FINAL Remedial Investigation/ Feasibility Study Work Plan

Quiet Cove Property
Anacortes, Washington
Ecology Agreed Order No. DE 11346

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

January 25, 2017

GeoEngineers
Earth Science + Technology

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym/ Abbreviation	Description
AET	Apparent Effects Threshold
ARI	Analytical Resources, Inc.
ARARs	Applicable or Relevant and Appropriate Requirements
AST	aboveground storage tank
ASTM	ASTM International
BETX	benzene, ethylbenzene, toluene and xylenes
bgs	below ground surface
BSAF	biota-sediment accumulation factor
CF	conversion factor
CFR	Code of Federal Regulations
City	City of Anacortes
CLARC	Cleanup Levels and Risk Calculation
cPAHs	carcinogenic polycyclic aromatic hydrocarbons
COPC	contaminant of potential concern
CSL	Cleanup Screening Level
CUL_{sed}	sediment cleanup level
Cw	groundwater concentration protective of sediment
DAHP	Department of Archaeology and Historic Preservation
DCAP	Draft Cleanup Action Plan
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethylene
DP	direct-push
DPS	Distinct Population Segment
DNR	Washington Department of Natural Resources
Ecology	Washington State Department of Ecology
EDB	1,2 dibromoethane
EDC	1,2 dichloroethane

EPA	United States Environmental Protection Agency
EPH	extractable petroleum hydrocarbons
EPI	Estimation Program Interface
ESA	Endangered Species Act
ESU	evolutionarily significant unit
Frontier	Frontier Analytical
GeoEngineers	GeoEngineers, Inc.
GPS	global positioning system
HASP	Health and Safety Plan
HSA	hollow-stem auger
HSP	Habitat Survey Plan
HVOCs	halogenated volatile organic compounds
IPG	Integrated Planning Grant
ISIS	Integrated Site Information System
K_{oc}	organic carbon partitioning coefficient
L/kg	liter per kilogram
LIDAR	Light Detection and Ranging
mg/kg	milligrams per kilogram
MLLW	mean lower low water
MS	Manufacturing/Shipping
MTCA	Model Toxics Control Act
MTBE	methyl tertiary-butyl ether
ng/kg	nanograms per kilograms
NMFS	National Marine Fisheries Service (now NOAA Fisheries)
Order	Agreed Order No. DE 11346
ORNL	Oak Ridge National Laboratory
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PCSM	preliminary conceptual site model
Port	Port of Anacortes
ppm	parts per million
PPP	Public Participation Plan

PQL	practical quantitation limit
PSEP	Puget Sound Estuary Program
QA/QC	quality assurance/quality control
RAIS	Risk Assessment Information System
RAOs	remedial action objectives
RCW	Revised Code of Washington
RI/FS	remedial investigation/feasibility study
ROW	right-of-way
SAP	Sampling and Analysis Plan
SCO	Sediment Cleanup Objective
SCUM II	Sediment Cleanup User's Manual II
SIM	selective ion monitoring
Site	Quiet Cove
SMS	Sediment Management Standards
SVOCs	semi-volatile organic compounds
TEE	terrestrial ecological evaluation
TEF	toxicity equivalency factor
TEQ	toxicity equivalent (refers to concentration basis)
TOC	total organic carbon
TS	total solids
TVS	total volatile solids
USFWS	United States Fish and Wildlife Service
µg/L	micrograms per liter
µg/mg	micrograms per milligram
USGS	United States Geological Survey
VOCs	volatile organic compounds
VPH	volatile petroleum hydrocarbons
WAC	Washington Administrative Code

1.0 INTRODUCTION

This Remedial Investigation (RI)/Feasibility Study (FS) Work Plan (Work Plan) has been prepared for the Quiet Cove Property (Site) on behalf of the Port of Anacortes (Port). The Site is situated along the southeast shoreline of Guemes Channel at 202 O Avenue (at the intersection of 2nd Street and O Avenue) in Anacortes, Washington (Figure 1) and is part of the Washington State Department of Ecology's (Ecology) Puget Sound Initiative and regional cleanup efforts on Fidalgo Island. The Site is listed in Ecology's Integrated Site Information System (ISIS) under Facility Site Identification No. 20859 and Cleanup Site Identification No. 12482.

Ecology issued Agreed Order No. DE 11346 (Order) pursuant to the authority of the Model Toxics Control Act (MTCA), Revised Code of Washington (RCW) 70.105D.050(1). Under the Order, the Port is required to complete a remedial investigation, per Washington Administrative Code (WAC) 173-340-350 and WAC 173-204-560 to define the nature and extent of previously identified contamination in media of concern at the property. Completion of this Work Plan is an initial requirement of the Order.

This RI/FS Work Plan presents the tasks that will be completed by the Port to delineate the nature and extent of contamination and to evaluate cleanup alternatives for the previously identified contamination at the Site. The objectives of this RI/FS Work Plan include:

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

2.0 SITE BACKGROUND AND SETTING

2.1. Location and Property Description

The 0.8-acre Quiet Cove property lays between 2nd and 3rd Streets on O Avenue and is composed of three tax parcels according to Skagit County records. Tax parcel numbers and legal descriptions are summarized in the following table. Tax parcels for the Site and surrounding area are shown on Figure 2.

Tax Parcel Number	Legal Description
P55354	Lots 1 to 6 of Block 66, Anacortes, Together with the North 1/2 of Vacated Alley adjacent thereto, ORD#1760, Survey AF#201501210019 (0.4500 acre)
P55358	Lots 16 to 18 of Block 66, Anacortes, Together with the South 1/2 of Vacated Alley Adjacent thereto, ORD#1760, Survey AF#201501210019 (0.2200 acre)
P55359	Lots 19 to 20 of Block 66, Anacortes, Together with the South 1/2 of Vacated Alley Adjacent thereto, ORD#1760, Survey AF#201501210019 (0.1500 acre)

Adjacent properties include a Port-owned storage yard to the west and a bulk fuel distribution facility owned and operated by Texaco/Reisner to the southwest. Guemes Channel is north and west of the Site.

The Quiet Cove property is relatively flat, gently sloping to the northwest. The property and surrounding area is generally covered with buildings, concrete, gravel or asphalt with the exception of planter strips located on the 2nd and 3rd Street, and O Avenue Rights-Of-Way (ROWs). Stormwater runoff at the Site is collected in catch basins that discharge to the City of Anacortes (City) stormwater system. The City's stormwater system and other utilities in the vicinity of the Site are shown on Figure 2. Currently, an office and two warehouse buildings are present in the northwest portion of the property. A chain link fence surrounds the property preventing general public access. Vehicle and pedestrian access to the property is through a gated entrance south of 2nd Street.

2.2. Cultural Resources

Guemes Channel connects Rosario Strait with Fidalgo and Padilla Bays, which are high-priority, "early-action" cleanup areas under the Puget Sound Initiative. Ecology is working with stakeholders, including local Indian tribes, to keep them informed of the cleanup of contaminated sites and sediments in the vicinity of the Fidalgo/Padilla Bay areas. Local tribes that have been engaged by Ecology under the Puget Sound Initiative at Fidalgo/Padilla Bays include the Swinomish, Samish and Lummi Tribes.

Cultural records (Lenz, 2013) indicate that the Samish occupied the shoreline areas of Guemes Channel. Large historical middens representing winter villages and smaller sites related to camping and shellfish gathering are common in similar settings. Currently, no archaeological or culturally important sites are known to exist on or immediately adjacent to the Quiet Cove Site. If potential cultural resources are encountered during Site investigation activities, work will be stopped immediately and the Port notified. Procedures for the inadvertent discovery of cultural resources are further discussed in Section 6.0.

2.3. Environmental Setting

The topographic, geologic and hydrogeologic settings of the Site and surrounding area are summarized in the following sections.

2.3.1. Site Topography and Surface Water

The ground surface within the property boundary is generally flat with an approximate elevation of 13 feet above mean lower low water (MLLW)[1]. Within the surrounding area, the ground surface gently slopes to the northwest toward the southern shoreline of Guemes Channel.

The marine waters of Guemes Channel represent the closest surface water in the vicinity of the Site (Figure 1). The topography of the Site and surrounding area interpolated from Light Detection and Ranging (LiDAR) aerial imagery dated July 12, 2010 is shown on Figure 2.

2.3.2. Geology/Stratigraphy

Based on previous subsurface investigations (see Section 3.0) and review of the United States Geological Survey (USGS) map of the Bellingham Quadrangle (Lapen, 2000), mapped soils in the vicinity of the property include soils characteristic of both glacial and non-glacial processes that have occurred during the last 12,000 years. Surface soil deposits are identified as artificial fill and recessional marine (glaciomarine) drift from the Everson interstade of the Fraser glaciation.

The stratigraphy of the Site generally consists of fill material overlying native shoreline and glaciomarine deposits. Fill deposits consist primarily of fine to coarse sand with gravel and varying silt content ranging in thickness from 2 to 7 feet. Shoreline deposits consist primarily of well-sorted medium to coarse sand with occasional gravel and varying silt content. Organic deposits (peat) of varying thickness (1 to 3 feet) were observed at several boring locations; however, peat is not continuous throughout the Site and surrounding area. The underlying glaciomarine deposits consist primarily of unsorted, unstratified silt and clay with varying amounts of sands and gravels at depths greater than 14 feet below ground surface (bgs).

2.3.3. Hydrogeology

Groundwater conditions observed during previous investigations indicate the presence of unconfined groundwater in the near-surface fill and shoreline deposits (GeoEngineers, 2014). Measured depth to groundwater ranges from approximately 5 to 10 feet bgs (elevation 6.31 to 9.91 MLLW). Based on measurements recorded in previous environmental investigations, groundwater is inferred to generally flow across the Site to the northwest. Groundwater levels and flow direction are expected to vary northeast of the Site as a result of the presence of a City stormwater line centrally located along O Avenue and discharging to Guemes Channel north of the Site. Groundwater levels and flow direction may also vary west of the Site as a result of tidal fluctuations.

2.4. Ecological Setting

2.4.1. Upland Area

The Site and surrounding area provide little or no wildlife habitat. Surfaces in these areas are paved with asphalt and concrete with the exception of the 2nd Street ROW west of O Avenue and the west/southwest portion of the Port and Texaco/Reisner properties, which consist of compacted gravel.

[1] Surface topography and features were interpolated from Light Detection and Ranging (LiDAR) aerial imagery dated July 12, 2010. Interpolated surface topography and features have an approximate 1-foot accuracy.

The property is zoned MS (Manufacturing/Shipping) and is currently being used for material storage supporting the Curtis Wharf International Shipping Terminal. Trucks and equipment regularly traverse the compacted gravel portions of 2nd Street to transport personnel and cargo. Access to the property and surrounding Port and Texaco/Reisner properties are controlled by fencing.

2.4.1.1. Terrestrial Ecological Receptors

In accordance with WAC 173-340-7491, the Site qualifies for an exclusion from the terrestrial ecological evaluation (TEE) because:

1. There is less than 1.5 acres of contiguous undeveloped land[2] on the site or within 500 feet of any area of the site; and
2. Contaminants of concern including chlorinated dioxins or furans, polychlorinated biphenyl (PCB) mixtures, dichlorodiphenyltrichloroethylene (DDT), dichlorodiphenyldichloroethylene (DDE), dichlorodiphenyldichloroethane (DDD), aldrin, chlordane, dieldrin, endosulfan, endrin, heptachlor or heptachlor epoxide, benzene hexachloride, toxaphene, hexachlorobenzene, pentachlorophenol, or pentachlorobenzene either were not detected within the source area or are not believed to be present at the Site based on known historical property use and operations.

2.4.1.2. Endangered or Threatened Terrestrial Plants and Animals

The following United States Fish and Wildlife Service (USFWS) endangered or threatened terrestrial animal species are listed for Skagit County; however, because of the lack of suitable habitat, are not expected to occur on or near the Site.

- Oregon spotted frog (*Rana pretiosa*)
- Yellow-billed cuckoo (*Coccyzus americanus*)
- Canada lynx (*Lynx Canadensis*)
- Gray wolf (*Canis lupus*)
- Grizzly bear (*Ursus arctos = U. a. horribilis*)
- Northern Spotted Owl (*Strix occidentalis caurina*)

A search of the Washington Department of Natural Resources (DNR) Natural Heritage Program database identified the following federally-listed endangered or threatened plants for Skagit County (DNR, 2016); however, because of the lack of suitable habitat, are not expected to occur on or near the Site.

- Golden paintbrush (*Castilleja levisecta*)

[2] As defined by Ecology, "undeveloped land" means land that is not covered by buildings, roads, paved areas or other barriers that would prevent wildlife from feeding on plants, earthworms, insects or other food in or on the soil, and "contiguous" undeveloped land means an area of undeveloped land that is not divided into smaller areas by highways, extensive paving or similar structures that are likely to reduce the potential use of the overall area by wildlife.

2.4.2. Marine Area

The Site is adjacent to the southern shoreline of Guemes Channel (Figure 1). The shoreline southwest of the Site is part of the City's N Avenue Park, which spans both City and Port properties. A public parking area and beach access are located at the northern terminus of N Avenue.

Guemes Channel provides juvenile and adult habitat for various marine fishes, anadromous salmonids and invertebrate species. The area also provides seasonal habitat for marine mammals, seabirds and other waterfowl. The following federally-listed species and/or their habitat are known to occur, or potentially occur, in the vicinity of the Site based on the listings under Section 7 of the Endangered Species Act (ESA) from the USFWS (USFWS, 2016a and USFWS, 2016b) and National Marine Fisheries Service (NMFS, 2012a, b, c and d) for the marine waters of Skagit County.

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

2.5. Operational History and Use

The property was historically used for bulk fuel storage and distribution from approximately 1909 to at least 1977. The final date when fuel operations ceased is unknown. As reported in the February 17, 1910 Anacortes American, Standard Oil erected a dock (in the general vicinity of what is now Curtis Wharf) and bulk fuel plant on the Anacortes waterfront at 2nd Street and O Avenue in November 1909 selling 40,000 gallons of oil a month. Standard Oil operated the bulk fuel facility until the late 1970s at which time the facility was decommissioned and the aboveground tanks were removed. Skagit County Assessor records indicate that the property was sold to Thomas and Patricia Stowe in 1977. Following the purchase of the property, the Stowes began to operate a storage yard for marine vessels and recreational vehicles, and leased office and warehouse space to various tenants for marine-related sales and services. In 2013, the property was purchased by the Port.

The approximate location of the historical features at the Site are shown on Figure 3 based on historical drawings and photographs. A copy of the Standard Oil facility drawing dated May 31, 1921 shows the property layout while operating as a bulk fuel storage and distribution facility (Appendix A). Historical aerial and other photographs of the property and surrounding area are presented in Appendix B.

According to the Standard Oil engineering drawing, the facility layout included a 280,000 gallon above ground storage tank (AST), a 158,000 gallon AST, a 56,000 gallon AST, a 43,000 gallon AST, four 20,000 gallon ASTs, a pump house, three stall garage with attached boiler room, warehouse with covered area for barrel storage and an office. Product supply lines within the property connected each of the ASTs to the central pump house. During operation, the facility received fuel from a historical wooden pier through a series of product supply lines which were located underground south of the bulkhead (Figure 3). North of the bulkhead (Figure 3), product supply lines were hung beneath the historical wooden pier which was later demolished during the late 1990s according to historical aerial photographs (Appendix B). According to historical aerial photographs (Appendix B), the facility remained largely unchanged throughout its operational history. The facility layout is visible in a circa 1920s, 1971 and 1977 aerial photographs (Appendix B). As noted on the engineering drawing, Lots 16 through 20 located south of the main facility (Parcel No. P55358 and P55359) were acquired during the 1960s.

The property west of the Site is currently owned by the Port and was the location of a former coal storage shed presumably used to support railroad operations in Anacortes due to its proximity to the historical rail line (Figure 3). The property located to the southwest of the Site is currently owned by Texaco/Reisner for use as a bulk fuel facility. Bulk fuel operations at this location began as early as 1925. Historically, the Texaco/Reisner facility also operated a fuel terminal (referred to as the Reisner Petroleum Terminal) located at the northern end of N Avenue. Based on historical aerial photographs (Appendix B), the Reisner Petroleum Terminal was removed between 1971 and 1977. Currently, fuel to the Texaco/Reisner facility is supplied by truck.

The development and operational history for the Quiet Cove property is presented in the following table.

Timeline	Operational History
1910 to late-1970s	Standard Oil operated a bulk fuel storage and distribution facility at the Quiet Cove property. During the 1960s, Standard Oil acquired Parcel No. P55358 and P55359 according to the Engineer's Drawings presented in Appendix A.
Late-1970s	Bulk fuel storage and distribution operations ceased and the above ground storage tanks were removed.
Late-1970s to 2013	Thomas and Patricia Stowe operated a storage yard for marine vessels and recreational vehicles, and leased office and warehouse space to various tenants for marine-related sales and services. Parcels P55358 and P55359 were redeveloped between 1977 and 1994 as shown on historical aerial photographs (Appendix B). During this time, northern and southern portions of the property were paved.
2013 to Present	Port of Anacortes purchased the Quiet Cove property. Currently, the Port plans to redevelop the property in conjunction with expansion and improvements to the Curtis Wharf International Shipping Terminal facility located north of the Site.

2.6. Current and Future Site Use

Since the late 1970s, the property has been used for the storage of marine vessels and recreational vehicles, and contains several building that have been leased to various tenants for sales and marine services. The western adjacent property (also owned by the Port) is used for general storage. The southwestern adjacent property (owned by Texaco/Reisner) continues to operate as a bulk fuel storage and distribution facility generally consistent with the past operations. A beach with public access extends along the shoreline in the vicinity of these properties.

Currently, the Port plans to redevelop the property in conjunction with expansion and improvements to the Curtis Wharf International Shipping Terminal facility located north of the Site. Although the proposed redevelopment of the property is in the initial planning phase, the anticipated future use of the property is to support current terminal operations and services.

3.0 PREVIOUS INVESTIGATIONS

Environmental investigations that assessed impacts from historical property and adjacent property operations are summarized below. Previous investigations include a soil and groundwater investigation and cleanup action for the Former Reisner Petroleum Terminal (ThermoRetec, 2000 and 2001, respectively), and soil and groundwater investigation for the Quiet Cove property (GeoEngineers, 2014).

3.1. Former Reisner Petroleum Terminal Soil and Groundwater Investigation

ThermoRetec completed a soil and groundwater investigation (ThermoRetec, 2000) to characterize the type and extent of petroleum contamination located within the N Avenue ROW southwest of the Site in conjunction with a public beach access and parking area development project being completed by the City. This investigation included:

- Collection of soil samples using geoprobe drilling methods at six locations west of the Reisner/Texaco property (Figure 4). Soil was field screened and selected samples were submitted for chemical analysis of petroleum hydrocarbons and fuel additives (benzene, ethylbenzene, toluene and xylenes [BETX]). Analytical results indicated the presence of gasoline-, diesel- and heavy oil-range petroleum hydrocarbons and/or BETX in soil at locations B1, B2, B3, B4 and B5 at depths ranging from approximately 1 to 8 feet bgs.
- Collection of groundwater samples as grab samples from temporary well points at three of the soil boring locations (B1, B2 and B3; Figure 5). Groundwater samples were submitted for chemical analysis of petroleum hydrocarbons and/or benzene from these boring locations. Analytical results indicated the presence of gasoline- and diesel-range petroleum hydrocarbons and benzene at each location sampled.
- Collection of shallow (1 to 2.5 feet bgs) soil samples using hand auger drilling methods at 13 locations in the beach area northwest of the Reisner/Texaco property (Figure 4). Soil was field screened and selected samples were submitted for chemical analysis of petroleum hydrocarbons and BETX. Analytical results identified gasoline-, diesel- and heavy oil-range petroleum hydrocarbons in soil at locations HA-1, HA-2, HA-11 and HA-12.

3.2. Former Reisner Petroleum Terminal Cleanup Action

Cleanup activities were completed in March 2001 to remove contaminated soil in conjunction with buried product pipe removal activities at the northern terminus of N Avenue. Piping historically supplied fuel to the Reisner/Texaco bulk fueling facility from a former marine terminal (former Reisner Petroleum Terminal). The approximate location of the remedial excavation to remove product pipes and associated soil contamination are shown on Figure 4. According to the cleanup report (ThermoRetec, 2001), these product pipes were filled with diesel and kerosene (in separate lines) at the time of removal and that extensive corrosion of the piping was observed. Petroleum hydrocarbon contamination was also noted in portions of the piping removal trench.

Contaminated soil found during the pipe removal activities was temporarily stockpiled on-site. Upon completion of the pipe removal and excavation activities, a total of approximately 580 tons of petroleum-contaminated soil were transported off-site for thermal treatment and disposal. In addition, approximately 1,300 gallons of water was removed from the excavation, placed in a temporary storage tank and later transported from the site for treatment and disposal. During excavation, a 4-inch diameter metal pipeline was encountered that ran parallel to the Guemes Channel shoreline and extended northeast of the excavation. The metal line was left in place during excavation because the ownership and alignment of the pipe could not be verified[3].

To confirm the removal of petroleum contaminated soil, ThermoRetec collected four sidewall and four base samples from the excavation trench for chemical analysis of gasoline-, diesel-, and heavy oil-range petroleum hydrocarbons and BETX. Analytical results confirmed that petroleum contamination was not present at the excavation limit. The locations of the remedial excavation confirmation samples are unknown. The approximate location of the remedial excavation and product pipes removal area is shown relative to the Site on Figure 4. Following confirmation of the excavation sidewalls and base, clean backfill material was used to construct the parking area for the N Avenue Park.

In addition to the remedial excavation confirmation samples, four sediment samples (Shore-1, Shore-3, Shore-4 and Shore-5) were collected within the beach area below the high water line for chemical analysis of petroleum hydrocarbons, BETX and polycyclic aromatic hydrocarbons (PAHs). The results of these analyses indicated the presence of gasoline-, diesel- and heavy oil-range petroleum hydrocarbons and PAHs within the beach area downgradient from the remedial excavation. The depth and locations of the shoreline sediment samples are unknown.

3.3. Focused Quiet Cove Soil and Groundwater Investigation

A focused site investigation of the Quiet Cove property was completed under Ecology review and approval through an Integrated Planning Grant (IPG; GeoEngineers 2014). The primary objective of this investigation was to complete a planning-level study of the Site to evaluate the potential options for cleanup and redevelopment of the Site. The purpose of the focused environmental investigation was to gather RI-level

[3] Although ownership of the pipe encountered during excavation activities could not be identified, review of the the May 21, 1921 Engineers Drawing (Appendix A) which shows the layout of the Standard Oil bulk fuel and distribution facility makes no reference to a pipe extending west of the facility in the vicinity of the Reisner Petroleum remedial excavation.

environmental data to determine the extent of soil or groundwater contamination resulting from historical uses of the property. The focused environmental investigation included:

- Collection of soil samples using geoprobe drilling methods at 28 locations and collection of soil samples using hollow-stem auger drilling methods within the Site and surrounding area (Figure 4). Soil was field screened and selected samples were submitted for chemical analysis of one or more of the following:
    - Gasoline-, diesel- and oil-range petroleum hydrocarbons.
    - Carcinogenic polycyclic aromatic hydrocarbons (cPAHs) and naphthalenes;
    - Halogenated volatile organic compounds (HVOCs);
    - Volatile organic compounds (VOCs) including BETX, n-hexane, and the fuel oxygenates methyl tertiary-butyl ether (MTBE), 1,2-dibromoethane (EDB) and 1,2-dichloroethane (EDC);
    - PCBs; and
    - Metals including arsenic, cadmium, chromium, mercury and lead.

  Analytical results indicated the presence of gasoline-, diesel- and heavy oil-range petroleum hydrocarbons, BETX, cPAHs and metals (cadmium) in soil at multiple locations between 2 and 6 feet bgs exceeding MTCA Method A cleanup levels. The highest levels of observed contamination were centrally located within the Site.
- Collection of groundwater samples from permanent monitoring wells at five locations (MW-1 through MW-5) positioned both upgradient and downgradient of the Site (Figure 5). Groundwater samples were submitted for chemical analysis of one or more of the following:
    - Gasoline-, diesel- and oil-range petroleum hydrocarbons.
    - cPAHs and naphthalenes;
    - HVOCs;
    - VOCs including BTEX, and n-hexane, and the fuel oxygenates MTBE, EDB and EDC;
    - PCBs; and
    - Metals including arsenic, cadmium, chromium, mercury and lead.

Analytical results confirmed the presence of diesel- and heavy oil-range petroleum hydrocarbons in groundwater at the Site exceeding MTCA Method A cleanup levels. The highest levels of contamination were located near the former ASTs. Additionally, arsenic was detected in groundwater upgradient of the Site at a concentration exceeding the MTCA Method A cleanup level.

4.0 PRELIMINARY CONCEPTUAL SITE MODEL

A PCSM was developed based on the observed conditions at the Site, identified historical and current sources of contamination to Site media, the findings from previous investigations, and evaluation of the potential contaminant transport and exposure pathways. The PCSM was prepared to assist in identifying data gaps, develop an investigation approach to fill the data gaps, and for evaluating and identifying remedial actions for the Site.

The PCSM is presented on Figure 6 as a typical cross-section illustrating the general physical conditions and potential contaminant transport and exposure pathways that may be present at the Site. The following sections describe the specific elements of the PCSM.

4.1. Physical Conditions

4.1.1. Soil

Fill is present from the surface to depths ranging from approximately 2 to 7 feet bgs. The source of fill is not known; however, the material is similar in consistency with the underlying native soil suggesting that the fill was likely sourced from reworking/grading of the native material during initial property/area development. Native shoreline and glaciomarine deposits are under the fill.

4.1.2. Groundwater

Depth to groundwater is approximately 5 to 10 feet bgs. Groundwater flow is generally to the northwest; however, groundwater levels and flow direction may vary due to the presence of a City stormwater drain line and tidal influence from Guemes Channel.

Human ingestion of Site groundwater is not considered a potential exposure pathway because groundwater at the Site is not a current or reasonable future source of drinking water due to its proximity to Guemes Channel. Groundwater withdrawal from the Site over time would likely cause saltwater intrusion, which would make it unsuitable as a potable water source.

4.1.3. Stormwater

Precipitation falling on paved portions of the Quiet Cove property and surrounding area is directed toward one or more catch basins shown on Figure 2. In unpaved areas, stormwater either infiltrates into the ground or travels by overland flow down slope. Known components of the stormwater system including the locations of the catch basins and storm drain pipes as well as flow directions in the vicinity of the Site are shown on Figure 2.

4.1.4. Sediment

Intertidal and subtidal marine areas (Guemes Channel) are located west of the Site. The upper intertidal area primarily consists of loose beach sand and gravel deposits whereas the lower intertidal area primarily consists of gravel with varying silt and sand content. Below approximately -1 feet MLLW, surface sediment primarily consists of silt and sand (native glacial marine drift). Offshore, some piling and remnant pier structures associated with historical fueling (Reisner Petroleum Pier), marine shipping and/or fishing services are present. The shoreline west of Curtis Wharf includes an armored bulkhead with a mixture of riprap, rock and concrete debris.

4.2. Media of Potential Concern

The media of potential concern at the Site are soil, groundwater, marine sediment and marine surface water.

Based on the results of previous environmental studies, soil and groundwater beneath the property are impacted from historical operations. Groundwater flows through Site soil, to downgradient marine sediment and then discharges to the adjacent marine surface water.

There is currently no evidence that marine sediment has been impacted by the previously identified Site-related soil and groundwater contamination; however, Ecology has required a tiered evaluation of sediment quality and an evaluation of the groundwater-to-sediment pathway via an assessment of uplands soils to complete the Site characterization.

4.3. Release and Transport Mechanisms

Release and transport mechanisms for contaminants to media of potential concern are presented on Figure 6 and may include:

- Direct releases of hazardous substances to soil and/or groundwater;
- Leaching of hazardous substances from soil into groundwater and potential lateral migration of these substances in groundwater to the shoreline and into the adjacent marine surface water and sediment;
- Erosion of potentially-contaminated surface soil to the adjacent marine environment;
- Volatilization of contaminants from soil and groundwater to indoor/outdoor air;
- Deposition of hazardous substances to sediment from off-site sources; and
- Re-suspension (and potential transport) of contaminated sediment through bioturbation or marine disturbances (i.e., wave and current action).

4.4. Exposure Pathways and Potential Receptors

Potential exposure pathways related to the media of concern are discussed in the following sections.

4.4.1. Soil

Potential exposure pathways and receptors for contaminants in soil are:

- Direct contact, including incidental ingestion of soil, by workers performing excavation beneath Site pavement or performing work in the unpaved portions of the Site within the western adjacent Port property and/or 2nd Street ROW;
- Direct contact, including incidental ingestion of soil, by the public (children and adults) visiting the beach;
- Inhalation of VOCs emanating from soil to indoor/outdoor air by on-site workers or by the visitors (children and adults) to the beach; and
- Inhalation of particulates from soil or sediment in outdoor air by workers or by the public in the unpaved open space adjacent to the property and within the beach.

4.4.2. Groundwater

The following are potential exposure pathways and receptors for contaminants in groundwater:

- Direct contact, including incidental ingestion of groundwater, by workers performing excavations that extend past the water table;
- Direct contact, including incidental ingestion of groundwater, by people visiting the beach where groundwater may potentially discharge to the beach surface during low tides; and

- Inhalation of VOCs volatilizing from groundwater into indoor/outdoor air by on-site workers or by the public (children and adults) visiting the beach.

As described in Section 4.1, human ingestion of Site groundwater is not a potential exposure pathway because groundwater at the Site is not a current or reasonable future source of drinking water.

4.4.3. Sediment

The following are the potential exposure pathways and receptors if contaminants are in sediment associated with the adjacent beach:

- Direct contact, including incidental ingestion of sediment by the public (children and adults) and subsequent uptake;
- Direct contact, including incidental ingestion of sediment by benthic organisms and aquatic species and subsequent uptake;
- Ingestion by higher trophic level organisms (e.g., foraging fish, aquatic birds, and marine mammals) of benthic organisms that have accumulated contaminants; and
- Human ingestion of marine organisms (e.g., fish and shellfish) that have accumulated contaminants.

4.4.4. Marine Surface Water

Potential exposure pathways and receptors if contaminants are in marine surface water in Guemes Channel are:

- Direct contact by the public (children and adults) during recreational activities;
- Direct contact and subsequent uptake by aquatic organisms;
- Ingestion of contaminated benthic and aquatic organisms as prey by higher trophic level organisms in the food chain (e.g., foraging fish, aquatic birds, marine mammals, etc.); and
- Human ingestion of marine organisms exposed to waterborne contaminants.

5.0 EVALUATION OF EXISTING DATA

This section identifies preliminary screening levels, compares existing data to these screening levels and identifies COPCs.

5.1. Screening Levels

Screening levels for soil, groundwater and sediment have been developed for contaminants that have the potential to be detected in Site media based on the PCSM. Screening levels will be used to evaluate existing data, identify data gaps and to ensure that appropriate analytical method detection limits are utilized for the RI sampling and analysis. Consistent with Ecology's MTCA Cleanup Regulation (WAC 173-340) and Sediment Management Standard (WAC 173-204), the screening levels address potential exposure pathways for benthic organisms, human and higher trophic level ecological receptors, and the potential environmental impacts based on the current and planned future use of the Site. Several of these pathways may not be applicable for this Site, but were retained to ensure that detection limits would be adequate to assess nature and extent of contamination regardless of the exposure pathway.

Screening levels for soil and groundwater are presented in Tables 1 and 2. Screening levels for sediment are presented in Tables 3 and 4. Table 3 presents screening levels for protection of benthic organisms. Table 4 presents screening levels for protection of human health and higher trophic level ecological receptors in sediment.

For this Work Plan, cPAH, dioxin and furan, and dioxin-like PCBs data are presented as toxicity equivalents (TEQs) in accordance with WAC 173-340-708(8). Concentrations are weighted based on the toxicity of individual chemical relative to the most toxic chemical using toxicity equivalency factors (TEF) adopted by Ecology (Ecology 2015). When all constituents are not detected, the TEQ is derived using the detection limits, based on half their value.

Total PCBs in a given sample are calculated by summing all detected PCB Aroclors (i.e., detection limits are treated as zero in the sum) according to Ecology regulation. When all Aroclors are not detected, then the single highest detection limit is reported. If total PCBs are based on congeners, rather than Aroclors, undetected congeners are included in the sum at half the detection limit value. If none are detected, the highest individual detection limit is reported.

The criteria utilized in the development of soil, groundwater and sediment screening levels are presented in the following sections.

5.1.1. Soil

Soil screening levels presented in Table 1 were identified based on anticipated future property land use, property zoning and public access. Potentially applicable regulatory criteria considered for the derivation of soil screening levels, based on exposure and transport pathways, and potential receptors, include:

- MTCA Method A soil cleanup levels protective of human health and the environment for unrestricted land use (WAC 173-340-740[2]) for those chemicals for which Method B values are not available (e.g., petroleum hydrocarbons and lead). The MTCA Method A value for total PCBs is also included in the table because it captures the chemical-specific level mandated in the Federal Toxic Substance Control Act;
- MTCA Method B soil cleanup levels (standard formula values for carcinogens and non-carcinogens) protective of human health (ingestion only) for unrestricted land use (WAC 173-340-740(3)(b)(iii)(B);
- Soil criteria protective of groundwater calculated using the MTCA three-phase partitioning model (WAC 173-340-747[3] [a]). For each constituent, the protective groundwater concentration used in the calculation was selected as the lowest of the respective applicable marine surface water regulatory criteria or non-potable groundwater criteria. Note that a detection of a constituent exceeding this screening level will not necessarily trigger a subsequent tier of assessment, but instead will be evaluated based on the specific constituent and magnitude of the detection, as several of the models used in developing the screening levels are known to be conservative, particularly those based on protection of the vapor pathway. Ecology has indicated, "Use of the groundwater and deep soil gas screening levels will often be overly-conservative when the VOCs of interest are those described with the types of fuel releases described in EPA's 2015 document *Technical Guide for Addressing Petroleum Vapor Intrusion at Leaking Underground Storage Tank Sites*." (Ecology, 2016).
- Groundwater exposure pathways will be further evaluated as part of the development of preliminary cleanup levels during the FS. At that time, the soil protective of groundwater as marine surface water

pathway will be recalculated for those chemicals with groundwater exceedances using the current exposure endpoint. For the purpose of developing screening levels, default assumptions provided in WAC 173-340-747(4) for saturated and unsaturated zone soil were used in the calculations. Model input parameter values were taken directly from Ecology's Cleanup Levels and Risk Calculations (CLARC) database dated August 2015 (Ecology, 2015a) with the following exceptions:

- Where K_{oc} and Henry's Law constant values were not available in the CLARC database, the values were generally obtained from the United States Environmental Protection Agency's (EPA's) Estimation Program Interface (EPI) Suite, Version 4.11 (EPA, 2016) or Oak Ridge National Laboratory (ORNL) Risk Assessment Information System (RAIS).
- K_{oc} values for Aroclor 1242 and Aroclor 1254 were obtained from EPA's "Technical Background Document for Draft Soil Screening Level Guidance" dated March 1994 and K_{oc} values for Aroclor 1221, Aroclor 1232 and Aroclor 1248 were obtained from EPA's "Aquatic Fate Process Data for Organic Priority Pollutants" dated 1982.
- The default fraction of organic carbon (f_{oc}) of 0.001 from WAC 173-340-747(4)(c)(i)(B) (Equation 747-2) was used to calculate soil screening levels based on the protection of groundwater.

The selected soil screening levels are the lowest of the applicable numerical values from the above listed regulatory criteria. In accordance with WAC 173-340-705(6), the screening levels were adjusted as necessary based on background concentrations and practical quantitation limit (PQL) such that the derived screening level for a given constituent was not set at a level below the natural background concentration or the PQL, whichever is higher. Natural background concentrations (except for arsenic) were referenced from Ecology Publication 94-115 "*Natural Background Soil Metals Concentrations in Washington State*" (Ecology, 1994) using 90th percentile values published for the Puget Sound Basin. The arsenic background is established in regulation and published as the MTCA Method A value. Analytical PQLs were obtained from Analytical Resources, Inc. (ARI) of Tukwila, Washington, an Ecology accredited analytical laboratory. Discussions with ARI regarding the analytical requirements for this project indicate that the soil PQLs listed in Table 1 are the lowest practicably achievable values that can be obtained using conventional, accepted analytical methods.

5.1.2. Groundwater

Groundwater screening levels presented in Table 2 were identified based on the anticipated future land use, property zoning and proximity to marine surface water. Potential risks associated with groundwater at the Site include:

- Acute and chronic effects to aquatic organisms resulting from exposure to contaminants in surface water and sediment where groundwater discharges to adjacent marine surface water.
- Human consumption of seafood exposed to contaminants in surface water and sediment where groundwater discharges to adjacent marine surface water.
- Vapor intrusion from contaminants in groundwater.

As indicated in Section 4.1, groundwater at the property is not currently being used for drinking water and is not likely to be a future source of potable or drinking water. Potentially applicable regulatory criteria considered for the derivation of groundwater screening levels, based on exposure and transport pathways, and potential receptors, include:

- Marine surface water criteria protective of aquatic organisms and human health, including:
  - Water quality criteria published in the Water Quality Standards for Surface Waters of the State of Washington (WAC 173-201A).
  - Concentrations established under the National Toxics Rule (Code of Federal Regulations [CFR] Title 40, Part 131).
  - Water quality criteria based on the protection of aquatic organisms (acute and chronic criteria) and human health published under Section 304 of the Federal Clean Water Act.
  - MTCA Method B standard formula values (for carcinogens and non-carcinogens) protective of human health (consumption of aquatic organisms) (WAC 173-340-730[3]). As noted in WAC 173-340-730(3)(b)(iii), the standard formula values are necessary when sufficiently protective criteria have not been established under applicable state and federal laws. Ecology considers a criteria sufficiently protective if the excess cancer risk is not greater than 1×10^{-5} or the hazard quotient is not greater than 1 (Ecology, 2005). State or federal criteria that are not sufficiently protective were adjusted to a cancer risk of 1×10^{-5} or a hazard quotient of 1.
- Groundwater criteria protective of indoor air from vapor intrusion.
  - Screening levels for indoor air from vapor intrusion were calculated from MTCA Method B air cleanup levels (for carcinogens and non-carcinogens) referenced Ecology's CLARC database dated August 2015 (Ecology, 2015a) adjusted for Henry's Law constants and temperature. As noted above in 5.1.1, these values for petroleum hydrocarbons are known to be overly conservative.
- Groundwater criteria protective of sediment.
  - Screening levels were developed for groundwater to be protective of sediment quality in consideration of the groundwater to sediment transport pathway. The screening levels for groundwater protective of sediment were calculated assuming equilibrium between sediment and groundwater in the sediment pore spaces. The sediment screening levels for protection of benthic organisms and higher trophic levels (presented in the following sections) were used to develop the screening levels for the groundwater to sediment transport pathway. The following equations were used to calculate groundwater concentrations protective of organic carbon-normalized and dry weight criteria:

    Organic Carbon-Normalized Criteria:

    $Cw = (CUL_{sed}/K_{oc}) \times CF$

    Where:

    Cw = groundwater concentration protective of sediment (micrograms per liter [µg/L])

    CUL_{sed} = Sediment cleanup level (milligrams per kilogram [mg/kg] organic carbon)

    K_{oc} = organic carbon partitioning coefficient (liters per kilogram [L/kg])

    CF = conversion factor (1,000 micrograms per milligram [µg/mg])

Dry Weight Criteria:

$C_w = (C_{sed} / (K_{oc} \times f_{oc})) \times CF$ for organic compounds and $C_w = (C_{sed} / K_d) \times CF$ for inorganic compounds

Where:

C_w = groundwater concentration protective of sediment (µg/L)

C_{sed} = sediment concentration protective of benthic organisms and higher trophic levels (mg/kg dry weight)

K_{oc} = organic carbon partitioning coefficient (L/kg)

f_{oc} = decimal fraction organic carbon (f_{oc} of 0.02)

K_d = distribution coefficient (L/kg)

CF = conversion factor (1,000 µg/mg)

K_{oc} and K_d values were taken directly from Ecology's CLARC database dated August 2015 (Ecology, 2015a). Where K_{oc} values were not available in CLARC, they were obtained from EPA's EPI Suite, Version 4.11 (EPA, 2016) or ORNL RAIS.

The lowest of the applicable numerical values from the above listed regulatory criteria were selected as groundwater screening levels. In accordance with WAC 173-340-705(6), the screening levels were adjusted as necessary based on analytical PQLs obtained from ARI such that the derived screening level for a given constituent was not set at a level below the PQL. Discussions with this laboratory regarding the analytical requirements for this project indicate that the groundwater PQLs listed in Table 2 are the lowest practicably achievable values that can be obtained using conventional, accepted analytical methods.

5.1.3. Sediment Screening Levels for Protection of Benthic Organisms

Sediment screening levels for protection of benthic organisms are presented in Table 3. Sediment screening levels for benthic invertebrate community health are the numeric Sediment Cleanup Objectives (SCOs) from WAC 173-204-562 for the protection of the benthic community in marine and low salinity sediment corresponding to sediment quality that will result in no adverse effects.

The Sediment Management Standards (SMS) benthic community health-based SCO of WAC 173-204-562 provide numeric criteria for a broad range of chemicals expressed as either dry-weight or organic carbon-normalized concentrations. The analytical results for nonpolar organics are normalized to the organic carbon content of the sediment when the total organic carbon (TOC) in a given sample falls between 0.5 to 3.5 percent (inclusive). The TOC-normalized results are then compared to the SCO. Analytical results for nonpolar organics with TOC concentrations outside of the 0.5 to 3.5 percent range are screened against Marine Sediment Apparent Effects Threshold (AET) values on a dry-weight basis (Ecology's *Sediment Cleanup User's Manual II* [SCUM II] guidance, Table 8-1; Ecology, 2015b). Because SMS do not include a screening level for dioxin/furan TEQ and no regional background study of the area has been completed to date, a screening level based on the programmatic PQL (5 nanograms per kilogram [ng/kg]) provided by Ecology will be used.

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

Sediment screening levels for the protection of human health and protection of higher trophic level ecological receptors are presented in Table 4. Sediment screening levels for human health exposure to sediment via ingestion and dermal contact were developed utilizing equations and parameter values from Ecology's SCUM II guidance. The preliminary sediment screening levels based on sediment ingestion and dermal contact shown in Table 4 represent the values for three potential receptors that were evaluated:

- A child exposed during beach play;
- An adult exposed during clam digging (subsistence harvesting); and
- An adult exposed during net fishing (subsistence harvesting).

For evaluating exposure scenarios, the intertidal area is defined as beach above -3 feet MLLW and the subtidal area as below -3 feet MLLW. Children exposed to sediment during beach play and adults exposed to sediment during clam digging are assumed to be exposed primarily to intertidal sediment (at elevations greater than -3 feet MLLW). Likewise, the clam digging exposure scenario is expected to apply to intertidal sediment (at elevations greater than -3 feet MLLW). The potential exposure scenario for net fishing relates to both intertidal and subtidal sediment but tends to be less conservative than other human health exposure pathways. Beach play and clam digging exposure scenarios, which tend to result in more conservative screening levels, were retained for use in evaluating the exposure of net fishers and higher order aquatic ecological receptors to avoid potential data gaps during RI data collection. The RI/FS Report will confirm the exposure pathways for the Site and define cleanup levels based on the identified exposure pathways.

Because tissue data does not currently exist for the Site, site-specific biota-sediment accumulation factors (BSAFs) are not available to calculate risk-based sediment screening levels. A simplified approach (Option 1 within SCUM II) where the SCO and Cleanup Screening Level (CSL) are established at background (natural and regional, respectively) or the PQL was selected to develop sediment screening levels for evaluation of bioaccumulative effects on human health and higher trophic level organisms. For bioaccumulative chemicals such as dioxins/furans, dioxin-like PCBs, total PCBs, PAHs, arsenic, cadmium, lead and mercury, site-specific risk-based sediment screening levels are presented in Table 4. Sediment screening levels for human health and higher trophic level ecological receptors were chosen from lowest of bioaccumulative and direct contact pathways.

Consistent with the SCUM II guidance, where the risk-based value is lower than natural background or PQL, the screening level defaults to the higher of natural background or PQL. Table 4 presents the natural background, PQL and the screening level selected for each chemical constituent.

5.1.5. Wood Debris and Biological Testing

Currently, there are no sediment cleanup levels established for wood waste. However, studies conducted in Washington State (Kathman et. al., 1984; Kirkpatrick et. al., 1998; Floyd and Snider, 2000; and SAIC, 1999) show that sediment with 20 percent wood waste by volume could negatively impact the benthic community resulting from:

- The physical presence of wood waste, which prevents biota from thriving and recruiting in and on native, healthy substrate.

- Decreased dissolved oxygen due to microbial decomposition, which can create an unhealthy or toxic environment for biota.
- Decomposition by-products such as sulfides, ammonia, and phenols, which can cause or contribute to toxicity.

The degree of wood waste impacts on the benthic community depends on factors such as physical attributes of the wood waste (i.e., bark, scraps, chips, sawdust, logs, and dimensional lumber), degree of incorporation into sediment, volume present, currents and flushing in the area, type of habitat present (i.e., freshwater or marine), source of the wood waste and degree of decomposition and weathering.

To evaluate adverse benthic community effects from chemicals and other potential environmental stressors such as wood debris (if found to be present at the Site), biological testing as a direct measure of toxicity (which is considered definitive) may be perfomed to override chemical results per SMS, with respect to the potential for benthic community impacts[4]. Based on an evaluation of initial and/or follow-up sediment sampling results (further described in Section 6.5), the Port in consultation with Ecology may elect to conduct individual bioassays on a location-by-location basis. The need for bioassays will be determined after review of the planned RI activities and if elected, would be completed under an addendum to the Work Plan.

5.2. Comparison of Existing Data to Screening Levels

Existing soil and groundwater data were compared to screening levels presented in Section 5.1 and results are presented in Tables 6 and 7 and summarized below. Figures 4 and 5 summarize screening level exceedances in the existing soil and groundwater data at the Site and surrounding area.

5.2.1. Comparison of Existing Soil Data to Screening Levels

5.2.1.1. Metals

Metals including arsenic, cadmium, chromium (total), lead and mercury either were not detected or were detected at concentrations less than soil screening levels in soil samples obtained from the Site. Although mercury was not detected, the reporting limit for mercury was greater than the soil screening level.

Metals were not analyzed in soil samples collected as part of the Former Reisner Petroleum Terminal Investigation.

5.2.1.2. Petroleum Hydrocarbons

Gasoline-range petroleum hydrocarbons were detected in soil collected at four locations (GEI-8, GEI-10, GEI-16 and GEI-17; Figure 4) within the central portion of the Site at a concentration greater than the soil screening level. Diesel-and heavy oil-range petroleum hydrocarbons were detected in soil collected at seven locations (GEI-1, GEI-2, GEI-4, GEI-10, GEI-17, GEI-18 and GEI-25; Figure 4) at concentrations greater than the soil screening levels.

Southwest of the Site, gasoline-range hydrocarbons were detected at concentrations greater than the soil screening level at locations HA-11 and B2. Diesel-range hydrocarbons were detected at a concentration greater than the soil screening level at location B5. These exceedances are near the location where the Texaco/Reisner product pipes were removed in 2001.

[4] Human health effects are evaluated separately and cannot be overridden by aquatic toxicity tests.

5.2.1.3. Volatile Organic Compounds

BETX constituents were detected in soil samples collected from seven locations (GEI-1, GEI-2, GEI-3, GEI-10, GEI-16, GEI-17 and GEI-25; Figure 4) at concentrations greater than their soil screening levels. At locations GEI-4, GEI-8, GEI-10 and GEI-25, ethylbenzene did not exceed soil screening level; however, the reporting limit for ethylbenzene was greater than the soil screening level and therefore, presence of this contaminant cannot be confirmed. In addition to BETX, HVOCs, n-hexane, and fuel oxygenates MTBE, EDB and EDC were analyzed in soil samples collected from the Site, These compounds either were not detected or were detected at concentrations less than soil screening levels. However, multiple compounds had elevated reporting limits exceeding the soil screening levels.

Southwest of the Site, BETX either was not detected or was detected at concentrations less than the soil screening levels. However, the BETX compounds had elevated reporting limits exceeding the soil screening levels at multiple locations. HVOCs, n-hexane and fuel oxygenates were not analyzed in soil samples collected during the Former Reisner Petroleum Terminal Investigation.

5.2.1.4. Polycyclic Aromatic Hydrocarbons

Carcinogenic PAHs and naphthalenes were detected at concentrations greater than the soil screening levels at each of the three locations (GEI-4, GEI-10 and GEI-25; Figure 4) submitted for chemical analysis.

PAHs and naphthalenes were not analyzed in soil samples collected during the Former Reisner Petroleum Terminal Investigation.

5.2.1.5. Polychlorinated Biphenyls

PCBs were not detected at concentrations greater than the soil screening levels at in soil samples submitted for chemical analysis. However, the reporting limits for PCB Aroclors exceeded the soil screening level for the saturated zone at locations GEI 10 and GEI-25 (Figure 4).

PCBs were not analyzed in soil samples collected during the Former Reisner Petroleum Terminal Investigation.

5.2.2. Comparison of Existing Groundwater Data to Screening Levels

5.2.2.1. Metals

Total and dissolved metals including arsenic, cadmium, chromium (total), lead and mercury either were not detected or were detected at concentrations less than groundwater screening levels with one exception. Total and dissolved arsenic was detected in groundwater from MW-5 (upgradient location; Figure 5) at a concentration greater than the groundwater screening level.

Metals were not analyzed in groundwater samples collected during the Former Reisner Petroleum Terminal Investigation.

5.2.2.2. Petroleum Hydrocarbons

Gasoline-range petroleum hydrocarbons were not detected in groundwater samples collected from monitoring wells MW-1 through MW-5 (Figure 5). Diesel-and/or heavy oil-range petroleum hydrocarbons were detected in groundwater samples collected from monitoring wells MW-1 through MW-5 (Figure 5).

Southwest of the Site, gasoline-range hydrocarbons were detected at a concentration greater than the groundwater screening level at locations B2 and B3 (grab sample locations; Figure 5). Diesel-range hydrocarbons were detected at a concentration greater than the groundwater screening level at locations B1 through B3 (Figure 5).

5.2.2.3. Volatile Organic Compounds

HVOCs, BETX, n-hexane, and fuel oxygenates MTBE, EDB and EDC were not detected in groundwater samples collected from the Site.

Southwest of the Site, benzene was detected in groundwater samples collected from locations B1 through B3 at a concentration exceeding the groundwater screening level. HVOCs, n-hexane and fuel oxygenates were not analyzed in soil samples collected during the Former Reisner Petroleum Terminal Investigation.

5.2.2.4. Polycyclic Aromatic Hydrocarbons

Carcinogenic PAHs and naphthalenes either were not detected or were detected at concentrations less than the groundwater screening levels with three exceptions. Naphthalenes exceeded the groundwater screening level in MW-3 and MW-5. Benzo[a]anthracene exceeded the groundwater screening level at MW-3.

PAHs and naphthalenes were not analyzed in groundwater samples collected during the Former Reisner Petroleum Terminal Investigation.

5.3. Contaminants of Potential Concern

COPCs are identified for each media of concern based on identified exceedances of the screening levels or where data gaps in the existing site characterization exist. The following compounds are identified as COPCs at this Site:

Contaminant of Potential Concern	Rationale
Soil	
Metals (arsenic, cadmium, chromium, lead, and mercury)	The presence of metals including arsenic, cadmium, chromium (total), lead and mercury were evaluated only at a limited number of locations during previous investigations.
Petroleum Hydrocarbons	Soil samples exceed screening levels at multiple locations at the Site and at Texaco/Reisner sample locations southwest of the Site.
BETX	Soil samples exceed screening levels at multiple locations at the Site. Detection limit greater than screening level at multiple Texaco/Reisner sample locations southwest of the Site.
n-Hexane and Fuel Oxygenates MTBE, EDB and EDC	Reporting limits exceed soil screening levels for multiple compounds in samples collected at multiple locations at the Site. Fuel additives were evaluated only at a limited number of soil sampling locations during previous investigations.
cPAHs and Naphthalenes	Soil samples exceed soil screening levels at each location submitted for chemical analysis. PAHs and naphthalenes were evaluated at a limited number of soil sampling locations during previous investigations.
Groundwater	
Metals	Arsenic exceeded the groundwater screening level at location MW-5 located upgradient of the former bulk fuel facility. Metals including arsenic, cadmium, chromium (total), lead and mercury were only evaluated at a limited number of locations during previous investigations.

Contaminant of Potential Concern	Rationale
Petroleum Hydrocarbons	Petroleum hydrocarbons were found to exceed groundwater screening levels at multiple locations at the Site and at Texaco/Reisner sample locations southwest of the Site.
BETX	BETX compounds were found to exceed groundwater screening levels at Texaco/Reisner sample locations southwest of the Site. BETX detected in soil at the Site exceeded screening levels.
n-Hexane and Fuel Oxygenates MTBE, EDB and EDC	Fuel additives were only evaluated at a limited number of soil and groundwater sampling locations during previous investigations.
cPAHs and Naphthalenes	Concentrations of cPAHs and naphthalenes exceed soil screening levels at each location submitted for chemical analysis. CPAHs and naphthalenes were only evaluated at a limited number of groundwater sampling locations during previous investigations.
Sediment	
Wood Debris	There is no identified source in the sediment area. A visual evaluation for the presence/absence of wood debris has been required by Ecology.
Metals (arsenic, cadmium, chromium, copper, mercury, silver and zinc)	Metals including arsenic, cadmium, chromium, lead, and mercury are an upland area COPC. Ecology has required metals including silver and zinc for consistency with the SMS.
Petroleum Hydrocarbons	Upland Area COPC.
BETX	Upland Area COPC.
n-Hexane and Fuel Oxygenates MTBE, EDB and EDC	Upland Area COPC.
SVOCs (including cPAHs, PAHs, phenols, phthalates, chlorinated organics and miscellaneous extractables)	Upland area COPC for cPAH and naphthalene. There is no identified source in the sediment area. Ecology has required SVOCs for consistency with the SMS.
PCBs	There is no identified source in the sediment area and low level aroclor analysis of a discrete set of samples did not identify PCBs in the upland area. Ecology has required PCB congener analysis for consistency with the SMS, based on Tier 1 soil, groundwater and sediment sample results.
Dioxins and Furans	There is no identified source in the sediment area. Ecology has required dioxin and furan congener analysis for consistency with the SMS, based on Tier 1 soil, groundwater and sediment sample results.

Notes:
SVOC = semi-volatile organic compounds

5.4. Identification of Data Gaps

To date, only partial characterization of the Site has been completed. The existing data do not fully characterize the potential source area and the nature and extent of contamination at the Site. Specific data gaps include the following:

- Horizontal and vertical extent of contaminants in fill and native soil north, west and south of the former bulk fuel facility.

- Potential for co-mingling of Site-related contaminants with off-property source areas (i.e., contaminants identified in soil west of the Texaco/Reisner bulk fueling facility).
- Horizontal extent of contaminants in groundwater north, east, south and west of the former bulk fuel facility.
- Potential for transport via groundwater/co-mingling with off-property source areas (i.e., contaminants identified in groundwater west of the Texaco/Reisner bulk fueling facility).
- The extent to which contamination from the uplands may have migrated downgradient to the adjacent sediment area.
- Current hydrological conditions at the Site and surrounding area.
- Current presence or absence of habitat receptors within the intertidal area west of the Site if contamination from the uplands is identified in the sediment area.

6.0 REMEDIAL INVESTIGATION STUDY APPROACH

The RI will include sampling and analysis of soil, groundwater and sediment samples to delineate the nature and extent of contamination at the Site. The approach and rationale to complete the RI is presented in Table 8 and summarized in the following sections. Data gathered to complete the RI will follow a tiered approach consisting of initial and follow-up soil, groundwater and sediment sampling and sample analyses. Information gathered from initial analyses will be used to guide follow-up sampling and analysis activities to define the nature and extent of contamination at the Site and evaluate the potential impact to sediment. In addition, topographic/land, seep and habitat surveys will be completed as part of the RI to further evaluate the environmental and ecological setting of the Site and surrounding area.

Field methods and quality assurance (QA) procedures for sampling and analysis are described in the Sampling and Analysis Plan (SAP) provided in Appendix C. Health and safety procedures for the RI fieldwork are described in the Health and Safety Plan (HASP) presented in Appendix D.

6.1. Topographic/Land Survey

A topographic survey will be performed as part of the RI to characterize current surface conditions at the Site and will include the intertidal portions of the RI study area extending from the northern end of N Avenue to Curtis Wharf. Additional surveys may be performed in other areas based on the result of the RI to further evaluate surface conditions in areas not covered by the initial survey. The survey will be completed by a professional surveyor registered in the State of Washington to create a comprehensive survey of the RI study area.

6.2. Historical Product Supply Line Survey

During the 1990s, the former Curtis Wharf pier structure was demolished and replaced due to disrepair and safety issues. At this time, it is believed that the product supply lines located beneath the former pier structure historically used during bulk fuel operations were removed and capped at the bulkhead. As requested by Ecology, the current condition of the bulkhead area below Curtis Wharf corresponding with the location of the historical product supply lines will be visually evaluated and photo documented during a daytime low tide.

6.3. Seep Survey

As requested by Ecology, a survey of the beach area for groundwater seeps will be completed along the shoreline west of the Site. The survey will be completed during low tide using a hand-held global positioning system (GPS) unit (Trimble GeoExplorer or similar) to identify the location of any observed seeps. The seep survey will be performed during a -1 foot tide (MLLW) or greater to capture the area of transmissive material above bay mud.

6.4. Soil Investigation

The objective of the soil investigation is to define the nature and extent of contamination in soil such that a cleanup action can be selected for the Site. The overall objectives of the soil investigation include:

- Characterization of Site stratigraphy in portions of the Site not previously investigated including areas to the north, east, south and west of the former bulk fueling facility; and
- Characterization of the nature and extent of hazardous substances in soil associated with historical Site operations.

