus worker activity.
	Rain/snow	• Wear appropriate PPE (rain gear). • Be aware of slip hazards, puddles, and electrical hazards when working in wet conditions. • If extremely cold conditions are forecast, consider additional precautions or postponing work activity.	• Inspect PPE daily prior to use. • Routinely inspect work area for deteriorating conditions.
	Sunshine	• Have sunscreen available for ultraviolet protection. • Have abundant water available to prevent dehydration. • Consider wearing wide-brimmed headwear and light-colored, lightweight, sun-blocking clothing.	• Ensure that sunscreen and water are available.
	Lightning	• Do not begin or continue work until lightning subsides for at least 20 minutes. Disconnect and do not use or touch electronic equipment.	• Obtain weather forecast and updates as needed.
	High winds	• Wear goggles or safety glasses if dust or debris are visible.	• Ensure that goggles or safety glasses are available.

Job Safety Analysis

Decontamination Activities

Training Requirements:

- All personnel working on hazardous waste sites must receive appropriate training as required by 29 Code of Federal Regulations (CFR) 1910.120(e), including but not limited to initial 40-hour, 8-hour supervisor, and annual 8-hour refresher trainings.
- Medical clearance must be received on an annual basis as required by 29 CFR 1910.120(f).
- If boating is involved, and a professional captained vessel is not in use, boat operators must take the appropriate state boater safety courses.
- All assigned employees are required to familiarize themselves with the contents of this JSA before starting a work activity and review it with their supervisor during their daily safety meeting.

Job Safety Analysis

Anchor QEA Motor Vehicle Operation

Project Name: Shelton Harbor Sediment Cleanup Unit	**Project Number:** 110008-01.01	**JSA Number:** 005	**Issue Date:** April 19, 2017
Location: Shelton, Washington	**Contractor:** Anchor QEA, LLC	**Analysis by:** Eli Patmont	**Analysis Date:** April 19, 2017
Work Operation: Anchor QEA motor vehicle operation	**Superintendent/Competent Person:** Nathan Soccorsy	**Revised by:** Nathan Soccorsy	**Revised Date:** June 12, 2017
Required Personal Protective Equipment (PPE): • Wear seat belt at all times • Make sure that clothing will not interfere with driving		**Reviewed by:** Nora Kochie	**Reviewed Date:** July 6, 2017
		Approved by: Nathan Soccorsy	**Approved Date:** July 6, 2017

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Anchor QEA motor vehicle operation	Unfamiliar with the vehicle	• Allow yourself some time to get familiar with an Anchor QEA vehicle, a rental vehicle, or one not used very often. • Test the lights, windshield wipers, hazard lights, horn, parking brake, and other important functions. • Review the dashboard controls, steering radius, and overhead and side clearances. • Allow extra side, front, and back space around the vehicle while driving or parking an unfamiliar vehicle. • Adjust mirrors and the seat while the vehicle is in park. • Drive slowly in confined locations, as in a parking garage, parking lots, or industrial settings. Confirm adequate clearances by sight before turning or backing up in tight or unfamiliar locations. • Use a second person to be a spotter outside the vehicle if needed in tight spaces.	• Inspect fluid levels and air pressure in tires, adjust mirrors and seat positions appropriately, monitor the fuel level, and fill up when the fuel level is low
	Speed	• Fasten and properly adjust the seat belt. • Obey all posted speed limits. • Radar detectors are prohibited in all company-owned, leased, or rented vehicles. • Reduce travel speed during hazardous conditions (e.g., rain, fog, or snow). • Identify whether your vehicle has Anti-Lock Brakes (ABS). If it does, DO NOT pump the brakes to stop when the vehicle has begun to skid. Apply steady pressure to the brakes. If the vehicle does not have ABS, pump the brakes to stop during slippery conditions.	• Seatbelt

