DEPARTMENT OF ECOLOGY
State of Washington

SITE HAZARD ASSESSMENT
Worksheet 1: Summary Score Sheet

SITE NAME: Time Oil Bulk Terminal **Rank: 1**

Cleanup Site ID: 14604

Facility/Site ID: 75486194

Completed on 7/7/2020 for inclusion on the August 2020 Hazardous Sites List.

LOCATION OF SITE

2701-2805 W Commodore Way and 2820 W Fort Street

Seattle, King County, WA 98199

Township 25N, Range 3E, Section 11

Latitude, Longitude: 47.66257, -122.39350

Tax Parcel ID: 1125039050, 1125039081, 1125039113, 1125039120, 4237900240, 4237900405

SITE DESCRIPTION

Within Currently Defined Site Boundaries

The Time Oil Bulk Terminal site (Site) includes multiple tax parcels, the West Commodore Way right-of-way where it passes between these parcels, and potentially impacted sediments in Salmon Bay. The Site is located in the Interbay neighborhood of Seattle within the Ballard Interbay North Manufacturing Industrial Center (BINMIC). From approximately 1941 to 2001, a bulk petroleum storage facility was located on the Site. Petroleum facility operations included the distribution of multiple types of petroleum products (gasoline, diesel, kerosene, mineral spirits) between transport ships, railroad tank cars, and trucks. Petroleum awaiting distribution was stored in aboveground storage tanks (ASTs), transferred via piping to barreling sheds where 5 gallon and 55 gallon drums were filled, and then drums moved via inclined gravity conveyors to the waterfront where they were loaded onto ships docked in Salmon Bay.

While the current Site boundary encompasses the entirety of the former Time Oil property, historically the Site was divided into 3 sites in Ecology's records. These sites were located on different tax parcels within the overall Site, had been used for different parts of the fuel distribution process, and had different sources of contamination. See Figures 1 and 2 for the general location and layout of the Site. Historical and current site features are shown in Figures 3 and 4. Information on how each property was used during Time Oil operations is included below. Information on other tenants and uses of the properties is included in the table in the following section of the report.

The Bulk Terminal Property (FSID 75486194/CSID 7123) was originally defined as only the property on the southwest corner of W Commodore Way and 27th Ave W, on tax parcel 1125039050. The Bulk Terminal Property was enrolled in Ecology's Voluntary Cleanup Program (VCP) from 2002-2010 and 2015-2017 under VCP project numbers NW0931, NW1667, NW1705, and NW2948. During fuel terminal operations, this parcel housed 14 ASTs, ranging in size from 219,450 to 966,000 gallon capacity. Structures on the property included an office building, warehouse, barreling sheds, overhead fuel loading racks, barrel inclines, and 5 rail spurs.

The property located to the west of the Bulk Terminal Property on tax parcel 4237900405 is known as the ASKO Property (FSID 78837111/CSID 12548). It was enrolled in VCP from 2015-2017 under project number NW2950. During fuel terminal operations, structures and uses of this property included barrel storage areas, truck storage and parking, vehicle maintenance, barreling sheds, and 4 rail spurs. The ASKO Property is impacted by contamination that originates on both that property as well as the south-adjacent BNSF Property (parcel 4237900240), where large volumes of fuel reportedly arrived on rail cars for transfer to the Time Oil facility. Contamination from the Bulk Terminal and ASKO Properties extends to the north under West Commodore Way.

The East Waterfront Property (FSID 7417688, 36574721, and 55872689/CSID 7740) is located north of the ASKO Property across West Commodore Way on tax parcel 1125039120. It was enrolled in VCP in 2015 under project number NW2949. During fuel terminal operations, structures and uses of the property included barrel

inclines, the pipeline utilidor, a warehouse, a garage used for vehicle and equipment repair and maintenance, and a laboratory for testing oil. A dock extends through the in-water portion of the East Waterfront Property and onto an adjacent parcel to the north, known as the DNR Aquatic Waterway Use Property (parcel 1125039113).

To the west of the East Waterfront Property is tax parcel 1125039081, known as the West Waterfront Property. Available information suggests that while this property was owned by Time Oil, it was used primarily for recreational boat docking and storage and not for bulk terminal activities.

The Site is currently enrolled in VCP under project number NW3201. Negotiations are currently underway to proceed with cleanup under a Prospective Purchaser Consent Decree. The Property addressed under the Decree includes the Bulk Terminal, ASKO, East Waterfront, and West Waterfront parcels. Most of the text in the following sections addresses the Property because the majority of the characterization and remediation to date has taken place on these parcels. The Site also includes the adjoining BNSF and DNR Aquatic Waterway Use parcels, as well as sediment within Salmon Bay.

Historical Owners and Operators

From	To	Owner/Operator	Site Uses
		BULK TERMINAL PARCEL (1125039050)	
1905		C.F Anderson, H.D. Chaplin	residential
1920s	1930s	Salmon Bay Manufacturing Company and Rattan Furniture Manufacturing Company	furniture manufacturing
1939	1941	Jobbers Petroleum Sales Co.	developed into bulk fuel terminal
1941	2001	Time Oil Company	petroleum bulk storage facility
	present	Marine Service & Supply Inc.	marine retail company office and storage (occupied buildings extend onto ASKO parcel)
		ASKO PARCEL (4237900405)	
1905		G. Anderson	residential and agricultural
1946	1950	Time Oil Company	property purchased by Time Oil and incorporated into fuel terminal operations
1960	1974	Time Oil Company	truck storage area and parking lot for terminal facility, vehicle maintenance
1974	present	buildings leased, tenants included Precision Engineering Specialists, Select Industries, ASKO Industrial Repair and Marine Service & Supply	marine engine repair; hydraulic and machine repair; marine supply sales, storage, and equipment repair

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		EAST WATERFRONT PARCEL (1125039120)	
1905		G. and C.F. Anderson	residential
	1930s	Rattan Furniture Manufacturing Company	structures included saw mill and dry kiln and extended onto east-adjacent property
1930s	1961		houseboats present along shoreline, northern portion also used for log booming
1939	1941	Jobbers Petroleum Sales	developed into fuel terminal
1941		Time Oil Company	incorporated into fuel terminal activities
1972	2011	George Broom's Sons	sail and rigging warehouse, tenant in warehouse building
1980	1992	Icicle Seafoods	boat repair for fishing fleet
2005	approx. 2014	ASKO Selective Plating	electroplating of metal parts, tenant in warehouse building
		WEST WATERFRONT PARCEL (1125039081)	
1946-1950		Time Oil Company	recreational boat docking and storage
		BNSF PARCEL (4237900240)	
	present	BNSF Railway Company	rail line
		DNR AQUATIC WATERWAY USE PARCEL (1125039113)	
	present	WA Department of Natural Resources	leased to Time Oil and used as part of fuel terminal operations; shipping dock constructed in 1943

Area Surrounding the Site

The Site is bordered by commercial or industrial facilities to the east and west. Nearby residential areas include Lockhaven Marina and Apartments, located northwest of the Site, and an area of single family homes located about 300 feet south of the Site, located across railroad tracks and a vegetated hillside. Across Salmon Bay, north of the Site, are the Hiram M. Chittenden Locks, which connect Puget Sound to Lake Union.

The Site is connected to the municipal water and sewer system. Stormwater from paved areas of the Bulk Terminal and ASKO properties is released to the sewer, in some cases following treatment in an on-Site treatment plant. Stormwater from unpaved areas and from the East Waterfront property either infiltrates into the soil or runs off into Salmon Bay. The North Trunk Sewer line runs under West Commodore Way. This line is 12 feet in diameter, and transports wastewater to the West Point Treatment Plant. Additional utility mains, including natural gas and water, are also located under West Commodore Way.

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SITE CHARACTERIZATION AND/OR REMEDIATION

Extensive characterization was done on the Site between 1999 and 2019. For brevity, many of the details of characterization activities have been left out of the text of this SHA, but may be found in the reports listed in the References section below. Areas of contamination are described with respect to indicator hazardous substances for the Site - benzene, arsenic, pentachlorophenol, trichloroethylene (TCE), vinyl chloride, gasoline range petroleum hydrocarbons (TPH-G), diesel range petroleum hydrocarbons, and oil range petroleum hydrocarbons. Compliance for diesel and oil range petroleum hydrocarbons is usually evaluated by considering the total of the diesel and oil range hydrocarbons, referred to throughout this report as TPH-Dx. There are additional contaminants present that are not on this list (i.e. dioxins/furans), but in general they are co-located with the indicator hazardous substances.

