DEPARTMENT OF ECOLOGY
State of Washington

Cleanup Action Plan

Time Oil Bulk Terminal
Seattle, WA

Facility Site ID: 75486194
Cleanup Site ID: 14604

September 28, 2020

Publication and Contact Information

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Toxics Cleanup Program

Washington State Department of Ecology

Northwest Regional Office

Bellevue, Washington

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List of Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
AOC	Area of concern
APA	Asset purchase agreement
ASKO	ASKO Hydraulic
AST	Aboveground storage tank
bgs	Below ground surface
BNSF	BNSF Railway Company
CAA	Cleanup action area
Cantera	Cantera Development Group, LLC
CAP	Cleanup Action Plan
CCMP	Construction Compliance Monitoring Plan
CPOC	Conditional point of compliance
CSM	Conceptual Site Model
CUL	Cleanup level
cVOC	Chlorinated volatile organic compound
CY	Cubic yards
DCA	Disproportionate cost analysis
DNR	Washington State Department of Natural Resources
DRO	Diesel-range organics
Ecology	Washington State Department of Ecology
EDR	Engineering Design Report
FS	Feasibility Study
GMP	Groundwater Monitoring Plan
GRO	Gasoline-range organics
gZVI	Granular zero-valent iron
IC	Institutional control
IDP	Inadvertent Discovery Plan
IHS	Indicator hazardous substance
ISS	In situ solidification and stabilization
LNAPL	Light non-aqueous-phase liquid
LTCMP	Long-Term Compliance Monitoring Plan
mg/kg	Milligrams per kilogram
MNA	Monitored natural attenuation

Acronym/ Abbreviation	Definition
MTCA	Model Toxics Control Act
ORO	Oil-range organics
penta	Pentachlorophenol
POC	Point of compliance
PPCD	Prospective Purchaser Consent Decree
PRB	Permeable reactive barrier
Property	The parcels subject to an asset purchase agreement between the prospective purchaser and current owner (King County Parcel Nos. 1125039050, 1125039081, 1125039120, and 4237900405)
QAPP	Quality Assurance Project Plan
RAA	Remedial Action Area
RACR	Remedial Action Completion Report
RAO	Remedial Action Objective
RCW	Revised Code of Washington
REL	Remediation level
RI	Remedial Investigation
RI Work Plan	Supplemental Upland Remedial Investigation Work Plan
ROW	Right-of-way
SAP	Sampling and Analysis Plan
SES	SoundEarth Strategies, Inc.
Site	Time Oil Bulk Terminal Site
SMP	Soil Management Plan
SMS	Sediment Management Standards
SREMP	Soil and Remedial Element Management Plan
TBT	Tributyltin
TCE	Trichloroethene
TOC	TOC Holdings Co and any predecessor entity including Time Oil Company
TPH	Total petroleum hydrocarbons
UST	Underground storage tank
VI	Vapor intrusion
VCP	Voluntary Cleanup Program
WAC	Washington Administrative Code
WBZ	Water-bearing zone

1.0 Introduction

This document presents the Cleanup Action Plan (CAP) for certain portions of the Time Oil Bulk Terminal Site **(Site)** located in Seattle, Washington (Figure 1.1). Time Oil Company and its derivatives (collectively **TOC**) operated a bulk fuel storage and distribution facility (TOC Seattle Terminal) within the Site.

1.1 General Facility Information and Site/Property Definitions

Site Name: Time Oil Bulk Terminal
Facility Site ID No.: 75486194[1]
Cleanup Site ID No.: 14604

Property Address: 2701–2805 W. Commodore Way, Seattle, 98199
Parcel Numbers: 112503-9050, -9081, -9113, -9120 and 423790-0405
Owner: Chapter 7 Trustee of the Bankruptcy Estate of TOC Holdings Co.

The Site, as defined under the Model Toxics Control Act (MTCA; Washington Administrative Code [WAC] 1730-340), is generally defined by where a hazardous substance, other than a consumer product in consumer use, has been deposited, stored, disposed of, or placed, or has otherwise come to be located. The Site includes multiple parcels where hazardous substances were released or have come to be located from industrial operations. Investigations show that multiple releases have commingled.

Multiple parcels within the Site are the subject of an asset purchase agreement (APA) between Cantera Development Group, LLC (Cantera) and Edmund J. Wood, Chapter 7 Trustee of the Bankruptcy Estate of TOC Holdings Co. (TOC), the current owner of the parcels. It is expected that Cantera will be assigning its rights to the parcels under the APA to a new entity, TOC Seattle Terminal, LLC, at the time of closing. The parcels subject to the APA are the Bulk Terminal parcel, the ASKO Hydraulic (ASKO) parcel, the East Waterfront parcel, and the West Waterfront parcel[2] (Figure 1.2). These parcels are collectively termed the **Property** for purposes of this CAP.

The Site also includes adjoining BNSF Railway Company (BNSF) property (BNSF parcel) and a Washington State Department of Natural Resources (DNR) Aquatic Waterway Use parcel (DNR parcel), and other potentially impacted areas including sediment in Salmon Bay (Figure 1.2). Cleanup of the BNSF parcel will be the subject of a separate legal agreement between BNSF and

[1] This Site comprises multiple previously listed Sites associated with various Facility Site ID numbers and Cleanup Site ID numbers. See Section 1.4 for more information on the regulatory history.

[2] In previous documents these parcels were identified as the Bulk Terminal Property, ASKO Property, East Waterfront Property, and West Waterfront Property.

Ecology. Cleanup actions for sediment areas of Salmon Bay, including the DNR parcel, are not included in this CAP.

1.2 Purpose

This document is a requirement of MTCA, RCW Chapter 70.105D, and WAC Chapter 173-340. The purpose of the CAP is to identify the proposed cleanup action at the Site; to establish the actions required to achieve a reasonable restoration time frame at the RAA, including engineered and institutional controls; and to identify the necessary requirements of engineering and monitoring plans, as further described in this document.

Specific MTCA requirements for CAPs are set forth in WAC 173-340-380(1). Consistent with these requirements, this CAP provides the following:

- Cleanup standards and remediation levels (RELs) for each hazardous substance in each medium of concern
- Summary of the remedial action alternatives considered in the Supplemental Upland Remedial Investigation (RI) and Feasibility Study (FS) for the RAA (Floyd|Snider 2020)
- Description of the proposed cleanup action, including justification for selection of the proposed cleanup action
- Implementation schedule
- Institutional controls (ICs)
- Restoration time frame
- Applicable state and federal laws
- Descriptions of the types, levels, and amounts of hazardous substances remaining in the RAA, and the measures that will be used to prevent migration and contact with those substances
- A preliminary determination that the proposed cleanup action will comply with WAC 173-340-360

In addition, this CAP includes an appended draft Groundwater Monitoring Plan (GMP) and describes contingency planning requirements.

1.3 Preliminary Determination

Ecology has made a preliminary determination that the cleanup described in this CAP will comply with the requirements for selection of a remedy under WAC 173-340-360. Specifically these requirements include a cleanup action that will be protective of human health and the environment, attain federal and state requirements that are applicable or relevant and

appropriate, comply with cleanup standards, provide for compliance monitoring, use permanent solutions to the maximum extent practicable, provide for a reasonable restoration time frame, and consider public concerns.

1.4 Project Background and Regulatory Overview

Documented investigation and remediation activities began at the Property in the early 1990s and have continued intermittently since then. TOC entered the Property into Ecology's Voluntary Cleanup Program (VCP) for technical advice and assistance on independent remedial actions for a period of time between approximately 2002 and 2007, and re-enrolled portions of the Property in the VCP in 2015. For administrative purposes, Ecology listed the parcels separately on the Confirmed and Suspected Sites List when TOC re-enrolled into VCP. The parcels were identified as follows:

- Bulk Terminal parcel (listed as Time Oil Co Seattle Terminal)
  Facility Site ID No. 75486194
  Cleanup Site ID No. 7123
  VCP No. NW2948
- ASKO parcel (listed as Time Oil Co ASKO Property)
  Facility Site ID No. 78837111
  Cleanup Site ID No. 12548
  VCP No. NW2950
- East Waterfront parcel (listed as Time Oil 2754 Commodore)
  Facility Site No. 7417688
  Cleanup Site ID No. 7740
  VCP No. NW2949

SoundEarth Strategies, Inc. (SES) had previously prepared separate RI and FS reports for each of these parcels, which were submitted to Ecology in 2015 (SES 2014a, 2014b, 2014c, 2014d, 2014e, 2014f). Ecology responded with opinion letters on each parcel. SES conducted further investigation and remediation activities until mid-2016, when TOC filed for bankruptcy and terminated its VCP contract. The Property is currently owned by the Bankruptcy Estate of TOC Holdings, managed by a court-appointed Chapter 7 Trustee.

Cantera is currently in a due diligence process to evaluate environmental contamination and other feasibility issues associated with the Property. As part of the due diligence process, Cantera enrolled the Property into the VCP in July 2018. Ecology accepted the VCP application on July 10, 2018, and identified the Site as Time Oil Bulk Terminal with VCP Project No. NW3201.

A draft Supplemental Upland RI Work Plan (RI Work Plan) was submitted to Ecology by Cantera in October 2018. The RI Work Plan was finalized in March 2019 and approved by Ecology in

correspondence dated April 8, 2019 (Floyd|Snider 2019). The RI Work Plan focused on RAA investigations.

The supplemental upland RI field investigation collected groundwater and soil data between March and August 2019 to fill the remaining data gaps necessary to complete the Supplemental Upland RI/FS for the Property. A draft Supplemental Upland RI/FS was submitted by Cantera in September 2019 and a final draft submitted in June 2020 for public review and comment. The Supplemental Upland RI/FS was subsequently finalized in September 2020.

The RIs and FSs prepared by SES, the Supplemental Upland RI/FS prepared by Floyd|Snider, and other previously prepared remedial reports are the technical basis for the cleanup actions to be conducted at the RAA.

2.0 Site Location and Background

2.1 Location and Definition

2.1.1 Site Location

The Site is located on the south shore of Salmon Bay, part of the Lake Washington Ship Canal, and within the Interbay commercial/industrial district (Figure 1.1). This district includes the Port of Seattle's nearby Fishermen's Terminal. A large residential area, the Magnolia neighborhood occupies the upland area south of the Property.

The freshwater Salmon Bay terminates at the Hiram Chittenden locks, the closest portion of which is approximately 200 feet west of the Property. The marine waters of Shilshole Bay, part of Puget Sound, are on the west side of the locks at an elevation approximately 20 feet lower than the elevation of Salmon Bay.

Land use near the Property is residential to the west and commercial/industrial to the east. The area to the south is occupied by the BNSF railroad and beyond that a forested hillside bordering the Magnolia neighborhood.

2.1.2 Property Description

The Property encompasses a total of 10.42 acres, with 5.67 acres south of W. Commodore Way and 4.75 acres north of the roadway and along the Salmon Bay shoreline. W. Commodore Way, a dedicated easement to the City of Seattle right of way (ROW), runs between the Bulk Terminal and ASKO parcels and the East Waterfront and West Waterfront parcels (Figure 1.2).

The Property is composed of four King County tax parcels as mentioned before: Bulk Terminal parcel (No. 1125039050); ASKO parcel (No. 4237900405); East Waterfront parcel (No. 1125039120); and West Waterfront parcel (No. 1125039081).

The 4.10-acre Bulk Terminal parcel on the south side of W. Commodore Way at 2737 W. Commodore Way is bounded to the east by W. Fort Street and beyond by a multi-tenant warehouse building. An active BNSF mainline borders the Bulk Terminal parcel on the south.

The 1.57-acre ASKO parcel located on the south side of W. Commodore Way at 2805 W. Commodore way is bounded to the west by a multi-tenant warehouse building and beyond by 31st Avenue West. The BNSF mainline also borders this parcel on the south.

The 3.17-acre East Waterfront parcel located on the north side of W. Commodore Way at 2750 W. Commodore Way is bounded to the east by the Port of Seattle Maritime Industrial Center. Its northern boundary is within Salmon Bay.

The 1.58-acre West Waterfront parcel north of W. Commodore Way at 2800 W. Commodore Way is bounded to the west by the Lockhaven Apartments and Marina.

2.1.3 Zoning

The Property and immediately surrounding area have mixed industrial zoning designations. The East Waterfront and West Waterfront parcels are zoned by the City of Seattle as IG1 (focus on marine/rail industrial uses), and the Bulk Terminal and ASKO parcels are zoned IG2 (broader range of industrial function, including commercial). The City of Seattle prohibits residential use in all industrial zones.

2.2 Historical and Current Property Use

2.2.1 Historical Property Use

Former Property features and operational areas are shown on Figures 2.1a and 2.1b. A brief summary of the operational history of the Property is provided below.

Former TOC operations date back to 1941. The Bulk Terminal, ASKO, and East Waterfront parcels housed bulk petroleum storage and distributed petroleum products via ships, rail, and trucks. While primarily consisting of aboveground storage tanks (ASTs), there were also a few underground storage tanks (USTs) on the Property. Bulk petroleum was supplied to the facility primarily via railcar.

Key features of the Property during the historical operations included:

- A bulk petroleum tank farm containing 14 large-volume ASTs and a connecting complex of pipelines
- An additional 3 ASTs on the ASKO parcel
- An oil and solvent storage area, with adjoining steam cleaning area
- Railroad spur lines
- Barreling sheds where petroleum products were placed into barrels for shipment
- Two barrel inclines that carried filled barrels of petroleum products under W. Commodore Way to be loaded onto ships at the East Waterfront parcel
- Overhead loading racks that were used to fill tanker trucks with petroleum products
- An underground pipeline utilidor that extended beneath W. Commodore Way to the East Waterfront parcel
- Various vehicle and equipment maintenance facilities
- Pentachlorophenol mixing facilities

Beginning in the 1970s, TOC also leased a warehouse on the ASKO parcel to a series of hydraulic repair shops that conducted machine shop operations until sometime between 2015 and 2017.

On the East Waterfront parcel, TOC leased a portion of the Property to Icicle Seafoods who performed hydraulic equipment maintenance and was presumed to conduct sandblasting between 1980 and 1992 (TOC 1993).

An overview of the historical operations at the Property indicate that the West Waterfront parcel was not used for petroleum handling or other industrial operations, although historical aerial photos appear to show activity on the East Waterfront parcel extending onto the West Waterfront parcel at certain times. The West Waterfront parcel is developed with storage sheds and piers for recreational and houseboat moorage.

As noted previously, a BNSF rail line borders the south side of the Property. Four rail spurs formerly entered onto the Property from the main BNSF line (Figure 2.1a). One spur extended to the southeast end of the tank farm on the Bulk Terminal parcel. Large volumes of fuel reportedly arrived on rail cars and were transferred from tanker cars via hoses to the tank farm (Foster Wheeler 2000).

2.2.2 Current Property Condition, Utilities, and Use

Many of the historical structures/facilities noted in the previous section have been demolished and removed. In 2006, the large bulk petroleum ASTs and associated piping and infrastructure were removed by TOC. Also removed at different times were several USTs, the overhead loading racks, the barrel inclines, a solvent storage AST, and the utilidor piping.

The Property currently has a vacant office building, several unused sheds that were used to house stormwater and groundwater treatment systems during and after TOC operations, and remnant 1940s-era commercial/warehouse buildings (Figure 2.2). Other buildings include a former maintenance/machine shop, a storage building, a garage/shed, and a former laboratory.

The only active use of the Property is by Marine Service & Supply, a fishing marine supply retail operation. This company leases a portion of the commercial/warehouse space and uses existing asphalt paved areas for vehicle access and parking.

Areas not covered by buildings are paved with asphalt in poor to good condition or are unpaved and overgrown with grasses, blackberries, and other vegetation. Exceptions include areas in the former tank farm area within the Bulk Terminal parcel and within the East Waterfront parcel that were extensively disturbed during former demolition/remedial excavation efforts—these areas have native or fill soil at the surface. The Salmon Bay shoreline bank is covered with a heavily vegetated mix of soil and concrete/rock armoring.

The surface elevation of the Property drops approximately 45 feet downward from the south Property line to the shoreline at Salmon Bay. Slopes within the Property vary from nearly level to steeply dipping.

There is little or no stormwater run-on to the Property, and rain falling on the Property mostly infiltrates rather than entering into a storm drain system or discharging to Salmon Bay. In

particular, infiltration predominates in the former tank farm area (Bulk Terminal parcel) where the ground surface is relatively flat. Stormwater runoff that does occur in this area is captured in a permitted collection system that discharges to the sanitary sewer.

For areas west of the office building on the Bulk Terminal and ASKO parcels, runoff drains as sheet flow across paved and unpaved vegetated surfaces down towards W. Commodore Way, or is captured in catch basins located around the former maintenance/machine shop. In both instances, the flows enter the municipal storm drain system. Conditions are similar at the East Waterfront parcel, where any sheet flow that occurs drains down toward Salmon Bay; however direct discharge into the bay has not been observed.

Observations made during storm events indicate soil erosion and transport in stormwater runoff is not occurring, except potentially in the former tank farm area where bare soils are exposed; however, as noted above, runoff in this area is captured and discharged to the sanitary sewer.

The Property currently has connections for power, water, and sewer that extend to utility lines in the W. Commodore Way ROW. Utilities in the ROW include a large-diameter sewer main (Figure 2.2) constructed in the early 1900s. The sewer main is a 30- to 40-foot deep, 12-foot-diameter brick-lined tunnel that discharges westerly to the West Point treatment plant. An equally large-diameter sewer trunk line from the Magnolia neighborhood joins the main line from the south near the west edge of the ASKO parcel, and a smaller sewer trunk line joins where 27th Avenue W. meets W. Commodore Way (Figure 2.2).

2.2.3 Future Property Use

The mixed industrial zoning prohibits residential development, absent zoning changes in the future. Future use will, therefore, be limited to commercial and industrial development. This development and the remedial action will likely require that the RAA be cleared of all existing improvements and vegetation, along with significant excavation and grading.

2.3 Previous Studies and Interim Actions

Environmental investigations and actions that have been completed at the Property are summarized as follows:

- Phased soil and groundwater investigations were completed at the Property by the Foster Wheeler Corporation between 1999 and 2002. These investigations were focused primarily on the Bulk Terminal and East Waterfront parcels and included installation of 112 soil borings and 36 monitoring wells. Soil samples were collected during all soil boring installation events, and several rounds of groundwater monitoring at Property wells were completed between 1999 and 2005.
- Multiple RIs were completed by SES for the Bulk Terminal, ASKO, and East Waterfront parcels between 2006 and 2013. The scope of these RIs included installation and sampling

of 269 additional soil borings and installation and sampling of 85 additional monitoring wells. An additional 24 groundwater monitoring events for the RIs were completed for one or more parcels. The RIs also included aquifer testing and limited soil vapor sampling.

- Supplemental soil and groundwater investigations were completed by SES between 2014 and 2015, subsequent to the RIs. These investigations included installation and sampling of 35 additional soil borings and additional groundwater monitoring at existing wells.
- Supplemental RI field work was completed by Floyd|Snider in 2019. This investigation included installation of 17 additional monitoring wells, focused soil sampling, and Property-wide groundwater monitoring.

There have been numerous targeted interim cleanup actions completed at the Property, dating back as early as 1991 (Figure 2.3). Specifically, there have been numerous excavations at the Bulk Terminal and East Waterfront parcels that targeted removal of petroleum hydrocarbon-, pentachlorophenol (penta)/dioxin/furan-, and metals-impacted soils. In addition, a groundwater and light non-aqueous-phase liquid (LNAPL) treatment and recovery system operated on the Bulk Terminal parcel for approximately 5 years. The interim actions left concentrations of penta greater than the interim action level of 2.5 milligrams per kilogram (mg/kg) in soil, and the MTCA Method B cleanup level (CUL) of 0.05 mg/kg (see Table 3.1), and monitored natural attenuation (MNA) was the remaining phase of the remedy. Additional active cleanup for penta is not proposed in this CAP, and the remaining penta will continue to be monitored in groundwater.

2.4 Conceptual Site Model

A conceptual site model (CSM) of contaminant sources and migration at the Property is illustrated in Figure 2.4 and discussed below. Figures 2.5 and 2.6 provide additional cross-sections illustrating the extent and distribution of contaminants in soil and groundwater.

Soils at the Property consist of 2 to 5 feet of surface fill underlain by interglacial sediments to the depth explored, 20 to 60 feet. The fill is composed of sand, silty sand, and gravel. The interglacial sediments are composed of stiff silts interbedded with sands and silty sands.

Shallow groundwater occurs within the silty sands under perched, water table, and slightly confined conditions, and four water-bearing zones (WBZs) have been identified within the depth explored: the Perched WBZ, Shallow WBZ, Intermediate WBZ, and Deep WBZ. The top of the saturated zone for the Shallow WBZ, effectively the water table, ranges from less than 5 feet below ground surface (bgs) at the Salmon Bay shoreline to nearly 30 feet bgs at the upper south end of the Property.

Horizontal groundwater flow directions in the Perched and Shallow WBZs are to the north and west toward Salmon Bay. Vertical leakage downward also appears to be occurring between the four WBZs, and from groundwater in the Shallow WBZ into or along the sewer main in W. Commodore Way. The WBZs ultimately discharge into Salmon Bay and potentially Shilshole Bay.

Known past industrial operations and releases on the Bulk Terminal, ASKO, and East Waterfront parcels caused or contributed to the contamination at the Property. Sources of contamination include leaks and spills from:

- Petroleum storage and handling on the Bulk Terminal, ASKO, and East Waterfront parcels, including operation of USTs and ASTs; transfer of petroleum to barrels; and transportation of petroleum via loading racks, a barrel incline, and the underground pipeline utilidor
- Mixing diesel with penta in an AST on the Bulk Terminal parcel
- Machine shop and steam cleaning operations on the ASKO parcel
- Vehicle maintenance on the eastern portion of the East Waterfront parcel
- Icicle Seafood maintenance operations on the East Waterfront parcel including sandblasting and vehicle maintenance
- BNSF railroad product loading and off-loading operations

As a result of these releases, the primary contaminants at the Property consist of petroleum products (gasoline, diesel, oil), benzene, penta, chlorinated solvents (trichloroethene [TCE] and vinyl chloride [VC]), and heavy metals. It is also possible tributyltin (TBT) associated with boat maintenance activities may be present in soils within the East Waterfront parcel.

Leaks and spills of the contaminants referenced above have migrated downward through the soil to groundwater, creating contaminant plumes. Because the releases were from surface or near-surface sources and because of existing hydrogeologic conditions, most of the petroleum-contaminated soil is within 20 to 25 feet of ground surface, and most of the TCE-contaminated soil is within 30 to 40 feet of ground surface. The metals contamination, by contrast, is generally close to the surface. The lateral spread of contaminants in soil have been largely defined, except for metals in soil on the East Waterfront parcel.

The bulk of the groundwater contamination resulting from the leaks and spills referenced above also appears to be relatively shallow within the upper two WBZs (Perched and Shallow), although the Intermediate WBZ is impacted in some areas. In addition, two areas of petroleum LNAPL are present at measured thicknesses up to 5 feet on the Bulk Terminal parcel and the adjacent W. Commodore Way ROW. The primary petroleum hydrocarbon contaminant in groundwater is total diesel- plus oil-range organics (Total DRO+ORO), although gasoline-range organics (GRO) and other petroleum constituents (e.g., benzene) are also present. The primary chlorinated compounds are TCE and VC.

A total petroleum hydrocarbon (TPH) plume in the Shallow WBZ extends from the Bulk Terminal parcel to the north and northwest toward W. Commodore Way, where it generally terminates. It appears that plume migration beyond the ROW is generally prevented by leakage into or along the sewer main. However, in one area, the TPH plume may extend beyond the ROW. Further plume evaluation will be completed as part of post-remedy groundwater monitoring. The TPH

plume also appears to extend to the southeast/southwest periodically in response to the reversal of groundwater flow associated with mounding in the central part of the former tank farm.

A chlorinated solvent (TCE and VC) plume in the Shallow WBZ (and Perched WBZ) is present on the ASKO parcel, where it begins at the southern Property boundary and ends within the W. Commodore Way ROW. The Intermediate WBZ is also impacted, although to a much lesser extent than the Shallow WBZ. Data from the BNSF parcel indicate that at least part of the chlorinated solvent plume originates on that property. Like the TPH plume, leakage into or along the sewer main in the street ROW appears to be preventing the chlorinated solvent plume from migrating further downgradient toward Salmon Bay, except potentially at one location. At this location, additional groundwater sampling will be conducted post-remedy to confirm that the plume does not extend across the ROW.

2.5 Areas of Concern

Due to the large size of the Property and the RAA, it was divided into areas of concern (AOCs) for the purposes of defining remedial actions (Figure 2.7). The Upland AOC consists of the Bulk Terminal parcel and ASKO parcel and includes the W. Commodore Way ROW to the north of both properties. The Shoreline AOC consists of the East Waterfront parcel. The BNSF AOC is located upgradient of the Upland AOC and will be addressed under a separate agreement between Ecology and BNSF.