The sample approach and rationale for the soil investigation is summarized in Table 8. Proposed soil sample locations are shown on Figure 7. Discrete soil intervals will be sampled at each boring location for chemical analysis or archived for later analysis (Table 9).

Using information obtained from previous Site investigations, Tier 1 samples (i.e., those locations and depth intervals below ground surface that will be analyzed first) will be collected at locations to address identified data gaps and to provide more comprehensive coverage of the Site. Follow-up analysis will be performed on archived samples representing deeper intervals at Tier 1 locations and/or archived samples from Tier 2 locations to define the vertical and horizontal extent of contamination, where necessary. Follow-up sample analysis of individual Tier 2 samples will be for contaminants exceeding their respective soil screening levels (Table 1) in the closest Tier 1 sample (e.g., next shallower interval within a Tier 1 core or adjacent Tier 1 core). Any additional sample analysis will be determined by the Port in consultation with Ecology.

Soil sampling will be completed using a combination of methodologies including; 1) direct-push (DP) explorations at sampling locations GEI-29 through GEI-45, and 2) hollow-stem auger (HSA) explorations at sampling locations MW-6 through MW-11 (the latter are also proposed well locations). The soil explorations will be advanced to at least three feet into the native soil or to approximately 15 feet bgs, whichever occurs first. If evidence of petroleum contamination is observed, the exploration will be advanced to at least three feet below the observed depth of contamination, regardless of stratigraphy, or until refusal. Anticipated exploration depths range from 5 to 15 feet bgs.

A minimum of three soil samples will be collected from each exploration for chemical analysis targeting the fill and native soil horizons, and the interface between the vadose and saturated zones (water table). Soil will be screened in the field for the presence of contamination (e.g., sheen, odor, detectable vapors). The procedures for field screening are presented in Appendix C. At Tier 1 locations, soil with the greatest evidence of contamination based on the field screening will be initially submitted for chemical analysis. In addition, soil samples obtained above and below the layer with field screening evidence of contamination will also be submitted for chemical analysis from each Tier 1 soil sample location. Additional samples at Tier 1 locations may be collected and archived for potential follow-up analysis depending on observations made at the time of sampling. Soil samples will be submitted for the following analyses that have been identified as COPCs for soil:

- Metals (arsenic, cadmium, chromium, lead and mercury) by EPA Method 6000/7000 series.
- Gasoline-range petroleum hydrocarbons by Ecology Method NWTPH-Gx.
- Diesel- and heavy oil-range petroleum hydrocarbons by Ecology Method NWTPH-Dx.
- BETX by EPA Method 8260.
- Naphthalenes and cPAHs by EPA Method 8270D/SIM.
- Fuel additives including EDB, EDC, MTBE and n-hexane by EPA Method 8260.

If soil samples exceed a screening level based on a protection of a preliminary groundwater screening level, this will not automatically trigger a further tier of assessment. Instead, dependent on the constituent and magnitude of the detection, the Port will evaluate installation of additional groundwater monitoring wells in consultation with Ecology to empirically evaluate groundwater conditions caused by the soil concentration.

6.5. Groundwater Investigation

The objective of the groundwater investigation is to define the nature and extent of contamination in groundwater, where present, to support the analysis, development and selection of a cleanup action for the Site. The overall objectives of the groundwater investigation include:

- Characterization of Site hydrogeology including groundwater gradients/flow direction, hydraulic conductivity/transmissivity and the effect of tidal fluctuations and the Curtis Wharf bulkhead on groundwater gradients and flow direction; and
- Characterization of the nature and extent of hazardous substances in groundwater associated with historical Site operations.

The sample approach and rationale for the groundwater investigation is summarized in Table 8. Proposed groundwater sample locations include both existing and new wells, which are shown on Figure 8. Groundwater sampling and analysis will be completed in a tiered approach (Table 10).

Using information obtained from previous Site investigations, Tier 1 sample locations were positioned to address identified data gaps and to provide comprehensive coverage of the Site. Based on initial analytical results, follow-up samples may be collected during a separate sampling round from either the Tier 1 and/or Tier 2 locations for potential fingerprint analysis to distinguish between Site and off-Site contaminant sources (i.e., potential groundwater contamination sourcing from the Reisner/Texaco property). Additional groundwater collection and analysis may also be performed at Tier 1 and/or Tier 2 locations based on the results of sediment sample analysis to evaluate whether the pathway from the upland to the marine environment is complete. Additional sampling locations to define the nature and extent of contamination, if required, will be determined in consultation with Ecology.

Two groundwater sampling events will be completed to evaluate groundwater conditions. Sampling will be completed at times generally representative of “wet” season and “dry” season conditions. The month of February will be targeted for the “wet” season monitoring event to capture the portion of the year with increased precipitation and for consistency with other Anacortes Sites. The month of August will be targeted for the “dry” season monitoring event to capture the portion of the year with decreased precipitation and for consistency with other Anacortes Sites.

Groundwater samples will be collected using low flow techniques from the existing (MW-1 through MW-5) and new (MW-6 through MW-10) monitoring wells for chemical analysis during low tides, where appropriate. Groundwater samples for potential follow-up chemical analysis may be collected during a subsequent monitoring event based on a review of the initial groundwater and/or sediment investigation results. Procedures for monitoring well installation, well development, and water level monitoring and groundwater sample collection are presented in Appendix C. Groundwater samples will be collected at least two weeks after well development and a tidal study to evaluate groundwater flow characteristics including elevation changes in Site groundwater in response to water level changes in Guemes Channel (see Section 2.3.3). Groundwater samples collected from Tier 1 locations will be submitted for analysis of the following chemicals that have been identified as COPCs for the Site:

- Total and dissolved metals (arsenic, cadmium, chromium, lead and mercury) by EPA Method 200.8 and 6000/7000 series.
- Gasoline-range petroleum hydrocarbons by Ecology Method NWTPH-Gx.
- Diesel- and heavy oil-range petroleum hydrocarbons by Ecology Method NWTPH-Dx.
- BETX by EPA Method 8260.
- Naphthalenes and cPAHs by EPA Method 8270D/SIM.
- Fuel additives including EDB, EDC, MTBE and n-hexane by EPA Method 8260.

If these COPCs are not detected and no other indirect evidence is found as determined in consultation with Ecology, then the pathway from the upland to the marine environment will be deemed incomplete and further evaluation for this pathway will not be conducted. If further investigation of the sediment is triggered, then groundwater samples may be collected for follow-up chemical analysis during a separate monitoring event to evaluate whether the pathway from the upland to the marine environment is complete. In addition, if COPCs are detected at MW-8, groundwater samples may be collected for follow-up chemical analysis during a separate monitoring event for potential fingerprint analysis to distinguish between site and off-site contamination source(s). Groundwater samples for follow-up analysis may include, but are not limited to, the following based on what chemicals exceed screening levels in either Tier 1 groundwater samples or sediment samples and Ecology's requirements:

- Extractable petroleum hydrocarbon (EPH) and volatile petroleum hydrocarbon (VPH) analysis.
- Total and dissolved SMS metals (arsenic, cadmium, chromium [total], copper, lead, mercury, silver and zinc) by EPA Method 200.8 and 6000/7000 series.
- SMS semi-volatile organic compounds (SVOCs) by EPA Method 8270D/SIM.
- PCB congeners by EPA Method 1668C.

6.5.1. Hydraulic Conductivity Testing and 72-Hour Tidal Study

Hydraulic conductivity testing and a 72-hour tidal study will be performed at monitoring well locations MW-2, MW-4 and MW-6 through MW-9 and MW-11 (Figure 8) to characterize groundwater flow characteristics and gradients at the Site. The aquifer hydraulic conductivity will be estimated by conducting slug tests. The 72-hour tidal study will be conducted to evaluate elevation changes in Site groundwater in response to water level changes in Guemes Channel. Water level elevation data will be collected every 15 minutes in each monitoring well using electronic data loggers and well transducers. Electronic data measurements

will be confirmed by periodically obtaining manual water level measurements during the study. Groundwater flow directions determined from the tidal study will be used in conjunction with groundwater monitoring analytical results to better define fate and transport of Site contaminants in groundwater.

Procedures for performing the slug tests and tidal study are presented in Appendix C.

6.6. Sediment Investigation

The objective of the sediment investigation is to evaluate sediment quality west of the former bulk fueling facility to determine if upland contamination has impacted the marine environment. The overall objectives of the sediment investigation include:

- Determine if contamination extends from the upland portion of the Site to the beach area located west of the former bulk fueling facility;
- If the initial testing indicates that contamination does extend to the beach area, use results of chemical analyses to identify surface and/or subsurface locations for follow-up chemical analysis;
- Evaluate for the presence or absence of wood debris; and if present, the nature and extent;
- Evaluate the terrestrial/aquatic ecological setting including a description of onsite and surrounding habitat types and conditions, ecological receptors, and potentially threatened/endangered species, in areas where sediment sampling occurs;
- Evaluate results from chemical analyses to identify the need and locations for potential follow-up bioassay testing to determine compliance with SMS biological criteria, if elected; and
- Evaluate results from chemical analyses to identify the need and locations for potential follow-up site-specific sediment/tissue sampling and analysis to support human health and ecological risk evaluation, if elected.

The sample approach and rationale for the sediment investigation is summarized in Table 8. Proposed sediment sample locations are shown on Figure 7. Federal permits will be required to collect sediment samples and the collection effort will be constrained to the allowable in-water work windows specified by the permit.

Sediment sampling and analysis will be completed in a tiered approach (Table 11). Initially, a three point surface composite sample (Tier 1A sample SED-1-COMP; Figure 7) will be collected west of the Curtis Wharf Bulkhead to evaluate sediment quality downgradient of a known area of contamination[5]. This composite surface sediment sample will be submitted for analysis of upland COPC and Ecology required analysis for consistency with the SMS to determine if the upland to sediment pathway is potentially complete:

- Gasoline-range petroleum hydrocarbons by Ecology Method NWTPH-Gx.
- BETX by EPA 8260.
- Diesel- and heavy oil-range petroleum hydrocarbons by Ecology Method NWTPH-Dx.

[5] The adjacent upland was the location of historical product supply lines that extended from the Site to the northern pier face of Curtis Wharf and monitoring well MW-3 in which petroleum hydrocarbon-related contamination exceeded groundwater screening levels (Figure 5).

- Fuel additives including EDB, EDC, MTBE and n-hexane by EPA Method 8260.
- SMS metals (arsenic, cadmium, chromium [total], copper, lead, mercury, silver and zinc) by EPA Method 6000/7000 series.
- SMS SVOCs including PAHs and cPAHs by EPA Method 8270/SIM.
- Bulk/porewater ammonia by EPA 350.1 M/SM 4500-NH3.
- Bulk/porewater sulfides by Puget Sound Estuary Program (PSEP) 1986/SM 4500-S2.
- Grain size by PSEP 1986 or ASTM International (ASTM)-Mod.
- TOC by PSEP 1981.
- Total volatile solids (TVS) by PSEP 1986/ASTM D2974.
- Total solids (TS) by SM2540G.

Sample SED-1-COMP may be submitted for additional chemical analysis to evaluate soil/groundwater to sediment exposure pathway or potential off-site contamination source(s), if elected by the Port or required by Ecology. Additionally, selected archived samples collected from discrete boring locations SED-1A through SED-1C (Figure 7) may be submitted for chemical analysis to evaluate soil/groundwater to sediment pathway, evaluate potential off-site contamination source(s) and/or improve delineation of sediment contamination, if elected by the Port or required by Ecology. Further characterization of the composite sample SED-1-COMP and/or discrete archived samples (Tier 1B chemical analysis) may be conducted to evaluate the soil/groundwater to sediment exposure pathway or potential off-site contamination source(s), if elected by the Port or required by Ecology. Follow-up analytes may include, but are not limited to the following:

- PCB congeners by EPA Method 1668C.
- Dioxins and furans by EPA Method 1613

In addition to chemical analysis of sediment samples at SED-1 (Figure 7), upland soil-to-sediment pathway will further be evaluated using the data collected during the soil investigation (upland shoreline sample locations GEI-38 through GEI-40) as described in greater detail above in Section 6.3. If there is evidence that the upland soil-to-sediment pathway may be complete (i.e., COPC are identified in sediment composite sample SED-1-COMP and/or discrete archived samples or at upland shoreline soil sample locations GEI-38 through GEI-40) as determined in consultation with Ecology, sediment samples will be collected from Tier 2 sample locations to further evaluate the soil/groundwater to sediment exposure pathway or potential off-site contamination source(s) west of the former bulk fuel facility. Tier 2 sample locations SED-2 through SED-4 were chosen based on the previously identified elevation of the likely native sediment contact with more recently deposited material (approximately -1 foot MLLW) and represents the area discharge of groundwater to surface water. Tier 2 sample locations (SED-5 through SED-7; Figure 7) were chosen to represent the likely area where upland groundwater may be migrating and ultimately discharging to Guemes Channel based on inferred groundwater flow at the Site.

Surface sediment samples from locations SED-2 through SED-4 and fill sediment horizon, native sediment horizon, and water table samples from locations SED-5 through SED-7 (Figure 7) will be submitted for the above listed initial upland COPC and SMS parameters as required by Ecology to determine if the upland to sediment pathway is potentially complete. Sufficient material will be collected from the Tier 2 sediment sample locations for potential follow-up analysis including but not limited to PCBs and/or dioxins and furans

to evaluate the soil/groundwater to sediment exposure pathway or potential off-site contamination source(s). Determination of the follow-up laboratory analyses will be in accordance with the criteria defined in this Work Plan (including Table 8) and if necessary, in consultation with Ecology.

Details regarding field protocols and quality assurance and control procedures that will be utilized to complete the sediment investigation are presented in Appendix C.

6.6.1. Biological Testing

Biological testing may be performed by the Port on surface sediment samples to better define potential toxic effects of hazardous substances identified in sediment in accordance with SMS. The results for wood debris parameters (bulk/porewater ammonia and bulk/porewater sulfides) and chemical concentrations from the initial and/or follow-up sediment investigations will be evaluated to determine the need for biological testing. If elected, the Port will consult with Ecology to develop a Work Plan addendum to describe the scope and approach of sampling and analysis to support the biological testing study. The addendum would identify the objectives and data to be collected for the study and is subject to Ecology approval. On approval of the addendum, a subsequent field effort would be performed to collect sediment samples for testing.

Biological testing, if elected, will be performed by an Ecology-certified laboratory.

6.6.2. Paired Tissue/Sediment Study

A paired tissue/sediment study may be performed by the Port to provide data for a site-specific human health and ecological receptor risk evaluation on bioaccumulative chemicals exceeding sediment screening levels. The results for chemical concentrations from the initial and/or follow-up sediment investigations will be evaluated to determine the need for paired tissue/sediment testing. If elected, the Port will consult with Ecology to develop a Work Plan addendum to describe the scope and approach of sampling and analysis to support the tissue/sediment study. The addendum would identify the objectives and data to be collected for the study and would be subject to Ecology approval. On approval of the addendum, a subsequent field effort would be performed to collect sediment and tissue samples from selected organisms within the study area to evaluate bioaccumulation factors at the Site.

Chemical analysis of sediment and tissue, if elected, will be performed by an Ecology-certified laboratory.

6.7. Procedures for the Inadvertent Discovery of Cultural Resources

As discussed in Section 2.2, the potential for encountering cultural resources/archaeological materials at the Site is believed to be low. During the RI, field inspectors that are generally aware of the potential types of cultural artifacts that could be encountered will be utilized to oversee the investigation activities. If potential archaeological resources are identified by the field inspector during the RI, work will be stopped immediately and the Port notified. The Port will retain a professional archaeologist to evaluate the potential discovery and determine its cultural significance. If it is determined that the discovery is not culturally significant, work activities will resume. In the unanticipated event of a potential archaeological discovery, the following steps shall be taken:

1. **Stop Work and Protect the Discovery Site –** If any agency employee, contractor, or subcontractor believes that he or she has uncovered any cultural resources, all work within a minimum of 50 feet of the discovery ("discovery site") will be stopped to provide for its total security, protection and integrity. The discovery site shall be secured and vehicles, equipment, and unauthorized personnel will not be permitted to traverse the discovery site.

2. **Notify the Port –** The individual making the discovery will immediately contact GeoEngineers, Inc. (GeoEngineers) who will then notify the Project Coordinator for the Port (contact information presented in the table below).
3. **Notify the Project Archaeologist –** Immediately following the work stoppage and notification to the Port, a Project Archaeologist shall be retained by the Port to evaluate the potential discovery.
4. **Identify the Find –** The Project Archaeologist, in coordination with the Port, is responsible for ensuring that appropriate steps have been taken to protect the discovery site. The Project Archaeologist shall be qualified as a professional archaeologist under the Secretary of Interior's Professional Qualification Standards (as outlined in 36 CFR Part 61). As such, the Project Archaeologist shall be qualified to examine the find to determine if it is archaeological. If it is determined not to be archaeological, work may proceed at the discovery site with no further delay.
5. **Notify Additional Parties –** If the discovery is determined by the Project Archaeologist to be a cultural resource, the Port or their designee will provide notification to Ecology, Department of Archaeology and Historic Preservation (DAHP), the Swinomish, Samish, and Lummi Tribes. Confidentiality of the find will be maintained by Project leads and their contractors.
6. **Obtain Consent to Proceed with Construction –** Investigation work will not recommence at the discovery site until treatment has been completed and the Tribes, DAHP, and/or jurisdictional agencies, as appropriate, have provided written or verbal consent to proceed.

Contact information for key personnel for the inadvertent discovery of cultural resources is summarized in the following table.

CONTACT LIST FOR THE INADVERTENT DISCOVERY OF CULTURAL RESOURCES

Contact Name	Organization	Title	Contact Number
John Herzog (Primary Contact)	GeoEngineers, Inc.	Technical Project Manager	(o) 206.728.2674 (c) 206.406.6431
Robert Trahan (Alternate Contact)	GeoEngineers, Inc.	Field Coordinator	(o) 206.728.2674 (c) 206.240.2300
Becky Darden	Port of Anacortes	Project Coordinator	(o) 360.299.1831
Arianne Fernandez	Ecology	Project Coordinator	(o) 360.407.7209
Rob Whitlam	DAHP	State Archaeologist	(o) 360.586.3080
Larry Campbell	Swinomish Nation	Swinomish Indian Tribal Community	(o) 360.466.1615
Jackie Ferry	Samish Nation	Cultural Resources	(o) 360-293-6404
Lena Tso	Lummi Nation	Lummi Tribal Historic Preservation Office	(o) 360.384.2259

7.0 FEASIBILITY STUDY

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

- Establish cleanup levels, points of compliance and as necessary, establish remediation levels;
- Identify Applicable or Relevant and Appropriate Requirements (ARARs);
- Delineate media requiring remedial action;
- Develop remedial action objectives (RAOs);
- Screen and evaluate separate upland and in-water cleanup alternatives, if necessary, in accordance with WAC 173-340-350(8) and WAC 173-204-560(4). Based on this evaluation, select a preferred alternative for upland and sediment cleanup in accordance with WAC 173-340-360 and WAC 173-204-570; and
- If sediment contamination is identified, and if a particular remedial alternative would impact habitat, then mitigation of those impacts will be included in the evaluation of remedial alternatives.

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

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

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

Cleanup levels for soil will be protective of human health and the environment including aquatic ecological receptors, groundwater, and sediment based on current and future uses of the property. The point of compliance for soil will also be established.

Cleanup levels for groundwater will be based on protection of human health, surface water and sediment in Guemes Channel. Groundwater at or potentially affected by the Site is not a current or reasonable future source of drinking water. It is expected that information developed during the RI will be used to demonstrate that groundwater at the property meets the requirements of WAC 173-340-720 for non-potable groundwater. A groundwater point of compliance will be developed. The point of compliance may be conditional, located at or near the groundwater/surface water interface.

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

7.2. Applicable or Relevant and Appropriate Requirements

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

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

- Washington State Water Pollution Control Act (Chapter 90.48 RCW) and the implementing regulations: Water Quality Standards for Surface Waters of the State of Washington (Chapter 173-201A WAC).
- EPA National Recommended Water Quality Criteria – Section 304 Clean Water Act.
- EPA Water Quality Standards (National Toxics Rule) – 40 CFR 131.
- Minimum Standards for Construction and Maintenance of Wells (Chapter 173-160 RCW).
- The federal Clean Water Act, with respect to in-water work associated with dredging or sediment capping.
- Endangered Species Act, due to listing of Puget Sound chinook and of Coastal/Puget Sound bull trout.
- Washington Hazardous Waste Management Act and the implementing regulations: Dangerous Waste Regulations (Chapter 173-303 WAC), to the extent that any dangerous wastes are discovered or generated during the cleanup action.
- Washington's Shoreline Management Act with respect to construction cleanup activities conducted within 200 feet of the shoreline.
- Archaeological and Historical Preservation: The Archaeological and Historical Preservation Act (16 USCA 496a-1) would be applicable if any subject materials are discovered during Site grading and excavation activities.
- Archaeological Resources Protection Act, 16 USC 470aa; 43 CFR 7.
- Washington Clean Air Act (Chapter 70.94 WAC).
- Health and Safety: Site cleanup-related construction activities would need to be performed in accordance with the requirements of the Washington Industrial Safety and Health Act (RCW 49.17) and the federal Occupational Safety and Health Act (29 CFR 1910, 1926). These applicable regulations include requirements that workers are to be protected from exposure to contaminants and that excavations are to be properly shored.

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

7.3. Identification of Media Requiring Remedial Action

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

7.4. Development of Remedial Action Objectives

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

7.5. Development of Cleanup Alternatives

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

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

7.6. Evaluation of Cleanup Alternatives

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

7.7. Habitat Mitigation

If contamination from releases from the uplands bulk fueling facility is found to extend into and impact sediments, then any remedy that impacts habitat will include an evaluation of options to minimize and mitigate any habitat impacts from the remedy.

8.0 PUBLIC PARTICIPATION

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

9.0 PROJECT MANAGEMENT

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

9.1. Designated Project Coordinators

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

- Arianne Fernandez – Washington State Department of Ecology
- Becky Darden – Port of Anacortes

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

9.2. Technical Project Manager

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

9.3. Field Coordinator

The Field Coordinator for RI activities that will be completed under this Work Plan is Robert Trahan. The Field Coordinator is responsible for the daily management of activities in the field.

9.4. Quality Assurance Leader

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

9.5. Laboratory Management

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

10.0 REPORTING AND SCHEDULE

10.1. Reporting

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

10.1.1. Data Report Technical Memorandum

As required by the Agreed Order, The Port will provide Ecology with the results of the field investigation in the form of a Data Report Technical Memorandum so that a determination can be made with regard to whether additional investigation is required to fully define the nature and extent of contamination. The information provided to Ecology will describe the analytical results of the field activities, the affected media, the extent of contamination (plotted on maps and screened against screening levels, and identification of data gaps that need to be filled to complete the RI/FS with respect to the nature and extent of contamination and toxic/bioaccumulative effects.

10.1.2. RI/FS Report

A draft, draft final (if necessary), and final RI/FS report meeting the requirements of WAC 173-340-350, WAC 173-340-560, WAC 173-204-550 and WAC 173-204-560 will be prepared and submitted to Ecology for review and approval. The RI/FS report will contain the results of the RI and will provide information regarding the full extent and magnitude of soil, groundwater, surface water, and/or adjacent marine sediment contamination including toxic and bioaccumulative effects. The FS portion of the report will present and evaluate cleanup action alternatives to address the identified contamination at the Site. Based on the evaluation of alternatives (WAC 173-340-350(8) and WAC 173-204-570), the FS will identify a preferred cleanup action alternative for the Site in compliance with WAC 173-340-360 and WAC 173-204-560.

10.1.3. Draft Cleanup Action Plan

Upon Ecology approval of the RI/FS report, the Port will prepare a draft and draft final Cleanup Action Plan (CAP) in accordance with WAC 173-340-380 and WAC 173-204-570. The draft CAP will address the proposed cleanup action alternatives for the remediation of all impacted media in the upland and in-water portions of the Site, respectively, based on the results of the RI/FS. The draft CAP will include a general description of the proposed cleanup actions along with the following sections:

- A general description of the proposed cleanup action and the rationale for selection, including results of any remedial technology pilot studies, if necessary.
- A summary of the other alternatives evaluated in the RI/FS.
- Identification and summary of the applicable local, state, and federal laws pertinent to the proposed cleanup.
- Identification of Cleanup standards and the points of compliance along with a rationale regarding their selection for each hazardous substance and for each medium of concern at the Site based on the results of the RI/FS.
- Descriptions of any institutional/engineering controls, if proposed.
- A preliminary schedule for implementation of field construction work and subsequent maintenance and monitoring.

10.2. Schedule

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

PROJECT MILESTONES	SCHEDULE
Remedial Investigation/Feasibility Study (RI/FS) Work Plan Submittal	
Agreed Order Effective Date	February 23, 2016
Draft RI /FS Work Plan	Due to Ecology June 22, 2016
Final RI/FS Work Plan	90 calendar days following receipt of Ecology's review comments on the Draft RI/FS Work Plan, and then will undergo a 45-calendar day review period by Ecology.
Field RI	
Field RI	Commence within 60 calendar days of Ecology's approval of the Final RI/FS Work Plan. Separate mobilizations and field schedules may be required to complete the site investigation.
Data Report Technical Memorandum	60 calendar days following receipt of final validated data from all RI/FS analytical data.
Additional Field RI Activities (if needed)	The scope, schedule, and submittal requirements for additional field RI activities will be developed in consultation with Ecology. Plans for additional field RI activities will be submitted to Ecology for review and concurrence within 60 calendar days of Ecology's determination that additional RI activities are warranted.
RI/FS Report Submittal	
Draft RI/FS Report	180 calendar days following Ecology's approval of the Final RI/FS Work Plan. If Ecology review of the Data Report Technical Memorandum finds significant data gaps have not been filled, at Ecology's discretion, the Draft RI/FS Report submittal may be extended.
Final RI/FS Report	45 calendar days following Ecology comments on the Draft RI/FS. The Final RI/FS Report will undergo a 30-day public comment period. Ecology will complete a responsiveness summary to public comment on the Final RI/FS Report before approval of the document.
Draft Cleanup Action Plan (DCAP) Submittal	
Preliminary DCAP	120 calendar days after the RI/FS Report is finalized.
Final DCAP	60 calendar days following Ecology's comments on the Preliminary DCAP. The Final DCAP will undergo a 30-day public comment review period.

11.0 LIMITATIONS

We have prepared this Work Plan for use by the Port of Anacortes during the RI/FS at the Quiet Cove Site located at 202 O Avenue in Anacortes, Washington. Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted environmental science practices in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

Any electronic form, facsimile or hard copy of the original document (email, text, table, and/or figure), if provided, and any attachments are only a copy of the original document. The original document is stored by GeoEngineers, Inc. and will serve as the official document of record.

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TABLES

GeoEngineers

Table 1

Soil Screening Levels

Quiet Cove Property
Anacortes, Washington

Analyte	Criteria for Protection of Human Health[1]			Criteria for Protection of Groundwater					Modifying Factor		Soil Screening Level (Adjusted for Natural Background and PQL)	
	MTCA Method A Cleanup Level for Unrestricted Land Use	MTCA Method B Cleanup Level for Direct Contact (Standard Formula Value)		Equilibrium Partition Coefficients[2]			Soil Concentration Protective of Preliminary Groundwater Cleanup Level[3]		Natural Background[4]	Practical Quantitation Limit (PQL)[5]		
		Carc.	Non-Carc.	K_{oc} (org.)	K_d (metals)	H	Vadose Zone	Saturated Zone			Vadose Zone	Saturated Zone
Metals (mg/kg)												
Arsenic	--	0.67	24	--	29	--	2.92	0.15	20	5	20	20
Cadmium	--	--	80	--	6.7	--	1.21	0.061	1	0.20	1.2	1
Chromium (total)	--	--	120,000	--	1,000	--	1000	50.01	48	0.50	1,000	50
Lead	250	--	--	--	10,000	--	420	21	24	2	250	24
Mercury	2	--	--	--	52	4.70E-01	0.026	0.0013	0.07	0.05	0.07	0.07
Petroleum Hydrocarbons (mg/kg)												
Gasoline-Range	30/100[6]	--	--	--	--	--	--	--	--	5	30/100[6]	30/100[6]
Diesel-Range	2,000	--	--	--	--	--	--	--	--	5	2,000	2,000
Heavy Oil-Range	2,000	--	--	--	--	--	--	--	--	10	2,000	2,000
BETX Compounds (mg/kg)												
Benzene	--	18.18	320	62	--	2.28E-01	0.0135	0.00084	--	0.05	0.05	0.05
Ethylbenzene	--	--	8,000	204	--	3.23E-01	1.12	0.064	--	0.05	1.12	0.06
Toluene	--	--	6,400	140	--	2.72E-01	3.78	0.22	--	0.05	3.78	0.22
Xylenes	--	--	16,000	233	--	2.79E-01	2.83	0.16	--	0.05	2.83	0.16
Halogenated Volatile Organic Compounds (HVOCs; mg/kg)												
1,1,1,2-Tetrachloroethane	--	38.46	2,400	86.03	--	1.02E-01	0.04	0.00276	--	0.001	0.044	0.003
1,1,1-Trichloroethane	--	--	160,000	135	--	7.05E-01	41.50	2.209	--	0.001	41.5	2.21
1,1,2,2-Tetrachloroethane	--	5	1,600	79	--	1.41E-02	0.0168	0.00110	--	0.002	0.017	0.002
1,1,2-Trichloroethane	--	17.54	320	75	--	3.74E-02	0.0251	0.00163	--	0.001	0.025	0.002
1,1-Dichloroethane	--	175.4	16,000	53	--	2.30E-01	0.061	0.0038	--	0.001	0.061	0.0038
1,1-Dichloroethene	--	--	4,000	65	--	1.07E+00	0.023	0.0011	--	0.001	0.023	0.0011
1,1-Dichloropropene	--	--	--	60.7	--	--	--	--	--	0.001	--	--
1,2,3-Trichlorobenzene	--	--	--	1383	--	5.11E-02	--	--	--	0.005	--	--
1,2,3-Trichloropropane	--	0.033	320	115.8	--	1.40E-02	--	--	--	0.002	0.033	0.033
1,2,4-Trichlorobenzene	--	34.48	800	1,659	--	5.82E-02	0.019	0.001	--	0.005	0.019	0.005
1,2-Dibromo-3-chloropropane	--	1.25	16	116	--	6.01E-03	--	--	--	0.005	1.25	1.25
1,2-Dichlorobenzene	--	--	7,200	379	--	7.79E-02	30.12	1.71	--	0.001	30.12	1.71
1,2-Dichloroethane (EDC)	--	10.99	480	38	--	4.01E-02	0.0203	0.00136	--	0.001	0.02	0.001
1,2-Dichloropropane	--	27.78	7200	47	--	1.15E-01	0.0200	0.00130	--	0.001	0.02	0.001
1,3-Dichlorobenzene	--	--	--	375.3	--	--	--	--	--	0.001	--	--
1,3-Dichloropropane	--	--	--	72.17	--	3.99E-02	--	--	--	0.001	--	--
1,4-Dichlorobenzene	--	185.2	5600	616	--	9.96E-02	0.08	0.0044	--	0.067	0.08	0.067
2,2-Dichloropropane	--	--	--	43.89	--	--	--	--	--	0.001	--	--
2-Chloroethyl Vinyl Ether	--	--	--	18	--	--	--	--	--	0.005	--	--
2-Chlorotoluene	--	--	1,600	382.9	--	1.46E-01	--	--	--	0.001	1,600	1,600
4-Chlorotoluene	--	--	--	375	--	--	--	--	--	0.001	--	--
Bromobenzene	--	--	--	2.34E+02	--	1.01E-01	--	--	--	0.001	--	--
Bromochloromethane	--	--	--	2.17E+01	--	5.97E-02	--	--	--	0.005	--	--

Analyte	Criteria for Protection of Human Health[1]			Criteria for Protection of Groundwater					Modifying Factor		Soil Screening Level (Adjusted for Natural Background and PQL)	
	MTCA Method A Cleanup Level for Unrestricted Land Use	MTCA Method B Cleanup Level for Direct Contact (Standard Formula Value)		Equilibrium Partition Coefficients[2]			Soil Concentration Protective of Preliminary Groundwater Cleanup Level[3]		Natural Background[4]	Practical Quantitation Limit (PQL)[5]		
		Carc.	Non-Carc.	K_{oc} (org.)	K_d (metals)	H	Vadose Zone	Saturated Zone			Vadose Zone	Saturated Zone
Bromoform	--	126.6	1,600	126	--	2.19E-02	0.787	0.0495	--	0.001	0.79	0.05
Bromomethane	--	--	112	9	--	2.56E-01	0.060	0.0038	--	0.001	0.06	0.0038
Carbon Tetrachloride	--	14.29	320	152	--	1.25E+00	0.005	0.00024	--	0.001	0.005	0.001
Chlorobenzene	--	--	1,600	224	--	1.52E-01	2.50	0.146	--	0.001	2.5	0.146
Chloroethane	--	--	--	21.73	--	4.54E-01	95.47	5.64	--	0.005	95.47	5.64
Chloroform	--	32.26	800	53	--	1.50E-01	0.0064	0.00041	--	0.001	0.0064	0.001
Chloromethane	--	--	--	6	--	3.61E-01	0.73	0.045	--	0.001	0.725	0.045
Cis-1,2-Dichloroethene	--	--	160	35.5	--	1.67E-01	--	--	--	0.001	160	160
Cis-1,3-Dichloropropene	--	--	--	72	--	--	--	--	--	0.001	--	--
Dibromochloromethane	--	11.9	1,600	63.1	--	3.21E-02	0.0241	0.00158	--	0.001	0.024	0.002
Dibromomethane	--	--	800	21.73	--	3.36E-02	--	--	--	0.001	800	800
Dichlorodifluoromethane (CFC 12)	--	--	16,000	43.89	--	1.40E+01	0.17	0.0019	--	0.001	0.17	0.0019
1,2-Dibromoethane (EDB)	--	0.5	720	66	--	2.66E-02	0.0015	0.000099	--	0.001	0.002	0.001
Methyl Iodide	--	--	--	13	--	--	--	--	--	0.001	--	--
Methyl t-Butyl Ether (MTBE)	--	555.6	--	11	--	1.80E-02	2.592	0.182	--	0.001	2.59	0.18
Methylene Chloride	--	500	480	10	--	8.98E-02	4.356	0.2967	--	0.002	4.36	0.3
n-Hexane	--	--	4800	1,482	--	6.50E-01	0.27	0.014	--	0.001	0.27	0.01
Tetrachloroethene (PCE)	--	476.2	480	265	--	7.54E-01	0.094	0.0049	--	0.001	0.094	0.0049
Trans-1,2-Dichloroethene	--	--	1,600	38	--	3.85E-01	21.71	1.299	--	0.001	21.71	1.3
Trans-1,3-Dichloropropene	--	--	--	72	--	--	--	--	--	0.001	--	--
Trichloroethene (TCE)	--	12	40	94	--	4.22E-01	0.0103	0.00059	--	0.001	0.01	0.001
Trichlorofluoromethane (CFC 11)	--	--	24,000	44	--	3.97E+00	1.41	0.04	--	0.001	1.4	0.04
Vinyl Chloride	--	0.67	240	18.6	--	1.11E+00	0.0063	0.00031	--	0.001	0.006	0.001
Non-carcinogenic Polycyclic Aromatic Hydrocarbons (PAHs; mg/kg)												
1-Methylnaphthalene	--	34.48	5600	2,528	--	2.10E-02	--	--	--	0.0067	34.48	34.48
2-Methylnaphthalene	--	--	320	2,478	--	2.12E-02	0.77	0.040	--	0.0067	0.77	0.04
Acenaphthene	--	--	4,800	4,898	--	7.52E-03	0.32	0.02	--	0.0067	0.32	0.02
Acenaphthylene	--	--	--	5,027	--	--	--	0.068	--	0.0067	--	0.068
Anthracene	--	--	24,000	23,493	--	2.67E-03	4	0.2	--	0.0067	4.41	0.2
Benzo[g,h,i]perylene	--	--	--	1,951,000	--	--	--	1.95	--	0.0067	--	1.95
Fluoranthene	--	--	3,200	49,096	--	6.60E-04	3.20	0.16	--	0.0067	3.2	0.16
Fluorene	--	--	3,200	7,707	--	2.61E-03	0.46	0.02		0.0067	0.5	0.02
Naphthalene	--	--	1,600	1,191	--	1.98E-02	0.25	0.013	--	0.0067	0.25	0.01
Phenanthrene	--	--	--	16,690	--	--	--	0.10	--	0.0067	--	0.101
Pyrene	--	--	2,400	67,992	--	4.51E-04	20.01	1.00	--	0.0067	20	1
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs; mg/kg)												
Benzo[a]anthracene	--	1.37	--	357,537	--	1.37E-04	0.07	0.0036	--	0.0067	0.07	0.007
Benzo[a]pyrene	--	0.14	--	968,774	--	4.63E-05	0.19	0.010	--	0.0067	0.14	0.010
Benzo[b]fluoranthene	--	1.37	--	1,230,000	--	4.55E-03	0.25	0.012	--	0.0067	0.25	0.012
Benzo[k]fluoranthene	--	13.7	--	1,230,000	--	3.40E-05	0.32	0.016	--	0.0067	0.32	0.016
Chrysene	--	137	--	398,000	--	3.88E-03	0.25	0.0124	--	0.0067	0.25	0.0124
Dibenz[a,h]anthracene	--	0.14	--	1,789,101	--	6.03E-07	0.36	0.018	--	0.0067	0.14	0.018
Indeno[1,2,3-c,d]pyrene	--	1.37	--	3,470,000	--	6.56E-05	0.69	0.035	--	0.0067	0.69	0.035
cPAHs TEQ	--	--	--	968,774	--	4.63E-05	0.22	0.011	--	0.0067	0.22	0.011

Analyte	Criteria for Protection of Human Health[1]			Criteria for Protection of Groundwater					Modifying Factor		Soil Screening Level (Adjusted for Natural Background and PQL)	
	MTCA Method A Cleanup Level for Unrestricted Land Use	MTCA Method B Cleanup Level for Direct Contact (Standard Formula Value)		Equilibrium Partition Coefficients[2]			Soil Concentration Protective of Preliminary Groundwater Cleanup Level[3]		Natural Background[4]	Practical Quantitation Limit (PQL)[5]		
		Carc.	Non-Carc.	K_{oc} (org.)	K_d (metals)	H	Vadose Zone	Saturated Zone			Vadose Zone	Saturated Zone
Polychlorinated Biphenyls (PCBs; mg/kg)												
Total PCBs (Sum of Aroclors or Congeners)	1	0.5	--	309,000	--	1.20E-02	0.062	0.0031	--	0.05	0.062	0.05
Dioxins and Furans (ng/kg)												
Total dioxins/furans - human health TEQ	--	12.82	93	249,100	--	0.002	0.080	0.004	5.2[7]	2.2	5.2[7]	5.2[7]

Notes:

[1] MTCA Method A soil cleanup levels are shown for those chemicals for which Method B values are not available (e.g., petroleum hydrocarbons and lead). MTCA Method A value for total PCBs is also included to show chemical-specific cleanup level mandated in the Federal Toxic Substance Control Act (TSCA).

[2] Values for Kd and/or Koc and/or Henry's Law Constant not available from Cleanup Levels and Risk Calculation (CLARC) database were referenced from Estimation Program Interface (EPI) EPI Suite v4.11 (http://www.epa.gov/oppt/exposure/pubs/episuitedl.htm) or Oak Ridge National Laboratory (ORNL) Risk Assessment Information System (RAIS).

[3] Soil concentrations protective of groundwater calculated per WAC 173-340-740(3)(b)(iii)(A) using Equations 747-1 and 747-2 referencing groundwater screening levels presented in Table 2. Method A Cleanup Values are used for petroleum hydrocarbon soil concentrations protective of groundwater.

[4] Metals background values (Puget Sound Region 90th percentile values) are from *Natural Background Soil Metals Concentrations in Washington State* (Ecology Publication #94-115, 1994), with the exception of arsenic which is referenced from MTCA Table 745-1 (WAC 173-340-900).

[5] Lowest available PQL value from Analytical Resources Inc. (ARI) of Tukwila, Washington.

[6] Screening level for gasoline-range petroleum hydrocarbons is 30 mg/kg if benzene is present and 100 mg/kg if not present.

[7] Background for dioxins/furans from "Natural Background for Dioxins/Furans in WA Soils." Ecology Technical Memorandum #8 dated August 9, 2010.

EPA = Environmental Protection Agency

k_d = Distribution coefficient

k_{oc} = Soil organic carbon-water partitioning coefficient (L/kg)

L/kg = Liter per kilogram

mg/kg = Milligrams per kilogram

ng/kg = Nanogram per kilogram

MTCA = Washington State Model Toxics Control Act

PQL = Practical quantitation limit

-- = No screening criteria available.

TEQ = Toxic equivalent concentration (toxicity equivalency factor (TEF) values are presented in Table 5).

Calculated concentrations protective of groundwater as marine surface water assume unsaturated soil, and are calculated based on groundwater screening levels before adjustment for background and PQLs.

Table 2

Groundwater Screening Levels

Quiet Cove Property

Anacortes, Washington

Analyte	Criteria for Protection of Aquatic Organisms and Human Health									Groundwater Screening Level Protective of Sediment[5]	MTCA Method B Groundwater Screening Level for Protection of Vapor Intrusion		Modifying Factor		Groundwater Screening Level (Adjusted for Natural Background and PQL)
	Marine Surface Water Quality Criteria[1]		National Toxics Rule[2]			Clean Water Act[3]			MTCA Method B Surface Water Cleanup Level[4]				Natural Background[6]	Practical Quantitation Limit (PQL)[7]	
	Acute	Chronic	Protection of Marine Aquatic Life: Acute	Protection of Marine Aquatic Life: Chronic	AWQC for Protection of Human Health	Protection of Marine Aquatic Life: Acute	Protection of Marine Aquatic Life: Chronic	AWQC for Protection of Human Health			Carc.	Non-Carc.			
Metals (µg/L)															
Arsenic	69	36	69	36	0.14	69	36	0.14	0.098	43.1	--	--	5	0.5	5
Cadmium	42	9.3	42	9.3	--	40	8.8	--	40.5	114.5	--	--	--	0.1	8.8
Chromium[8] (total)	1,100	50	1,100	50	--	1,100	50	--	243,056	389.9	--	--	--	1	50
Lead	210	8.1	210	8.1	--	210	8.1	--	--	2.1	--	--	--	0.1	2.1
Mercury	1.8	0.025	2.1	0.025	0.15	1.8	0.94	0.3	--	3.8	--	0.89	--	0.02	0.025
Petroleum Hydrocarbons (µg/L)															
Gasoline-Range	--	--	--	--	--	--	--	--	800/1000[9,10]	--	--	--	--	100	800/1000[9]
Diesel-Range	--	--	--	--	--	--	--	--	500[9]	--	--	--	--	100	500
Heavy Oil-Range	--	--	--	--	--	--	--	--	500[9]	--	--	--	--	200	500
BETX Compounds (µg/L)															
Benzene	--	--	--	--	71	71	71	58	22.66	--	2.4	102.7	--	0.2	2.4
Ethylbenzene	--	--	--	--	29,000	29000	29000	130	6,823	--	--	2,783	--	0.2	130
Toluene	--	--	--	--	200,000	200000	200000	520	18,855	--	--	15,584	--	0.2	520
Xylenes	--	--	--	--	--	--	--	--	--	--	--	310	--	0.2	310
Halogenated Volatile Organic Compounds (HVOCs; µg/L)															
1,1,1,2-Tetrachloroethane	--	--	--	--	--	--	--	--	--	--	7.40	--	--	0.2	7.40
1,1,1-Trichloroethane	--	--	--	--	--	--	--	200,000	925,926	--	--	5,238	--	0.2	5,238
1,1,2,2-Tetrachloroethane	11	11	11	11	11	11	11	3	6.48	--	6.20	--	--	0.2	3
1,1,2-Trichloroethane	--	--	--	--	42	42	42	8.9	25.27	--	7.71	4.51	--	0.2	4.51
1,1-Dichloroethane	--	--	--	--	--	--	--	20,000	--	--	11.230	--	--	0.2	11.23
1,1-Dichloroethene	--	--	--	--	3.2	3.2	3.2	7,100	23,148	--	--	130.0	--	0.2	3.2
1,1-Dichloropropene	--	--	--	--	--	--	--	--	--	--	--	--	--	0.20	--
1,2,3-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	0.50	--
1,2,3-Trichloropropane	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	--
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	0.076	2.03	--	--	39.18	--	0.5	0.50
1,2-Dibromo-3-chloropropane	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	--
1,2-Dichlorobenzene	--	--	--	17000	17,000	17000	17000	3,000	4,167	--	--	2,571	--	0.2	2,571
1,2-Dichloroethane (EDC)	--	--	--	99	99	99	99	650	59.35	--	4.20	139.8	--	0.2	4.20
1,2-Dichloropropane	--	--	--	--	--	--	--	31	43.91	--	3.89	28.44	--	0.2	3.89
1,3-Dichlorobenzene	--	--	--	2600	2,600	2600	2600	10	2,600	--	--	--	--	0.2	10
1,3-Dichloropropane	--	--	--	--	--	--	--	--	--	--	--	--	--	0.20	--
1,4-Dichlorobenzene	--	--	--	2600	2,600	2600	2600	900	214.3	--	4.85	7,808	--	0.2	4.85
2,2-Dichloropropane	--	--	--	--	--	--	--	--	--	--	--	--	--	0.20	--
2-Chloroethyl Vinyl Ether	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0	--
2-Chlorotoluene	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0	--
4-Chlorotoluene	--	--	--	--	--	--	--	--	--	--	--	--	--	0.20	--
Bromobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	0.20	--
Bromochloromethane	--	--	--	--	--	--	--	--	--	--	--	--	--	0.20	--
Bromoform	--	--	--	--	360	360	360	120	215.9	--	200.0	--	--	0.2	120

Analyte	Criteria for Protection of Aquatic Organisms and Human Health									Groundwater Screening Level Protective of Sediment[5]	MTCA Method B Groundwater Screening Level for Protection of Vapor Intrusion		Modifying Factor		Groundwater Screening Level (Adjusted for Natural Background and PQL)
	Marine Surface Water Quality Criteria[1]		National Toxics Rule[2]			Clean Water Act[3]			MTCA Method B Surface Water Cleanup Level[4]				Natural Background[6]	Practical Quantitation Limit (PQL)[7]	
	Acute	Chronic	Protection of Marine Aquatic Life: Acute	Protection of Marine Aquatic Life: Chronic	AWQC for Protection of Human Health	Protection of Marine Aquatic Life: Acute	Protection of Marine Aquatic Life: Chronic	AWQC for Protection of Human Health			Carc.	Non-Carc.			
Bromomethane	--	--	--	--	4,000	4000	4000	10,000	955.2	--	--	13.00	--	1.0	13
Carbon Tetrachloride	--	--	--	--	4.4	4.4	4.4	5.0	4.87	--	0.54	59.16	--	0.2	0.54
Chlorobenzene	--	--	--	--	21,000	21000	21000	800	5,185	--	--	285.7	--	0.2	286
Chloroethane	--	--	--	--	--	--	--	--	--	--	--	18,286	--	0.2	18,286
Chloroform	--	--	--	--	470	470	470	2,000	55.02	--	1.20	494.6	--	0.2	1.2
Chloromethane	--	--	--	--	--	--	--	--	--	--	--	152.8	--	0.5	152.8
Cis-1,2-Dichloroethene	--	--	--	--	--	--	--	--	--	--	--	--	--	0.2	--
Cis-1,3-Dichloropropene	--	--	--	--	--	--	--	--	--	--	--	--	--	0.2	--
Dibromochloromethane	--	--	--	--	34	34	34	27	20.31	--	4.53	--	--	0.2	4.53
Dibromomethane	--	--	--	--	--	--	--	--	--	--	--	--	--	0.2	--
Dichlorodifluoromethane (CFC 12)	--	--	--	--	--	--	--	--	--	--	--	5.66	--	0.2	5.66
1,2-Dibromoethane (EDB)	--	--	--	--	--	--	--	--	--	--	0.28	276.8	--	0.2	0.3
Methyl Iodide	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0	--
Methyl t-Butyl Ether (MTBE)	--	--	--	--	--	--	--	--	--	--	610.0	87,003	--	0.5	610
Methylene Chloride	--	--	--	--	1,600	1600	1600	1,000	3,601	--	4,434	4,865	--	1.0	1,000
n-Hexane	--	--	--	--	--	--	--	--	--	--	--	7.8000	--	0.2	7.8
Tetrachloroethene (PCE)	--	--	--	--	8.85	8.85	8.85	29	99.56	--	22.89	43.5	--	0.2	8.9
Trans-1,2-Dichloroethene	--	--	--	--	--	--	--	4,000	32,407	--	--	--	--	0.2	4,000
Trans-1,3-Dichloropropene	--	--	--	--	--	--	--	--	--	--	--	--	--	0.2	--
Trichloroethene (TCE)	--	--	--	--	81	81	81	7	12.81	--	1.55	3.84	--	0.2	1.55
Trichlorofluoromethane (CFC 11)	--	--	--	--	--	--	--	--	--	--	--	120.0	--	0.2	120
Vinyl Chloride	--	--	--	--	525	525	525	1.6	3.7	--	0.35	56.69	--	1.0	1
Non-carcinogenic Polycyclic Aromatic Hydrocarbons (PAHs; µg/L)															
1-Methylnaphthalene	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0	--
2-Methylnaphthalene	--	--	--	--	--	--	--	--	--	14.45	--	--	--	1.0	14.45
Acenaphthene	--	--	--	--	--	--	--	90	648.1	3.17	--	--	--	1.0	3.17
Acenaphthylene	--	--	--	--	--	--	--	--	--	12.75	--	--	--	1.0	12.75
Anthracene	110000	110000	110000	110000	110,000	110000	110000	400	25,926	9.3	--	--	--	1.0	9.3
Benzo[g,h,i]perylene	--	--	--	--	--	--	--	--	--	0.016	--	--	--	1.0	1
Fluoranthene	370	370	370	370	370	370	370	20	86.42	3.25	--	--	--	1.0	3.25
Fluorene	14000	14000	14000	14000	14,000	14000	14000	70	3,457	2.93	--	--	--	1.0	2.93
Naphthalene	--	--	--	--	--	--	--	--	4,714	73.78	8.93	166.5	--	1.0	8.93
Phenanthrene	--	--	--	--	--	--	--	--	--	5.94	--	--	--	1.0	5.94
Pyrene	11000	11000	11000	11000	11,000	11000	11000	30	2,593	14.68	--	--	--	1	14.68
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs; µg/L)															
Benzo[a]anthracene	0.0311	0.0311	0.0311	0.0311	0.031	0.0311	0.0311	0.0013	0.30	0.31	--	--	--	0.01	0.01
Benzo[a]pyrene	0.0311	0.0311	0.0311	0.0311	0.031	0.0311	0.0311	0.00013	0.03	0.033	--	--	--	0.01	0.01
Benzo[b]fluoranthene	0.0311	0.0311	0.0311	0.0311	0.031	0.0311	0.0311	0.0013	0.30	0.19	--	--	--	0.01	0.01
Benzo[k]fluoranthene	0.0311	0.0311	0.0311	0.0311	0.031	0.0311	0.0311	0.013	2.96	0.26	--	--	--	0.01	0.013
Chrysene	0.0311	0.0311	0.0311	0.0311	0.031	0.0311	0.0311	0.130	29.6	0.28	--	--	--	0.01	0.031
Dibenz[a,h]anthracene	0.0311	0.0311	0.0311	0.0311	0.031	0.0311	0.0311	0.00013	0.03	0.0067	--	--	--	0.01	0.01
Indeno[1,2,3-c,d]pyrene	0.0311	0.0311	0.0311	0.0311	0.031	0.0311	0.0311	0.0013	0.30	0.0098	--	--	--	0.01	0.01
cPAHs TEQ	--	--	--	--	0.031	--	--	0.018	0.03	0.011	--	--	--	0.01	0.011

Analyte	Criteria for Protection of Aquatic Organisms and Human Health								MTCA Method B Surface Water Cleanup Level[4]	Groundwater Screening Level Protective of Sediment[5]	MTCA Method B Groundwater Screening Level for Protection of Vapor Intrusion		Modifying Factor		Groundwater Screening Level (Adjusted for Natural Background and PQL)
	Marine Surface Water Quality Criteria[1]		National Toxics Rule[2]			Clean Water Act[3]									
			Protection of Marine Aquatic Life		AWQC for Protection of Human Health	Protection of Marine Aquatic Life		AWQC for Protection of Human Health			Carc.	Non-Carc.	Natural Background[6]	Practical Quantitation Limit (PQL)[7]	
	Acute	Chronic	Acute	Chronic		Acute	Chronic								
Polychlorinated Biphenyls (PCBs; µg/L)															
Total PCBs (Sum of Aroclors or Congeners)	10	0.03	0.00017	0.03	0.00017	0.00017	0.03	0.000064	0.0001	0.039	–	–	–	0.01	0.010
Dioxins and Furans (ng/L)															
Total dioxins/furans - human health TEQ	–	–	–	–	0.014	–	–	0.0051	0.01	10.56	–	–	–	0.016	0.016

Notes:

[1] Water quality criteria for protection of aquatic life from WAC 173-201A-240 (Water Quality Standards for Surface Waters of the State of Washington).

[2] Ambient water quality criteria (AWQC) for protection of human health from 40 CFR Part 131d (National Toxics Rule).

[3] National Recommended Water Quality Criteria (http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm; accessed March 2016).

[4] The values presented are the lowest of the MTCA Method B carcinogenic and non-carcinogenic criteria for surface water. The carcinogenic and non-carcinogenic criteria for surface water are adjusted for cases when a state or federal surface water standard is available, but is not considered to be "sufficiently protective" under MTCA (that is, the standard is based on a hazard quotient greater than 1 or a cancer risk greater than 1 x 10-5). For these cases, WAC 173-340-720(7)(b) and -730(5)(b) allows the standard to be adjusted downward to a hazard quotient of 1 or a cancer risk of 1 x 10-5.

[5] For ionizing organics, Cw (µg/L) = (C_{sed} (mg/kg OC) / K_{oc} (L/kg OC)) x 1000 µg/mg; for non-ionizing organics, C_w (mg/L) = (C_{sed} (mg/kg) / K_d (L/kg)*foc) x 1000 µg/kg (assumes foc of 2%) and for metals, C_w (mg/L) = (C_{sed} (mg/kg) / K_d (L/kg)) x 1000 µg/kg.

[6] Metals background values (Puget Sound Region 90th percentile values) are from *Natural Background Soil Metals Concentrations in Washington State* (Ecology Publication #94-115, 1994), with the exception of arsenic which is referenced from MTCA Table 745-1 (WAC 173-340-900).

[7] Lowest available PQL value from Analytical Resources Inc. (ARI) of Tukwila, Washington.

[8] Trivalent chromium (chromium III) is assumed where no value is available for total chromium.

[9] MTCA Method A groundwater cleanup level; MTCA Method B surface water cleanup level is not available for total petroleum hydrocarbons.

[10] The screening level for gasoline-range petroleum hydrocarbons is 800 µg/L if benzene is present and 1,000 µg/L if not present.

MTCA = Washington State Model Toxics Control Act

ng/L = Nanogram per liter

µg/L = Microgram per liter

PQL = Practical quantitation limit

– = No screening criteria available.

TEQ = Toxic equivalent concentration (toxicity equivalency factor (TEF) values are presented in Table 5).