Previous work has used MTCA Method A or B cleanup levels as screening levels. Mentions of these screening levels in the following text does not mean they are accepted cleanup levels for the Site. Cleanup levels for soil and groundwater at the Site are being developed as part of the Supplemental Upland RI/FS and Cleanup Action Plan. At the time of this Site Hazard Assessment, these documents were available as Public Review Drafts, but had not been finalized.

BULK TERMINAL PROPERTY
The majority of the contamination on the Bulk Terminal property is petroleum and related compounds. Soil is contaminated with TPH-G, TPH-Dx, and benzene. Past Site features that are potential sources of soil contamination include the ASTs present on the eastern half of the property, fuel pumps and underground petroleum storage tanks (USTs) located at the northeast corner of the headquarters office building, and barreling sheds located in the northwest portion of the property. Groundwater is contaminated with TPH-G, TPH-Dx, and benzene in both the shallow and intermediate aquifers. Areas of non-aqueous phase liquid (NAPL) are present in the central and northern parts of the property (see Figure 5). Groundwater contamination is generally located in the same areas as soil contamination, including off-property under West Commodore Way.

Multiple interim actions have occurred on the Bulk Terminal property to address petroleum contamination (see Figure 6). In 1991, the USTs near the office building were removed and replaced. During the removal, approximately 140 cubic yards of contaminated soil was removed. Confirmation samples indicated that contaminated soil remained outside of the excavation boundaries. In 2002, 13 cubic yards of soil were excavated following a hydraulic fluid leak from a truck at the western edge of the parking area. Confirmation samples indicated that all contaminated soil was removed. In 2003, a pilot test was run to determine the efficacy of a dual-phase extraction system to address Site contamination. An estimated 19 pounds of TPH were removed from the subsurface during the pilot test. In 2006, the UST near the office building, fuel dispensers, and a vapor knockout tank were removed. Confirmation sampling indicated remaining TPH-G, TPH-Dx, and benzene in soil in this area. In 2010 and 2014, additional USTs were removed east of the headquarters building. A groundwater and NAPL recovery system was operated on the property between 2012 and 2017. The system removed groundwater through recovery wells and treated it prior to discharge into the sanitary sewer. Additional details of system operation and duration of use are not available in Ecology's files.

To evaluate the risk of vapor intrusion of petroleum compounds into the former Time Oil headquarters building, soil vapor sampling was done in 2015. Benzene, toluene, ethylbenzene, and xylenes, volatile compounds often present in TPH-G, were not detected in soil vapor above the applicable MTCA Method B screening levels.

For approximately 4 months in 1967, wood preservative was produced on Site for export overseas as part of a military contract. The preservative was produced by mixing pentachlorophenol crystals into heated diesel in a mixing and storage AST. This AST was located in the central portion of the property, west of the petroleum ASTs in the Lower Tank Yard. Soil and groundwater contaminated with pentachlorophenol are present in this area.

Multiple interim actions have occurred on the Bulk Terminal property to address pentachlorophenol contamination. In 2002, approximately 70 cubic yards of contaminated soil were excavated and removed from the Site. In 2010, heat-activated sodium persulfate was injected into the subsurface in an attempt to decrease pentachlorophenol concentrations in groundwater. A total of 302,500 gallons of 10% aqueous phase sodium persulfate was injected through 144 injection wells. Groundwater monitoring in the years following injection

(2011-2013) indicated an approximately 85% decrease in concentration of pentachlorophenol. Multiple rounds of soil excavations were performed in 2011 and 2012 to remove areas with the highest concentrations of pentachlorophenol and dioxin/furans, a related contaminant. Soil targeted for removal had concentrations of pentachlorophenol above Method B cleanup levels protective of direct contact with soil and dioxin/furan concentrations above Seattle background (determined as the 90th percentile of Seattle area concentrations, 46 ng/kg). Approximately 4500 tons of soil were removed during these excavations.

ASKO PROPERTY

Site characterization on the ASKO property began in 2000. Many of the investigations have been focused around former site features that may be sources of contamination including a barreling shed and a vehicle maintenance shop. The maintenance shop had an associated steam cleaning area, oil and solvent storage area, and USTs.

There are two source areas of contamination on the ASKO property. One is near the maintenance shop, and the second is south of the property on the adjacent BNSF property. Groundwater contamination from these areas has combined to form one area of contamination that extends under most of the ASKO property, under part of the south-adjacent BNSF parcel, and under part of the north-adjacent West Commodore Way right-of-way. (Figure 5) Vertically, petroleum contamination is limited to perched and shallow groundwater layers, while TCE contamination has reached the deeper intermediate groundwater layer.

To evaluate the risk of vapor intrusion of chlorinated compounds and petroleum on the ASKO property, 3 soil vapor samples were collected in 2015. Benzene, vinyl chloride, and 1,2-dichloroethane were present above Method B screening levels. Indoor and ambient (outdoor) air samples were then collected in 3 buildings to further evaluate vapor intrusion - the former Time Oil headquarters building, the Marine Service & Supply Warehouse, and the Marine Service & Supply office building. Samples were not collected in the building occupied by ASKO, since they used the same solvents in their work. Results did not indicate that vapor intrusion was occurring in any building sampled.

The only reported interim action on the ASKO property was the removal of a heating or waste oil UST near the maintenance shop. This was done before 2000. No additional details are available in Ecology's files.

EAST WATERFRONT PROPERTY

Interim actions to address contamination on the East Waterfront property began in the early 1990s (Figure 7). In 1991, a 500 gallon UST west of the former warehouse building was removed. The UST stored waste oil generated by Time Oil fleet vehicle maintenance. Between overexcavation at the time of tank removal and an additional excavation in 1992, approximately 250 cubic yards of petroleum contaminated soil was removed. Groundwater in this area is very shallow (2-6 feet bgs), and a sheen was observed on groundwater during excavation. Confirmation soil samples taken on the north and east excavation boundaries indicated remaining TPH-G, TPH-Dx, and benzene above preliminary cleanup levels. An additional excavation was done in 2013, removing 1700 cubic yards of contaminated soil north and east of the original excavation boundaries. Contamination remains on the east side of the excavation underneath the shed and garage buildings.

In 1992, Icicle Seafoods, a long time tenant, vacated the property. At this time, spot excavations were performed to address areas of surface contamination related to Icicle business activities. These included 5 areas of visible petroleum staining on the surface soil and 3 areas of discarded sand blast grit, which contained high concentrations of arsenic, chromium, and cadmium. Confirmation samples collected from the petroleum areas did not contain petroleum above laboratory reporting limits. Confirmation samples from sand blast grit areas did not contain metals above the applicable Method A Industrial cleanup levels.

In 2011, an investigation was done in the area of a possible gasoline UST south of the building on the west side of the property. The investigation area was under a compressor shed, which was demolished for the investigation and rebuilt afterward. Excavations did not find any evidence of the UST or piping system, and soil samples collected in this area did not show TPH-G contamination. The pipeline utilidor, located south of the East Waterfront property under West Commodore Way, was removed in 2012. Petroleum contaminated soil in this area was excavated as part of the removal.

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Groundwater contamination is less extensive on the East Waterfront property than the Bulk Terminal and ASKO property, but is present, primarily in the northern portion of the property (see Figure 5).

IN-WATER AREA
The extent of Site contamination in Salmon Bay has not been determined. Limited sediment sampling has been conducted in the area of Salmon Bay near the Site.

Samples were collected near the Site as part of a series of studies Ecology conducted on the contamination status of Salmon Bay sediments between 1995 and 2000 (see Figure 8). These samples are identified as location 3B in the Phase II sediment report and locations 3B2 and 3B3 in the Phase III report. Sediment collected in these locations had elevated concentrations of metals, PAHs, and tributyltin. Multiple bioassays were positive for sediment toxicity for sample 3B3.