Job Safety Analysis

Anchor QEA Motor Vehicle Operation

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Anchor QEA motor vehicle operation (continued)	Distance spacing	• Continually check your rear and side view mirrors. • Use the 3-second rule to keep a safe distance between vehicles. • Increase the 3-second rule as necessary during hazardous travel conditions. • Regularly scan the area you will be entering in the next 10 to 12 seconds. • Always leave yourself an "out" during travel. • When stopping, make sure that you leave enough distance between you and the car in front of you. You should be able to see the rear tires of the vehicle in front when stopped. • Obey the speed limit and traffic regulations. • When at a red light and it turns green, use the "delayed start" technique, by counting to three before you take your foot off the brake. • DO NOT TAILGATE. • Keep headlights (and running lights, if available) on for maximum visibility.	• Seatbelt
	Skids	• If the vehicle has begun to skid out of control, turn the steering wheel in the direction of the skid and re-adjust the wheel, as necessary. • Reduce speed during hazardous travel conditions. • Use 4-wheel drive, if available, when driving vehicles off-road, on steep inclines, or in muddy conditions. • Do not take vehicles off-road if they cannot be operated safely.	• Seatbelt
	Blind spots	• Become familiar with any blind spots associated with your vehicle. • Adjust mirrors to give the maximum viewing area. • Use your directional devices to signal all turns and when changing lanes; check rear and side view mirror and glance over your shoulder to check that the lane is clear. • Avoid other driver's blind spots; slow down and let the other vehicle pass. • If parked for an extended period and staying in the vehicle, be sure to inspect the area for changed conditions (e.g., a car that moved in behind you) before leaving.	• Seatbelt • Mirrors
	Backing	• Back into parking spaces upon arrival whenever possible. • Perform a 360-degree walk around the vehicle before backing to identify any new conditions or obstructions. • Use a spotter when backing whenever possible. • Understand hand signals. • Sound the horn prior to backing. • Check the rear and side view mirrors prior to backing. • Back slowly in areas of obstructed vision. • Anticipate others who may be backing out into your pathway and adjust accordingly.	• Seatbelt • Mirrors

Job Safety Analysis

Anchor QEA Motor Vehicle Operation

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Anchor QEA motor vehicle operation (continued)	Distractions (e.g., cell phones, reading maps or directions, eating)	• Obey state or local laws regarding cell phone use, at a minimum. • Certain clients prohibit cell phone use regardless of the state you are operating in—know your client's policy. • Use hands-free devices (not hand-held cellular phones) while driving. • Pull over to the side of the road when making a call or checking directions.	• Seatbelt • Hands-free devices connected and ready for use
	Accidents	• In the event of an accident, use the following procedures: – Stop, call for medical assistance, notify police, and complete an accident report and submit it to your supervisor. – Notify the Project Manager (PM) and Field Lead (FL). – Complete the appropriate incident investigation reports. – Contact Debbie Ashton, Operations Manager, at (503) 924-6172. – Contact Diana Reynolds, Insurance Liaison, at (302) 236-8403.	• Seatbelt
	Influenced by drugs or alcohol	• NEVER DRIVE UNDER THE INFLUENCE OF DRUGS OR ALCOHOL. • Keep in mind that the person in another vehicle may be under the influence of controlled substances, and be prepared for erratic or sudden driving changes on their part.	• Seatbelt
	Driver attitude	• Do not operate any vehicle when abnormally tired, temporarily disabled (i.e., injured), or under the influence of drugs or alcohol. • Keep an even temper when driving. Do not let the actions of others affect your attitude. • Do not allow yourself to become frustrated, rushed, distracted, or drowsy.	• Seatbelt
	Fatigue	• Stop and rest if fatigued. Exit the road and enter a safe area. Rest until fully refreshed. • Be aware that certain medications (such as cold or allergy medicines) may make you drowsy when driving a vehicle.	• Seatbelt
	Vehicle loading	• DO NOT OVERLOAD the vehicle. • Secure all equipment and supplies within the body of the vehicle using proper tie-downs. • Do not block side view mirrors with the load. • Do not transport U.S. Department of Transportation (DOT)-manifested hazardous materials. • Dispatch all equipment and personnel with proper forms and identification.	• Seatbelt