The West Waterfront parcel is not within an AOC or the RAA and does not appear to be impacted by historical operations. There are no known significant industrial operations in this area, and no known or suspected former or current potential sources of contamination. However, soil and groundwater sampling was not conducted to confirm the lack of contaminant impact throughout this parcel. This undeveloped parcel will likely require characterization and potential cleanup action if contamination greater than Site CULs is found during future development. This CAP requires comprehensive soil management and contingency plans that will protect human health and the environment prior to and during any development of the West Waterfront parcel.

The media of concern for each AOC include soil, groundwater, and air (soil vapor).

3.0 Indicator Hazardous Substances and Cleanup Standards

3.1 Indicator Hazardous Substances

Chemicals of interest identified in the Supplemental Upland RI/FS were based on Property data and historical operations. These were evaluated to select indicator hazardous substances (IHSs), chemicals that pose the greatest overall threat to human health and the environment due to their toxicity, spatial distribution, and/or concentrations present at the Property. The IHSs identified in soil and groundwater at the Property include arsenic, GRO, DRO, ORO, benzene, TCE, VC (groundwater only), and penta.

Dioxins/furans were formerly present in soils at the Property in significant concentrations and volumes. Given their toxicity, this compound group would normally be considered an IHS for purposes of cleanup. However, most of the soils contaminated with dioxins/furans were excavated during a series of previous removal actions, leaving a relatively small residual. In addition, the dioxins/furans are collocated with the penta-contaminated soils. Penta was, therefore, selected as the IHS representing both.

The nature and extent of these IHSs has been sufficiently delineated through the former RIs and the Supplemental Upland RI/FS to investigate the Property and determine the RAA, thus providing the basis for selection of a cleanup action in accordance with MTCA and its implementing regulations (WAC 173-340-350(1)).

3.2 Cleanup Standards

Cleanup standards are defined under MTCA as a CUL combined with a point of compliance (POC) where the CUL must be met, in conjunction with any additional regulatory requirements that apply (WAC 173-340-200).

In addition, the following Property-specific considerations guided the selection of cleanup standards:

- A single CUL is provided for each analyte in each medium.
- Soil CULs protective of leaching to groundwater are based on saturated conditions.
- The Property is zoned for mixed commercial/industrial use and will remain so for the foreseeable future.
- Soil CULs will be protective of industrial worker exposure; therefore, ICs will apply where industrial CULs are used (WAC 173-340-440 (4)(c)).
- The final CUL chosen is the most conservative value when there are multiple transport/exposure pathways and multiple possible CULs.

- Contaminated soils will remain in place as part of the selected cleanup action (Upland AOC portion of the RAA), requiring that these soils be isolated with a surface cap, and that ICs be implemented to maintain the integrity of the cap. The ICs will include a Soil Management Plan and an Environment Covenant.
- Shallow groundwater at the Property has been determined to be potable in accordance with MTCA requirements (WAC 173-340-720(2), requiring that ICs be implemented to prohibit groundwater withdrawal or use.

CULs for Property IHSs were developed for all relevant current or potential future transport/exposure pathways, (see Table 3.1 below). The relevant transport pathways include leaching from soil to groundwater, transport of groundwater to surface water and sediment, bioaccumulation from surface water or sediment into seafood, and vaporization from soil or groundwater to air. The relevant exposure pathways include contact with soil or sediment by humans or ecological receptors, consumption of groundwater or surface water by humans, consumption of seafood by humans or ecological receptors, and inhalation of air by humans.

Applicable standards considered in the development of CULs included National Primary Drinking Water Standards, state primary and secondary maximum contaminant levels, national recommended water quality criteria under the Clean Water Act, Water Quality Standards for Surface Waters of the State of Washington, MTCA, and Sediment Management Standards (SMS).

Soil erosion and transport to freshwater sediment via overland flow, bank wash, or discharge to a storm drain (and subsequently to Salmon Bay) does not appear to be a current pathway. RI field observations indicate the soil erosion to sediment pathway is not currently active at the Property. Future controls will be required to manage upland soils so that a release does not occur to surface water or sediment in Salmon Bay.

POCs for groundwater and soil were established in accordance with MTCA (WAC 173-340-720) as follows:

- **Air:** The POC for air is throughout the Site, both outdoors and indoors, including subsurface structures or other structures large enough to fit a person.
- **Groundwater:** The standard POC under MTCA is throughout the Site to the maximum depth of potentially impacted groundwater. However, the planned remedial action will not result in groundwater meeting CULs within a reasonable restoration time frame at the standard POC. Because it has been demonstrated under WAC 173-340-350 through -390 that it is not practicable to meet the CUL throughout the Site within a reasonable restoration time frame, a conditional POC (CPOC) is appropriate and must be set as close as practicable to the source of contamination. Because the intent is to completely clean up soil and groundwater in the Shoreline AOC within a reasonable restoration time frame, the groundwater CPOC will be at the downgradient edge of the Upland AOC within the W. Commodore Way ROW (see Figure 5.1).

- **Soil:** The standard POC for soil based on protection of groundwater is throughout the Site. Cleanup actions for unrestricted land use that rely on containment will often not achieve CULs at the standard POC. Pursuant to MTCA, Ecology can determine that a cleanup action complies with cleanup standards provided certain conditions are met. Among these are the selection of a remedy that is permanent to the maximum extent practicable, the cleanup action is protective of human health and terrestrial ecological receptors, ICs are put in place to protect the remedy, and compliance monitoring and periodic reviews are required to ensure that the containment remains protective (WAC 173-340-740 [6][f]).

The Supplemental Upland RI/FS proposed one TPH CUL for Total DRO+ORO for protection of human health. A subsequent terrestrial ecological evaluation re-evaluation indicated the need for additional DRO and ORO CULs for protection of terrestrial species (Ecology 2020).

Table 3.1: Summary of Cleanup Standards for Indicator Hazardous Substances

Proposed IHS	Cleanup Standard		
	Value	**Basis**	**Point of Compliance**
Groundwater			
Arsenic	5 µg/L	Statewide natural background	Conditional— At W. Commodore Way
GRO	800 µg/L	Protection of drinking water	
Total DRO+ORO	500 µg/L	Protection of drinking water	
Benzene	0.44 µg/L	Protection of surface water	
TCE	0.5 µg/L	Protection of surface water (PQL-based)	
Vinyl chloride	0.2 µg/L	Protection of surface water (PQL-based)	
Penta	0.2 µg/L	Protection of surface water (PQL-based)	
Soil[(a)]			
Arsenic	7.3 mg/kg	Natural background	Regulatory Determination
GRO	30 mg/kg	Protection of groundwater	
DRO	570 mg/kg	Protection of terrestrial species	
ORO	1,600 mg/kg	Protection of terrestrial species	
Total DRO+ORO	2,000 mg/kg	Protection of groundwater	
Benzene	0.02 mg/kg	Protection of surface water (PQL-based)	
TCE	0.02 mg/kg	Protection of surface water (PQL-based)	
Penta	0.05 mg/kg	Protection of surface water (PQL-based)	
Air[(b)]			
GRO+DRO[(c)]	140 µg/m^3	Inhalation (Implementation Memo 18)	Indoor and Outdoor Air Throughout Site
Benzene	0.32 µg/m^3	Inhalation (MTCA Eq. 750-2)	
TCE	0.33 µg/m^3	Inhalation (MTCA Eq. 750-2 modified for early life exposure)	
Vinyl chloride	0.28 µg/m^3	Inhalation (MTCA Eq. 750-2)	

Notes:

µg/L	Micrograms per liter
mg/kg	Milligrams per kilogram
µg/m^3	Micrograms per cubic meter
PQL	Practical quantitation limit

(a) A soil CUL will be established for tributyltin (TBT), if soils tested for this compound, as described below (Section 3.4), detect TBT at concentrations at or above the 26 mg/kg Method B CUL for protection of human direct contact.

(b) If site-specific measurements of outdoor background air concentrations exceed these health-based levels, the cleanup levels must be adjusted up to the outdoor background air concentrations.

(c) The CUL provided for GRO and DRO is the generic indoor air cleanup level for total petroleum hydrocarbons (TPH) provided in Ecology's Implementation Memo 18 for Petroleum Vapor Intrusion. A site-specific CUL for TPH will be established during vapor intrusion assessment using Site petroleum hydrocarbon data in accordance with Appendix B of Implementation Memo 18 or the most current Ecology guidance at the time of assessment.

3.3 Remediation Levels

In accordance with WAC 173 340-200, a REL "means a concentration of a hazardous substance in soil, air, water, or sediment above which a particular cleanup action component will be required as part of a cleanup action at a site." RELs may be developed as a tool at sites where a combination of cleanup action components are used to achieve CULs. RELs are not the same as CULs but define the concentration or other method of identification of an IHS above which a contaminated medium must be remediated in some manner. RELs exceed CULs but provide a level at which a particular cleanup action component will be used. A cleanup action that uses RELs must meet the requirements of MTCA, including a cleanup action that uses permanent solutions to the maximum extent practicable and provides for a reasonable restoration time frame. Soil RELs have been established for this cleanup action as presented in Table 3.2 below.

RELs are appropriate for the Upland AOC portion of the RAA where implementation of multiple aggressive removal or treatment technologies will be necessary to achieve proposed CULs for groundwater at the proposed CPOC. In the Upland AOC, the contamination is more severe and widespread, and thus it was demonstrated in the FS that RELs were necessary for the cleanup action. RELs are not used in the cleanup of soils in the Shoreline AOC portion of the RAA or for groundwater.

Table 3.2: Summary of Remediation Levels

Indicator Hazardous Substance	Upland AOC Soil Remediation Level	Point of Compliance
GRO	5,000 mg/kg	Upland AOC
Total DRO+ORO	12,000 mg/kg	
Benzene	GRO compliance with soil REL	
TCE	1.0 mg/kg	
LNAPL	No visible LNAPL	

The use of RELs is expected to result in remediation of approximately 80 percent of the volume of contaminated soil exceeding the CULs in the Upland AOC. The proposed RELs, in combination with ICs, will achieve the short-term remediation goals of worker protection and reduction of contaminants in soil vapor, as well as the long-term goal of achieving compliance with the groundwater CULs at the CPOC.

3.4 Other Contaminants

TBT, an organometallic paint additive, could be present in shallow soils on the East Waterfront parcel. If present in the soil, its release would likely be associated with former boat hull maintenance activities, including sandblasting. Additional soil sampling will be necessary as part of pre-remedial design investigations to confirm if TBT is present and, if so, the nature and extent of the contamination.

The following approach is appropriate to manage potential TBT contamination at the Property. Soils containing TBT could pose a risk to humans through direct contact or to benthic species if soils erode into Salmon Bay.

1. TBT will be analyzed in soils during the pre-remedial design investigation. Sampling locations will be set, in part, on the assumption they may be collocated with metals, which will also be further evaluated as part of a separate pre-remedial design data gap investigation.

    a. If TBT concentrations are greater than the MTCA Method B human direct contact CUL (24 mg/kg[3]), the lateral and vertical extent of soil exceeding the MTCA Method B CUL to a depth of 15 feet must be defined.

    b. If TBT concentrations are less than the MTCA Method B CUL, the lateral and vertical extent of soil exceeding a targeted REL[4] of 0.047 mg/kg[5] to a depth of 2 feet bgs must be defined. Soils within this depth interval are considered potentially erodible.

2. Cleanup actions to remediate TBT found exceeding CULs are as follows:

    a. If the TBT is completely collocated with areas of elevated metals concentrations (greater than the CUL), TBT cleanup will occur when the metals are cleaned up.

[3] Based on MTCA Method B standard formula value for tributyltin oxide, non-carcinogenic, for unrestricted land use.

[4] In this context, the use of a targeted REL for TBT applies to pre-design data collection and evaluation and provides a lower limit to be used for the approach outlined in this section, specifically to determine whether additional actions are necessary as outlined in item 3 of this approach.

[5] This value was established to provide a lower limit that is protective of the bank erosion pathway, should it become a complete pathway in the future.

b. If the TBT is not collocated or is incompletely collocated with metals, additional cleanup of areas with TBT concentrations exceeding the MTCA Method B CUL will be necessary. Additional FS may be necessary to determine cleanup action alternatives.

3. If TBT is detected at concentrations greater than the targeted REL of 0.047 mg/kg but less than the MTCA Method B CUL, then either of the following will be required:

   a. Soil will be cleaned up to meet the targeted REL of 0.047 mg/kg, which is protective of a future erosion pathway.

   b. A Soil Management Plan will be developed and implemented and will include the elements described in Section 6.1.8.

4.0 Cleanup Action Areas

Due to the large size of the RAA and the various plumes and source areas, seven cleanup action areas (CAAs) are defined within the AOCs where the IHSs in soil are similar and can be remediated by the same technologies. The CAA vertical and horizontal boundaries are generally based on distinct source areas where IHS concentrations in soil are greater than the proposed CULs. Refer to Figure 4.1 for the CAA boundaries, and the following figures for IHS concentrations relative to CAA boundaries: Figures 4.2 (arsenic), 4.3 (GRO), 4.4 (DRO and ORO), 4.5 (benzene), 4.6 (TCE), 4.7 (VC), and 4.8 (penta).

4.1 Upland Area of Concern

Within the Upland AOC, there are five CAAs with distinct IHS distributions and depths of contamination, as shown on Figure 4.9. Isolated soil samples outside a source area with concentrations greater than a proposed CUL, but surrounded by samples with concentrations less than the proposed CUL, were not included in a CAA. A summary of the Upland AOC CAAs follows.

- **CAA-1** is on the Bulk Terminal parcel within the footprint of the former tank farm and along the southern and southeastern edge of the 2012 excavation area. CAA-1 is separated into two subareas: CAA-1.a and CAA-1.b. CAA-1.a is characterized by shallow and discontinuous soil CUL exceedances (less than 5 feet bgs) of GRO, Total DRO+ORO, and benzene. CAA-1.b is characterized by more continuous contamination in shallow soil (less than 10 feet bgs) with some deeper, discontinuous CUL exceedances. CAA-1.a has LNAPL along its northwest boundary, which was measured at thicknesses of 2.8 to 4.4 feet during the April/May 2019 groundwater monitoring event. CAA-1 includes a primary ongoing source of petroleum (TPH and benzene) to groundwater in the Upland AOC.
- **CAA-2** is on the Bulk Terminal parcel and under the W. Commodore Way ROW. This CAA is within the area of the former gasoline and diesel USTs, former pump island, and former utilidor. CAA-2 is divided into two subareas, CAA-2.a and CAA-2.b, to differentiate between the Bulk Terminal parcel and the portion under the W. Commodore Way ROW, respectively. CAA-2 encompasses the larger LNAPL area, which was measured at a maximum thickness of 5.2 feet during the April/May 2019 groundwater monitoring event. CAA-2 has fairly continuous soil impacts greater than the proposed CULs for GRO, Total DRO+ORO, and benzene throughout the CAA to a depth of 20 feet bgs, with the majority of contamination between 0 to 15 feet bgs. There are also a limited number of penta soil exceedances collocated with TPH exceedances near the 2012 interim action excavation extent that are greater than the proposed CUL. CAA-2 is within the GRO, Total DRO+ORO, and benzene groundwater plumes. CAA-2 includes a primary ongoing source of petroleum (TPH and benzene) to groundwater in the Upland AOC.

- **CAA-3** is located on the Bulk Terminal and ASKO parcels within the footprint of the former barrel inclines and former barreling sheds. This CAA is characterized by scattered GRO and Total DRO+ORO CUL exceedances in soil shallower than 7.5 feet bgs. There are also limited exceedances of benzene and TCE in this CAA that are collocated with GRO and Total DRO+ORO. Soil contamination in CAA-3 does not appear to be a primary contributor to groundwater contaminant plumes.
- **CAA-4** is located on the ASKO parcel and includes an area of TCE contamination that originates on the former rail spur in the BNSF AOC and extends from the BNSF property line northward across a large portion of the ASKO parcel (Figure 4.9). CAA-4 is characterized primarily by soil CUL exceedances of TCE from 2 to 30 feet bgs. CAA-4 is broken into two subareas, CAA-4.a and CAA-4.b, to distinguish between the western portion of the CAA where the majority of contamination exists between 5 and 20 feet bgs and the larger eastern portion of the CAA where most of the source mass is between 5 and 28 feet bgs. CAA-4 also has limited and discontinuous exceedances of GRO, Total DRO+ORO, and benzene, primarily in shallow vadose zone soil, that are all located within the footprint of TCE contamination. CAA-4 includes a primary ongoing source of chlorinated volatile organic compounds (cVOCs; TCE and VC) and petroleum (TPH and benzene) to groundwater in the Upland AOC.
- **CAA-5** is near the former oil and solvent storage barrel racks and steam cleaning area on the ASKO parcel. CAA-5 is characterized primarily by shallow (less than 8 feet bgs) soil exceedances of the CULs for GRO and Total DRO+ORO. There are also limited collocated arsenic exceedances. Localized soil contamination in CAA-5 appears to contribute to limited arsenic and petroleum impacts in groundwater only in the Perched WBZ. CAA-5 also lies within the deeper TCE and VC groundwater plume below 10 to 15 feet bgs.

4.2 Shoreline Area of Concern

Within the Shoreline AOC, there are two CAAs as shown on Figure 4.10, each defined by a distinct footprint of IHSs, as described below. The majority of TPH impacts in soil in the Shoreline AOC were previously excavated as part of an independent interim action in 2013. Limited soil and groundwater impacts remain in this AOC, and the boundaries of the CAAs in this area are intended to encompass all remaining soils that contain TPH and metals concentrations greater than CULs, except for a few isolated outliers.

Note that the full extent of metals exceeding CULs has yet to be determined, and there remains the possibility that TBT is present at concentrations that would warrant cleanup, as described earlier in this document. In addition, the actual boundary of the area exceeding the TPH CULs will be determined during the remedial action and is likely to vary slightly from that shown on Figure 4.10. A summary of the CAAs in this area follows.

- **CAA-6** is located on the East Waterfront parcel in the vicinity of the former barrel incline, former utilidor, and former warehouse and garage/vehicle maintenance building. The CAA extends north to the Salmon Bay shoreline. The area is characterized by shallow soil impacts of GRO, Total DRO+ORO, and benzene. CAA-6 is broken into subareas CAA-6.a and CAA-6.b. The depth of soil impacts varies across the CAA in accordance with depth to groundwater; deeper CUL exceedances extend to approximately 12 feet bgs in the southern portion of the CAA (CAA-6.a) and shallower impacts are limited to less than 3 feet bgs in the northern portion closest to the shoreline (CAA-6.b). CAA-6 also contains localized groundwater impacts of GRO, Total DRO+ORO, benzene, and arsenic. CAA-6.a includes a localized ongoing continuous source of petroleum (TPH and benzene) to groundwater in the Shoreline AOC; scattered and shallow soil impacts in CAA-6.b do not appear to be contributing to groundwater contamination.
- **CAA-7** is located on the western shoreline edge of the East Waterfront parcel in an area with documented former sandblast grit piles. This area contains exceedances of the proposed CUL for arsenic in surface soil (less than 1 feet bgs) and a portion of the arsenic groundwater plume. Arsenic in soil appears to be a localized source of impacts to groundwater along the shoreline. Additional metals and TBT could be associated with sandblast grit and, therefore, if present, collocated with arsenic exceeding CULs. Metals and TBT will be further delineated during remedial design.

5.0 Remedial Alternatives Evaluation and Selection

5.1 Alternatives Considered

Six remedial action alternatives were evaluated in the Supplemental Upland RI/FS to address both soil and groundwater contamination at the Property. The alternatives included a range of potentially applicable technologies and cleanup action options for each of the CAAs and varied to some degree between the parcels, based on the nature and extent of IHSs.

For the Upland AOC, not all technologies that are applicable to the ASKO parcel are applicable to the Bulk Terminal parcel. Cleanup action options were, therefore, evaluated separately for each parcel before determining combined approaches for the Upland AOC as a whole.

For the Shoreline AOC, an alternatives analysis was not necessary because soil excavation and offsite disposal was the alternative proposed. This is a permanent solution under MTCA.

Property-wide alternatives evaluated during the FS are summarized in Table 5.1 and include the following common elements:

- LNAPL removal and/or in situ solidification and stabilization (ISS) at CAA-1 and CAA-2
- Installation of a permeable reactive barrier (PRB) at CAA-4 to address elevated cVOC concentrations in Perched WBZ groundwater migrating onto the ASKO parcel from the upgradient BNSF parcel
- Capping and ICs for all CAAs within the Upland AOC
- Excavation and offsite disposal of all soil exceeding CULs for the CAAs within the Shoreline AOC
- MNA of groundwater outside of active treatment areas
- Compliance monitoring
- Contingency planning, including specific triggers to evaluate whether groundwater will attain CULs within the established restoration time frame

For the Upland AOC, the six alternatives varied as follows:

- Alternative A.1 – Excavation and offsite disposal of all soil exceeding CULs throughout the RAA
- Alternative A.2 – Excavation and offsite disposal of soil exceeding RELs in CAA-1, CAA-2, CAA-3, and CAA-4
- Alternative B – Excavation and offsite disposal of soil exceeding RELs in CAA-1, CAA-2.b, and CAA-3; ISS to treat soil exceeding RELs in CAA-2.a and CAA-4; and excavation and offsite disposal of all soil exceeding CULs in CAA-5

- Alternative C – Excavation and offsite disposal of soil exceeding RELs in CAA-1, CAA-2.b, and CAA-3; ISS to treat soil exceeding RELs in CAA-2.a and CAA-4; "hot spot" excavation and offsite disposal of soil exceeding CULs in CAA-5; and in situ treatment of groundwater in CAA-5
- Alternative D – Excavation and offsite disposal of soil exceeding RELs in CAA-1.a and CAA-2; and electrical resistance heating to treat cVOCs in soil and groundwater in CAA-4
- Alternative E – Excavation and offsite disposal of soil exceeding RELs in CAA-1.a and CAA-2.b; and ISS to treat soil exceeding RELs in CAA-2.a and CAA-4.

Essentially, for the Upland AOC, variable amounts of excavation and LNAPL removal were considered for the TPH in CAA-1,-2, and -3, and various types of treatment methods were considered for the cVOCs/TPH in CAA-4 and -5.

Each of the RAA-wide alternatives were screened relative to MTCA threshold and other requirements in accordance with WAC 173-340-360(2)(a) and (2)(b), and evaluated according to disproportionate cost analysis (DCA) procedures in WAC 173-340-360(3)(e). Results of the evaluation identified Alternative C as the preferred alternative, because it meets threshold requirements, uses permanent solutions to the maximum extent practicable, considers public concerns, and provides a reasonable restoration time frame.

5.2 Selected Remedy

Following consideration of the FS and technical consultations, Ecology has determined that the cleanup action for the RAA consists of multiple elements, as illustrated in Figure 5.1. The selected remedy consists of the following elements, plus the common elements listed in Section 5.1:

- **East Waterfront parcel.** Soil excavation for TPH and metals, evaluation and potential excavation of TBT with a contingency for a Soil Management Plan if TBT remains at concentrations greater than the targeted REL.
- **Bulk Terminal parcel.** Soil excavation and ISS for TPH, LNAPL removal or encapsulation, pavement and ICs (including Soil and Remedial Element Management Plan [SREMP]).
- **ASKO parcel.** Minor soil excavation coupled with ISS for cVOCs and TPH. This parcel also includes a passive in situ groundwater treatment zone to treat cVOCs in groundwater near the CPOC, a PRB to treat cVOCs in groundwater entering the RAA from the BNSF parcel, pavement, and ICs (including SREMP).

CAA-specific cleanup actions are itemized as follows:

- Excavation of soil with IHS concentrations greater than RELs to the maximum extent practicable in CAA-1, CAA-2.b, and CAA-3
- Removal and ISS of LNAPL in CAA-1.a and CAA-2

- ISS to address source area soil with IHS concentrations greater than RELs in CAA-2.a and CAA-4
- Installation of an interceptor trench and PRB wall along the upgradient edge of CAA-4 to capture and treat groundwater containing IHSs greater than the CULs from the adjacent BNSF parcel
- Hot spot excavation and focused groundwater treatment in CAA-5
- Excavation and offsite disposal of contaminated soil with IHS concentrations greater than CULs in CAA-6 and CAA-7
- Capping and ICs for the Upland AOC

Implementation of this cleanup action is expected to remove or encapsulate approximately 90,000 gallons of LNAPL and effectively remove or treat an estimated 36,000 cubic yards (CY) of soil containing IHSs at concentrations greater than the RELs or CULs. More details regarding the cleanup action and implementation are included in Section 6.0.