Table 3

Sediment Screening Levels for Protection of Benthic Organisms

Quiet Cove Property
Anacortes, Washington

Analyte	Criteria for Protection of Benthic Organisms						Modifying Factors			Sediment Screening Level for Protection of Benthic Organisms[5] (Adjusted for Natural Background and PQL)			
	Sediment Management Standard[1] (SMS)			Apparent Effects Threshold (AET) Criteria[2]									
	Sediment Quality Objectives (SQO)	Cleanup Screening Level (CSL)	Units	Lowest AET (LAET)	Second Lowest AET (2LAET)	Units	Natural Background[3]	Practical Quantitation Limit (PQL)[4]	Units	Organic Carbon (0.5% to 3.5%)	Units	Organic Carbon (<0.5% or >3.5%)	Units
Metals													
Arsenic	57	93	mg/kg	57	93	mg/kg	11	5	mg/kg	57	mg/kg	57	mg/kg
Cadmium	5.1	6.7		5.1	6.7		1	0.2		5.1		5.1	
Chromium (total)	260	270		260	270		62	0.5		260		260	
Copper	390	390		390	390		45	0.2		390		390	
Lead	450	530		450	530		21	2		450		450	
Mercury	0.41	0.59		0.41	0.59		0.2	0.05		0.41		0.41	
Silver	6.1	6.1		6.1	6.1		0.2	0.3		6.1		6.1	
Zinc	410	960		410	960		93	1		410		410	
Low Molecular Weight Polycyclic Aromatic Hydrocarbons (LPAHs)													
Total LPAH[6]	370	780	mg/kg OC	5.2	5.2	mg/kg	--	0.005	mg/kg	370	mg/kg OC	5.2	mg/kg
Naphthalene	99	170		2.1	2.1		--	0.005		99		2.1	
Acenaphthylene	66	66		1.3	1.3		--	0.005		66		1.3	
Acenaphthene	16	57		0.5	0.5		--	0.005		16		0.5	
Fluorene	23	79		0.54	0.54		--	0.005		23		0.54	
Phenanthrene	100	480		1.5	1.5		--	0.005		100		1.5	
Anthracene	220	1,200		0.96	0.96		--	0.005		220		0.96	
2-Methylnaphthalene	38	64		0.67	0.67		--	0.005		38		0.67	
High Molecular Weight Polycyclic Aromatic Hydrocarbons (HPAHs)													
Total HPAH[7]	960	5,300	mg/kg OC	12	17	mg/kg	--	0.005	mg/kg	960	mg/kg OC	12	mg/kg
Fluoranthene	160	1,200		1.7	2.5		--	0.005		160		1.7	
Pyrene	1,000	1,400		2.6	3.3		--	0.005		1000		2.6	
Benzo(a)anthracene	110	270		1.3	1.6		--	0.005		110		1.3	
Chrysene	110	460		1.4	2.8		--	0.005		110		1.4	
Total benzofluoranthenes	230	450		3.2	3.6		--	0.005		230		3.2	
Benzo(a)pyrene	99	210		1.6	1.6		--	0.005		99		1.6	
Indeno(1,2,3-c,d)pyrene	34	88		0.60	0.69		--	0.005		34		0.60	
Dibenzo(a,h)anthracene	12	33		0.23	0.23		--	0.005		12		0.23	
Benzo(ghi)perylene	31	78		0.67	0.72		--	0.005		31		0.67	
Chlorinated Organic Compounds													
1,2-Dichlorobenzene	2.3	2.3	mg/kg OC	0.035	0.05	mg/kg	--	0.2	mg/kg	2.3	mg/kg OC	0.035	mg/kg
1,4-Dichlorobenzene	3.1	9		0.11	0.11		--	0.2		3.1		0.11	
1,2,4-Trichlorobenzene	0.81	1.8		0.031	0.051		--	0.2		0.81		0.031	
Hexachlorobenzene	0.38	2.3		0.022	0.07		--	0.001		0.38		0.022	
Phthalates													
Dimethyl phthalate	53	53	mg/kg OC	0.071	0.16	mg/kg	--	0.02	mg/kg	53	mg/kg OC	0.071	mg/kg
Diethyl phthalate	61	110		0.2	> 1.2		--	0.02		61		0.2	
Dibutyl phthalate	220	1,700		1.4	1.4		--	0.02		220		1.4	
Butyl benzyl phthalate	4.9	64		0.063	0.9		--	0.02		4.9		0.063	
Bis(2-ethylhexyl) phthalate	47	78		1.3	1.9		--	0.05		47		1.3	
Di-n-octyl phthalate	58	4,500		6.2	6.2		--	0.02		58		6.2	

Analyte	Criteria for Protection of Benthic Organisms						Modifying Factors			Sediment Screening Level for Protection of Benthic Organisms[5] (Adjusted for Natural Background and PQL)			
	Sediment Management Standard[1] (SMS)			Apparent Effects Threshold (AET) Criteria[2]									
	Sediment Quality Objectives (SQO)	Cleanup Screening Level (CSL)	Units	Lowest AET (LAET)	Second Lowest AET (2LAET)	Units	Natural Background[3]	Practical Quantitation Limit (PQL)[4]	Units	Organic Carbon (0.5% to 3.5%)	Units	Organic Carbon (<0.5% or >3.5%)	Units
Miscellaneous Extractables													
Dibenzofuran	15	58	mg/kg OC	0.54	0.54	mg/kg	--	0.02	mg/kg	15	mg/kg OC	0.54	mg/kg
Hexachlorobutadiene	3.9	6.2		0.011	0.12		--	0.001		3.9		0.011	
N-nitrosodiphenylamine	11	11		0.028	0.04		--	0.02		11		0.028	
Benzyl alcohol	0.057	0.073	mg/kg	0.057	0.073	mg/kg	--	0.02	mg/kg	0.057	mg/kg	0.057	mg/kg
Benzoic acid	0.65	0.65		0.65	0.65		--	0.2		0.65		0.65	
Phenols													
Phenol	0.42	1	mg/kg	0.42	1.2	mg/kg	--	0.1	mg/kg	0.42	mg/kg	0.42	mg/kg
2-Methylphenol	0.063	0.063		0.63	0.063		--	0.02		0.063		0.063	
4-Methylphenol	0.67	0.67		0.67	0.67		--	0.02		0.67		0.67	
2,4-Dimethylphenol	0.029	0.29		0.029	0.029		--	0.025		0.029		0.029	
Pentachlorophenol	0.36	0.69		0.36	0.69		--	0.1		0.36		0.36	
Polychlorinated Biphenyls (PCBs)													
Total PCBs (Sum of Total of Aroclors)	12	65	mg/kg OC	0.13	1	mg/kg	0.0035	0.000002	mg/kg	12	mg/kg OC	0.13	mg/kg

Notes:

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

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

[3] Metals background values (Puget Sound Region 90th percentile values) are from *Natural Background Soil Metals Concentrations in Washington State* (Ecology Publication #94-115, 1994), with the exception of arsenic which is reference from MTCA A Table 745-1 (WAC 173-340-900).

[4] Lowest available PQL value from Analytical Resources Inc. (ARI) of Tukwila, Washington.

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

[6] Total LPAHs are the sum of naphthalene, acenaphthylene, acenapthene, fluorene, phenanthrene and anthracene; 2-methylnapthalene is not included in the sum of LPAHs.

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

mg/kg = milligram per kilogram

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

ng/kg = nanogram per kilogram

µg/kg = microgram per kilogram

µg/L = microgram per liter

-- = Criteria not applicable or not available

EPA = Environmental Protection Agency

TEQ = Toxic equivalent concentration (toxicity equivalency factor (TEF) values are presented in Table 5).

Table 4

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

Quiet Cove Property
Anacortes, Washington

Analyte	Criteria for Protection of Human Health							Modifying Factors		Sediment Screening Level for Protection of Human Health and Higher Trophic Level Ecological Receptors[5]	
	Bioaccumulation via Consumption of Aquatic Organisms	Direct Contact via Beach Play[2]		Direct Contact via Clamming[2]		Direct Contact via Net Fishing[2]		Natural Background[3]	Practical Quantitation Limit[4] (PQL)	Intertidal Sediment (above -3 ft MLLW)	Subtidal Sediment (below -3 ft MLLW)
	Natural Background or PQL[1]	Carcinogenic (at 10^{-6} risk)	Non-Carcinogenic	Carcinogenic (at 10^{-6} risk)	Non-Carcinogenic	Carcinogenic (at 10^{-6} risk)	Non-Carcinogenic				
Metals (mg/kg)											
Arsenic	11	4.5	160	0.45	190	2.9	1,200	11	5	11	11
Cadmium	0.8	--	380	--	280	--	3,300	0.8	0.2	0.8	0.8
Chromium (total)	--	--	400,000	--	230,000	--	3,700,000	62	0.5	230,000	3,700,000
Copper	--	--	26,000	--	50,000	--	180,000	45	0.2	26,000	180,000
Lead	21	--	--	--	--	--	--	21	2	21	21
Mercury	0.2	--	190	--	370	--	1,400	0.2	0.05	0.2	0.2
Silver	--	--	3,200	--	6,200	--	23,000	0.2	0.3	3,200	23,000
Zinc	--	--	190,000	--	370,000	--	1,400,000	93	1	190,000	1,400,000
Low Molecular Weight Polycyclic Aromatic Hydrocarbons (LPAHs; mg/kg)											
Total LPAH[6]	--	--	--	--	--	--	--	--	0.005	--	--
Naphthalene	--	--	9,100	--	8,200	--	74,000	--	0.005	8,200	74,000
Acenaphthylene	--	--	27,000	--	25,000	--	220,000	--	0.005	25,000	220,000
Acenaphthene	--	--	27,000	--	25,000	--	220,000	--	0.005	25,000	220,000
Fluorene	--	--	18,000	--	16,000	--	150,000	--	0.005	16,000	150,000
Phenanthrene	--	--	140,000	--	120,000	--	1,100,000	--	0.005	120,000	1,100,000
Anthracene	--	--	140,000	--	120,000	--	1,100,000	--	0.005	120,000	1,100,000
2-Methylnaphthalene	--	--	1,800	--	1,600	--	15,000	--	0.005	1,600	15,000
High Molecular Weight Polycyclic Aromatic Hydrocarbons (HPAHs; mg/kg)											
Total HPAH[7]	--	--	--	--	--	--	--	--	0.005	--	--
Fluoranthene	--	--	18,000	--	16,000	--	150,000	--	0.005	16,000	150,000
Pyrene	--	--	14,000	--	12,000	--	110,000	--	0.005	12,000	110,000
Benzo(a)anthracene	--	7.8	--	0.6	--	5.4	--	--	0.005	0.60	5
Chrysene	--	78	--	6	--	54	--	--	0.005	6.0	54
Benzofluoranthenes (b, J, k)	--	7.8	--	0.6	--	5.4	--	--	0.005	0.60	5.4
Benzo(a)pyrene	--	0.78	--	0.06	--	0.54	--	--	0.005	0.060	0.54
Indeno(1,2,3-c,d)pyrene	--	7.8	--	0.6	--	5.4	--	--	0.005	0.60	5.4
Dibenzo(a,h)anthracene	--	7.8	--	0.6	--	5.4	--	--	0.005	0.60	5.4
Benzo(ghi)perylene	--	--	14,000	--	12,000	--	110,000	--	0.005	12,000	110,000
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs; mg/kg)											
Total cPAHs - TEQ	0.021	0.78	--	0.06	--	0.54	--	0.021	0.005	0.021	0.021
Chlorinated Organic Compounds (mg/kg)											
1,2-Dichlorobenzene	--	--	45,000	--	46,000	--	350,000	--	0.2	45,000	350,000
1,4-Dichlorobenzene	--	1,100	35,000	100	36,000	780	270,000	--	0.2	100	780
1,2,4-Trichlorobenzene	--	210	4,900	19	5,100	140	39,000	--	0.2	19	140
Hexachlorobenzene	--	3.9	400	0.34	410	2.6	3,100	--	0.001	0.34	2.6

Analyte	Criteria for Protection of Human Health							Modifying Factors		Sediment Screening Level for Protection of Human Health and Higher Trophic Level Ecological Receptors[5]	
	Bioaccumulation via Consumption of Aquatic Organisms	Direct Contact via Beach Play[2]		Direct Contact via Clamming[2]		Direct Contact via Net Fishing[2]		Natural Background[3]	Practical Quantitation Limit[4] (PQL)	Intertidal Sediment (above -3 ft MLLW)	Subtidal Sediment (below -3 ft MLLW)
	Natural Background or PQL[1]	Carcinogenic (at 10^{-6} risk)	Non-Carcinogenic	Carcinogenic (at 10^{-6} risk)	Non-Carcinogenic	Carcinogenic (at 10^{-6} risk)	Non-Carcinogenic				
Phthalates (mg/kg)											
Diethyl phthalate	--	--	400,000	--	410,000	--	3,100,000	--	0.02	400,000	3,100,000
Dibutyl phthalate	--	--	49,000	--	51,000	--	390,000	--	0.02	49,000	390,000
Butyl benzyl phthalate	--	3,300	99,000	290	100,000	2,200	780,000	--	0.02	290	2,200
Bis(2-ethylhexyl) phthalate	--	440	9,900	39	10,000	300	78,000	--	0.05	39	300
Di-n-octyl phthalate	--	--	4,900	--	5,100	--	39,000	--	0.02	4,900	39,000
Miscellaneous Extractables (mg/kg)											
Dibenzofuran	--	--	490	--	510	--	3,900	--	0.02	490	3,900
Hexachlorobutadiene	--	79	490	7	510	54	3,900	--	0.001	7.0	54
N-nitrosodiphenylamine	--	1,300	--	110	--	860	--	--	0.02	110	860
Benzyl alcohol	--	--	49,000	--	51,000	--	390,000	--	0	49,000	390,000
Benzoic acid	--	--	2,000,000	--	2,000,000	--	16,000,000	--	0	2,000,000	16,000,000
Phenols (mg/kg)											
Phenol	--	--	150,000	--	150,000	--	1,200,000	--	0.1	150,000	1,200,000
2-Methylphenol	--	--	25,000	--	25,000	--	200,000	--	0.02	25,000	200,000
4-Methylphenol	--	--	49,000	--	51,000	--	390,000	--	0.02	49,000	390,000
2,4-Dimethylphenol	--	--	9,900	--	10,000	--	78,000	--	0.025	9,900	78,000
Pentachlorophenol	--	11	1,700	0.62	1,200	8.1	15,000	--	0.1	0.6	8.1
Polychlorinated Biphenyls (PCBs; µg/kg)											
Total Dioxin-Like PCBs - human health TEQ	0.0007	0.1	0.73	0.015	1.30	0.062	5.3	--	0.0007[8]	0.0007	0.0007
Total PCBs (Sum of Total for Aroclors or Congeners)	--	2,800	8,800	210	7,700	1,900	72,000	--	0.002	210.0	1900.0
Dioxins and Furans (ng/kg)											
Total dioxins/furans - human health TEQ	5	100	730	15	1,300	62	5,300	4	5[9]	5	5

Notes:

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

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

[3] Natural background concentrations are derived from the calculated values (90/90 UTL) from the Bold plus dataset and presented in Table 10-1 of Ecology's Final SCUM II (Ecology, 2015) guidance document.

[4] PQL values from Analytical Resources, Inc. of Tukwila, Washington and Frontier Analytical Laboratory of El Dorado Hills, California.

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

[6] Total LPAHs are the sum of naphthalene, acenapthylene, acenapthene, fluorene, phenanthrene and anthracene; 2-methylnapthalene is not included in the sum of LPAHs.

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

[8] Ecology-recommended PQL of 0.7 parts per trillion (pptr), dry-weight toxicity equivalent quotient (TEQ).

[9] Ecology-recommended PQL of 5 parts per trillion (pptr), dry-weight toxicity equivalent quotient (TEQ).

mg/kg = milligram per kilogram

µg/kg = microgram per kilogram

ng/kg = nanogram per kilogram

-- = No criterion is currently available for this analyte

TEQ = Toxic equivalent concentration (toxicity equivalency factor (TEF) values are presented in Table 5).

Table 5

Toxicity Equivalency Factors (TEF)

Quiet Cove Property

Anacortes, Washington

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

Notes:

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

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

Table 6

Summary of Existing Soil Chemical Analytical Data

Quiet Cove Property
Anacortes, Washington

Sample Location[1]	Soil Screening Level		HA-1	HA-2	HA-4	HA-10	HA-11	HA-12	HA-13	B1	B1	B2	B3
Sample Identification			HA-1	HA-2	HA-4	HA-10	HA-11	HA-12	HA-13	B1-6	B1-8	B2-4	B3-2
Sample Date			04/05/00	04/05/00	04/05/00	04/05/00	04/05/00	04/05/00	04/05/00	04/06/00	04/06/00	04/06/00	04/06/00
Sample Depth (feet bgs)			1.8	2.3	1.8	1.3	1.3	1.3	1.3	6-8 feet	8-10 feet	4-6 feet	2-4 feet
Sampled By	Vadose Zone	Saturated Zone	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec
Sample Horizon			Vadose	Vadose	Vadose	Vadose	Vadose	Vadose	Vadose	Saturated	Saturated	Saturated	Vadose
Metals (mg/kg)													
Arsenic	20	20	--	--	--	--	--	--	--	--	--	--	--
Cadmium	1.2	1	--	--	--	--	--	--	--	--	--	--	--
Chromium (total)	1,000	50	--	--	--	--	--	--	--	--	--	--	--
Lead	250	24	--	--	--	--	--	--	--	--	--	--	--
Mercury	0.07	0.07	--	--	--	--	--	--	--	--	--	--	--
Petroleum Hydrocarbons (mg/kg)													
Gasoline-Range[2]	30/1006	30/1006	5 U	5 U	5 U	5 U	**5,770**	**30.3**	5 U	5 U	5 U	**1,970**	**46**
Diesel-Range	2,000	2,000	**407**	**10**	10 U	10 U	**1,590**	**113**	10 U	**48**	10 U	**111**	**27**
Heavy Oil-Range	2,000	2,000	**227**	25 U	25 U	25 U	275 U	**33.5**	25 U	**30**	25 U	25 U	**26**
BETX Compounds (mg/kg)													
Benzene	0.05	0.05	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	2.5 U	0.05 U	0.05 U	1 U	0.09 U
Ethylbenzene	1.12	0.06	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	17.5 U	0.05 U	0.05 U	1 U	0.08 U
Toluene	3.78	0.22	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.341 U	35 U	0.05 U	0.05 U	4 U	**0.13**
Xylenes	2.83	0.16	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	150 U	0.1 U	0.1 U	20 U	**0.19**
Volatile Organic Compounds (VOCs; mg/kg)													
1,1,1,2-Tetrachloroethane	0.044	0.003	--	--	--	--	--	--	--	--	--	--	--
1,1,1-Trichloroethane	41.5	2.21	--	--	--	--	--	--	--	--	--	--	--
1,1,2,2-Tetrachloroethane	0.017	0.002	--	--	--	--	--	--	--	--	--	--	--
1,1,2-Trichloroethane	0.025	0.002	--	--	--	--	--	--	--	--	--	--	--
1,1-Dichloroethane	0.061	0.0038	--	--	--	--	--	--	--	--	--	--	--
1,1-Dichloroethene	0.023	0.0011	--	--	--	--	--	--	--	--	--	--	--
1,1-Dichloropropene	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3-Trichloropropane	0.033	0.033	--	--	--	--	--	--	--	--	--	--	--
1,2,4-Trichlorobenzene	0.019	0.005	--	--	--	--	--	--	--	--	--	--	--
1,2-Dibromo-3-chloropropane	1.25	1.25	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichlorobenzene	30.12	1.71	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichloroethane (EDC)	0.02	0.001	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichloropropane	0.02	0.001	--	--	--	--	--	--	--	--	--	--	--
1,3-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--
1,3-Dichloropropane	--	--	--	--	--	--	--	--	--	--	--	--	--
1,4-Dichlorobenzene	0.08	0.067	--	--	--	--	--	--	--	--	--	--	--
2,2-Dichloropropane	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Chloroethyl Vinyl Ether	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Chlorotoluene	1,600	1,600	--	--	--	--	--	--	--	--	--	--	--
4-Chlorotoluene	--	--	--	--	--	--	--	--	--	--	--	--	--
Bromobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--
Bromochloromethane	--	--	--	--	--	--	--	--	--	--	--	--	--
Bromoform	0.79	0.05	--	--	--	--	--	--	--	--	--	--	--

Sample Location[1]	Soil Screening Level		HA-1	HA-2	HA-4	HA-10	HA-11	HA-12	HA-13	B1	B1	B2	B3
Sample Identification			HA-1	HA-2	HA-4	HA-10	HA-11	HA-12	HA-13	B1-6	B1-8	B2-4	B3-2
Sample Date			04/05/00	04/05/00	04/05/00	04/05/00	04/05/00	04/05/00	04/05/00	04/06/00	04/06/00	04/06/00	04/06/00
Sample Depth (feet bgs)			1.8	2.3	1.8	1.3	1.3	1.3	1.3	6-8 feet	8-10 feet	4-6 feet	2-4 feet
Sampled By	Vadose Zone	Saturated Zone	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec
Sample Horizon			Vadose	Vadose	Vadose	Vadose	Vadose	Vadose	Vadose	Saturated	Saturated	Saturated	Vadose
Bromomethane	0.06	0.0038	--	--	--	--	--	--	--	--	--	--	--
Carbon Tetrachloride	0.005	0.001	--	--	--	--	--	--	--	--	--	--	--
Chlorobenzene	2.5	0.15	--	--	--	--	--	--	--	--	--	--	--
Chloroethane	95.47	5.64	--	--	--	--	--	--	--	--	--	--	--
Chloroform	0.0064	0.001	--	--	--	--	--	--	--	--	--	--	--
Chloromethane	0.73	0.045	--	--	--	--	--	--	--	--	--	--	--
Cis-1,2-Dichloroethene	160	160	--	--	--	--	--	--	--	--	--	--	--
Cis-1,3-Dichloropropene	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibromochloromethane	0.024	0.002	--	--	--	--	--	--	--	--	--	--	--
Dibromomethane	800	800	--	--	--	--	--	--	--	--	--	--	--
Dichlorodifluoromethane (CFC 12)	0.17	0.0019	--	--	--	--	--	--	--	--	--	--	--
1,2-Dibromoethane (EDB)	0.002	0.001	--	--	--	--	--	--	--	--	--	--	--
Methyl Iodide	--	--	--	--	--	--	--	--	--	--	--	--	--
Methyl t-Butyl Ether (MTBE)	2.59	0.18	--	--	--	--	--	--	--	--	--	--	--
Methylene Chloride	4.36	0.3	--	--	--	--	--	--	--	--	--	--	--
n-Hexane	0.27	0.01	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene (PCE)	0.094	0.0049	--	--	--	--	--	--	--	--	--	--	--
Trans-1,2-Dichloroethene	21.7	1.3	--	--	--	--	--	--	--	--	--	--	--
Trans-1,3-Dichloropropene	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethene (TCE)	0.01	0.001	--	--	--	--	--	--	--	--	--	--	--
Trichlorofluoromethane (CFC 11)	1.4	0.04	--	--	--	--	--	--	--	--	--	--	--
Vinyl Chloride	0.006	0.001	--	--	--	--	--	--	--	--	--	--	--
Polycyclic Aromatic Hydrocarbons (PAHs; mg/kg)													
1-Methylnaphthalene	34.48	34.48	--	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	0.77	0.04	--	--	--	--	--	--	--	--	--	--	--
Acenaphthene	0.32	0.02	--	--	--	--	--	--	--	--	--	--	--
Acenaphthylene	--	0.068	--	--	--	--	--	--	--	--	--	--	--
Anthracene	4.41	0.2	--	--	--	--	--	--	--	--	--	--	--
Benzo[g,h,i]perylene	--	1.95	--	--	--	--	--	--	--	--	--	--	--
Fluoranthene	3.2	0.16	--	--	--	--	--	--	--	--	--	--	--
Fluorene	0.5	0.02	--	--	--	--	--	--	--	--	--	--	--
Naphthalenes	0.25	0.01	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	0.1	--	--	--	--	--	--	--	--	--	--	--
Pyrene	20	1.00	--	--	--	--	--	--	--	--	--	--	--
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs; mg/kg)													
Benzo[a]anthracene	0.07	0.007	--	--	--	--	--	--	--	--	--	--	--
Benzo[a]pyrene	0.14	0.010	--	--	--	--	--	--	--	--	--	--	--
Benzo[b]fluoranthene	0.25	0.012	--	--	--	--	--	--	--	--	--	--	--
Benzo[k]fluoranthene	0.32	0.016	--	--	--	--	--	--	--	--	--	--	--
Chrysene	0.25	0.012	--	--	--	--	--	--	--	--	--	--	--
Dibenz[a,h]anthracene	0.14	0.018	--	--	--	--	--	--	--	--	--	--	--
Indeno[1,2,3-c,d]pyrene	0.69	0.035	--	--	--	--	--	--	--	--	--	--	--
cPAHs TEQ[3]	0.22	0.011	--	--	--	--	--	--	--	--	--	--	--

Sample Location[1]	Soil Screening Level		HA-1	HA-2	HA-4	HA-10	HA-11	HA-12	HA-13	B1	B1	B2	B3
Sample Identification			HA-1	HA-2	HA-4	HA-10	HA-11	HA-12	HA-13	B1-6	B1-8	B2-4	B3-2
Sample Date			04/05/00	04/05/00	04/05/00	04/05/00	04/05/00	04/05/00	04/05/00	04/06/00	04/06/00	04/06/00	04/06/00
Sample Depth (feet bgs)			1.8	2.3	1.8	1.3	1.3	1.3	1.3	6-8 feet	8-10 feet	4-6 feet	2-4 feet
Sampled By	Vadose Zone	Saturated Zone	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec
Sample Horizon			Vadose	Vadose	Vadose	Vadose	Vadose	Vadose	Vadose	Saturated	Saturated	Saturated	Vadose
Polychlorinated Biphenyls (PCBs; mg/kg)													
Total PCBs (sum of Aroclors)	0.062	0.050	--	--	--	--	--	--	--	--	--	--	--
Dioxins and Furans (ng/kg)													
Total dioxins/furans - human health TEQ	5.27	5.27	--	--	--	--	--	--	--	--	--	--	--

Notes:

[1] Sample locations are shown on Figure 4.

[2] Screening level for gasoline-range petroleum hydrocarbons is 30 mg/kg if benzene is present and 100 mg/kg if not present.

[3] Total carcinogenic Polycyclic Aromatic Hydrocarbon (cPAH) calculated using toxic equivalent (TEQ) methodology relative to benzo(a)pyrene. cPAHs that were not detected were assigned a value of one half of the detection limit for these calculations.

mg/kg = milligrams per kilogram

ng/kg = nanograms per kilogram

T = total concentration

U = not detected above the laboratory reporting limit

Bold font indicates compound was detected.

Blue shading indicates that the compound was not detected with a reporting limit greater than the soil screening level.

Green shading indicates that the compound was detected at concentrations greater than the soil screening level.

Sample Location[1]	Soil Screening Level		B3	B4	B5	B5	B6	GEI-1		GEI-2			GEI-3
Sample Identification			B3-10	B4-6	B5-4	B5-8	B6-10	GEI-1-3-033114	GEI-1-5-033114	GEI-2-1-033114	GEI-2-3-033114	GEI-2-5-033114	GEI-3-3-033114
Sample Date			04/06/00	04/06/00	04/06/00	04/06/00	04/06/00	03/31/14	03/31/14	03/31/14	03/31/14	03/31/14	03/31/14
Sample Depth (feet bgs)			10-12 feet	6-8 feet	4-5 feet	8-10 feet	10-12 feet	4-6 feet	8-10 feet	0-2 feet	4-6 feet	8-10 feet	4-6 feet
Sampled By	Vadose Zone	Saturated Zone	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers
Sample Horizon			Saturated	Saturated	Saturated	Saturated	Saturated	Saturated	Saturated	Vadose	Saturated	Saturated	Saturated
Metals (mg/kg)													
Arsenic	20	20	--	--	--	--	--	--	--	--	--	--	--
Cadmium	1.2	1	--	--	--	--	--	--	--	--	--	--	--
Chromium (total)	1,000	50	--	--	--	--	--	--	--	--	--	--	--
Lead	250	24	--	--	--	--	--	--	--	--	--	--	--
Mercury	0.07	0.07	--	--	--	--	--	--	--	--	--	--	--
Petroleum Hydrocarbons (mg/kg)													
Gasoline-Range2	30/100	30/100	5 U	5 U	**12**	**81**	5 U	7.4 U	7.8 U	3.4 U	7.7 U	3.8 U	7.6 U
Diesel-Range	2,000	2,000	10 U	**16**	**2,110**	**668**	10 U	**5,800**	**540**	**48**	**2,400**	**510**	**750**
Heavy Oil-Range	2,000	2,000	25 U	**39**	**881**	**207**	25 U	**940**	**97**	**210**	**440**	**77**	**73**
BETX Compounds (mg/kg)													
Benzene	0.05	0.05	0.05 U	0.05 U	0.05 U	0.1 U	0.05 U	0.02 U	0.02 U	**0.055**	0.02 U	0.02 U	0.02 U
Ethylbenzene	1.12	0.06	0.05 U	0.05 U	0.05 U	0.1 U	0.05 U	0.074 U	0.078 U	**0.039**	0.077 U	0.038 U	0.076 U
Toluene	3.78	0.22	0.05 U	0.05 U	0.05 U	0.16 U	0.05 U	**0.24**	0.078 U	**0.21**	0.077 U	0.038 U	**0.30**
Xylenes	2.83	0.16	0.1 U	0.1 U	0.1 U	0.2 U	0.1 U	**0.64**	0.078 U	**0.31**	0.077 U	0.038 U	**0.91**
Volatile Organic Compounds (VOCs; mg/kg)													
1,1,1,2-Tetrachloroethane	0.044	0.003	--	--	--	--	--	--	--	--	--	--	--
1,1,1-Trichloroethane	41.50	2.209	--	--	--	--	--	--	--	--	--	--	--
1,1,2,2-Tetrachloroethane	0.017	0.002	--	--	--	--	--	--	--	--	--	--	--
1,1,2-Trichloroethane	0.0251	0.002	--	--	--	--	--	--	--	--	--	--	--
1,1-Dichloroethane	0.061	0.0038	--	--	--	--	--	--	--	--	--	--	--
1,1-Dichloroethene	0.023	0.0011	--	--	--	--	--	--	--	--	--	--	--
1,1-Dichloropropene	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3-Trichloropropane	0.033	0.033	--	--	--	--	--	--	--	--	--	--	--
1,2,4-Trichlorobenzene	0.019	0.005	--	--	--	--	--	--	--	--	--	--	--
1,2-Dibromo-3-chloropropane	1.250	1.250	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichlorobenzene	30.12	1.71	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichloroethane (EDC)	0.020	0.001	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichloropropane	0.020	0.001	--	--	--	--	--	--	--	--	--	--	--
1,3-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--
1,3-Dichloropropane	--	--	--	--	--	--	--	--	--	--	--	--	--
1,4-Dichlorobenzene	0.08	0.067	--	--	--	--	--	--	--	--	--	--	--
2,2-Dichloropropane	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Chloroethyl Vinyl Ether	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Chlorotoluene	1,600.00	1,600.00	--	--	--	--	--	--	--	--	--	--	--
4-Chlorotoluene	--	--	--	--	--	--	--	--	--	--	--	--	--
Bromobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--
Bromochloromethane	--	--	--	--	--	--	--	--	--	--	--	--	--
Bromoform	0.787	0.0495	--	--	--	--	--	--	--	--	--	--	--

Sample Location[1]	Soil Screening Level		B3	B4	B5	B5	B6	GEI-1		GEI-2			GEI-3
Sample Identification			B3-10	B4-6	B5-4	B5-8	B6-10	GEI-1-3-033114	GEI-1-5-033114	GEI-2-1-033114	GEI-2-3-033114	GEI-2-5-033114	GEI-3-3-033114
Sample Date			04/06/00	04/06/00	04/06/00	04/06/00	04/06/00	03/31/14	03/31/14	03/31/14	03/31/14	03/31/14	03/31/14
Sample Depth (feet bgs)			10-12 feet	6-8 feet	4-5 feet	8-10 feet	10-12 feet	4-6 feet	8-10 feet	0-2 feet	4-6 feet	8-10 feet	4-6 feet
Sampled By	Vadose Zone	Saturated Zone	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers
Sample Horizon			Saturated	Saturated	Saturated	Saturated	Saturated	Saturated	Saturated	Vadose	Saturated	Saturated	Saturated
Bromomethane	0.060	0.0038	--	--	--	--	--	--	--	--	--	--	--
Carbon Tetrachloride	0.0050	0.001	--	--	--	--	--	--	--	--	--	--	--
Chlorobenzene	2.5	0.146	--	--	--	--	--	--	--	--	--	--	--
Chloroethane	95.47	5.64	--	--	--	--	--	--	--	--	--	--	--
Chloroform	0.0064	0.001	--	--	--	--	--	--	--	--	--	--	--
Chloromethane	0.725	0.045	--	--	--	--	--	--	--	--	--	--	--
Cis-1,2-Dichloroethene	160.00	160.000	--	--	--	--	--	--	--	--	--	--	--
Cis-1,3-Dichloropropene	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibromochloromethane	0.0241	0.002	--	--	--	--	--	--	--	--	--	--	--
Dibromomethane	800.00	800.000	--	--	--	--	--	--	--	--	--	--	--
Dichlorodifluoromethane (CFC 12)	0.17	0.00	--	--	--	--	--	--	--	--	--	--	--
1,2-Dibromoethane (EDB)	0.002	0.001	--	--	--	--	--	--	--	--	--	--	--
Methyl Iodide	--	--	--	--	--	--	--	--	--	--	--	--	--
Methyl t-Butyl Ether (MTBE)	2.592	0.182	--	--	--	--	--	--	--	--	--	--	--
Methylene Chloride	4.356	0.297	--	--	--	--	--	--	--	--	--	--	--
n-Hexane	0.27	0.01	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene (PCE)	0.094	0.0049	--	--	--	--	--	--	--	--	--	--	--
Trans-1,2-Dichloroethene	21.71	1.299	--	--	--	--	--	--	--	--	--	--	--
Trans-1,3-Dichloropropene	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethene (TCE)	0.0103	0.001	--	--	--	--	--	--	--	--	--	--	--
Trichlorofluoromethane (CFC 11)	1.4	0.04	--	--	--	--	--	--	--	--	--	--	--
Vinyl Chloride	0.006	0.001	--	--	--	--	--	--	--	--	--	--	--
Polycyclic Aromatic Hydrocarbons (PAHs; mg/kg)													
1-Methylnaphthalene	34.483	34.483	--	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	0.775	0.040	--	--	--	--	--	--	--	--	--	--	--
Acenaphthene	0.32	0.02	--	--	--	--	--	--	--	--	--	--	--
Acenaphthylene	--	0.068	--	--	--	--	--	--	--	--	--	--	--
Anthracene	4	0.2	--	--	--	--	--	--	--	--	--	--	--
Benzo[g,h,i]perylene	--	1.951	--	--	--	--	--	--	--	--	--	--	--
Fluoranthene	3.2	0.16	--	--	--	--	--	--	--	--	--	--	--
Fluorene	0.5	0.02	--	--	--	--	--	--	--	--	--	--	--
Naphthalenes	0.25	0.01	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	0.101	--	--	--	--	--	--	--	--	--	--	--
Pyrene	20	1.00	--	--	--	--	--	--	--	--	--	--	--
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs; mg/kg)													
Benzo[a]anthracene	0.07	0.007	--	--	--	--	--	--	--	--	--	--	--
Benzo[a]pyrene	0.14	0.010	--	--	--	--	--	--	--	--	--	--	--
Benzo[b]fluoranthene	0.25	0.012	--	--	--	--	--	--	--	--	--	--	--
Benzo[k]fluoranthene	0.32	0.016	--	--	--	--	--	--	--	--	--	--	--
Chrysene	0.25	0.0124	--	--	--	--	--	--	--	--	--	--	--
Dibenz[a,h]anthracene	0.14	0.018	--	--	--	--	--	--	--	--	--	--	--
Indeno[1,2,3-c,d]pyrene	0.69	0.035	--	--	--	--	--	--	--	--	--	--	--
cPAHs TEQ3	0.22	0.011	--	--	--	--	--	--	--	--	--	--	--

Sample Location[1]	Soil Screening Level		B3	B4	B5	B5	B6	GEI-1		GEI-2			GEI-3
Sample Identification			B3-10	B4-6	B5-4	B5-8	B6-10	GEI-1-3-033114	GEI-1-5-033114	GEI-2-1-033114	GEI-2-3-033114	GEI-2-5-033114	GEI-3-3-033114
Sample Date			04/06/00	04/06/00	04/06/00	04/06/00	04/06/00	03/31/14	03/31/14	03/31/14	03/31/14	03/31/14	03/31/14
Sample Depth (feet bgs)			10-12 feet	6-8 feet	4-5 feet	8-10 feet	10-12 feet	4-6 feet	8-10 feet	0-2 feet	4-6 feet	8-10 feet	4-6 feet
Sampled By	Vadose Zone	Saturated Zone	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	ThermoRetec	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers
Sample Horizon			Saturated	Saturated	Saturated	Saturated	Saturated	Saturated	Saturated	Vadose	Saturated	Saturated	Saturated
Polychlorinated Biphenyls (PCBs; mg/kg)													
Total PCBs (sum of Aroclors)	0.062	0.050	--	--	--	--	--	--	--	--	--	--	--
Dioxins and Furans (ng/kg)													
Total dioxins/furans - human health TEQ	5.2	5.2	--	--	--	--	--	--	--	--	--	--	--

Notes:

[1] Sample locations are shown on Figure 4.

[2] Screening level for gasoline-range petroleum hydrocarbons is 30 mg/kg if benzene is present and 100 mg/kg if not present.

[3] Total carcinogenic Polycyclic Aromatic Hydrocarbon (cPAH) calculated using toxic equivalent (TEQ) methodology relative to benzo(a)pyrene. cPAHs that were not detected were assigned a value of one half of the detection limit for these calculations.

mg/kg = milligrams per kilogram

ng/kg = nanograms per kilogram

T = total concentration

U = not detected above the laboratory reporting limit

Bold font indicates compound was detected.

Blue shading indicates that the compound was not detected with a reporting limit greater than the soil screening level.

Green shading indicates that the compound was detected at concentrations greater than the soil screening level.

Sample Location[1]	Soil Screening Level		GEI-4			GEI-8		GEI-9		GEI-10			GEI-12
Sample Identification			GEI-4-1-040114	GEI-4-2-040114	GEI-4-3-040114	GEI-8-3-033114	GEI-8-5-033114	GEI-9-3-040114	GEI-9-5-040114	GEI-10-1-033114	GEI-10-3-033114	GEI-10-6-033114	GEI-12-3-040114
Sample Date			04/01/14	04/01/14	04/01/14	03/31/14	03/31/14	04/01/14	04/01/14	03/31/14	03/31/14	03/31/14	04/01/14
Sample Depth (feet bgs)			0-2 feet	2-3 feet	4-6 feet	4-6 feet	8-10 feet	5-7 feet	8-10 feet	0-2 feet	4-6 feet	8-10 feet	5-7 feet
Sampled By	Vadose Zone	Saturated Zone	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers
Sample Horizon			Vadose	Vadose	Saturated	Saturated	Saturated	Saturated	Saturated	Vadose	Saturated	Saturated	Saturated
Metals (mg/kg)													
Arsenic	20	20	--	14 U	--	--	--	--	--	--	12 U	--	--
Cadmium	1.2	1	--	**2.4**	--	--	--	--	--	--	0.59 U	--	--
Chromium (total)	1,000	50	--	**13**	--	--	--	--	--	--	**34**	--	--
Lead	250	24	--	**79**	--	--	--	--	--	--	**13**	--	--
Mercury	0.07	0.07	--	0.34 U	--	--	--	--	--	--	0.29 U	--	--
Petroleum Hydrocarbons (mg/kg)													
Gasoline-Range2	30/100	30/100	3.3 U	6.9 U	9.3 U	**260**	3.3 U	5.0 U	4.8 U	3.3 U	**420**	6.3 U	3.5 U
Diesel-Range	2,000	2,000	**170**	**18,000**	**730**	**1,200**	29 U	30 U	29 U	**1,800**	**5,600**	30 U	29 U
Heavy Oil-Range	2,000	2,000	**1,200**	**21,000**	**940**	**810**	58 U	60 U	59 U	**3,500**	**8,100**	60 U	58 U
BETX Compounds (mg/kg)													
Benzene	0.05	0.05	0.02 U	0.02 U	0.02 U	**0.048**	0.02 U	0.02 U	0.02 U	0.02 U	**0.043**	0.02 U	0.02 U
Ethylbenzene	1.12	0.06	0.033 U	0.069 U	0.093 U	0.11 U	0.033 U	0.05 U	0.048 U	0.033 U	0.083 U	0.063 U	0.035 U
Toluene	3.78	0.22	0.033 U	0.069 U	0.093 U	**0.14**	0.033 U	0.05 U	0.048 U	0.033 U	**0.21**	0.063 U	0.035 U
Xylenes	2.83	0.16	0.033 U	0.069 U	0.093 U	**0.28**	0.033 U	0.05 U	0.048 U	0.033 U	**0.65**	0.063 U	0.035 U
Volatile Organic Compounds (VOCs; mg/kg)													
1,1,1,2-Tetrachloroethane	0.044	0.003	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
1,1,1-Trichloroethane	41.50	2.209	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
1,1,2,2-Tetrachloroethane	0.017	0.002	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
1,1,2-Trichloroethane	0.0251	0.002	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
1,1-Dichloroethane	0.061	0.0038	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
1,1-Dichloroethene	0.023	0.0011	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
1,1-Dichloropropene	--	--	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
1,2,3-Trichlorobenzene	--	--	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
1,2,3-Trichloropropane	0.033	0.033	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
1,2,4-Trichlorobenzene	0.019	0.005	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
1,2-Dibromo-3-chloropropane	1.250	1.250	--	0.330 U	--	--	--	--	--	--	0.230 U	--	--
1,2-Dichlorobenzene	30.12	1.71	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
1,2-Dichloroethane (EDC)	0.020	0.001	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
1,2-Dichloropropane	0.020	0.001	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
1,3-Dichlorobenzene	--	--	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
1,3-Dichloropropane	--	--	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
1,4-Dichlorobenzene	0.08	0.067	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
2,2-Dichloropropane	--	--	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
2-Chloroethyl Vinyl Ether	--	--	--	0.520 U	--	--	--	--	--	--	0.360 U	--	--
2-Chlorotoluene	1,600.00	1,600.00	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
4-Chlorotoluene	--	--	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
Bromobenzene	--	--	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
Bromochloromethane	--	--	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
Bromoform	0.787	0.0495	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--

Sample Location[1]	Soil Screening Level		GEI-4			GEI-8		GEI-9		GEI-10			GEI-12
Sample Identification			GEI-4-1-040114	GEI-4-2-040114	GEI-4-3-040114	GEI-8-3-033114	GEI-8-5-033114	GEI-9-3-040114	GEI-9-5-040114	GEI-10-1-033114	GEI-10-3-033114	GEI-10-6-033114	GEI-12-3-040114
Sample Date			04/01/14	04/01/14	04/01/14	03/31/14	03/31/14	04/01/14	04/01/14	03/31/14	03/31/14	03/31/14	04/01/14
Sample Depth (feet bgs)			0-2 feet	2-3 feet	4-6 feet	4-6 feet	8-10 feet	5-7 feet	8-10 feet	0-2 feet	4-6 feet	8-10 feet	5-7 feet
Sampled By	Vadose Zone	Saturated Zone	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers
Sample Horizon			Vadose	Vadose	Saturated	Saturated	Saturated	Saturated	Saturated	Vadose	Saturated	Saturated	Saturated
Bromomethane	0.060	0.0038	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
Carbon Tetrachloride	0.0050	0.001	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
Chlorobenzene	2.5	0.146	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
Chloroethane	95.47	5.64	--	0.330 U	--	--	--	--	--	--	0.230 U	--	--
Chloroform	0.0064	0.001	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
Chloromethane	0.725	0.045	--	0.420 U	--	--	--	--	--	--	0.290 U	--	--
Cis-1,2-Dichloroethene	160.00	160.000	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
Cis-1,3-Dichloropropene	--	--	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
Dibromochloromethane	0.0241	0.002	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
Dibromomethane	800.00	800.000	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
Dichlorodifluoromethane (CFC 12)	0.17	0.00	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
1,2-Dibromoethane (EDB)	0.002	0.001	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
Methyl Iodide	--	--	--	0.330 U	--	--	--	--	--	--	0.230 U	--	--
Methyl t-Butyl Ether (MTBE)	2.592	0.182	--	0.085 U	--	--	--	--	--	--	0.059 U	--	--
Methylene Chloride	4.356	0.297	--	0.330 U	--	--	--	--	--	--	0.230 U	--	--
n-Hexane	0.27	0.01	--	0.069 U	--	--	--	--	--	--	0.083 U	--	--
Tetrachloroethene (PCE)	0.094	0.0049	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
Trans-1,2-Dichloroethene	21.71	1.299	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
Trans-1,3-Dichloropropene	--	--	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
Trichloroethene (TCE)	0.0103	0.001	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
Trichlorofluoromethane (CFC 11)	1.4	0.04	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
Vinyl Chloride	0.006	0.001	--	0.065 U	--	--	--	--	--	--	0.045 U	--	--
Polycyclic Aromatic Hydrocarbons (PAHs; mg/kg)													
1-Methylnaphthalene	34.483	34.483	--	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	0.775	0.040	--	--	--	--	--	--	--	--	--	--	--
Acenaphthene	0.32	0.02	--	--	--	--	--	--	--	--	--	--	--
Acenaphthylene	--	0.068	--	--	--	--	--	--	--	--	--	--	--
Anthracene	4	0.2	--	--	--	--	--	--	--	--	--	--	--
Benzo[g,h,i]perylene	--	1.951	--	--	--	--	--	--	--	--	--	--	--
Fluoranthene	3.2	0.16	--	--	--	--	--	--	--	--	--	--	--
Fluorene	0.5	0.02	--	--	--	--	--	--	--	--	--	--	--
Naphthalenes	0.25	0.01	--	**27.4 T**	--	--	--	--	--	--	**18.5 T**	--	--
Phenanthrene	--	0.101	--	--	--	--	--	--	--	--	--	--	--
Pyrene	20	1.00	--	--	--	--	--	--	--	--	--	--	--
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs; mg/kg)													
Benzo[a]anthracene	0.07	0.007	--	**0.77**	--	--	--	--	--	--	**3.90**	--	--
Benzo[a]pyrene	0.14	0.010	--	**0.18**	--	--	--	--	--	--	**3.00**	--	--
Benzo[b]fluoranthene	0.25	0.012	--	**0.22**	--	--	--	--	--	--	**2.40**	--	--
Benzo[k]fluoranthene	0.32	0.016	--	0.18 U	--	--	--	--	--	--	**1.10**	--	--
Chrysene	0.25	0.0124	--	**1.2**	--	--	--	--	--	--	**2.80**	--	--
Dibenz[a,h]anthracene	0.14	0.018	--	0.18 U	--	--	--	--	--	--	**0.68**	--	--
Indeno[1,2,3-c,d]pyrene	0.69	0.035	--	0.18 U	--	--	--	--	--	--	**1.30**	--	--
cPAHs TEQ3	0.22	0.011	--	**0.32 T**	--	--	--	--	--	--	**3.97 T**	--	--

Sample Location[1]	Soil Screening Level		GEI-4			GEI-8		GEI-9		GEI-10			GEI-12
Sample Identification			GEI-4-1-040114	GEI-4-2-040114	GEI-4-3-040114	GEI-8-3-033114	GEI-8-5-033114	GEI-9-3-040114	GEI-9-5-040114	GEI-10-1-033114	GEI-10-3-033114	GEI-10-6-033114	GEI-12-3-040114
Sample Date			04/01/14	04/01/14	04/01/14	03/31/14	03/31/14	04/01/14	04/01/14	03/31/14	03/31/14	03/31/14	04/01/14
Sample Depth (feet bgs)			0-2 feet	2-3 feet	4-6 feet	4-6 feet	8-10 feet	5-7 feet	8-10 feet	0-2 feet	4-6 feet	8-10 feet	5-7 feet
Sampled By	Vadose Zone	Saturated Zone	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers
Sample Horizon			Vadose	Vadose	Saturated	Saturated	Saturated	Saturated	Saturated	Vadose	Saturated	Saturated	Saturated
Polychlorinated Biphenyls (PCBs; mg/kg)													
Total PCBs (sum of Aroclors)	0.062	0.050	--	0.068 UT	--	--	--	--	--	--	0.059 UT	--	--
Dioxins and Furans (ng/kg)													
Total dioxins/furans - human health TEQ	5.2	5.2	--	--	--	--	--	--	--	--	--	--	--

Notes:

[1] Sample locations are shown on Figure 4.

[2] Screening level for gasoline-range petroleum hydrocarbons is 30 mg/kg if benzene is present and 100 mg/kg if not present.

[3] Total carcinogenic Polycyclic Aromatic Hydrocarbon (cPAH) calculated using toxic equivalent (TEQ) methodology relative to benzo(a)pyrene. cPAHs that were not detected were assigned a value of one half of the detection limit for these calculations.

mg/kg = milligrams per kilogram

ng/kg = nanograms per kilogram

T = total concentration

U = not detected above the laboratory reporting limit

Bold font indicates compound was detected.

Blue shading indicates that the compound was not detected with a reporting limit greater than the soil screening level.

Green shading indicates that the compound was detected at concentrations greater than the soil screening level.

Sample Location[1]	Soil Screening Level		GEI-13		GEI-14	GEI-16		GEI-17	GEI-18			GEI-19	
Sample Identification			GEI-13-2-040114	GEI-13-4-040114	GEI-14-3-040114	GEI-16-3-033114	GEI-16-5-033114	GEI-17-3-033114	GEI-18-1-033114	GEI-18-3-033114	GEI-18-5-033114	GEI-19-1-040114	GEI-19-3-040114
Sample Date			04/01/14	04/01/14	04/01/14	03/31/14	03/31/14	03/31/14	03/31/14	03/31/14	03/31/14	04/01/14	04/01/14
Sample Depth (feet bgs)			2-3 feet	6-8 feet	4-6 feet	4-6 feet	8-10 feet	4-6 feet	0-2 feet	4-6 feet	8-10 feet	0-2 feet	4-6 feet
Sampled By			GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers
Sample Horizon	Vadose Zone	Saturated Zone	Vadose	Saturated	Saturated	Saturated	Saturated	Saturated	Vadose	Saturated	Saturated	Vadose	Saturated
Metals (mg/kg)													
Arsenic	20	20	--	--	--	--	--	--	--	--	--	--	--
Cadmium	1.2	1	--	--	--	--	--	--	--	--	--	--	--
Chromium (total)	1,000	50	--	--	--	--	--	--	--	--	--	--	--
Lead	250	24	--	--	--	--	--	--	--	--	--	--	--
Mercury	0.07	0.07	--	--	--	--	--	--	--	--	--	--	--
Petroleum Hydrocarbons (mg/kg)													
Gasoline-Range2	30/100	30/100	9.4 U	3.7 U	5.2 U	**150**	5.4 U	**9,400**	3.2 U	4.0 U	3.8 U	4.0 U	3.6 U
Diesel-Range	2,000	2,000	**1,900**	30 U	34 U	**1,600**	30 U	**14,000**	**270**	**2,200**	**71**	29 U	29 U
Heavy Oil-Range	2,000	2,000	**80**	60 U	68 U	**440**	60 U	**2,900**	**1,300**	**2,300**	61 U	58 U	58 U
BETX Compounds (mg/kg)													
Benzene	0.05	0.05	**0.023**	0.02 U	0.02 U	**0.11**	0.02 U	**62**	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Ethylbenzene	1.12	0.06	0.094 U	0.037 U	0.052 U	0.43 U	0.054 U	**16**	0.032 U	0.04 U	0.038 U	0.04 U	0.036 U
Toluene	3.78	0.22	**0.99**	0.037 U	0.052 U	**0.85**	0.054 U	**180**	0.032 U	**0.11**	0.038 U	0.04 U	0.036 U
Xylenes	2.83	0.16	**0.71**	0.037 U	0.052 U	**0.56**	0.054 U	**361**	0.032 U	**0.23**	0.038 U	0.04 U	0.036 U
Volatile Organic Compounds (VOCs; mg/kg)													
1,1,1,2-Tetrachloroethane	0.044	0.003	--	--	--	--	--	--	--	--	--	--	--
1,1,1-Trichloroethane	41.50	2.209	--	--	--	--	--	--	--	--	--	--	--
1,1,2,2-Tetrachloroethane	0.017	0.002	--	--	--	--	--	--	--	--	--	--	--
1,1,2-Trichloroethane	0.0251	0.002	--	--	--	--	--	--	--	--	--	--	--
1,1-Dichloroethane	0.061	0.0038	--	--	--	--	--	--	--	--	--	--	--
1,1-Dichloroethene	0.023	0.0011	--	--	--	--	--	--	--	--	--	--	--
1,1-Dichloropropene	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3-Trichloropropane	0.033	0.033	--	--	--	--	--	--	--	--	--	--	--
1,2,4-Trichlorobenzene	0.019	0.005	--	--	--	--	--	--	--	--	--	--	--
1,2-Dibromo-3-chloropropane	1.250	1.250	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichlorobenzene	30.12	1.71	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichloroethane (EDC)	0.020	0.001	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichloropropane	0.020	0.001	--	--	--	--	--	--	--	--	--	--	--
1,3-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--
1,3-Dichloropropane	--	--	--	--	--	--	--	--	--	--	--	--	--
1,4-Dichlorobenzene	0.08	0.067	--	--	--	--	--	--	--	--	--	--	--
2,2-Dichloropropane	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Chloroethyl Vinyl Ether	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Chlorotoluene	1,600.00	1,600.00	--	--	--	--	--	--	--	--	--	--	--
4-Chlorotoluene	--	--	--	--	--	--	--	--	--	--	--	--	--
Bromobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--
Bromochloromethane	--	--	--	--	--	--	--	--	--	--	--	--	--
Bromoform	0.787	0.0495	--	--	--	--	--	--	--	--	--	--	--

Sample Location[1]	Soil Screening Level		GEI-13		GEI-14	GEI-16		GEI-17	GEI-18			GEI-19	
Sample Identification			GEI-13-2-040114	GEI-13-4-040114	GEI-14-3-040114	GEI-16-3-033114	GEI-16-5-033114	GEI-17-3-033114	GEI-18-1-033114	GEI-18-3-033114	GEI-18-5-033114	GEI-19-1-040114	GEI-19-3-040114
Sample Date			04/01/14	04/01/14	04/01/14	03/31/14	03/31/14	03/31/14	03/31/14	03/31/14	03/31/14	04/01/14	04/01/14
Sample Depth (feet bgs)			2-3 feet	6-8 feet	4-6 feet	4-6 feet	8-10 feet	4-6 feet	0-2 feet	4-6 feet	8-10 feet	0-2 feet	4-6 feet
Sampled By	Vadose Zone	Saturated Zone	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers
Sample Horizon			Vadose	Saturated	Saturated	Saturated	Saturated	Saturated	Vadose	Saturated	Saturated	Vadose	Saturated
Bromomethane	0.060	0.0038	--	--	--	--	--	--	--	--	--	--	--
Carbon Tetrachloride	0.0050	0.001	--	--	--	--	--	--	--	--	--	--	--
Chlorobenzene	2.5	0.146	--	--	--	--	--	--	--	--	--	--	--
Chloroethane	95.47	5.64	--	--	--	--	--	--	--	--	--	--	--
Chloroform	0.0064	0.001	--	--	--	--	--	--	--	--	--	--	--
Chloromethane	0.725	0.045	--	--	--	--	--	--	--	--	--	--	--
Cis-1,2-Dichloroethene	160.00	160.000	--	--	--	--	--	--	--	--	--	--	--
Cis-1,3-Dichloropropene	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibromochloromethane	0.0241	0.002	--	--	--	--	--	--	--	--	--	--	--
Dibromomethane	800.00	800.000	--	--	--	--	--	--	--	--	--	--	--
Dichlorodifluoromethane (CFC 12)	0.17	0.00	--	--	--	--	--	--	--	--	--	--	--
1,2-Dibromoethane (EDB)	0.002	0.001	--	--	--	--	--	--	--	--	--	--	--
Methyl Iodide	--	--	--	--	--	--	--	--	--	--	--	--	--
Methyl t-Butyl Ether (MTBE)	2.592	0.182	--	--	--	--	--	--	--	--	--	--	--
Methylene Chloride	4.356	0.297	--	--	--	--	--	--	--	--	--	--	--
n-Hexane	0.27	0.01	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene (PCE)	0.094	0.0049	--	--	--	--	--	--	--	--	--	--	--
Trans-1,2-Dichloroethene	21.71	1.299	--	--	--	--	--	--	--	--	--	--	--
Trans-1,3-Dichloropropene	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethene (TCE)	0.0103	0.001	--	--	--	--	--	--	--	--	--	--	--
Trichlorofluoromethane (CFC 11)	1.4	0.04	--	--	--	--	--	--	--	--	--	--	--
Vinyl Chloride	0.006	0.001	--	--	--	--	--	--	--	--	--	--	--
Polycyclic Aromatic Hydrocarbons (PAHs; mg/kg)													
1-Methylnaphthalene	34.483	34.483	--	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	0.775	0.040	--	--	--	--	--	--	--	--	--	--	--
Acenaphthene	0.32	0.02	--	--	--	--	--	--	--	--	--	--	--
Acenaphthylene	--	0.068	--	--	--	--	--	--	--	--	--	--	--
Anthracene	4	0.2	--	--	--	--	--	--	--	--	--	--	--
Benzo[g,h,i]perylene	--	1.951	--	--	--	--	--	--	--	--	--	--	--
Fluoranthene	3.2	0.16	--	--	--	--	--	--	--	--	--	--	--
Fluorene	0.5	0.02	--	--	--	--	--	--	--	--	--	--	--
Naphthalenes	0.25	0.01	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	0.101	--	--	--	--	--	--	--	--	--	--	--
Pyrene	20	1.00	--	--	--	--	--	--	--	--	--	--	--
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs; mg/kg)													
Benzo[a]anthracene	0.07	0.007	--	--	--	--	--	--	--	--	--	--	--
Benzo[a]pyrene	0.14	0.010	--	--	--	--	--	--	--	--	--	--	--
Benzo[b]fluoranthene	0.25	0.012	--	--	--	--	--	--	--	--	--	--	--
Benzo[k]fluoranthene	0.32	0.016	--	--	--	--	--	--	--	--	--	--	--
Chrysene	0.25	0.0124	--	--	--	--	--	--	--	--	--	--	--
Dibenz[a,h]anthracene	0.14	0.018	--	--	--	--	--	--	--	--	--	--	--
Indeno[1,2,3-c,d]pyrene	0.69	0.035	--	--	--	--	--	--	--	--	--	--	--
cPAHs TEQ3	0.22	0.011	--	--	--	--	--	--	--	--	--	--	--

Sample Location[1]	Soil Screening Level		GEI-13		GEI-14	GEI-16		GEI-17	GEI-18			GEI-19	
Sample Identification			GEI-13-2-040114	GEI-13-4-040114	GEI-14-3-040114	GEI-16-3-033114	GEI-16-5-033114	GEI-17-3-033114	GEI-18-1-033114	GEI-18-3-033114	GEI-18-5-033114	GEI-19-1-040114	GEI-19-3-040114
Sample Date			04/01/14	04/01/14	04/01/14	03/31/14	03/31/14	03/31/14	03/31/14	03/31/14	03/31/14	04/01/14	04/01/14
Sample Depth (feet bgs)			2-3 feet	6-8 feet	4-6 feet	4-6 feet	8-10 feet	4-6 feet	0-2 feet	4-6 feet	8-10 feet	0-2 feet	4-6 feet
Sampled By	Vadose Zone	Saturated Zone	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers
Sample Horizon			Vadose	Saturated	Saturated	Saturated	Saturated	Saturated	Vadose	Saturated	Saturated	Vadose	Saturated
Polychlorinated Biphenyls (PCBs; mg/kg)													
Total PCBs (sum of Aroclors)	0.062	0.050	--	--	--	--	--	--	--	--	--	--	--
Dioxins and Furans (ng/kg)													
Total dioxins/furans - human health TEQ	5.2	5.2	--	--	--	--	--	--	--	--	--	--	--

Notes:

[1] Sample locations are shown on Figure 4.