In 2018 and 2019, additional sediment sampling was done near the Site as well as farther out into Salmon Bay to provide background samples. Chemicals that exceeded predicted cleanup levels for the Site (final cleanup levels have not been established) in at least one Site or background sample include metals, PAHs, TPH-Dx, pentachlorophenol, phthalates, dioxin/furans, tributyltin, and sulfides.

ADDITIONAL INFORMATION COLLECTED BY THE SITE HAZARD ASSESSOR

The Assessor reviewed reports available in Ecology's files. The list in the References provides the source of the information in this Site Hazard Assessment; it is not, however, a full list of what is available in the Site file.

SPECIAL CONSIDERATIONS

Checked boxes indicate routes applicable for Washington Ranking Method (WARM) scoring

☑ **Surface Water**

Contaminated groundwater discharging to surface water on the East Waterfront parcel is included as a contaminant transport pathway in the current conceptual site model.

☑ **Air**

Volatile contaminants present in subsurface.

☑ **Groundwater**

Documented contamination in groundwater.

ROUTE SCORES

Surface Water/ Human Health:	30.2	Surface Water/ Environment:	44.4
Air/ Human Health:	38.5	Air/ Environment:	1.6
Groundwater/ Human Health:	44.8		

Overall Rank: 1

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REFERENCES

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3 Floyd Snider. February 6, 2019. Technical Memorandum RE: Addendum to the Surface Sediment Quality Evaluation Sampling and Analysis Plan/Quality Assurance Project Plan.

4 Floyd Snider. July 2018. Surface Sediment Quality Evaluation Sampling and Analysis Plan/Quality Assurance Project Plan.

5 Floyd Snider. June 2020. Time Oil Bulk Terminal PPA: Supplemental Upland Remedial Investigation and Feasibility Study. [Public Review Draft]

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SITE HAZARD ASSESSMENT
Worksheet 2: Route Documentation

SITE NAME: Time Oil Bulk Terminal

Cleanup Site ID: 14604

Facility/Site ID: 75486194

1. SURFACE WATER ROUTE

List those substances to be considered for scoring:

TPH-Dx (scored as naphthalene), benzene (as individual chemical and to represent TPH-G), arsenic

Explain the basis for choice of substances to be used in scoring:

substances above preliminary cleanup levels in groundwater on the northern portion of the East Waterfront property

List those management units to be considered for scoring:

groundwater

Explain basis for choice of unit to be used in scoring:

groundwater is documented to be contaminated and flowing toward nearby surface water

2. AIR ROUTE

List those substances to be considered for scoring:

TCE, vinyl chloride, benzene

Explain the basis for choice of substances to be used in scoring:

volatile substances present in the subsurface

List those management units to be considered for scoring:

soil, groundwater

Explain basis for choice of unit to be used in scoring:

contaminated media that may contribute to air contamination via vapor intrusion

3. GROUNDWATER ROUTE

List those substances to be considered for scoring:

TPH-Dx (scored as naphthalene), benzene (as individual chemical and to represent TPH-G), pentachlorophenol, TCE, vinyl chloride, arsenic

Explain the basis for choice of substances to be used in scoring:

substances present above preliminary cleanup levels in groundwater

List those management units to be considered for scoring:

groundwater

Explain basis for choice of unit to be used in scoring:

groundwater is documented to be contaminated

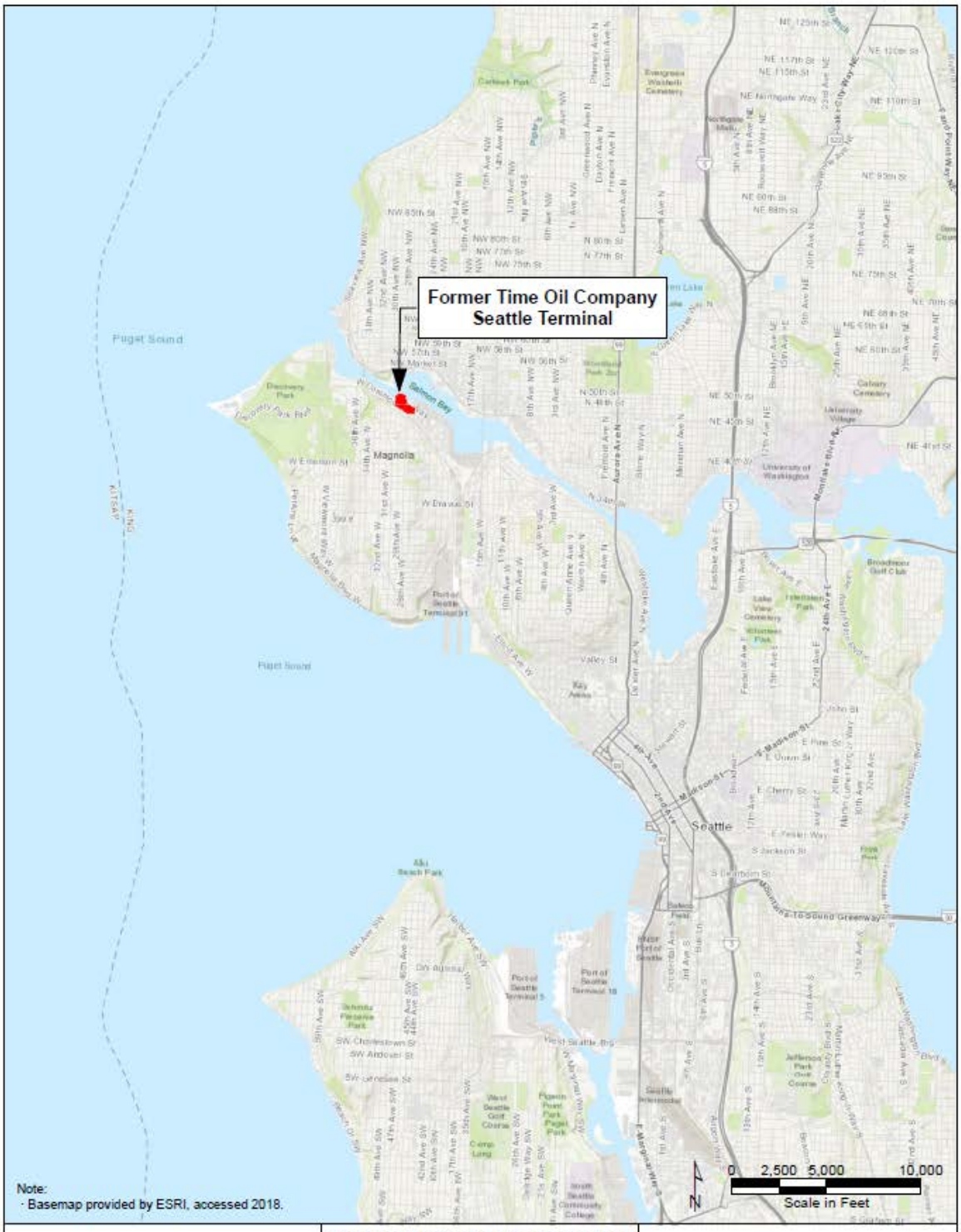

Figure 1. General location of the Site.