Job Safety Analysis

Anchor QEA Motor Vehicle Operation

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Anchor QEA motor vehicle operation (continued)	Equipment failure	• Perform daily inspections of your vehicle. • Maintain vehicle safety equipment (e.g., mirrors, alarms, horns, wipers, lights, and brakes). • Maintain the vehicle (e.g., tire pressure and fluid levels). • Any vehicle with mechanical defects that may endanger the safety of the driver, passengers, or the public shall not be used. • Ensure that appropriate safety equipment is in the vehicle. Safety equipment should include a spare tire, jack, first-aid kit, fire extinguisher, and flashlight. Flares and/or reflective triangles should be available in larger trucks. • Ensure that the proper documentation is in the vehicle. Documentation should include an operations manual for the vehicle, insurance card, vehicle registration, and accident forms.	• Seatbelt

Training Requirements:

- All drivers are required to have a valid driver's license, and all vehicles must have appropriate state vehicle registration and inspection stickers. The use of hand-held wireless devices is prohibited while driving any vehicle for business use at any time, for personal use during business hours, and as defined by law.
- **If operating a vehicle or vehicle and trailer with a capacity greater than 10,000 pounds, U.S. Department of Transportation regulations may apply. Contact the PM prior to any travel in this configuration.**
- All assigned employees are required to read, familiarize themselves with the contents of this Job Safety Analysis, and sign the signature page before the operation of an Anchor QEA vehicle, and review it with their supervisor during their daily safety meeting.
- All assigned employees are required to enroll and complete the Smith System Virtual Driving training programs (*Distracted Driving* and *Small Vehicle Forward - Five Keys to Safe Driving*) prior to driving an Anchor QEA vehicle.

Job Safety Analysis

Anchor QEA Motor Vehicle Operation

Vehicle Operation Job Safety Analysis Acknowledgement Form

The Anchor QEA Motor Vehicle Operation Job Safety Analysis must be read, understood, and signed before the operation of any Anchor QEA vehicle. My signature below certifies that I have read and understand the procedures presented in the Anchor QEA Motor Vehicle Operation Job Safety Analysis and have completed the Smith System Virtual Driving *Distracted Driving* and *Small Vehicle Forward - Five Keys to Safe Driving* training programs.

Date	Name (print)	Signature

Job Safety Analysis

Anchor QEA Motor Vehicle Operation

Date	Name (print)	Signature

Job Safety Analysis

Sample and Laboratory Glassware Handling

Project Name: Shelton Harbor Sediment Cleanup Unit	**Project Number:** 110008-01.01	**JSA Number:** 006	**Issue Date:** April 19, 2017
Location: Shelton, Washington	**Contractor:** Anchor QEA, LLC	**Analysis by:** Eli Patmont	**Analysis Date:** April 19, 2017
Work Operation: Sample and laboratory glassware handling	**Superintendent/Competent Person:** Nathan Soccorsy	**Revised by:** Nathan Soccorsy	**Revised Date:** June 12, 2017
Required Personal Protective Equipment (PPE): • Modified Level D – Long pants, long sleeves, and/or Tyvek coveralls if handling potentially contaminated media, and steel-toed footwear conforming to ASTM International (ASTM) F2412-05/ASTM F2413-05 • Safety glasses/splash goggles, hard hat, nitrile outer gloves • U.S. Coast Guard-approved personal flotation device (PFD; see cold stress section for cold-weather PFD information)		**Reviewed by:** Nora Kochie	**Reviewed Date:** July 6, 2017
		Approved by: Nathan Soccorsy	**Approved Date:** July 6, 2017