[2] Screening level for gasoline-range petroleum hydrocarbons is 30 mg/kg if benzene is present and 100 mg/kg if not present.

[3] Total carcinogenic Polycyclic Aromatic Hydrocarbon (cPAH) calculated using toxic equivalent (TEQ) methodology relative to benzo(a)pyrene. cPAHs that were not detected were assigned a value of one half of the detection limit for these calculations.

mg/kg = milligrams per kilogram

ng/kg = nanograms per kilogram

T = total concentration

U = not detected above the laboratory reporting limit

Bold font indicates compound was detected.

Blue shading indicates that the compound was not detected with a reporting limit greater than the soil screening level.

Green shading indicates that the compound was detected at concentrations greater than the soil screening level.

Sample Location[1]	Soil Screening Level		GEI-20	GEI-21	GEI-25			GEI-27	GEI-28
Sample Identification			GEI-20-3-040114	GEI-21-3-040114	GEI-25-1-040114	GEI-25-3-040114	GEI-25-5-040114	GEI-27-3-040214	GEI-28-4-040214
Sample Date			04/01/14	04/01/14	04/01/14	04/01/14	04/01/14	04/02/14	04/02/14
Sample Depth (feet bgs)			4-6 feet	4-6 feet	0-2 feet	4-6 feet	8-10 feet	6-7.5 feet	6-8 feet
Sampled By	Vadose Zone	Saturated Zone	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers
Sample Horizon			Saturated	Saturated	Vadose	Saturated	Saturated	Saturated	Saturated
Metals (mg/kg)									
Arsenic	20	20	--	--	--	12 U	--	--	--
Cadmium	1.2	1	--	--	--	0.62 U	--	--	--
Chromium (total)	1,000	50	--	--	--	**52**	--	--	--
Lead	250	24	--	--	--	17	--	--	--
Mercury	0.07	0.07	--	--	--	0.31 U	--	--	--
Petroleum Hydrocarbons (mg/kg)									
Gasoline-Range2	30/100	30/100	3.9 U	5.8 U	3.3 U	3.9 U	17 U	4.9 U	4.0 U
Diesel-Range	2,000	2,000	29 U	29 U	**250**	**4,300**	**76**	32 U	29 U
Heavy Oil-Range	2,000	2,000	59 U	59 U	**1,100**	**1,200**	**580**	64 U	58 U
BETX Compounds (mg/kg)									
Benzene	0.05	0.05	0.02 U	0.02 U	0.02 U	0.02 U	0.033 U	0.02 U	0.02 U
Ethylbenzene	1.12	0.06	0.039 U	0.058 U	0.033 U	0.039 U	0.17 U	0.049 U	0.04 U
Toluene	3.78	0.22	0.039 U	0.058 U	0.033 U	**0.26**	0.17 U	0.049 U	0.04 U
Xylenes	2.83	0.16	0.039 U	0.058 U	**0.042**	**0.16**	0.17 U	0.049 U	0.04 U
Volatile Organic Compounds (VOCs; mg/kg)									
1,1,1,2-Tetrachloroethane	0.044	0.003	--	--	--	0.037 U	--	--	--
1,1,1-Trichloroethane	41.50	2.209	--	--	--	0.037 U	--	--	--
1,1,2,2-Tetrachloroethane	0.017	0.002	--	--	--	0.037 U	--	--	--
1,1,2-Trichloroethane	0.0251	0.002	--	--	--	0.037 U	--	--	--
1,1-Dichloroethane	0.061	0.0038	--	--	--	0.037 U	--	--	--
1,1-Dichloroethene	0.023	0.0011	--	--	--	0.037 U	--	--	--
1,1-Dichloropropene	--	--	--	--	--	0.037 U	--	--	--
1,2,3-Trichlorobenzene	--	--	--	--	--	0.037 U	--	--	--
1,2,3-Trichloropropane	0.033	0.033	--	--	--	0.037 U	--	--	--
1,2,4-Trichlorobenzene	0.019	0.005	--	--	--	0.037 U	--	--	--
1,2-Dibromo-3-chloropropane	1.250	1.250	--	--	--	0.190 U	--	--	--
1,2-Dichlorobenzene	30.12	1.71	--	--	--	0.037 U	--	--	--
1,2-Dichloroethane (EDC)	0.020	0.001	--	--	--	0.037 U	--	--	--
1,2-Dichloropropane	0.020	0.001	--	--	--	0.037 U	--	--	--
1,3-Dichlorobenzene	--	--	--	--	--	0.037 U	--	--	--
1,3-Dichloropropane	--	--	--	--	--	0.037 U	--	--	--
1,4-Dichlorobenzene	0.08	0.067	--	--	--	0.037 U	--	--	--
2,2-Dichloropropane	--	--	--	--	--	0.037 U	--	--	--
2-Chloroethyl Vinyl Ether	--	--	--	--	--	0.290 U	--	--	--
2-Chlorotoluene	1,600.00	1,600.00	--	--	--	0.037 U	--	--	--
4-Chlorotoluene	--	--	--	--	--	0.037 U	--	--	--
Bromobenzene	--	--	--	--	--	0.037 U	--	--	--
Bromochloromethane	--	--	--	--	--	0.037 U	--	--	--
Bromoform	0.787	0.0495	--	--	--	0.037 U	--	--	--

Sample Location[1]	Soil Screening Level		GEI-20	GEI-21	GEI-25			GEI-27	GEI-28
Sample Identification			GEI-20-3-040114	GEI-21-3-040114	GEI-25-1-040114	GEI-25-3-040114	GEI-25-5-040114	GEI-27-3-040214	GEI-28-4-040214
Sample Date			04/01/14	04/01/14	04/01/14	04/01/14	04/01/14	04/02/14	04/02/14
Sample Depth (feet bgs)			4-6 feet	4-6 feet	0-2 feet	4-6 feet	8-10 feet	6-7.5 feet	6-8 feet
Sampled By	Vadose Zone	Saturated Zone	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers
Sample Horizon			Saturated	Saturated	Vadose	Saturated	Saturated	Saturated	Saturated
Bromomethane	0.060	0.0038	--	--	--	0.037 U	--	--	--
Carbon Tetrachloride	0.0050	0.001	--	--	--	0.037 U	--	--	--
Chlorobenzene	2.5	0.146	--	--	--	0.037 U	--	--	--
Chloroethane	95.47	5.64	--	--	--	0.190 U	--	--	--
Chloroform	0.0064	0.001	--	--	--	0.037 U	--	--	--
Chloromethane	0.725	0.045	--	--	--	0.240 U	--	--	--
Cis-1,2-Dichloroethene	160.00	160.000	--	--	--	0.037 U	--	--	--
Cis-1,3-Dichloropropene	--	--	--	--	--	0.037 U	--	--	--
Dibromochloromethane	0.0241	0.002	--	--	--	0.037 U	--	--	--
Dibromomethane	800.00	800.000	--	--	--	0.037 U	--	--	--
Dichlorodifluoromethane (CFC 12)	0.17	0.00	--	--	--	0.037 U	--	--	--
1,2-Dibromoethane (EDB)	0.002	0.001	--	--	--	0.037 U	--	--	--
Methyl Iodide	--	--	--	--	--	0.190 U	--	--	--
Methyl t-Butyl Ether (MTBE)	2.592	0.182	--	--	--	0.048 U	--	--	--
Methylene Chloride	4.356	0.297	--	--	--	0.190 U	--	--	--
n-Hexane	0.27	0.01	--	--	--	**0.074**	--	--	--
Tetrachloroethene (PCE)	0.094	0.0049	--	--	--	0.037 U	--	--	--
Trans-1,2-Dichloroethene	21.71	1.299	--	--	--	0.037 U	--	--	--
Trans-1,3-Dichloropropene	--	--	--	--	--	0.037 U	--	--	--
Trichloroethene (TCE)	0.0103	0.001	--	--	--	0.037 U	--	--	--
Trichlorofluoromethane (CFC 11)	1.4	0.04	--	--	--	0.037 U	--	--	--
Vinyl Chloride	0.006	0.001	--	--	--	0.037 U	--	--	--
Polycyclic Aromatic Hydrocarbons (PAHs; mg/kg)									
1-Methylnaphthalene	34.483	34.483	--	--	--	--	--	--	--
2-Methylnaphthalene	0.775	0.040	--	--	--	--	--	--	--
Acenaphthene	0.32	0.02	--	--	--	--	--	--	--
Acenaphthylene	--	0.068	--	--	--	--	--	--	--
Anthracene	4	0.2	--	--	--	--	--	--	--
Benzo[g,h,i]perylene	--	1.951	--	--	--	--	--	--	--
Fluoranthene	3.2	0.16	--	--	--	--	--	--	--
Fluorene	0.5	0.02	--	--	--	--	--	--	--
Naphthalenes	0.25	0.01	--	--	--	**9.3 T**	--	--	--
Phenanthrene	--	0.101	--	--	--	--	--	--	--
Pyrene	20	1.00	--	--	--	--	--	--	--
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs; mg/kg)									
Benzo[a]anthracene	0.07	0.007	--	--	--	**0.19**	--	--	--
Benzo[a]pyrene	0.14	0.010	--	--	--	**0.11**	--	--	--
Benzo[b]fluoranthene	0.25	0.012	--	--	--	**0.08**	--	--	--
Benzo[k]fluoranthene	0.32	0.016	--	--	--	**0.05**	--	--	--
Chrysene	0.25	0.0124	--	--	--	**0.20**	--	--	--
Dibenz[a,h]anthracene	0.14	0.018	--	--	--	0.039 U	--	--	--
Indeno[1,2,3-c,d]pyrene	0.69	0.035	--	--	--	**0.05**	--	--	--
cPAHs TEQ3	0.22	0.011	--	--	--	**0.15 T**	--	--	--

Sample Location[1]	Soil Screening Level		GEI-20	GEI-21	GEI-25			GEI-27	GEI-28
Sample Identification			GEI-20-3-040114	GEI-21-3-040114	GEI-25-1-040114	GEI-25-3-040114	GEI-25-5-040114	GEI-27-3-040214	GEI-28-4-040214
Sample Date			04/01/14	04/01/14	04/01/14	04/01/14	04/01/14	04/02/14	04/02/14
Sample Depth (feet bgs)			4-6 feet	4-6 feet	0-2 feet	4-6 feet	8-10 feet	6-7.5 feet	6-8 feet
Sampled By	Vadose Zone	Saturated Zone	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers
Sample Horizon			Saturated	Saturated	Vadose	Saturated	Saturated	Saturated	Saturated
Polychlorinated Biphenyls (PCBs; mg/kg)									
Total PCBs (sum of Aroclors)	0.062	0.050	--	--	--	0.062 UT	--	--	--
Dioxins and Furans (ng/kg)									
Total dioxins/furans - human health TEQ	5.2	5.2	--	--	--	--	--	--	--

Notes:

[1] Sample locations are shown on Figure 4.

[2] Screening level for gasoline-range petroleum hydrocarbons is 30 mg/kg if benzene is present and 100 mg/kg if not present.

[3] Total carcinogenic Polycyclic Aromatic Hydrocarbon (cPAH) calculated using toxic equivalent (TEQ) methodology relative to benzo(a)pyrene. cPAHs that were not detected were assigned a value of one half of the detection limit for these calculations.

mg/kg = milligrams per kilogram

ng/kg = nanograms per kilogram

T = total concentration

U = not detected above the laboratory reporting limit

Bold font indicates compound was detected.

Blue shading indicates that the compound was not detected with a reporting limit greater than the soil screening level.

Green shading indicates that the compound was detected at concentrations greater than the soil screening level.

Table 7

Summary of Existing Groundwater Chemical Analytical Data

Quiet Cove Property
Anacortes, Washington

Sample Location[1]	Groundwater Screening Level	B1	B2	B3	MW-1	MW-2	MW-3	MW-3 (Duplicate)	MW-4	MW-5
Sample Identification		B1-8	B2-7.5	B3-6	QC-MW-1-1-7.1.14	QC-MW-2-1-7.1.14	QC-MW-3-1-7.1.14	QC-MW-3-DUP-1-7.1.14	QC-MW-4-1-7.1.14	QC-MW-5-1-7.1.14
Sample Date		04/06/00	04/06/00	04/06/00	07/01/14	07/01/14	07/01/14	07/01/14	07/01/14	07/01/14
Depth to Groundwater (feet bgs)		10	6	6	5	6	6	6	10.5	7.5
Sampled By		ThermoRetec	ThermoRetec	ThermoRetec	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers
Total Metals (µg/L)										
Arsenic	5	--	--	--	--	--	**4.9**	--	--	**10**
Cadmium	9	--	--	--	--	--	4.4 U	--	--	4.4 U
Chromium (total)	50	--	--	--	--	--	**11**	--	--	**46**
Lead	2.1	--	--	--	--	--	1.1 U	--	--	**7.1**
Mercury	0.025	--	--	--	--	--	0.5 U	--	--	0.5 U
Dissolved Metals (µg/L)										
Arsenic	5	--	--	--	--	--	4.5	--	--	**6.6**
Cadmium	9	--	--	--	--	--	4 U	--	--	4 U
Chromium (total)	50	--	--	--	--	--	10 U	--	--	10 U
Lead	2	--	--	--	--	--	1 U	--	--	1 U
Mercury	0.025	--	--	--	--	--	0.5 U	--	--	0.5 U
Petroleum Hydrocarbons (µg/L)										
Gasoline-Range[2]	800/10009	**237**	**1,460**	**970**	100 U	**110**	**480**	**530**	**510**	**440**
Diesel-Range	500	**1,980**	**4,560**	**4,840**	**860**	**2,100**	**2,600 J**	**2,400 J**	**1,300 J**	**1,500 J**
Heavy Oil-Range	500	750 U	1510 U	750 U	410 U	**980**	**700**	**640**	410 U	450 U
BETX Compounds (µg/L)										
Benzene	2.4	**10**	**45**	**67**	1 U	1 U	0.2 U	1 U	1 U	0.2 U
Ethylbenzene	130	0.5 U	6.9 U	**33.9**	1 U	1 U	0.49	1 U	1 U	0.2 U
Toluene	520	0.5 U	1.5 U	**4.6**	1 U	1 U	1 U	1 U	1 U	1 U
Xylenes	310	2.4 U	7.2 U	**5.5**	1 U	1 U	1.56	1.8	1 U	0.22
Halogenated Volatile Organic Compounds (HVOCs; µg/L)										
1,1,1,2-Tetrachloroethane	7.4	--	--	--	--	--	0.2 U	--	--	0.2 U
1,1,1-Trichloroethane	5,238	--	--	--	--	--	0.2 U	--	--	0.2 U
1,1,2,2-Tetrachloroethane	3	--	--	--	--	--	0.2 U	--	--	0.2 U
1,1,2-Trichloroethane	4.51	--	--	--	--	--	0.2 U	--	--	0.2 U
1,1-Dichloroethane	11.23	--	--	--	--	--	0.2 U	--	--	0.2 U
1,1-Dichloroethene	3.2	--	--	--	--	--	0.2 U	--	--	0.2 U
1,1-Dichloropropene	--	--	--	--	--	--	0.2 U	--	--	0.2 U
1,2,3-Trichlorobenzene	--	--	--	--	--	--	0.2 U	--	--	0.2 U
1,2,3-Trichloropropane	--	--	--	--	--	--	0.2 U	--	--	0.2 U
1,2,4-Trichlorobenzene	0.5	--	--	--	--	--	0.2 U	--	--	0.2 U
1,2-Dibromo-3-chloropropane	--	--	--	--	--	--	1 U	--	--	1 U
1,2-Dichlorobenzene	2,571	--	--	--	--	--	0.2 U	--	--	0.2 U
1,2-Dichloroethane (EDC)	4.2	--	--	--	--	--	0.2 U	--	--	0.2 U
1,2-Dichloropropane	3.89	--	--	--	--	--	0.2 U	--	--	0.2 U
1,3-Dichlorobenzene	10	--	--	--	--	--	0.2 U	--	--	0.2 U
1,3-Dichloropropane	--	--	--	--	--	--	0.2 U	--	--	0.2 U
1,4-Dichlorobenzene	4.85	--	--	--	--	--	0.2 U	--	--	0.2 U
2,2-Dichloropropane	--	--	--	--	--	--	0.2 U	--	--	0.2 U

Sample Location[1]	Groundwater Screening Level	B1	B2	B3	MW-1	MW-2	MW-3	MW-3 (Duplicate)	MW-4	MW-5
Sample Identification		B1-8	B2-7.5	B3-6	QC-MW-1-1-7.1.14	QC-MW-2-1-7.1.14	QC-MW-3-1-7.1.14	QC-MW-3-DUP-1-7.1.14	QC-MW-4-1-7.1.14	QC-MW-5-1-7.1.14
Sample Date		04/06/00	04/06/00	04/06/00	07/01/14	07/01/14	07/01/14	07/01/14	07/01/14	07/01/14
Depth to Groundwater (feet bgs)		10	6	6	5	6	6	6	10.5	7.5
Sampled By		ThermoRetec	ThermoRetec	ThermoRetec	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers	GeoEngineers
2-Chloroethyl Vinyl Ether	--	--	--	--	--	--	0.2 U	--	--	0.2 U
2-Chlorotoluene	--	--	--	--	--	--	1 U	--	--	1 U
4-Chlorotoluene	--	--	--	--	--	--	0.2 U	--	--	0.2 U
Bromobenzene	--	--	--	--	--	--	0.2 U	--	--	0.2 U
Bromochloromethane	--	--	--	--	--	--	0.2 U	--	--	0.2 U
Bromoform	120	--	--	--	--	--	0.2 U	--	--	0.2 U
Bromomethane	13	--	--	--	--	--	0.2 U	--	--	0.2 U
Carbon Tetrachloride	0.54	--	--	--	--	--	1 U	--	--	1 U
Chlorobenzene	286	--	--	--	--	--	0.2 U	--	--	0.2 U
Chloroethane	18,286	--	--	--	--	--	0.2 U	--	--	0.2 U
Chloroform	1.20	--	--	--	--	--	0.2 U	--	--	0.2 U
Chloromethane	152.8	--	--	--	--	--	1 U	--	--	1 U
Cis-1,2-Dichloroethene	--	--	--	--	--	--	0.2 U	--	--	0.2 U
Cis-1,3-Dichloropropene	--	--	--	--	--	--	1 U	--	--	1 U
Dibromochloromethane	4.53	--	--	--	--	--	0.2 U	--	--	0.2 U
Dibromomethane	--	--	--	--	--	--	0.2 U	--	--	0.2 U
Dichlorodifluoromethane (CFC 12)	5.66	--	--	--	--	--	0.2 U	--	--	0.2 U
1,2-Dibromoethane (EDB)	0.28	--	--	--	--	--	0.2 U	--	--	0.2 U
Methyl Iodide	--	--	--	--	--	--	0.26 U	--	--	0.26 U
Methyl t-Butyl Ether (MTBE)	610	--	--	--	--	--	1 U	--	--	1 U
Methylene Chloride	1,000	--	--	--	--	--	1 U	--	--	1 U
n-Hexane	7.8	--	--	--	--	--	0.2 U	--	--	0.2 U
Tetrachloroethene (PCE)	9	--	--	--	--	--	0.2 U	--	--	0.2 U
Trans-1,2-Dichloroethene	4,000	--	--	--	--	--	0.2 U	--	--	0.2 U
Trans-1,3-Dichloropropene	--	--	--	--	--	--	0.2 U	--	--	0.2 U
Trichloroethene (TCE)	1.55	--	--	--	--	--	0.2 U	--	--	0.2 U
Trichlorofluoromethane (CFC 11)	120	--	--	--	--	--	0.2 U	--	--	0.2 U
Vinyl Chloride	1	--	--	--	--	--	0.2 U	--	--	0.2 U
Non-carcinogenic Polycyclic Aromatic Hydrocarbons (PAHs; µg/L)										
1-Methylnaphthalene	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	14.5	--	--	--	--	--	--	--	--	--
Acenaphthene	3.2	--	--	--	--	--	--	--	--	--
Acenaphthylene	12.7	--	--	--	--	--	--	--	--	--
Anthracene	9.3	--	--	--	--	--	--	--	--	--
Benzo[g,h,i]perylene	1.0	--	--	--	--	--	--	--	--	--
Fluoranthene	3.2	--	--	--	--	--	--	--	--	--
Fluorene	2.9	--	--	--	--	--	--	--	--	--
Naphthalene	8.9	--	--	--	--	--	**56**	--	--	**18.8**
Phenanthrene	5.9	--	--	--	--	--	--	--	--	--
Pyrene	14.7	--	--	--	--	--	--	--	--	--
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs; µg/L)										
Benzo[a]anthracene	0.01	--	--	--	--	--	**0.015**	--	--	0.0095 U
Benzo[a]pyrene	0.01	--	--	--	--	--	0.0094 U	--	--	0.0095 U
Benzo[b]fluoranthene	0.01	--	--	--	--	--	0.0094 U	--	--	0.0095 U
Benzo[k]fluoranthene	0.013	--	--	--	--	--	0.0094 U	--	--	0.0095 U

Sample Location[1]	Groundwater Screening Level	B1	B2	B3	MW-1	MW-2	MW-3	MW-3 (Duplicate)	MW-4	MW-5
Sample Identification		**B1-8**	**B2-7.5**	**B3-6**	**QC-MW-1-1-7.1.14**	**QC-MW-2-1-7.1.14**	**QC-MW-3-1-7.1.14**	**QC-MW-3-DUP-1-7.1.14**	**QC-MW-4-1-7.1.14**	**QC-MW-5-1-7.1.14**
Sample Date		**04/06/00**	**04/06/00**	**04/06/00**	**07/01/14**	**07/01/14**	**07/01/14**	**07/01/14**	**07/01/14**	**07/01/14**
Depth to Groundwater (feet bgs)		**10**	**6**	**6**	**5**	**6**	**6**	**6**	**10.5**	**7.5**
Sampled By		**ThermoRetec**	**ThermoRetec**	**ThermoRetec**	**GeoEngineers**	**GeoEngineers**	**GeoEngineers**	**GeoEngineers**	**GeoEngineers**	**GeoEngineers**
Chrysene	0.031	--	--	--	--	--	**0.017**	--	--	0.0095 U
Dibenz[a,h]anthracene	0.01	--	--	--	--	--	0.0094 U	--	--	0.0095 U
Indeno[1,2,3-c,d]pyrene	0.01	--	--	--	--	--	0.0094 U	--	--	0.0095 U
cPAHs TEQ[3]	0.011	--	--	--	--	--	**0.0083 T**	--	--	0.0072 UT
Polychlorinated Biphenyls (PCBs; (µg/L)										
Total PCBs (sum of Aroclors)	0.01	--	--	--	--	--	--	--	--	--
Dioxins and Furans (ng/L)										
Total dioxins/furans - human health TEQ	0.016	--	--	--	--	--	--	--	--	--

Notes:

[1] Sample locations are shown on Figure 5.

[2] Screening level for gasoline-range petroleum hydrocarbons is 800 µg/L if benzene is present and 1000 µg/L if not present.

[3] Total carcinogenic Polycyclic Aromatic Hydrocarbon (cPAH) calculated using toxic equivalent (TEQ) methodology relative to benzo(a)pyrene. cPAHs that were not detected were assigned a value of one half of the detection limit for these calculations.

bgs = below ground surface

µg/L = milligrams per kilogram

ng/L = nanograms per kilogram

T = total concentration

J = estimated result

U = not detected above the laboratory reporting limit

Bold font indicates compound was detected.

Blue shading indicates that the compound was not detected with a reporting limit greater than the groundwater screening level.

Green shading indicates that the compound was detected at concentrations greater than the groundwater screening level.

Table 8

Proposed Remedial Investigation/Feasibility Study Work Plan – Approach and Rationale

Quiet Cove Property

Anacortes, Washington

Media of Concern	Data Gap	Proposed RI/FS Investigation Locations[1]	Boring Depth/ Soil Sampling	Well Screen Interval/ Groundwater Sampling	Proposed Sample Analysis Priority	Proposed Analysis
Soil	Characterization of Site Geology/ Stratigraphy: ■ Characterization of stratigraphy in portions of the Site not previously investigated. ■ Characterization of the soil fill and native soil horizon in portions of the Site not previously investigated.	Direct-Push Boring: ■ GEI-29 through GEI-45 Hollow-Stem Auger Boring: ■ MW-6 through MW-11	■ Advance boring at least three feet into the native soil or to approximately 15 feet bgs, whichever occurs first. ■ If evidence of petroleum contamination is observed, advance the boring to at least three feet below the observed depth of contamination, or until refusal.	■ N/A	Tier 1 Sample Analysis: ■ Submit selected soil samples from GEI-29 through GEI-32 and GEI-38 through GEI-44 for chemical analysis. Tier 2 Sample Analysis: ■ Submit selected archived samples for chemical analysis to improve delineation of soil contamination.	Contaminants of potential concern in soil based on previous study results and historical operations: ■ Diesel and Heavy Oil (NWTPH-Dx) ■ Gasoline/BTEX (NWTPH-Gx/EPA 8260) ■ MTCA Metals2 (EPA 6000/7000) ■ PAHs (EPA 8270D/SIM) ■ Fuel additives including EDB, EDC, MTBE, and n-Hexane (EPA 8260)
	Characterization of the Nature and Extent of Contamination: ■ Evaluation of potential soil contamination associated with historical Site operations and use. ■ Characterization of the horizontal and vertical extent of contaminants in the fill and native soil associated with historical Site operations and use.		■ Collect samples from the fill soil horizon, native soil horizon, and from the approximate surface of the water table for potential chemical analysis. ■ Archive additional samples for potential follow-up analysis.			
Groundwater	Characterization of Site Hydrogeology: ■ Characterization of groundwater gradients/ flow direction at the Site. ■ Characterization of hydraulic conductivity/ transmissivity. ■ Characterization of tidal influence on groundwater gradients, and flow direction. ■ Characterization of the effect of Curtis Wharf bulkhead on groundwater gradients/flow direction at the Site.	Existing Monitoring Wells: ■ MW-2 and MW-4 New Monitoring Wells: ■ MW-6 through MW-9 and MW11	■ N/A	■ Utilize existing monitoring wells. ■ Install 10-foot well screen across water table observed on day of drilling at proposed new monitoring well locations. Screen interval will be adjusted to account for potential tidal fluctuation.	■ N/A	Tidal Study: ■ Record changes in water level every 15 minutes over a 72-hour period using a combination of pressure transducers with internal data loggers corrected for atmospheric pressure. Hydraulic Conductivity Test: ■ Record changes in water level while performing drawdown test to identify the range of hydraulic conductivities present.
	Characterization of the Nature and Extent of Contamination: ■ Characterization of the horizontal extent of contaminants in groundwater in portions of the Site not previously investigated.	Existing Monitoring Wells: ■ MW-1 through MW-5 New Monitoring Wells: ■ MW-6 through MW-11 ■ Additional locations as necessary to determine nature and extent as required/ approved by Ecology.		■ Collect at least one round of groundwater samples for chemical analysis. ■ Conduct additional sampling for potential fingerprint analysis to distinguish between site and off-site contamination source(s). ■ Conduct additional sampling, based on sediment sampling analysis to evaluate whether the pathway from the upland to the marine environment is complete.	Tier 1 Sample Analysis: ■ Submit groundwater samples from MW-1 through MW-10 for chemical analysis. Tier 2 Sample Analysis: ■ Submit groundwater sample from MW-8 and MW-11 for fingerprint analysis based on analytical results of MW-8, if elected by the Port or required by Ecology. ■ Submit groundwater samples from selected monitoring wells for additional analysis to evaluate groundwater to sediment exposure pathway, if elected by the Port or required by Ecology.	Contaminants of potential concern in groundwater based on previous study results and historical operations include: ■ Diesel and Heavy Oil (NWTPH-Dx) ■ Gasoline/BTEX (NWTPH-Gx/EPA 8260) ■ Total and Dissolved MTCA Metals[2] (EPA 6000/7000/200.8) ■ PAHs (EPA 8270D/SIM) ■ Fuel additives including EDB, EDC, MTBE, and n-Hexane (EPA 8260)) Additional groundwater analysis may be performed for contaminants are detected in sediment or for potential fingerprint analysis to distinguish between site and off-site contamination source(s), including, but not limited to, any combination of the following: ■ PCBs (EPA 1668C) ■ SMS Metals[3] (EPA 6000/7000/200.8) ■ SMS SVOCs (EPA 8270/SIM) ■ EPH and VPH

Media of Concern	Data Gap	Proposed RI/FS Investigation Locations	Boring Depth/ Soil Sampling	Well Screen Interval/ Groundwater Sampling	Proposed Sample Analysis Priority	Proposed Laboratory Analysis
Sediment	Characterization of Site Geology/ Stratigraphy: ■ Characterization of stratigraphy in portions of the Site not previously investigated. ■ Characterization of the soil fill and native soil horizon in portions of the Site not previously investigated. Characterization of Nature and Extent of Contamination: ■ Characterization of sediment in and adjacent to the beach area located west of the Quiet Cove Property. ■ Characterization of sediment in beach area located adjacent to former/current outfalls.	Composite Surface (0 to 10 cm) Grab Sample: ■ SED-1-COMP ▪ SED-1A ▪ SED-1B ▪ SED-1C Direct-Push Boring: ■ SED-1A through SED-1C and SED-2 through SED-7	■ Advance boring at least three feet into the native soil or to approximately 15 feet bgs, whichever occurs first. ■ If evidence of petroleum contamination is observed, advance the boring to at least three feet below the observed depth of contamination, or until refusal. ■ Collect surface (0 to 10 cm) samples for potential chemical analysis. Sufficient sample volume will be collected for potential follow-up analysis of additional chemical parameters. ■ Collect samples from the fill sediment horizon, native sediment horizon, and from the approximate surface of the water table for potential chemical analysis. Sufficient sample volume will be collected for potential follow-up analysis of additional chemical parameters. ■ Archive additional samples for potential follow-up analysis.	■ N/A	Tier 1A Sample Analysis: ■ Submit a composite surface sediment sample SED-1-COMP (surface composite from locations SED-1A through SED-1C) for analysis to evaluate soil/groundwater to sediment pathway. ■ Submit sediment samples collected at location SED-1B from the fill sediment horizon, native sediment horizon, and from the approximate surface of the water table for chemical analysis to evaluate soil/groundwater to sediment pathway. Tier 1B Sample Analysis: ■ Submit sample SED-1-COMP for additional chemical analysis to evaluate soil/groundwater to sediment exposure pathway or potential off-site contamination source(s), if elected by the Port or required by Ecology. ■ Submit selected archived samples collected from discrete boring location SED-1B for chemical analysis to evaluate soil/groundwater to sediment pathway, evaluate potential off-site contamination source(s) if elected by the Port or required by Ecology. Tier 2A Sample Analysis: ■ Submit sediment samples collected at locations SED-2 through SED-4 from the approximate groundwater to surface water discharge point for chemical analysis based on up-gradient soil sample and Tier 1 sediment sample results. ■ Submit sediment samples collected at locations SED-5 through SED-7 from the fill sediment horizon, native sediment horizon, and from the approximate surface of the water table for chemical analysis based on up-gradient soil sample and Tier 1 sediment sample results. Tier 2B Sample Analysis: ■ Submit sediment samples collected at locations SED-2 through SED-4 from the approximate groundwater to surface water discharge point for chemical analysis for additional chemical analysis to evaluate soil/groundwater to sediment exposure pathway or potential off-site contamination source(s), if elected by the Port or required by Ecology. ■ Submit sediment samples collected at locations SED-5 through SED-7 from the fill sediment horizon, native sediment horizon, and from the approximate surface of the water table for additional chemical analysis to evaluate soil/groundwater to sediment exposure pathway or potential off-site contamination source(s), if elected by the Port or required by Ecology. ■ Submit selected archived samples collected from SED-1A through SED-1C and SED-2 through SED-7 for chemical analysis to evaluate soil/groundwater to sediment pathway and/or improve delineation of sediment contamination, if elected by the Port or required by Ecology.	Contaminants of potential concern in sediment based on previous study results for upland media include: ■ Diesel and Heavy Oil (NWTPH-Dx) ■ Gasoline/BTEX (NWTPH-Gx/EPA 8260) ■ Fuel additives including EDB, EDC, MTBE, and n-Hexane (EPA 8260). ■ Grain Size (PSEP 1986 or ASTM-Mod) ■ TOC (PSEP 1981) ■ TVS (PSEP 1986/ASTM D2974) ■ TS (SM2540G) ■ SMS Metals[4] (EPA 6000/7000) ■ SMS SVOCs/PAHs (EPA 8270/SIM) ■ Bulk/Porewater Ammonia (EPA 350.1/SM 4500-NH3) ■ Bulk/Porewater Sulfides (PSEP 1986/SM 4500-S2) Additional sediment sample analysis may be performed in consultation with Ecology for potential contaminants of concern, including, but not limited to, any combination of the following: ■ Dioxins/Furans (EPA 1613) ■ PCB Congeners (EPA 1668C)

Media of Concern	Data Gap	Proposed RI/FS Investigation Locations	Boring Depth/ Soil Sampling	Well Screen Interval/ Groundwater Sampling	Proposed Sample Analysis Priority	Proposed Laboratory Analysis
Sediment	Evaluation of potential biological effects in surface sediment to evaluate compliance with SMS biological criteria: ■ Evaluation of potential biological effects where chemical concentrations and/or visual measures of wood debris exceed screening levels.	■ TBD	■ TBD	■ N/A	Tier 3 Sample Analysis: ■ TBD	■ To be determined based on results of SMS chemical analyses and visual measures of wood debris. ■ Sample collection for bioassay testing to be performed in a subsequent phase of sampling and testing, if elected by the Port, or required by Ecology.

Notes:

[1]Proposed RI/FS investigation locations are shown on Figures 7 and 8.

[2] Metals include arsenic, cadmium, chromium, lead, and mercury.

[3] Metals include arsenic, cadmium, chromium [total], copper, lead, mercury, silver and zinc.

bgs = below ground surface

NWTPH-G = Gasoline-Range Petroleum Hydrocarbons

NWTPH-Dx = Diesel- and Heavy Oil-Range Petroleum Hydrocarbons

BTEX = Benzene, Toluene, Ethylbenzene, Xylenes

EPA = Environmental Protection Agency

PAH = Polycyclic Aromatic Hydrocarbons

VOCs = Volatile Organic Compounds

SVOCs = Semi-Volatile Organic Compounds

PID = Photoionization Detector

SIM = Selected Ion Mode

PCBs = Polychlorinated Biphenyls

SMS = Sediment Management Standards

PSEP = Puget Sound Estuarine Protocols

TOC = Total Organic Carbon

TVS = Total Volatile Solids

TS = Total Solids

Table 9

Soil Sampling and Analysis Plan

Quiet Cove Property
Anacortes, Washington

Sample Location[1]	Sample Analysis Priority		Target Sample Interval[4] (feet bgs)	Anticipated Sample Horizon[5]			Petroleum Hydrocarbons (TPH)		Volatile Organic Compounds (VOCs)		MTCA Metals[6] (EPA 6000/7000)	Polycyclic Aromatic Hydrocarbons (PAHs)		Archive
	Tier 1[2]	Tier 2[3]		Fill	Water Table	Native	Gasoline-Range (NWTPH-Gx)	Diesel- and Heavy Oil-Range (NWTPH-Dx)	BETX (EPA 8260)	EDB, EDC, MTBE and n-Hexane (EPA 8260)		Carcinogenic PAHs (EPA 8270-SIM)	Naphthalenes (EPA 8270-SIM)	
Direct-Push (DP) Sample Location														
GEI-29	X		0-2	■			X	X	X	X	X	X	X	
			2-4	■										A
			4-6	■	■		X	X	X	X	X	X	X	
			6-8	■										A
			8-10			■	X	X	X	X	X	X	X	
GEI-30	X		0-2	■			X	X	X	X	X	X	X	
			2-4	■										A
			4-6	■	■		X	X	X	X	X	X	X	
			6-8	■										A
			8-10			■	X	X	X	X	X	X	X	
GEI-31	X		0-2	■			X	X	X	X	X	X	X	
			2-4	■										A
			4-6	■	■		X	X	X	X	X	X	X	
			6-8	■										A
			8-10			■	X	X	X	X	X	X	X	
GEI-32	X		0-2	■			X	X	X	X	X	X	X	
			2-4	■										A
			4-6	■	■		X	X	X	X	X	X	X	
			6-8	■										A
			8-10			■	X	X	X	X	X	X	X	
GEI-33		X	0-2	■										A
			2-4	■										A
			4-6	■	■									A
			6-8	■										A
			8-10			■								A
GEI-34		X	0-2	■										A
			2-4	■										A
			4-6	■	■									A
			6-8	■										A
			8-10			■								A
GEI-35		X	0-2	■										A
			2-4	■										A
			4-6	■	■									A
			6-8	■										A
			8-10			■								A
GEI-36		X	0-2	■										A
			2-4	■										A
			4-6	■	■									A
			6-8	■										A
			8-10			■								A
GEI-37		X	0-2	■										A
			2-4	■										A
			4-6	■	■									A
			6-8	■										A
			8-10			■								A

Sample Location[1]	Sample Analysis Priority		Target Sample Interval[4] (feet bgs)	Anticipated Sample Horizon[5]			Petroleum Hydrocarbons (TPH)		Volatile Organic Compounds (VOCs)		MTCA Metals[6] (EPA 6000/7000)	Polycyclic Aromatic Hydrocarbons (PAHs)		Archive
	Tier 1[2]	Tier 2[3]		Fill	Water Table	Native	Gasoline-Range (NWTPH-Gx)	Diesel- and Heavy Oil-Range (NWTPH-Dx)	BETX (EPA 8260)	EDB, EDC, MTBE and n-Hexane (EPA 8260)		Carcinogenic PAHs (EPA 8270-SIM)	Naphthalenes (EPA 8270-SIM)	
GEI-38	X		0-2	■			X	X	X	X	X	X	X	
			2-4	■										A
			4-6	■	■		X	X	X	X	X	X	X	
			6-8	■										A
			8-10	■										A
			10-12			■	X	X	X	X	X	X	X	
			12-14			■								A
			14-16			■								A
GEI-39	X		0-2	■			X	X	X	X	X	X	X	
			2-4	■										A
			4-6	■	■		X	X	X	X	X	X	X	
			6-8	■										A
			8-10	■										A
			10-12			■	X	X	X	X	X	X	X	
			12-14			■								A
			14-16			■								A
GEI-40	X		0-2	■			X	X	X	X	X	X	X	
			2-4	■										A
			4-6	■	■		X	X	X	X	X	X	X	
			6-8	■										A
			8-10	■										A
			10-12			■	X	X	X	X	X	X	X	
			12-14			■								A
			14-16			■								A
GEI-41	X		0-2	■										A
			2-4		■	■	X	X	X	X	X	X	X	
			4-6			■	X	X	X	X	X	X	X	
GEI-42	X		0-2	■										A
			2-4		■	■	X	X	X	X	X	X	X	
			4-6			■	X	X	X	X	X	X	X	
GEI-43	X		0-2	■										A
			2-4		■	■	X	X	X	X	X	X	X	
			4-6			■	X	X	X	X	X	X	X	
GEI-44	X		0-2	■			X	X	X	X	X	X	X	
			2-4	■										A
			4-6	■	■		X	X	X	X	X	X	X	
			6-8	■										A
			8-10	■										A
			10-12			■	X	X	X	X	X	X	X	
			12-14			■								A
GEI-45		X	0-2	■										A
			2-4	■										A
			4-6	■	■									A
			6-8	■										A
			8-10	■										A
			10-12			■								A
			12-14			■								A

Sample Location[1]	Sample Analysis Priority		Target Sample Interval[4] (feet bgs)	Anticipated Sample Horizon[5]			Petroleum Hydrocarbons (TPH)		Volatile Organic Compounds (VOCs)		MTCA Metals[6] (EPA 6000/7000)	Polycyclic Aromatic Hydrocarbons (PAHs)		Archive
	Tier 1[2]	Tier 2[3]		Fill	Water Table	Native	Gasoline-Range (NWTPH-Gx)	Diesel- and Heavy Oil-Range (NWTPH-Dx)	BETX (EPA 8260)	EDB, EDC, MTBE and n-Hexane (EPA 8260)		Carcinogenic PAHs (EPA 8270-SIM)	Naphthalenes (EPA 8270-SIM)	
Hollow-Stem Auger (HSA) Sample Location														
MW-6		X	0-2	■										A
			2-4	■										A
			4-6	■										A
			6-8	■	■									A
			8-10			■								A
			10-12			■								A
			12-14			■								A
			14-16			■								A
MW-7		X	0-2	■										A
			2-4	■										A
			4-6	■										A
			6-8	■	■									A
			8-10	■										A
			10-12			■								A
			12-14			■								A
			14-16			■								A
MW-8		X	0-2	■										A
			2-4	■										A
			4-6	■	■									A
			6-8	■										A
			8-10	■										A
			10-12			■								A
			12-14			■								A
			14-16			■								A
MW-9		X	0-2	■										A
			2-4	■										A
			4-6	■	■									A
			6-8	■										A
			8-10	■										A
			10-12			■								A
			12-14			■								A
			14-16			■								A
MW-10		X	0-2	■										A
			2-4	■										A
			4-6	■	■									A
			6-8	■										A
			8-10			■								A
			10-12			■								A
			12-14			■								A
			14-16			■								A
MW-11		X	0-2	■										A
			2-4	■										A
			4-6	■										A
			6-8	■	■									A
			8-10			■								A
			10-12			■								A
			12-14			■								A
			14-16			■								A

Notes:

[1] The approximate sample locations are shown on Figure 7.

[2] Tier 1 sample analysis will be completed as part of the initial soil investigation to evaluate nature and extent of Site contamination.

[3] Tier 2 sample analysis will be performed on archived samples based on a review of the initial soil investigation results to evaluate soil/groundwater to sediment pathway, evaluate potential off-site contamination source(s) and/or improve delineation of sediment contamination, if elected by the Port or required by Ecology.

[4] Sample intervals may be adjusted based on observed field conditions to collect samples representative to the fill and native soil horizon, and interface between the saturate and vadose zone. The exploration will be advanced to at least three feet into native soil or to approximately fifteen feet below ground surface (bgs), whichever occurs first. If field screening evidence of contamination is observed, the exploration will be advanced to at least three feet below the observed depth of contamination, or until refusal.

[5] Anticipated sample horizon is based on existing information. Actual field conditions may differ.

[6] MTCA metals include arsenic, cadmium, chromium (total), lead and mercury.

bgs = below ground surface

BETX = Benzene, Ethylbenzene, Toluene and Xylenes

EDB = 1,2-Dichloroethane

EDC = 1,2-Dichloroethane

EPA = Environmental Protection Agency

MTBE = Methyl t-Butyl Ether

MTCA = Model Toxics Control Act

A = Sample for archive analysis.

X = Selected sample for initial chemical analysis .

Table 10

Groundwater Sampling and Analysis Plan

Quiet Cove Property
Anacortes, Washington

Sample Location[1]	Sample Analysis Priority		Petroleum Hydrocarbons (TPH)				Volatile Organic Compounds (VOCs)		MTCA Metals[5]		Polycyclic Aromatic Hydrocarbons (PAHs)		SMS Metals[6]		SMS Semi-Volatile Organic Compounds (SVOCs) (EPA 8270D/SIM)	Polychlorinated Biphenyl's (PCBs) (EPA 1668C)
	Tier 1[2]	Tier 2[3]	Gasoline-Range (NWTPH-Gx)	Diesel- and Heavy Oil-Range (NWTPH-Dx)	Extractable Petroleum Hydrocarbons[4] (EPH)	Volatile Petroleum Hydrocarbons[4] (VPH)	BETX (EPA 8260)	EDB, EDC, MTBE and n-Hexane (EPA 8260)	Total Metals (EPA 6000/ 7000/200.8)	Dissolved Metals (EPA 6000/ 7000/200.8)	Carcinogenic PAHs (EPA 8270-SIM)	Naphthalenes (EPA 8270-SIM)	Total Metals (EPA 6000/ 7000/200.8)	Dissolved Metals (EPA 6000/ 7000/200.8)		
Existing Monitoring Well																
MW-1	X		X	X			X	X	X	X	X	X				
		X											O	O	O	O
MW-2	X		X	X			X	X	X	X	X	X				
		X											O	O	O	O
MW-3	X		X	X			X	X	X	X	X	X				
		X											O	O	O	O
MW-4	X		X	X			X	X	X	X	X	X				
		X											O	O	O	O
MW-5	X		X	X			X	X	X	X	X	X				
		X											O	O	O	O
New Monitoring Well																
MW-6	X		X	X			X	X	X	X	X	X				
		X											O	O	O	O
MW-7	X		X	X			X	X	X	X	X	X				
		X											O	O	O	O
MW-8	X		X	X			X	X	X	X	X	X				
		X			O	O							O	O	O	O
MW-9	X		X	X			X	X	X	X	X	X				
		X											O	O	O	O
MW-10	X		X	X			X	X	X	X	X	X				
		X			O	O							O	O	O	O
MW-11	X															
		X			O	O							O	O	O	O

Notes:

[1] The approximate sample locations are shown on Figure 8.

[2] Tier 1 sample analysis will be completed as part of the initial groundwater investigation to evaluate nature and extent of Site contamination.

[3] Tier 2 sample analysis will be completed under separate mobilization to evaluate soil/groundwater to sediment pathway, evaluate potential off-site contamination source(s) and/or improve delineation of sediment contamination, if elected by the Port or required by Ecology.

[4] Analysis may be performed based on the results of the initial groundwater investigation to evaluate potential off-site contaminant source(s).

[5] MTCA metals include arsenic, cadmium, chromium (total), lead and mercury.

[6] SMS metals include arsenic, cadmium, chromium [total], copper, lead, mercury, silver and zinc.

BETX = Benzene, Ethylbenzene, Toluene and Xylenes

EDB = 1,2-Dichloroethane

EDC = 1,2-Dichloroethane

EPA = Environmental Protection Agency

MTBE = Methyl t-Butyl Ether

MTCA = Model Toxics Control Act

O = Sample for potential follow-up analysis under a separate mobilization based on a review of Tier 1 sample results.

X = Selected sample for initial chemical analysis.

Table 11

Sediment Sampling and Analysis Plan

Quiet Cove Property
Anacortes, Washington

Sample Location[1]	Sample Analysis Priority[2]				Target Sample Interval[3] (feet bgs)	Anticipated Sample Horizon[4]			Petroleum Hydrocarbons (TPH)		Volatile Organic Compounds (VOCs)		Metals	Conventionals			SMS Metals[5] (EPA 6000/ 7000)	SMS SVOCs (EPA 8270D/ SIM)	Polychlorinated Biphenyl's (PCBs) (EPA 1668C)	Dioxins/ Furans (EPA 1613)	Archive
	Tier 1		Tier 2																		
	A	B	A	B		Fill	Water Table	Native	Gasoline-Range (NWTPH-Gx)	Diesel- and Heavy Oil-Range (NWTPH-Dx)	BETX (EPA 8260)	EDB, EDC, MTBE and n-Hexane (EPA 8260)	Arsenic and Cadmium (EPA 6000/ 7000)	Grain Size (PSEP 1986 or ASTM-Mod)	TOC, TVS, TS (PSEP 1981/1986/ ASTM D2974/ SM2540G)	Sulfides and Ammonia (SM4500-S2/ SM4500-NH3)				
Surface Sample Location																					
SED-1-COMP	X				0-10 cm	■			X	X	X	X	X	X	X	X	X	X			
		X																	O	O	
SED-2			X		0-10 cm			■	X	X	X	X	X	X	X	X	X	X			
				X															O	O	
SED-3			X		0-10 cm			■	X	X	X	X	X	X	X	X	X	X			
				X															O	O	
SED-4			X		0-10 cm			■	X	X	X	X	X	X	X	X	X	X			
				X															O	O	
Subsurface Sample Location																					
SED-1A				X	0-2	■															A
					2-4	■															A
					4-6	■															A
					6-8	■	■														A
					8-10			■													A
					10-12			■													A
SED-1B	X				0-2	■															A
					2-4	■			X	X	X	X	X	X	X	X	X	X			
					4-6	■	■		X	X	X	X	X	X	X	X	X	X			
					6-8			■	X	X	X	X	X	X	X	X	X	X			
					8-10			■													A
		X			0-2	■															A
					2-4	■													O	O	
					4-6	■	■												O	O	
					6-8			■											O	O	
					8-10			■													A
SED-1C				X	0-2	■															A
					2-4	■	■														A
					4-6			■													A
					6-8			■													A
SED-2				X	0-2			■													A
					2-4			■													A
SED-3				X	0-2			■													A
					2-4			■													A
SED-4				X	0-2			■													A
					2-4			■													A

Sample Location[1]	Sample Analysis Priority[2]				Target Sample Interval[3] (feet bgs)	Anticipated Sample Horizon[4]			Petroleum Hydrocarbons (TPH)		Volatile Organic Compounds (VOCs)		Metals	Conventionals			SMS Metals[5] (EPA 6000/ 7000)	SMS SVOCs (EPA 8270D/ SIM)	Polychlorinated Biphenyl's (PCBs) (EPA 1668C)	Dioxins/ Furans (EPA 1613)	Archive
	Tier 1		Tier 2																		
	A	B	A	B		Fill	Water Table	Native	Gasoline-Range (NWTPH-Gx)	Diesel- and Heavy Oil-Range (NWTPH-Dx)	BETX (EPA 8260)	EDB, EDC, MTBE and n-Hexane (EPA 8260)	Arsenic and Cadmium (EPA 6000/ 7000)	Grain Size (PSEP 1986 or ASTM-Mod)	TOC, TVS, TS (PSEP 1981/1986/ ASTM D2974/ SM2540G)	Sulfides and Ammonia (SM4500-S2/ SM4500-NH3)				
SED-5			X		0-2	■															A
					2-4	■			X	X	X	X	X	X	X	X	X	X			
					4-6	■															A
					6-8	■	■		X	X	X	X	X	X	X	X	X	X			
					8-10			■	X	X	X	X	X	X	X	X	X	X			
					10-12			■													A
				X	0-2	■															A
					2-4	■													O	O	
					4-6	■															A
					6-8	■	■												O	O	
					8-10			■											O	O	
					10-12			■													A
SED-6			X		0-2	■															A
					2-4	■			X	X	X	X	X	X	X	X	X	X			
					4-6	■															A
					6-8	■	■		X	X	X	X	X	X	X	X	X	X			
					8-10			■	X	X	X	X	X	X	X	X	X	X			
					10-12			■													A
				X	0-2	■															A
					2-4	■													O	O	
					4-6	■															A
					6-8	■	■												O	O	
					8-10			■											O	O	
					10-12			■													A
SED-7			X		0-2	■															A
					2-4	■			X	X	X	X	X	X	X	X	X	X			
					4-6	■															A
					6-8	■	■		X	X	X	X	X	X	X	X	X	X			
					8-10			■	X	X	X	X	X	X	X	X	X	X			
					10-12			■													A
				X	0-2	■															A
					2-4	■													O	O	
					4-6	■															A
					6-8	■	■												O	O	
					8-10			■											O	O	
					10-12			■													A

Notes:

[1] The approximate sample locations are shown on Figure 7.

[2] A three point surface composite sample (Tier 1 sample) will be collected west of the Curtis Wharf Bulkhead to evaluate sediment quality for upland COPC. Further characterization of the composite sample may be conducted using archived sediment to evaluate SMS parameters in consultation with Ecology following a review of initial sample results. Sediment samples from Tier 2 locations will be submitted for chemical analysis of contaminants found to be exceeding screening levels at Tier 1 sediment and/or upland shoreline soil or groundwater samples. Sufficient material will be collected from the Tier 2 sediment sample locations for potential follow-up analysis of SMS parameter. A third tier of sampling and analysis (Tier 3) may be performed following review of Tier 2 sediment sample results and identification of contaminant exceedances. Determination of the follow-up laboratory analyses from Tier 2 and potential Tier 3 locations will be in consultation with Ecology.

[3] Sample intervals may be adjusted in the field based on observed conditions to characterize sediment in the fill and native horizon, and at the water table. The exploration will be advanced to at least three feet into native soil or to approximately fifteen feet below ground surface (bgs), whichever occurs first. If field screening evidence of contamination is observed, the exploration will be advanced to at least three below the observed depth of contamination, or until refusal.

[4] Anticipated sample horizon is based on existing information. The sample horizon may differ based on observed conditions.

[5] MTCA metals include arsenic, cadmium, chromium (total), lead and mercury.

bgs = below ground surface

BETX = Benzene, Ethylbenzene, Toluene and Xylenes

EDB = 1,2-Dichloroethane

EDC = 1,2-Dichloroethane

EPA = Environmental Protection Agency

MTBE = Methyl t-Butyl Ether

MTCA = Model Toxics Control Act

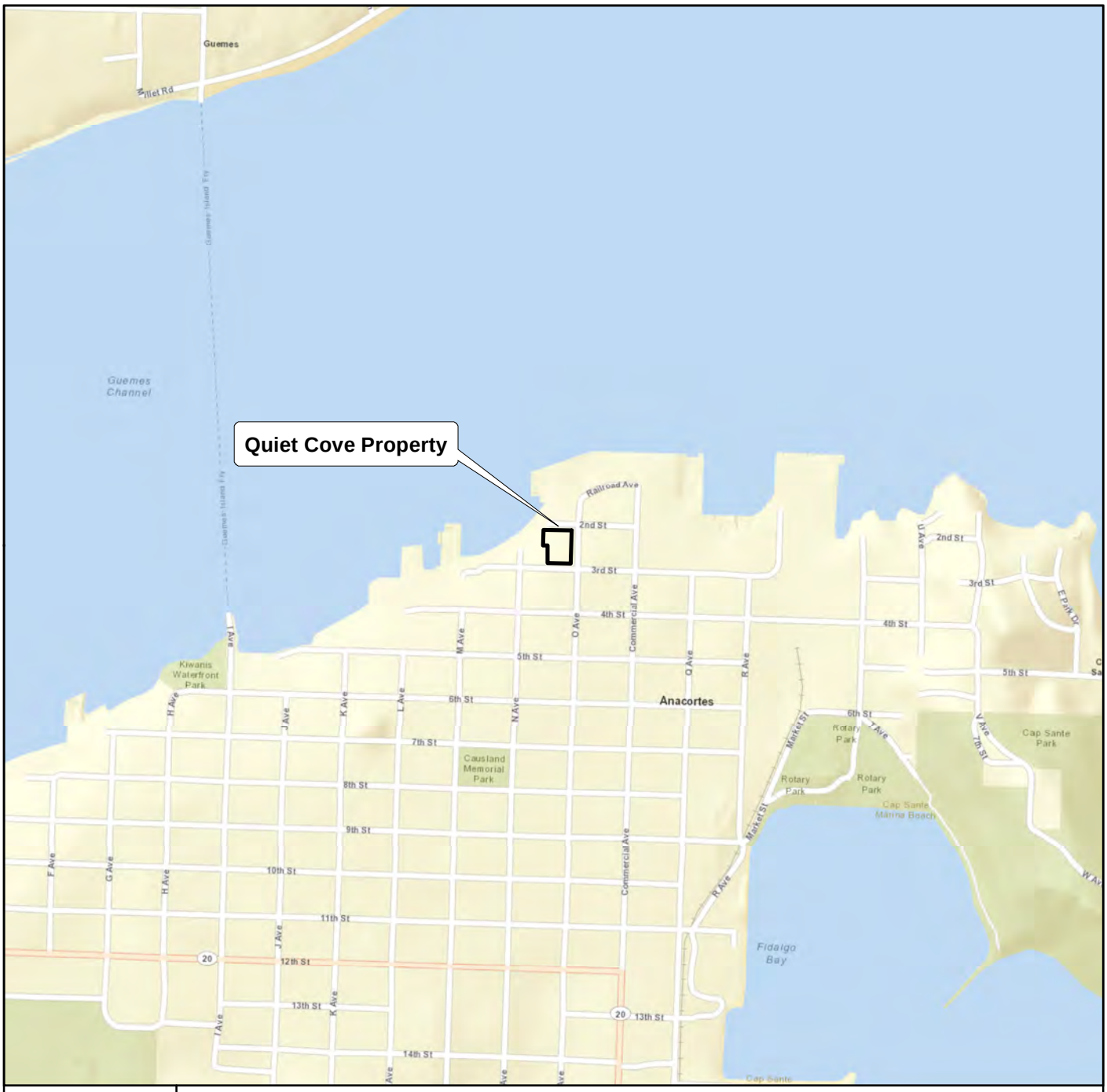
O = Sample for follow-up analysis to evaluate soil/groundwater to sediment pathway, evaluate potential off-site contamination source(s) and/or improve delineation of sediment contamination, if elected by the Port or required by Ecology.

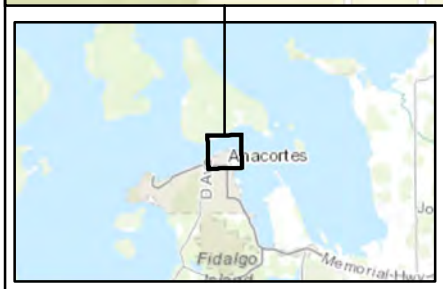
X = Selected sample for initial chemical analysis to evaluate nature and extent of Site contamination.

A = Sample for archive analysis.

FIGURES

GeoEngineers





N
W E
S

1,000 0 1,000

Feet

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: ESRI Data & Maps, Street Data 2013.