5.3 Justification for Selection of Remedy

The cleanup action is a comprehensive final remedy for the RAA that complies with all the applicable remedy selection requirements under MTCA. Specifically, the cleanup action meets the minimum requirements under WAC 173-340-360(2)(a) as follows:

- **Protects Human Health and the Environment.** The selected remedy will protect human health and the environment in both the short- and long-term. The remedy will permanently reduce the identified risks presently posed to human health and the environment through a combination of source area removal and stabilization, in situ groundwater treatment, and natural attenuation.
- **Complies with Cleanup Standards.** The selected remedy is expected to comply with the cleanup standards for groundwater and soil at the POCs within a reasonable time frame.
- **Complies with Applicable State and Federal Laws.** The selected remedy is expected to comply with all state and federal laws and regulations.
- **Provides Compliance Monitoring.** The selected remedy will include compliance monitoring for soil and groundwater to assess the effectiveness and permanence of each remedy element.

The cleanup action also meets the other requirements under WAC 173-340-360(2)(b), as follows:

- **Uses Permanent Solutions to the Maximum Extent Practicable.** The selected remedy utilizes LNAPL removal in conjunction with excavation and ISS technologies, which will

remove or immobilize a large portion of the existing contaminant mass in the subsurface and effectively eliminate a significant source of contamination to groundwater.

- **Provides for Reasonable Restoration Time Frame.** The restoration time frame for RAA groundwater with the selected remedy is estimated to be 15 years, based on the expected time for groundwater to achieve compliance with CULs at the CPOC. A shorter restoration time frame of 5 years is anticipated for the Shoreline AOC.

  Compliance with the soil cleanup standards will be met when the Property is developed, the ground surface capped, and ICs implemented. These actions are expected to occur in less than 15 years. Compliance with the soil cleanup standards is expected to occur immediately after remedy implementation in the Shoreline AOC.

- **Considers Public Concerns.** A draft of this document was presented to the public and stakeholders for public review and comment. The Supplemental Upland RI/FS was also presented for public comment. Comments were received, reviewed by Ecology, and addressed in a responsiveness summary. Ecology determined that no changes to either of the documents were required.

Because this remedy relies on a CPOC due to the impracticality of attaining CULs throughout the Upland AOC, it is not considered a permanent groundwater cleanup action under WAC 173 340-360(2)(c)(i). However, the selected remedy does meet the following requirements for nonpermanent groundwater cleanup actions under WAC 173-340-360(2)(c)(ii):

- **Treatment or Removal of the Source Including LNAPL.** Source area soil and LNAPL will be treated or removed in the RAA and, therefore, remove or reduce ongoing sources to groundwater.
- **Groundwater Containment, Including Barriers, to Avoid Spreading of the Groundwater Plume.** The interceptor trench, PRB wall, and other technology will be implemented to provide in situ treatment of contaminated groundwater to reduce IHS concentrations and minimize spreading of the plume. Specifically, the interceptor trench and PRB wall will capture and treat contaminated groundwater migrating onto the Property from the upgradient BNSF parcel, effectively reducing the potential for recontamination.

6.0 Description of the Cleanup Action

As discussed in Section 5.2, the cleanup action comprises a combination of cleanup actions, which are described below. More specific plans will be developed in the Engineering Design Report (EDR), which will be prepared prior to implementation of the cleanup action.

6.1 Cleanup Action Components

6.1.1 LNAPL Removal/Immobilization

Multiple methods will be used to address LNAPL. At CAA-1.a, in the area of the former tank farm, and at CAA-2.b in the W. Commodore Way ROW, LNAPL will be removed using a combination of excavation and vacuum extraction. At CAA-2.a, LNAPL will be immobilized by encapsulation using ISS technology, as described in Section 6.1.3.

Standard excavation means and methods will be used to remove soil containing LNAPL from areas CAA-1.a and CAA-2.b. In addition, a vacuum truck will be used to extract any LNAPL that accumulates in the excavated areas during the soil removal activities. LNAPL and associated soils removed from these areas will be transported offsite to a permitted facility for disposal.

These activities are expected to remove (or encapsulate) approximately 13,000 gallons of LNAPL from CAA-1 and approximately 77,000 gallons of LNAPL from CAA-2.

Groundwater encountered while removing LNAPL will also be removed and disposed of off-Property or through a permitted discharge to sanitary sewer.

6.1.2 Soil Excavation with Offsite Disposal

Contaminated soil will be excavated from CAA-1, CAA-2.b, CAA-3, CAA-5, CAA-6, and CAA-7, as shown on Figure 5.1, using standard excavation means and methods. The proposed excavation boundaries and depths shown on Figure 5.1 are subject to change and may differ than those shown. The final excavation limits (horizontal and vertical) will be determined based on the results of pre-remedial design sampling and excavation performance sampling indicating compliance with the RELs or CULs. It should be noted that there are areas beneath buildings at the Property that have not been sampled. Areas of unexpected contamination may be encountered when the buildings are demolished and the underlying soil exposed. The EDR must outline contingency procedures for further actions if unexpected contamination is encountered.

Excavated soil must be transported offsite to a permitted Subtitle D landfill for disposal. Once the final limits are reached, the excavated areas on the Property will be backfilled with clean imported material and temporarily restored with a gravel surface until planned redevelopment and other restoration activities can begin. The excavated area within the W. Commodore Way ROW will also be backfilled with clean imported fill and restored with a pavement section meeting City of Seattle requirements.

The following is a summary of the estimated volumes and anticipated depths expected for contaminated soil removal at each area.

- **CAA-1:** Approximately 1,300 CY of soil will be excavated to 5 feet bgs at CAA-1.a and approximately 800 CY of soil will be excavated to 10 feet bgs at CAA-1.b to remove GRO, Total DRO+ORO, and benzene at concentrations greater than the RELs.
- **CAA-2.b:** Approximately 2,100 CY of soil will be excavated to 15 feet bgs to remove GRO, Total DRO+ORO, and benzene at concentrations greater than the RELs.
- **CAA-3:** Approximately 800 CY of soil will be excavated to 5 feet bgs to remove GRO, Total DRO+ORO, and TCE at concentrations greater than the RELs. Removal of this soil will also remove collocated benzene concentrations greater than the CUL.
- **CAA-5:** Approximately 200 CY of soil will be excavated to 5 feet bgs to remove Total DRO+ORO and arsenic at concentrations greater than the CULs.
- **CAA-6:** Approximately 1,000 CY of soil will be excavated to 6 feet bgs, with a small portion to 12 feet bgs, at CAA-6.a to remove GRO, Total DRO+ORO, and benzene at concentrations greater than the CULs. At CAA-6.b, approximately 300 CY of soil will be excavated to a depth of 3 feet bgs to remove GRO, Total DRO+ORO, benzene, and arsenic at concentrations greater than the CULs.
- **CAA-7:** Approximately 60 CY of surficial soil will be excavated to 1 foot bgs to remove arsenic and other collocated metals (and TBT, if present) at concentrations greater than the CULs. As noted previously, this volume could increase once the full extent of metals contamination has been determined during the pre-remedial design investigation.

6.1.3 In Situ Solidification and Stabilization

ISS will be implemented at CAA-2.a and CAA-4 to encapsulate source area soil and a portion of the LNAPL remaining at the RAA. ISS will necessarily key into the lower permeability silt layer in the treatment areas to provide stability. Anticipated treatment depths and estimated volumes of contaminated material to be treated by ISS in each area are summarized as follows:

- **CAA-2.a:** ISS will key into a depth of 23 feet bgs to treat approximately 10,200 CY of soil contaminated with GRO, Total DRO+ORO, and benzene at concentrations greater than the proposed RELs.
- **CAA-4:** ISS will key into a depth of 30 feet bgs to treat approximately 5,900 CY of soil in CAA-4.a and approximately 11,300 CY of soil in CAA-4.b contaminated with TCE, GRO, Total DRO+ORO, and benzene at concentrations greater than the proposed RELs.

Pre-design data may be warranted to determine the lateral extent of ISS treatment in CAA-4; additional data needs will be evaluated by the engineer as part of design.

ISS treatment will consist of mixing contaminated media with grout in overlapping columns or cells to create a homogenous monolith that encapsulates and solidifies contaminants. The conceptual ISS layout as presented on Figure 5.1 presents a proposed arrangement of ISS mixing columns and cells in CAA-4 and CAA-2.a, respectively. Appropriate equipment and methods will be selected as part of design and will be based on subsurface lithology and vertical limits for the ISS treatment. In addition to mechanical ISS mixing equipment, ancillary equipment is expected include reagent storage silos, a temporary reagent batch plant for mixing grout, grout pumps, crane mats, generator, forklift, personnel lift, hydraulic sampling device, and support excavator.

A grout mixture will be prepared in batches then pumped to the ISS treatment areas where it will be mechanically mixed with the contaminated soils (including LNAPL) using a drill-mounted auger, excavator bucket, or excavator-mounted rotary equipment. Mixing will be conducted from the surface to the bottom treatment elevation.

Due to the added volume of grout, swell material is expected to be approximately 30 percent of the total ISS volume. Swell material may be managed through benching of the ISS treatment areas prior to ISS implementation (i.e., excavation of surface soils to allow swell management within the treatment area) and/or use as backfill or grading material during redevelopment of the Property. Because the swell material is expected to be highly contaminated, any excess volume not managed within the ISS area will need to be consolidated into one or a few locations, rather than distributed around the Property. Management of this material will be assessed during the engineering design phase. In addition, necessary performance testing will be determined as part of the engineering design phase and will be included in the EDR and Construction Compliance Monitoring Plan (CCMP).

6.1.4 Groundwater Treatment

In situ groundwater treatment will be conducted north of the proposed excavation area in CAA-5 to address the TCE and VC plume and residual dissolved benzene on the ASKO parcel immediately upgradient of the W. Commodore Way ROW. Treatment fluids will be injected into the subsurface through a series of direct-push borings to create a passive treatment zone of chemical reduction and bioremediation. Fluids will be injected at each location under low pressure using a direct-push drill rig to provide even distribution within the target treatment zone. Injection depths are expected to be in the range of 20 to 30 feet bgs within the Shallow WBZ. The proposed in situ treatment zone will be approximately 160 feet long and 15 feet wide, as shown on Figure 5.1.

REGENESIS® remediation products are proposed for the in situ groundwater treatment, and include the following:

- **PlumeStop®:** a colloidal liquid activated carbon that allows sorption of dissolved-phase contaminants and create an in situ flow-through passive treatment zone.

- **S-MicroZVI®:** a sulfidated micro ZVI that promotes in situ chemical reduction processes to destroy dissolved contaminants and limit the amount of daughter products produced as part of the reductive dechlorination process.
- **Bio-Dechlor INOCULUM Plus®**: an enriched natural microbial consortium containing species of *Dehalococcoides sp.* bacteria capable of stimulating rapid dechlorination of TCE and associated daughter products.

The combined use of these products is expected to result in a relatively rapid reduction of dissolved contaminant concentrations in the groundwater plume. Additional consideration will be given to the use of these or other products in the EDR.

Pre-design data will be necessary to evaluate mass flux zones, which are areas of elevated hydraulic conductivity, to better define the target treatment zones and to improve the overall design. In addition, the engineer will determine if additional soil or groundwater data are necessary to determine the required volume of reagent to be used and confirm treatment injection locations.

6.1.5 Interceptor Trench and Permeable Reactive Barrier Wall

An interceptor trench with a PRB wall will be installed at the ASKO/BNSF boundary to capture and treat impacted groundwater migrating within the Perched WBZ onto the ASKO parcel from the BNSF parcel. The trench will be installed along the southwestern edge of the ISS monolith in CAA-4 and the PRB wall will be installed at the northwestern (downgradient) end of the interceptor trench (refer to Figure 5.1). The low permeability of the ISS monolith and the high permeability of the interceptor trench will divert the captured groundwater to the PRB wall for in situ flow-through treatment.

The interceptor trench will be constructed with a total length of approximately 120 feet and will be approximately 3 feet wide and 15 feet deep. The PRB wall will be approximately 15 feet long, 3 feet wide, and 15 feet deep and will be designed with enough residence time for IHSs to be treated to a minimum 90 percent concentration reduction.

Both the interceptor trench and PRB wall will be installed using typical excavation means and methods. Immediately following excavation, the interceptor trench will be backfilled with drain rock from the bottom of the trench to approximately 2 feet bgs, then backfilled to approximately 6 inches bgs with sand. The excavation for the PRB wall will be backfilled with granular zero-valent iron (gZVI) from the bottom of the wall to approximately 2 to 4 feet bgs to create an effective vertical treatment zone of approximately 11 to 13 feet. The wall will then be backfilled with sand over the gZVI to approximately 6 inches bgs. Both the interceptor trench and PRB wall will be sealed at the top with pavement when capping is installed during redevelopment of the Property.

6.1.6 Capping and RAA Stabilization/Restoration

Placement of a cap will be required for the Upland AOC to mitigate direct contact exposures to contaminants that will remain in place (to 15 feet bgs) above the CULs following implementation of the above-described actions. Capping in the Upland AOC is expected to include a combination of pavement, constructed landscape areas, and buildings to be installed during Property development. In conjunction with the cap, ICs that require maintenance of the cap as a physical barrier in perpetuity will be implemented as described in Section 6.1.8.

Because cleanup of the Shoreline AOC is intended to fully achieve the soil CULs, a protective cap is not required as part of the remedy in this area. Following soil excavation and ground surface restoration, best management practices will be employed to maintain surface gravel and any existing pavement and vegetation that remains on the East Waterfront parcel as a stabilization measure to control soil erosion until redevelopment occurs. Future development will include measures to prevent erosion if warranted based on post-remedy soil concentrations.

6.1.7 Monitored Natural Attenuation

MNA for groundwater is a component of the cleanup action after LNAPL and source soils are addressed via excavation and ISS and after implementing focused groundwater treatment. MNA will utilize post-remedy groundwater monitoring, with a network of new and existing monitoring wells located throughout the RAA. The groundwater monitoring will be performed in accordance with a GMP, a draft of which is appended to this CAP (Appendix A). Note that the GMP will be part of the Long-Term Compliance Monitoring Plan (LTCMP), as described in Section 7.0.

6.1.8 Institutional and Other Property Controls

ICs are measures undertaken to limit or prohibit activities that may interfere with the integrity of the cleanup action or that may result in exposures to hazardous substances at the Site. ICs in the form of an Environmental Covenant will be required for the Upland AOC parcels. The Environmental Covenant will impose restrictions on future uses of the ASKO and Bulk Terminal parcels consistent with industrial land use and will prohibit the use of groundwater as drinking water. It is anticipated the Environmental Covenant will be for any areas where a cap is present to limit direct contact with contaminated soils that will remain in place at concentrations greater than CULs.

Ecology will prepare the Environmental Covenant consistent with WAC 173-340-440 and RCW 64.70 and in consultation with the grantor or other parties.

In addition to the Environmental Covenant, Property controls will include a SREMP for any future ground-disturbing activities on the Property. This plan will also be part of the LTCMP and will be prepared upon completion of active cleanup action construction activities, prior to Property redevelopment. The SREMP will contain at least the following elements:

- A description of soil conditions on the Property including identification of specific areas and depths where contamination remains in place and at what concentration(s)
- Specific soil handling and management procedures for future subsurface work in areas within the Upland AOC where contaminated soils will remain in place beneath the cap
- Procedures for identifying, processing, and disposing of contaminated soils encountered during development activities in areas not expected to be contaminated
- Best management practices to prevent soil erosion to the storm drain system or directly to sediment in Salmon Bay, if warranted by post-remediation conditions
- Health and safety protocols specific to the soil handling and management procedures
- Protocols for notifying Ecology of planned (or proposed) ground-disturbing activities as well as any instances in which a site control measure fails resulting in a release or new exposure pathway
- Protocols for providing necessary data to agencies involved in environmental permitting for future construction activities
- A description of remedial elements (e.g., pavement and monitoring wells) that will require routine inspection and maintenance

The procedures specified in the SREMP will be applicable to any future Property redevelopment or maintenance that involves removal or disturbance of material below the surface cap or disturbance of surface soils or other ground cover that may create a future erosion pathway, if warranted based on post-remedial conditions.

In conjunction with the ICs and Upland AOC capping, other engineering controls may be implemented to prevent potential exposure to hazardous substances remaining in place following remedy implementation. This may include mitigation measures to minimize exposures to vapor intrusion (VI). The VI pathway will be evaluated following remedial construction, but prior to Property redevelopment, for any proposed buildings in the Upland AOC where volatile constituents will remain in soil and groundwater at concentrations exceeding the CULs. Refer to Section 7.2.1 for additional details regarding contingencies for VI.

6.2 Applicable Local, State, and Federal Laws

The cleanup action must comply with MTCA cleanup regulations (WAC 173-340), SMS (WAC 173-204-570), federal laws, and substantive requirements of applicable local and state laws. Under WAC 173-340-350 and WAC 173-340-710, the term “legally applicable requirements” refers to regulatory cleanup standards; standards of control; and other environmental requirements, criteria, or limitations established under state or federal law that specifically address a remedial action, location, chemical of concern, or other circumstance at the Property. The “relevant and appropriate requirements” are regulatory requirements or guidance that do not apply to the RAA

under law but have been determined to be appropriate for use by Ecology. These requirements are often categorized as location-specific, action-specific, or chemical-specific.

The cleanup action complies with all applicable local, state, and federal laws that are outlined in Table 6.1. Chemical-specific requirements will be met through compliance with applicable CUL criteria. Location-specific requirements will be met through compliance with all applicable state, federal, and local regulations in place for the physical location of the Property. Applicable action-specific requirements will be met through implementation of construction activities in compliance with all applicable construction-related requirements, such as health and safety restrictions, Property use and other local permits, and disposal requirements for excavated soil.

6.3 Compliance with Remedial Action Objectives

Remedial action objectives (RAOs) for the RAA include the following:

- Address public concerns by facilitating the cleanup and redevelopment of an underutilized property located in a prime industrial shoreline setting.
- Address soil contamination to protect human health and the environment (ecological receptors) from exposure to hazardous substances via direct contact.
- Reduce concentrations of IHSs in soil on the Property that are long-term sources of continuing groundwater contamination.
- Remediate LNAPL from the Bulk Terminal parcel and the adjacent W. Commodore Way ROW to improve groundwater and air quality.
- Reduce concentrations of volatile compounds in soil and groundwater to reduce or eliminate the potential for VI.
- Reduce concentrations of IHSs in groundwater to protect surface water quality in Salmon Bay.
- Eliminate potential future contaminated soil erosion into Salmon Bay sediment.
- Comply with local, state, and federal laws and site-specific cleanup standards.
- Provide for compliance monitoring and contingency plans to ensure continued protection of human health and the environment following active cleanup actions.

The cleanup action described herein will meet all of these RAOs.

Excavation and ISS in the Upland AOC will reduce the direct contact pathway risk, reduce significant sources of IHSs to groundwater to improve groundwater quality, and reduce volatile compounds in soil and groundwater to reduce the risk of VI. LNAPL will also be removed or encapsulated through excavation and ISS on the Bulk Terminal parcel, and in situ groundwater treatment on the ASKO parcel will reduce dissolved-phase mass and improve groundwater quality.

Contaminated soil that will remain in place in the Upland AOC that could pose a risk to the direct contact and VI pathways will be controlled through ICs and a cap, and potentially other engineering controls, if warranted, as part of Property redevelopment.

Remedial excavation on the Shoreline AOC will address all contaminated soil exceeding the CULs on the East Waterfront parcel and eliminate the direct contact pathway to human health and ecological receptors. This will also reduce sources of IHSs to groundwater to improve groundwater quality. In addition, post-remedy construction soil management procedures will be established prior to redevelopment. These procedures will prevent soil erosion to sediments and protect the surrounding environment by establishing best management practices for erosion control.

This cleanup action also includes provisions for compliance monitoring, as discussed in Section 7.1.

6.4 Restoration Time Frame

The restoration time frame for the cleanup action is 15 years, which is the estimated time for all media to achieve compliance with the cleanup standards at all relevant POCs. In particular, 15 years is the estimate for groundwater to meet CULs at the CPOC. Restoration time frames will be less for some media and in some areas of the RAA as follows.

- Soils within the Upland AOC will meet RELs within 4 to 6 months upon completion of excavation and ISS activities, but will not meet CULs within a reasonable time frame. Compliance with the soil cleanup standards will be met when the Property is developed, the ground surface capped, and ICs implemented. Property development is expected to take less than 15 years.
- Groundwater within the Upland AOC is expected to meet the CULs at the CPOC within 15 years following completion of the Upland AOC remedial construction activities.
- Soils within the Shoreline AOC are expected to meet cleanup standards upon completion of soil excavation activities, which are expected to take 1 month.
- Groundwater within the Shoreline AOC is expected to meet CULs within 5 years following completion of the Shoreline AOC remedial construction.
- Air. It is uncertain whether air is currently exceeding CULs within some of the buildings remaining at the RAA. However, air would meet CULs within 1 month of completing the Upland AOC remedial construction activities, which will include the demolition and removal of existing buildings. Construction of new buildings within the Upland AOC will include provisions for VI engineering controls to protect future indoor air quality, if necessary.

6.5 Hazardous Substances Remaining Following Remedial Action

This section provides an estimate of the residual hazardous substances that will remain as part of the containment remedy within the Upland AOC. None is expected to remain within the Shoreline AOC. The volume estimates noted below do not account for the discontinuous nature of the contamination and, therefore, are likely to be high. Remaining contamination below an upland cap or within ISS-stabilized masses is anticipated to be as follows:

- CAA-1.a: Approximately 1,500 CY of contaminated soil with hazardous substance concentrations greater than CULs would remain in place. The detected maximum IHS concentrations remaining will be 940 mg/kg GRO, 12,000 mg/kg Total DRO+ORO, and 14 mg/kg benzene.
- CAA-1.b: Approximately 1,100 CY of contaminated soil with hazardous substances concentrations greater than CULs and, to an extent, RELs would remain in place. The detected maximum IHS concentrations remaining will be 2,800 mg/kg GRO, 2,700 mg/kg Total DRO+ORO, and 40 mg/kg benzene.
- CAA-2: Approximately 4,700 CY of contaminated soil with hazardous substance concentrations greater than CULs would remain in place. The detected maximum IHS concentrations remaining will be 4,300 mg/kg GRO, 11,000 mg/kg Total DRO+ORO, and 7.7 mg/kg benzene.
- CAA-3: Approximately 1,800 CY of contaminated soil with hazardous substance concentrations greater than CULs and, to an extent, RELs would remain in place. The detected maximum IHS concentrations remaining will be 9,700 mg/kg GRO, 8,300 mg/kg Total DRO+ORO, 0.25 mg/kg benzene, and 4.4 mg/kg TCE.
- CAA-4: Approximately 4,300 CY of contaminated soil with hazardous substance concentrations greater than CULs would remain in place. The detected IHS maximum concentrations remaining will be 1,600 mg/kg GRO, 3,200 mg/kg Total DRO+ORO, 0.61 mg/kg benzene, and 0.82 mg/kg TCE.
- CAA-5: Approximately 1,100 CY of contaminated soil with IHS concentrations greater than CULs and, to an extent, RELs would remain in place. The detected maximum IHS concentrations remaining will be 4,700 mg/kg GRO, 5,300 mg/kg Total DRO+ORO, 5.4 mg/kg TCE, and 14 mg/kg arsenic.
- Outside CAA Boundaries: Approximately 3,000 CY of contaminated soil with hazardous substance concentrations greater than CULs would remain in place. The detected maximum IHS concentrations remaining will be 1,500 mg/kg GRO (north boundary of the Bulk Terminal parcel east of CAA-2); 11,000 mg/kg Total DRO+ORO (in W. Commodore Way ROW); 1.4 mg/kg benzene (north of CAA-2 in W. Commodore Way); 0.21 mg/kg TCE (east of CAA-4); and 14 mg/kg arsenic (southeast corner of Bulk Terminal parcel).

- ISS Treatment Areas: The existing contamination in these areas will remain encapsulated within the solidified mass. Section 6.1.3 details anticipated treatment volumes.

7.0 Cleanup Action Monitoring and Contingency Actions

Compliance monitoring for soil and groundwater will be conducted within the RAA as described in general terms in the following sections. Contingency actions are also identified should groundwater CULs not be met in the predicted restoration time frame.

7.1 Compliance Monitoring

Compliance monitoring to ensure the protectiveness of the cleanup action will be implemented in accordance with WAC 173-340-410, Compliance Monitoring Requirements. These regulations call out three types of monitoring – Protection, Performance, and Confirmation. Each will be implemented at the Property as part of the cleanup actions in the RAA.

The required Protection, Performance, and Confirmation monitoring will include a number of compliance monitoring elements. These will be detailed in two separate documents: the CCMP and the LTCMP.

The CCMP will be prepared as part of final design, prior to remedial construction. As such, this document will be applicable during the remedial construction work and will describe performance, confirmation, and compliance monitoring that will be necessary during construction, including all necessary construction plans (see below). Results of compliance monitoring during construction will be documented in Remedial Action Completion Reports (RACRs).