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Transporting and using glassware	Breakage of containers during field activities	• Use appropriately sized tubs or bottle carriers with dividers to prevent bottle-to-bottle contact during transport. • Consider using coated glassware, if practicable. • Carry oversize bottles in tubs or bottle carriers using both hands during transfer to the sampling vessel and whenever the vessel is underway.	• Ensure dividers are sufficient and will remain in place during transport.
	Faulty glassware	• Replace any glassware that is chipped, nicked, or cracked.	• Inspect glassware before use.
	Impact with equipment and other objects	• Use care when loading and unloading sampling equipment. • Minimize the handling of individual containers to the extent possible.	
Filling sample containers	Over-tightening of bottle lids causing breakage	• Avoid use of excessive force to tighten bottle caps (i.e., finger tight). • Secure lids with clear tape to prevent opening during transport.	
	Breakage during sample collection	• Place containers in plastic tubs between aliquots to limit contact with hard surfaces. • Place containers on a stable and non-slip surface during collection. • Use the buddy system as needed to hold bottles during filling.	

Job Safety Analysis

Sample and Laboratory Glassware Handling

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Filling sample containers (continued)	Contact with sample preservatives (generally HCL or H_2SO_4 to lower pH to less than 2)	• Wear nitrile gloves and protective eyewear to prevent skin and eye contact if a container is damaged. • Do not open preserved bottles until necessary.	
Packing samples for shipment	Breakage during packing and shipment	• Use bottle wraps, foam sleeves, or bubble wrap to prevent bottle contact in the cooler. • Pack coolers snugly, but do not over pack.	• Ensure glass bottles do not touch to minimize potential breakage during transport.

Training Requirements:

- All personnel working on hazardous waste sites must receive appropriate training as required by 29 Code of Federal Regulations (CFR) 1910.120(e), including, but not limited to initial 40-hour, 8-hour supervisor, and annual 8-hour refresher trainings.
- Medical clearance must be received on an annual basis as required by 29 CFR 1910.120(f).
- All assigned employees are required to familiarize themselves with the contents of this JSA before starting a work activity and review it with their supervisor during their daily safety meeting.

Job Safety Analysis

Investigation-derived Waste Management

Project Name: Shelton Harbor Sediment Cleanup Unit	**Project Number:** 110008-01.01	**JSA Number:** 007	**Issue Date:** April 19, 2017
Location: Shelton, Washington	**Contractor:** Anchor QEA, LLC	**Analysis by:** Eli Patmont	**Analysis Date:** April 19, 2017
Work Operation: Investigation-derived waste management	**Superintendent/Competent Person:** Nathan Soccorsy	**Revised by:** Nathan Soccorsy	**Revised Date:** June 12, 2017
Required Personal Protective Equipment (PPE): • Modified Level D – Long pants, long sleeves, and/or Tyvek coveralls if handling potentially contaminated media, and steel-toed footwear conforming to ASTM International (ASTM) F2412-05/ASTM F2413-05 • Safety glasses/splash goggles, hard hat, nitrile outer gloves • U.S. Coast Guard-approved personal flotation device (PFD; see cold stress section for cold-weather PFD information)		**Reviewed by:** Nora Kochie	**Reviewed Date:** July 6, 2017
		Approved by: Nathan Soccorsy	**Approved Date:** July 6, 2017

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Containerizing investigation-derived waste (IDW) at the source	Lifting	• Use care when lifting to redistribute IDW from one container (e.g., drums and buckets) to another at the source. • Seek assistance if loads are too heavy, or if you are experiencing fatigue. • Fill containers only to the degree that will be manageable in the future (e.g., half full) and to limit weight.	• Inspect containers for competency (i.e., no cracks, and handles in good repair).
	Pinch points	• Wear hand protection when closing containers. • Use the buddy system when affixing drum rings.	• Inspect drums for rust or sharp edges prior to opening or closing.
Relocating or staging IDW containers	Lifting	• Use task-specific tools whenever possible to move full containers (i.e., hoists, drum caddies or dollies, and vehicles). • When task-specific tools are not available, use the buddy system to move containers that are reasonable to lift. • Never roll drums or containers holding IDW. • Stage containers in areas protected from heavy traffic and weather, if possible.	• Ensure tools are in good repair. • Assess IDW container weight prior to moving.