Transverse Mercator, Zone 10 N North, North American Datum 1983
North arrow oriented to grid north

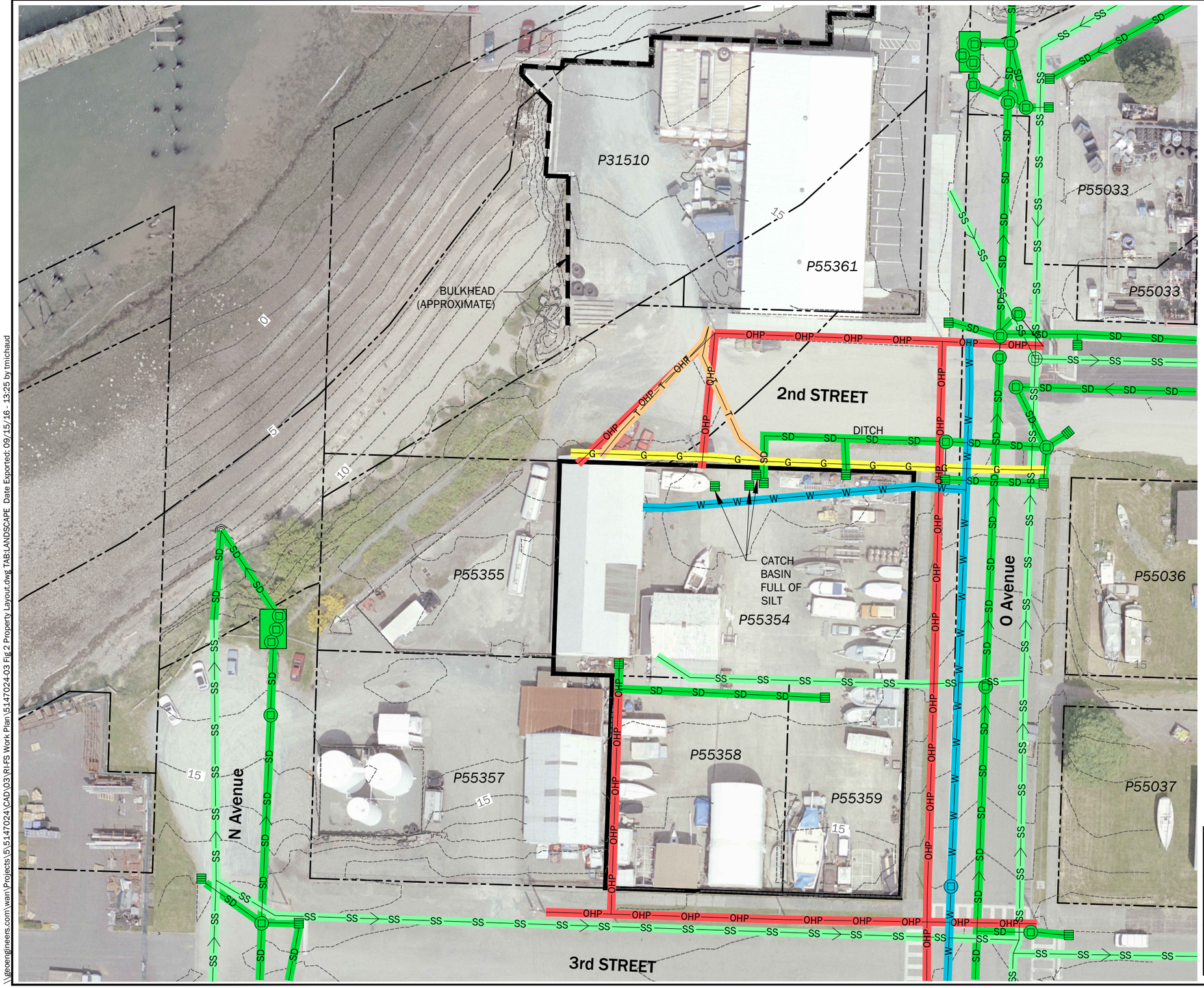
Vicinity Map

Quiet Cove Property
Anacortes, Washington

GeoEngineers

Figure 1

Office: Redmond Path:C:\Users\maugust\Desktop\xxxxxxxx_F1_VicinityMap.mxd Map Revised: 1/28/2014 MSA



Legend

- Quiet Cove Property Boundary
- Skagit County Parcel Boundary
- Natural Gas
- Overhead Power
- Telephone
- Sanitary Sewer (SS) and Flow Direction
- Storm Drain (SD) and Flow Direction
- Water
- Manhole
- Catch Basin
- Outfall
- Topographic Contour

N

W E

S

50 0 50

FEET

Notes:

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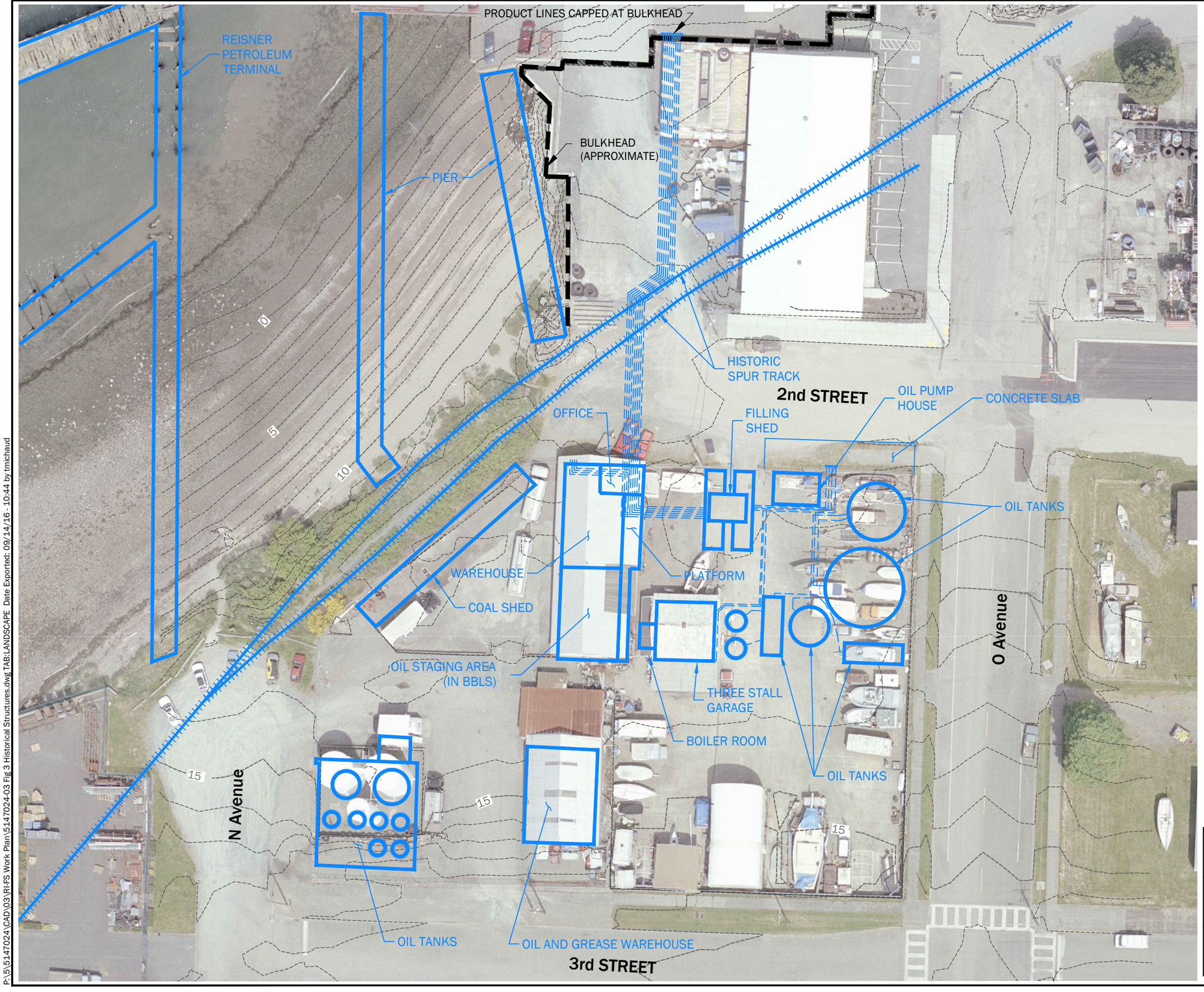
Data Source: Base Aerial taken by David C. Smith & Associates, Inc. on 6/17/2009. Utility and topography provided by Port of Anacortes on 4/8/2016. Historical features are based on Sanborn Maps dated October 1925.

Current Property Layout and Utilities

Quiet Cove Property
Anacortes, Washington

GeoEngineers

Figure 2



Legend

- Quiet Cove Property Boundary
- Historical Features
- Product Supply Line
- 10 Topographic Contour

N W E S

50 0 50
FEET

Notes:

1. The locations of all features shown are approximate. A detailed layout of the Property and Bulk Fuel facilities is shown on the May 31, 1921 Standard Oil Engineers drawing presented in Appendix A.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication

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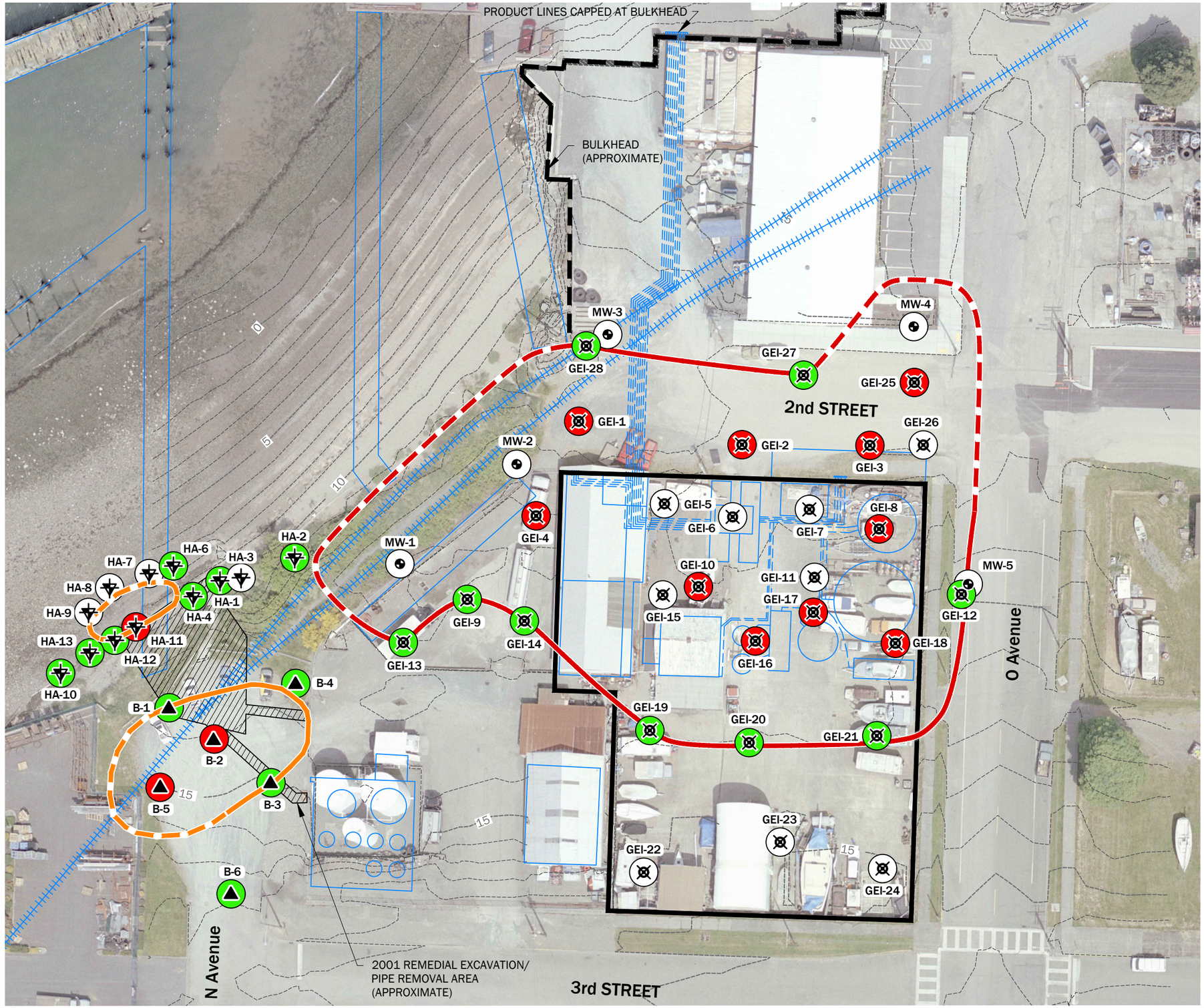
Historical Features

Quiet Cove Property
Anacortes, Washington

GeoEngineers | **Figure 3**



Legend

- Quiet Cove Property Boundary
- Historical Features
- 10 — Topographic Contour
- B-1 — Boring Location (Thermo Retec, 2000)
- HA-1 — Hand Auger Boring Location (Thermo Retec, 2000)
- GEI-1 — Boring Location (GeoEngineers, 2014)
- MW-4 — Monitoring Well Location (GeoEngineers, 2014)
- Exceedance of Screening Level(s) in Soil
- No Exceedance Screening Level(s) in Soil
- No Soil Data

Quiet Cove Site
- Approximate Extent of Contaminated Soil (Defined by Existing Data)
- Approximate Extent of Contaminated Soil (Inferred from Existing Data)

Off-Property Contaminant Sources
- Approximate Extent of Contaminated Soil (Defined by Existing Data)
- Approximate Extent of Contaminated Soil (Inferred from Existing Data)

N W E S

50 0 50
FEET

Notes:

1. The locations of all features shown are approximate. A detailed layout of the Property and Bulk Fuel facilities is shown on the May 31, 1921 Standard Oil Engineers drawing presented in Appendix A.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication

Data Source: Base Aerial taken by David C. Smith & Associates, Inc. on 6/17/2009. Utility and topography provided by Port of Anacortes on 4/8/2016. Historical features are based on Sanborn Maps dated October 1925.

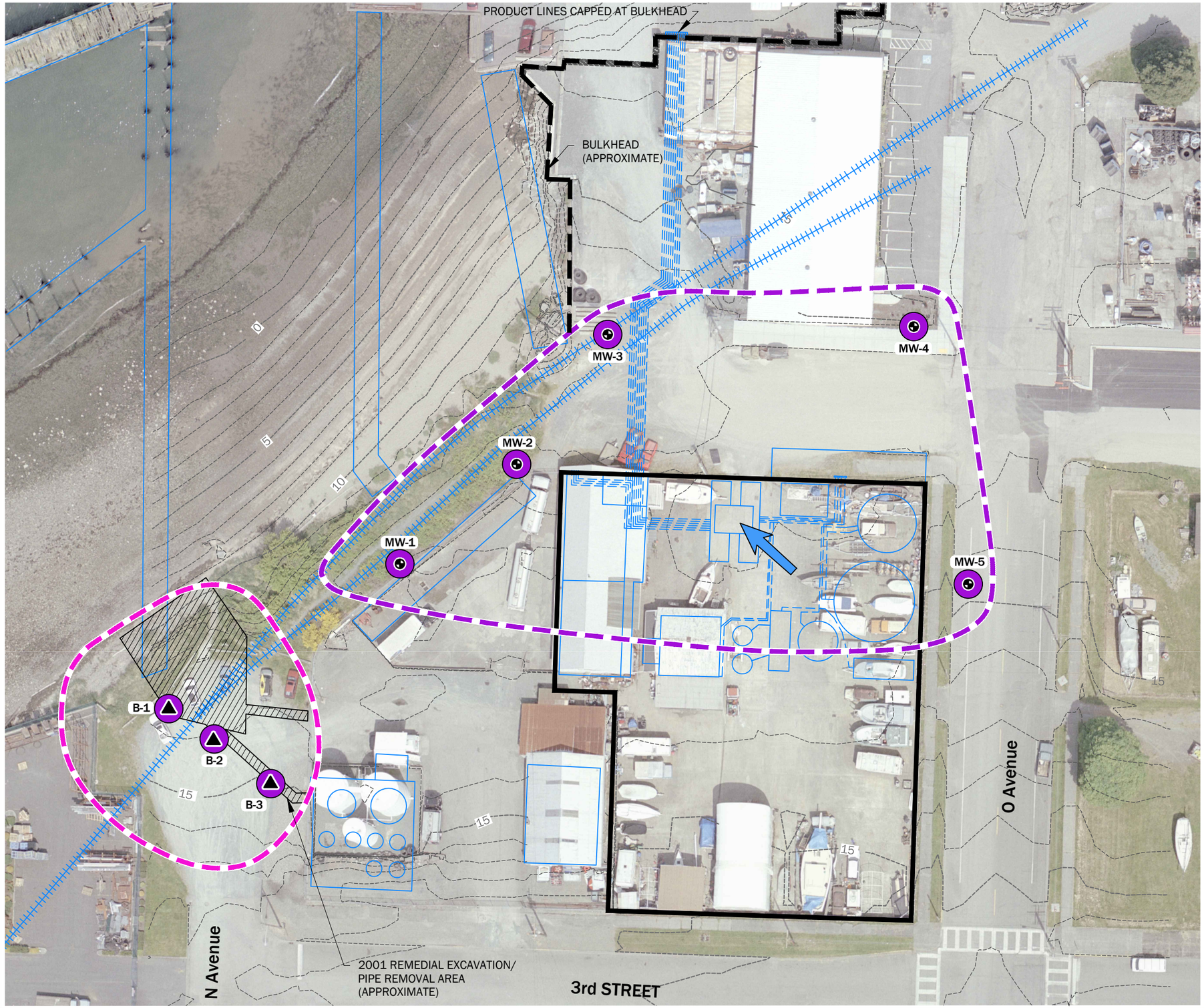
Previous Soil Sample Locations and Summary of Existing Data

Quiet Cove Property
Anacortes, Washington

GeoEngineers

Figure 4

P:\5\5147024\CAD\03\RI-FS Work Plan\5147024-03 Fig 4 Previous Soil Sampling Locations.dwg TAB:LANDSCAPE Date Exported: 09/14/16 - 10:53 by tmichaud



Legend

- Quiet Cove Property Boundary
- Historical Features
- 10 — Topographic Contour
- B-1 — Grab Sample Location (Thermo Retec, 2000)
- MW-4 — Monitoring Well Location (GeoEngineers, 2014)
- Exceedance of Screening Level(s) in Groundwater
- No Exceedance Screening Level(s) in Groundwater
- Inferred Groundwater Flow Direction
- Quiet Cove Site — Approximate Extent of Contaminated Groundwater (Inferred from Existing Data)
- Off-Property Contaminant Sources — Approximate Extent of Contaminated Groundwater (Inferred from Existing Data)

N / W / E / S

50 0 50
FEET

Notes:

1. The locations of all features shown are approximate. A detailed layout of the Property and Bulk Fuel facilities is shown on the May 31, 1921 Standard Oil Engineers drawing presented in Appendix A.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication

Data Source: Base Aerial taken by David C. Smith & Associates, Inc. on 6/17/2009. Utility and topography provided by Port of Anacortes on 4/8/2016. Historical features are based on Sanborn Maps dated October 1925.

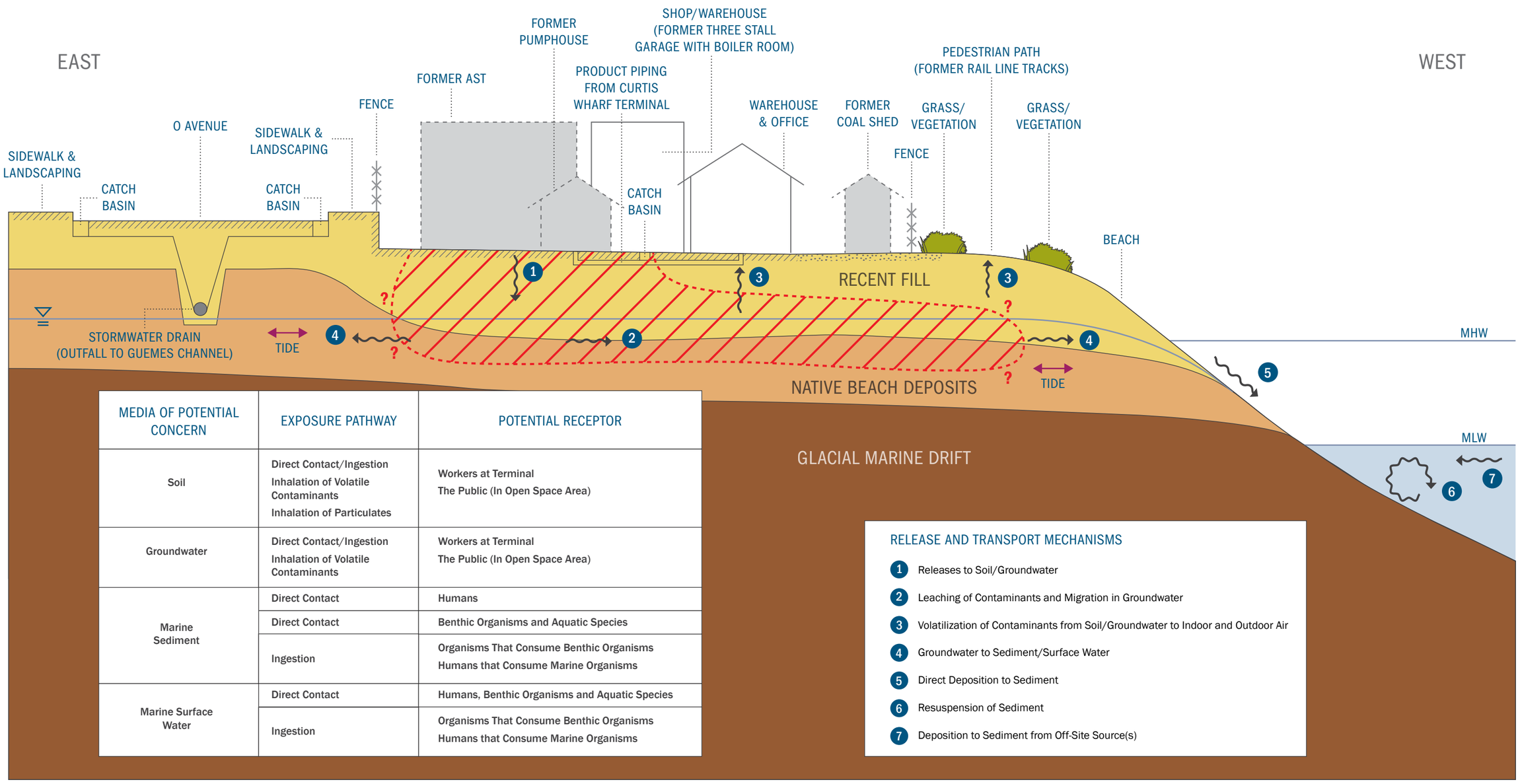
Previous Groundwater Sample Locations and Summary of Existing Data

Quiet Cove Property
Anacortes, Washington

GeoEngineers

Figure 5

P:\5\5147024\CAD\03\RI-FS Work Plan\5147024-03 Fig 5 Previous GW Sampling Locations.dwg TAB:LANDSCAPE Date Exported: 09/14/16 - 10:57 by tmichaud



MEDIA OF POTENTIAL CONCERN	EXPOSURE PATHWAY	POTENTIAL RECEPTOR
Soil	Direct Contact/Ingestion Inhalation of Volatile Contaminants Inhalation of Particulates	Workers at Terminal The Public (In Open Space Area)
Groundwater	Direct Contact/Ingestion Inhalation of Volatile Contaminants	Workers at Terminal The Public (In Open Space Area)
Marine Sediment	Direct Contact	Humans
	Direct Contact	Benthic Organisms and Aquatic Species
	Ingestion	Organisms That Consume Benthic Organisms Humans that Consume Marine Organisms
Marine Surface Water	Direct Contact	Humans, Benthic Organisms and Aquatic Species
	Ingestion	Organisms That Consume Benthic Organisms Humans that Consume Marine Organisms

RELEASE AND TRANSPORT MECHANISMS

1. Releases to Soil/Groundwater
2. Leaching of Contaminants and Migration in Groundwater
3. Volatilization of Contaminants from Soil/Groundwater to Indoor and Outdoor Air
4. Groundwater to Sediment/Surface Water
5. Direct Deposition to Sediment
6. Resuspension of Sediment
7. Deposition to Sediment from Off-Site Source(s)

Notes:

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Legend

- Groundwater Level
- Inferred Groundwater Flow Direction
- MHW Mean High Water
- MLW Mean Low Water
- Potential Contaminant Transport Pathway
- Contaminated Soil/ Groundwater (Conceptual)

Stratigraphy

- Asphalt/Concrete Paved Surface
- Gravel Paved Surface
- Recent Fill - Loose to Dense Sand with Occasional Gravel and Variable Silt Content
- Beach Deposits (Native) - Loose to Dense Sand with Occasional Gravel and Variable Silt Content
- Glacial Marine Drift (Native) - Hard Silt and Clay with Variable Sand and Silt Content

Not to Scale

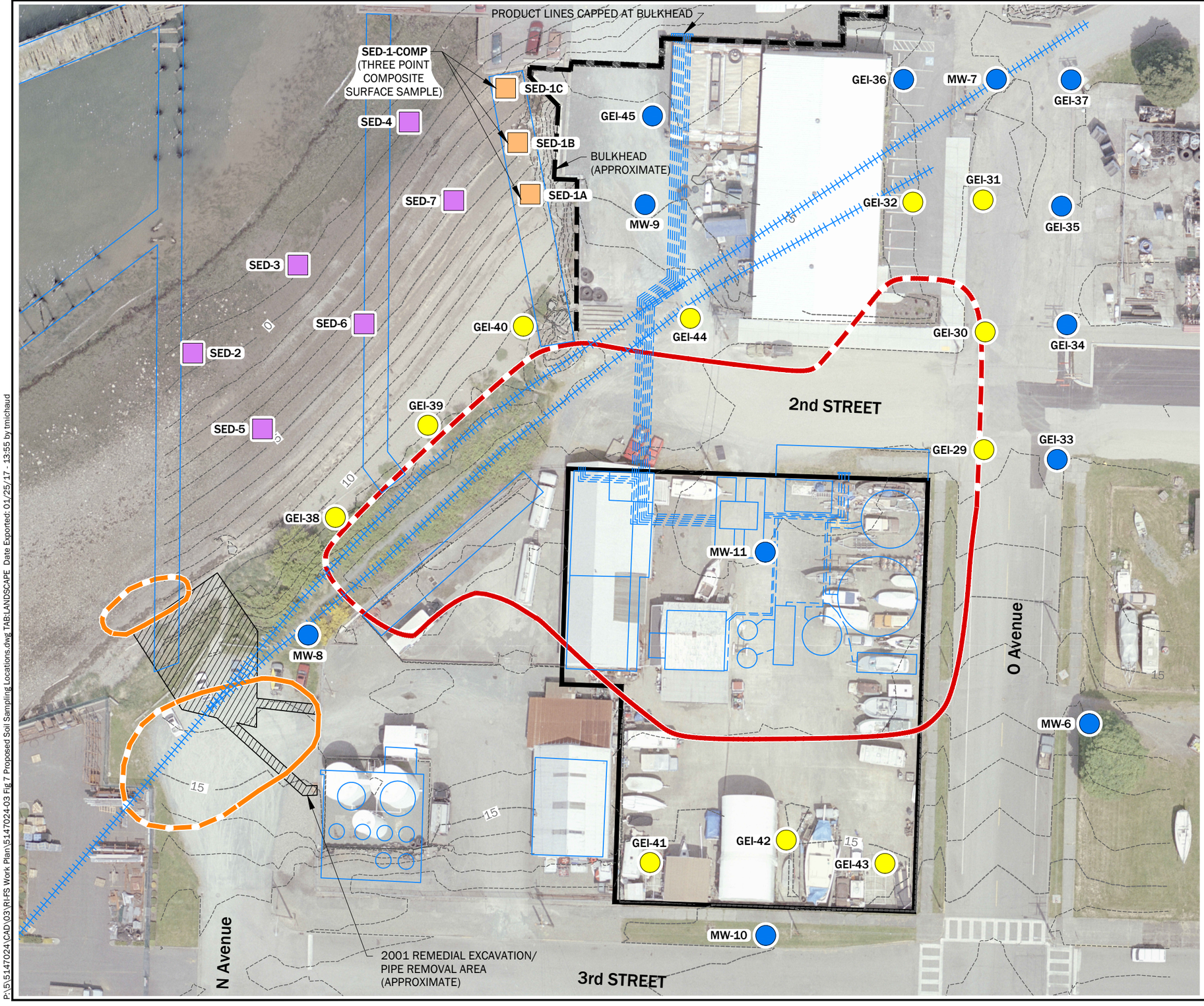
Preliminary Conceptual Site Model

Quiet Cove Property
Anacortes, Washington

GeoEngineers

Figure 6

P:\5\5147024\Graphics_Misc\Fig-6-Preliminary-Conceptual-Site-Model.ai Exported 5/19/2016 by spride



Legend

- Quiet Cove Property Boundary
- Historical Features
- Topographic Contour
- Quiet Cove Site Approximate Extent of Contaminated Soil (Defined by Existing Data)
- Approximate Extent of Contaminated Soil (Inferred from Existing Data)
- Off-Property Contaminant Sources Approximate Extent of Contaminated Soil (Defined by Existing Data)
- Approximate Extent of Contaminated Soil (Inferred from Existing Data)
- Proposed RI Sampling and Analysis* Proposed Location for Tier 1 Soil Analysis
- Proposed Location for Tier 2 Soil Analysis
- Proposed Location for Tier 1 Sediment Analysis
- Proposed Location for Tier 2 Sediment Analysis

*Refer to Table 8 for Sample Approach and Rationale. Refer to Tables 9 and 11 for Sample and Analysis Plan. Unless otherwise noted, borings will be advanced to at least three feet into native or fifteen feet below ground surface, whichever occurs first.

N W E S

50 0 50
FEET

Notes:

1. The locations of all features shown are approximate. A detailed layout of the Property and Bulk Fuel facilities is shown on the May 31, 1921 Standard Oil Engineers drawing presented in Appendix A.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication

Data Source: Base Aerial taken by David C. Smith & Associates, Inc. on 6/17/2009. Utility and topography provided by Port of Anacortes on 4/8/2016. Historical features are based on Sanborn Maps dated October 1925.

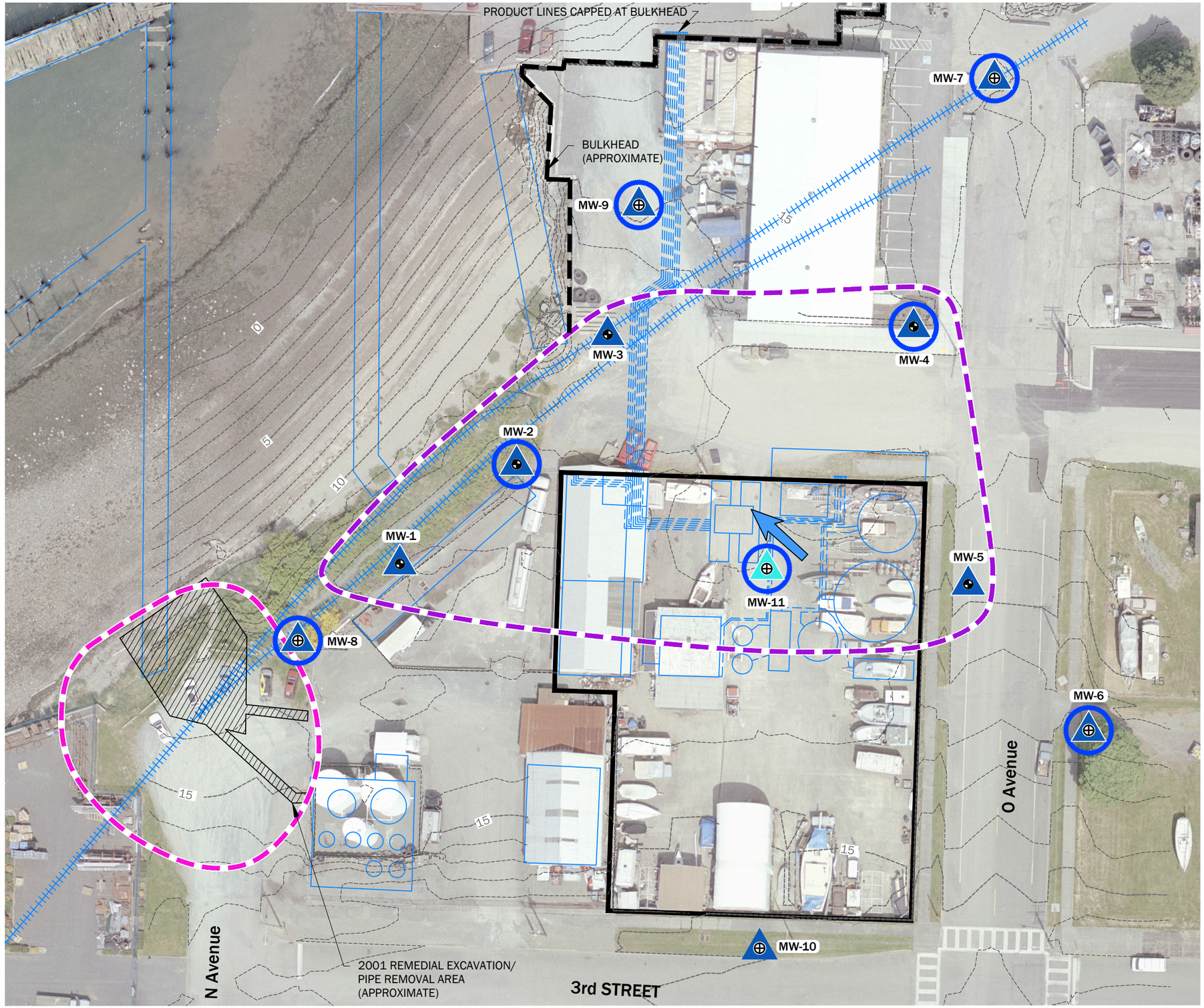
Proposed Soil and Sediment Remedial Investigation Sample Locations

Quiet Cove Property
Anacortes, Washington

GeoEngineers

Figure 7

P:\5\5147024\CAD\03\RI-FS Work Plan\5147024-03 Fig 7 Proposed Soil Sampling Locations.dwg TAB:LANDSCAPE Date Exported: 01/25/17 - 13:55 by tmichaud



Legend

- Quiet Cove Property Boundary
- Historical Features
- 10 — Topographic Contour
- MW-4 — Existing Monitoring Well Location
- MW-6 — Proposed Monitoring Well Location
- Inferred Groundwater Flow Direction
- Quiet Cove Site — Approximate Extent of Contaminated Groundwater (Inferred from Existing Data)
- Off-Property Contaminant Sources — Approximate Extent of Contaminated Groundwater (Inferred from Existing Data)
- Proposed RI Sampling and Analysis* — Proposed Location for Tier 1/Tier 2 Groundwater Analysis
- Proposed Location for Tier 2 Groundwater Analysis
- Proposed Location for Hydraulic Conductivity/Tidal Study

*Refer to Table 8 for Sample Approach and Rationale. Refer to Table 10 for Sample and Analysis Plan.

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FEET

Notes:

1. The locations of all features shown are approximate. A detailed layout of the Property and Bulk Fuel facilities is shown on the May 31, 1921 Standard Oil Engineers drawing presented in Appendix A.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication

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Proposed Groundwater Remedial Investigation Sample Locations

Quiet Cove Property
Anacortes, Washington

GeoEngineers

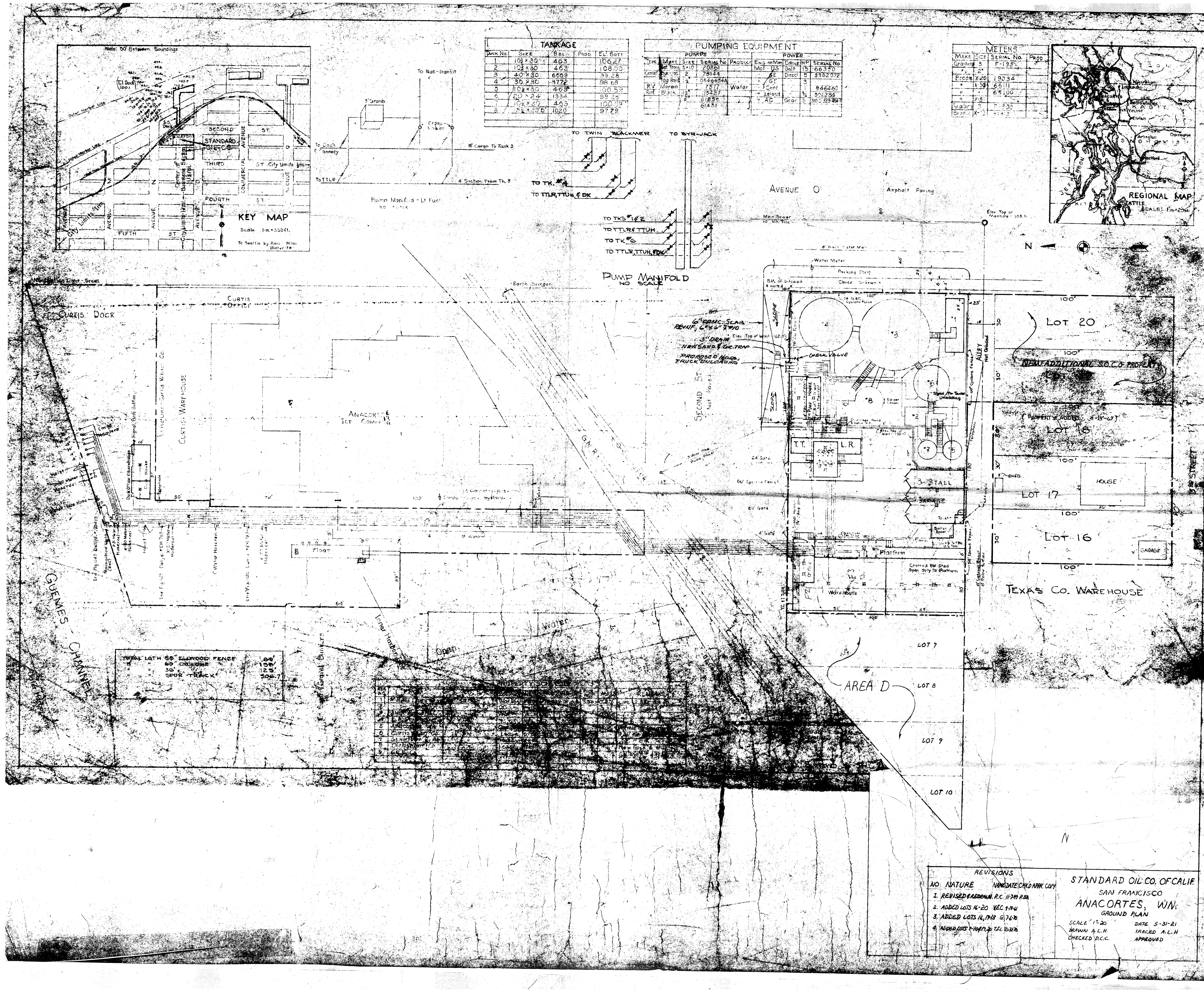
Figure 8

P:\5\5147024\CAD\03\RI-FS Work Plan\5147024-03 Fig 8 Proposed GW Sampling Locations.dwg TAB:LANDSCAPE Date Exported: 01/25/17 - 13:58 by tmichaud

APPENDICES

GeoEngineers

APPENDIX A
Standard Oil Engineering Drawing



TANKAGE

Tank No.	Size	Bbl.	Prod.	El. Bott.
1	10½×30	463		106.27
2	10½×30	463		108.00
3	40×30	6669		98.28
4	30×30	3772		98.68
5	10½×30	463		100.59
6	20×24	1334		99.28
7	10½×30	463		100.59
8	15½×29'6"	1020		97.79

PUMPING EQUIPMENT

Pumps					Power			
Type	Make	Size	Serial No.	Product	Eng. or Mot.	Drive	HP	Serial No.
	Nat. Trans	5×10	20861		Mot - U.S.	Belt	15	66350
Centrif.	Byr-Jac	2	78144		GE	Direct	5	3562972
	Ing. Rand	1½	0646654A		GE		3	
RV	Moraine	1	7577	Water	Cent			846460
Rot.	Black	1½	15427		Leland		¾	506284
		2	61256		AC	Gear	5	310-C-325-4547
			61451					

METERS

Make	Size	Serial No.	Prod.
Granberg	3	F-193	
"	2"		
Brodie	X-20	19034	
"	X-50	66111	
"	"	65100	
"	X-8		
Granberg	3	F-800	
Brodie	X-10	[illegible]	

TOTAL LGTH 58" ELLWOOD FENCE	89'
" " 60" CYCLONE	150'
" " 36" "	125'
" " SPUR TRACK	306.7'

PROPERTY SCHEDULE

Ref. No.	Owner		Type		Plat No.	Acres	Remarks
1	[illegible]	[illegible]	War. Deed	[illegible]	3.56	0.476	Lots 2 [illegible]
2	[illegible]		QC	[illegible]			Lot [illegible]
3	[illegible]		[illegible]				[illegible]
4	[illegible]		[illegible]				[illegible]
5	Anacortes [illegible]		[illegible]				[illegible]
6	Curtis Whf. Co.		Lease	[illegible]			[illegible]
7	Gt. Nor. [illegible] Ry Co.		[illegible]				[illegible]
8	Curtis Whf. Co.		Lease	[illegible]			New Dock [illegible]
9	G.N. Ry Co.		[illegible]				[illegible]

REVISIONS

No.	Nature	Name	Date	Chk'd	Appr.	Copy
1.	REVISED & REDRAWN	R.C.	11-7-49	R.B.A.		
2.	ADDED LOTS 16-20	V.E.C.	9-18-61			
3.	ADDED LOTS 16, 17 & 18	G.	7-6-70			
4.	ADDED LOTS 7-10 & 19, 20	T.F.L.	8-31-70			

STANDARD OIL CO. OF CALIF.
SAN FRANCISCO
ANACORTES, WN.
GROUND PLAN

SCALE 1"=20' | DATE 5-31-21
DRAWN A.L.H. | TRACED A.L.H.
CHECKED D.C.C. | APPROVED

APPENDIX B
Historical Photographs

Photocopy of photograph (Original print, Anacortes Museum.) Photographer unknown. Early view, c. 1905, looking north and east, before the construction of the Cement and Plaster Warehouse and the expansion of the wharf itself to the west. - Curtis Wharf, O & Second Streets, Anacortes, Skagit County, WA

Photo from Survey HABS WA-198-13

Historical Photograph – Circa 1905
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-1

Notes:
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Data Source: Library of Congress

Photocopy of photograph (Original print, Anacortes Museum.) Published in the Anacortes American, April 1907. Tacoma Engineering Company, Photographer. View to the north. On the right; early ticket office, south facade; behind it, a warehouse, east section of the present building; on the left, the original freight warehouse, the west section of the present building. Note wharf configuration in front of Ticket Office. - Curtis Wharf, O & Second Streets, Anacortes, Skagit County, WA

Photo from Survey HABS WA-198-14

Notes:

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

Data Source: Library of Congress

Historical Photograph – Circa 1907
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-2

Photocopy of photograph (Original print, Anacortes Museum.) The Standard Oil complex is forefront in this image with tanks, a Red Crown gasoline facility (part of Standard Oil) and Standard Oil Company offices in the lower right. Anacortes Iron Works (1019 3rd Street) is located behind the tanks at 3rd Street and O Avenue.

Notes:

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

Data Source: Anacortes Museum & Maritime Heritage Center

Historical Photograph – Circa 1909
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-2

Photocopy of photograph (Original print, Wallie V. Funk Collection.) Photographer unknown. Published in the Anacortes American, 12 October 1911; 'Plant of the Anacortes Ice Company and Curtis Dock.' Photograph probably earlier. View looking northwest, left to right; Cement and Plaster Warehouse; Ice Plant (with towers); Cold Storage Warehouse; Freight Warehouse; a warehouse; and early ticket office. - Curtis Wharf, O & Second Streets, Anacortes, Skagit County, WA

Photo from Survey HABS WA-198-15

Historical Photograph – Circa 1911
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-3

Notes:
1. This photo is for information purposes. It is intended to assist in showing Site and surrounding features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Library of Congress

Photocopy of photograph (Original print, Wallie V. Funk Collection.) Photographer unknown. Published in the Anacortes American, 19 March 1914, 'Curtis Wharf Company Handles City's Extensive Maritime Traffic.' View looking northeast. In the foreground, the Standard Oil Dock; behind it, the west side of the main dock. In the center, west facade, Hay and Grain Warehouse (Bottling Works not yet built.) To the right, Feed Mill. Note coal bin at northwest corner of the Hay and Grain Warehouse. - Curtis Wharf, O & Second Streets, Anacortes, Skagit County, WA

Photo from Survey HABS WA-198-16

Historical Photograph – Circa 1914
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-4

Notes:
1. This photo is for information purposes. It is intended to assist in showing Site and surrounding features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Library of Congress

Photocopy of photograph (Original print, Anacortes Museum.) Photographer unknown, c. 1915. View to the northeast, west side of main wharf in the background. Right to left: Cement and Plaster Warehouse (labelled 'Curtis Wharf Warehouse #2'); Feed Mill; and Bottling Works, with the Sand and Gravel Wharf across from it, to the left. - Curtis Wharf, O & Second Streets, Anacortes, Skagit County, WA

Photo from Survey HABS WA-198-17

Notes:

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Data Source: Library of Congress

Historical Photograph – Circa 1915
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-5

Photocopy of photograph (Original print, Wallie V. Funk Collection.) Photographer unknown, c. 1920. View looking north, ferry slip in the center; to the right is the main wharf. Buildings on the main wharf, right to left: 'Ferry Cigar Stand,' no longer extant; Feed Mill; Bottling Works (with dormer). On the left, the Sand and Gravel Wharf. - Curtis Wharf, O & Second Streets, Anacortes, Skagit County, WA

Photo from Survey HABS WA-198-18

Notes:

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Data Source: Library of Congress

Historical Photograph – Circa 1920
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-6

Photocopy of photograph (Original print, Wallie V. Funk Collection.) Photographer unknown, c. 1928. View looking north: ferry slip in the center. To the right is the south facade of the Feed Mill; to the left, the Sand and Gravel Wharf. - Curtis Wharf, O & Second Streets, Anacortes, Skagit County, WA

Photo from Survey HABS WA-198-19

Notes:

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Data Source: Library of Congress

Historical Photograph – Circa 1928
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-7

Photocopy of photograph (Original print, Wallie V. Funk Collection.) Photographer unknown, c. 1934. Northwest corner of the main dock, west facade of the Freight Warehouse to the right. Passengers embarking onto the twinstack single screw 'Tacoma,' travelling to Victoria on the Puget Sound Navigation Company's 'Black Ball' line. - Curtis Wharf, O & Second Streets, Anacortes, Skagit County, WA

Photo from Survey HABS WA-198-20

Notes:

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Data Source: Library of Congress

Historical Photograph – Circa 1934
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-8

Panoramic view, city of Anacortes, from the top of a tanker barge at the Port of Anacortes. View looking southwest. - Curtis Wharf, O & Second Streets, Anacortes, Skagit County, WA.

Photo from Survey HABS WA-198-01

Historical Photograph – Circa 1970s
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-9

Notes:
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Data Source: Library of Congress

Panoramic view, Curtis Wharf, from the top of a tanker barge at the Port of Anacortes. View looking south. - Curtis Wharf, O & Second Streets, Anacortes, Skagit County, WA

Photo from Survey HABS WA-198-02

Notes:

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Data Source: Library of Congress

Historical Photograph – Circa 1970s
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-10

Panoramic view, Guemes Channel, from the top of a tanker barge at the Port of Anacortes. View looking southeast. - Curtis Wharf, O & Second Streets, Anacortes, Skagit County, WA

Photo from Survey HABS WA-198-03

Notes:

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Data Source: Library of Congress

Historical Photograph – Circa 1970s
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-11

East side of Curtis Wharf, as seen from the pier at the Port of Anacortes. View looking south and west. - Curtis Wharf, O & Second Streets, Anacortes, Skagit County, WA

Photo from Survey HABS WA-198-04

Notes:

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Data Source: Library of Congress

Historical Photograph – Circa 1970s
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-12

Freight Warehouse, east facade, on the right; east facade and southeast corner of Ticket Office on the left. - Curtis Wharf, O & Second Streets, Anacortes, Skagit County, WA

Photo from Survey HABS WA-198-05

Notes:

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Data Source: Library of Congress

Historical Photograph – Circa 1970s
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-13

Looking into the inner court. Left to right: Cold Storage Warehouse, east facade; Freight Warehouse, south facade; Ticket Office, southwest corner. - Curtis Wharf, O & Second Streets, Anacortes, Skagit County, WA

Photo from Survey HABS WA-198-06

Notes:

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Data Source: Library of Congress

Historical Photograph – Circa 1970s
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-14

View looking south and west along the railroad right-of-way. Cement and Plaster Warehouse on the left; Creamery on the right. - Curtis Wharf, O & Second Streets, Anacortes, Skagit County, WA

Photo from Survey HABS WA-198-07

Notes:

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Data Source: Library of Congress

Historical Photograph – Circa 1970s
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-15

"Rephotographic" of WA-198-18. Directly north, in the center, is the ferry slip; on the right, west side of main dock; on the left, the Sand and Gravel Wharf - Curtis Wharf, O & Second Streets, Anacortes, Skagit County, WA

Photo from Survey HABS WA-198-10

Notes:

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Data Source: Library of Congress

Historical Photograph – Circa 1970s
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-16

Panoramic view, Guemes Channel, from the top of a tanker barge at the Port of Anacortes. View looking southeast. - Curtis Wharf, O & Second Streets, Anacortes, Skagit County, WA

Photo from Survey HABS WA-198-03

Notes:

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Data Source: Library of Congress

Historical Photograph – Circa 1970s
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-17

View east into the inner court between the Freight Warehouse and the Cold Storage Warehouse from the Sand and Gravel Wharf. Ferry slip is in the foreground. - Curtis Wharf, O & Second Streets, Anacortes, Skagit County, WA

Photo from Survey HABS WA-198-11

Notes:

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Data Source: Library of Congress

Historical Photograph – Circa 1970s
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-18

Photocopy of photograph (Original print, Port of Anacortes.) Brady's Anacortes Studio, Photographer, date unknown. Overview of Curtis Wharf. North section of main dock is intact; Sand and Gravel Wharf on the right. - Curtis Wharf, O & Second Streets, Anacortes, Skagit County, WA

Photo from Survey HABS WA-198-12

Notes:

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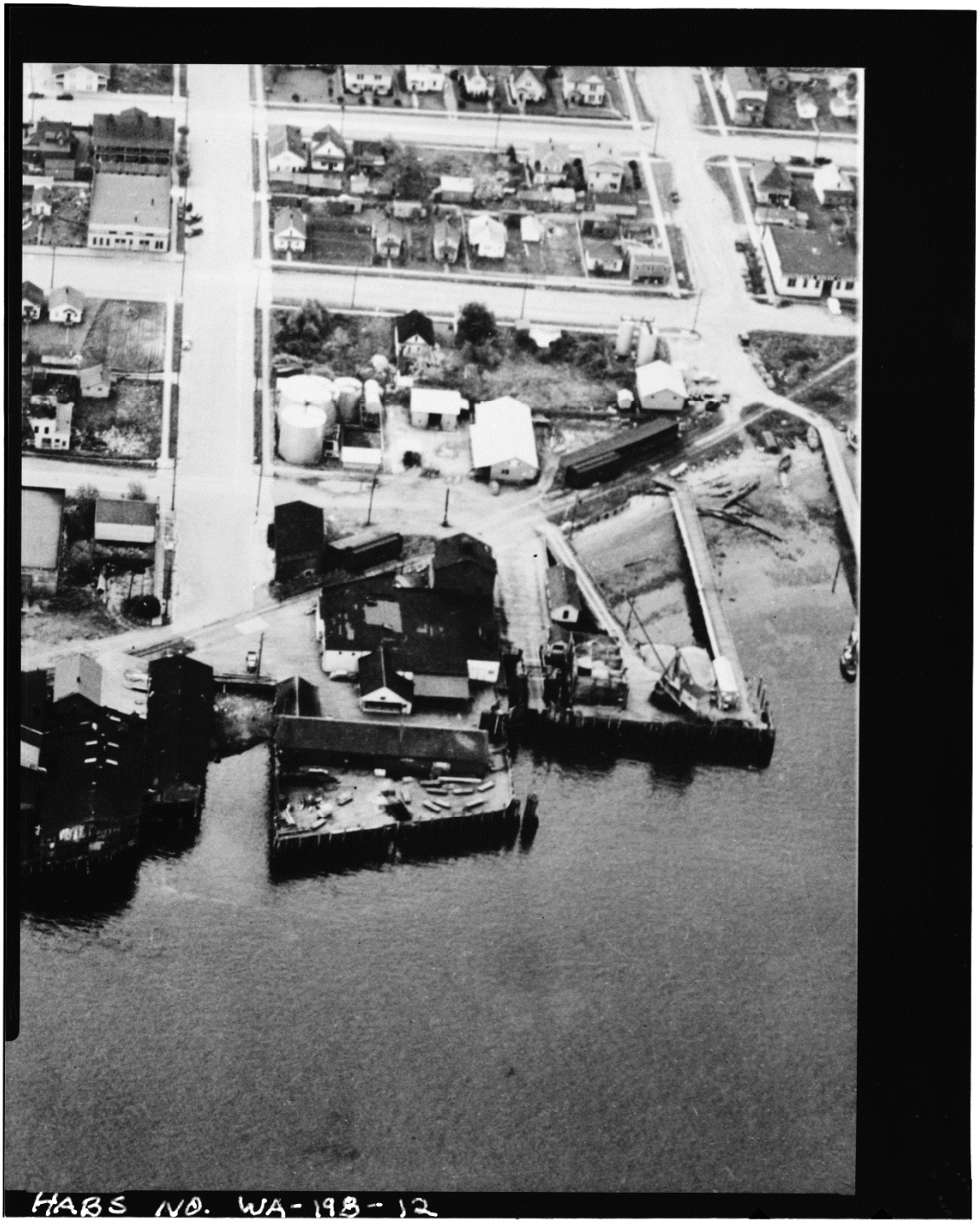
Data Source: Library of Congress

Historical Photograph – Circa 1970s
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-19



Photocopy of photograph (Original print, Port of Anacortes.) Brady's Anacortes Studio, Photographer, date unknown. Overview of Curtis Wharf and surrounding area. North section of main dock is intact; Sand and Gravel Wharf on the right. - Curtis Wharf, O & Second Streets, Anacortes, Skagit County, WA

Photo from Survey HABS WA-198-12

Aerial Photograph – Circa 1920s
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-20

Notes:
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Data Source: Library of Congress

Overview of Quiet Cove and surrounding area. Reisner Petroleum Terminal to the south of Curtis Wharf is intact; Standard Oil Facility and railroad line in central potion of photograph. - O & Second Streets, Anacortes, Skagit County, WA

Photo from Anacortes Museum & Heritage Center

Aerial Photograph – Circa 1971
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-21

Notes:
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Data Source: Anacortes Museum & Heritage Center

Overview of Quiet Cove and surrounding area. Reisner Petroleum Terminal to the southwest of Curtis Wharf is no longer intact; Standard Oil Facility and railroad line in central potion of photograph. - O & Second Streets, Anacortes, Skagit County, WA

Photo from Washington State Deportment of Ecology Coastal Atlas
https://fortress.wa.gov/ecy/coastalatlas/tools/ShorePhotos.aspx

Aerial Photograph – Circa 1977
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-22

Notes:
1. This photo is for information purposes. It is intended to assist in showing Site and surrounding features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Washington State Deportment of Ecology Coastal Atlas

Overview of Quiet Cove and surrounding area. Standard Oil Facility and railroad line is no longer intact. - O & Second Streets, Anacortes, Skagit County, WA

Photo from Washington State Deportment of Ecology Coastal Atlas
https://fortress.wa.gov/ecy/coastalatlas/tools/ShorePhotos.aspx

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Data Source: Washington State Deportment of Ecology Coastal Atlas

Aerial Photograph – Circa 1994
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-23

Overview of Quiet Cove and surrounding area - O & Second Streets, Anacortes, Skagit County, WA

Photo from Washington State Deportment of Ecology Coastal Atlas
https://fortress.wa.gov/ecy/coastalatlas/tools/ShorePhotos.aspx

Notes:
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Data Source: Washington State Deportment of Ecology Coastal Atlas

Aerial Photograph – Circa 2001
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-24

Overview of Quiet Cove and surrounding area - O & Second Streets, Anacortes, Skagit County, WA

Photo from Washington State Deportment of Ecology Coastal Atlas
https://fortress.wa.gov/ecy/coastalatlas/tools/ShorePhotos.aspx

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Data Source: Washington State Deportment of Ecology Coastal Atlas

Aerial Photograph – Circa 2006
Quiet Cove and Surrounding Area

Quiet Cove Site
Anacortes, Washington

GeoEngineers

Figure B-25

APPENDIX C
Sampling and Analysis Plan

FINAL Sampling and Analysis Plan

Quiet Cove Property
Anacortes, Washington
Ecology Agreed Order No. DE 11346

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

January 25, 2017

GeoEngineers
Earth Science + Technology

FINAL Sampling and Analysis Plan

Quiet Cove Property
Anacortes, Washington
Ecology Agreed Order No. DE 11346

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

January 25, 2017

GeoEngineers

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FINAL Sampling and Analysis Plan

Quiet Cove Property
Anacortes, Washington
Ecology Agreed Order No. DE 11346

File No. 5147-024-03

January 25, 2017

Prepared for:

Washington State Department of Ecology
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On Behalf of:

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Table of Contents

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

Acronym/ Abbreviation	Description
AFDW	ash-free dry-weight
ARI	Analytical Resources, Inc.
ASTM	ASTM International
bgs	below ground surface
COC	chain-of-custody
COPC	contaminant of potential concern
cPAH	carcinogenic polycyclic aromatic hydrocarbons
DMMP	Dredged Material Management Program
DP	direct-push
DQO	data quality objective
Ecology	Washington State Department of Ecology
EDD	electronic data deliverable
EIM	Environmental Information Management system
EPA	United States Environmental Protection Agency
EPH	extractable petroleum hydrocarbon
eV	electron volt
Frontier	Frontier Analytical Laboratory
FS	feasibility study
GeoEngineers	GeoEngineers, Inc.
GPS	global positioning system
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HPAHs	high molecular weight polycyclic aromatic hydrocarbons
HR/MS	high-resolution mass spectrometry
HSA	hollow-stem auger
KM	Kaplan-Meier
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LPAHs	low molecular weight polycyclic aromatic hydrocarbons

MDL	method detection limit
mg/kg	milligrams per kilogram
MLLW	mean lower low water
MRL	method reporting limit
MS	matrix spike
MSD	matrix spike duplicate
MTCA	Model Toxics Control Act
NAD	North American Datum
NTU	nephelometric turbidity unit
Order	Ecology Agreed Order No. DE 11346
OSHA	Occupational Safety and Health Administration
PAH	polycyclic aromatic hydrocarbon
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PCB	polychlorinated biphenyl
PID	photoionization detector
Port	Port of Anacortes
PPE	personal protective equipment
ppm	part per million
%D	percent difference
%R	percent recovery
PQL	practical quantitation limit
psi	pounds per square inch
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RI	remedial investigation
RL	reporting limit
RPD	relative percent difference
SAP	Sampling and Analysis Plan
Site	Quiet Cove Site
SMS	Sediment Management Standards
SOP	standard operating procedure

SVOC	semi-volatile organic compound
TEF	toxicity equivalency factor
TEQ	toxicity equivalent (refers to concentration basis)
TOC	total organic carbon
TRL	target reporting limit
TS	total solids
TVS	total volatile solids
TWIC	Transportation Worker Identification Credential
USCGS	United States Coast and Geodetic Survey
VOC	volatile organic compound
VPC	volatile petroleum compound
VPH	volatile petroleum hydrocarbon
WAC	Washington Administrative Code
WHO	World Health Organization

1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) has been prepared for sampling and analytical activities that will be completed as part of Remedial Investigation (RI) activities for the Quiet Cove Site (Site). The Site is a cleanup site included in the Washington State Department of Ecology's (Ecology) Puget Sound Initiative and is being addressed through an Ecology-issued Agreed Order No. DE 11346 (Order). This SAP has been prepared as required by the Agreed Order in accordance with sampling requirements in Washington Administrative Code (WAC) 173-340-820 and under the Sediment Management Standards (SMS; Chapter 173-204 WAC). This SAP supports the Remedial Investigation/Feasibility Study (RI/FS) Work Plan that details the historical property use, environmental and ecological setting, previous environmental investigations, and current Site conditions and the overall RI/FS approach and rationale to evaluate the Site contamination.