The LTCMP will be applicable during post-construction and post-property development and will include a revised GMP, SREMP, and VI Contingency Plan. The LTCMP must be prepared after the remedial construction is complete and will be revised, as needed, after development. Results of long-term compliance monitoring will be documented in LTCMP Annual Reports.

7.1.1 Protection Monitoring

Two periods of protection monitoring will be required. The first will be for health and safety protection during remedial construction. The second will be after remedial construction.

- Remedial construction protection will be described in a Health and Safety Plan submitted as part of the CCMP.
- Post-remedial construction protection will be described in the SREMP portion of the LTCMP. This document will be applicable to activities conducted at the RAA following remedy implementation that have the potential to disturb capped areas. The SREMP will include health and safety protocols that describe worker protection monitoring requirements specific to post-remedy soil handling and management procedures. The

SREMP must include mitigation or measures to maintain protection from soil VI, depending on the development.

7.1.2 Performance Monitoring

As with protection monitoring, two periods of performance monitoring will be required. The first will occur during remedial construction; the second after remedial construction is complete.

During remedial construction—soil excavation, LNAPL removal, ISS. Measures required to confirm that the cleanup action has attained remedial construction performance standards will be described in the CCMP. This document will include two separate plans, a Sampling and Analysis Plan (SAP)/Quality Assurance Project Plan (QAPP) and an Inadvertent Discovery Plan (IDP).

The SAP/QAPP will include the following:

- Remedial sampling to more accurately assess the areal extent and depth of soil contamination requiring excavation and to better inform the groundwater treatment area and reagent quantities. This sampling will augment the performance monitoring that is typically conducted during remedy construction. Completing this monitoring in advance of design will allow for a more accurate remedial design, leading to cost and time savings.
- Excavation base and sidewall sampling during remedy construction to ensure that the cleanup action meets the soil RAOs.
- Construction quality control and quality assurance testing during ISS to ensure that the treatment meets applicable performance standards for strength and hydraulic conductivity.
- The use of field kits, if necessary, to identify the presence of LNAPL (either residually trapped or mobile) in soil samples during excavation. Field kits would be used in concert with visual observations to confirm removal of LNAPL from the RAA.
- Quality control monitoring for construction activities, such as survey confirmation of excavation limits and volumes and extent of ISS treatment areas.

The IDP will include procedures for identifying, handling, and reporting unexpected cultural or historical artifacts encountered during remedial construction.

After remedial construction—groundwater. A groundwater monitoring program will be implemented to observe and document remedy effectiveness after construction. Initially this will be a performance monitoring effort, because groundwater will not have attained CULs at the CPOC. As areas in the RAA reach CULs (in particular, groundwater within the East Waterfront parcel), monitoring in those areas will transition to confirmation monitoring.

The groundwater monitoring program will be outlined in the GMP, part of the LTCMP. A draft of the GMP is appended, as noted previously, and will be finalized after remedial construction is

completed. Ecology has not made a final determination as to the adequacy of the locations, frequencies, or analytical schedule provided in the draft GMP. Therefore, the final version prepared after remedial construction is complete will likely differ from the draft. The GMP may also need to be revised as part of Property development to accommodate changes created by the development or other factors. It should be noted the GMP may also be revised at multiple points in the future based on development or other impacts at the Site.

After remedial construction—VI. Given that volatile contaminants will remain in soil and groundwater in the Upland AOC, a vapor intrusion (VI) evaluation will be necessary for the Property, as discussed in Section 7.2.1 below. This VI evaluation, which will be conducted following Ecology guidance, may lead to additional performance monitoring. If necessary, this performance monitoring plan will be delivered as part of the LTCMP. In addition, based on the results of the additional VI monitoring, contingency actions may be necessary and will also be included within the LTCMP.

7.1.3 Confirmation Monitoring

Confirmation monitoring is used to confirm the long-term effectiveness of the cleanup action after cleanup standards or applicable RELs have been attained.

Soil. For soil, confirmation monitoring will be necessary once the remedial construction is complete and the required controls are in place for long-term operation and maintenance in accordance with this CAP and required deliverables, including the EDR. The long-term effectiveness will be confirmed through an ongoing monitoring and maintenance program that will be defined in the SREMP portion of the LTCMP. Future development may require revisions to the confirmation monitoring for soil.

Groundwater. Confirmation monitoring is expected to start first at the East Waterfront parcel where groundwater is expected to attain CULs within 5 years. Although the type and timing of development are not known for this area, a provisional confirmation monitoring plan is included in the draft GMP (Appendix A) for this area, given how quickly groundwater is expected to meet CULs. If redevelopment occurs within the 5-year period, the provisional plan will likely need to be modified.

For the rest of the RAA, the time frame to reach CULs is predicted to be 15 years. A provisional confirmation monitoring plan is included in the draft GMP (Appendix A) that includes a provision for adaptive management that allows for subsequent revisions and alterations of the frequency, locations, and analytes. It is uncertain when the transition from performance to confirmation monitoring will occur; therefore, the specific confirmation monitoring scope will not be established until groundwater begins to approach CULs at the CPOC. This kind of monitoring program typically utilizes a subset of the monitoring wells used for performance monitoring.

Soil Vapor. As noted previously, the potential for VI in the Upland AOC will be evaluated after the remedial construction is completed. If a performance monitoring program has been

instituted as a result of this evaluation and has shown that soil vapor concentrations have declined such that screening levels protective of the VI pathway have been met, a confirmation monitoring program may be instituted to confirm that soil vapor concentrations remain below the screening levels. The scope of confirmation monitoring will be developed, if necessary, at the close of the performance monitoring period.

7.2 Contingency Actions

Contingency actions may be required if additional risk reduction measures are needed after remedy implementation.

7.2.1 Contingency for VI Engineering Controls

The need for implementing VI engineering controls will be evaluated in the Upland AOC where planned buildings are to be located in or near remaining contamination in the RAA and are intended to be occupied by workers. VI risks will be assessed after the completion of soil excavation, LNAPL removal, and ISS and prior to redevelopment of the ASKO and Bulk Terminal parcels. The initial assessment will be completed when the footprints of planned buildings are known and VI risk from remaining soil and groundwater contamination can be assessed. VI assessment will be conducted in accordance with Ecology's *Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action* (Ecology 2009) and subsequent updates to the guidance (Ecology 2016, 2018, and 2019) and will include the following:

- An initial assessment will be performed to determine whether contaminant concentrations in soil or groundwater exceed the applicable screening levels at locations sufficiently close to the planned building(s) to pose a potential risk for VI. The applicable screening levels and horizontal and vertical boundaries for their application will be based on the most current Ecology guidance at the time of the evaluation.
- If the initial assessment indicates that there is a potential risk for VI, sampling will be conducted to measure contaminant concentrations in soil gas in the location of the planned building(s). Soil gas samples will be collected and analyzed according to the most current Ecology guidance and will be compared to the applicable and appropriate screening levels at the time of the evaluation.

The results of the VI assessment will be used to assess whether engineering controls will be necessary during building construction to mitigate the VI risk. Engineering controls may include alteration of the building design to avoid higher concentrations of soil gas, installation of a vapor barrier, or installation of passive or active sub-slab vapor mitigation systems. Protocols to evaluate the efficacy of these controls will be developed as appropriate and would likely include collection of indoor air samples after installation and comparison of data to appropriate MTCA CULs.

Results from the VI assessment(s) will be included in the LTCMP Annual Reports(s) or a separate VI memorandum depending on timing of this assessment.

7.2.2 Contingency Remedial Actions for Groundwater

The potential exists that groundwater will not meet CULs at the CPOC within 15 years. If extrapolations from the groundwater compliance monitoring data indicate that IHS concentrations are not declining at a rate sufficient to reach CULs within 15 years, contingency action(s) will be evaluated and undertaken as directed by Ecology to correct the situation. If a contingency evaluation is necessary, consideration will be given to factors such as the severity of predicted CUL exceedance and volumetric proportion of groundwater not expected to reach CULs. The decision point for determining whether to implement contingency measures will be 5 years from the end of remedial construction, or Property development, if the latter causes a potentially significant disruption of the groundwater recharge and flow regime.

Procedures for groundwater monitoring data analysis are discussed in the appended draft GMP. If a contingency evaluation is necessary, it can be included in the annual report for that year or a separate document.

The appropriate type and degree of contingent action will be subject to review and approval by Ecology. Possible contingent situations include, but are not limited to, the following:

- If degradation appears to be occurring based on downward contaminant concentration trends but at rates too slow to reliably meet CULs within the predicted restoration time frame, geochemical parameters could be evaluated upgradient and downgradient of the CPOC and new materials used to accelerate or augment natural attenuation (e.g., edible oil or sulfate salts).
- If degradation is not apparent or occurring at a very low rate suggesting the restoration time frame will not be met, an untreated ongoing source of contamination or less than ideal degradation conditions may be present. In this case, additional upgradient evaluations/investigations might be undertaken to identify and mitigate the potential source or enhance the degradation process. Possible mitigations include direct source removal or in situ application of products to mineralize or bind contaminants such as zero-valent iron or activated carbon.

8.0 Implementation Schedule

Implementation of the remedial action defined in this CAP is expected to occur over the next several years in conjunction with Property redevelopment, with the Shoreline AOC cleanup first, followed by the Upland AOC cleanup. Property development may also occur in phases, with a relatively short period of time between phases. An extended period of compliance monitoring will follow the remediation/development work.

The following table outlines a generalized schedule for the remedial action based on the expected chronology of key activities and deliverables.

Table 8.1: Schedule of Deliverables and Activities

Implementation Step or Deliverable	Due Date[6] or Time Frame
Pre-Construction Design Activities	Currently underway
Submit Agency Review Draft Pre-Remedial Design Work Plan	Within 30 days of effective date of Prospective Purchaser Consent Decree (PPCD)
Finalize Pre-Remedial Design Work Plan	30 days after receipt of Ecology's final comments
Implement Pre-Remedial Design Work Plan	Initiate within 45 days of Ecology approval of final Work Plan
Submit Agency Review Draft EDR	Within 180 days of effective date of PPCD
Finalize EDR	90 days after receipt of Ecology final comments
Acquire project permits	Prior to start of remedial action construction
Remedial Action Construction	Initiate within 90 days of Ecology approval of the EDR or after permit acquisition
Submit Agency Review Draft RACRs	150 days following construction completion for each phase of remedial action construction[7]
Submit Final RACRs	45 days after receipt of Ecology's final comments
Submit Agency Review Draft LTCMP	90 days following remedial construction completion
Finalize LTCMP[8]	45 days following receipt of Ecology's final comments on LTCMP
Implement Final LTCMP	In accordance with schedules established in the Final LTCMP. Groundwater compliance monitoring to begin no later than 1 year after remedial construction completion.
Property Development	After remedial action construction. Timeline and ownership uncertain. Expected to be in phases.
Revise LTCMP	Following Property redevelopment, if appropriate and with Ecology concurrence.
Submit LTCMP Annual Monitoring Reports	March 1 for the prior calendar year
Submit Quarterly Progress Reports	15 days after the end of each quarter

[6] Schedule is in calendar days.

[7] The placement of pavement or buildings as part of the Upland AOC remedy will occur during Property redevelopment. Remedy implementation will not be considered complete for the Upland AOC until redevelopment is complete.

[8] The LTCMP will be a "living" document and may be modified as deemed appropriate with Ecology concurrence.

9.0 References

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Tables

Figures

Appendix A

Draft Groundwater Monitoring Plan

Tables

Table 5.1
Alternative Evaluation

Cleanup Action Area (CAA)	Alternative A.1	Alternative A.2	Alternative B	Alternative C	Alternative D	Alternative E
Upland AOC—Bulk Terminal (includes CAA-3)						
CAA-1.a	**Excavate to CULs** (2,800 CY, 5 ft bgs) Remove LNAPL to maximum extent practicable.	**Excavate to RELs** (2,200 CY, 5 ft bgs) Remove LNAPL to maximum extent practicable.	**Excavate to RELs** (2,200 CY, 5 ft bgs) Remove LNAPL to maximum extent practicable.	**Excavate to RELs** (1,300 CY, 5 ft bgs) Remove LNAPL to maximum extent practicable.	**Excavate to RELs** (600 CY, 5 ft bgs) Remove LNAPL to maximum extent practicable.	**Excavate to RELs** (600 CY, 5 ft bgs) Remove LNAPL to maximum extent practicable.
CAA-1.b	**Excavate to CULs** (1,900 CY, 10 ft bgs)	**Excavate to RELs** (1,600 CY, 10 ft bgs)	**Excavate to RELs** (1,600 CY, 10 ft bgs)	**Excavate to RELs** (800 CY, 10 ft bgs)	**No Action**	**No Action**
CAA-2	**Excavate to CULs** (13,400 CY, 15 ft bgs) Remove LNAPL to maximum extent practicable.	**Excavate to RELs** (8,800 CY, 15 ft bgs) Remove LNAPL to maximum extent practicable.	**ISS to RELs** in CAA-2.a (10,200 CY, 23 ft bgs) **Excavate to RELs** in CAA-2.b (2,100 CY, 15 ft bgs) and remove LNAPL	**ISS to RELs** in CAA-2.a (10,200 CY, 23 ft bgs) **Excavate to RELs** in CAA-2.b (2,100 CY, 15 ft bgs) and remove LNAPL	**Excavate to RELs** (7,900 CY, 20 ft bgs) Remove LNAPL to maximum extent practicable.	**ISS to RELs** in CAA-2.a (10,200 CY, 23 ft bgs) **Excavate to RELs** in CAA-2.b (2,100 CY, 15 ft bgs) and remove LNAPL
CAA-3	**Excavate to CULs** (2,600 CY, 5 ft bgs)	**Excavate to RELs** (1,700 CY, 5 ft bgs)	**Excavate to RELs** (800 CY, 5 ft bgs)	**Excavate to RELs** (800 CY, 5 ft bgs)	**No Action**	**No Action**
CAA-4.a	**Excavate to CULs** (4,000 CY, 20 ft bgs) Install PRB Wall along BNSF AOC boundary.	**Excavate to CULs** (4,000 CY, 20 ft bgs) Install PRB Wall along BNSF AOC boundary.	**ISS to RELs** (5,900 CY, 30 ft bgs) Install interceptor trench and PRB wall along BNSF AOC boundary.	**ISS to RELs** (5,900 CY, 30 ft bgs) Install interceptor trench and PRB wall along BNSF AOC boundary.	**Thermal to RELs** (4,000 CY to 20 ft bgs)	**ISS to RELs** (5,900 CY, 30 ft bgs) Install interceptor trench and PRB wall along BNSF AOC boundary.
CAA-4.b	**Excavate to CULs** (14,800 CY, 28 ft bgs) Install PRB Wall along BNSF AOC boundary.	**Excavate to RELs** (10,500 CY, 28 ft bgs) Install PRB Wall along BNSF AOC boundary.	**ISS to RELs** (11,300 CY, 30 ft bgs) Install interceptor trench and PRB wall along BNSF AOC boundary.	**ISS to RELs** (11,300 CY, 30 ft bgs) Install interceptor trench and PRB wall along BNSF AOC boundary.	**Thermal to RELs** (7,500 CY to 20 ft bgs)	**ISS to RELs** (11,300 CY, 30 ft bgs) Install interceptor trench and PRB wall along BNSF AOC boundary.
CAA-5	**Excavate to CULs** (1,300 CY, 5 ft bgs)	**No Action**	**Excavate to CULs** (1,300 CY, 5 ft bgs)	**Excavate to CULs** (200 CY, 5 ft bgs) **ERD Treatment (gw only)**	**No Action**	**No Action**
CAA-6	**Excavate to CULs** (1,300 CY)	**Excavate to CULs** (1,300 CY)	**Excavate to CULs** (1,300 CY)	**Excavate to CULs** (1,300 CY)	**Excavate to CULs** (1,300 CY)	**Excavate to CULs** (1,300 CY)
CAA-7	**Excavate to CULs** (60 CY)	**Excavate to CULs** (60 CY)	**Excavate to CULs** (60 CY)	**Excavate to CULs** (60 CY)	**Excavate to CULs** (60 CY)	**Excavate to CULs** (60 CY)
Upland AOC	Cap with pavement or buildings. Implement groundwater monitoring plan. Implement institutional controls that would restrict groundwater withdrawal, require maintenance of the cap, and require a Soil Management Plan.					
Restoration Timeframe	*10 years*	*15 years*	*15 years*	*15 years*	*15 years*	*15 years*
Cost	***$16,151,000***	***$12,244,000***	***$8,251,000***	***$7,821,000***	***$7,404,000***	***$6,725,000***
Total Soil Excavation or Treatment	42,160	30,160	36,760	33,960	21,360	31,460

Note:

Preferred Sitewide Remedial Alternative

Abbreviations:

AOC	Area of Concern	ft	Feet
bgs	Below ground surface	gw	Groundwater
BNSF	BNSF Railway Company	ISS	In situ solidification and stabilization
CUL	Cleanup level	LNAPL	Light non-aqueous-phase liquid
CY	Cubic yard	PRB	Permeable reactive barrier
Ecology	Washington State Department of Ecology	REL	Remediation level
ERD	Enhanced reductive dechlorination		

Table 6.1
Applicable Local, State, and Federal Laws for the Selected Cleanup Alternative

Standard, Requirement, or Limitation [1]	Description
Location-Specific Requirements [2]	
State Environmental Policy Act (RCW 43.21C; WAC 197-10)	SEPA review is required for MTCA cleanup actions; Ecology will be the lead agency for this effort.
Washington Shoreline Management Act (RCW 90.58; WAC 173-14)	The Washington Shoreline Management Act, authorized under the federal Coastal Zone Management Act, establishes requirements for substantial development occurring within the waters of Washington or within 200 feet of a shoreline.
Seattle Shoreline Master Program (SMC 23.60A)	Implements the requirements imposed on the City of Seattle by the Washington Shoreline Management Act (RCW 90.58) and ensures that development under the program will not cause a net loss of ecological functions. Applies to areas with 200 feet of a waterbody regulated by the program.
Seattle Critical Areas Regulations (SMC 25.09)	This chapter establishes regulations pertaining to the development within or adjacent to critical areas, which include areas that provide a variety of biological and physical functions that benefit the City of Seattle and its residents, including water quality protection, fish and wildlife habitat, and food chain support.
Endangered Species Act (16 USC 1531 et seq.; 50 CFR 17, 225, and 402) Migratory Bird Treaty Act (16 USC 742a-j and 40 CFR 10.13)	These statutes regulate the incidental take of migratory birds (such as Canada geese) and other endangered species by facility operations and construction activities.
Native American Graves Protection and Repatriation Act (25 USC 3001 through 3013; 43 CFR 10) Washington's Indian Graves and Records Law (RCW 27.44)	These statutes prohibit the destruction or removal of Native American cultural items and require written notification of inadvertent discovery to the appropriate agencies and Native American tribe. These programs are applicable to the remedial action if cultural items are found. The activities must cease in the area of the discovery; a reasonable effort must be made to protect the items discovered; and notice must be provided.
Archaeological Resources Protection Act (16 USC 470aa et seq.; 43 CFR 7)	This program sets forth requirements that are triggered when archaeological resources are discovered. These requirements only apply if archaeological items are discovered during implementation of the selected remedy.
National Historic Preservation Act (16 USC 470 et seq.; 36 CFR parts 60, 63, and 800)	This program sets forth a national policy of historic preservation and provides a process that must be followed to ensure that impacts of actions on archaeological, historic, and other cultural resources are protected.
Action-Specific Requirements [3]	
State Environmental Policy Act (RCW 43.21C, WAC 197-11)	Establishes the state's policy for protection and preservation of the natural environment. Applies to cleanup actions conducted under MTCA.
Resource Conservation and Recovery Act (42 USC 6921-6949a; 40 CFR Part 268, Subtitles C and D)	Establishes requirements for the identification, handling, and disposal of hazardous and non-hazardous waste.
Dangerous Waste Regulations (RCW 70.105; WAC 173-303)	Establishes regulations that are the state equivalent of RCRA requirements for determining whether a solid waste is a state dangerous waste. This regulation also provides requirements for the management of dangerous wastes.
Solid Waste Disposal Act (42 USC Sec. 6901-6992; 40 CFR 257-258) Federal Land Disposal Requirements (40 CFR 268)	Protects health and the environment and promotes conservation of valuable material and energy resources. The Solid Waste Disposal Act establishes a framework for regulation of solid waste disposal. Federal land disposal requirements promulgated under the authority of the Solid Waste Disposal Act set minimum safety requirements for landfills including limitations on storage and land disposal for hazardous substances.
Department of Transportation Hazardous Materials Regulations (49 CFR 172)	Regulates the safe and secure transportation of hazardous materials, including documentation and handling requirements for shipping.
Washington Minimum Functional Standards for Solid Waste Handling (WAC 173-304)	Sets minimum functional standards for the proper handling of all solid waste materials originating from residences, commercial, agricultural, and industrial operations, as well as other sources.
Washington Solid Waste Handling Standards (RCW 70.95 and WAC 173-350)	Establishes minimum standards for handling and disposal of solid waste. Solid waste includes wastes that are likely to be generated as a result of site remediation, including contaminated soils, construction and demolition wastes, and garbage.
Washington Water Pollution Control Law (RCW 90.48; WAC 173-216, WAC 173-220) National Pollution Discharge Elimination System (CWA Part 402)	Washington has been delegated authority to issue NPDES permits. CWA Section 301, 302, and 303 require states to adopt water quality standards and implement a NPDES permitting process. The Washington Water Pollution Control Law and regulations address this requirement.
Noise Control Act of 1974 (RCW 70.107, WAC 173-60)	Establishes maximum noise levels.
Washington State Underground Injection Control Program (WAC 173-218)	Washington is authorized under CWA Sections 144 through 147 to administer a statewide Underground Injection Control program to protect groundwater by regulating the discharge of fluid from injection wells including temporary injection points.
City of Seattle Traffic Code (SMC 11.1)	The City of Seattle code regulates construction use and permitting in the right of way.

Table 6.1
Applicable Local, State, and Federal Laws for the Selected Cleanup Alternative

Standard, Requirement, or Limitation [1]	Description
Action-Specific Requirements [3] (cont.)	
City of Seattle Construction Codes for Grading (SMC 22.170)	Required for the excavation or addition of material within an Environmentally Critical Area, movement of more than 500 cubic yards of material, and in-place modification of the ground (soil remediation).
Seattle of Seattle Construction Codes for Demolition (Seattle Building Code Chapter 33)	Regulates the demolition of any structures within an Environmentally Critical Area or greater than 120 square feet in size.
National Electrical Code (NFPA 70) and the Seattle Electric Code Supplement for Class 1 Division 2 Environments.	Establishes restrictions and guidelines for temporary and/or permanent electrical installations.
City of Seattle Water Utilities Code (SMC 21.04)	Establishes rules for hydrant water use.
King County Industrial Waste Program	The King County Industrial Waste Program monitors discharge of liquid waste to the wastewater (sanitary sewer) system. Any discharges during construction to the wastewater system must be approved by King County prior to discharge. The King County Industrial Waste Program monitors volume and water quality of liquid waste discharged to the system.
Federal, State, and Local Air Quality Protection Programs State Implementation of Ambient Air Quality Standards NWAPA Ambient and Emission Standards Regional Standards for Fugitive Dust Emissions Toxic Air Pollutants	Regulations promulgated under the federal Clean Air Act (42 USC 7401) and the Washington State Clean Air Act (RCW 70.94) govern the release of airborne contaminants from point and non-point sources. Local air pollution control authorities such as PSCAA have also set forth regulations for implementing these air quality requirements. These requirements may be applicable to the Site for the purposes of demolition or dust control. PSCAA requires notification prior to demolition of any building with asbestos-containing material. Both PSCAA (under Regulation III) and WAC 173-460 establish ambient source impact levels for arsenic.
Chemical-Specific Requirements [4]	
Model Toxics Control Act (WAC 173-340)	Establishes Washington administrative processes and standards to identify, investigate, and clean up facilities where hazardous substances are located.
Drinking Water Standards—State MCLs (WAC 246-290-310)	Establishes standards for contaminant levels in drinking water for water system purveyors.
Water Quality Standards for Groundwaters of the State of Washington (WAC 173-200)	Implements the Water Pollution Control Act and the Water Resources Act of 1971 (90.54 RCW).
National Recommended Water Quality Standards (40 CFR 131) Washington Maximum Contaminant Levels (WAC 246-290-310)	These water quality standards define the water quality goals of the water body by designating the use or uses to be made of the water and by setting criteria necessary to protect the uses. States adopt water quality standards from 40 CFR 131 to protect public health or welfare, enhance the quality of water, and serve the purposes of the CWA. Washington water quality standards (MCLs) are presented in WAC.

Notes:

1 Projects conducted under a consent decree are exempt from the procedural requirements of most state and local permits (RCW 70.105D.090); however, the remedial actions must still comply with the substantive requirements of the exempt permits. Therefore, for exempt permits, the statutory review timelines do not apply; actual timelines will be based on negotiations with the jurisdiction or agency, which should result in an expedited review timeline.