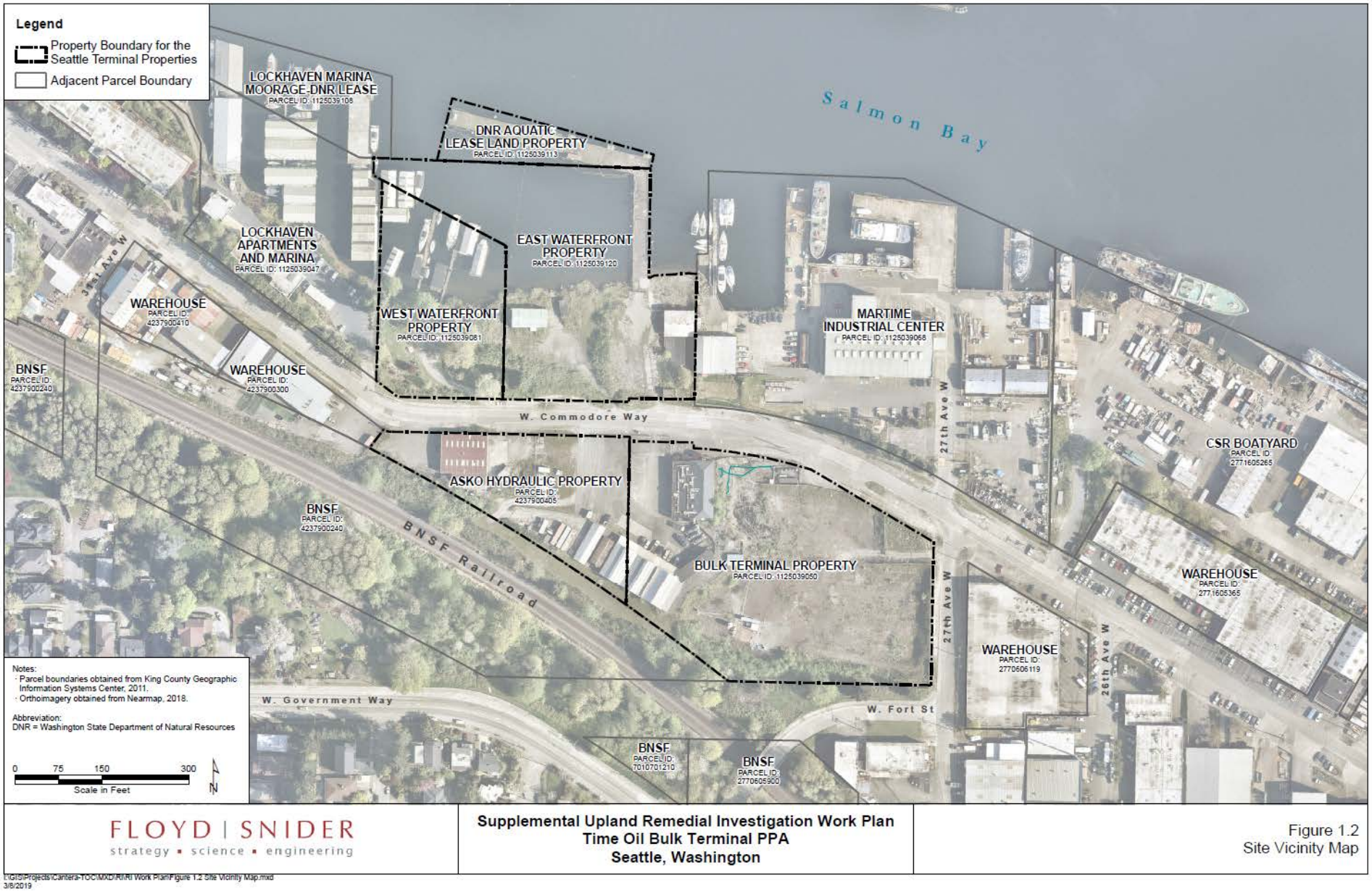

Figure 2. Location of the parcels discussed in detail in text above and usage of nearby parcels.

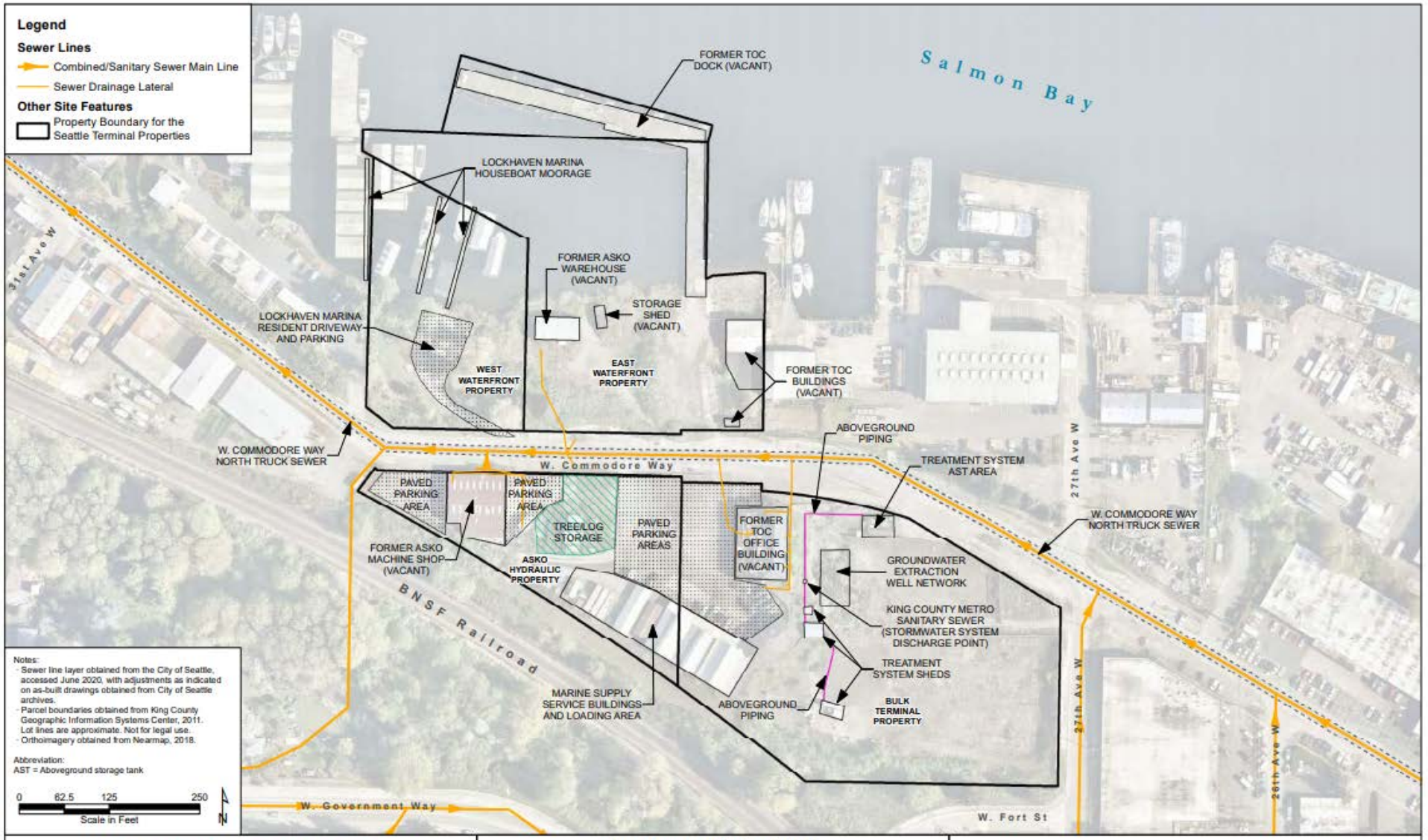

Figure 3. Current structures and features on the Site.