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

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

2.0 PROJECT AND TASK DESCRIPTION

2.1. Project Description and Objectives

Field investigations will be completed to characterize the nature and extent of hazardous substances in areas where historical uses may have resulted in a release to the environment. RI activities will include the following:

- Characterization of the geology/stratigraphy including: nature and extent of fill materials (i.e., soil fill, wood fill, construction debris such as concrete and brick, etc.) and nature and depth to native soil (i.e., depth to native materials underlying the fill);
- Characterize the groundwater gradient and flow direction, and evaluate the hydraulic connection between groundwater and adjacent marine surface water; and
- Characterization of the nature and extent of hazardous substances in media of concern.

Environmental data gathering for the RI will follow a tiered approach consisting of an initial investigation and follow-up analyses of archived samples or additional investigations as described in the RI/FS Work Plan. Sample locations and laboratory analyses that will be completed are detailed in the RI/FS Work Plan. The following sections describe the field procedures to be utilized during the RI.

2.1.1. Physical and Chemical Testing

Samples will be submitted for analysis of hazardous substances based on proximity to specific past Site activities and previous sample results. Selected samples obtained as part of the RI will be submitted to Analytical Resources, Inc. (ARI) of Tukwila, Washington, for all or a subset of the following analytes:

- Grain size;
- Total organic carbon (TOC);
- Total volatile solids (TVS);
- Total solids (TS)
- Bulk/porewater ammonia;
- Bulk/porewater sulfides;
- Metals;
- Gasoline-, diesel- and heavy oil-range petroleum hydrocarbons;
- Volatile petroleum compounds (VPCs)
- Volatile organic compounds (VOCs)
- Semi-volatile organic compounds (SVOCs);

In addition, samples to be analyzed by high-resolution mass spectrometry (HR/MS) will be submitted to Frontier Analytical Laboratory (Frontier) of El Dorado Hills, California, for any combination of the following:

- Polychlorinated biphenyl's (PCBs); and
- Dioxins and furans.

Samples not initially selected for analyses for hazardous substances from a specific location will be archived for potential future analysis to adequately characterize the nature and extent of contamination following review of the initial sample results. The extraction of porewater from sediment samples for analysis will be performed by the laboratory in accordance with Dredged Material Management Program (DMMP) procedures (DMMP, 1998). Porewater analysis will only be performed on Tier 1 samples (i.e., porewater will not be archived due to sample holding time constraints).

2.1.2. Biological Testing

Ecology may require, or the Port may choose to perform, biological testing on surface sediment samples to better define potential toxic effects of hazardous substances identified in sediment in accordance with SMS. Sample locations, timing, sampling procedures, laboratory protocol and performance criteria for bioassays to further evaluate site-specific toxicity will be presented in an addendum to the RI/FS Work Plan and submitted to Ecology for review and approval prior to sampling. A subsequent field effort will be performed to collect surface sediment samples for bioassay testing. The samples for bioassay testing will be collected at the previous sample locations to the extent practical so that the results from previous chemical analyses can be utilized to characterize the sediment that is to undergo bioassay testing.

2.1.3. Sediment/Tissue Study

A paired tissue/sediment study may be performed by the Port to provide data for a site-specific human health and ecological receptor risk evaluation on bioaccumulative chemicals exceeding sediment screening levels. The paired tissue/sediment study and subsequent evaluation would determine the risk from dioxins/furans, carcinogenic PAHs (cPAHs), PCBs, mercury, arsenic, cadmium and/or lead at this Site and will include congener data for dioxins/furans and PCBs. In addition, other bioaccumulative chemicals of concern may be identified and evaluated in human and/or ecological risk assessments based on data collected during the initial data results and following procedures outlined in WAC 173-204-564(2)(c)(iii).

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

3.0 DATA QUALITY OBJECTIVES

The primary DQO for this RI is to collect environmental sampling data of known, acceptable, and documentable quality. The specific objectives established for the project are:

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

3.1. Chemical Quality Objectives

The sampling design, field procedures, useable laboratory procedures, and QC procedures established for this project were developed to provide defensible data. Specific factors that may affect data usability include quantitative factors (precision, bias, accuracy, completeness, and reporting limits) and qualitative factors such as representativeness and comparability. The specific DQOs associated with these data quality factors are discussed below. Method-specific DQOs for chemical laboratory analyses are presented in Tables C-1 through C-3.

3.1.1. Analytical Detection Limits

Analytical methods have quantitative limitations at a given statistical level of confidence that are often expressed as the method detection limit (MDL). Although results reported near the MDL provide insight for sediment conditions, quality assurance dictates that analytical methods achieve a consistently reliable level of detection known as the practical quantitation limit (PQL), which is typically demonstrated with the lowest point of a linear calibration. The contract laboratory will provide numerical results for all analytes and report them as detected above the PQL or undetected at the PQL.

The PQLs for contaminants of potential concern (COPCs) provided by the Ecology-certified laboratory contract laboratory (ARI) are presented in Table C-4 for soil and groundwater, and Table C-5 for sediment. The PQLs presented in Tables C-4 and C-5 are considered target reporting limits (TRLs) because several factors may influence final reporting limits. First, moisture and other physical conditions of sediment affect detection limits. Second, analytical procedures may require sample dilutions or other practices to quantify a particular analyte at concentrations above the range of the instrument. The effect is that other analytes could be reported as undetected but at a value higher than a specified TRL. Data users must be aware that high non-detect values, although correctly reported, can bias statistical summaries and careful interpretation is required to correctly characterize subsurface conditions.

3.1.2. Precision

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

Where

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

D_1 = Concentration of analyte in primary sample.

D_2 = Concentration of analyte in duplicate sample.

The calculation applies to split samples, replicate analyses, duplicate spiked environmental samples (matrix spike duplicates), and laboratory control duplicates. The RPD will be calculated for samples and compared to the applicable criteria. Precision can also be expressed as the percent difference (%D) between replicate analyses. Project RPD goals for all analyses are presented in Tables C-1 through C-3, unless the primary and duplicate sample results are less than 5 times the method reporting limit (MRL), in which case RPD goals will not apply for data quality assessment purposes.

3.1.3. Accuracy

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

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

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

Accuracy (%R) criteria for surrogate spikes, matrix spikes, and laboratory control samples (blank spikes) are presented in Tables C-1 through C-3.

3.1.4. Representativeness, Completeness, and Comparability

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

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

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

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

3.1.5. Holding Times

Holding times are defined as the time between sample collection and extraction, sample collection and analysis, or sample extraction and analysis. Recommended holding times are presented in Tables C-6 through C-8. If the analysis of an archived sample is required but the sample exceeds the respective holding time, either discard the sample and collect a new representative sample for analysis and/or consult with Ecology to determine if the sample may still be used.

3.1.6. Quality Control Blank Samples

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

Analytical results for QC blanks will be interpreted in general accordance with EPA's National Functional Guidelines for Organic (EPA, 2008) and Inorganic Data (EPA, 2004) Review and professional judgment. QC blank samples are discussed further in Section 4.12.

4.0 DATA GENERATION AND ACQUISITION

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

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

4.1. Sample Process Design

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

4.2. Sampling Methods

The RI will characterize the nature and extent of contamination at the Site. RI activities will include soil, groundwater and sediment sample collection for potential laboratory analysis. The RI sampling locations, approach and rationale are described in RI/FS Work Plan. Sampling methods for soil, groundwater and sediment are presented in the following sections.

4.2.1. Soil Investigation

The soil investigation will consist of completing hollow-stem auger (HSA) and direct-push (DP) borings. Information obtained from previous investigations was used to support selection of the soil sample locations. Soil borings will be used to characterize Site stratigraphy and to collect soil samples for chemical analyses. Prior to the completion of any soil exploration, underground utilities will be located (public and private) in the area of the proposed exploration locations. An air knife (vacuum truck) may be used to clear soil from the surface to approximately 5 feet below ground surface (bgs) at selected exploration locations if utilities are not able to be clearly identified. If an air knife is used to clear drilling locations, a hand auger will be used to attempt to collect samples from the near-surface soils.

Soil boring and soil sample collection methods to be used during the RI investigation are described below. Soil cuttings from borings completed for the soil sampling activities will be placed in labeled and sealed 55-gallon drums. The drums will be stored temporarily at a secure location on Port of Anacortes (Port) property pending receipt of analytical results and off-site disposal at a permitted facility.

4.2.1.1. Hollow-stem Auger Borings

HSA borings for obtaining soil samples will be drilled using a truck-mounted HSA drilling rig. It is anticipated that the HSA borings at the Site will be advanced at least 3 feet into the native soil or to approximately 15 feet bgs, whichever occurs first. If evidence of petroleum contamination is observed, the boring will be advanced to at least 3 feet below the observed depth of contamination, or until refusal. HSA borings will be completed by a licensed driller in the State of Washington. A representative from GeoEngineers, Inc.'s

(GeoEngineers) staff will be present to examine and classify the soils encountered and prepare a detailed log of each exploration (i.e., boring log).

Soil samples will be obtained from the HSA borings on a 2.5-foot interval using a 2.5-inch-diameter split-barrel sampler or equivalent. The sampler will be advanced a maximum of 18 inches at each sample interval. The number of hammer blows to advance the sampler will be recorded on a boring log across 6-inch intervals. Soil recovered from each sample interval will be visually classified in general accordance with ASTM International (ASTM) D-2488 and screened in the field for the presence of contamination. The absence or presence of wood debris will also be recorded on a boring log. If wood debris is present, the type or types of wood debris (i.e., saw dust, bark, chips, chunks, twigs, fibers, etc.), the estimated quantity (i.e., observed percent by volume) of each wood type, and the depth interval where the wood is observed will be recorded on a boring log form. Field screening will consist of visual observation for the presence of contamination (i.e., staining, discoloration, etc.), water sheen testing (i.e., petroleum hydrocarbons), and organic vapor monitoring. Field screening procedures are discussed further in Section 4.3. Observations of soil and groundwater conditions and soil field screening results for each exploration will be included on the boring log.

4.2.1.2. Direct-Push Borings

DP borings for obtaining soil samples will be drilled using a truck-mounted direct-push drilling rig. It is anticipated that the DP borings at the Site will be advanced at least three feet into the native soil or to approximately 15 feet bgs, whichever occurs first. If evidence of petroleum contamination is observed, the boring will be advanced to at least three feet below the observed depth of contamination, or until refusal. DP borings will be completed by a licensed driller in the State of Washington. A representative from GeoEngineers' staff will be present to examine and classify the soils encountered and prepare a detailed boring log of each exploration.

Continuous soil samples in 2-foot intervals will be obtained from the DP borings using a "macrocore" sampler or equivalent in direct pushes up to 5 feet in length. Push length may be reduced if recovery is poor. Soil from each sample interval will be visually classified, field screened and logged in the same manner as described in Section 4.2.1.1 above.

4.2.1.3. Hand Auger Borings

A hand auger will be used at boring locations in which an air knife is used to clear utilities where they are not clearly identified. Soil from each sample interval will be visually classified, field screened and logged in the same manner as described in Section 4.2.1.1.

4.2.1.4. Soil Sample Collection and Chemical Analysis

Samples will be collected that are representative of contaminated or potentially contaminated materials and/or different material types. A minimum of three soil samples will be retained from each boring for laboratory analysis. Samples collected from the borings not submitted for chemical analysis will be archived for potential follow-up testing.

At least one soil sample will be collected from each location from the fill, vadose zone/saturated zone interface (i.e., from the water table) observed at the time of sampling, and native soil horizon. The native soil sample will be collected from a depth of at least 1 foot below the fill/native soil interface to ensure that the sample is representative of native material. If field screening (i.e., visual observation of staining, sheen, measurement of VOCs, etc.) indicates the presence of potentially contaminated soil, additional samples

may be collected for chemical analysis to characterize the nature and extent of contamination. Selected samples for chemical analysis will be based on a review of the boring logs, material type, and field screening results.

Sample intervals will be individually homogenized and placed into the appropriate laboratory-supplied sample containers. Samples for volatile analysis (i.e., gasoline, VPCs and/or VOCs) will be collected from the center of the sampling interval from undisturbed soil sample prior to homogenization using EPA Method 5035A sampling procedures consistent with Ecology guidance to reduce volatilization and biodegradation of the sample constituents. Immediately upon collection of the samples, the samples will be placed into a cooler with ice and logged on the chain-of-custody using quality assurance and control procedures described in Section 4.8.

To evaluate the presence of multiple sources of petroleum hydrocarbons, selected samples may be submitted for volatile petroleum hydrocarbon (VPH) or extractable petroleum hydrocarbon (EPH) analysis based on the initial soil investigation results. The petroleum hydrocarbon analysis results will be reviewed to identify samples with concentrations greater than 200 milligrams per kilogram (mg/kg) gasoline-range petroleum hydrocarbons and 2,000 mg/kg diesel- or heavy oil-range petroleum hydrocarbons. In addition, chromatograms for samples with elevated petroleum hydrocarbons will be reviewed to identify petroleum signatures (i.e., finger printing) for potential sources.

4.2.2. Groundwater Investigation

Groundwater samples will be collected from new and existing Site monitoring wells for chemical analysis of hazardous substances as identified in Table 8. Information obtained from previous investigations was used to support selection of the groundwater sample locations.

Procedures for monitoring well installation, well development, water level measurement and groundwater sample collection are described in the following sections.

4.2.2.1. Monitoring Well Construction

Drilling and construction of the monitoring wells will be conducted by a Washington State licensed driller in general accordance with the Minimum Standards for Construction and Maintenance of Wells (WAC 173-160). It is anticipated that the monitoring wells will be completed least 5 feet below the observed water level at the time of drilling. Installation of the monitoring wells will be observed by a GeoEngineers representative who will maintain a detailed log of the materials observed and depths of the wells. Monitoring well borings will be drilled using a truck mounted HSA drill rig or similar equipment. Soil cuttings from borings completed for the monitoring well installation will be placed in labeled and sealed 55-gallon drums. The drums will be stored temporarily at a secure location on Port property pending receipt of analytical results and off-site disposal at a permitted facility.

Wells will be constructed of 2-inch-diameter, flush-threaded, Schedule 40 polyvinyl chloride (PVC) casing with machine-slotted PVC screen (0.010-inch). The top of the well screens will be located approximately 5 feet above the observed groundwater level, or within 3 feet of the ground surface, whichever is deeper. The wells' location and the potential for influence on groundwater levels in the well from changes in water levels relative to adjacent marine surface water will be considered when placing the well screen. The well screen intervals may be modified based on field screening results or variations in soil type. Screened intervals of approximately 10 to 15 feet in length are anticipated.

Following placement of the well screen and casing in the borehole, a filter pack will be installed around the well screen. The filter pack will extend from the bottom of the well to approximately 2 feet above the top of the well screen. It is anticipated that filter pack material will consist of commercially prepared 10-20 silica sand. However, an alternate sand size/gradation may be used to minimize the turbidity of water entering the wells depending on the materials observed at the time of drilling.

A bentonite annular seal at least 1-foot thick will be placed above the sand pack to a depth of about 1 foot bgs. Each well will be completed with a concrete surface seal, and either a flush-mount or above-ground steel or aluminum monument. The monument will be cemented in place from the surface to a depth of about 1 foot bgs.

4.2.2.2. Monitoring Well Development

Each monitoring well will be developed to remove water introduced into the well during drilling (if any), stabilize the filter pack and formation materials surrounding the well screen, and restore the hydraulic connection between the well screen and the surrounding soil. The well screen interval will be gently surged with a decontaminated bailer or surge block and the well will be purged of water.

Development will continue until a minimum of five casing volumes of water have been removed and turbidity of the discharged water is relatively low. The goal of well development will be to reduce the turbidity content of the water to approximately 10 nephelometric turbidity unit (NTU) if practical. Up to 10 well volumes of water will be removed from the wells in an effort to attain the 10 NTU goal. The removal rate and volume of groundwater removed will be recorded during well development procedures. Water that is removed from the well during well development activities will be stored temporarily at a secure location on Port property in labeled 55-gallon drums, pending receipt of analytical results and off-site disposal at a permitted facility. Depths to water in the monitoring wells will be measured prior to development.

4.2.2.3. Water Level Measurements

Prior to groundwater sampling, a groundwater level "snapshot" will be performed by measuring water levels in all wells within an approximate one hour duration. Water levels will be measured using an electronic water level indicator and will be recorded to the nearest 0.01 foot. The measurement point will be the north rim of the top of the well casing. Well casing and ground surface elevations will be referenced from temporary or permanent benchmarks as described in Section 4.4.

4.2.2.4. Groundwater Sampling

Sampling of monitoring wells located adjacent to the shoreline (i.e., tidally influenced wells) will be performed within one hour before and three hours after the day-time low tide to the extent practicable. Wells nearest the shoreline will be sampled first. Groundwater samples will be obtained by field personnel using low-flow/low-turbidity sampling techniques (EPA, 2010) to minimize the suspension of sediment in the samples. The wells will be purged and groundwater samples will be obtained from the wells using a peristaltic or submersible pump and disposable polyethylene tubing. Groundwater will be purged from the wells at a rate not to exceed 0.5 liter per minute. A Horiba U-50 (or similar) water quality measuring system with a flow-through cell will be used to monitor the following water quality parameters during purging:

- Electrical conductivity;
- Dissolved oxygen;
- pH;

- Salinity;
- Turbidity;
- Total dissolved solids;
- Oxidation-reduction potential; and
- Temperature.

Samples will be collected from the wells after these parameters vary by less than 10 percent on three consecutive measurements or after five well volumes have been removed, whichever occurs first. The field measurements will be documented on the field log.

Groundwater samples will be collected in laboratory-supplied containers, placed into a cooler with ice and logged on the chain-of-custody using quality control and assurance procedures described in Section 4.8. Attempts will be made to fill containers for VOC analyses ("VOA" vials) with no head space remaining. The goal will be "no head space." Note that the presence of several very small air bubbles (less than several millimeters in diameter) are occasionally unavoidable. Samples collected for dissolved metals analyses will be filtered in the field using a disposable inline 0.45 micron filter.

4.2.2.5. Tidal Study

Water levels in selected monitoring wells will be recorded using a combination of pressure transducers with internal data loggers and electronic water level indicators. The data collection will include continuous (every 15 minutes) transducer-based water level measurements in monitoring wells and in Guemes Channel from a temporary stilling well. The location of the stilling well will be determined based on identification of a location that will not be affected by Site operations or by excess turbulence/surges associated with boat traffic during the study to the extent possible. The data logger will be programmed to automatically convert pressure to water levels. A vented transducer will be used that internally corrects for fluctuations in atmospheric pressure. Procedures for conducting the 72-hour tidal study are summarized below:

1. At each monitoring well, a pressure transducer will be lowered into the well and securely fastened to the top of the well casing for the duration of the monitoring period. A transducer will also be established in an adjacent marine surface water stilling well at a secured location at the Site.
2. The transducers will be set to record the height of the water column above the transducer at 15-minute intervals.
3. Pressure transducers will be rated to a minimum 15 pounds per square inch (psi) range capable of measuring a water level change of 23 feet with a resolution of 0.01 foot.
4. Depth to water will also be measured from the top of the well casing to the nearest 0.01 foot with a manual electronic water level indicator. Depth-to-water level will be manually measured up to four times at each location during the monitoring period.
5. At the end of the monitoring period, the pressure transducers will be removed and the water level data will be uploaded to a computer.

Similar procedures will be used to monitor surface water levels in the stilling well located in Guemes Channel.

The mean hydraulic gradient will be estimated using the method described in Serfes (Serfes, 1991).

4.2.2.6. Hydraulic Conductivity Testing

Hydraulic conductivity at the Site will be estimated using slug tests and/or step drawdown tests. Hydraulic conductivity tests will be performed in selected monitoring wells to identify the range of hydraulic conductivities in subsurface material at the Site. The well location and tidal stage will be considered when performing and interpreting the hydraulic conductivity tests to minimize the interference of tidal fluctuations on the aquifer and the determination of the hydraulic conductivities.

Slug tests will be performed using a PVC slug rod, a down-hole pressure transducer as described above, and a water-level indicator in general accordance with ASTM D 4044-99. The general procedure for conducting the slug tests in monitoring wells is summarized below:

1. At each monitoring well, the static depth of groundwater will be measured prior to suspending the pressure transducer near the bottom of the well.
2. After stabilization of the groundwater level (from the displacement of the transducer) the slug rod will be quickly lowered into the well until it is submerged in the water column (falling-head test).
3. The recovery of the perturbed water level will be monitored until it has returned to within 95 percent of the initial head indicated by the transducer prior to the introduction of the slug rod.
4. Once the water level has re-equilibrated, the slug rod will be quickly removed from the water column and the groundwater level will be monitored for recovery (rising-head test).
5. After the water level has recovered to within approximately 95 percent of the initial head indicated by the transducer, the depth to groundwater will be manually measured again and the transducer will be removed and the well secured.

The slug test response data will be analyzed using the Bouwer and Rice Method (Bouwer and Rice 1976; Bouwer, 1989).

If hydraulic conductivities are such that slug tests do not yield useful information as determined by the geologist, hydrogeologist or engineer performing the test, then step-drawdown tests may also be performed to determine hydraulic conductivity. The general procedure for conducting the drawdown tests in monitoring wells is summarized below:

1. At each monitoring well, the static depth of groundwater will be measured prior to suspending the pressure transducer near the bottom of the well.
2. Insert a vented pressure transducer into the well and secure it near the bottom of the well. The vented pressure transducer shall be set to record water level measurements at approximately 0.1-second intervals during the tests. The vented pressure transducer will be connected to a laptop computer or equivalent data processor during the test.
3. Insert a decontaminated submersible groundwater pump into the well; the inlet of the pump (bottom of the pump) should be a minimum of approximately 1 foot above the top of the vented pressure transducer.
4. Allow the groundwater level to return to within 95 percent of the initial head indicated by the transducer prior to the introduction of the groundwater pump.

5. Turn the pump on and withdraw groundwater at a constant low-flow rate (approximately 0.5 to 5 gallons per minute) for up to 30 minutes. Contain the purge water for transfer to a disposal drum. Note that the flow rate could be too high (well runs dry), or too low (water level does not draw down enough to yield usable results). Turn the flow rate down if the well appears to be running dry (i.e., if the flow rate appears to be falling despite constant pump speed). Assuming the flow rate is not too high, check to see if the flow rate is too low by downloading the pressure transducer data approximately 15 minutes into the test; verify that the well is drawing down sufficiently to yield usable results.
6. After the pump is turned off, the groundwater level recovery response will be monitored until the level returns to within 95 percent of the initial head indicated by the transducer prior to the introduction of the groundwater pump. Once stabilization has occurred, a manual measurement using a manual electronic water level indicator will be done prior to removing the transducer and pump from the well.

4.2.3. Sediment Investigation

The sediment investigation will be completed using hand tools or land-based drilling equipment including HSA and DP drilling methods described in Section 4.2.1. Sediment sampling locations were selected based on previous soil and groundwater investigation data, proximity to stormwater outfalls, and accessibility.

Sediment sample collection methods to be used during the RI investigation are described in the following sections.

4.2.3.1. Surface Sediment Collection and Processing

Surface sediment samples will be obtained using hand tool (stainless steel trowel or spoon). Surface samples will be obtained from the upper 10 centimeters of sediment. Sampling equipment will be decontaminated and inspected before sampling. The procedures for collecting surface sediment samples are as follows:

1. Identify the sample location using a handheld global-positioning system (GPS).
2. Record the location of the sample.
3. Use a stainless steel spoon to collect the sediment from the top 10 cm and place in stainless steel bowl(s). An equal portion of material (i.e., 1/3 of the total sample volume) will be retained from sampling locations SED-1A through SED-1C to prepare the composite surface sample SED-1-COMP with the exception of samples collected for volatile analysis. Samples for volatile analysis will be collected from a discrete location prior to homogenization following the Ecology 5035A methodology
4. Sediment samples for porewater analysis (ammonia, sulfide and tributyltin ion) will be collected prior to any observation, testing, photography, classification or homogenization of the sample material, by carefully placing relatively undisturbed sediment directly into a sample jar. The sample jar will be filled completely to eliminate headspace. Porewater extraction will be conducted at the laboratory.
5. Visually classify sediment in accordance with ASTM International (ASTM) D 2488 methods and the Unified Soil Classification System (ASTM D 2487) and record on the field form. In addition to the visual classification, sediment samples shall be observed and field screened. Qualitative descriptive parameters including biota, debris, and presence of staining shall also be recorded.
6. The visual absence or presence of wood debris in the surface sediment sample will be recorded on the field form. If wood debris is present, the type or types of wood debris (i.e., saw dust, bark, chips, chunks, twigs, fibers, etc.), the estimated quantity (i.e., observed percent by volume) of each type of wood debris, and the depth interval where the wood is observed will be recorded on the field form.

7. Photograph the sediment sample. Include in the camera's field of view a sheet of paper or whiteboard with the sample name written in large print; use care not to touch the sediment with the paper/whiteboard or with hands contaminated with whiteboard ink.
8. To avoid cross-contamination, a clean hands/dirty hands approach to use of whiteboard pens and erasers and lab pens will be utilized during all sample collection activities where subsequent chemical analyses will be carried out on the samples collected. Gloves that have been in contact with lab pens and whiteboard pens will not be used for sample handling.
9. Homogenize the sediment to a uniform appearance (i.e., color and texture) to the extent practicable in accordance with SCUM II within a stainless steel mixing bowl using a stainless steel spoon and/or stainless steel mixing paddle attached to a power drill.
10. Distribute the sample to designated sample containers and ensure that the samples are properly labeled and tightly closed. Sample containers will be filled to minimize headspace.
11. Clean the exterior of the sample containers and store them in a cooler with ice.
12. Decontaminate all equipment as described in Section 4.5.
13. Double check that field collection forms are completely filled out.

4.2.3.2. Subsurface Sediment Sample Collection and Processing

Subsurface sediment samples will be obtained using HSA, DP or other drilling methods as determined to best meet the specific sampling objectives. Continuous cores will be advanced to at least three feet into the native material. Subsurface sediment samples will be collected continuously in 2-foot intervals and submitted to the laboratory for analysis or archive. If additional volume is needed than is available in the 2-foot interval then additional cores may be completed to obtain more volume or, if necessary, intervals may be combined to provide adequate sample volume. The procedures for collecting subsurface sediment samples are as follows:

1. Maneuver the drill rig to the sampling location using a handheld GPS.
2. Record the location of the sample.
3. Drive the sampler into the sediment surface to the target depth or until refusal.
4. Collect a continuous core to the specified target depth or until refusal.
5. For each core interval, record the penetration depth on the field form.
6. Extract the core barrel and open using a decontaminated core-opening device.
7. Visually classify sediment in accordance with ASTM D 2488 methods and the Unified Soil Classification System (ASTM D 2487) and record on the field form. In addition to the visual classification, sediment samples shall be observed and field screened. Qualitative descriptive parameters including biota, debris, and presence of product/staining shall also be recorded.
8. The visual absence or presence of wood debris in the subsurface sediment sample will be recorded on the field form. If wood debris is present, the type or types of wood debris (i.e., saw dust, bark, chips, chunks, twigs, fibers, etc.), the estimated quantity (i.e., observed percent by volume) of each type of wood debris, and the depth interval where the wood is observed will be recorded on the field form.
9. Photograph the sample. Include in the camera's field of view a sheet of paper or whiteboard with the sample name written in large black print; use care not to touch the sediment with the paper/whiteboard

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

10. Collect sediment from the liner using a decontaminated stainless steel spoon. Minimize collection of sediment that has been in contact with the sides of the core liner, or the core-opening device to the extent possible. Place the sediment into a decontaminated stainless steel homogenization bowl. Cover the container with a new sheet of aluminum foil and dispose after use.
11. Homogenize the sediment to a uniform appearance (i.e., color and texture) to the extent practicable in accordance with SCUM II within a stainless steel mixing bowl using a stainless steel spoon and/or stainless steel mixing paddle attached to a power drill.
12. Distribute the sample to appropriate sample containers and ensure that the samples are properly labeled and tightly closed.
13. Clean the exterior of the sample containers and store them in a cooler with ice.
14. Decontaminate all equipment as described in Section 4.5.
15. Double check that field collection forms are completely filled out.

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

Drill cuttings from borings completed for the sediment sampling activities will be placed in labeled and sealed 55-gallon drums. The drums will be stored temporarily at a secure location on Port property pending receipt of analytical results and off-site disposal at a permitted facility.

4.3. Field Screening

Soil and sediment samples will be field screened for evidence of possible contamination. Field screening results will be recorded on the field forms and the results will be used as a general guideline to delineate areas of possible contamination. Screening results will also be used to aid in the selection of soil or sediment samples to be submitted for chemical analysis. The following screening methods will be used:

- Visual and olfactory screening;
- Water sheen screening; and
- Headspace vapor screening.

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

4.3.1. Visual and Olfactory Screening

The soil/sediment will be observed for unusual color, consistency, and staining and/or odor indicative of possible contamination.

4.3.2. Water Sheen Screening

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

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

4.3.3. Headspace Vapor Screening

This is a semi-quantitative field screening method that can help identify the presence or absence of volatile chemicals (i.e. petroleum hydrocarbons or VOCs). A portion of the soil or sediment sample is placed into a resealable plastic bag for headspace vapor screening. Ambient air is captured in the bag; the bag is sealed and then shaken gently to expose the solids to the air trapped in the bag. Vapors present within the sample bag's headspace are measured by inserting the probe of a photoionization detector (PID) through a small opening in the bag making sure the probe doesn't come into contact with the soil/sediment.

A PID measures the concentration of organic vapors ionizable by a 10.6 electron volt (eV) lamp in parts per million (ppm) and quantifies organic vapor concentrations in the range between 0.1 ppm and 2,000 ppm (isobutylene equivalent) with an accuracy of 1 ppm between 0 ppm and 100 ppm. The maximum ppm value and the ambient air temperature will be recorded on the field form for each sample. The PID will be calibrated in accordance with the manufacturer's recommendation using a 100 ppm isobutylene standard. If operating in cold weather, the PID will be kept on (pumping), and moisture filters will be changed frequently for better cold-weather performance. A sufficient number of extra batteries and extra filters will be available to ensure continued operation of the PID. A "pump test," will be performed as necessary in the field using 100 ppm isobutylene gas to check that the PID has remained properly calibrated throughout the day. More frequent pump tests will occur during cold damp weather. The PID will be recalibrated if the pump test indicates the PID is off by more than 10 ppm.

4.4. Surveying

4.4.1. Vertical Controls

Monitoring well casing rim elevation and mudline surface elevation will be surveyed by GeoEngineers or subcontracted surveyor licensed in the State of Washington referencing temporary or permanent benchmarks. Elevations will be surveyed using a laser level or similar equipment, which has an accuracy of 0.01 feet. Elevations will be referenced to mean lower low water (MLLW).

The vertical datum for the Site will be derived from running levels to the United States Coast and Geodetic Survey (USCGS) 2-inch brass disk set in the vertical wall at the northeast corner of the Old Train Depot located at 7th Street and R Avenue (National Geodetic Survey designation – PID – TR0689; MLLW – Elevation 16.98 feet; NAVD 88 – Elevation 16.33 feet).

4.4.2. Horizontal Controls

Monitoring well, boring locations and other pertinent information (e.g., shoreline seep locations) will be surveyed by GeoEngineers or subcontracted surveyor licensed in the State of Washington. Station positions will be determined in latitude and longitude referenced to North American Datum of 1983 (NAD83) using a hand-held GPS unit (e.g., Trimble GeoXT) or other survey equipment.

4.5. Sampling Equipment and Decontamination Procedures

Soil samples will be collected using coring/drilling equipment (i.e., hollow-stem auger and/or direct-push) and hand tools including stainless steel spoons and stainless steel mixing bowls. Reusable sampling equipment that comes in contact with soil, groundwater or sediment will be decontaminated before each use. Decontamination procedures for this equipment will consist of the following:

1. Washing with a brush and non-phosphate detergent solution (e.g., Liqui-Nox and distilled water),
2. Rinsing with distilled water, and
3. Wrapping or covering the decontaminated equipment with aluminum foil. Field personnel will limit cross-contamination by changing gloves between sampling locations.

Drilling equipment (auger, soil sampler, direct-push barrel) that comes into contact with soil or sediment will be decontaminated before each use. Decontamination procedures for this equipment will consist of the following:

1. Washing with pressurized hot water,
2. Wash with brush and non-phosphate detergent solution, and
3. Rinse with potable water.

Wash water used to decontaminate the reusable sampling equipment will be collected and stored on-site in 55-gallon drums.

4.6. Disposal of Investigation-Derived Materials

4.6.1. Soil and Sediment

Soil and/or sediment cuttings from borings completed during investigation activities will be placed in labeled and sealed 55-gallon drums. The drums will be temporarily stored at a secure location on Port property pending receipt of analytical results and off-site disposal at a permitted facility. Each drum will be labeled with the following information:

- Non-classified Waste Material, Laboratory Analysis in Progress/media (e.g., soil, water) contained in the drum;
- Source of the material in the drum (i.e., investigation locations and depths where appropriate);
- Date material was generated; and
- Name and telephone number of GeoEngineers contact person.

4.6.2. Groundwater and Decontamination Water

Development and purge water removed from the monitoring wells, and decontamination water generated during all sampling activities will be placed in labeled and sealed 55-gallon drums. The drums will be temporarily stored at a secure location on Port property pending receipt of analytical results and off-site disposal at a permitted facility. Each drum will be labeled with the following information:

- Non-classified Waste Material, Laboratory Analysis in Progress/media (e.g., water) contained in the drum;
- Source of the material in the drum (i.e., investigation locations and depths where appropriate);
- Date material was generated; and
- Name and telephone number of GeoEngineers contact person.

4.6.3. Disposition of Incidental Waste

Incidental waste including disposable personal protective equipment (PPE) generated during sampling activities includes items such as gloves, plastic sheeting, aluminum foil, sample tubing, paper towels and similar expended and discarded field supplies. These materials are considered *de minimis* and will be disposed of in a local trash receptacle or county disposal facility.

4.7. Sample Containers and Labeling

The field coordinator will establish field protocol to manage field sample collection, handling, and documentation. Sediment samples will be placed in appropriate laboratory-prepared containers. Sample containers and preservatives are listed in Tables C-6 through C-8.

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

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

The sample collection activities will be noted in the field log books. The field coordinator will monitor consistency between sample containers/labels, field log books, and chain-of-custody (COC) forms.

4.8. Chain of Custody

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

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

- The samples shipped to the laboratory will be accompanied by a COC record documenting which samples are present in the cooler. When transferring possession of samples, the individuals

relinquishing and receiving the samples will sign, date, and note the times of the sample transfer on the record. This custody record will document transfer of sample custody from the sampler to other persons, including the laboratory.

- The samples will be properly packed for shipment and dispatched to the laboratory for analysis, with a separate, signed COC enclosed in each sample cooler. If a GeoEngineers representative is not the person delivering the sample coolers to the laboratory, sample shipping containers will be custody-sealed before being delivered to the laboratory. The preferred procedure for custody sealing includes use of a custody signed seal placed across filament tape that is wrapped around the cooler at least twice. The custody seal should then be folded over and attached to itself in such a way as the package can only be accessed by cutting the filament tape or breaking the seal.
- Samples will be shipped and analyzed within the established hold times that are listed in Tables C-6 through C-8.

The laboratory will utilize an established system for sample check-in, sample tracking, laboratory analyses assignment and performance, and sample check-out. The system will allow management review of the laboratory data before the issuance of laboratory reports. The management review will be accomplished on two levels including 1) review of raw data for each analysis, and 2) review of the final results to check for consistency or agreement of the results between parameters. Computers are routinely used for this purpose to take advantage of fast retrieval of information.

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

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

4.9. Field Documentation

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

The following general guidelines should be followed in documenting fieldwork:

- Documentation will be maintained in a dedicated field notebook and on field forms.

- Notebook documentation will be completed in waterproof ink or permanent marker and written errors will be crossed out with a single line.

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

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

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

4.10. Sample Preservation, Container and Hold Times

Samples for fixed laboratory analysis will be prepared, containerized, and preserved in the field in accordance with the guidelines described in Tables C-6 through C-8. Samples will be kept on ice in coolers from the time of collection until delivery to the laboratory. The samples will be preserved and hand delivered by the Field Staff, Field Coordinator, Technical Project Manager or courier to the laboratory. Alternatively, samples may be packaged and shipped to the laboratory. Samples will be kept at 0°to 6°C during delivery to the laboratory and in refrigerated coolers while at the laboratory until analyzed.

4.11. Analytical Methods

Samples and QC samples shall be analyzed following the analytical methods listed in Tables C-4 and C-5, using laboratory instruments prescribed in the methods. The analytical methods must meet the technical acceptance criteria specified by the method prior to the analysis of environmental samples. Samples that are not analyzed initially (i.e., placed on “hold”) will be stored at the laboratory for at least 6 months, and will be disposed of by the laboratory following this period. Samples to be analyzed initially will be analyzed within proper holding times, which are listed in Tables C-6 through C-8.

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

4.12. Quality Control

Quality control activities that will be implemented for each sampling, analysis or measurement technique are summarized in Tables C-9 through C-12. Formulas for calculating QC statistics are provided in Section 3.1.

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

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

4.12.1. Field Quality Control

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

4.12.1.1. Field Duplicates

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

4.12.1.2. Trip Blanks

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

4.12.2. Laboratory Quality Control

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

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

4.12.2.1. Laboratory Blanks

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

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

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

For EPA Method 1668C, method blank contamination for individual PCB congeners is greater than two times the minimum level (Table 2 of the method) or one-third the regulatory compliance limit, whichever is greater; or if any potentially interfering compound is found in the blank at the minimum level for each PCB congener listed in Table 2 of the method (assuming a response factor of 1 relative to the quantitation listed at that level of chlorination for a potentially interfering compound; i.e., a compound not listed in this method), analysis of samples must be halted until the sample batch is re-extracted and the extracts re-analyzed, and the blank associated with the sample batch shows no evidence of contamination at these levels. All samples must be associated with an uncontaminated method blank before the results for those samples may be reported or used for permitting or regulatory compliance purposes. If re-analysis options have been exhausted, congeners within three times the blank congener concentration will be appropriately flagged and not included in the PCB total.

4.12.2.2. Calibrations

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

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

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

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

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

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

4.12.2.5. Laboratory Replicates/Duplicates

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

4.12.2.6. Surrogate Spikes

Surrogate spikes are used to verify proper extraction procedures and the accuracy of the analytical instrument. Surrogates are substances with characteristics similar to the target analytes. A known concentration of surrogate is added to the project sample and passed through the instrument, and percent recovery is calculated. Each surrogate used has acceptance limits (i.e., an acceptable range) for percent recovery. If a surrogate recovery is low, sample results may be biased low and depending on the recovery value, a possibility of false negatives may exist. Conversely, when recoveries are above the specified acceptance limits, a possibility of false positives exist, although non-detect results are considered accurate.

4.13. Instrument/Equipment Testing, Inspection, and Maintenance

4.13.1. Field Instrumentation

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

4.13.2. Laboratory Instrumentation

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

4.14. Laboratory Data Reporting and Deliverables

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

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

5.0 DATA REDUCTION AND ASSESSMENT PROCEDURES

The process for generating and checking data, as well as the process for producing reports for field and analytical laboratory data, are summarized in the following sections.

5.1. Data Reduction

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

5.2. Review of Field Documentation and Laboratory Receipt Information

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

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

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

5.3. Data Verification/Validation

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

The QA leader will validate data collected during the supplemental investigation to ensure that the data are valid and usable. At a minimum, a Stage 2B validation will be performed on the RI data in general conformance with EPA functional guidelines for data validation (EPA, 2004 and EPA, 2008). At a minimum, the following items will be reviewed to verify the data as applicable:

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

When sample analytical data are received from the analytical laboratory, they will undergo a QC review by the QA leader. The accuracy and precision achieved will be compared to the laboratory's analytical control limits. Example control limits are presented in Tables C-1 through C-3. Calculations of RPDs will follow standard statistical conventions and formulas as presented in in this document. Additional specifications

and professional judgment by the QA leader may be incorporated when appropriate data from specific matrices and field samples are available.

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

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

The data quality assessment will help to achieve an acceptable level of confidence in the decisions that are to be made based upon the project data. The project analytical data will be submitted to Ecology's Environmental Information Management (EIM) system within 60 days after the data quality assessment is completed.

5.4. TOC Normalized Data

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

5.5. Calculating Chemical Sums

The following guidelines will be used to calculate chemical sums:

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

- Total benzofluoranthenes represents the sum of detected concentrations of the b, j, and k isomers of benzofluoranthenes (WAC 173-204-562(2)(k)). In some cases, the testing laboratory may report the total benzofluoranthenes concentration rather than concentrations of individual compounds since they may not be able to resolve all three isomers.
- Total PCBs represent the sum of the detected concentrations of Aroclors® 1016, 1221, 1232, 1242, 1248, 1254 and 1260 or the sum of the congeners, using half the PQL for those congeners that were reported as not detected.
- Total cPAHs will be calculated using the toxicity equivalent (TEQ) approach in accordance with WAC 173-340-708(8)(e). Total cPAH TEQs will be calculated using toxicity equivalency factor (TEF) values referenced from Model Toxics Control Act (MTCA) Table 708.2 (WAC 173-340-900). For non-detect results, one-half the PQL will be used in the TEQ calculations.
- Total dioxin/furans and dioxin-like PCB congeners will be calculated using the TEQ approach in accordance with WAC 173-340-708(8)(d). Total dioxin/furan TEQs will be calculated using the 2005 World Health Organization (WHO) TEF values to characterize the toxicity of these mixtures.

The TEFs and minimum individual cPAHs that should be included in the TEQ calculations are listed in Table 5 of the RI/FS Work Plan.

For the summation of chemical totals, any "U" qualified data, which may be data reported at the PQL, the MDL, or the reporting limit (RL), represent non-detects. For the calculations, no distinction is made between these different types of detection limits, and any "U" qualified data are treated as "non-detects". The following guidelines will be used for reporting and summing non-detects for LPAHs, HPAHs, benzofluoranthenes and PCBs (when measured as Aroclors):

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

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

For calculating TEQ, total cPAH, dioxin and furan, and dioxin-like PCB congener TEQs, the sum will be calculated using a substitution at one-half the detection limit (i.e., n=1/2). However, using this alternative may result in generated sums that are estimates with unknown bias and precision. Therefore, these estimates will be bounded by reporting sums using a substitution of the detection limit at n=0 and n=1. As an alternative, the Kaplan-Meier (KM) method for estimating the TEQ sums when non-detected congeners are present within a sample may be used.

6.0 PROJECT MANAGEMENT AND ORGANIZATION

The project management and organization elements for the RI including the key personnel, roles and responsibilities of the participants and special training/certification are presented in the following sections.

6.1. Project Organization and Responsibilities

Key individuals and positions providing QA and QC are summarized in the following table. A description of the responsibilities, lines of authority and communication for the key individuals and positions providing QA and QC is presented in Sections 6.1.1 through 6.1.8.

Project Role	Name and Organization	Contact Information
Project Coordinator	Becky Darden Port of Anacortes	360.299.1831 becky@portofanacortes.com 100 Commercial Ave. Anacortes, WA 98221
Technical Project Manager	John Herzog GeoEngineers	206.406.6431 jherzog@geoengineers.com 600 Stewart Street, Suite 1700 Seattle, Washington 98101
Task Manager/Field Coordinator	Robert Trahan GeoEngineers	206.239.3253 rtrahan@geoengineers.com 600 Stewart Street, Suite 1700 Seattle, Washington 98101
Health and Safety Manger	Wayne Adams GeoEngineers	253.722.2793 wadams@geoengineers.com 1101 Fawcett Avenue, Suite 200 Tacoma, Washington 98402
Quality Assurance Leader	Mark Lybeer GeoEngineers	206.278.2674 mlybeer@geoengineers.com 600 Stewart Street, Suite 1700 Seattle, Washington 98101
Laboratory Project Manager	Cheronne Oreiro Analytical Resources Inc.	206.621.6490 cheronneo@arilabs.com 333 9th Avenue North Seattle, WA 98109

6.1.1. Port of Anacortes Project Coordinator

The Port's project coordinator duties consist of implementing the project approach and tasks, overseeing the project team members during performance of project tasks.

6.1.2. Technical Project Manager

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

The technical project manager's duties also include implementing the project approach and tasks, overseeing project team members during performance of project tasks, adhering to and communicating the status of budgets and schedules to the Port project manager, providing technical oversight, and providing overall production and review of project deliverables. The technical project manager shall

maintain the official, approved RI/FS Work Plan and supporting documents, and shall be responsible for distributing updated documents to the recipients listed in Section 6.1.

6.1.3. Task Manager

The task manager is responsible for the daily management of project tasks including providing technical direction to the field staff, produces task specific documents including the RI/FS Work Plan and supporting documents, develops schedules and allocates resources for field tasks, coordinates data collection activities to be consistent with information requirements, supervises the compilation of field data and laboratory analytical results, assures that data are correctly and completely reported, implements and oversees field sampling in accordance with project plan and supervises field personnel. Additionally, the task manger coordinates work with on-site subcontractors, verifies that appropriate sampling, testing, and measurement procedures are followed, coordinates the transfer of field data, sample tracking forms, and log books to the technical project manager for data reduction and validation, and participates in QA corrective actions as required.

6.1.4. Field Coordinator

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

6.1.5. Technical/Field Staff

Technical/field staff have the primary responsibility for duties involving field data collection and documentation. Technical/field staff are responsible for:

- Understanding and following the RI/FS Work Plan, SAP and Health and Safety Plan (HASP).
- Checking all equipment and supplies in advance of field operations.
- Ensuring that samples are properly collected, preserved, labeled, packaged, and shipped.
- Ensuring that all field data are carefully recorded in accordance with the RI/FS Work Plan and supporting documents.
- Following COC procedures and SOPs when they are required.

6.1.6. Quality Assurance Leader

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

6.1.7. Health and Safety Manager

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

6.1.8. Laboratory Project Manager

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

6.2. Special Training Requirements/Certification

The Superfund Amendments and Reauthorization Act of 1986 required the Secretary of Labor to issue regulations providing health and safety standards and guidelines for workers engaged in hazardous waste operations. Occupational Safety and Health Administration (OSHA) regulations (29 CFR 1910.120) require training to provide employees with the knowledge and skills necessary to enable them to perform their jobs safely and with minimum risk to their personal health. All sampling personnel will have completed the 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training course and 8-hour refresher courses, as necessary, to meet OSHA regulations.

7.0 LIMITATIONS

We have prepared this Sampling and Analysis Plan for use by the Port of Anacortes during the RI/FS at the Quiet Cove Site located at 202 O Avenue in Anacortes, Washington. Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted environmental science practices in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

Any electronic form, facsimile or hard copy of the original document (email, text, table, and/or figure), if provided, and any attachments are only a copy of the original document. The original document is stored by GeoEngineers, Inc. and will serve as the official document of record.

8.0 REFERENCES

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TABLES

GeoEngineers

Table C-1

Measurement Quality Objectives - Conventionals, Hydrocarbons, VOCs, SVOCs, PCBs and Metals

Quiet Cove Property
Anacortes, Washington

Laboratory Analysis	Laboratory Control Sample (LCS) %R Limits		Matrix Spike (MS) %R Limits		Surrogate Standard (SS) %R Limits[1,2,3]			MS Duplicate Samples or Lab Duplicate RPD Limits[4] (%)		Field Duplicate Samples RPD Limits[4] (%)	
	Soil/Sed	Water	Soil/Sed	Water	Soil	Sediment	Water (Default liq-liq Extraction)	Soil/Sed	Water	Soil/Sed	Water
Grain size	--	--	--	--	--	--	--	--	--	--	--
Total Organic Carbon (TOC)	75 - 125	--	75 - 125	--	--	--	--	--	--	≤50	--
Total Volatile Solids (TVS)	--	--	--	--	--	--	--	±20	--	≤50	--
Total Solids (TS)	--	--	--	--	--	--	--	--	--	≤50	--
Sulfides[4]	75 - 125	--	75 - 125	--	--	--	--	±20	--	≤50	--
Ammonia[4]	75 - 125	--	75 - 125	--	--	--	--	±20	--	≤50	--
Gasoline-Range Hydrocarbons	50 - 150	50 - 150	--	--	50 - 150	50 - 150	50 - 150	≤30	≤30	≤50	≤35
Diesel- and Heavy Oil-Range Hydrocarbons	50 - 150	50 - 150	--	--	50 - 150	50 - 150	50 - 150	≤40	≤40	≤50	≤35
VOCs	Laboratory Specific Control Limits[1]	Laboratory Specific Control Limits[1]	Laboratory Specific Control Limits[1]	Laboratory Specific Control Limits[1]	80 - 128 (1,2-Dichloroethane-d4) 80 - 120 (All Other Surrogates)	80 - 128 (1,2-Dichloroethane-d4) 80 - 120 (All Other Surrogates)	80 - 128 (1,2-Dichloroethane-d4) 80 - 120 (All Other Surrogates)	≤30	≤30	≤50	≤35
SVOCs	Laboratory Specific Control Limits[1]	Laboratory Specific Control Limits[1]	Laboratory Specific Control Limits[1]	Laboratory Specific Control Limits[1]	22 - 120 (2-Fluorophenol) 27 - 120 (Phenol-d5) 36 - 120 (2-Chlorophenol-d4) 38 - 120 (1,2-Dichlorobenzene-d4) 32 - 120 (Nitorobenzene-d5) 39 - 120 (2-Fluorobiphenyl) 31 - 131 (2,4,6-Tribromophenol) 31 - 130 (p-Terphenyl-d14)	27 - 120 (2-Fluorophenol) 29 - 120 (Phenol-d5) 31 - 120 (2-Chlorophenol-d4) 32 - 120 (1,2-Dichlorobenzene-d4) 30 - 120 (Nitorobenzene-d5) 35 - 120 (2-Fluorobiphenyl) 24 - 134 (2,4,6-Tribromophenol) 37 - 120 (p-Terphenyl-d14)	33 - 120 (2-Fluorophenol) 38 - 120 (Phenol-d5) 41 - 120 (2-Chlorophenol-d4) 20 - 120 (1,2-Dichlorobenzene-d4) 27 - 120 (Nitorobenzene-d5) 33 - 120 (2-Fluorobiphenyl) 52 - 120 (2,4,6-Tribromophenol) 28 - 120 (p-Terphenyl-d14) 39 - 120 (1,4-Dioxane-d8)	≤30	≤30	≤50	≤35
Aroclor-PCBs RL = 0.01 ug/L = 4.0 ug/kg	56 - 120 (Aroclor-1016) 58 - 120 (Aroclor-1260)	56 - 120 (Aroclor-1016) 58 - 120 (Aroclor-1260)	56 - 120 (Aroclor-1016) 58 - 120 (Aroclor-1260)	56 - 120 (Aroclor-1016) 58 - 120 (Aroclor-1260)	Primary/Secondary Columns 40 - 126 (DCB) 44 - 120 (TCX)	Primary/Secondary Columns 40 - 126 (DCB) 44 - 120 (TCX)	Primary/Secondary Columns 29 - 120 (DCB) 32 - 120 (TCX)	≤30	≤30	≤50	≤35
Metals	80 - 120	80 - 120	75 - 125	75 - 125	--			≤20	≤20	≤50	≤35

Notes:

[1]Compound-specific ranges will be provided by the laboratory when contracted.

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

[3]Individual surrogate recoveries are compound-specific.

[4]RPD control limits are only applicable if the primary and duplicate sample concentrations are greater than 5 times the method reporting limit (MRL). For results less than 5 times the MRL, the difference between the primary and duplicate samples must be less than 2X the MRL for soils/sediments and 1X the MRL for waters.