2 Location-specific requirements are applicable to the specific area where the Site is located, and can restrict the performance of activities, including cleanup actions, solely because they occur in specific locations.

3 Action-specific requirements are applicable to certain types of activities that occur or technologies that are used during the implementation of cleanup actions.

4 Chemical-specific requirements are applicable to the types of contaminants present at the Site. The cleanup of contaminated media at the Site must meet the CULs developed under MTCA; these CULs are considered chemical-specific requirements.

Abbreviations:

CFR	Code of Federal Regulations
CUL	Cleanup level
CWA	Clean Water Act
Ecology	Washington State Department of Ecology
MCL	Maximum Contaminant Level
MTCA	Model Toxics Control Act
NPDES	National Pollutant Discharge Elimination System
NWAPA	Northwest Air Pollution Authority
PSCAA	Puget Sound Clean Air Agency
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
SEPA	State Environmental Policy Act
SMC	Seattle Municipal Code
USC	U.S. Code
WAC	Washington Administrative Code

Figures

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Seattle, Washington

Figure 1.1
Property Location

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9/11/2020

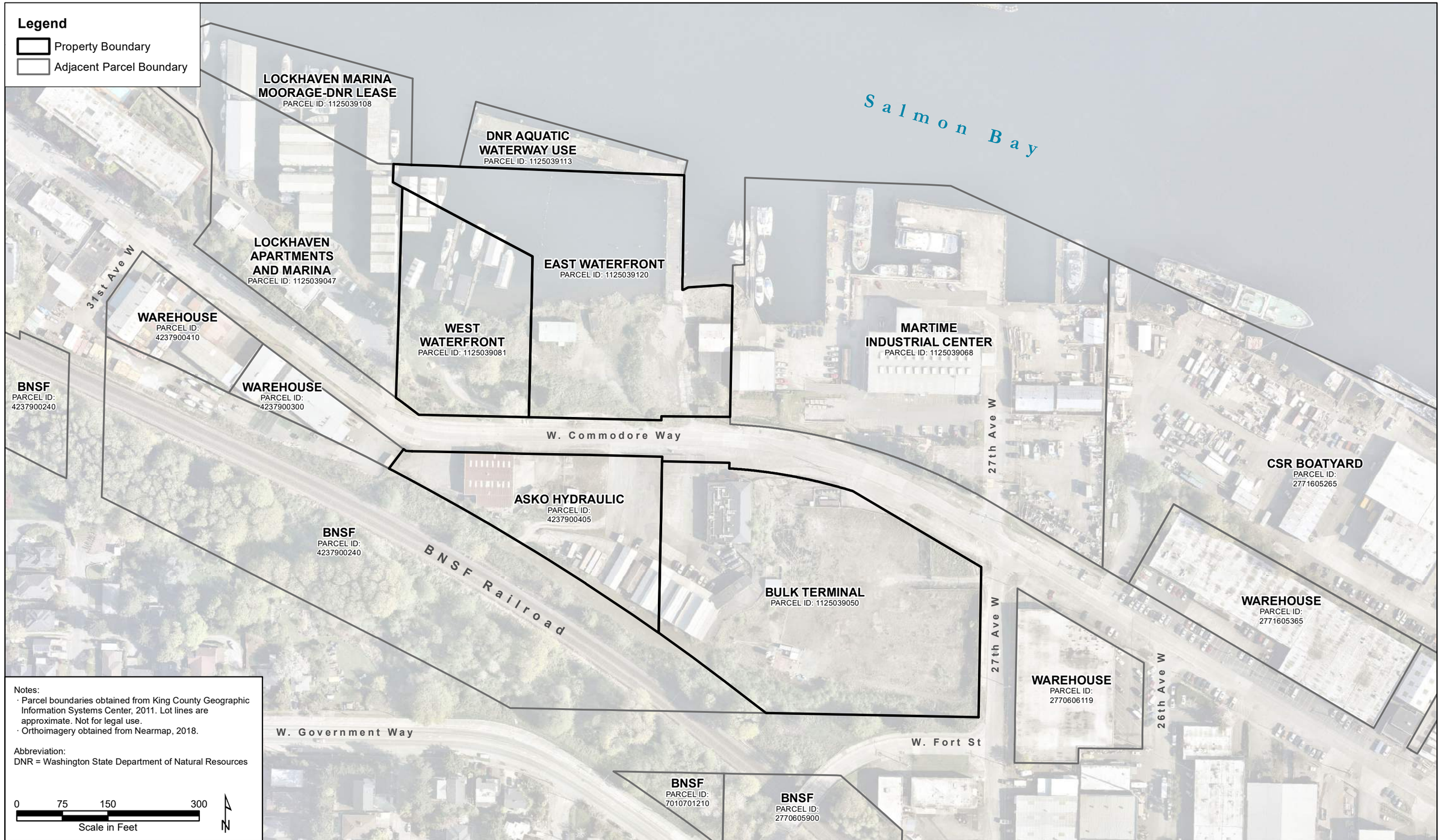

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Figure 1.2
Property Map

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9/11/2020

Summary of AST Volume and Contents		
Tank ID	**Volume (gallons)**	**Contents**
1	630,000	Gasoline
2	328,020	Gasoline
3	219,450	Gasoline
4	219,450	Diesel
5	219,450	Stove oil
6	328,020	Gasoline
7	798,000	Diesel/gasoline
8	630,000	Diesel/gasoline
9	630,000	Diesel/gasoline
10	630,000	Diesel/gasoline
11	630,000	Diesel/gasoline
12	966,000	Diesel/gasoline
13	798,000	Diesel/gasoline
14	966,000	Diesel/gasoline
15	~10,000	Wood preservative (penta/diesel)

Legend

- (1) Former AST (with Tank ID)
- Former Aboveground Feature
- Former Belowground Feature
- Property Boundary

FORMER WAREHOUSE
SHED
GARAGE
MATCH LINE
FORMER BARREL INCLINE
FORMER TESTING LABORATORY
FORMER UTILIDOR
FORMER OVERHEAD LOADING RACKS
FORMER BOTTOM LOADING RACK
W. COMMODORE WAY NORTH TRUCK SEWER
W. Commodore Way
27th Ave W
FORMER GASOLINE/ DIESEL USTS
EAST BARREL INCLINE
FORMER BARRELING SHED #1
FORMER TOC HOLDINGS OFFICE
FORMER PUMP ISLAND
FORMER TANK FARM
FORMER MANIFOLD PIT
FORMER BARRELING SHED #2
FORMER PENTA MIXING AST
LOWER TANK YARD
MARINE SERVICE AND SUPPLY
MATCH LINE
FORMER BOILER HOUSE
BULK TERMINAL
UPPER TANK YARD
BNSF Railroad
W. Fort St

Notes:
- Parcel boundaries obtained from King County Geographic Information Systems Center, 2011. Lot lines are approximate. Not for legal use.
- Orthoimagery obtained from U.S. Geological Survey, 2002.

Abbreviations:
AST = Aboveground storage tank
Penta = Pentachlorophenol
UST = Underground storage tank

0 30 60 120
Scale in Feet
N

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Figure 2.1a
Former Property Features–East

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9/11/2020

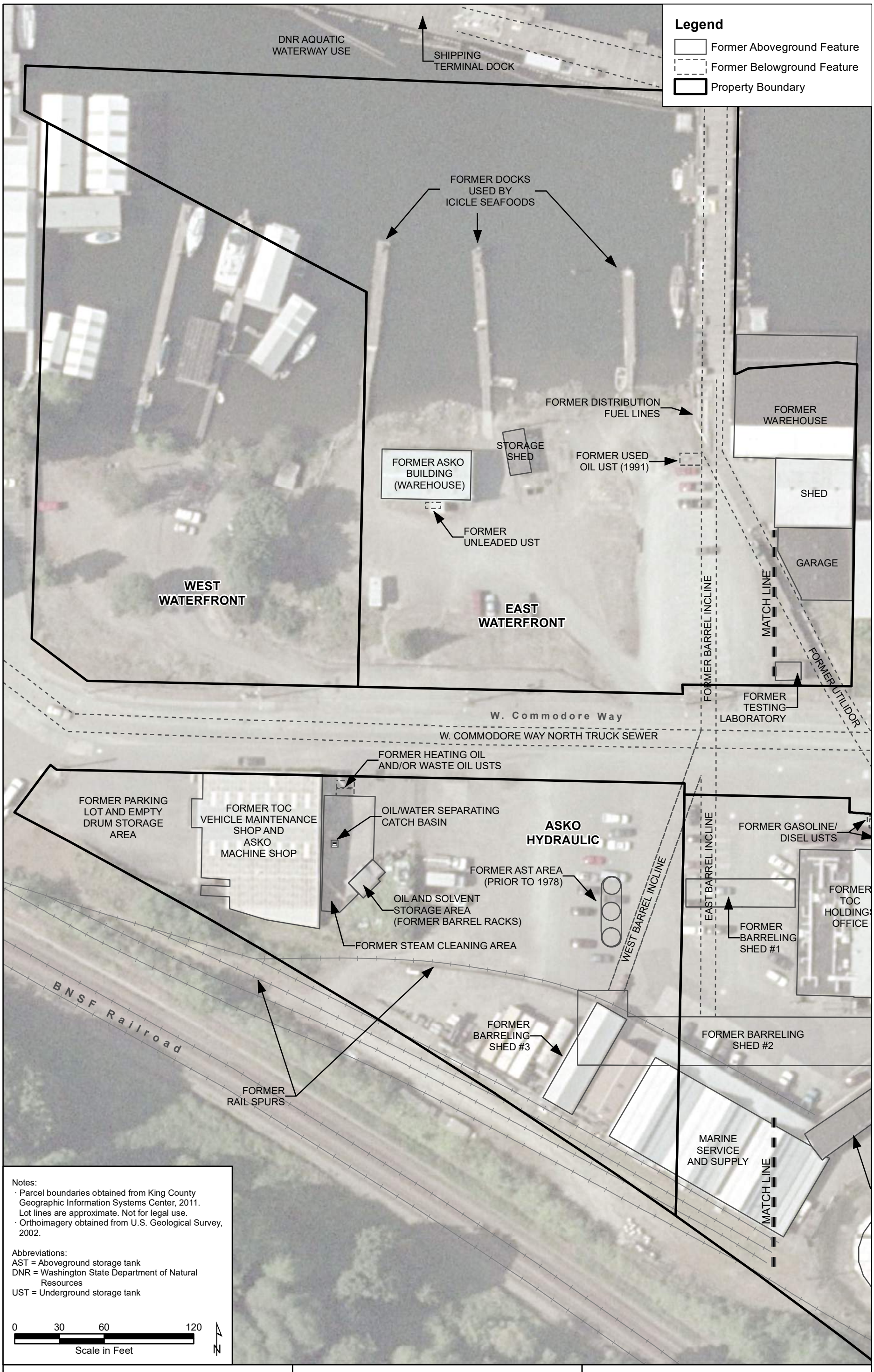

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Figure 2.1b
Former Property Features–West

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9/11/2020

Legend

Sewer Lines

- Combined/Sanitary Sewer Main Line
- Sewer Drainage Lateral

Other Site Features

- Property Boundary

Salmon Bay

FORMER TOC DOCK (VACANT)

LOCKHAVEN MARINA HOUSEBOAT MOORAGE

FORMER ASKO WAREHOUSE (VACANT)

STORAGE SHED (VACANT)

LOCKHAVEN MARINA RESIDENT DRIVEWAY AND PARKING

WEST WATERFRONT

EAST WATERFRONT

FORMER TOC BUILDINGS (VACANT)

31st Ave W

W. COMMODORE WAY NORTH TRUCK SEWER

W. Commodore Way

ABOVEGROUND PIPING

TREATMENT SYSTEM AST AREA

27th Ave W

W. COMMODORE WAY NORTH TRUCK SEWER

PAVED PARKING AREA

PAVED PARKING AREA

TREE/LOG STORAGE

PAVED PARKING AREAS

FORMER TOC OFFICE BUILDING (VACANT)

FORMER ASKO MACHINE SHOP (VACANT)

ASKO HYDRAULIC

GROUNDWATER EXTRACTION WELL NETWORK

KING COUNTY METRO SANITARY SEWER (STORMWATER SYSTEM DISCHARGE POINT)

BNSF Railroad

TREATMENT SYSTEM SHEDS

MARINE SUPPLY SERVICE BUILDINGS AND LOADING AREA

ABOVEGROUND PIPING

BULK TERMINAL

27th Ave W

26th Ave W

W. Government Way

W. Fort St

Notes:
- Sewer line layer obtained from the City of Seattle, accessed June 2020, with adjustments as indicated on as-built drawings obtained from City of Seattle archives.
- Parcel boundaries obtained from King County Geographic Information Systems Center, 2011. Lot lines are approximate. Not for legal use.
- Orthoimagery obtained from Nearmap, 2018.

Abbreviation:
AST = Aboveground storage tank

0 62.5 125 250
Scale in Feet

N

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Figure 2.2
Current Property Features

I:\GIS\Projects\Cantera-TOC\MXD\CAP\CAP 2019\Figure 2.2 Current Property Features.mxd
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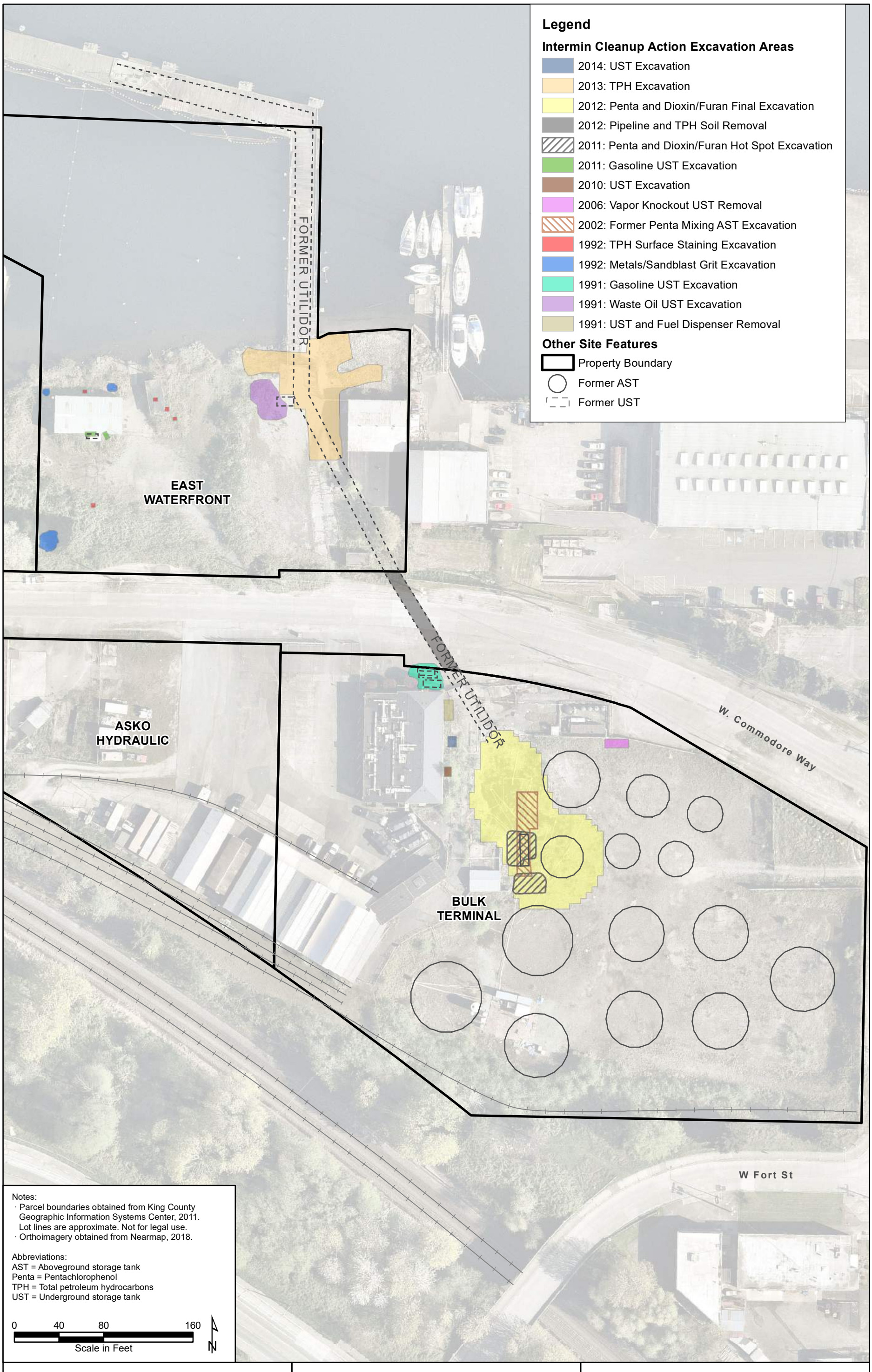

Notes:
- Parcel boundaries obtained from King County Geographic Information Systems Center, 2011. Lot lines are approximate. Not for legal use.
- Orthoimagery obtained from Nearmap, 2018.

Abbreviations:
AST = Aboveground storage tank
Penta = Pentachlorophenol
TPH = Total petroleum hydrocarbons
UST = Underground storage tank

0 40 80 160
Scale in Feet

N

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Figure 2.3
Former Soil Excavation Areas

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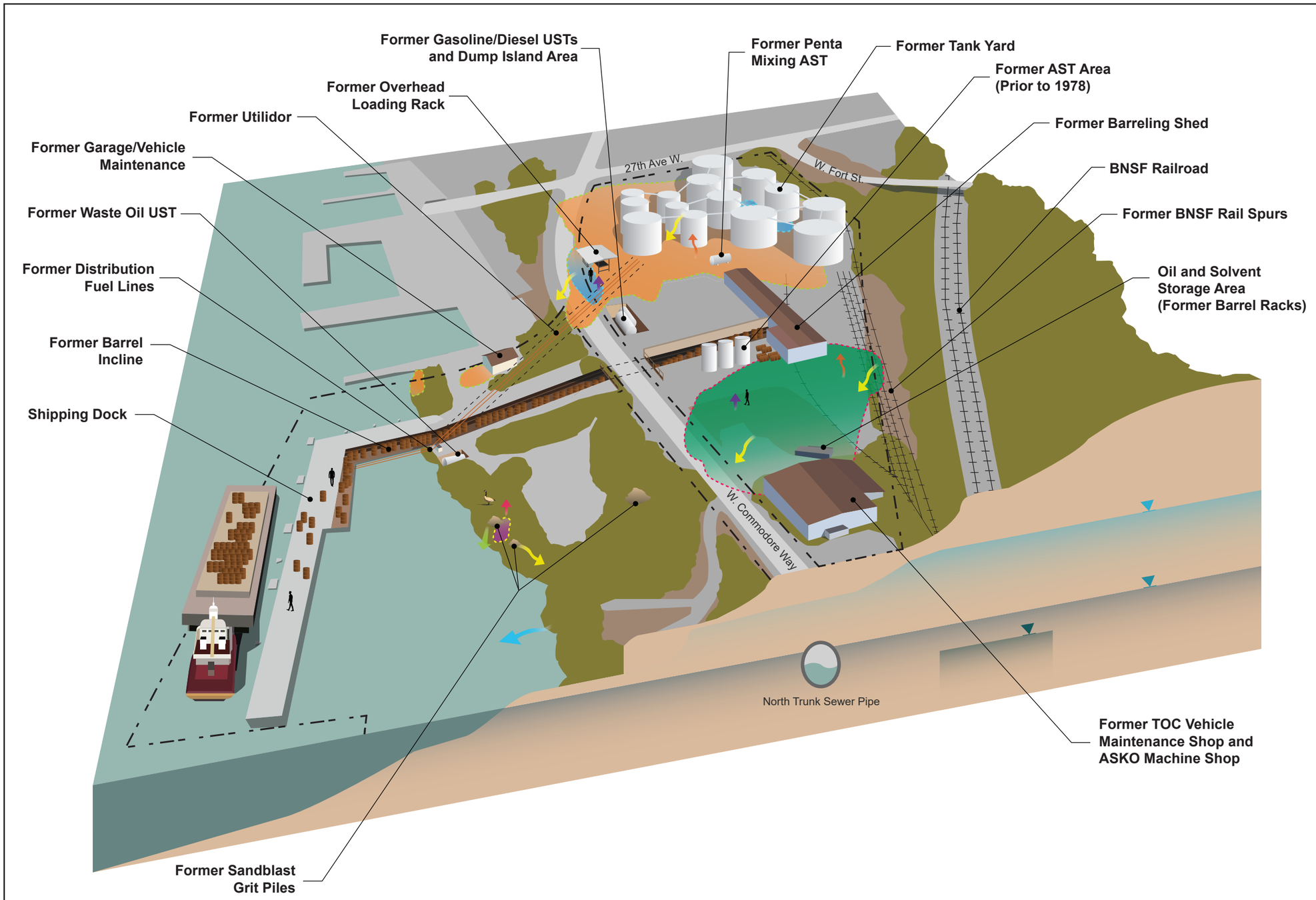

Legend

Site Features

- Property Boundary
- Former Belowground Feature
- LNAPL Area (approximate)
- Paved Areas
- Unpaved Areas
- Vegetated Areas
- Surface Water
- Observed Shallow Groundwater (April/May 2019)
- Observed Intermediate Groundwater (July 2019)
- Observed Deep Groundwater (April/May 2019)

IHS Distribution

- cVOCs in Soil and/or Groundwater (approximate)
- TPH in Soil and/or Groundwater (approximate)
- Arsenic in Soil and/or Groundwater (approximate)

Migration and Exposure Pathways

- Groundwater to Surface Water Discharge
- Leaching to Groundwater
- Stormwater Runoff
- Worker Direct Contact
- Ecological Direct Contact
- Soil Vapor

Note:
- Model not to scale.

Abbreviations:
AST = Aboveground storage tank
BNSF = BNSF Railway
cVOC = Chlorinated volatile organic compound
LNAPL = Light non-aqueous-phase liquid
Penta = Pentachlorophenol
TPH = Total petroleum hydrocarbons
UST = Underground storage tank

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Figure 2.4
Conceptual Site Model

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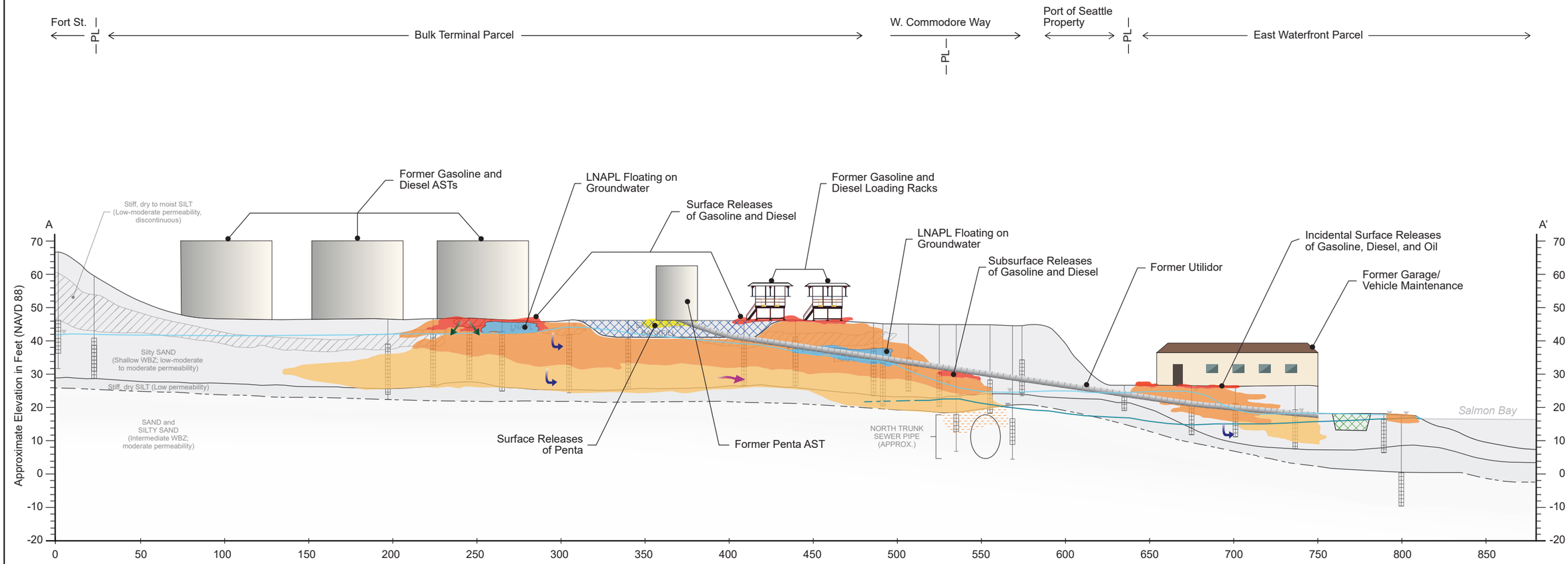
06/26/2020



Legend

Site Features

- Shallow WBZ Potentiometric Surface
- Intermediate WBZ Potentiometric Surface (dashed where inferred)
- Contact Boundary Between Lithologies (dashed where inferred)
- LNAPL Area (approximate)
- Interim Action Excavation to Remove Penta in Soil
- Interim Action Excavation to Remove TPH and Benzene in Soil

IHS Distribution

- TPH and Benzene in Soil and/or Groundwater > proposed CULs (approximate)
- TPH and Benzene in Groundwater > proposed CULs (approximate)
- Limited Migration Through Low Permeability Silt (approximate)

Migration and Exposure Pathways

- Downward and Outward Migration in Vadose Zone
- Dissolution
- Downgradient Migration in Groundwater

Notes:
-- Indicates that proposed CUL is not established.
- Lithology based on soil borings installed by IT Corporation, Sound Earth Strategies, and Floyd|Snider.
- Well location IDs are shown on Figure 5.6.