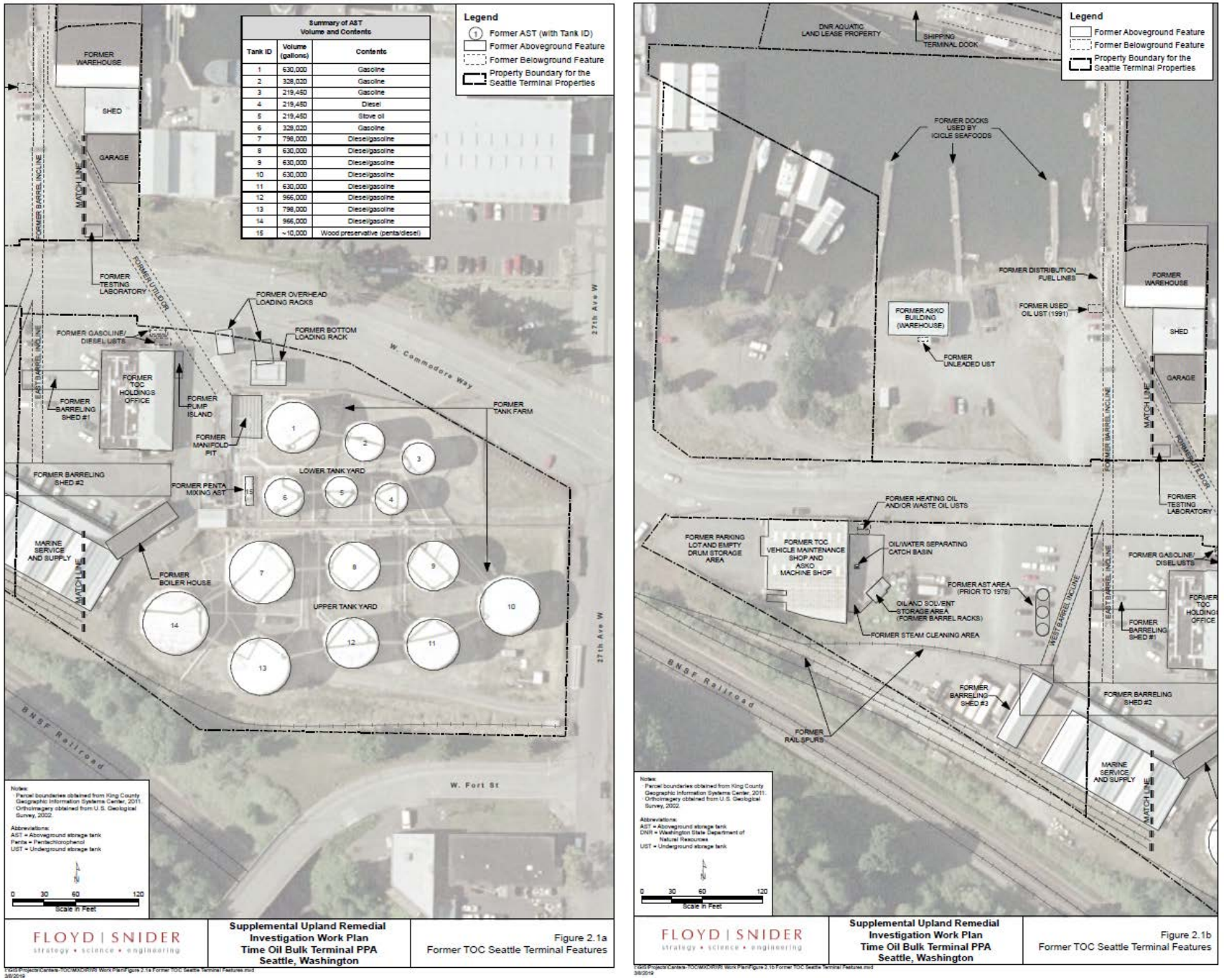

Figure 4. Historical structures and features on the Bulk Terminal (left), Asko, and East Waterfront (right) properties.

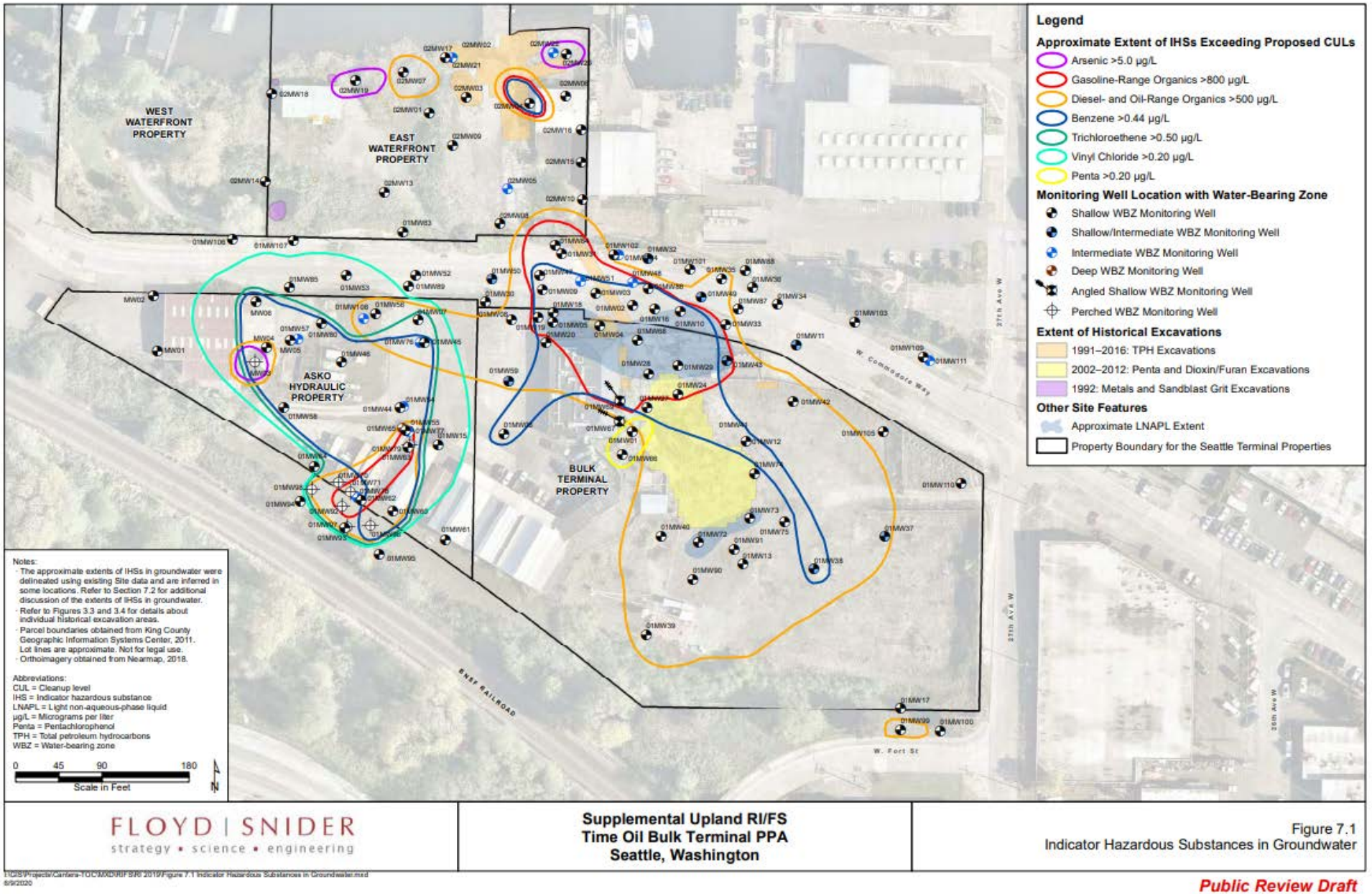

Figure 5. Areas of groundwater contamination on the Site.