Job Safety Analysis

Investigation-derived Waste Management

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Relocating or staging IDW containers (continued)	Pinch points or crushing	• Use tools to achieve the final arrangement when staging containers—do not place hands on the edges of containers while moving them into place. • Stand well clear of containers being moved in case they become dislodged from their handling tool during transport. • Do not stack IDW containers, as this poses a risk for container toppling and damage. • Place containers on a wooden pallet for easy transfer using a pallet jack, if possible.	• Inspect drums for evidence of cracks or rust.
IDW management – general	Splash	• Wear the required PPE at all times. • Use care to minimize splashing or smearing of IDW during handling and containerization.	• Inspect PPE upon donning and periodically during tasks.

Training Requirements:

- All personnel working on hazardous waste sites must receive appropriate training as required by 29 Code of Federal Regulations (CFR) 1910.120(e), including but not limited to initial 40-hour, 8-hour supervisor, and annual 8-hour refresher trainings.
- Medical clearance must be received on an annual basis as required by 29 CFR 1910.120(f).
- All assigned employees are required to familiarize themselves with the contents of this JSA before starting a work activity and review it with their supervisor during their daily safety meeting.

Appendix C
Safety Data Sheets (SDS)

Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

Printing date: 31.12.2013 **Revision:** 31.12.2013

1 Identification of the substance/mixture and of the company/undertaking

· **1.1 Product identifier**

· **Trade name: ALCONOX**

· **1.2 Relevant identified uses of the substance or mixture and uses advised against**
No further relevant information available.

· **Application of the substance / the mixture:** Cleaning material/ Detergent

· **1.3 Details of the supplier of the Safety Data Sheet**
· **Manufacturer/Supplier:**
Alconox, Inc.
30 Glenn St., Suite 309
White Plains, NY 10603
Phone: 914-948-4040
· **Further information obtainable from:** Product Safety Department

· **1.4 Emergency telephone number:**
ChemTel Inc.
(800)255-3924, +1 (813)248-0585

2 Hazards identification

· **2.1 Classification of the substance or mixture**
· **Classification according to Regulation (EC) No 1272/2008**


GHS05 corrosion
Eye Dam. 1; H318: Causes serious eye damage.


GHS07
Skin Irrit. 2; H315: Causes skin irritation.

· **Classification according to Directive 67/548/EEC or Directive 1999/45/EC**

Xi; Irritant
R38-41: Irritating to skin. Risk of serious damage to eyes.
· **Information concerning particular hazards for human and environment:**
The product has to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.
· **Classification system:**
The classification is according to the latest editions of the EU-lists, and extended by company and literature data.
The classification is in accordance with the latest editions of international substances lists, and is supplemented by information from technical literature and by information provided by the company.

· **2.2 Label elements**
· **Labelling according to Regulation (EC) No 1272/2008**
The product is classified and labelled according to the CLP regulation.

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Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

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Trade name: ALCONOX

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· **Hazard pictograms**

GHS05

· **Signal word:** Danger

· **Hazard-determining components of labelling:**
sodium dodecylbenzene sulfonate

· **Hazard statements**
H315: Causes skin irritation.
H318: Causes serious eye damage.

· **Precautionary statements**
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P264: Wash thoroughly after handling.
P305+P351+P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310: Immediately call a POISON CENTER or doctor/physician.
P321: Specific treatment (see on this label).
P362: Take off contaminated clothing and wash before reuse.
P332+P313: If skin irritation occurs: Get medical advice/attention.
P302+P352: IF ON SKIN: Wash with plenty of soap and water.