Abbreviations:
AST = Aboveground storage tank
CUL = Cleanup level
DRO = Diesel-range organics
GRO = Gasoline-range organics
IHS = Indicator hazardous substance
LNAPL = Light non-aqueous-phase liquid
µg/L = Micrograms per liter
mg/kg = Milligrams per kilogram
NAVD 88 = North American Vertical Datum of 1988
ORO = Oil-range organics
Penta = Pentachlorophenol
PL = Property line (approximate)
TCE = Trichloroethene
TPH = Total petroleum hydrocarbons
WBZ = Water-bearing zone

Horizontal Scale in Feet
0 60 120
0 30 60
Vertical Scale in Feet
Vertical Exageration X 2

Proposed Cleanup Levels		
Indicator Hazardous Substance	**Groundwater**	**Soil**
Arsenic	5 µg/L	7.3 mg/kg
GRO	800 µg/L	30 mg/kg
DRO+ORO	500 µg/L	2,000 mg/kg
Benzene	0.44 µg/L	0.02 mg/kg
TCE	0.5 µg/L	0.02 mg/kg
Vinyl chloride	0.2 µg/L	--
Penta	0.2 µg/L	0.05 mg/kg

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Figure 2.5
Conceptual Site Model Cross-Section A-A'

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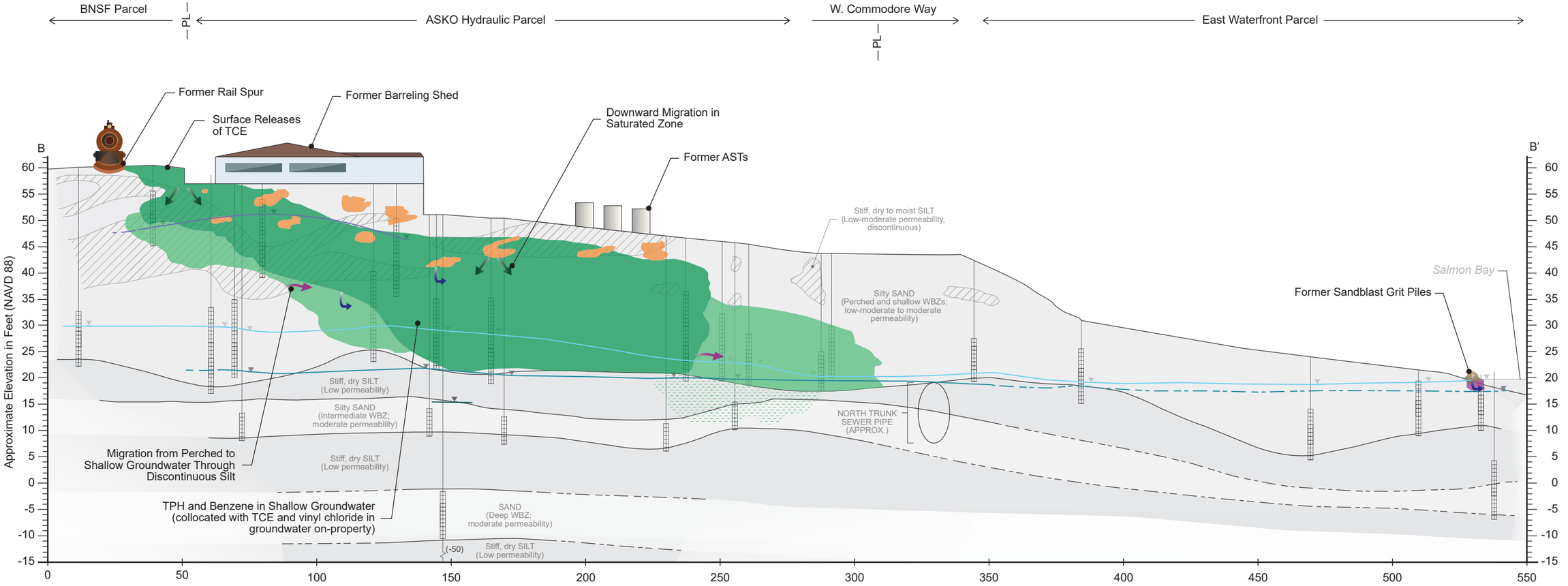
06/22/2020



Legend

Site Features

- Perched WBZ Potentiometric Surface (dashed where inferred)
- Shallow WBZ Potentiometric Surface
- Intermediate WBZ Potentiometric Surface (dashed where inferred)
- Deep WBZ Potentiometric Surface
- Contact Boundary Between Lithologies (dashed where inferred)

IHS Distribution

- TPH and Benzene in Soil > Proposed CULs (approximate)
- Arsenic in Soil and/or Groundwater > Proposed CULs (approximate)
- TCE in Soil and/or Groundwater > Proposed CULs (approximate)
- TCE and Breakdown Products (Vinyl Chloride) in Groundwater > Proposed CULs (approximate)
- Limited Migration Through Low Permeability Silt > Proposed CULs (approximate)

Migration and Exposure Pathways

- Downward and Outward Migration in Vadose Zone
- Dissolution
- Downgradient Migration in Groundwater

Notes:
-- Indicates that proposed CUL is not established.
- Lithology based on soil borings installed by IT Corporation, Sound Earth Strategies, and Floyd|Snider.
- Well location IDs are shown on Figure 5.7.

Abbreviations:
AST = Aboveground storage tank
CUL = Cleanup level
DRO = Diesel-range organics
GRO = Gasoline-range organics
IHS = Indicator hazardous substance
LNAPL = Light non-aqueous-phase liquid
µg/L = Micrograms per liter
mg/kg = Milligrams per kilogram
NAVD 88 = North American Vertical Datum of 1988
ORO = Oil-range organics
Penta = Pentachlorophenol
PL = Property line (approximate)
TCE = Trichloroethene
TPH = Total petroleum hydrocarbons
WBZ = Water-bearing zone

Horizontal Scale in Feet
0 40 80
0 20 40
Vertical Scale in Feet
Vertical Exaggeration X 2

Proposed Cleanup Levels		
Indicator Hazardous Substance	**Groundwater**	**Soil**
Arsenic	5 µg/L	7.3 mg/kg
GRO	800 µg/L	30 mg/kg
DRO+ORO	500 µg/L	2,000 mg/kg
Benzene	0.44 µg/L	0.02 mg/kg
TCE	0.5 µg/L	0.02 mg/kg
Vinyl chloride	0.2 µg/L	--
Penta	0.2 µg/L	0.05 mg/kg

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Figure 2.6
Conceptual Site Model Cross-Section B-B'

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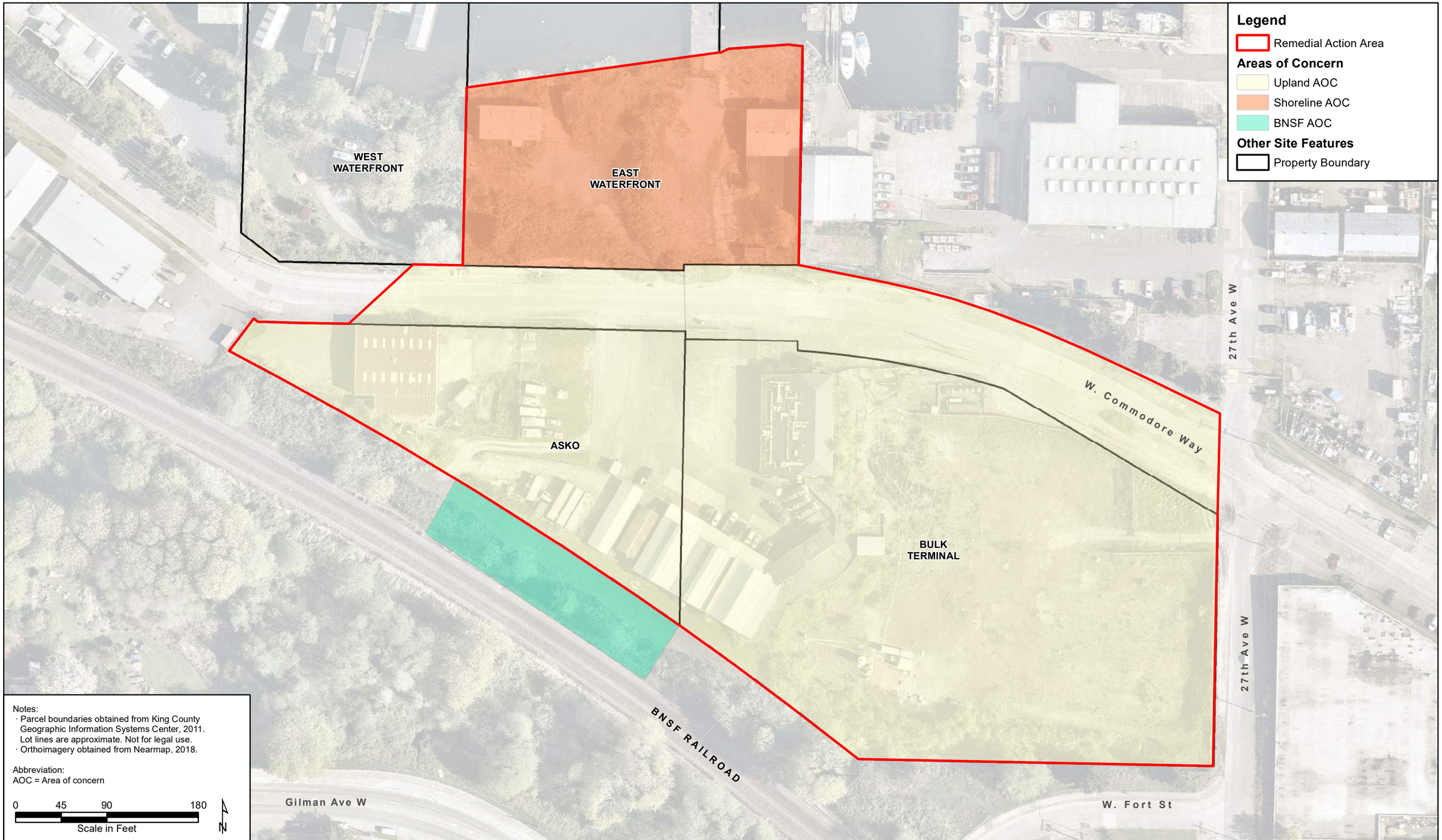

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Time Oil Bulk Terminal Site
Seattle, Washington

Figure 2.7
Areas of Concern and Remedial Action Area

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9/11/2020

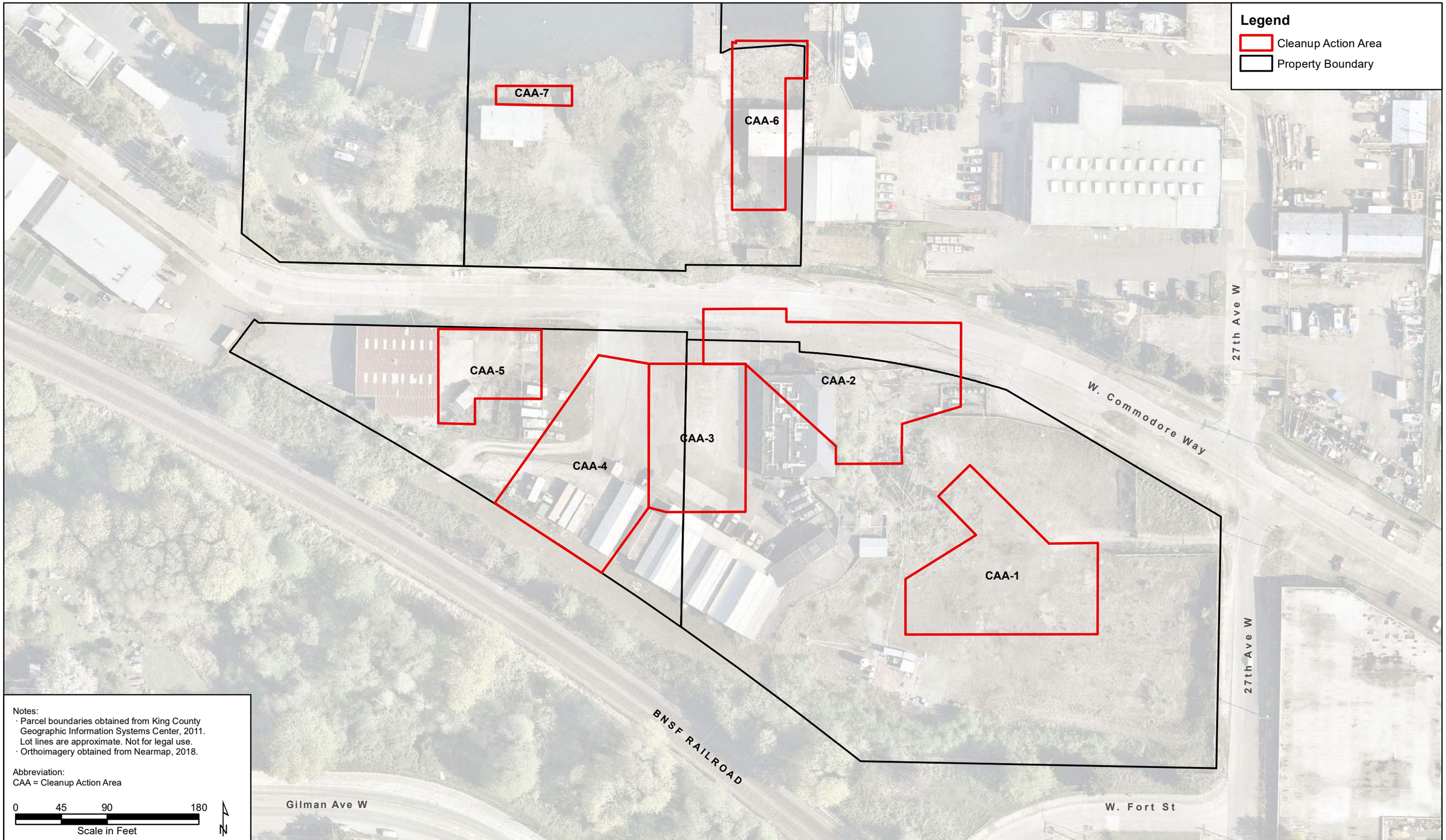

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Figure 4.1
Cleanup Action Areas

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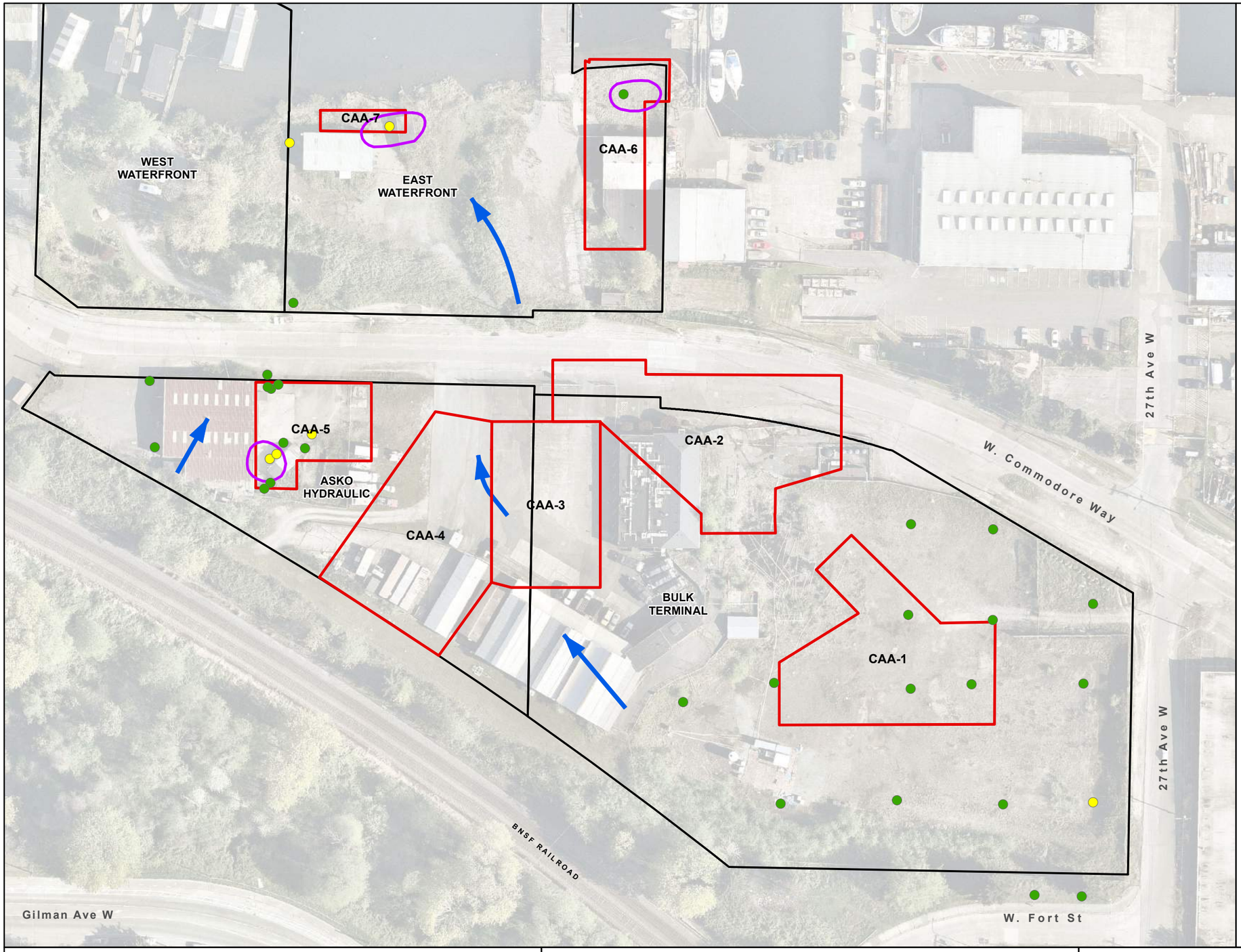

Legend

- Cleanup Action Area

Soil Sample Results

- All Results Less Than CUL
- One or More Results Greater Than

Approximate Extent of IHS Exceeding CUL in Groundwater

- Arsenic >5.0 µg/L

Other Site Features

- Predominant Shallow Groundwater Flow Direction (April/May 2019)
- Property Boundary

Arsenic Cleanup Levels
Soil: 7.3 mg/kg
Groundwater: 5.0 µg/L

Notes:
- The approximate extents of IHSs in groundwater were delineated using existing Site data and are inferred in some locations.
- Soil distribution based on soil concentrations at any depth; the maximum concentration per location was used.
- Parcel boundaries obtained from King County Geographic Information Systems Center, 2011. Lot lines are approximate. Not for legal use.
- Orthoimagery obtained from Nearmap, 2018.

Abbreviations:
CUL = Cleanup level
IHS = Indicator hazardous substance
µg/L = Micrograms per liter
mg/kg = Milligrams per kilogram

N

0 45 90 180
Scale in Feet

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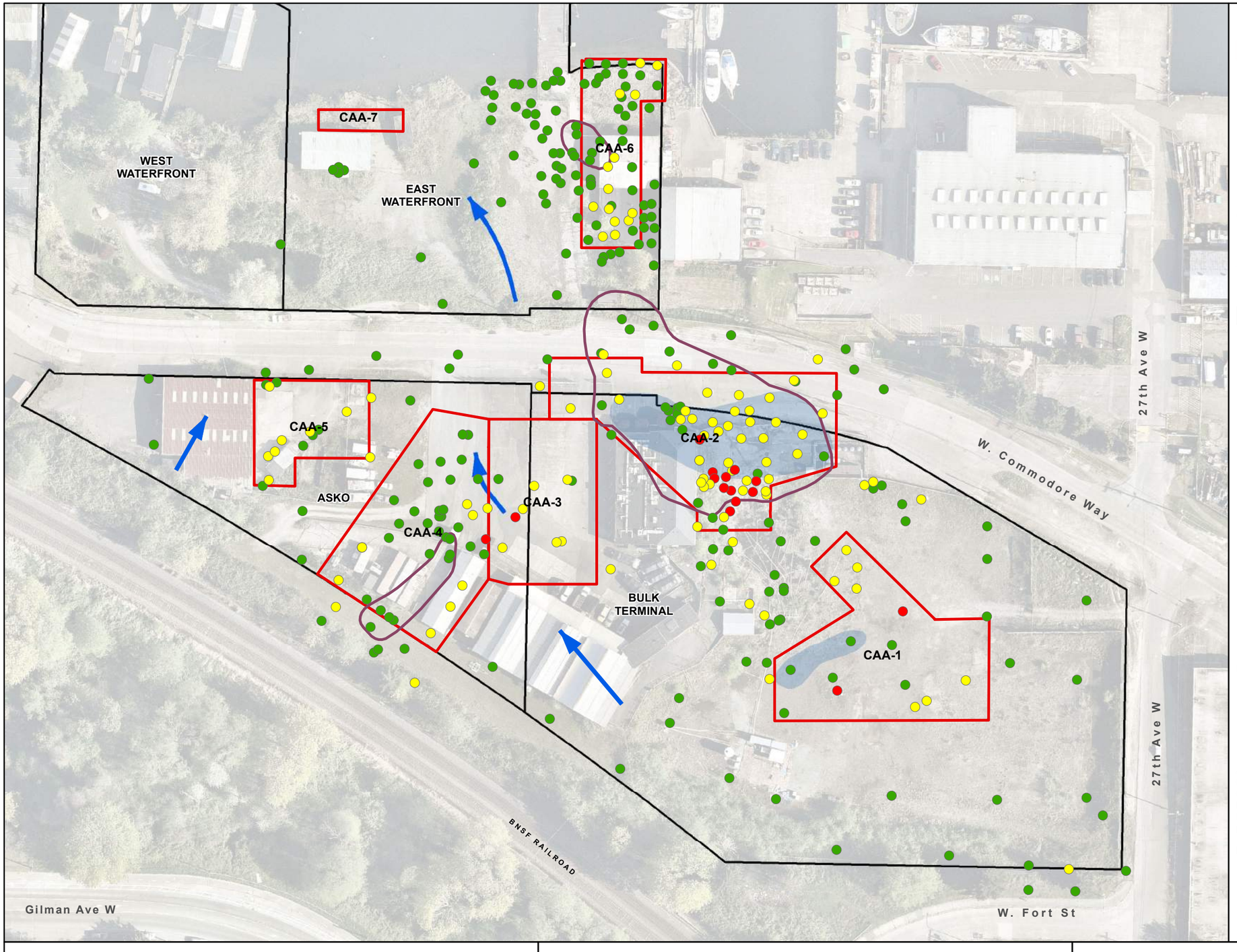
Figure 4.2
Arsenic Occurence in Soil and Groundwater

I:\GIS\Projects\Cantera-TOC\MXD\CAP\CAP 2019\Figure 4.2 Arsenic Occurence in Soil and Groundwater.mxd
9/11/2020



Legend

Cleanup Action Area

Soil Sample Results

- All Results Less Than CUL
- One or More Results Greater Than CUL and Less Than REL
- One or More Results Greater Than REL

Approximate Extent of IHS Exceeding CUL in Groundwater

Gasoline-Range Organics >800 µg/L

Other Site Features

- Predominant Shallow Groundwater Flow Direction (April/May 2019)
- Approximate LNAPL Extent
- Property Boundary

GRO Cleanup Levels
Soil: 30 mg/kg
Groundwater: 800 µg/L

GRO Remediation Levels
Soil: 5,000 mg/kg

Notes:
- The approximate extents of IHSs in groundwater were delineated using existing Site data and are inferred in some locations.
- Soil distribution based on soil concentrations at any depth; the maximum concentration per location was used.
- Parcel boundaries obtained from King County Geographic Information Systems Center, 2011. Lot lines are approximate. Not for legal use.
- Orthoimagery obtained from Nearmap, 2018.