EPA = U.S. Environmental Protection Agency

VOCs = Volatile Organic Compounds

SVOCs = Semi-Volatile Organic Compounds

PCBs = Polychlorinated biphenyls

RL = Reporting Limit

RPD = Relative percent difference

RSD = Relative standard deviation

DCB = Decachlorobiphenyl

TCX = Tetrachlorometaxylene

MS = Matrix spike

Table C-2

Measurement Quality Objectives - Dioxins and Furans

Quiet Cove Property

Anacortes, Washington

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

Laboratory Analysis	Initial Precision and Recovery		Ongoing Precision and Recovery (%)	Initial Calibration (%)	Calibration Verification (%)	Labeled Compound (% Recovery)	
	RSD (%)	Recovery (%)				Warning Limit	Control Limit
$13C_{12}$-1,2,3,4,7,8-HxCDF	43	27 - 152	19 - 202	35	76 - 131	40 - 120	26 - 152
$13C_{12}$-1,2,3,6,7,8-HxCDF	35	30 - 122	21 - 159	35	70 - 143	40 - 120	26 - 123
$13C_{12}$-1,2,3,7,8,9-HxCDF	40	24 - 157	17 - 205	35	74 - 135	40 - 120	29 - 147
$13C_{12}$-2,3,4,6,7,8-HxCDF	37	29 - 136	22 - 176	35	73 - 137	40 - 120	28 - 136
$13C_{12}$-1,2,3,4,6,7,8-HpCDD	35	34 - 129	26 - 166	35	72 - 138	40 - 120	23 - 140
$13C_{12}$-1,2,3,4,6,7,8-HpCDF	41	32 - 110	21 - 158	35	78 - 129	40 - 120	28 - 143
$13C_{12}$-1,2,3,4,7,8,9-HpCDF	40	28 - 141	20 - 186	35	77 - 129	40 - 120	26 - 138
$13C_{12}$-OCDD	48	21 - 138	13 - 199	35	48 - 208	25 - 120	17 - 157
Cleanup Standard							
$37Cl_4$-2,3,7,8-TCDD	36	39 - 154	31 - 191	35	79 - 127	40 - 120	35 - 197

Notes:

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

RSD = Relative standard deviation

Table C-3

Measurement Quality Objectives - PCB Congeners

Quiet Cove Property

Anacortes, Washington

Laboratory Analysis	Test Concentration[1,2,3] (ng/ml)	Calibration Verification (%)	Initial Precision and Recovery		Ongoing Precision and Recovery (%)	Surrogate Standard (% Recovery in Sample)
			RSD (%)	Recovery (%)		
Compound						
PCB-1	50	72 - 125	25	70 - 130	60 - 135	-
PCB-3	50	72 - 125	25	70 - 130	60 - 135	-
PCB-4	50	72 - 125	25	70 - 130	60 - 135	-
PCB-15	50	72 - 125	25	70 - 130	60 - 135	-
PCB-19	50	72 - 125	25	70 - 130	60 - 135	-
PCB-37	50	72 - 125	25	70 - 130	60 - 135	-
PCB-54	50	72 - 125	25	70 - 130	60 - 135	-
PCB-77	50	72 - 125	25	70 - 130	60 - 135	-
PCB-81	50	72 - 125	25	70 - 130	60 - 135	-
PCB-104	50	72 - 125	25	70 - 130	60 - 135	-
PCB-105	50	72 - 125	25	70 - 130	60 - 135	-
PCB-114	50	72 - 125	25	70 - 130	60 - 135	-
PCB-118	50	72 - 125	25	70 - 130	60 - 135	-
PCB-123	50	72 - 125	25	70 - 130	60 - 135	-
PCB-126	50	72 - 125	25	70 - 130	60 - 135	-
PCB-155	50	72 - 125	25	70 - 130	60 - 135	-
PCB-156	50	72 - 125	25	70 - 130	60 - 135	-
PCB-157	50	72 - 125	25	70 - 130	60 - 135	-
PCB-167	50	72 - 125	25	70 - 130	60 - 135	-
PCB-169	50	72 - 125	25	70 - 130	60 - 135	-
PCB-188	50	72 - 125	25	70 - 130	60 - 135	-
PCB-189	50	72 - 125	25	70 - 130	60 - 135	-
PCB-202	50	72 - 125	25	70 - 130	60 - 135	-
PCB-205	50	72 - 125	25	70 - 130	60 - 135	-
PCB-206	50	72 - 125	25	70 - 130	60 - 135	-

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

Laboratory Analysis	Test Concentration[1,2,3] (ng/ml)	Calibration Verification (%)	Initial Precision and Recovery		Ongoing Precision and Recovery (%)	Surrogate Standard (% Recovery in Sample)
			RSD (%)	Recovery (%)		
13C-PCB-208	100	50 - 145	50	45 - 135	40 - 145	10 - 145
13C-PCB-209	100	50 - 145	50	45 - 135	40 - 145	10 - 145
Cleanup Surrogate Compounds						
13C-PCB-28	100	65 - 135	70	20 - 135	15 - 145	5 - 145
13C-PCB-111	100	75 - 125	50	45 - 135	40 - 145	10 - 145
13C-PCB-178	100	75 - 125	50	45 - 135	40 - 145	10 - 145

Notes:

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

[2] Concentration of Congeners and Surrogates in final extract of IPR and OPR

[3] Concentration of Surrogates in all final extracts

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

PCBs = Polychlorinated biphenyls

ng/ml = nanogram per milliliter

Table C-4

Method Analysis and Target Reporting Limits for Soil and Groundwater

Quiet Cove Property

Anacortes, Washington

Laboratory Analysis	CAS Number[1]	Analytical Method	Practical Quantitation Limit[2] (PQL)	
			Soil (mg/kg)	Groundwater (µg/L)
Metals				
Arsenic	7440-38-2	EPA 6010/6020/200.8	5	0.5
Cadmium	7440-43-9	EPA 6010/6020/200.8	0.20	0.10
Chromium (total)	7440-47-3	EPA 6010/6020/200.8	0.50	0.5
Copper	7440-50-8	EPA 6010/6020/200.8	0.2	0.5
Lead	7439-92-1	EPA 6010/6020/200.8	2	0.1
Mercury	7439-97-6	EPA 7470A/7471A/1631E	0.05	0.02
Silver	7440-22-4	EPA 6010/6020/200.8	0.3	0.2
Zinc	7440-66-6	EPA 6010/6020/200.8	1	4
Petroleum Hydrocarbons				
Gasoline-Range	8006-61-9	NWTPH-G	5	100
Diesel-Range	68334-30-5	NWTPH-DX with SI/Gel Cleanup	5	100
Heavy Oil-Range	30109	NWTPH-DX with SI/Gel Cleanup	10	200
Volatile Petroleum Hydrocarbons (VPH)	30181	Ecology VPH	10	50
Extractable Petroleum Hydrocarbons (EPH)	30102	Ecology EPH	2	50
BETX Compounds				
Benzene	71-43-2	EPA 8260	0.050	0.2
Ethylbenzene	100-41-4	EPA 8260	0.050	0.2
Toluene	108-88-3	EPA 8260	0.050	0.2
Xylenes	1330-20-7	EPA 8260	0.050	0.2
Volatile Organic Compounds (VOCs)				
1,1,1,2-Tetrachloroethane	630-20-6	EPA 8260	0.001	0.2
1,1,1-Trichloroethane	71-55-6	EPA 8260	0.001	0.2
1,1,2,2-Tetrachloroethane	79-34-5	EPA 8260	0.002	0.2
1,1,2-trichloro-1,2,2-trifluoroethane (CFC113)	76-13-1	EPA 8260	0.002	0.2
1,1,2-Trichloroethane	79-00-5	EPA 8260	0.001	0.2
1,1-Dichloroethane	75-34-3	EPA 8260	0.001	0.2
1,1-Dichloroethene	75-35-4	EPA 8260	0.001	0.2
1,1-Dichloropropene	563-58-6	EPA 8260	0.001	0.2
1,2,3-Trichlorobenzene	87-61-6	EPA 8260	0.005	0.5
1,2,3-Trichloropropane	96-18-4	EPA 8260	0.002	0.5
1,2,4-Trichlorobenzene	120-82-1	EPA 8260	0.005	0.500
1,2,4-Trimethylbenzene	95-63-6	EPA 8260	0.001	0.2
1,2-Dibromo-3-chloropropane	96-12-8	EPA 8260	0.005	0.5
1,2-Dichlorobenzene	95-50-1	EPA 8260	0.001	0.2
1,2-Dichloroethane (EDC)	107-06-2	EPA 8260	0.001	0.2
1,2-Dichloropropane	78-87-5	EPA 8260	0.001	0.2
1,3,5-Trimethylbenzene	108-67-8	EPA 8260	0.001	0.200
1,3-Dichlorobenzene	541-73-1	EPA 8260	0.001	0.200
1,3-Dichloropropane	142-28-9	EPA 8260	0.001	0.2
1,4-Dichlorobenzene	106-46-7	EPA 8260	0.067	0.2
2,2-Dichloropropane	594-20-7	EPA 8260	0.001	0.2
2-Butanone (MEK)	78-93-3	EPA 8260	0.005	5.000
2-Chloroethyl Vinyl Ether	110-75-8	EPA 8260	0.005	1.000
2-Chlorotoluene	95-49-8	EPA 8260	0.001	1.000
2-Hexanone	591-78-6	EPA 8260	0.001	5

Laboratory Analysis	CAS Number[1]	Analytical Method	Practical Quantitation Limit[2] (PQL)	
			Soil (mg/kg)	Groundwater (µg/L)
4-Chlorotoluene	106-43-4	EPA 8260	0.001	0.2
4-Methyl-2-Pentanone (Methyl Isobutyl Ketone)	108-10-1	EPA 8260	0.005	5.000
Acetone	67-64-1	EPA 8260	0.005	5.000
Acrolein	107-02-8	EPA 8260	0.05	5
Acrylonitrile	107-13-1	EPA 8260	0.005	1
Bromobenzene	108-86-1	EPA 8260	0.001	0.2
Bromochloromethane	74-97-5	EPA 8260	0.005	0.2
Bromoform	75-25-2	EPA 8260	0.001	0.200
Bromomethane	74-83-9	EPA 8260	0.001	1.000
Carbon Disulfide	75-15-0	EPA 8260	0.001	0.200
Carbon Tetrachloride	56-23-5	EPA 8260	0.001	0.200
Chlorobenzene	108-90-7	EPA 8260	0.001	0.200
Chloroethane	75-00-3	EPA 8260	0.005	0.200
Chloroform	67-66-3	EPA 8260	0.001	0.200
Chloromethane	74-87-3	EPA 8260	0.001	0.500
Cis-1,2-Dichloroethene	156-59-2	EPA 8260	0.001	0.200
Cis-1,3-Dichloropropene	10061-01-5	EPA 8260	0.001	0.200
Dibromochloromethane	124-48-1	EPA 8260	0.001	0.200
Dibromomethane	74-95-3	EPA 8260	0.001	0.200
Dichlorobromomethane	75-27-4	EPA 8260	0.001	0.200
Dichlorodifluoromethane (CFC 12)	75-71-8	EPA 8260	0.001	0.200
1,2-Dibromoethane (EDB)	106-93-4	EPA 8260	0.001	0.200
Hexachlorobutadiene	87-68-3	EPA 8260	0.005	0.500
Isopropylbenzene	98-82-8	EPA 8260	0.001	0.200
Methyl Iodide	74-88-4	EPA 8260	0.001	1.000
Methyl t-Butyl Ether (MTBE)	1634-04-4	EPA 8260	0.001	0.500
Methylene Chloride	75-09-2	EPA 8260	0.002	1.000
Naphthalene	91-20-3	EPA 8260	0.005	0.500
n-Butylbenzene	104-51-8	EPA 8260	0.001	0.200
n-Hexane	110-54-3	EPA 8260	0.001	0.200
n-Propylbenzene	103-65-1	EPA 8260	0.001	0.200
p-Isopropyltoluene	99-87-6	EPA 8260	0.001	0.200
sec-Butylbenzene	135-98-8	EPA 8260	0.001	0.200
Styrene	100-42-5	EPA 8260	0.001	0.200
tert-Butylbenzene	98-06-6	EPA 8260	0.001	0.200
Tetrachloroethene (PCE)	127-18-4	EPA 8260	0.001	0.200
Trans-1,2-Dichloroethene	156-60-5	EPA 8260	0.001	0.200
Trans-1,3-Dichloropropene	10061-02-6	EPA 8260	0.001	0.200
Trans-1,4-Dichloro-2-butene	110-57-6	EPA 8260	0.005	0.200
Trichloroethene (TCE)	79-01-6	EPA 8260	0.001	0.200
Trichlorofluoromethane (CFC 11)	75-69-4	EPA 8260	0.001	0.200
Vinyl Acetate	108-05-4	EPA 8260	0.005	0.200
Vinyl Chloride	75-01-4	EPA 8260	0.001	1.000
Semi-volatile Organic Compounds (SVOCs)				
1,2,4-Trichlorobenzene	120-82-1	EPA 8270/SIM	0.067	1
1,2-Dichlorobenzene	95-50-1	EPA 8270/SIM	0.067	1
1,3-Dichlorobenzene	541-73-1	EPA 8270/SIM	0.067	1
1,4-Dichlorobenzene	106-46-7	EPA 8270/SIM	0.067	1
2,2'-Oxybis[1-chloropropane]	52438-91-2	EPA 8270/SIM	0.067	1
2,4,5-Trichlorophenol	95-95-4	EPA 8270/SIM	0.33	5

Laboratory Analysis	CAS Number[1]	Analytical Method	Practical Quantitation Limit[2] (PQL)	
			Soil (mg/kg)	Groundwater (µg/L)
2,4,6-Trichlorophenol	88-06-2	EPA 8270/SIM	0.33	3
2,4-Dichlorophenol	120-83-2	EPA 8270/SIM	0.33	3
2,4-Dimethylphenol	105-67-9	EPA 8270/SIM	0.067	3
2,4-Dinitrophenol	51-28-5	EPA 8270/SIM	0.67	20
2,4-Dinitrotoluene	121-14-2	EPA 8270/SIM	0.33	3
2,6-Dinitrotoluene	606-20-2	EPA 8270/SIM	0.33	3
2-Chloronaphthalene	91-58-7	EPA 8270/SIM	0.067	1
2-Chlorophenol	95-57-8	EPA 8270/SIM	0.067	1
2-Nitroaniline	88-74-4	EPA 8270/SIM	0.33	3
2-Nitrophenol	88-75-5	EPA 8270/SIM	0.33	3
3,3'-Dichlorobenzidine	91-94-1	EPA 8270/SIM	0.33	5
3-Nitroaniline	99-09-2	EPA 8270/SIM	0.33	3
4,6-Dinitro-2-methylphenol	534-52-1	EPA 8270/SIM	0.67	10
4-Bromophenyl-phenylether	101-55-3	EPA 8270/SIM	0.067	1
4-Chloro-3-Methylphenol	59-50-7	EPA 8270/SIM	0.33	3
4-Chloroaniline	106-47-8	EPA 8270/SIM	0.33	5
4-Chlorophenyl-phenylether	7005-72-3	EPA 8270/SIM	0.067	1
4-Nitroaniline	100-01-6	EPA 8270/SIM	0.33	3
4-Nitrophenol	100-02-7	EPA 8270/SIM	0.33	10
Benzoic acid	65-85-0	EPA 8270/SIM	0.67	20
Benzyl alcohol	100-51-6	EPA 8270/SIM	0.33	2
bis(2-Chloroethoxy)methane	111-91-1	EPA 8270/SIM	0.067	1
bis(2-chloroethyl)ether	111-44-4	EPA 8270/SIM	0.067	1
bis(2-Ethylhexyl)phthalate	117-81-7	EPA 8270/SIM	0.067	3
Butylbenzylphthalate	85-68-7	EPA 8270/SIM	0.067	1
Carbazole	86-74-8	EPA 8270/SIM	0.067	1
Dibenzofuran	132-64-9	EPA 8270/SIM	0.067	1
Diethylphthalate	84-66-2	EPA 8270/SIM	0.067	1
Dimethylphthalate	131-11-3	EPA 8270/SIM	0.067	1
Di-n-butylphthalate	84-74-2	EPA 8270/SIM	0.067	1
Di-n-octylphthalate	117-84-0	EPA 8270/SIM	0.067	1
Hexachlorobenzene	118-74-1	EPA 8270/SIM	0.067	1
Hexachlorobutadiene	87-68-3	EPA 8270/SIM	0.067	3
Hexachlorocyclopentadiene	77-47-4	EPA 8270/SIM	0.067	5
Hexachloroethane	67-72-1	EPA 8270/SIM	0.067	2
Isophorone	78-59-1	EPA 8270/SIM	0.067	1
Nitrobenzene	98-95-3	EPA 8270/SIM	0.067	1
n-Nitroso-di-n-propylamine	621-64-7	EPA 8270/SIM	0.067	1
n-Nitrosodiphenylamine	86-30-6	EPA 8270/SIM	0.067	1
o-Cresol (2-Methylphenol)	95-48-7	EPA 8270/SIM	0.067	1
p-Cresol (4-Methylphenol)	106-44-5	EPA 8270/SIM	0.067	2
Pentachlorophenol	87-86-5	EPA 8270/SIM	0.33	10
Phenol	108-95-2	EPA 8270/SIM	0.067	1
Non-carcinogenic Polycyclic Aromatic Hydrocarbons (PAHs)				
1-Methylnaphthalene	90-12-0	EPA 8270-SIM	0.005	1
2-Methylnaphthalene	91-57-6	EPA 8270-SIM	0.005	1
Acenaphthene	83-32-9	EPA 8270-SIM	0.005	1
Acenaphthylene	208-96-8	EPA 8270-SIM	0.005	1
Anthracene	120-12-7	EPA 8270-SIM	0.005	1
Benzo[g,h,i]perylene	191-24-2	EPA 8270-SIM	0.005	1

Laboratory Analysis	CAS Number[1]	Analytical Method	Practical Quantitation Limit[2] (PQL)	
			Soil (mg/kg)	Groundwater (µg/L)
Fluoranthene	206-44-0	EPA 8270-SIM	0.005	1
Fluorene	86-73-7	EPA 8270-SIM	0.005	1
Naphthalene	91-20-3	EPA 8270-SIM	0.005	1
Phenanthrene	85-01-8	EPA 8270-SIM	0.005	1
Pyrene	129-00-0	EPA 8270-SIM	0.005	1
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs)				
Benzo[a]anthracene	56-55-3	EPA 8270-SIM	0.005	0.010
Benzo[a]pyrene	50-32-8	EPA 8270-SIM	0.005	0.010
Benzo[b]fluoranthene	205-99-2	EPA 8270-SIM	0.005	0.010
Benzo[k]fluoranthene	207-08-9	EPA 8270-SIM	0.005	0.010
Chrysene	218-01-9	EPA 8270-SIM	0.005	0.010
Dibenz[a,h]anthracene	53-70-3	EPA 8270-SIM	0.005	0.010
Indeno[1,2,3-c,d]pyrene	193-39-5	EPA 8270-SIM	0.005	0.010
Polychlorinated Biphenyls (PCBs)				
PCB Aroclor 1240	12674-11-2	EPA 8082	0.05	0.01
PCB-aroclor 1242	53469-21-9	EPA 8082	0.05	0.01
PCB-aroclor 1248	12672-29-6	EPA 8082	0.05	0.01
PCB-aroclor 1254	11097-69-1	EPA 8082	0.05	0.01
PCB-aroclor 1260	11096-82-5	EPA 8082	0.05	0.01
Dioxins & Furans				
2,3,7,8-TCDD	1746-01-6	EPA 1613	5.00E-07	1.60E-08
1,2,3,7,8-PeCDD	40321-76-4	EPA 1613	2.50E-06	1.60E-08
1,2,3,4,7,8-HxCDD	39227-28-6	EPA 1613	2.50E-06	1.60E-08
1,2,3,6,7,8-HxCDD	57653-85-7	EPA 1613	2.50E-06	1.60E-08
1,2,3,7,8,9-HxCDD	19408-74-3	EPA 1613	2.50E-06	1.60E-08
1,2,3,4,6,7,8-HpCDD	35822-46-9	EPA 1613	2.50E-06	1.60E-08
OCDD	3268-87-9	EPA 1613	5.00E-06	1.60E-08
2,3,7,8-TCDF	51207-31-9	EPA 1613	5.00E-07	1.60E-08
1,2,3,7,8-PeCDF	57117-41-6	EPA 1613	2.50E-06	1.60E-08
2,3,4,7,8-PeCDF	57117-31-4	EPA 1613	2.50E-06	1.60E-08
1,2,3,4,7,8-HxCDF	70648-26-9	EPA 1613	2.50E-06	1.60E-08
1,2,3,6,7,8-HxCDF	57117-44-9	EPA 1613	2.50E-06	1.60E-08
1,2,3,7,8,9-HxCDF	72918-21-9	EPA 1613	2.50E-06	1.60E-08
2,3,4,6,7,8-HxCDF	60851-34-5	EPA 1613	2.50E-06	1.60E-08
1,2,3,4,6,7,8-HpCDF	67562-39-4	EPA 1613	2.50E-06	1.60E-08
1,2,3,4,7,8,9-HPCDF	55673-89-7	EPA 1613	2.50E-06	1.60E-08
OCDF	39001-02-0	EPA 1613	5.00E-06	1.60E-08

Notes:

[1] Chemical abstract service (CAS) registry number.

[2] Practical Quantitation Limit (PQL) values from ARI of Tukwila, Washington and Frontier Analytical Laboratory of El Dorado Hills, California.

mg/kg = milligram per kilogram

µg/kg = microgram per kilogram

ng/kg = nanogram per kilogram

Table C-5

Method Analysis and Target Reporting Limits for Sediment

Quiet Cove Property

Anacortes, Washington

Laboratory Analysis	CAS Number[1]	Analytical Method	Practical Quantification Limit (PQL[2])
Conventionals			
Grain Size (%)	--	PSEP 1986 or ASTM-Mod	--
Total solids (%)	--	SM2540G	0.1
Total volatile solids (%)	--	PSEP 1986/ASTM D2974	0.1
Total Organic Carbon (%)	--	Plumb 1981	0.1
Bulk Ammonia (mg/kg)	--	EPA 350.1 M	1
Bulk Sulfides (mg/kg)	--	SM4500-S2/PSEP 1986	1
Porewater Ammonia (mg/L)	--	SM4500-NH3	0.04
Porewater Sulfide (mg/L)	--	SM4500-S2	0.05
Metals (mg/kg)			
Arsenic	7440-38-2	EPA 6010/6020	5
Cadmium	7440-43-9	EPA 6010/6020	0.2
Chromium	7440-47-3	EPA 6010/6020	0.5
Copper	7440-50-8	EPA 6010/6020	0.2
Lead	7439-92-1	EPA 6010/6020	2
Mercury	7439-97-6	EPA 7470A/7471A	0.05
Silver	7440-22-4	EPA 6010/6020	0.3
Zinc	7440-66-6	EPA 6010/6020	1
Polycyclic Aromatic Hydrocarbons (PAHs; µg/kg)			
Total LPAH	--	--	5
Naphthalene	91-20-3	EPA 8270-SIM	5
Acenaphthylene	208-96-8	EPA 8270-SIM	5
Acenaphthene	83-32-9	EPA 8270-SIM	5
Fluorene	86-73-7	EPA 8270-SIM	5
Phenanthrene	85-01-8	EPA 8270-SIM	5
Anthracene	120-12-7	EPA 8270-SIM	5
2-Methylnaphthalene	91-57-6	EPA 8270-SIM	5
Total HPAH	--	--	5
Fluoranthene	206-44-0	EPA 8270-SIM	5
Pyrene	129-00-0	EPA 8270-SIM	5
Benz(a)anthracene	56-55-3	EPA 8270-SIM	5
Chrysene	218-01-9	EPA 8270-SIM	5
Benzofluoranthenes (b, j ,k)	205-99-2/205-82-3/ 207-08-9	EPA 8270-SIM	5
Benzo(a)pyrene	50-32-8	EPA 8270-SIM	5
Indeno(1,2,3-c,d)pyrene	193-39-5	EPA 8270-SIM	5

Laboratory Analysis	CAS Number[1]	Analytical Method	Practical Quantification Limit (PQL[2])
Dibenz(a,h)anthracene	53-70-3	EPA 8270-SIM	5
Benzo(g,h,i)perylene	191-24-2	EPA 8270-SIM	5
Chlorinated Hydrocarbons (µg/kg)			
1,4-Dichlorobenzene	106-46-7	EPA 8270/SIM	5
1,3-Dichlorobenzene	541-73-1	EPA 8270/SIM	5
1,2-Dichlorobenzene	95-50-1	EPA 8270/SIM	5
1,2,4-Trichlorobenzene	120-82-1	EPA 8270/SIM	5
Hexachlorobenzene (HCB)	118-74-1	EPA 8270/SIM	5
Phthalates (µg/kg)			
Dimethyl phthalate	131-11-3	EPA 8270	20
Diethyl phthalate	84-66-2	EPA 8270	20
Di-n-butyl phthalate	84-74-2	EPA 8270	20
Butyl benzyl phthalate	85-68-7	EPA 8270/SIM	5
Bis(2-ethylhexyl) phthalate	117-81-7	EPA 8270	50
Di-n-octyl phthalate	117-84-0	EPA 8270	20
Miscellaneous Extractables (µg/kg)			
Dibenzofuran	132-64-9	EPA 8270/SIM	20
Hexachlorobutadiene	87-68-3	EPA 8270/SIM	5
N-Nitrosodiphenylamine	86-30-6	EPA 8270/SIM	5
Benzyl alcohol	100-51-6	EPA 8270	20
Benzoic acid	65-85-0	EPA 8270	200
Phenols (µg/kg)			
Phenol	108-95-2	EPA 8270	100
2-Methylphenol	95-48-7	EPA 8270	20
4-Methylphenol	106-44-5	EPA 8270	20
2,4-Dimethylphenol	105-67-9	EPA 8270/SIM	25
Pentachlorophenol	87-86-5	EPA 8270	100
Polychlorinated Biphenyl (PCB) Congeners (ng/kg)			
PCB-1	2051-60-7	EPA 1668C	2
PCB-2	2051-61-8	EPA 1668C	2
PCB-3	2051-62-9	EPA 1668C	2
PCB-4	13029-08-8	EPA 1668C	2
PCB-5	16605-91-7	EPA 1668C	2
PCB-6	25569-80-6	EPA 1668C	2
PCB-7	33284-50-3	EPA 1668C	2
PCB-8	34883-43-7	EPA 1668C	2
PCB-9	34883-39-1	EPA 1668C	2
PCB-10	33146-45-1	EPA 1668C	2
PCB-11	2050-67-1	EPA 1668C	2
PCB-12	2974-92-7	EPA 1668C	2
PCB-13	2974-90-5	EPA 1668C	2

Laboratory Analysis	CAS Number[1]	Analytical Method	Practical Quantification Limit (PQL[2])
PCB-14	34883-41-5	EPA 1668C	2
PCB-15	2050-68-2	EPA 1668C	2
PCB-16	38444-78-9	EPA 1668C	2
PCB-17	37680-66-3	EPA 1668C	2
PCB-18	37680-65-2	EPA 1668C	2
PCB-19	38444-73-4	EPA 1668C	2
PCB-20	38444-84-7	EPA 1668C	2
PCB-21	55702-46-0	EPA 1668C	2
PCB-22	38444-85-8	EPA 1668C	2
PCB-23	55720-44-0	EPA 1668C	2
PCB-24	55702-45-9	EPA 1668C	2
PCB-25	55712-37-3	EPA 1668C	2
PCB-26	38444-81-4	EPA 1668C	2
PCB-27	38444-76-7	EPA 1668C	2
PCB-28	7012-37-5	EPA 1668C	2
PCB-29	15862-07-4	EPA 1668C	2
PCB-30	35693-92-6	EPA 1668C	2
PCB-31	16606-02-3	EPA 1668C	2
PCB-32	38444-77-8	EPA 1668C	2
PCB-33	38444-86-9	EPA 1668C	2
PCB-34	37680-68-5	EPA 1668C	2
PCB-35	37680-69-6	EPA 1668C	2
PCB-36	38444-87-0	EPA 1668C	2
PCB-37	38444-90-5	EPA 1668C	2
PCB-38	53555-66-1	EPA 1668C	2
PCB-39	38444-88-1	EPA 1668C	2
PCB-40	38444-93-8	EPA 1668C	2
PCB-41	52663-59-9	EPA 1668C	2
PCB-42	36559-22-5	EPA 1668C	2
PCB-43	70362-46-8	EPA 1668C	2
PCB-44	41464-39-5	EPA 1668C	2
PCB-45	70362-45-7	EPA 1668C	2
PCB-46	41464-47-5	EPA 1668C	2
PCB-47	2437-79-8	EPA 1668C	2
PCB-48	70362-47-9	EPA 1668C	2
PCB-49	41464-40-8	EPA 1668C	2
PCB-50	62796-65-0	EPA 1668C	2
PCB-51	68194-04-7	EPA 1668C	2
PCB-52	35693-99-3	EPA 1668C	2
PCB-53	41464-41-9	EPA 1668C	2
PCB-54	15968-05-5	EPA 1668C	2

Laboratory Analysis	CAS Number[1]	Analytical Method	Practical Quantification Limit (PQL[2])
PCB-55	74338-24-2	EPA 1668C	2
PCB-56	41464-43-1	EPA 1668C	2
PCB-57	70424-67-8	EPA 1668C	2
PCB-58	41464-49-7	EPA 1668C	2
PCB-59	74472-33-6	EPA 1668C	2
PCB-60	33025-41-1	EPA 1668C	2
PCB-61	33284-53-6	EPA 1668C	2
PCB-62	54230-22-7	EPA 1668C	2
PCB-63	74472-34-7	EPA 1668C	2
PCB-64	52663-58-8	EPA 1668C	2
PCB-65	33284-54-7	EPA 1668C	2
PCB-66	32598-10-0	EPA 1668C	2
PCB-67	73575-53-8	EPA 1668C	2
PCB-68	73575-52-7	EPA 1668C	2
PCB-69	60233-24-1	EPA 1668C	2
PCB-70	32598-11-1	EPA 1668C	2
PCB-71	41464-46-4	EPA 1668C	2
PCB-72	41464-42-0	EPA 1668C	2
PCB-73	74338-23-1	EPA 1668C	2
PCB-74	32690-93-0	EPA 1668C	2
PCB-75	32598-12-2	EPA 1668C	2
PCB-76	70362-48-0	EPA 1668C	2
PCB-78	70362-49-1	EPA 1668C	2
PCB-79	41464-48-6	EPA 1668C	2
PCB-80	33284-52-5	EPA 1668C	2
PCB-82	52663-62-4	EPA 1668C	2
PCB-83	60145-20-2	EPA 1668C	2
PCB-84	52663-60-2	EPA 1668C	2
PCB-85	65510-45-4	EPA 1668C	2
PCB-86	55312-69-1	EPA 1668C	2
PCB-87	38380-02-8	EPA 1668C	2
PCB-88	55215-17-3	EPA 1668C	2
PCB-89	73575-57-2	EPA 1668C	2
PCB-90	68194-07-0	EPA 1668C	2
PCB-91	68194-05-8	EPA 1668C	2
PCB-92	52663-61-3	EPA 1668C	2
PCB-93	73575-56-1	EPA 1668C	2
PCB-94	73575-55-0	EPA 1668C	2
PCB-95	38379-99-6	EPA 1668C	2
PCB-96	73575-54-9	EPA 1668C	2
PCB-97	41464-51-1	EPA 1668C	2

Laboratory Analysis	CAS Number[1]	Analytical Method	Practical Quantification Limit (PQL[2])
PCB-98	60233-25-2	EPA 1668C	2
PCB-99	38380-01-7	EPA 1668C	2
PCB-100	39485-83-1	EPA 1668C	2
PCB-101	37680-73-2	EPA 1668C	2
PCB-102	68194-06-9	EPA 1668C	2
PCB-103	60145-21-3	EPA 1668C	2
PCB-104	56558-16-8	EPA 1668C	2
PCB-106	70424-69-0	EPA 1668C	2
PCB-107	70424-68-9	EPA 1668C	2
PCB-108	70362-41-3	EPA 1668C	2
PCB-109	74472-35-8	EPA 1668C	2
PCB-110	38380-03-9	EPA 1668C	2
PCB-111	39635-32-0	EPA 1668C	2
PCB-112	74472-36-9	EPA 1668C	2
PCB-113	68194-10-5	EPA 1668C	2
PCB-115	74472-38-1	EPA 1668C	2
PCB-116	18259-05-7	EPA 1668C	2
PCB-117	68194-11-6	EPA 1668C	2
PCB-119	56558-17-9	EPA 1668C	2
PCB-120	68194-12-7	EPA 1668C	2
PCB-121	56558-18-0	EPA 1668C	2
PCB-122	76842-07-4	EPA 1668C	2
PCB-124	70424-70-3	EPA 1668C	2
PCB-125	74472-39-2	EPA 1668C	2
PCB-127	39635-33-1	EPA 1668C	2
PCB-128	38380-07-3	EPA 1668C	2
PCB-129	55215-18-4	EPA 1668C	2
PCB-130	52663-66-8	EPA 1668C	2
PCB-131	61798-70-7	EPA 1668C	2
PCB-132	38380-05-1	EPA 1668C	2
PCB-133	35694-04-3	EPA 1668C	2
PCB-134	52704-70-8	EPA 1668C	2
PCB-135	52744-13-5	EPA 1668C	2
PCB-136	38411-22-2	EPA 1668C	2
PCB-137	35694-06-5	EPA 1668C	2
PCB-138	35065-28-2	EPA 1668C	2
PCB-139	56030-56-9	EPA 1668C	2
PCB-140	59291-64-4	EPA 1668C	2
PCB-141	52712-04-6	EPA 1668C	2
PCB-142	41411-61-4	EPA 1668C	2
PCB-143	68194-15-0	EPA 1668C	2

Laboratory Analysis	CAS Number[1]	Analytical Method	Practical Quantification Limit (PQL[2])
PCB-144	68194-14-9	EPA 1668C	2
PCB-145	74472-40-5	EPA 1668C	2
PCB-146	51908-16-8	EPA 1668C	2
PCB-147	68194-13-8	EPA 1668C	2
PCB-148	74472-41-6	EPA 1668C	2
PCB-149	38380-04-0	EPA 1668C	2
PCB-150	68194-08-1	EPA 1668C	2
PCB-151	52663-63-5	EPA 1668C	2
PCB-152	68194-09-2	EPA 1668C	2
PCB-153	35065-27-1	EPA 1668C	2
PCB-154	60145-22-4	EPA 1668C	2
PCB-155	33979-03-2	EPA 1668C	2
PCB-158	74472-42-7	EPA 1668C	2
PCB-159	39635-35-3	EPA 1668C	2
PCB-160	41411-62-5	EPA 1668C	2
PCB-161	74472-43-8	EPA 1668C	2
PCB-162	39635-34-2	EPA 1668C	2
PCB-163	74472-44-9	EPA 1668C	2
PCB-164	74472-45-0	EPA 1668C	2
PCB-165	74472-46-1	EPA 1668C	2
PCB-166	41411-63-6	EPA 1668C	2
PCB-168	59291-65-5	EPA 1668C	2
PCB-170	35065-30-6	EPA 1668C	2
PCB-171	52663-71-5	EPA 1668C	2
PCB-172	52663-74-8	EPA 1668C	2
PCB-173	68194-16-1	EPA 1668C	2
PCB-174	38411-25-5	EPA 1668C	2
PCB-175	40186-70-7	EPA 1668C	2
PCB-176	52663-65-7	EPA 1668C	2
PCB-177	52663-70-4	EPA 1668C	2
PCB-178	52663-67-9	EPA 1668C	2
PCB-179	52663-64-6	EPA 1668C	2
PCB-180	35065-29-3	EPA 1668C	2
PCB-181	74472-47-2	EPA 1668C	2
PCB-182	60145-23-5	EPA 1668C	2
PCB-183	52663-69-1	EPA 1668C	2
PCB-184	74472-48-3	EPA 1668C	2
PCB-185	52712-05-7	EPA 1668C	2
PCB-186	74472-49-4	EPA 1668C	2
PCB-187	52663-68-0	EPA 1668C	2
PCB-188	74487-85-7	EPA 1668C	2

Laboratory Analysis	CAS Number[1]	Analytical Method	Practical Quantification Limit (PQL[2])
PCB-190	41411-64-7	EPA 1668C	2
PCB-191	74472-50-7	EPA 1668C	2
PCB-192	74472-51-8	EPA 1668C	2
PCB-193	69782-91-8	EPA 1668C	2
PCB-194	35694-08-7	EPA 1668C	2
PCB-195	52663-78-2	EPA 1668C	2
PCB-196	42740-50-1	EPA 1668C	2
PCB-197	33091-17-7	EPA 1668C	2
PCB-198	68194-17-2	EPA 1668C	2
PCB-199	52663-75-9	EPA 1668C	2
PCB-200	52663-73-7	EPA 1668C	2
PCB-201	40186-71-8	EPA 1668C	2
PCB-202	2136-99-4	EPA 1668C	2
PCB-203	52663-76-0	EPA 1668C	2
PCB-204	74472-52-9	EPA 1668C	2
PCB-205	74472-53-0	EPA 1668C	2
PCB-206	40186-72-9	EPA 1668C	2
PCB-207	52663-79-3	EPA 1668C	2
PCB-208	52663-77-1	EPA 1668C	2
PCB-209	2051-24-3	EPA 1668C	2
Dioxin-Like Polychlorinated Biphenyls (PCBs; ng/kg)			
3,3',4,4'-Tetrachlorobiphenyl (PCB 77)	32598-13-3	EPA 1668C	2
3,4,4'5,-Tetrachlorobiphenyl (PCB 81)	70362-50-4	EPA 1668C	2
2,3,3',4,4'-Pentachlorobiphenyl (PCB 105)	32598-14-4	EPA 1668C	2
2,3,4,4',5-Pentachlorobiphenyl (PCB 114)	74472-37-0	EPA 1668C	2
2,3',4,4',5-Pentachlorobiphenyl (PCB 118)	31508-00-6	EPA 1668C	2
2',3,4,4',5-Pentachlorobephenyl (PCB 123)	65510-44-3	EPA 1668C	2
3,3',4,4',5-Pentachlorobiphenyl (PCB 126)	57465-28-8	EPA 1668C	2
2,3,3',4,4',5-Hexachlorobiphenyl (PCB 156)	38380-08-4	EPA 1668C	2
2,3,3',4,4',5'-Hexachlorobiphenyl (PCB 157)	69782-90-7	EPA 1668C	2
2,3',4,4',5,5'-Hexachlorobiphenyl (PCB 167)	52663-72-6	EPA 1668C	2
2,3',4,4',5,5'-Hexachlorobiphenyl (PCB 169)	32774-16-6	EPA 1668C	2
2,3,3',4,4',5,5'-Hexachlorobiphenyl (PCB 189)	39635-31-9	EPA 1668C	2
Dioxins & Furans (ng/kg)			
2,3,7,8-TCDD	1746-01-6	EPA 1613	0.5
1,2,3,7,8-PeCDD	40321-76-4	EPA 1613	2.5
1,2,3,4,7,8-HxCDD	39227-28-6	EPA 1613	2.5
1,2,3,6,7,8-HxCDD	57653-85-7	EPA 1613	2.5
1,2,3,7,8,9-HxCDD	19408-74-3	EPA 1613	2.5
1,2,3,4,6,7,8-HpCDD	35822-46-9	EPA 1613	2.5

Laboratory Analysis	CAS Number[1]	Analytical Method	Practical Quantification Limit (PQL[2])
OCDD	3268-87-9	EPA 1613	5
2,3,7,8-TCDF	51207-31-9	EPA 1613	0.5
1,2,3,7,8-PeCDF	57117-41-6	EPA 1613	2.5
2,3,4,7,8-PeCDF	57117-31-4	EPA 1613	2.5
1,2,3,4,7,8-HxCDF	70648-26-9	EPA 1613	2.5
1,2,3,6,7,8-HxCDF	57117-44-9	EPA 1613	2.5
1,2,3,7,8,9-HxCDF	72918-21-9	EPA 1613	2.5
2,3,4,6,7,8-HxCDF	60851-34-5	EPA 1613	2.5
1,2,3,4,6,7,8-HpCDF	67562-39-4	EPA 1613	2.5
1,2,3,4,7,8,9-HPCDF	55673-89-7	EPA 1613	2.5
OCDF	39001-02-0	EPA 1613	5

Notes:

[1] Chemical abstract service (CAS) registry number.

[2] Practical Quantitation Limit (PQL) values from ARI of Tukwila, Washington and Frontier Analytical Laboratory of El Dorado Hills, California.

mg/kg = milligram per kilogram

µg/L = microgram per liter

µg/kg = microgram per kilogram

ng/kg = nanogram per kilogram

Table C-6

Soil Sample Test Methods, Sample Size, Containers, Preservation and Holding Times

Quiet Cove Property

Anacortes, Washington

Laboratory Analysis	Analytical Method	Minimum Sample Size	Sample Container	Sample Preservation	Holding Time[1]
Metals (As, Cd, Cr, Pb and Hg)	EPA 6010/6020/ 7470/7471	100 g	4-oz glass WM with Teflon-lined lid	Cool ≤6°C	180 days/28 days for Mercury
Gasoline-Range Hydrocarbons	NWTPH-Gx	5 g	Two 40mL glass vial (VOA)	Cool ≤6°C	14 days to extraction/analysis
Diesel- and Oil-Range Hydrocarbons	NWTPH-Dx with acid/silica gel cleanup	100 g	8-oz amber glass WM with Teflon-lined lid	Cool ≤6°C	14 days to extraction/analysis
Volatile Petroleum Hydrocarbons	Ecology VPH	5 g	Two 40mL glass vial (VOA)	Cool ≤6°C, Methanol	14 days to extraction/analysis
Extractable Petroleum Hydrocarbons	Ecology EPH	100 g	8-oz amber glass WM with Teflon-lined lid	Cool ≤6°C	14 days to extraction/analysis
VOCs (Including Volatile Petroleum Compounds	EPA 8260	5 g	Three 40mL glass vial (VOA)	Cool ≤6°C Two VOAs - Sodium Bisulfate One VOA - Methanol	14 days to extraction/analysis
SVOCs (Including PAHs)	EPA 8270/SIM	100 g	8-oz amber glass WM with Teflon-lined lid	Cool ≤6°C	14 days to extraction, 40 days from extraction to analysis
PCB Aroclors	EPA 8082	100 g	8-oz amber glass WM with Teflon-lined lid	Cool ≤6°C	None
Dioxins and Furans	EPA 1613	100 g	8-oz amber glass WM with Teflon-lined lid	Freeze -18 C	1 year

Notes:

[1] Holding times are based on elapsed time from date of collection.

NWTPH = Northwest total petroleum hydrocarbons

Dx = diesel-range extended

EPA = Environmental Protection Agency

EPH = extractable petroleum hydrocarbons

g = gram

Gx = gasoline-range extended

mL = milliliter

oz. = ounce

PCBs = polychlorinated biphenyls

SIM = selected ion mode

SVOC = semi-volatile organic compound

VOC = volatile organic compound

VPH = volatile petroleum hydrocarbons

WM = wide mouth

Table C-7

Groundwater Sample Test Methods, Sample Size, Containers, Preservation and Holding Times

Quiet Cove Property

Anacortes, Washington

Laboratory Analysis	Analytical Method	Minimum Sample Size	Sample Container	Sample Preservation	Holding Time[1]
Metals (As, Cd, Cr, Pb and Hg)	EPA 6010/6020/200.8 7470/7471	500 mL	500mL HDPE bottle	Cool ≤6 C, HNO_3 - pH<2 (Dissolved metals preserved after filtration)	180 days/28 days for Mercury
Gasoline-Range Hydrocarbons	NWTPH-Gx	80 mL	Two 40mL glass vial (VOA)	Cool ≤6 C, HCl to pH < 2	14 days to extraction/analysis
Diesel- and Oil-Range Hydrocarbons	NWTPH-Dx	500 mL	Two 500 mL amber glass with Teflon-lined lid	Cool ≤6 C	14 days to extraction 40 days from extraction to analysis
Volatile Petroleum Hydrocarbons	Ecology VPH	120 mL	Three 40mL glass vial (VOA)	Cool ≤6°C, HCl	14 days to extraction/analysis
Extractable Petroleum Hydrocarbons	Ecology EPH	500 mL	Two 500mL amber glass with Teflon-lined lid	Cool ≤6°C	14 days to extraction/analysis
VOCs (Including Volatile Petroleum Compounds	EPA 8011/8021/8260	120 mL	Three 40mL glass vial (VOA)	Cool ≤6 C, HCl to pH < 2	14 days to extraction/analysis
SVOCs (Including PAHs)	EPA 8270/SIM	1 L	Four 500mL amber glass with Teflon-lined lid	Cool ≤6°C	14 days to extraction, 40 days from extraction to analysis
PCB Aroclors	EPA 8082	1 L	Two 1L amber glass with Teflon-lined lid	Cool ≤6°C	None
Dioxins and Furans	EPA 1613	1 L	Two 1L amber glass with Teflon-lined lid	Cool ≤6°C	1 year

Notes:

[1] Holding times are based on elapsed time from date of collection.

NWTPH = Northwest total petroleum hydrocarbons

Dx = diesel-range extended

EPA = Environmental Protection Agency

EPH = extractable petroleum hydrocarbons

Gx = gasoline-range extended

HCl = hydrocloric acid

HDPE = high density polyethylene

HNO_3 = nitric acid

L = liter

mL = milliliter

PCBs = polychlorinated biphenyls

SIM = selected ion mode

SVOC = semi-volatile organic compound

VOC = volatile organic compound

VPH = volatile petroleum hydrocarbons

Table C-8

Sediment Sample Test Methods, Sample Size, Containers, Preservation and Holding Times

Quiet Cove Property

Anacortes, Washington

Laboratory Analysis	Analytical Method	Minimum Sample Size	Sample Containers	Sample Preservation	Holding Time[1]
Grain Size	PSEP 1986 or ASTM-Mod	300 g	16-oz HDPE or Ziploc	Not Applicable	6 months
Total Organic Carbon (TOC)	PSEP 1986/Plumb 1981	10 g	8-oz glass WM with Teflon-lined lid	Cool ≤6°C	14 days
				Freeze -18°C	6 months
Total Volatile Solids (TVS)	PSEP 1986/ ASTM D2974	300 g	16-oz HDPE or Ziploc	Cool ≤ 6°C	6 months
Total Solids (TS)	SM2540G	10 g	From TOC Container	Cool ≤ 6°C	14 days
				Freeze -18°C	6 months
Bulk Sulfides	SM4500-S2	20g	2-oz glass WM with Teflon-lined lid	Cool ≤ 6°C, Zinc Acetate	7 days
Bulk Ammonia	EPA 350.1 M/SM4500-S2	10g	From TOC/TVS Container Container	Cool ≤ 6°C	7 days
Porewater Sulfide	SM4500-S2	1200g/150 mL	Two 32-oz glass WM with Teflon-lined lid	Cool <6°C	7 days until extraction 7 days after extraction
Porewater Ammonia	EPA 350.1M/SM4500-NH3	600g/75mL			7 days until extraction 28 days after extraction
Total Metals (As, Cd, Cr, Cu, Pb, Ag and Zn)	EPA 6010/6020	20 g	4-oz glass WM with Teflon-lined lid	Cool ≤ 6°C	6 months
				Freeze -18°C	2 years
Mercury	EPA 7471A	2 g	From Metals Container	Cool ≤ 6°C	28 days
Gasoline-Range Hydrocarbons	NWTPH-Gx	5 g	Two 40mL glass vial (VOA)	Cool ≤6°C	14 days to extraction/analysis
Diesel- and Oil-Range Hydrocarbons	NWTPH-Dx with acid/silica gel cleanup	100 g	8-oz amber glass WM with Teflon-lined lid	Cool ≤6°C	14 days to extraction/analysis

Laboratory Analysis	Analytical Method	Minimum Sample Size	Sample Containers	Sample Preservation	Holding Time[1]
Volatile Petroleum Hydrocarbons	Ecology VPH	5 g	Two 40mL glass vial (VOA)	Cool ≤6°C, Methanol	14 days to extraction/analysis
Extractable Petroleum Hydrocarbons	Ecology EPH	100 g	8-oz amber glass WM with Teflon-lined lid	Cool ≤6°C	14 days to extraction/analysis
VOCs (Including Volatile Petroleum Compounds	EPA ~~8021~~/8260	5 g	Three 40mL glass vial (VOA)	Cool ≤6°C Two VOAs - Sodium Bisulfate One VOA - Methanol	14 days to extraction/analysis
SVOCs (Including PAHs)	EPA 8270/SIM	150 g	16-oz glass WM with Teflon-lined lid	Cool <6°C	14 days until extraction
				Cool <6°C	40 days after extraction
				Freeze -18°C	1 year until extraction
PCB Congeners	EPA 1668C	100 g	4-oz amber glass WM with Teflon-lined lid	Cool <6°C/Store<-10°C	1 year until extraction
Dioxins and Furans	EPA 1613	100 g	4-oz amber glass WM with Teflon-lined lid	Cool <4°C/Store<-10°C	1 year until extraction
Bioassay	PSEP 1995	5 L	5 x 1L WM glass or HDPE	Cool, 4°C, nitrogen atmosphere	8 weeks

Notes:

[1] Holding times are based on elapsed time from date of collection.

ASTM = American Society for Testing and Materials
Dx = diesel-range extended
EPA = Environmental Protection Agency
EPH = extractable petroleum hydrocarbons
g = gram
Gx = gasoline-range extended
HDPE = high-density polyethylene
L = liter
mL = milliliter
NWTPH = Northwest total petroleum hydrocarbons
oz = ounce
PCBs = polychlorinated Biphenyls
PSEP = Puget Sound Estuary Program
SIM = selected Ion Mode
SVOC = semi-volatile organic compound
VOC = volatile organic compound
VPH = volatile petroleum hydrocarbons
WM = wide mouth

Table C-9

Quality Control Procedures and Acceptance Criteria for Organic Analysis[1,2,3]

Quiet Cove Property

Anacortes, Washington

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Instrument Quality Assurance/Quality Control			
Initial Calibration	Before sample analysis and when continuing calibration does not meet method requirements. See reference method(s) in Tables C-1 through C-3.	See reference method(s) in Tables C-4 and C-5.	Follow corrective actions specified in analytical method and/or ARI SOP
Continuing Calibration	Method-specific. See reference method(s) in Tables C-4 and C-5.	Method–specific. See reference method(s) in Tables C-4 and C-5.	Follow corrective actions specified in analytical method and/or ARI SOP
Method Quality Assurance/Quality Control			
Holding Times	All samples.	See Tables C-6 through C-8.	Laboratory to qualify results if holding times are exceeded. Data validator will use professional judgment to qualify results as estimated or reject data.
Method Detection Limits (MDL)	Update method detection limit studies annually.	See reference method(s) in Tables C-1 through C-8.	Revise detection limits.
Method Blanks	One per sample batch or every 20 samples, whichever is more frequent, or when there is a change in reagents.	Analyte concentration ≤ PQL. Control limits are not applicable if sample concentrations are < MDL.	Follow corrective actions specified in analytical method and/or ARI SOP. Laboratory to eliminate or greatly reduce laboratory contamination due to glassware, or reagents, or analytical system.
Analytical Laboratory Matrix Spike Duplicates	One matrix spike duplicate analysis with every sample batch or every 20 samples, whichever is more frequent.	Compound and matrix specific. Use intra-laboratory control chart results if sufficient data are available to generate control charts. Otherwise use analytical method default criteria.	No corrective action necessary for failing matrix spike duplicates. Matrix spike duplicates are not required organic QC.
Matrix Spikes	One per sample batch or every 20 samples, whichever is more frequent. Spiked with the same analytes at the same concentration as the laboratory control sample.	Compound and matrix specific, recovery should not exceed method or performance -based intra-laboratory control chart limits.	No corrective action necessary for failing matrix spikes. Matrix spikes are not required organic QC.

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Surrogate Spikes	Added to every organics sample as specified in analytical protocol.	Compound specific, recovery should not exceed the control limits specified in the method or performance-based intra- laboratory control limits.	Follow corrective actions specified in analytical method and/or ARI SOP
Laboratory Control Samples	One per analytical batch or every 20 samples, whichever is more frequent.	Compound specific, recovery should not exceed performance- based intra-laboratory control limits.	Follow corrective actions specified in analytical method and/or ARI SOP
Field Quality Assurance/Quality Control			
Field Duplicates	One per every 20 samples	Project, matrix, and compound specific	Modify field sample homogenization procedures.
Field Blanks	At project manager's discretion	Analyte concentration ≤ PQL	Compare to method blank results to rule out laboratory contamination. Modify sample collection and equipment decontamination procedures. Qualify associated data.

Notes:

[1] Instrument and method QA/QC to monitor the performance of the instrument and sample preparation procedures are the responsibility of the analytical laboratory. When an instrument or method control limit is exceeded, the laboratory is responsible for correcting the problem and reanalyzing the samples.

[2] Instrument and method QA/QC results reported in the final data package should always meet control limits with a very small number of exceptions that apply to difficult analytes as specified by EPA CLP. If instrument and method QA/QC procedures meet control limits, laboratory procedures are deemed to be adequate.

[3] Matrix and field QA/QC procedures monitor matrix effects, field procedures, and variability. Although poor analytical procedures may also result in poor spike recovery or duplicate results, the laboratory is not held responsible for meeting control limits for these QA/QC samples.

ARI = Analytical Resources Inc.

CLP = Contract Laboratory Program

MDL = method detection limit

PQL = practical quantification limit

QC = quality control

SOP = standard operating procedures

Table C-10

Quality Control Procedures and Acceptance Criteria for Metals Analysis[1,2,3]

Quiet Cove Property

Anacortes, Washington

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Instrument Quality Assurance/Quality Control			
Initial Calibration	Daily.	Correlation coefficient ≥0.995.	Laboratory to optimize and recalibrate the instrument and reanalyze any affected samples.
Initial Calibration Verification	Immediately after initial calibration.	90-110% recovery for ICP-AES, ICP-MS and GFAA (80-120% for Mercury), or method based.	Laboratory to resolve discrepancy prior to sample analysis.
Continuing Calibration Verification	After every 10 samples or every 2 hours, whichever is more frequent, and after the last sample.	90-110% recovery for ICP-AES and GFAA, 85-115% for ICP-MS (80-120% for mercury).	Follow corrective actions specified in analytical method and/or ARI SOP
Initial and Continuing Calibration Blanks	Immediately after initial calibration, then 10% of samples or every 2 hours, whichever is more frequent, and after the last sample.	Analyte concentration ≤ PQL.	Follow corrective actions specified in analytical method and/or ARI SOP
ICP Interelement Interference Check Samples	At the beginning and end of each analytical sequence or twice per 8- hour shift, whichever is more frequent.	80-120% of the true value.	Follow corrective actions specified in analytical method and/or ARI SOP
Method Quality Assurance/Quality Control			
Holding Times	All samples.	See Tables C-6 through C-8	Laboratory to qualify results if holding times are exceeded. Data validator will use professional judgment to qualify results as estimated or reject data.
Method Detection Limits (MDL)	Update method detection limit studies annually.	See reference method(s) in Tables C-1 through C-8	Revise detection limits.
Method Blanks	With every sample batch or every 20 samples, whichever is more frequent.	Analyte concentration ≤ PQL. Control limits are not applicable if sample concentrations are < MDL	Follow corrective actions specified in analytical method and/or ARI SOP

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Analytical (Laboratory) Duplicates or Matrix Spike Duplicates	One duplicate analysis with every sample batch or every 20 samples, whichever is more frequent; Use analytical replicates when samples are expected to contain target analytes. Use matrix spike replicates when samples are not expected to contain target analytes.	Analyte and matrix specific. Use intra- laboratory control chart limits if sufficient data are available to generate control charts; otherwise use analytical method default criteria.	Follow corrective actions specified in analytical method and/or ARI SOP
Matrix Spikes	With every sample batch or every 20 samples, whichever is more frequent.	75-125% recovery applied when the sample concentration is ≤4 times the spiked concentration for a particular analyte.	Follow corrective actions specified in analytical method and/or ARI SOP
Field Quality Assurance/Quality Control			
Field Duplicates	One per every 20 samples	Project, matrix, and compound specific	Modify field sample homogenization procedures.
Field Blanks	At project manager's discretion	Analyte concentration ≤ PQL	Compare to method blank results to rule out laboratory contamination. Modify sample collection and equipment decontamination procedures. Qualify associated data.

Notes:

[1] Instrument and method QA/QC to monitor the performance of the instrument and sample preparation procedures are the responsibility of the analytical laboratory. When an instrument or method control limit is exceeded, the laboratory is responsible for correcting the problem and reanalyzing the samples.

[2] Instrument and method QA/QC results reported in the final data package should always meet control limits with a very small number of exceptions that apply to difficult analytes as specified by EPA CLP. If instrument and method QA/QC procedures meet control limits, laboratory procedures are deemed to be adequate.

[3] Matrix and field QA/QC procedures monitor matrix effects, field procedures, and variability. Although poor analytical procedures may also result in poor spike recovery or duplicate results, the laboratory is not held responsible for meeting control limits for these QA/QC samples.

ARI = Analytical Resources Inc.

CLP = Contract Laboratory Program

GFAA = graphite furnace atomic absorption

ICP-AES - inductively coupled plasma/atomic emission spectrometry

ICP-MS = inductively coupled plasma/mass spectrometry

MDL = method detection limit

PQL = practical quantification limit

SOP = standard operating procedures

Table C-11

Quality Control Procedures and Acceptance Criteria for Conventional Analysis[1,2]

Quiet Cove Property

Anacortes, Washington

Analyte	Initial Calibration	Continuing Calibration	Calibration Blanks	Laboratory Control Samples	Matrix Spikes	Laboratory Duplicates	Method Blank
Grain Size	N/A	N/A	N/A	N/A	N/A	20% RSD	N/A
Total Organic Carbon (TOC)	Correlation Coefficient ≥ 0.995	90-110% Recovery	Analyte Concentration ≤ PQL	80-120% Recovery	75-125% Recovery	20% RSD	Analyte Concentration ≤ PQL
Total Volatile Solids (TVS)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total Solids (TS)	N/A	N/A	N/A	N/A	N/A	20% RSD	Analyte Concentration ≤PQL
Ammonia	Correlation Coefficient ≥0.995	90 -110% Recovery	Analyte concentration ≤ PQL	75 -120% Recovery	75 -125% Recovery	20% RSD	Analyte Concentration ≤ PQL
Total Sulfides	Correlation Coefficient ≥ 0.990	85 -115% Recovery	N/A	75 -125% Recovery	75 -125% Recovery	20% RSD	Analyte Concentration ≤ PQL

Notes:

[1] The control limits provided above are suggested limits only. They are based on EPA control limits for metals analyses (Table C-10), and an attempt has been made to take into consideration the expected analytical accuracy using PSEP methodology. The corrective action indicated for metals in Table C-10 will be applied to the conventional analytes using professional judgment.

[2] As applicable, the QA/QC procedures indicated in this table will be completed at the same frequency as for metals analyses (see Table C-10).

N/A = not applicable

PQL = practical quantification limit

RSD - relative standard deviation

Table C-12

Quality Control Procedures and Acceptance Criteria for PCDD/PCDF Analysis[1,2,3]

Quiet Cove Property
Anacortes, Washington

Quality Control Procedure	Frequency	Acceptance Criteria	Corrective Action
Instrument and Method Quality Assurance/Quality Control			
Ongoing Precision and Recovery	One per sample batch or every 20 samples, whichever is more frequent.	Recovery within limits presented in Table C-2.	1. Check calculation. 2. Re-extract and reanalyze batch.
Stable-isotope- labeled compounds	Spiked into each sample for every target analyte	Recovery within limits presented in Table C-2.	1. Check calculations. 2. Flag outlier and confirm not an ongoing trend.
		Ion abundance ratios must be within the criteria specified by the method.	
Sample target analyte Ion abundance ratios	All detected analytes for all samples.	Ion abundance ratios must be within the criteria specified by the method.	1. Report and qualify as EMPC if ratios outside limit.
Method blank	One per sample batch or every 20 samples, whichever is more frequent.	Detection ≤ minimum level as specified by the method.	1. If the method blank results are greater than the reporting limit, flag sample results greater than 10x's method blank with B qualifier.

Quality Control Procedure	Frequency	Acceptance Criteria	Corrective Action
GC/MS Tune	At the beginning of each 12 hour shift; must start and end each analytical sequence	>10,000 resolving power at m/z304.9825. Exact mass of 380.9760 within 5 ppm of theoretical values.	1. Re-analyze affected samples. 2. Reject all data not meeting method 1613B requirements.
Initial Calibration	Initially and when continuing calibration fails	Five point curve for all analytes. RSD must meet Table C-4 requirements for all target compounds and labeled compounds. Signal to noise ratio (S/N)>10. Ion abundance (IA) ratios within method specified limits.	
Window Defining/Column Performance Mix	Before every initial and continuing calibration	Valley < 25% for all peaks near 2378-TCDD/F peaks.	1. Re-analyze affected samples. 2. Reject all data not meeting method 1613B requirements.
Continuing Calibration	Must start and end each analytical sequence.	%Difference must use the limits for target compounds & labeled compounds as specified by the method. S/N>10. IA ratios within method specified limits.	
Confirmation of 2,3,7,8-TCDF	For all primary column detections of 2,3,7,8-TCDF using a DB-5 GC column or equivalent.	Confirmation presence of 2,3,7,8-TCDF in accordance with method 1613B requirements.	ARI uses a specific RTX-Dioxin 2 column which eliminates the need for second column confirmation
Sample data not achieving target reporting limits or method performance in presence of possibly interfering compounds	N/A	N/A	Rather than simply diluting an extract to reduce interferences, the lab should perform additional cleanup techniques identified in the method to insure minimal matrix effects and background interference. Thereafter, the lab can dilute the extract. If reanalysis is required, the laboratory shall report both initial and re-analysis results.
Sediment Reference Material	One per analytical project.	Results must be within 20% of the 95% confidence interval.	No corrective action required for SRM/CRM outliers.