· **Hazard description:**

· **WHMIS-symbols:**
D2B - Toxic material causing other toxic effects

· **NFPA ratings (scale 0 - 4)**

Health = 1
Fire = 0
Reactivity = 0

· **HMIS-ratings (scale 0 - 4)**

Health = 1
Fire = 0
Reactivity = 0

· **HMIS Long Term Health Hazard Substances**
None of the ingredients is listed.

· **2.3 Other hazards**

· **Results of PBT and vPvB assessment**

· **PBT:** Not applicable.

· **vPvB:** Not applicable.

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Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

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Trade name: ALCONOX

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3 Composition/information on ingredients

· **3.2 Mixtures**
· **Description:** Mixture of substances listed below with nonhazardous additions.

· **Dangerous components:**		
CAS: 68081-81-2	sodium dodecylbenzene sulfonate Xn R22; Xi R36 Acute Tox. 4, H302; Eye Irrit. 2, H319	10-25%
CAS: 497-19-8 EINECS: 207-838-8 Index number: 011-005-00-2	Sodium Carbonate Xi R36 Eye Irrit. 2, H319	2,5-10%
CAS: 7722-88-5 EINECS: 231-767-1	tetrasodium pyrophosphate substance with a Community workplace exposure limit	2,5-10%
CAS: 151-21-3 EINECS: 205-788-1	sodium dodecyl sulphate Xn R21/22; Xi R36/38 Acute Tox. 4, H302; Acute Tox. 4, H312; Skin Irrit. 2, H315; Eye Irrit. 2, H319	2,5-10%

· **Additional information:** For the wording of the listed risk phrases refer to section 16.

4 First aid measures

· **4.1 Description of first aid measures**
· **After inhalation:** Supply fresh air; consult doctor in case of complaints.
· **After skin contact:**
Immediately wash with water and soap and rinse thoroughly.
If skin irritation continues, consult a doctor.
· **After eye contact:**
Remove contact lenses if worn.
Rinse opened eye for several minutes under running water. If symptoms persist, consult a doctor.
· **After swallowing:**
Rinse out mouth and then drink plenty of water.
Do not induce vomiting; call for medical help immediately.
· **4.2 Most important symptoms and effects, both acute and delayed**
No further relevant information available.
· **4.3 Indication of any immediate medical attention and special treatment needed**
No further relevant information available.

5 Firefighting measures

· **5.1 Extinguishing media**
· **Suitable extinguishing agents:**
CO2, powder or water spray. Fight larger fires with water spray or alcohol resistant foam.

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Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

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· **5.2 Special hazards arising from the substance or mixture:** No further relevant information available.
· **5.3 Advice for firefighters**
· **Protective equipment:**
Wear self-contained respiratory protective device.
Wear fully protective suit.
· **Additional information:** No further relevant information available.

6 Accidental release measures

· **6.1 Personal precautions, protective equipment and emergency procedures**
Product forms slippery surface when combined with water.
· **6.2 Environmental precautions:** Do not allow to enter sewers/ surface or ground water.
· **6.3 Methods and material for containment and cleaning up:**
Pick up mechanically.
Clean the affected area carefully; suitable cleaners are:
Warm water
· **6.4 Reference to other sections**
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

7 Handling and storage

· **7.1 Precautions for safe handling**
Prevent formation of dust.
Keep receptacles tightly sealed.
· **Information about fire - and explosion protection:** No special measures required.

· **7.2 Conditions for safe storage, including any incompatibilities**
· **Storage:**
· **Requirements to be met by storerooms and receptacles:** No special requirements.
· **Information about storage in one common storage facility:** Not required.
· **Further information about storage conditions:** Protect from humidity and water.
· **7.3 Specific end use(s):** No further relevant information available.

8 Exposure controls/personal protection

· **Additional information about design of technical facilities:** No further data; see item 7.

· **8.1 Control parameters**

· **Ingredients with limit values that require monitoring at the workplace:**	
7722-88-5 tetrasodium pyrophosphate	
REL (USA)	5 mg/m³
TLV (USA)	TLV withdrawn
EV (Canada)	5 mg/m³

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· **Additional information:** The lists valid during the making were used as basis.