Abbreviations:
CUL = Cleanup level
GRO = Gasoline-range organics
IHS = Indicator hazardous substance
LNAPL = Light non-aqueous-phase liquid
µg/L = Micrograms per liter
mg/kg = Milligrams per kilogram
REL = Remediation level

N

0 45 90 180
Scale in Feet

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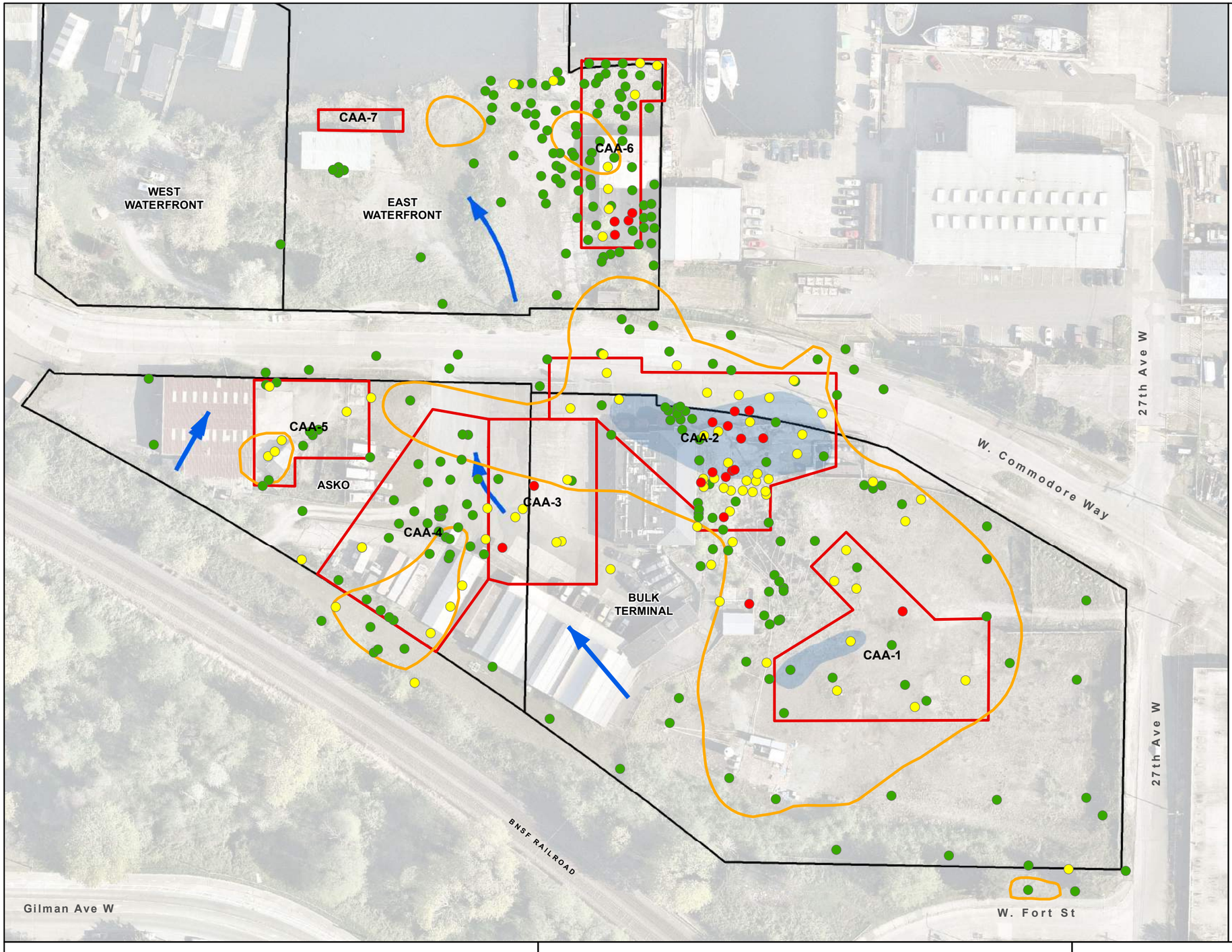
Figure 4.3
Gasoline-Range Organics Occurence in Soil and Groundwater

I:\GIS\Projects\Cantera-TOC\MXD\CAP\CAP 2019\Figure 4.3 GRO Occurence in Soil and Groundwater.mxd
9/11/2020



Legend

- Cleanup Action Area

Soil Sample Results

- All Results Less Than CUL
- One or More Results Greater Than CUL and Less Than REL
- One or More Results Greater Than REL

Approximate Extent of IHS Exceeding CUL in Groundwater

- Diesel- and Oil-Range Organics >500 µg/L

Other Site Features

- Predominant Shallow Groundwater Flow Direction (April/May 2019)
- Approximate LNAPL Extent
- Property Boundary

DRO+ORO Cleanup Levels

Soil Cleanup Levels

DRO: 570 mg/kg

ORO: 1,600 mg/kg

DRO+ORO: 2,000 mg/kg

Groundwater Cleanup Levels

DRO+ORO: 500 µg/L

DRO+ORO Remediation Levels

Soil: 12,000 mg/kg

Notes:

- A single TPH soil CUL for DRO+ORO was proposed in the Supplemental Upland RI/FS for protection of human health. A subsequent review of the terrestrial ecological evaluation by Ecology indicated the need for additional DRO and ORO soil CULs for protection of terrestrial species. Therefore, the final CULs selected by Ecology in the CAP include both individual CULs for DRO and ORO and a combined DRO+ORO CUL.
- The approximate extents of IHSs in groundwater were delineated using existing Site data and are inferred in some locations.
- Soil distribution based on soil concentrations at any depth; the maximum concentration per location was used.
- Parcel boundaries obtained from King County Geographic Information Systems Center, 2011. Lot lines are approximate. Not for legal use.
- Orthoimagery obtained from Nearmap, 2018.

Abbreviations:

CUL = Cleanup level
DRO = Diesel-range organics
IHS = Indicator hazardous substance
LNAPL = Light non-aqueous-phase liquid
µg/L = Micrograms per liter
mg/kg = Milligrams per kilogram
ORO = Oil-range organics
REL = Remediation level

N

0 45 90 180

Scale in Feet

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Figure 4.4
Diesel- and Oil-Range Organics Occurence in Soil and Groundwater

I:\GIS\Projects\Cantera-TOC\MXD\CAP\CAP 2019\Figure 4.4 DRO and ORO Occurence in Soil and Groundwater.mxd
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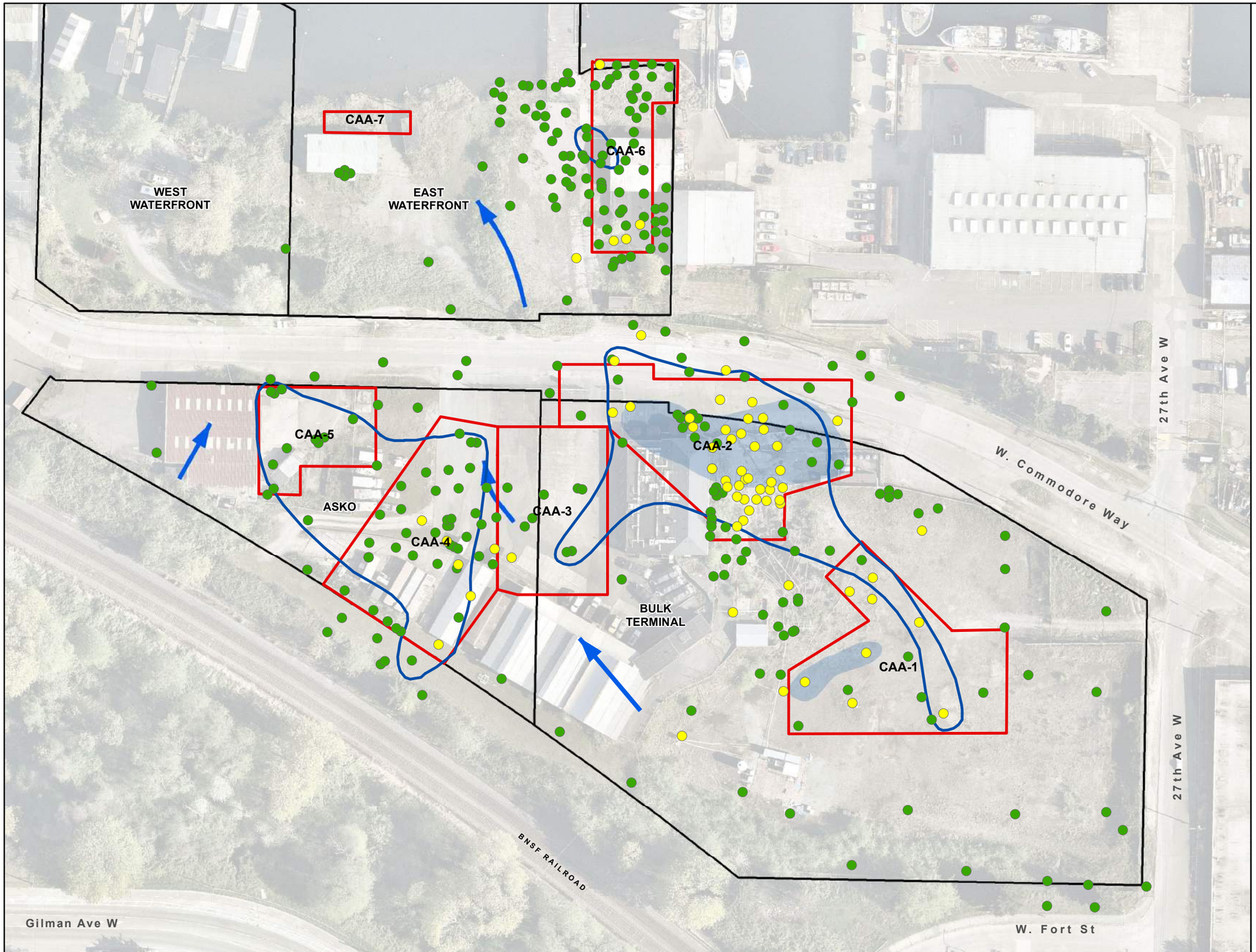

Legend

- Cleanup Action Area

Soil Sample Results

- All Results Less Than CUL
- One or More Results Greater Than CUL

Approximate Extent of IHS Exceeding CUL in Groundwater

- Benzene >0.44 µg/L

Other Site Features

- Predominant Shallow Groundwater Flow Direction (April/May 2019)
- Approximate LNAPL Extent
- Property Boundary

Benzene Cleanup Levels
Soil: 0.020 mg/kg
Groundwater: 0.44 µg/L

Notes:
- The approximate extents of IHSs in groundwater were delineated using existing Site data and are inferred in some locations.
- Soil distribution based on soil concentrations at any depth; the maximum concentration per location was used.
- Parcel boundaries obtained from King County Geographic Information Systems Center, 2011. Lot lines are approximate. Not for legal use.
- Orthoimagery obtained from Nearmap, 2018.

Abbreviations:
CUL = Cleanup level
IHS = Indicator hazardous substance
LNAPL = Light non-aqueous-phase liquid
µg/L = Micrograms per liter
mg/kg = Milligrams per kilogram

N

0 45 90 180
Scale in Feet

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Seattle, Washington

Figure 4.5
Benzene Occurence in Soil and Groundwater

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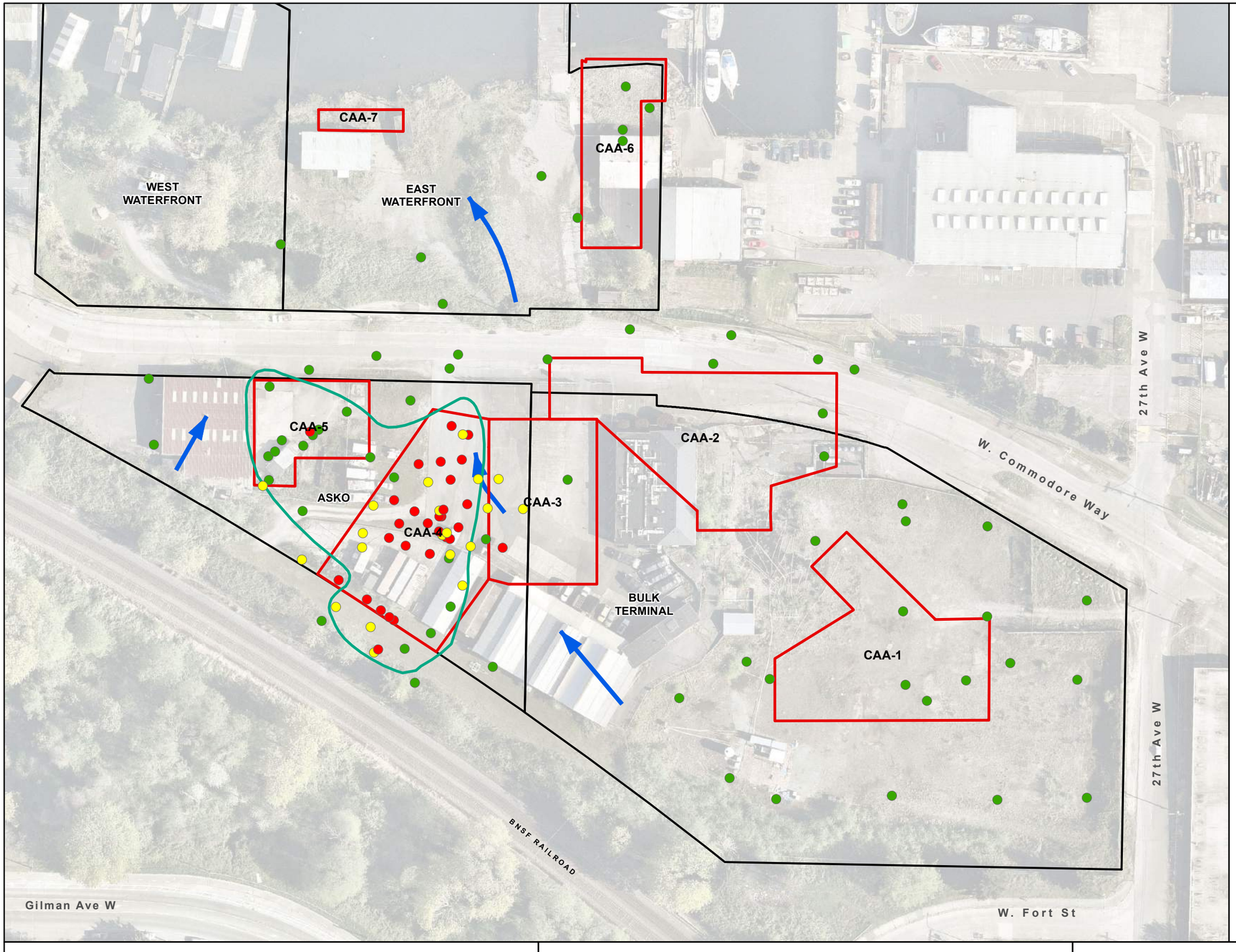
9/11/2020



Legend

Cleanup Action Area

Soil Sample Results

- All Results Less Than CUL
- One or More Results Greater Than CUL and Less Than REL
- One or More Results Greater Than REL

Approximate Extent of IHS Exceeding CUL in Groundwater

Trichloroethene >0.50 µg/L

Other Site Features

Predominant Shallow Groundwater Flow Direction (April/May 2019)

Property Boundary

Trichloroethene Cleanup Levels
Soil: 0.020 mg/kg
Groundwater: 0.50 µg/L

Trichloroethene Remediation Levels
Soil: 1 mg/kg

Notes:
- The approximate extents of IHSs in groundwater were delineated using existing Site data and are inferred in some locations.
- Soil distribution based on soil concentrations at any depth; the maximum concentration per location was used.
- Parcel boundaries obtained from King County Geographic Information Systems Center, 2011. Lot lines are approximate. Not for legal use.
- Orthoimagery obtained from Nearmap, 2018.

Abbreviations:
CUL = Cleanup level
IHS = Indicator hazardous substance
µg/L = Micrograms per liter
mg/kg = Milligrams per kilogram
REL = Remediation level

N

0 45 90 180
Scale in Feet

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Figure 4.6
Trichloroethene Occurence in Soil and Groundwater

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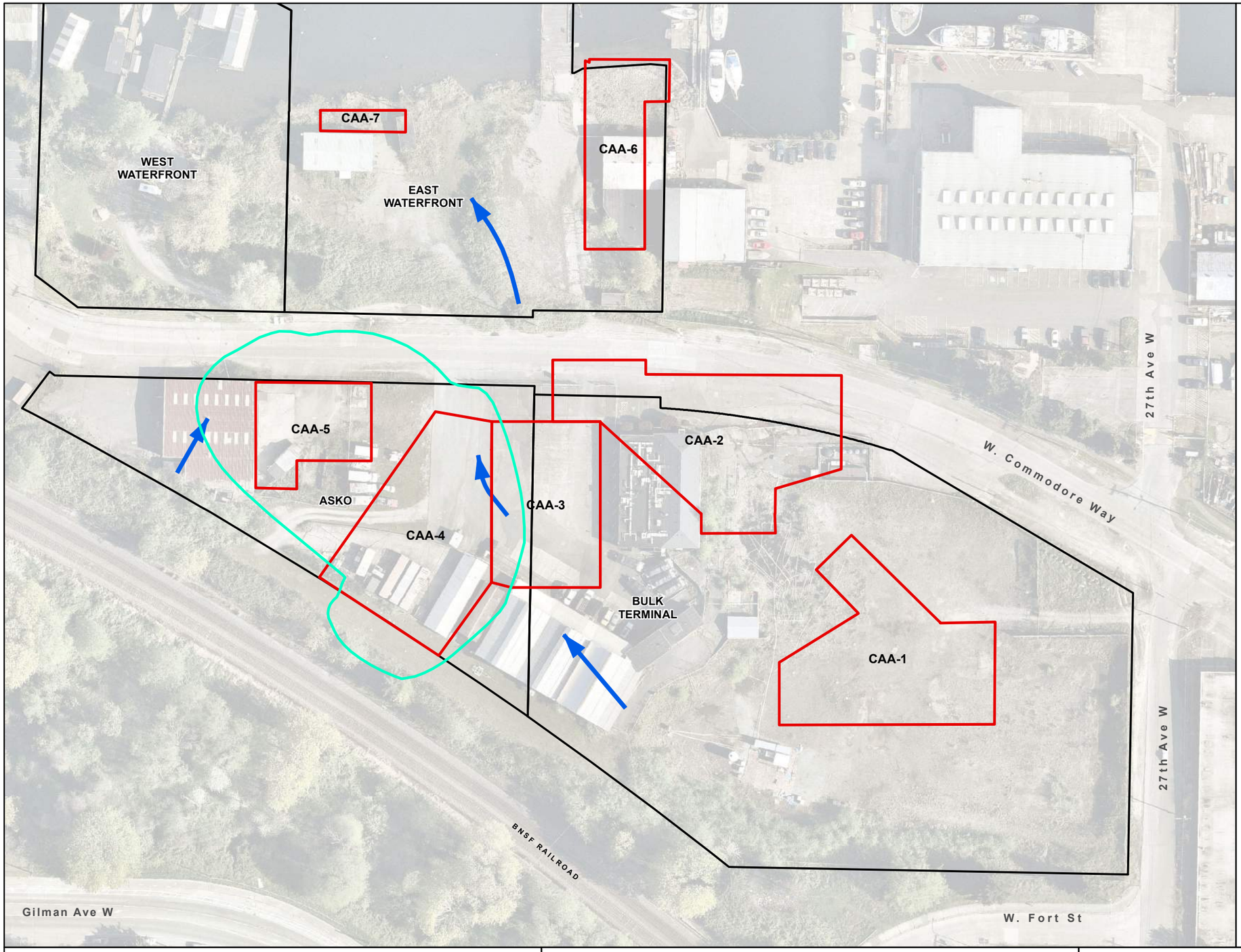

Legend

- Cleanup Action Area

Approximate Extent of IHS Exceeding CUL in Groundwater

- Vinyl Chloride >0.20 µg/L

Other Site Features

- Predominant Shallow Groundwater Flow Direction (April/May 2019)
- Property Boundary

Vinyl Chloride Cleanup Level
Groundwater: 0.20 µg/L

Notes:
- The approximate extents of IHSs in groundwater were delineated using existing Site data and are inferred in some locations.
- Parcel boundaries obtained from King County Geographic Information Systems Center, 2011. Lot lines are approximate. Not for legal use.
- Orthoimagery obtained from Nearmap, 2018.

Abbreviations:
CUL = Cleanup level
IHS = Indicator hazardous substance
µg/L = Micrograms per liter

N

0 45 90 180
Scale in Feet

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Figure 4.7
Vinyl Chloride Occurence in Groundwater

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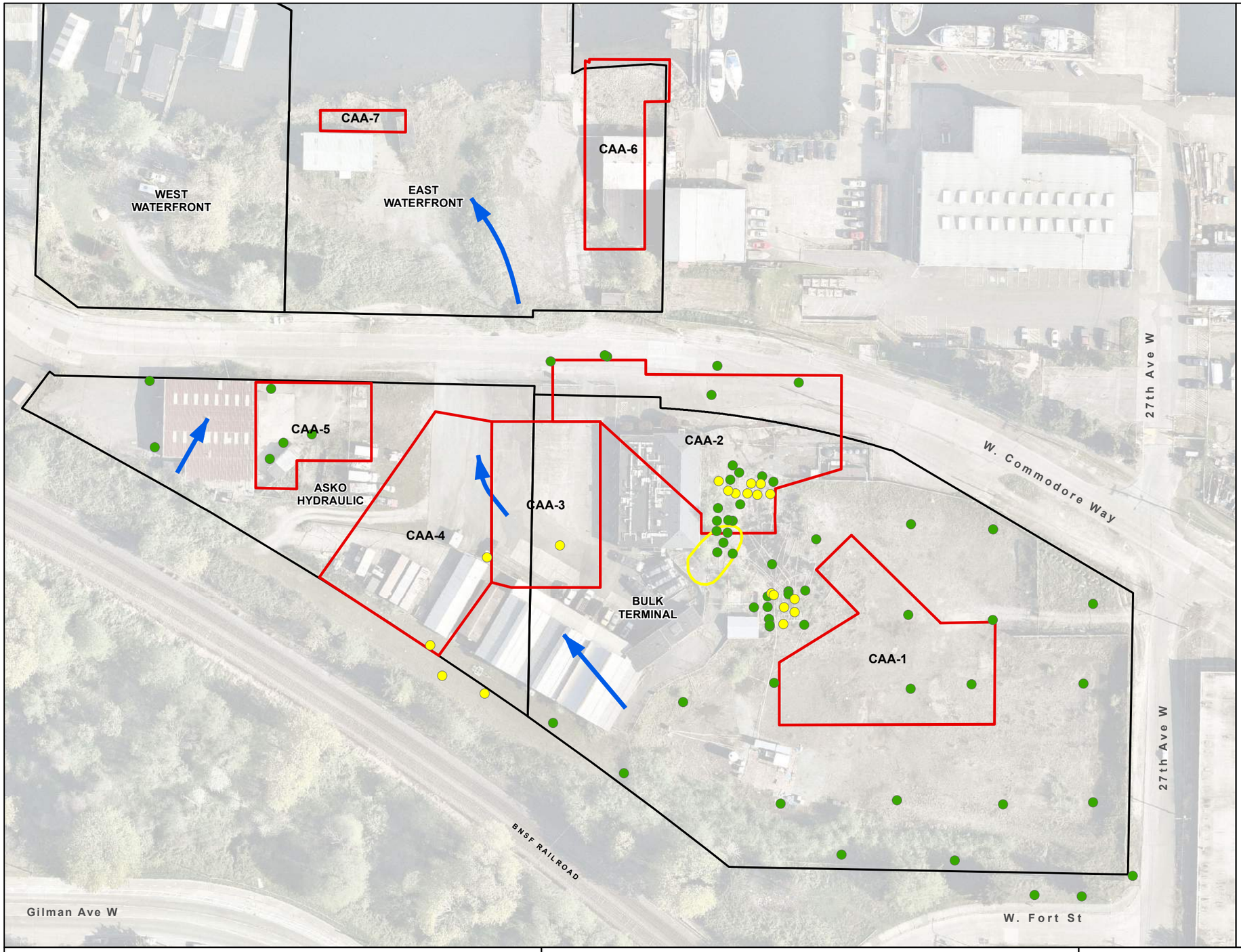

Legend

Cleanup Action Area

Soil Sample Results

All Results Less Than CUL

One or More Results Greater Than CUL

Approximate Extent of IHS Exceeding CUL in Groundwater

Penta >0.20 µg/L

Other Site Features

Predominant Shallow Groundwater Flow Direction (April/May 2019)

Property Boundary

Penta Cleanup Levels
Soil: 0.050 mg/kg
Groundwater: 0.20 µg/L

Notes:
- The approximate extents of IHSs in groundwater were delineated using existing Site data and are inferred in some locations.
- Soil distribution based on soil concentrations at any depth; the maximum concentration per location was used.
- Parcel boundaries obtained from King County Geographic Information Systems Center, 2011. Lot lines are approximate. Not for legal use.
- Orthoimagery obtained from Nearmap, 2018.