Quality Control Procedure	Frequency	Acceptance Criteria	Corrective Action
Field Quality Assurance/Quality Control			
Field Duplicates	One per every 20 samples	Project, matrix, and compound specific	Modify field sample homogenization procedures.
Field Blanks	At project manager's discretion	Analyte concentration ≤ PQL	Compare to method blank results to rule out laboratory contamination. Modify sample collection and equipment decontamination procedures. Qualify associated data.

Notes:

[1] Instrument and method QA/QC to monitor the performance of the instrument and sample preparation procedures are the responsibility of the analytical laboratory. When an instrument or method control limit is exceeded, the laboratory is responsible for correcting the problem and reanalyzing the samples.

[2] Instrument and method QA/QC results reported in the final data package should always meet control limits with a very small number of exceptions that apply to difficult analytes as specified by EPA CLP. If instrument and method QA/QC procedures meet control limits, laboratory procedures are deemed to be adequate.

[3] Matrix and field QA/QC procedures monitor matrix effects, field procedures, and variability. Although poor analytical procedures may also result in poor spike recovery or duplicate results, the laboratory is not held responsible for meeting control limits for these QA/QC samples.

CLP = Contract Laboratory Program

GC/MS = gas chromatography–mass spectrometry

MDL = method detection limit

N/A = not applicable

ppm = part per million

PQL = practical quantification limit

RM = reference material

RSD - relative standard deviation

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APPENDIX D
Health and Safety Plan

Health and Safety Plan

Quiet Cove Property
Anacortes, Washington
Ecology Agreed Order No. DE 11346

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

January 25, 2017

GeoEngineers
Earth Science + Technology

Health and Safety Plan

Quiet Cove Property
Anacortes, Washington
Ecology Agreed Order No. DE 11346

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

January 25, 2017

GeoEngineers

Plaza 600 Building
600 Stewart Street, Suite 1700
Seattle, Washington 98101
206.728.2674

Health and Safety Plan

Quiet Cove Property
Anacortes, Washington
Ecology Agreed Order No. DE 11346

File No. 5147-024-03

January 25, 2017

Prepared for:

Washington State Department of Ecology
P.O. Box 47600
Olympia, Washington 98504-7600

Attention: Arianne Fernandez

On Behalf of:

Becky Darden
Port of Anacortes
100 Commercial Avenue
Anacortes, Washington 98221

Prepared by:

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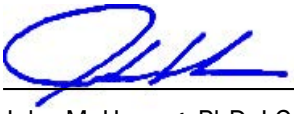
Seattle, Washington 98101
206.728.2674

Robert Trahan, LG
Senior Environmental Scientist



John M. Herzog, PhD, LG
Senior Principal

RST:BJT:NAM:JMH:

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ATTACHMENTS

GEOENGINEERS, INC.
SITE HEALTH AND SAFETY PLAN
QUIET COVE
FILE NO. 5147-024-03

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

Liability Clause: If requested by subcontractors, this site HASP may be provided for informational purposes only. In this case, Form 1 shall be signed by the subcontractor. Please be advised that this site-specific HASP is intended for use by GeoEngineers employees only. Nothing herein shall be construed as granting rights to GeoEngineers' subcontractors or any other contractors working on this site to use or legally rely on this HASP. GeoEngineers specifically disclaims any responsibility for the health and safety of any person not employed by the company.

1.0 GENERAL PROJECT INFORMATION

Project Name:	Quiet Cove
Project Number:	5147-024-03
Type of Project:	Environmental Investigation including drilling, monitoring well installation, groundwater sampling, marine sediment sampling and soil sampling.
Start/Completion:	Within 60 Calendars Days following Ecology's approval of the Remedial Investigation/Feasibility Study (RI/FS) Work Plan
Subcontractors:	Utility locate contractor, drilling contractor and concrete coring contractor

Chain of Command	Title	Name	Telephone Numbers
1	Project Manager	John Herzog	(c) 206.406.6431 (o) 206.239.3252
2	Site Safety Officer	TBD	TBD
3	Field Engineer/Geologist	TBD	TBD
4	Health and Safety Program Manager	Wayne Adams	(c) 253.350.4387 (o) 253.722.2793
N/A	Current Owner	Becky Darden Project Coordinator Port of Anacortes	(c) 360.661.4646 (o) 360.299.1831
N/A	Subcontractor(s)	TBD	TBD

1.1. Functional Responsibility

1.1.1. Project Manager

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

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

1.1.2. Site Safety Officer

The Site Safety Officer (SSO) will have the on-site responsibility and authority to modify and stop work, or remove personnel from the site if working conditions change that may affect on-site and off-site health and safety. The SSO will be the main contact for any on-site emergency situation. The SSO is First Aid and CPR qualified, and has current Hazardous Waste Operations and Emergency Response (HAZWOPER) training. The SSO is responsible for implementing and enforcing the project safety program and safe work practices during site activities. The SSO shall conduct daily safety meetings, perform air monitoring as required, conduct site safety inspections as required, coordinate emergency medical care, and ensure personnel are wearing the appropriate personal protective equipment (PPE). The SSO shall have advanced field work experience and shall be familiar with health and safety requirements specific to the project. The SSO has the authority to suspend site activities if unsafe conditions are reported or observed.

Duties of the SSO include the following:

- Implementing the HASP in the field and monitoring compliance with its guidelines by staff.
- Being sure that GeoEngineers field personnel have met the training and medical examination requirements. Advising other contractor employees of these requirements.
- Maintaining adequate and functioning safety supplies and equipment at the site.
- Setting up work zones, markers, signs and security systems, if necessary.
- Performing or supervising air quality measurements. Communicating information on these measurements to GeoEngineers field staff and subcontractor personnel.
- Communicating health and safety requirements and site hazards to field personnel, subcontractors and contractor employees, and site visitors.
- Directing personnel to wear PPE and guiding compliance with health and safety practices in the field.
- Consulting with the PM regarding new or unanticipated site conditions, including emergency response activities. If monitoring detects concentrations of potentially hazardous substances at or above the established exposure limits, notify/consult with the PM. Consult with the PM and the Health and Safety Program Manager (HSM) regarding new or unanticipated site conditions,

including emergency response activities. If field monitoring indicates concentrations of potentially hazardous substances at or above the established exposure limits, the HSM must be notified and corrective action taken.

- Documenting site accidents, illnesses and unsafe activities or conditions, and reporting them to the PM and the HSM.
- Directing decontamination operations of equipment and personnel.

1.1.3. Field Engineer/Geologist

The Field Engineer/Geologist working on-site that has the potential of coming in contact with hazardous substances or physical hazards is responsible for participating in the health and safety program and complying with the site-specific HASP. These personnel are required to:

- Participate and be familiar with the health and safety program as described in this manual.
- Notify the SSO when there is need to stop work to address an unsafe situation.
- Comply with the HASP and acknowledge understanding of the plan.
- Report to the SSO, PM or HSM any unsafe conditions and all facts pertaining to incidents or accidents that could result in physical injury or exposure to hazardous materials.
- Participate in health and safety training, including initial 40-hour Occupational Safety and Health Administration (OSHA) course, annual 8-hour HAZWOPER refresher, and First Aid/cardiopulmonary resuscitation (CPR) training.
- Participate in the medical surveillance program if applicable.
- Schedule and take a respirator fit test annually.
- Any field employee working onsite may stop work if the employee believes the work is unsafe.

1.1.4. Health and Safety Program Manager

The Health and Safety Program Manager (HSM) is responsible for implementing and promoting employee participation in the program. The HSM issues directives, advisories and information regarding health and safety to the technical staff. Additionally, the HSM has the authority to audit on-site compliance with Health and Safety Plans (HASPs), suspend work or modify work practices for safety reasons, and dismiss from the site any GeoEngineers or subcontractor employees whose conduct on the site endangers the health and safety of themselves or others.

1.1.5. Port of Anacortes Project Coordinator

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

1.1.6. Subcontractors Under GeoEngineers Supervision

Subcontractors working on the site under GeoEngineers supervision or direct control that have the potential of coming in contact with hazardous substances or physical hazards shall have their own health and safety program that is in line with the site-specific HASP.

1.2. List of Field Personnel and Training

Anticipated field personnel include the following:

- Nate Solomon
- Claudia De La Via
- Brian Anderson
- Robert Trahan
- Abhijit Joshi

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

1.3. Site Description

The Quiet Cove property is located at 202 O Avenue in Anacortes, Washington, southeast of Guemes Channel. The property is approximately 0.8 acres in size and is located at the intersection of 2nd Street and O Avenue. The Site is bordered to the north by 2nd Street, east by O Avenue and south by 3rd Street. The western portion of the property borders a Port of Anacortes owned storage yard and a bulk fuel distribution facility owned and operated by Texaco/Reisner.

The Quiet Cove Property is generally flat. The property and surrounding area is paved with concrete or asphalt with the exception of planter strips located on the 2nd and 3rd Street, and O Avenue Rights-Of-Way (ROW) and surface areas of 2nd Street, west adjacent Port and Texaco/Reisner properties which are gravel. Stormwater runoff at the Site is collected in catch basins that discharge to the City of Anacortes stormwater system. Currently, an office and two warehouse buildings are present in the northwest portion of the property. A chain link fence surrounds the property preventing general public access. Vehicle and pedestrian access to the property is through gated entrance south of 2nd Street.

1.4. Site History

The property was historically used for bulk fuel distribution from 1909 to at least 1977 (the date when fuel operations ceased is unknown). Fuel (primarily gasoline and diesel) was supplied to the facility from product lines routed from the property north across 2nd Street to the pier face of Curtis Wharf. While operating as a bulk fuel storage and distribution facility, fuel was stored in above ground storage tanks (ASTs) for general distribution. During the late 1970s, the bulk fuel facility was decommissioned and all of the ASTs and associated structures removed. Between 1977 and 2014, the property was operated as a storage yard for marine vessels and recreational vehicles, and leased office and warehouse space to various tents for sales and marine services. In 2013, the property was purchased by the Port as part of their plans for expansion and improvements to the Curtis Wharf International Shipping Terminal.

2.0 WORK PLAN

2.1. Project Description and Objectives

Field investigation activities will be completed to characterize the nature and extent of hazardous substances in areas where historical uses may have resulted in a release or releases to the environment. RI activities will include the following:

- Characterization of the geology/stratigraphy including: nature and extent of fill materials (i.e., soil fill, wood fill, construction debris such as concrete and brick, etc.) and nature and depth to native soil (i.e., depth to native materials underlying the fill);
- Characterize the groundwater gradient and flow direction, and evaluate the hydraulic connection between groundwater and adjacent marine surface water; and
- Characterization of the nature and extent of hazardous substances in media of concern.

RI data gathering for the RI will follow a phased or tiered approach consisting of an initial investigation and follow-up investigation(s) as described in the RI/FS Work Plan. Sample locations and laboratory analyses that will be completed are detailed in the RI/FS Work Plan.

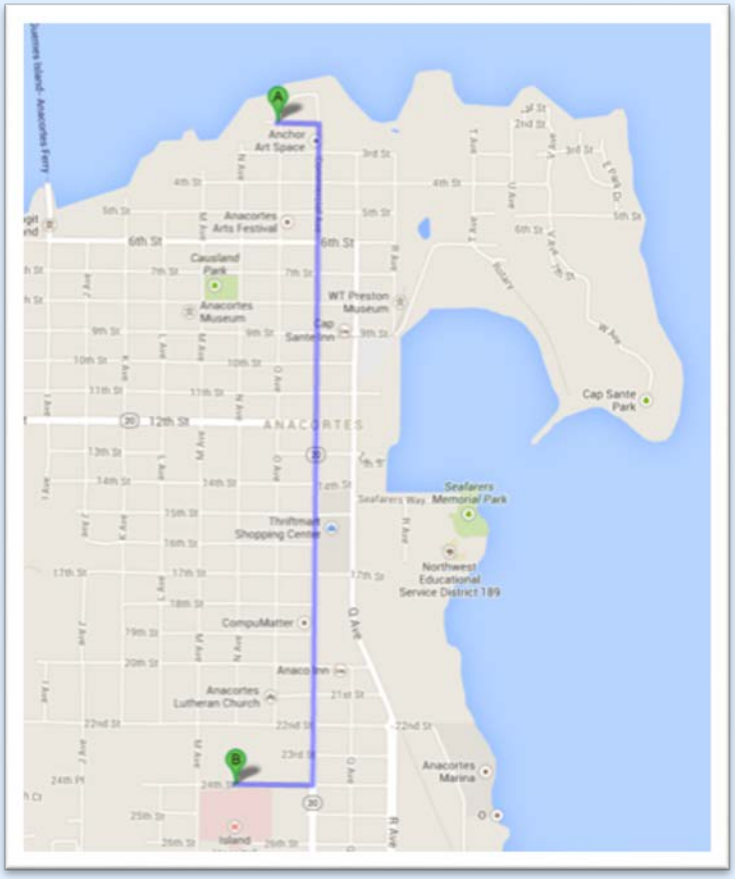
2.2. List of Field Activities

Anticipated field activities to be completed during the project:

Y/N	Field Activity	Y/N	Field Activity
Y	Site Reconnaissance	N	Vapor Measurements
Y	Exploratory Borings	N	Product Sample collection
N	Construction Monitoring	N	Soil Stockpile Testing
Y	Surveying	N	Remedial Excavation
N	Test Pit Exploration	N	Recovery of Free Product
Y	Soil Sample Collection	Y	Monitoring Well Installation
Y	Groundwater Sampling	Y	Monitoring Well Development
Y	Sediment Sampling	N	Underground Storage Tank (UST) Removal Monitoring
Y	Groundwater Depth/Free Product Measurement	N	Other: Click here to enter text.

3.0 EMERGENCY INFORMATION

Hospital Name and Address:	Island Hospital 1211 24th Street Anacortes, WA 98221
Phone Numbers (Hospital ER):	**Phone**: (360) 468-3185 /(360) 299-1300
Distance:	1.5 Miles

Route to Hospital: 1) Head east on 2nd St toward O Ave – 410 feet 2) Turn right onto Commercial Ave – 1.2 mile 3) Turn right onto 24th Street – 0.1 mile 4) Arrive at 1211 24th St, Anacortes	
Ambulance:	9-1-1
Poison Control:	Seattle (206) 253-2121; Other (800) 732-6985
Police:	9-1-1
Fire:	9-1-1
Location of Nearest Telephone:	Cell phones are carried by field personnel.
Nearest Fire Extinguisher:	Located in the GeoEngineers vehicle on-site.
Nearest First-Aid Kit:	Located in the GeoEngineers vehicle on-site.

3.1. Standard Emergency Procedures

- Get help
  - Send another worker to phone 9-1-1 (if necessary)
  - As soon as feasible, notify GeoEngineers' Project Manager
- Reduce risk to injured person
  - Turn off equipment
  - Move person from injury location (if in life-threatening situation only)

- Keep person warm
- Perform CPR (if necessary)

- Transport injured person to medical treatment facility (if necessary)
  - By ambulance (if necessary) or GeoEngineers vehicle
  - Stay with person at medical facility
  - Keep GeoEngineers Project Manager apprised of situation and notify Human Resources Manager of situation

3.2. Emergency Response

- Visual contact should be maintained between "pairs" on site, with the team remaining in proximity to assist each other in case of emergencies.
- If any member of the field crew experiences any adverse exposure symptoms while on site, the entire field crew should immediately halt work and act according to the instructions provided by the SSO.
- The discovery of any condition that would suggest the existence of a situation more hazardous than anticipated should result in the evacuation of the field team, contact of the PM, and reevaluation of the hazard and the level of protection required.
- If an accident occurs, the Site Safety Officer and the injured person are to complete, within 24 hours, an Accident Report (Form 3) for submittal to the PM, the HSPM, and HR. The PM should ensure that follow-up action is taken to correct the situation that caused the accident or exposure.

4.0 HAZARD ANALYSIS

A hazard analysis has been completed as part of preparation of this HASP. The hazard analysis was performed taking into account the known and potential hazards at the site and surrounding areas, as wells as the planned work activities. The results of the hazard analysis are presented in this section. The hazard assessment will be evaluated each day before beginning work. Updates will be made as necessary and documented in the daily field log.

The following are known applicable hazards.

4.1. Physical Hazards and Mitigation Measures/Procedures

PHYSICAL HAZARDS (POTENTIALLY PRESENT AT THE SITE)

Y/N	Physical Hazard
Y	Drill rigs and Concrete Coring, including working inside a warehouse
N	Backhoe
N	Trackhoe
N	Crane
N	Front End Loader

Y/N	Physical Hazard
N	Excavations/trenching (1:1 slopes for Type B soil)
N	Shored/braced excavation if greater than 4 feet of depth
Y	Overhead hazards/power lines
Y	Tripping/puncture hazards (debris on-site, steep slopes or pits)
Y	Unusual traffic hazard – Street traffic
Y	Heat/Cold, Humidity
Y	Utilities/ utility locate
Y	Noise
N	Other: Click here to enter text.

4.1.1. Mitigation Measures/Procedures

- A utility shall be completed as required for the location to prevent drilling or digging into utilities.
- Work areas will be marked with reflective cones, barricades and/or caution tape. High-visibility vests will be worn by on-site personnel to ensure they can be seen by vehicle and equipment operators.
- Field personnel will be aware of the location and motion of heavy equipment in the area of work to ensure a safe distance between personnel and the equipment. Personnel will be visible to the operator at all times and will remain out of the swing and/or direction of the equipment apparatus. Personnel will approach operating heavy equipment only when they are certain the operator has indicated that it is safe to do so through hand signal or other acceptable means.
- Heavy equipment and/or vehicles used on this site will not work within 20 feet of overhead utility lines without first ensuring that the lines are not energized. This distance may be reduced to 10 feet, depending on the client and the use of a safety watch.
- Personnel entry into unshored or unsloped excavations deeper than 4 feet is not allowed. Any trenching and shoring requirements will follow guidelines established in Washington Administrative Code (WAC) 296-155, the Washington State Construction Standards or OSHA 1926.651 Excavation Requirements. In the event that a worker is required to enter an excavation deeper than 4 feet, a trench box or other acceptable shoring will be employed or the side walls of the excavation will be sloped according to the soil type and guidelines as outlined in Department of Occupational Safety and Health (DOSH) and OSHA regulations. If the shoring/sloping deviates from that outlined in the WAC, it will be designed and stamped by a Professional Engineer (PE). Prior to entry, personnel will conduct air monitoring as described later in this plan. All hazardous encumbrances and excavated material will be stockpiled at least 2 feet from the edge of a trench or open pit. If concentrations of volatile gases accumulate within an open trench or excavation, the means of entering shall adhere to confined space entry and air monitoring procedures outlined under the air monitoring recommendations in this Plan and/or the GeoEngineers Health and Safety Programs.
- Personnel will avoid tripping hazards, steep slopes, pits and other hazardous encumbrances. If it becomes necessary to work within 6 feet of the edge of a pit, slope or other potentially hazardous

area, appropriate fall protection measures will be implemented by the Site Safety Officer in accordance with OSHA/DOSH regulations and the GeoEngineers Health and Safety Program.

- Cold stress control measures will be implemented according to the GeoEngineers Health and Safety Program to prevent frost nip (superficial freezing of the skin), frost bite (deep tissue freezing), or hypothermia (lowering of the core body temperature). Heated break areas and warm beverages shall be available during periods of cold weather.
- Heat stress control measures required for this site will be implemented according to GeoEngineers Health and Safety Program with water provided on-site.

4.1.2. Engineering Controls

Y/N	Engineering Control
N	Trench shoring (1:1 slope for Type B Soils)
Y	Location work spaces upwind/wind direction monitoring
N	Other soil covers (as needed)
N	Other (specify): Click here to enter text.

4.2. Biological Hazards and Mitigation Measures/Procedures

BIOLOGICAL HAZARDS (POTENTIALLY PRESENT AT SITE)

Y/N	Biological Hazard	Mitigation Measure/Procedure
N	Poison Ivy or other vegetation	Work gloves and long sleeve shirt
Y	Insects or snakes	Work gloves and long sleeve shirt
N	Hypodermic needles or other infectious hazards	Do not pick up or contact
N	Wildlife	Click here to enter text.
Y	Other: Bird droppings	Hard hat, gloves and long sleeve shirt

4.3. Ergonomic Hazards and Mitigation Measures/Procedures

4.3.1. Lifting Injuries

Back injuries often result from lifting objects that are too heavy or from using the wrong lifting technique. Keep your back healthy and pain-free by following common sense safety precautions.

- Minimize reaching by keeping frequently used items within arm's reach, moving your whole body as close as possible to the object.
- Avoid overextending by standing up when retrieving objects on shelves.
- Keep your back in shape with regular stretching exercises.
- Get help from a coworker or use a hand truck if the load is too heavy or bulky to lift alone.

4.3.2. Lifting Techniques

- Face the load; don't twist your body. Stand in a wide stance with your feet close to the object.

- Bend at the knees, keeping your back straight. Wrap your arms around the object.
- Let your legs do the lifting.
- Hold the object close to your body as you stand up straight. To set the load down, bend at the knees, not from the waist.

4.4. Chemical Hazards

CHEMICAL HAZARDS (POTENTIALLY PRESENT AT SITE)

Substance	Pathways
Petroleum Products Gasoline Diesel Heavy oil Waste oil	Air/Soil/Water
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs) and Naphthalenes	Air/Soil/Water
Halogenated Volatile Organic Compounds	Air/Soil/Water
Volatile Organic Compounds (VOCs) Benzene, ethylbenzene, toluene, xylenes (BETX) n-Hexane Methyl tertiary-butyl ether (MTBE) 1,2-dibromoethane (EDB) 1,2-dichloroethane (EDC)	Air/Soil/Water
Polychlorinated Biphenyl's (PCBs)	Air/Soil/Water
Metals Arsenic Cadmium Chromium Lead Mercury	Air/Soil/Water

SPECIFIC CHEMICAL HAZARDS AND EXPOSURES (POTENTIALLY PRESENT AT SITE)

Chemical or Compound/ Description	Exposure Limits/ IDLH	Exposure Route	Immediate Symptoms of Exposure/Health Effects
Arsenic	PEL 0.05 mg/m^3 IDLH 5.0 mg/m^3	Inhalation, skin absorption, skin and eye contact, ingestion	Ulceration of nasal septum; dermatitis; GI disturbances; peripheral neuropathy; respiratory irritation; hyperpigmentation of skin
Cadmium	PEL 0.005 mg/m3 IDLH 9 mg/m3	respiratory system, kidneys, prostate, blood	Pulmonary edema, dyspnea (breathing difficulty), cough, chest tightness, substernal (occurring beneath the sternum) pain; headache; chills, muscle

Chemical or Compound/ Description	Exposure Limits/ IDLH	Exposure Route	Immediate Symptoms of Exposure/Health Effects
			aches; nausea, vomiting, diarrhea; anosmia (loss of the sense of smell), emphysema, proteinuria, mild anemia; [potential occupational carcinogen]
Chromium	PEL 1 mg/m^3 IDLH 250 mg/m^3	Inhalation, ingestion, skin and eye contact	Irritated eyes, skin respiratory system
Lead	PEL 0.05 mg/m^3 IDLH 100 mg/m^3	Inhalation, ingestion, skin and eye contact	Lassitude; insomnia; facial pallor; abnormalities; weight loss, malnutrition, constipation, abdominal pain; colic; anemia; gingival lead line; tremors; paralysis of the wrist and ankles; encephalopathy; kidney disease; irritated eyes; hypertension
Mercury	PEL 0.05 mg/m^3 IDLH 10 mg/m^3	Inhalation, skin absorption, skin and eye contact, ingestion	Irritated eyes, skin; cough, chest pain, dyspnea, bronchitis, pneumonia; tremors, insomnia, irritability, indecision, headache, lassitude; stomatitis, salivation; GI disturbances, abnormalities, low weight; proteinuria
Gasoline (Unleaded) — clear liquid with a characteristic odor	PEL 300 ppm TLV 300 ppm STEL 500 ppm	Ingestion, inhalation, skin absorption, skin and eye contact	Irritated eyes, skin, and mucous membrane; fatigue; blurred vision; dizziness; slurred speech; confusion; convulsions; headache; dermatitis
Diesel Fuel — liquid with a characteristic odor	None established by OSHA, but ACGIH has adopted 100 mg/m3 for a TWA (as total hydrocarbons)	Ingestion, inhalation, skin absorption, skin and eye contact	Irritated eyes, skin, and mucous membrane; fatigue; blurred vision; dizziness; slurred speech; confusion; convulsions; headache; dermatitis
Waste oil – may contain metals, gas, antifreeze and PAHs	Depends on the ancillary contaminants	Ingestion, inhalation, skin absorption, skin and eye contact	Depends on the ancillary contaminants.
Lube Oil/Mineral Oil – as a mist	The current OSHA PEL for mineral oil mist is 5 mg/m3 of air as an 8-hr TWA	If the oil is not a mist, then route of exposure is skin and eye contact	Exposure to oil mists can cause eye, skin and upper respiratory tract irritation.
Benzene	OSHA PEL 1 ppm Short term: 5 ppm ACGIH PEL 0.5 ppm	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritated eyes, skin, nose, respiratory system; dizziness; headache, nausea, staggered gait; anorexia, lassitude (weakness, exhaustion); dermatitis; bone marrow depression; [potential occupational carcinogen]

Chemical or Compound/ Description	Exposure Limits/ IDLH	Exposure Route	Immediate Symptoms of Exposure/Health Effects
Toluene	PEL 100 ppm IDLH 500 ppm	Inhalation, absorption, ingestion, direct contact	Irritation to eyes, nose, exhaustion, confusion, dizziness, headaches, dilated pupils, euphoria, anxiety, teary eyes, muscle fatigue, insomnia, paresthesia, dermatitis, liver and kidney damage.
Ethyl benzene	PEL 100 ppm IDLH 800 ppm	Inhalation, ingestion, direct contact	Irritation to eyes, skin, respiratory system, burning
Xylenes	PEL 100 ppm IDLH 900 ppm	Inhalation, skin absorption, ingestion, direct contact	Irritation to eyes, skin, nose, throat, dizziness, excitement, drowsiness, incoordination, staggering gait, corneal vacuolization, anorexia, nausea, vomiting, abdominal
MTBE	PEL 40 ppm	Ingestion, Inhalation, skin absorption, direct contact	Irritation to eyes, skin, nose, throat and lungs, aspiration, chemical pneumonia, nausea, vomiting, diarrhea, tremors, convulsions, loss of consciousness, headache, dizziness, loss of balance or coordination.
Polycyclic aromatic hydrocarbons (PAH) as coal tar pitch volatiles	PEL 0.2 mg/m^3 TLV 0.2 mg/m^3 REL 0.1 mg/m^3 IDLH 80 mg/m^3	Inhalation, ingestion, skin and/or eye contact	Dermatitis, bronchitis, potential carcinogen
PCBs (as Arochlor 1254)—colorless to pale-yellow viscous liquid with a mild, hydrocarbon odor	PEL 0.5 mg/m^3 TLV 0.5 mg/m^3 REL 0.001 mg/m^3 IDLH 5.0 mg/m^3	Inhalation (dusts or mists), skin absorption, ingestion, skin and/or eye contact	Irritated eyes, chloracne, liver damage, reproductive effects, potential carcinogen

Notes:

IDLH = immediately dangerous to life or health
OSHA = Occupational Safety and Health Administration
ACGIH = American Conference of Governmental Industrial Hygienists
mg/m^3 = milligrams per cubic meter
TWA = time-weighted average (Over 8 hrs.)
PEL = permissible exposure limit
TLV = threshold limit value (over 10 hrs)
STEL = short-term exposure limit (15 min)
ppm = parts per million

4.4.1. Mitigation Measures/Procedures

- **Groundwater Sampling:** Splash hazard associated with groundwater extraction and sample collection. Possible corrosion hazard associated with sample preservatives. Wear protective clothing and eye protection and chemical-resistant gloves are required when handling samples.
- **Sample handling, packaging, and processing:** skin contact with contaminated media and preservative acids. Wear modified Level D personal protective equipment (PPE).

- **Decontamination of equipment:** inhalation or eye contact or skin contact with airborne mists or vapors, or contaminated liquids. Wear safety glasses; decontaminate clothing and skin prior to eating, drinking or other hand to mouth contact.

4.5. Additional Hazards

Update in Daily Report. Include evaluation of:

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

5.0 AIR MONITORING PLAN

An air monitoring plan has been prepared as part of development of this HASP. The air monitoring plan is based on the results of the chemical exposure assessment and the known and potential inhalation hazards on-site. The air monitoring plan addresses steps necessary to limit worker exposure. Non-occupational exposures are not addressed in this plan. When possible, position yourself up upwind of the field activity.

FIELD INSTRUMENTATION

	Applicable Field Instrumentation
X	Multi-Gas Detector (may include oxygen, carbon monoxide, hydrogen sulfide, lower explosive limit)
	Dust Monitor
	Other (i.e., detector tubes or badges) Please specify: Click here to enter text.

MONITORING FREQUENCY

	Applicable Monitoring Frequency/Locations and Type
X	Continuous during soil disturbance activities or handling samples
	15 minutes
	30 minutes
	Hourly

5.1. Action Levels for Volatile Organic Chemicals

- The workspace will be monitored using a photoionization detector (PID). These instruments must be properly maintained, calibrated and charged (refer to the instrument manuals for details). Zero this meter in the same relative humidity as the area in which it will be used and allow at least a 10-minute warm-up prior to zeroing. Do not zero in a contaminated area.

- An initial vapor measurement survey of the site should be conducted to detect "hot spots" if contaminated soil is exposed at the surface. Vapor measurement surveys of the workspace should be conducted at least hourly or more often if persistent petroleum-related odors are detected. Additionally, if vapor concentrations exceed 5 parts per million (ppm) above background continuously for a 5-minute period as measured in the breathing zone, upgrade to Level C personal protective equipment (PPE) or move to a non-contaminated area.
- Standard industrial hygiene/safety procedure is to require that action be taken to reduce worker exposure to organic vapors when vapor concentrations exceed one-half the threshold limit value (TLV). Because of the variety of chemicals, the PID will not indicate exposure to a specific permissible exposure limit (PEL) and is therefore not a preferred tool for determining worker exposure to chemicals. If odors are detected, then employees shall upgrade to respirators with Organic Vapor cartridges and will contact the Health and Safety Program Manager for other sampling options.

AIR MONITORING ACTION LEVELS

Contaminant	Activity	Monitoring Device	Frequency of Monitoring Breathing Zone	Action Level	Action
Organic Vapors	Environmental Remedial Actions	PID	Start of shift; prior to excavation entry; every 30 to 60 minutes and in event of odors	Background to 5 ppm in breathing zone	Use Level D or Modified Level D PPE
Organic Vapors	Environmental Remedial Actions	PID	Start of shift; prior to excavation entry; every 30 to 60 minutes and in event of odors	5 to 50 ppm in breathing zone	Upgrade to Level C PPE *
Organic Vapors	Environmental Remedial Actions	PID	Start of shift; prior to excavation entry; every 30 to 60 minutes	> 50 ppm in breathing zone	Stop work and evacuate the area. Contact Health and Safety Program Manager for guidance.
Combustible Atmosphere	Environmental Remedial Actions	PID	Start of shift; prior to excavation entry; every 30 to 60 minutes	>10% LEL or >1,000 ppm	Depends on contaminant. The PEL is usually exceeded before the lower explosive limit (LEL).
Combustible Atmosphere	Environmental Remedial Actions	PID or 4-gas meter	Start of shift; prior to excavation entry; every 30 to 60 minutes	>10% LEL or >1,000 ppm	Stop work and evacuate the site. Contact Health and Safety Program Manager for guidance.

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

*Contact the HSPM and Project Manager

6.0 SITE CONTROL PLAN

Use this section to provide an up-to-date Site Control Plan for cleanup operations to minimize employee exposure to hazardous substances.

6.1. Traffic or Vehicle Access Control Plans

GeoEngineers will work with the Port to obtain a Right-of-Way Permit from the City of Anacortes for borings performed near sidewalks and on roads, including preparation of a streamlined traffic control plan, if needed. Flagging and traffic control, if needed, will be performed by contractors of GeoEngineers. All persons contracting to perform flagging will have on site a current flagging card indicating that they are trained.

Traffic control procedures and devices must be used in accordance with Part VI of the Manual on Uniform Traffic Control Devices (MUTCD) and Washington Safety and Health Standard WAC 296-155-305. Where flaggers are needed, supervisor must ensure that each flagger has the qualifications, training and equipment necessary to perform assigned task in accordance with the MUTCD. Training must be updated every 3 years. At a minimum, flaggers must have a stop/slow paddle, high visibility clothing, safety shoes, and a hard hat, before approaching any right of way to control traffic.

6.2. Site Work Zones

Exclusion zones will be established within approximately 10 feet around each boring or well during drilling/sampling. Only persons with the appropriate training will enter this perimeter while work is being conducted there.

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

- Scrub brushes
- Spray rinse applicator
- Plastic garbage bags
- Container of Alconox/water solution and Alconox powder
- Hot zone/exclusion zone (Approximately 10 to 15 feet around boring locations).

METHOD OF DELINEATION/EXCLUDING NON-SITE PERSONNEL

Applicable Delineation/Exclusion Methods	
X	Fence
	Survey Tape
X	Traffic Cones
	Other

6.3. Buddy System

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

6.4. Site Communication Plan

Positive communications (within sight and hearing distance or via radio) should be maintained between pairs on-site, with the pair remaining in proximity to assist each other in case of emergencies. The team should prearrange hand signals or other emergency signals for communication when voice communication becomes impaired (including cases of lack of radios or radio breakdown) and an agreed upon location for an emergency assembly area.

In instances where communication cannot be maintained, you should consider suspending work until it can be restored. If this is not an option, the following are some examples for communication:

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

6.5. Emergency Action

In the event of an emergency, employees with convene in a designated area. Employees should communicate with others working on site and the PM to determine the Emergency Action Plan for each site. GeoEngineers employees and subcontractor(s) should be made aware of the Emergency Action for the site at each morning's safety tailgate meeting (drill rig shutoff switch, location of fire extinguishers, cell phone numbers, etc.). For medical assistance, see Section 3.0 above.

6.6. Decontamination Procedures

Decontamination, at a minimum, should include removing and disposing of PPE when exiting the exclusion zone and washing your hands. Decontamination may also consist of removing outer protective gloves and washing soiled boots and gloves using bucket and brush provided on-site in the contamination reduction zone. If needed, inner gloves will then be removed, and respirator, hands and face will be

washed in either a portable wash station or a bathroom facility at the site. Employees will perform decontamination procedures and wash before eating, drinking or leaving the site.

6.7. Waste Disposal or Storage

Incidental waste including used PPE is to be placed in a plastic bag for disposal. Investigation derived waste (IDW) will be place in 35/55-gallon drums and stored on site in a secure location pending characterization and disposal.

7.0 PERSONAL PROTECTIVE EQUIPMENT

Personal Protective Equipment (PPE) will consist of standard Level D equipment. Site activities include handling and sampling of soil, groundwater and sediment. Depth-to-groundwater measurements will be performed as well. Site hazards include potential exposure to hazardous materials, and physical hazards such as trips/falls, heavy equipment, and contaminant exposure.

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

- Half-face combination organic vapor/high efficiency particulate air (HEPA) or P100 cartridge respirators will be available on site to be used as necessary. P100 cartridges are to be used only if PID measurements are below the site action limit. P100 cartridges are used for protection against dust, metals and asbestos, while the combination organic vapor/HEPA cartridges are protective against both dust and vapor. Ensure that the PID or TLV will detect the chemicals of concern on-site.
- Level D PPE, unless a higher level of protection is required, will be worn on the site. Potentially exposed personnel will wash gloves, hands, face and other pertinent items to prevent hand-to-mouth contact. This will be done prior to hand-to-mouth activities including eating, smoking, etc.
- Adequate personnel and equipment decontamination will be used to decrease potential ingestion and inhalation.

PERSONAL PROTECTIVE EQUIPMENT

Applicable Personal Protection Equipment	
Field Equipment (specify):	
X	Hardhat (if overhead hazards, or client requests)
X	Steel-toed boots (if crushing hazards are a potential or if client requests)
X	Safety glasses (if dust, particles, or other hazards are present or client requests)
X	Reflective vest (if working near traffic or equipment)
X	Hearing protection (if it is difficult to carry on a conversation 3 feet away)
X	Rubber boots (if wet conditions)
Gloves (specify):	
X	Nitrile
	Latex

Applicable Personal Protection Equipment	
	Liners
	Leather
	Other (specify) Click here to enter text.
Protective Clothing (specify):	
	Tyvek (if dry conditions are encountered, Tyvek is sufficient) (modified Level D or Level C)
	Saranex (personnel shall use Saranex if liquids are handled or splash may be an issue) (modified Level D or Level C)
X	Cotton (Level D)
X	Rain gear (as needed) (Level D)
X	Layered warm clothing (as needed) (Level D)
Inhalation Hazard Protection (specify):	
X	Level D (no respirator)
	Level C (respirators with organic vapor/HEPA P100 filters)
	Level B (Self Contained Breathing Apparatus— STOP, Consult the HSM)

7.1. Personal Protective Clothing Inspections

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

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

7.2. Respirator Selection, Use and Maintenance

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

7.3. Respirator Cartridges

If the action levels identified in the Air Monitoring Action Levels Table in Section 5.0, are exceeded, site personnel should don respiratory protection appropriate for the known or suspected chemical of concern. For most sites, a half-face or full-face air purifying respirator with a National Institute for Occupational Safety and Health (NIOSH)-approved organic vapor/HEPA P100 combination cartridge (Level C), will be appropriate for the known or suspected chemicals of concern. Monitoring frequency should be continuous while using Level C respiratory protection. The SSO closely monitor personnel using respiratory protection, including observing for signs of fatigue or respiratory distress, the potential for cartridge breakthrough or increased resistance to inhalation, and the need for changes in the level of respiratory protection based on air monitoring. The frequency and duration of breaks should be increased for personnel working in respiratory protection. If at any time on-site air monitoring indicates Level B respiratory protection is warranted, personnel should leave the exclusion zone and consult with the HSM.

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

7.4. Respirator Inspection and Cleaning

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

8.0 ADDITIONAL ELEMENTS

8.1. Heat/Cold Stress

8.1.1. Cold Stress Prevention

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

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

8.1.2. Heat Stress Prevention

Keeping workers hydrated in a hot outdoor environment requires more water be provided than at other times of the year. When employee exposure is at or above an applicable temperature listed in the Heat Stress table below, Project Managers will ensure that:

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

HEAT STRESS

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

8.2. Personnel Medical Surveillance

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

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

8.3. Spill Containment Plans (Drum and Container Handling)

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

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

8.4. Entry Procedures for Tanks or Vaults (Confined Spaces)

GeoEngineers employees shall not enter confined spaces to perform work unless they have been properly trained and with hands-on experience in the use of retrieval equipment. If a project requires confined space entry, please include a copy of the confined space permit and include the training documentation in this HASP.

Trenches greater than 4 feet in depth with the potential for buildup of a hazardous atmosphere are considered confined spaces.

8.5. Sanitation

Washrooms are assumed to be present in on-site buildings. If necessary, portable toilets will be provided during work activities.

8.6. Lighting

Work is anticipated to be performed during daylight hours. Work may extend slightly into the evening provided adequate lighting is used (e.g. portable flood lights).

9.0 DOCUMENTATION TO BE COMPLETED FOR HAZWOPER PROJECTS

The following forms shall be completed:

- Daily Field Log (include the following information)
  - Updates on hazard assessments, field decisions, conversations with subcontractors, client or other parties, etc.;
  - Air monitoring/calibration results, including: personnel, locations monitored, activity at the time of monitoring, etc.;
  - Actions taken;
  - Action level for upgrading PPE and rationale; and
  - Meteorological conditions (temperature, wind direction, wind speed, humidity, rain, snow, etc.).
- FORM 1 – Health and Safety Pre-Entry Briefing and Acknowledgment of the Site Health and Safety Plan for GeoEngineers' Employees, Subcontractors and Visitors
- FORM 2 – Safety Meeting Record
- FORM 3 – Accident/Exposure Report Form

FORM 1
HEALTH AND SAFETY PRE-ENTRY BRIEFING AND ACKNOWLEDGEMENT OF THE SITE HEALTH AND SAFETY PLAN FOR GEOENGINEERS' EMPLOYEES, SUBCONTRACTORS AND VISITORS
QUIET COVE PROPERTY
FILE NO. 5147-024-03

Inform employees, contractors and subcontractors or their representatives about:

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

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

- A pre-entry briefing before any site activity is started.
- Additional briefings, as needed, to make sure that the Site-specific HASP is followed.
- Make sure employees working on the Site are informed of any risks identified and trained on how to protect themselves and other workers against the Site hazards and risks.
- Update information to reflect current sight activities and hazards.
- Personnel participating in this project must receive initial health and safety orientation. Thereafter, brief tailgate safety meetings will be held as deemed necessary by the Site Safety Officer.
- The orientation and the tailgate safety meetings shall include a discussion of emergency response, site communications and site hazards.

(GeoEngineers' Site workers shall complete this form, which should remain attached to the HASP and be filed with other project documentation). Please be advised that this site-specific HASP is intended for use by GeoEngineers employees only. Nothing herein shall be construed as granting rights to GeoEngineers' subcontractors or any other contractors working on this site to use or legally rely on this HASP. GeoEngineers specifically disclaims any responsibility for the health and safety of any person not employed by the company.

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

Print Name **Signature** **Date**

_____

_____

_____

FORM 2
SAFETY MEETING RECORD
QUIET COVE PROPERTY
FILE NO. 5147-024-03

Safety meetings should include a discussion of emergency response, site communications, site hazards and mitigation measures.

- Use in conjunction with the HASP and JHA to help identify hazards.

Date: _____ **Site Safety Officer (SSO):**_____

Topics: _____

Briefly describe what was discussed:

_____

_____

Attendees:

Print Name **Signature:**

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

FORM 3
ACCIDENT/EXPOSURE REPORT FORM
QUIET COVE
FILE NO. 5147-024-03

To (Supervisor): _____ From (Employee): _____

Telephone (with area code): _____

Name of injured or ill employee: _____

Date of accident: Time of accident: Exact location of accident:

Narrative description of accident/exposure (circle one):

Medical attention given on site:

Nature of illness or injury and part of body involved: Lost Time? Yes ☐ No ☐

Probably Disability (check one):

Fatal	Lost work day with days away from work	Lost work day with days of restricted activity	No lost work day	First Aid only
☐	☐	☐	☐	☐

Corrective action taken by reporting unit and corrective action that remains to be taken (by whom and when):

Employee Signature: Date:

Name of Supervisor:

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GeoEngineers

APPENDIX E
Public Participation Plan

Site Cleanup:

QUIET COVE

202 O Avenue, Anacortes
Skagit County, Washington

DRAFT PUBLIC PARTICIPATION PLAN

Prepared by:
Washington State Department of Ecology

DEPARTMENT OF
ECOLOGY
State of Washington

October 2015

This plan is for you!

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

For additional copies of this document, please contact:

Washington State Department of Ecology
Arianne Fernandez, Site Manager
Toxics Cleanup Program
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Olympia, WA 98504-7600
(360) 407-7209
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If you need this publication in an alternate format, please call the Toxics Cleanup Program at (360) 407-7170. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call (877) 833-6341 (TTY).

Table of Contents

1.0: Introduction and Overview of the Public Participation Plan

This Public Participation Plan (Plan) explains how you can become involved in improving the health of your community. It describes public participation opportunities that will be available during this review period for a site connected to the Fidalgo/Padilla Bay waterfronts – the Quiet Cove Site (the Site). The Site is generally located at 202 O Avenue in Anacortes, Skagit County, Washington. These opportunities are part of a collaborative effort by the Washington State Department of Ecology (Ecology) and Port of Anacortes (Port) to decide on cleanup actions for the Site. Current documents for review include:

- Draft Agreed Order (AO), a legal agreement between Ecology and the Potentially Liable Person (PLP), the Port, in which the Port agrees to provide remedial action at the Site where there has been a release or threatened release of hazardous substances.

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

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

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

- Notifying the public about available reports and studies about the Site.
- Notifying the public about review and comment opportunities during specific phases of the cleanup investigation.

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

- Providing appropriate public participation opportunities to learn about cleanup documents, and if community interest exists, holding meetings to solicit input and identify community concerns.
- Considering public comments received during public comment periods.

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

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

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

Part of the Puget Sound Initiative

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

Roles and Responsibilities

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

Organization of this Public Participation Plan

The sections that follow in this Plan provide:

- Section 2: Background information about the Site.
- Section 3: An overview of the local community that this Plan is intended to engage.

- Section 4: Public involvement opportunities in this cleanup.

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

2.0: Site Background

Site Description and Location

The Site is generally located at 202 O Avenue in Anacortes, Skagit County, Washington, along the east end of the Guemes Channel just northwest of Fidalgo/Padilla Bays (see Figure 1).

The Site is located between 2nd and 3rd Streets west of O Avenue, and it totals about 0.82 acres. The Site may extend across 2nd Street toward Curtis Wharf International Shipping Terminal and into the Guemes Channel to the northwest.

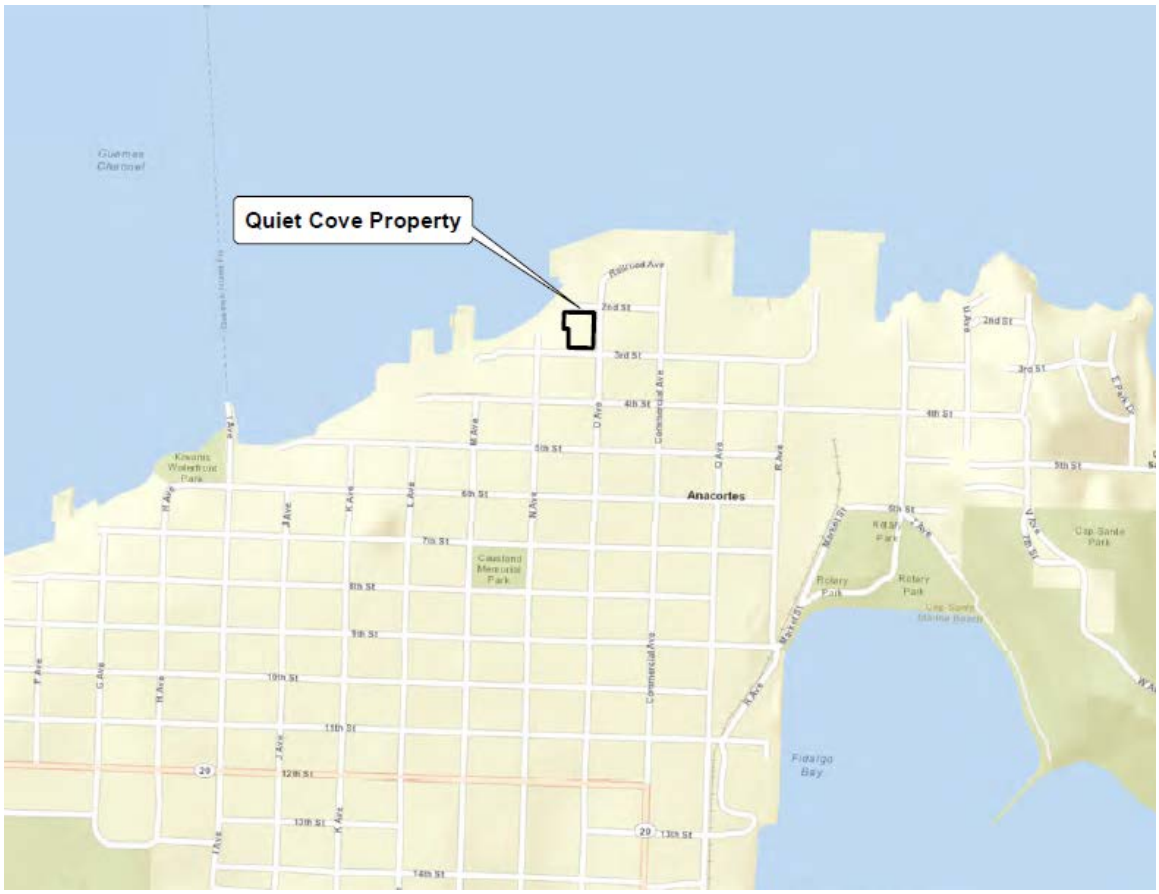


Figure 1: The Quiet Cove Site is shown in the above map, generally located at 202 O Avenue in Anacortes, Skagit County, WA.

General Site History and Contaminants

Quiet Cove sits along the east end of the Guemes Channel just northwest of Fidalgo/Padilla Bays. The Site began operating as a bulk fuel terminal and storage facility as early as 1909. The remnants from these operations (oil tanks, oil warehouse, filling shed, piping and more) were removed at an unknown date. Now, the Site's remaining buildings and pavement are used for storage space.

The Port purchased the upland area of the Site in July 2013 and performed an environmental investigation the following year.

This investigation found several contaminants exceeding accepted cleanup levels. Soil samples showed hydrocarbon and heavy metal contamination including:

- Benzene
- Toluene
- Ethylbenzene
- Xylenes
- Total petroleum hydrocarbons (TPHs)
- Carcinogenic Polycyclic Aromatic Hydrocarbons
- Naphthalenes
- Cadmium

Groundwater samples showed TPHs and arsenic.

In 2014, Ecology determined the Port is the PLP for the Site. Ecology and the Port will enter into an AO.

The Cleanup Process

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

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

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

- Draft RI report
- Draft FS report
- Draft CAP

These comment periods may be conducted separately or combined.

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

Interim Actions

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

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

Overview of Draft Agreed Order

The Draft AO is a proposed agreement between Ecology and the PLP (the Port). It is a legal document between Ecology and the Port in which the Port agrees to provide remedial action at the Site where there has been a release or threatened release of hazardous substances.

The Draft AO describes studies the Port agrees to perform at the Site as well as guidance for future investigations and cleanup actions:

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

3.0: Community Profile

Community Profile

Anacortes is Skagit County's second largest city and its largest seaport. It is the principal city on Fidalgo Island. The current population is approximately 16,232 people (about 7,680 households)[2] situated within approximately 12 square miles. Located on Fidalgo/Padilla Bays, Anacortes has 12.5 miles of saltwater shoreline which support three Port of Anacortes marine terminals, a shipyard, several yacht and mid-size boat building and sales operations, and four private marinas. In addition to the City's modern educational and health care facilities, four freshwater lakes and 3,300 acres of city-owned forestland and parks create a rural character in the community. The City's 2013 labor workforce was more than 13,232, predominantly employed in manufacturing, accommodations/food service, retail and health care.[3]

Key Community Concerns

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

[2] US Census Bureau, State & County QuickFacts, *available at* http://www.census.gov/quickfacts/table/PST045214/5301990,00 (Accessed 09/22/15).
[3] American Factfinder, City of Anacortes, Washington, *available at* http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF (Accessed 09/23/15).

4.0: Public Participation Opportunities

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

Measuring Success

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

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

If we are successful, this process will increase:

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

Activities and Information Sources

Ecology Contacts

Ecology is the lead contact for questions about the cleanup in your community. The Ecology staff person identified in this section is familiar with the cleanup process and activities at the Site. For more information about public involvement or the technical aspects of the cleanup, please visit our website at https://fortress.wa.gov/ecy/gsp/Sitepage.aspx?csid=12482, or contact:

Arianne Fernandez, Site Manager
Department of Ecology
Toxics Cleanup Program
PO Box 47600
Olympia, WA 98504-7600

Phone: (360) 407-7209
Email: Arianne.Fernandez@ecy.wa.gov

Ecology's Webpage

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

https://fortress.wa.gov/ecy/gsp/Sitepage.aspx?csid=12482

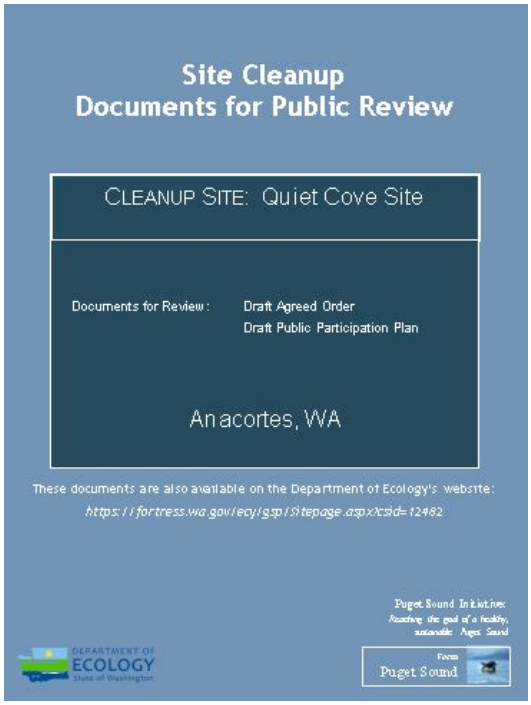
Information Centers/Document Repositories

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

- **Anacortes Public Library**
  1220 10th Street
  Anacortes, WA 98221
  Phone: (360) 293-1910
  Website: library.cityofanacortes.org

- **Department of Ecology Headquarters**
  300 Desmond Drive
  Lacey, WA 98503
  By appointment. Please contact Carol Dorn at (360) 407-7224 or Carol.Dorn@ecy.wa.gov.

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



Public Comment Periods

Public comment periods provide opportunities for you to review and comment on major documents, such as the Draft Consent Decree, Draft RI, Draft FS, Draft CAP and Draft Plan. The typical public comment period is 30 calendar days.

Notice of Public Comment Periods

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

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

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

Fact Sheets

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

MTCA Site Register

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

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

Mailing Lists

Ecology maintains both email and regular mail distribution lists throughout the cleanup process. The lists are created from carrier route delineations for addresses within one-quarter mile of the Site; potentially interested parties; public meeting sign-in sheets; and

requests made in person or by regular mail or email. You may request to be on a mailing list by contacting the Ecology staff person listed earlier in this section.

Optional Public Meetings

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

Submitting Comments

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

Response to Comments

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

Other

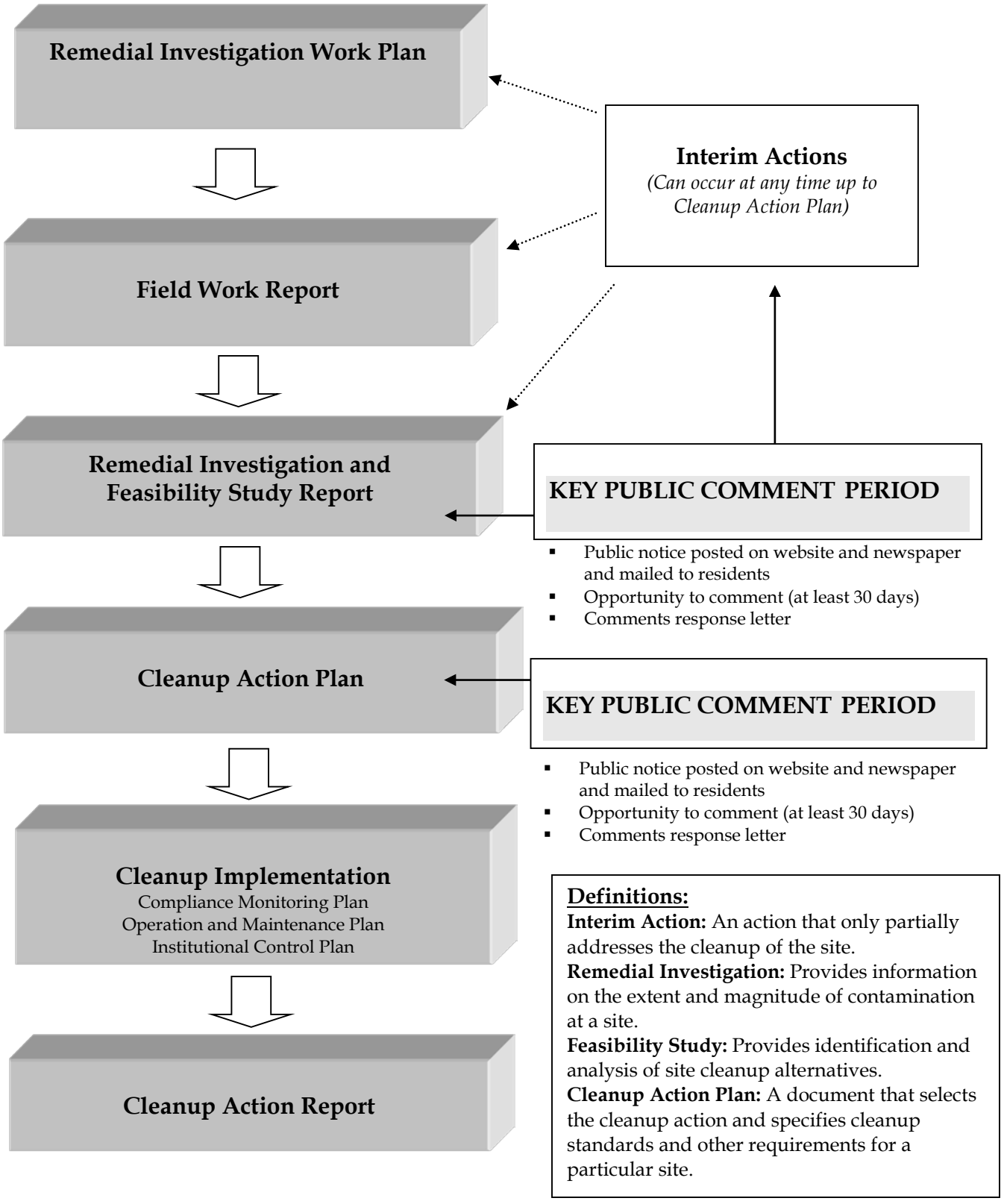
Ecology is committed to the public participation process and will consider additional means for delivering information and receiving comments, including combining public comment periods for other actions (such as those associated with the State Environmental Policy Act).

Public Participation Grants

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

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

Figure 2: Washington State Cleanup Process



Glossary

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

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

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

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

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

Consent Decree: A formal legal document that requires the PLP to carry out specifically identified cleanup actions.

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

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

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

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

needed to provide for completion of a site hazard assessment, state remedial investigation/feasibility study, or design of a cleanup action.

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

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

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

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

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

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

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