· **8.2 Exposure controls**
· **Personal protective equipment:**
· **General protective and hygienic measures:**
Keep away from foodstuffs, beverages and feed.
Immediately remove all soiled and contaminated clothing.
Wash hands before breaks and at the end of work.
Avoid contact with the skin.
Avoid contact with the eyes and skin.
· **Respiratory protection:**
Not required under normal conditions of use.
In case of brief exposure or low pollution use respiratory filter device. In case of intensive or longer exposure use self-contained respiratory protective device.
· **Protection of hands:**

Protective gloves

The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.
Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation.
· **Material of gloves**
Butyl rubber, BR
Nitrile rubber, NBR
Natural rubber, NR
Neoprene gloves
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material cannot be calculated in advance and has therefore to be checked prior to the application.
· **Penetration time of glove material**
The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.
· **Eye protection:**

Safety glasses

· **Body protection:** Protective work clothing

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Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

Printing date: 31.12.2013 **Revision:** 31.12.2013

Trade name: ALCONOX

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9 Physical and chemical properties

· **9.1 Information on basic physical and chemical properties**	
· **General Information**	
· **Appearance:**	
Form:	Powder
Colour:	White
· **Odour:**	Odourless
· **Odour threshold:**	Not determined.
· **pH-value (10 g/l) at 20 °C:**	9,5 (- NA for Powder form)
· **Change in condition**	
Melting point/Melting range:	Not Determined.
Boiling point/Boiling range:	Undetermined.
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Not determined.
· **Ignition temperature:**	
Decomposition temperature:	Not determined.
· **Self-igniting:**	Product is not self-igniting.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapour pressure:**	Not applicable.
· **Density at 20 °C:**	1,1 g/cm³
· **Relative density**	Not determined.
· **Vapour density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with water:**	Soluble.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
· **Solvent content:**	
Organic solvents:	0,0 %
Solids content:	100 %
· **9.2 Other information**	No further relevant information available.

(Contd. on page 7)

Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

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Trade name: ALCONOX

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10 Stability and reactivity

· **10.1 Reactivity**
· **10.2 Chemical stability**
· **Thermal decomposition / conditions to be avoided:**
No decomposition if used according to specifications.
· **10.3 Possibility of hazardous reactions**
Reacts with acids.
Reacts with strong alkali.
Reacts with strong oxidizing agents.
· **10.4 Conditions to avoid:** No further relevant information available.
· **10.5 Incompatible materials:** No further relevant information available.
· **10.6 Hazardous decomposition products:**
Carbon monoxide and carbon dioxide
Phosphorus compounds
Sulphur oxides (SOx)

11 Toxicological information

· **11.1 Information on toxicological effects**
· **Acute toxicity:**
· **Primary irritant effect:**
· **On the skin:** Irritant to skin and mucous membranes.
· **On the eye:** Strong irritant with the danger of severe eye injury.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**
The product shows the following dangers according to the calculation method of the General EU Classification Guidelines for Preparations as issued in the latest version:
Irritant
Swallowing will lead to a strong caustic effect on mouth and throat and to the danger of perforation of esophagus and stomach.

12 Ecological information

· **12.1 Toxicity**
· **Aquatic toxicity:** No further relevant information available.
· **12.2 Persistence and degradability:** No further relevant information available.
· **12.3 Bioaccumulative potential:** Not worth-mentioning accumulating in organisms
· **12.4 Mobility in soil:** No further relevant information available.
· **Additional ecological information:**
· **General notes:**
Water hazard class 2 (German Regulation) (Self-assessment): hazardous for water.
Do not allow product to reach ground water, water course or sewage system.
Danger to drinking water if even small quantities leak into the ground.
· **12.5 Results of PBT and vPvB assessment**
· **PBT:** Not applicable.