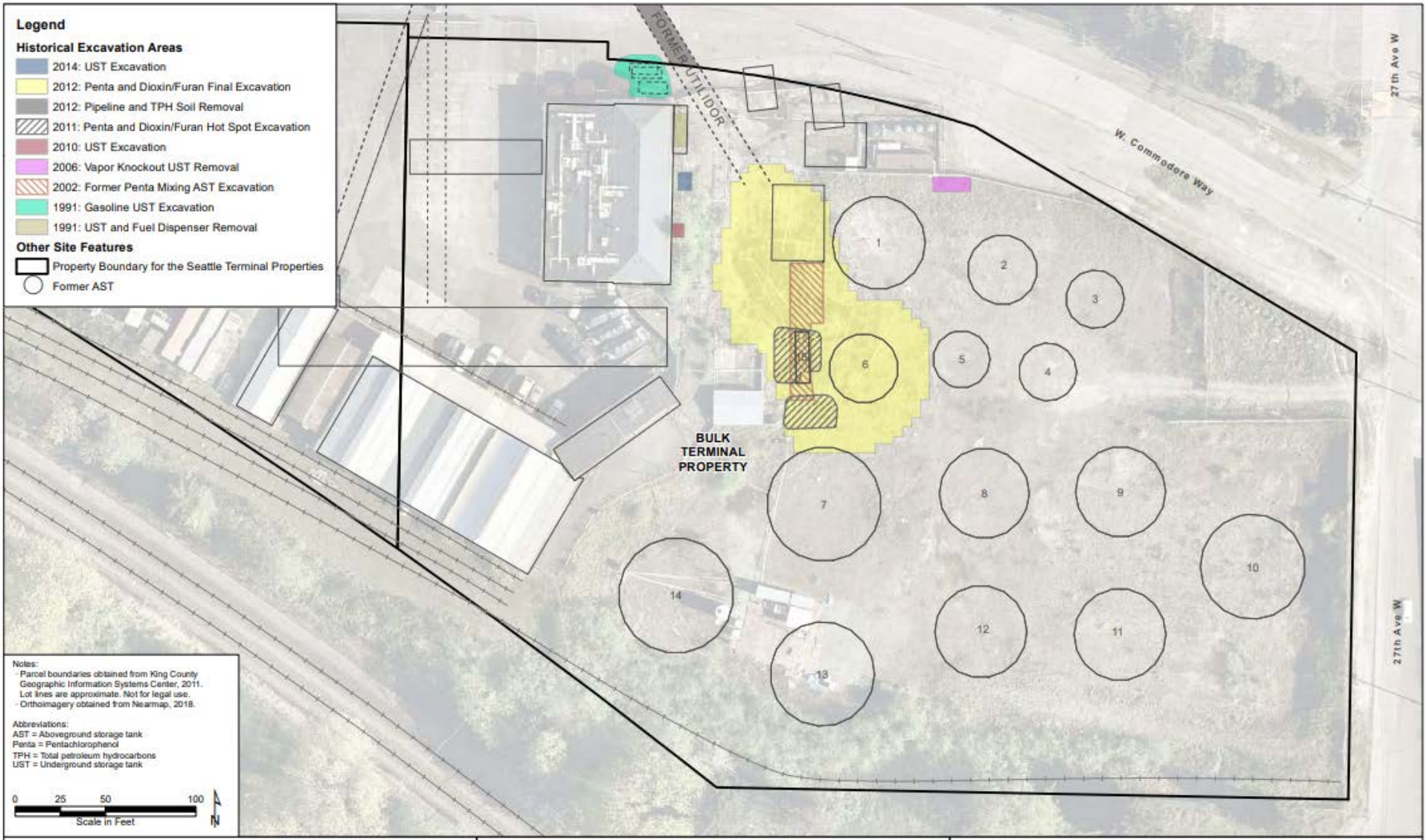

Figure 6. Areas of prior interim actions on the Bulk Terminal property.

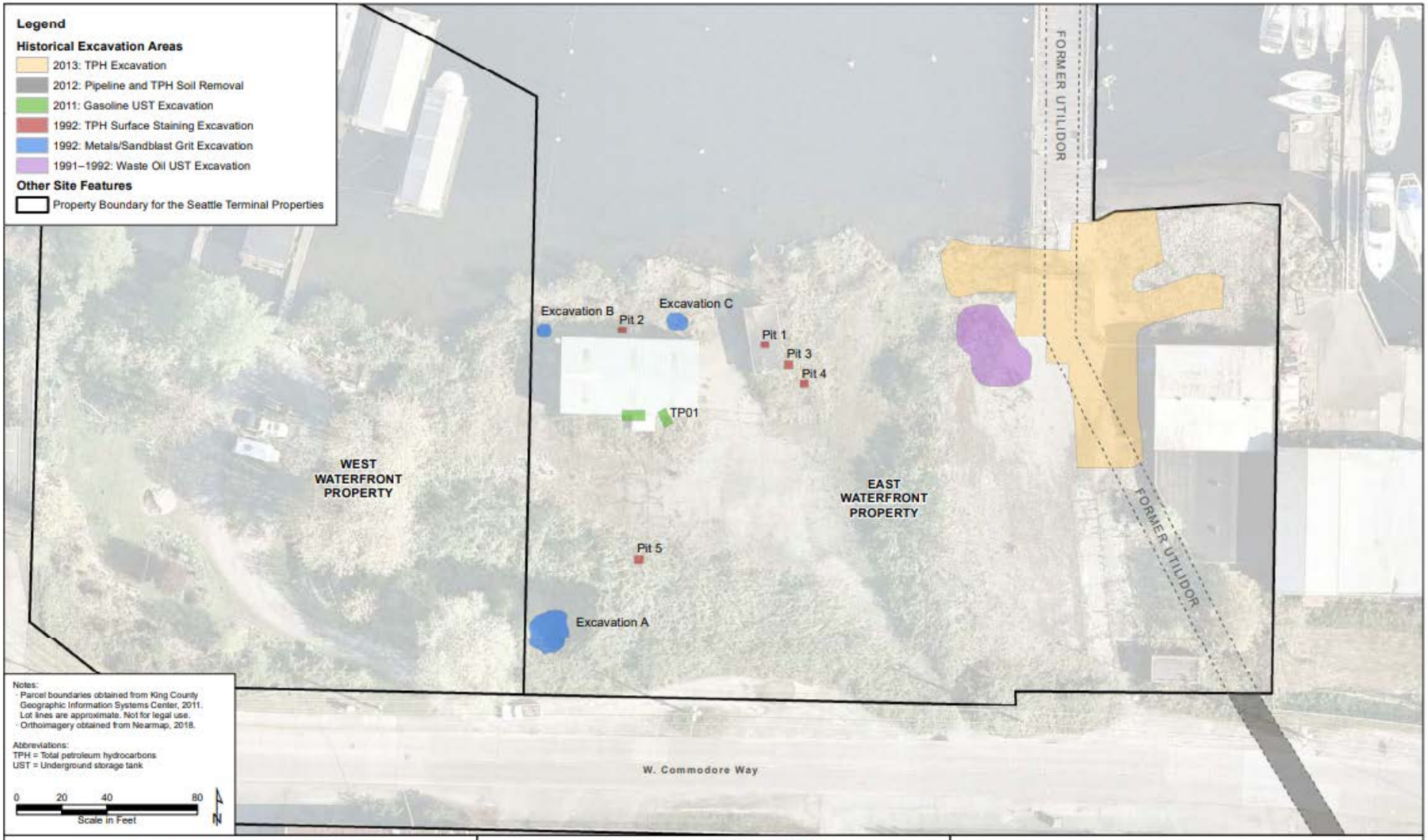

Figure 7. Areas of prior interim actions on the East Waterfront property.

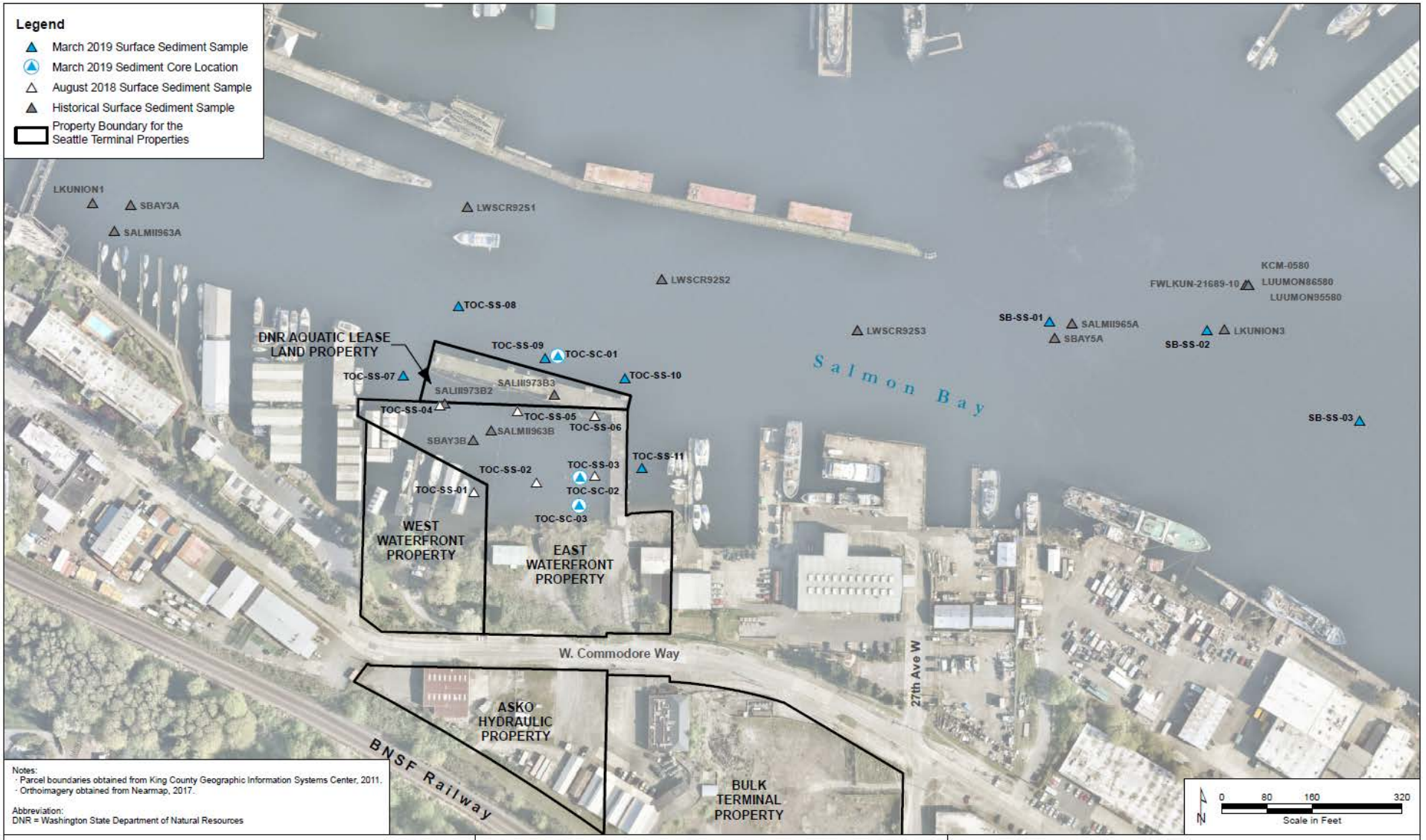

Figure 8. Sediment sampling locations.

Worksheet 4
Surface Water Route

CSID: 14604

Site: Time Oil Bulk Terminal

1.0 SUBSTANCE CHARACTERISTICS

1.1 Human Toxicity

	Drink. Wat. Stnd.		Acute Toxicity		Chronic Toxicity		Carcinogenicity	
Substance	Value (ug/L)	Score	Value (mg/kg)	Score	Value (mg/kg/day)	Score	Adj. CPFo (risk/mg/kg-day)	Score
arsenic	1.0E+01	8	7.6E+02	5	3.0E-04	5	1.5E+00	7
benzene	5.0E+00	8	3.3E+03	3	4.0E-03	3	5.5E-02	5
naphthalene (TPH-Dx)	--	X	4.9E+02	5	2.0E-02	1	--	X

Maximum score: 8

Bonus points: 2

Human Toxicity Score: 10

Source: WARM Toxicity Database

Range: 1-12

1.2 Environmental Toxicity

Freshwater: X

Marine:

Substance	Acute Water Quality Criterion Value (ug/L)	Score
arsenic	3.4E+02	4
benzene	5.3E+03	2
naphthalene	2.3E+03	2

Maximum score: 4

Environmental Toxicity Score: 4

Source: WARM Toxicity Database

Range: 2-10

1.3 Substance Quantity

Amount: 9700 ft^2

Basis: estimated area of contaminated groundwater on northern part of East Waterfront property

Source: site reports

Substance Quantity Score: 7

Range: 1-10

2.1 Containment

Description:	contaminated groundwater to surface water	
Source:	site reports, WARM scoring manual	Containment Score: 10
		Range: 0-10

SUBSTANCE PARAMETER CALCULATIONS

Human Health Pathway

SUBh (Human Toxicity + 3) x (Containment + 1) + Substance Quantity | 150.0

Environmental Pathway

SUBe (Environ. Toxicity + 3) x (Containment + 1) + Substance Quantity | 84.0

2.0 MIGRATION POTENTIAL

2.2 Surface Soil Permeability

Description:	fill - sand, silty sand, gravel	
Source:	site reports	Soil Permeability Score: 3
		Range: 1-7

2.3 Total Annual Precipitation

Amount (in.):	37.2	Annual Precipitation Score: 3
Source:	NOAA NCEI Sand Point station data	Range: 1-5

2.4 Maximum Two-Year/24-Hour Precipitation

Amount (in.):	1.8	24-Hour Precipitation Score: 2
Source:	WARM Scoring Manual	Range: 1-5

2.5 Flood Plain

Classification:	upland portion of Site not in flood plain	Floodplain Score: 0
Source:	iMap	Range: 0-2

2.6 Terrain Slope

Degree of slope:	12.80%	
Source:	USGS National Map; calculated for shoreline on East Waterway property	Terrain Slope Score: 5
		Range: 1-5

MIGRATION PARAMETER CALCULATION

MIG = Soil Permability + Annual Precip. + 24-Hour Precip. + Floodplain + Slope | 13.0

3.0 TARGETS

3.1 Distance to Surface Water

Name:	Salmon Bay		
Distance (ft):	0	Distance to Surface Water Score:	10
Source:	iMap	Range:	0-10

3.2 Population Served within 2 Miles

Population:	0	Population Served Score:	0
Source:	Ecology Water Rights Tracking System	Range:	0-75

3.3 Area Irrigated within 2 Miles

Basis:	active surface water claims in Salmon Bay all designated as commercial/industrial		
Area (acres):	0	Area Irrigated Score:	0
Source:	Ecology Water Rights Tracking System	Range:	0-30

3.4 Distance to Nearest Fishery Resource

Name:	Salmon Bay		
Distance (ft):	0	Distance to Fishery Score:	12
Source:	iMap	Range:	0-12

3.5 Distance to Nearest Sensitive Environment

Name:	Salmon Bay		
Distance (ft):	0	Distance to Sensitive Environment Score:	12
Source:	iMap	Range:	0-12

TARGET PARAMETER CALCULATIONS

Human Health Pathway

TARh: Dist. to Surface Water + Population Served + Area Irrigated — 10.0

Environmental Pathway

TARe: Dist. to Surface Water + Dist. to Fishery + Dist. to Sensit. Environ. — 34.0

4.0 RELEASE

Evid. of release?	no surface water samples collected, but sediment samples collected in the near-shore area also contain concentrations of some of these substances above screening levels		
Source:	site reports	Release Score (REL):	5.0
		Range:	0 or 5

SURFACE WATER ROUTE CALCULATIONS

Human Health Pathway

SWh = (SUBh x 40/175) x [(MIG x 25/24)) + REL + (TARh x 30/115)] / 24 **30.2**

Environmental Pathway

SWe = (SUBe x 40/153) x {(MIG x 25/24)) + REL + (TARe x 30/34)} / 24 **44.4**

Range: 0-100

Worksheet 5
Air Route

CSID: 14604

Site: Time Oil Bulk Terminal

1.0 SUBSTANCE CHARACTERISTICS

1.1 Introduction

No scoring in Section 1.1.

1.2 Human Toxicity

Substance	Amb. Air Stnd. Value (ug/m^3)	Score	Acute Toxicity Value (mg/m^3)	Score	Chronic Toxicity Value (mg/kg/day)	Score	Carcinogenicity Adj. CPFi (risk/mg/kg-day)	Score
benzene	3.5E-02	10	3.2E+04	3	8.6E-03	8	2.7E-02	5
TCE	5.0E-01	10	1.6E+04	3	5.7E-04	10	1.4E-02	5
vinyl chloride	1.3E-02	10	4.6E+05	1	2.9E-02	5	3.1E-02	5

Maximum score: 10

Bonus points: 2

Human Toxicity Score: 12

Source: WARM Toxicity Database

Range: 1-12

1.3 Mobility

Gaseous Mobility

Substance	Vapor Pressure Value (mm Hg)	Score	Henry's Law Value (atm-m3/ mol)	Score
benzene	9.5E+01	4	5.6E-03	4
TCE	5.8E+01	4	1.0E-02	4
vinyl chloride	2.7E+03	4	2.7E-02	4

Maximum score: 4

Source: WARM Toxicity Database

Particulate Mobility

Soil type:

Erodibility factor:

Climatic factor:

Mobility value:

Mobility Score: 4

Source:

Range: 0-4

1.4 Human Toxicity/Mobility

Source: WARM Scoring Manual

Human Tox/Mobil Score: 24

Range: 1-24

1.5 Environmental Toxicity/Mobility

Substance	Acute Value (mg/m^3)	Score
benzene	3.2E+04	3
TCE	1.6E+04	3
vinyl chloride	4.6E+05	1
Maximum score	3	

Source: WARM Toxicity Database

Environmental Toxicity Score: 3

Range: 1-10

Environmental Tox/Mobil Score: 6

Range: 1-24

1.6 Substance Quantity

Quantity: 90,000 ft^2

Basis: approximate area of groundwater contaminated with benzene, TCE, and/or vinyl chloride

Source: site reports

Substance Quantity Score: 7

Range: 1-10

2.1 Containment

Description: >2' of soil cover in most areas of volatile contaminants; no vapor collection system

Basis: site reports

Containment Score: 5

Range: 0-10

SUBSTANCE PARAMETER CALCULATIONS

Human Health Pathway

SUBh (Human Tox/Mobil + 5) x (Containment +1) + Substance Quantity: 181.0

Environmental Pathway

SUBe (Environ. Tox/Mobil + 5) x (Containment +1) + Substance Quantity: 73.0

3.0 TARGETS

3.1 Nearest Population

Description: commercial buildings east of Site

Distance (ft): approx. 100

Source: iMap

Nearest Population Score: 10

Range: 0-10

3.2 Nearest Sensitive Environment

Description:	Salmon Bay		
Distance (ft):	adjacent	Nearest Sensitive Environment Score:	7
Source:	iMap	Range:	0-7

3.3 Population within One-Half Mile

Number:	3,357	Population within Half Mile Score:	57.9
Source:	MO CDC	Range:	0-75

TARGET PARAMETER CALCULATIONS

Human Health Pathway

TARh: Nearest Population + Population within Half Mile **67.9**

Environmental Pathway

TARe Nearest Sensitive Environment **7.0**

4.0 RELEASE

Evid. of release?	no confirmed vapor intrusion		
Source:	site reports	Release Score (REL):	0.0
		Range:	0 or 5

AIR ROUTE CALCULATIONS

Human Health Pathway

AIRh = (SUBh x 60/329) x {REL + (TARh x 35/85} / 24 **38.5**

Environmental Pathway

AIRe = (SUBe x 60/329) x {REL + (TARe x 35/85} / 24 **1.6**

Range: 0-100

Worksheet 6
Groundwater Route

CSID: 14604

Site: Time Oil Bulk Terminal

1.0 SUBSTANCE CHARACTERISTICS

1.1 Human toxicity

	Drink. Wat. Stnd		Acute Toxicity		Chronic Toxicity		Carcinogenicity	
Substance	Value (ug/L)	Score	Value (mg/kg)	Score	Value (mg/kg/day)	Score	Adj. CPFo (risk/mg/kg-day)	Score
benzene	5.0E+00	8	3.3E+03	3	4.0E-03	3	5.5E-02	5
naphthalene	--	X	4.9E+02	5	2.0E-02	1	--	X
pentachlorophenol	1.0E+00	10	--	X	5.0E-03	3	3.2E-01	5
TCE	5.0E+00	8	2.4E+03	3	5.0E-04	5	4.6E-02	5
vinyl chloride	2.0E+00	8	5.0E+02	5	3.0E-03	3	1.5E+00	7
arsenic	1.0E+01	8	7.6E+02	5	3.0E-04	5	1.5E+00	7

Maximum score: 10

Bonus points: 2 — Human Toxicity Score: 12

Source: WARM Toxicity Database — Range: 1-12

1.2 Mobility

Substance	Solubility Value (mg/L)	Score
benzene	1.8E+03	3
naphthalene	3.1E+01	1
pentachlorophenol	2.0E+03	3
TCE	1.1E+03	3
vinyl chloride	2.8E+03	3
arsenic	K >1	3

Maximum value: 3 — Mobility Score: 3

Source: WARM Toxicity Database — Range: 1-3

1.3 Substance quantity

Quantity: 66,000 yd^3

Basis: approximate lateral area of contamianted groundwater (22,000 yd^2) x 3 yd depth (chosen as a value within the range of depths observed in different areas of contamination throughout the Site)

Source: site reports — Substance Quantity Score: 6

Range: 1-10

2.1 Containment

Description: groundwater is contaminated

Source: site reports — Containment Score: 10

Range: 0-10

SUBSTANCE PARAMETER CALCULATION

SUB = (Human Toxicity + Mobility + 3) x (Containment + 1) + Substance Quantity **204.0**

2.0 MIGRATION POTENTIAL

2.2 Net precipitation

Amount (in.):	23.3	Net Precipitation Score:	3
Source:	NOAA NCEI, ESRI	Range:	0-5

2.3 Subsurface Hydraulic Conductivity

Description:	fill		
Source:	site reports	Hydraulic Conductivity Score:	4
		Range:	1-4

2.4 Vertical Depth to Aquifer

Depth (ft):	0 - groundwater is contaminated	Depth to Aquifer Score:	8
Source:	site reports	Range:	1-8

MIGRATION PARAMETER CALCULATION

MIG = Depth to Aquifer + Net Precipitation + Hydraulic Conductivity **15.0**

3.0 TARGETS

3.1 Aquifer Usage

Description:	not used but usable		
Source:	iMap, WDOH Water System Database	Aquifer Use Score:	2
		Range:	1-10

3.2 Distance to Nearest Drinking Water Well

Distance (ft):	groundwater flows toward Salmon Bay; no wells present between contamination and Salmon Bay	Well Distance Score:	0
Source:	iMap, WDOH Water System Database	Range:	0-5

3.3 Population Served by Drinking Water Wells within Two Miles — Population Served Score: 0.0

No. of people:	0	Range:	0-100
Source:	iMap, WDOH Water System Database		

3.4 Area Irrigated by Wells within Two Miles — Area Irrigated Score: 0.0

Area (acres):	0	Range:	0-50
Source:	iMap, WDOH Water System Database		

TARGET PARAMETER CALCULATION

2.0

TAR = Aquifer Use + Well Distance + Population Served + Area Irrigated

4.0 RELEASE

Evid. of release? groundwater is contaminated

Release Score (REL): 5.0

Source: site reports

Range: 0 or 5

GROUND WATER ROUTE CALCULATION

44.8

GW = (SUB x 40/208) x {(MIG x 25/17) + REL + (TAR x 30/165)} / 24

Range: 0-100

Washington Ranking Method
Route Scoring Summary and Ranking Calculation

CSID: **14604**

Site: **Time Oil Bulk Terminal**

Human Health Route Scores

Pathway	Score	Quintile
Surface water	30.2	5
Air	38.5	4
Groundwater	44.8	4

Quintile	Value
High (H)	5
Middle (M)	4
Low (L)	4

Human Health Pathway Quintiles - based off February 2020 HSL

Quintile	Surface Water		Air		Groundwater	
1	<=	7.3	<=	8.6	<=	24.1
2	7.4	14.7	8.7	16.3	24.2	33.1
3	14.8	21.1	16.4	25.6	33.2	40.4
4	21.2	29.5	25.7	40.1	40.5	49.6
5	>=	29.6	>=	40.2	>=	49.7

$(H^2 + 2M + L) / 8$

Human Health Priority Bin Score: 4.6

Environmental Route Scores

Pathway	Score	Quintile
Surface water	44.4	4
Air	1.6	3

Quintile	Value
High (H)	4
Low (L)	3

Environmental Pathway Quintiles - based off February 2020 HSL

Quintile	Surface Water		Air	
1	<=	11.3	<=	1.2
2	11.4	24.1	1.3	1.5
3	24.2	32.4	1.6	13.8
4	32.5	49.6	13.9	27.3
5	>=	49.7	>=	27.4

$(H^2 + 2L) / 7$

Environmental Priority Bin Score: 3.1

FINAL MATRIX RANKING

Human Health Priority	Environmental Priority 5	4	3	2	1	n/a
5	1	1	1	1	1	1
4	1	2	2	2	3	2
3	1	2	3	4	4	3
2	2	3	4	4	5	3
1	2	3	4	5	5	5
n/a	3	4	5	5	5	NFA

n/a - not applicable

NFA - no further action

Site Rank: 1