(Contd. on page 8)

Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

Printing date: 31.12.2013 **Revision:** 31.12.2013

Trade name: ALCONOX

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· **vPvB:** Not applicable.
· **12.6 Other adverse effects:** No further relevant information available.

13 Disposal considerations

· **13.1 Waste treatment methods**
· **Recommendation**
Smaller quantities can be disposed of with household waste.
Small amounts may be diluted with plenty of water and washed away. Dispose of bigger amounts in accordance with Local Authority requirements.
The surfactant used in this product complies with the biodegradability criteria as laid down in Regulation (EC) No. 648/2004 on detergents. Data to support this assertion are held at the disposal of the competent authorities of the Member States and will be made available to them, at their direct request or at the request of a detergent manufacturer.

· **Uncleaned packaging:**
· **Recommendation:** Disposal must be made according to official regulations.
· **Recommended cleansing agents:** Water, if necessary together with cleansing agents.

14 Transport information

· **14.1 UN-Number** · **DOT, ADR, IMDG, IATA, ICAO**	Not Regulated
· **14.2 UN proper shipping name** · **DOT, ADR, IMDG, IATA, ICAO**	Not Regulated
· **14.3 Transport hazard class(es)** · **DOT, ADR, IMDG, IATA, ICAO** · **Class**	Not Regulated
· **14.4 Packing group** · **DOT, ADR, IMDG, IATA, ICAO**	Not Regulated
· **14.5 Environmental hazards:** · **Marine pollutant:**	No
· **14.6 Special precautions for user**	Not applicable.
· **14.7 Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	Not Regulated

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15 Regulatory information

· **15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture**
· **United States (USA)**
· **SARA**

· **Section 355 (extremely hazardous substances):**
None of the ingredients is listed.
· **Section 313 (Specific toxic chemical listings):**
None of the ingredients is listed.
· **TSCA (Toxic Substances Control Act):**
All ingredients are listed.

· **Proposition 65 (California):**

· **Chemicals known to cause cancer:**
None of the ingredients is listed.
· **Chemicals known to cause reproductive toxicity for females:**
None of the ingredients is listed.
· **Chemicals known to cause reproductive toxicity for males:**
None of the ingredients is listed.
· **Chemicals known to cause developmental toxicity:**
None of the ingredients is listed.

· **Carcinogenic Categories**

· **EPA (Environmental Protection Agency)**
None of the ingredients is listed.
· **IARC (International Agency for Research on Cancer)**
None of the ingredients is listed.
· **TLV (Threshold Limit Value established by ACGIH)**
None of the ingredients is listed.
· **NIOSH-Ca (National Institute for Occupational Safety and Health)**
None of the ingredients is listed.
· **OSHA-Ca (Occupational Safety & Health Administration)**
None of the ingredients is listed.

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· **Canada**

· **Canadian Domestic Substances List (DSL)**	
All ingredients are listed.	
· **Canadian Ingredient Disclosure list (limit 0.1%)**	
None of the ingredients is listed.	
· **Canadian Ingredient Disclosure list (limit 1%)**	
497-19-8	Sodium Carbonate
7722-88-5	tetrasodium pyrophosphate
151-21-3	sodium dodecyl sulphate

· **15.2 Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.

16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

· **Relevant phrases**
H302: Harmful if swallowed.
H312: Harmful in contact with skin.
H315: Causes skin irritation.
H319: Causes serious eye irritation.
R21/22: Harmful in contact with skin and if swallowed.
R22: Harmful if swallowed.
R36: Irritating to eyes.
R36/38: Irritating to eyes and skin.

· **Abbreviations and acronyms:**
ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road) IMDG: International Maritime Code for Dangerous Goods DOT: US Department of Transportation
IATA: International Air Transport Association
GHS: Globally Harmonized System of Classification and Labelling of Chemicals
ACGIH: American Conference of Governmental Industrial Hygienists
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)
WHMIS: Workplace Hazardous Materials Information System (Canada)