Abbreviations:
CUL = Cleanup level
IHS = Indicator hazardous substance
µg/L = Micrograms per liter
mg/kg = Milligrams per kilogram
Penta = Pentachlorophenol

N

0 45 90 180
Scale in Feet

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Figure 4.8
Pentachlorophenol Occurence in Soil and Groundwater

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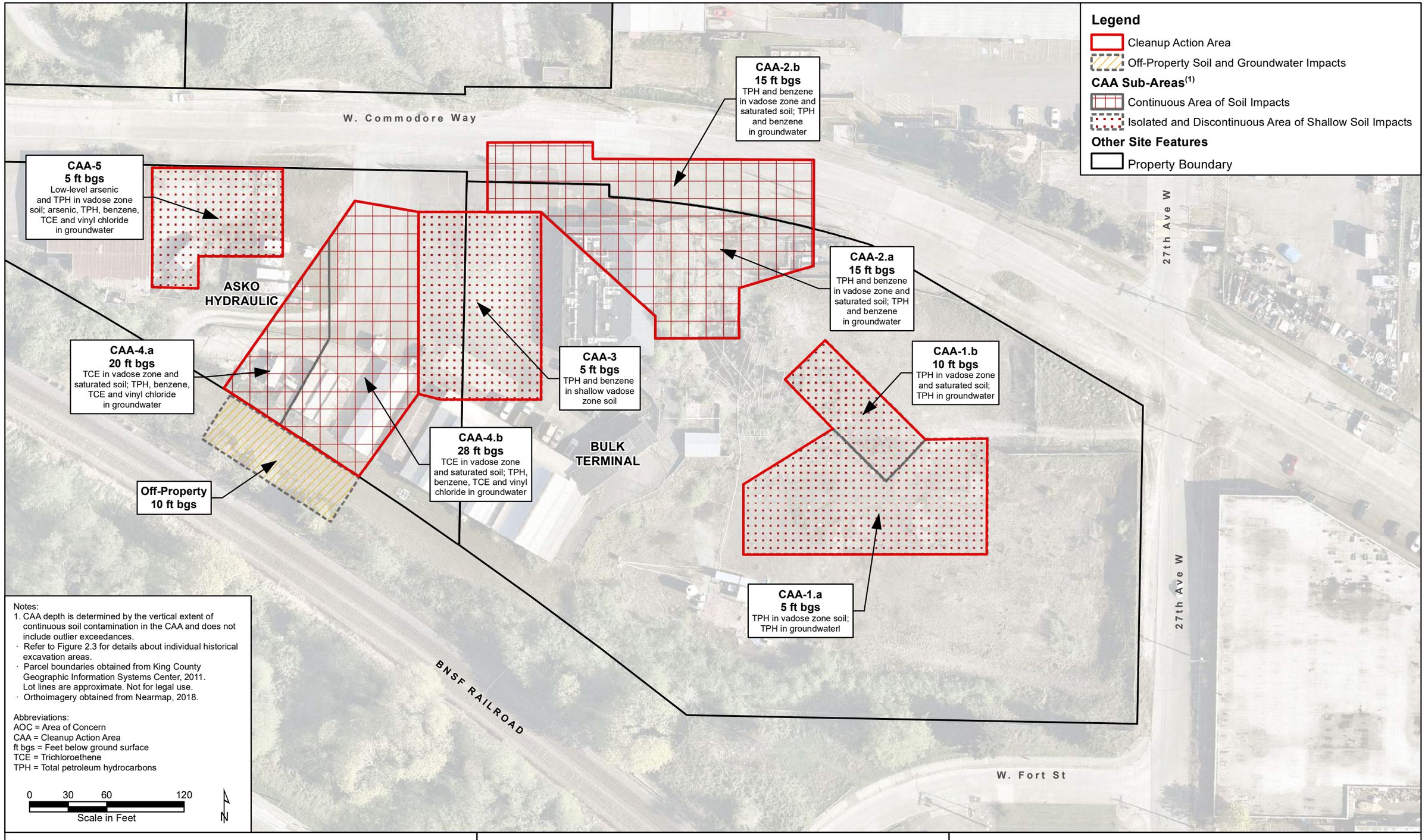

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Figure 4.9
Upland AOC Cleanup Action Areas
and Contaminant Depths/Distributions

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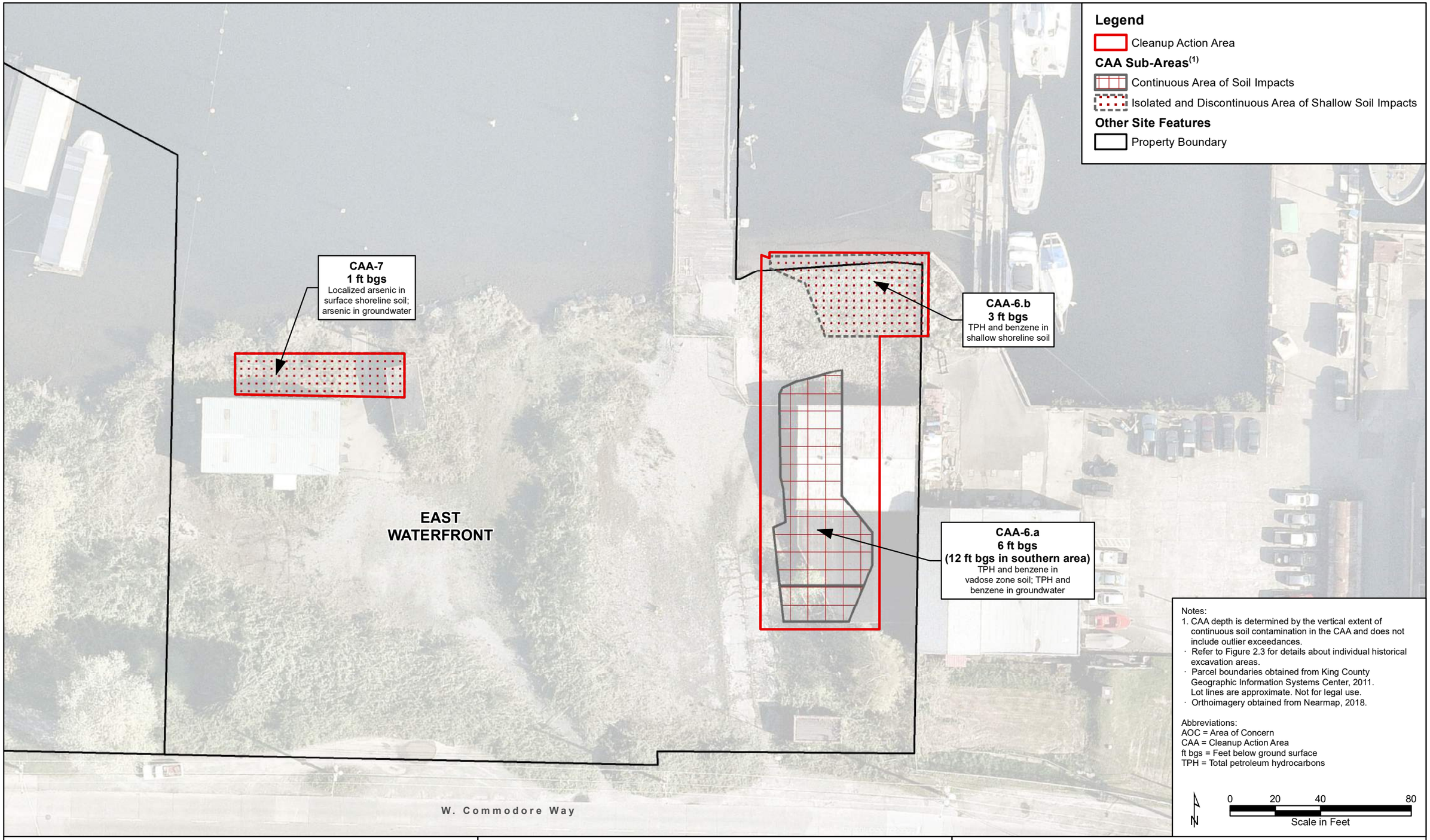

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Figure 4.10
Shoreline AOC Cleanup Action Areas and Contaminant Depths/Distributions

I:\GIS\Projects\Cantera-TOC\MXD\CAP\CAP 2019\Figure 4.10 Shoreline AOC CAA and Contaminant Depths_Distributions.mxd
9/11/2020

Preferred Remedial Alternative

Capping with Pavement or Buildings
Upland AOC

Excavation to CULs
- **CAA-5 Hotspot**
  5 ft bgs (200 CY)
- **CAA-6.a**
  6 ft bgs (700 CY)
  12 ft bgs (300 CY)
- **CAA-6.b**
  3 ft bgs (300 CY)
- **CAA-7**
  1 ft bgs (60 CY)
- **Total Volume Addressed**
  1,560 CY

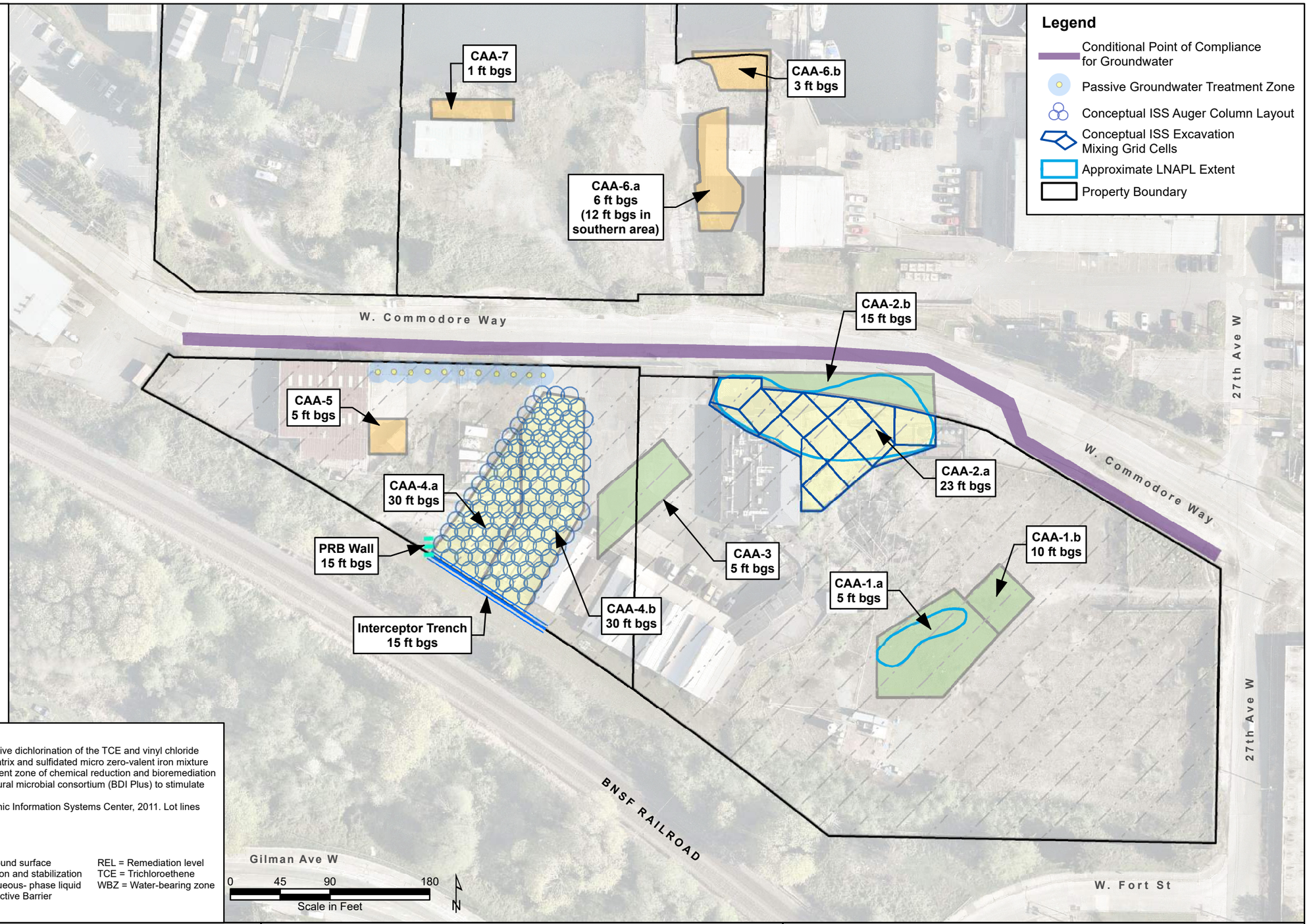
Excavation to RELs
- **CAA-1.a**
  5 ft bgs (1,300 CY)
  LNAPL Removal
- **CAA-1.b**
  10 ft bgs (800 CY)
- **CAA-2.b**
  15 ft bgs (2,100 CY)
  LNAPL Removal
- **CAA-3**
  5 ft bgs (800 CY)
- **Total Volume Addressed**
  5,000 CY

In Situ Stabilization/Solidification
- **CAA-2.a**
  23 ft bgs (10,200 CY)
- **CAA-4.a**
  30 ft bgs (5,900 CY)
- **CAA-4.b**
  30 ft bgs (11,300 CY)
- **Total Volume Addressed**
  27,400 CY

In Situ Groundwater Treatment[1]
CAA-5

Interceptor Trench
CAA-4

PRB Wall with ZVI
CAA-4



Notes:
1. In situ groundwater treatment includes enhanced reductive dichlorination of the TCE and vinyl chloride groundwater plume using a trademarked colloidal biomatrix and sulfidated micro zero-valent iron mixture (PlumeStop and S-MicroZVI) to create a passive treatment zone of chemical reduction and bioremediation in the Shallow WBZ and the addition of an enriched natural microbial consortium (BDI Plus) to stimulate rapid dichlorination of TCE.

· Parcel boundaries obtained from King County Geographic Information Systems Center, 2011. Lot lines are approximate. Not for legal use.
· Orthoimagery obtained from Nearmap, 2018.

Abbreviations:

AOC = Area of concern	ft bgs = Feet below ground surface	REL = Remediation level
BDI = Bio-Dechlor INOCULUM	ISS = In situ solidification and stabilization	TCE = Trichloroethene
CAA = Cleanup Action Area	LNAPL = Light non-aqueous- phase liquid	WBZ = Water-bearing zone
CUL = Cleanup level	PRB = Permeable Reactive Barrier	
CY = Cubic yards		

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Seattle, Washington

Figure 5.1
Property Cleanup Summary

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9/11/2020

Appendix A

Draft Groundwater Monitoring Plan

Time Oil Bulk Terminal Site

Groundwater Monitoring Plan

Prepared for

Cantera Development Group, LLC
2753 West 31st Street
Chicago, IL 60608

September 2020

Draft

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LIMITATIONS

This report has been prepared for the exclusive use of Cantera Development Group, LLC, their authorized agents, and regulatory agencies. It has been prepared following the described methods and information available at the time of the work. No other party should use this report for any purpose other than that originally intended, unless Floyd|Snider agrees in advance to such reliance in writing. The information contained herein should not be utilized for any purpose or project except the one originally intended. Under no circumstances shall this document be altered, updated, or revised without written authorization of Floyd|Snider.

The interpretations and conclusions contained in this report are based in part on previous site characterization data collected by others and Floyd|Snider cannot assure the accuracy of this information.

Table of Contents

List of Tables

List of Figures

List of Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
AOC	Area of concern
ASKO	ASKO Hydraulic
BMP	Best management practice
BNSF	BNSF Railway Company
CAP	Cleanup Action Plan
CPOC	Conditional point of compliance
CUL	Cleanup Level
cVOC	Chlorinated volatile organic compound
DO	Dissolved oxygen
DRO	Diesel-range organics
Ecology	Washington State Department of Ecology
GMP	Groundwater Monitoring Plan
GRO	Gasoline-range organics
IHS	Indicator hazardous substance
ISS	In situ solidification and stabilization
LTCMP	Long-Term Compliance Monitoring Plan
ORO	Oil-range organics
Owner	Property Owner
penta	Pentachlorophenol
POC	Point of compliance
Property	The parcels subject to an asset purchase agreement between the prospective purchaser and current owner (King County Parcel Nos. 1125039050, 1125039081, 1125039120, and 4237900405)
QAPP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
Site	Time Oil Bulk Terminal Site
TCE	Trichloroethene
TPH	Total petroleum hydrocarbons
WAC	Washington Administrative Code
WBZ	Water-bearing zone

1.0 Introduction

This draft Groundwater Monitoring Plan (GMP) is presented as an appendix to the Cleanup Action Plan (CAP) for the Time Oil Bulk Terminal Site (Site). The Site is the location of the former Time Oil Company (TOC) Seattle Terminal facility located on W. Commodore Way in Seattle, Washington (Property). For the purposes of this document, the Property is defined as the four separate upland parcels within the Site commonly identified as the Bulk Terminal, ASKO Hydraulic (ASKO), East Waterfront, and West Waterfront. Three of the four parcels (all but the West Waterfront) are subject to cleanup actions and associated compliance monitoring.

This draft GMP provides the basis for groundwater monitoring that will be necessary after implementation of remedial actions at the Property that are specified in the CAP to evaluate effectiveness of the remedial actions and to determine compliance with Site cleanup levels (CULs) for indicator hazardous substances (IHSs; arsenic, gasoline-range organics [GRO], total diesel-range organics [DRO] and oil-range organics [ORO], benzene, trichloroethene [TCE], vinyl chloride, and pentachlorophenol [penta]) specified in the CAP at the applicable point of compliance (POC). Cleanup standards are defined as a CUL combined with a POC where the CUL applies. A conditional POC (CPOC) has been established for the Property, as shown on Figure A.1. This draft GMP also establishes the proposed monitoring well network and provides detail regarding compliance monitoring, proposed sample analyses, data evaluation, and contingency actions.

This draft GMP will be updated and included as part of the Long-Term Compliance Monitoring Plan (LTCMP) for the Property that will be established post-remedy. The LTCMP will describe required monitoring during and after remedy implementation to ensure the long-term protectiveness of the remedy.

The objectives of compliance monitoring as stated in Washington Administrative Code (WAC) 173-340-410 include protection monitoring, performance monitoring, and confirmation monitoring. The proposed GMP will fulfill the objectives of performance and confirmation monitoring as described below:

- **Performance Monitoring** is used to confirm that the cleanup action has attained cleanup standards and other performance standards. Short-term performance monitoring will be conducted for the first 2 years following remedy construction to document that remedial goals are being achieved. Long-term performance monitoring will be conducted until cleanup standards have been attained, which is defined as meeting CULs at the CPOC and downgradient of the CPOC.
- **Confirmation Monitoring** is used to confirm the long-term effectiveness of the cleanup action after completion of the preferred remedy once cleanup standards have been attained. Confirmation monitoring will include long-term groundwater monitoring to confirm that IHS concentrations remain less than the CULs at the CPOC and downgradient of the CPOC.

Specific details provided in this draft GMP are subject to change based on finalization of the CAP, engineering design, post-remedy conditions, and plans for Property redevelopment. It is anticipated that the changes will be relatively minor, such as specific location of proposed monitoring wells after further modeling is completed as part of engineering design and more specificity regarding the analytical schedule, but the overall GMP will be generally consistent with this draft. The specific monitoring locations and analytical schedule may also be adjusted during implementation of this plan in coordination with the Washington State Department of Ecology (Ecology) if needed to meet the objectives of performance monitoring and compliance monitoring as described above. Implementation of this plan will be the responsibility of the Property Owner (Owner).

A Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) for the groundwater monitoring will be prepared as part of the final GMP and LTCMP.

2.0 Proposed Well Decommissioning and Installation Plan

A monitoring well network will be established at the Property to assess performance of the cleanup action and compliance with the CULs for groundwater specified in the CAP. This network will include monitoring wells located at the CPOC for the Property and downgradient of the CPOC to measure compliance with cleanup standards, wells upgradient of the CPOC to measure and quantify the effects of remediation, and sentinel wells to monitor the nature and extent of contaminants in groundwater when CULs have not been achieved at the CPOC or to evaluate plume boundary conditions.

The existing network of monitoring wells will be used for groundwater monitoring to the extent possible; however, many wells will require decommissioning due to their location (i.e., within ground-disturbing remediation areas) or their construction. Additional monitoring wells will be installed after remedy implementation to replace certain decommissioned wells and fill remaining gaps in the monitoring well network. The proposed pre-construction well decommissioning and post-construction well installation is described in the following sections and presented in Table A.1. The locations of monitoring wells that are proposed to be decommissioned and installed are shown on Figure A.1. The proposed short-term performance monitoring includes monitoring well locations as shown on Figure A.2 and is discussed in further detail in Section 3.0. The proposed long-term monitoring includes monitoring well locations as shown on Figure A.3. The long-term monitoring, which includes a sentinel well monitoring network, is discussed in further detail in Sections 4.0. The proposed network may be adjusted as part of finalization of the GMP and preparation of the LTCMP.

2.1 MONITORING WELL DECOMMISSIONING

Existing monitoring wells that are located within or immediately adjacent to areas with planned ground-disturbing remediation will be decommissioned by a licensed driller in accordance with Washington State Minimum Standards (WAC 173-160) prior to construction. Wells to be decommissioned prior to construction as summarized on Figure A.1 and Table A.1 include:

- Wells within or immediately adjacent to the planned in situ solidification and stabilization (ISS) and excavation areas that will be disturbed by construction.
- Wells that are determined to be in locations that will not yield critical data for performance or compliance, which will be decommissioned as a best management practice (BMP) to limit the number of potential pathways for contamination to groundwater at the Property.
- Wells that were constructed to span two water-bearing zones (WBZs), do not contact any WBZs and have insufficient water or are dry, or are irreparably damaged.

It should also be noted that additional wells may require decommissioning and relocation if future development activities are likely to damage the wells or render them inaccessible. Decommissioning and replacement of additional wells is discussed in the short-term and long-term monitoring plans presented in Sections 3.0 and 4.0.

2.2 MONITORING WELL INSTALLATION

New monitoring wells will be installed after construction to replace existing key wells that will be decommissioned for remedy construction and to complete the monitoring well network for comprehensive monitoring of IHSs. Wells to be installed include the following:

- Replacement of key Bulk Terminal wells that will be decommissioned for remedy construction (01MW11R, 01MW19R, 01MW24R, 01MW49R, 01MW87R, and 01MW90R)
- Replacement of key ASKO wells that will be decommissioned for remedy construction (01MW45R, MW03R, and MW04R)
- Additional wells to complete the downgradient well network for the ASKO parcel (01MW112 and 01MW113)
- Replacement of key East Waterfront well 02MW04R that will be decommissioned for remedy construction

2.3 COMPLIANCE MONITORING WELL NETWORK

The compliance monitoring well network will include various locations to fulfill the objectives of performance and confirmation monitoring, and will consist of the following types of wells as shown on Figures A.2 and A.3:

- **Quarterly and Semiannual Performance:**
  - These locations will be routinely monitored during the short-term monitoring period to assess remedy performance.
- **Contingency:**
  - These locations will be monitored as needed (i.e., to evaluate flow pattern changes) throughout short-term monitoring to gather performance data.
- **Confirmation:**
  - These locations are located at the CPOC and downgradient of the CPOC and will be routinely monitored during the long-term monitoring period to assess remedy performance.
  - Once cleanup standards are met, monitoring at these locations will transition from performance to confirmation and will be monitored to confirm that the cleanup standards continue to be met.
- **Performance:**
  - These locations will be routinely monitored during the long-term monitoring period and are located upgradient and downgradient of the CPOC in key locations for assessing remedy performance.
- **Sentinel:**
  - These locations will be used to gather information on the contaminant plume extents during long-term monitoring and will be monitored only as needed throughout long-term monitoring.

3.0 Short-Term Performance Monitoring

Post-remediation short-term performance monitoring to assess remedy effectiveness within and downgradient of active treatment areas will include assessment of the natural attenuation processes, groundwater flow patterns, and groundwater quality trends following active remediation. Performance monitoring will be initiated within 1 year after completion of remedial construction and will be conducted for a period of 2 years for the Shoreline Area of Concern (AOC) and 4 years for the Upland AOC. Performance monitoring will be conducted semiannually during the wet and dry seasons, and a subset of the performance monitoring wells located at the downgradient boundaries of the pre-construction contaminant plumes will be sampled on a quarterly basis for at least eight quarters as shown on Figure A.2. A SAP/QAPP will be prepared as part of the LTCMP and will include specific details regarding sample collection procedures, analytical methods, and reporting limits for the short-term performance monitoring.

Short-term performance monitoring wells will be sampled for relevant IHSs and parameters that are indicators of natural attenuation of organic compounds (dissolved oxygen [DO], nitrates, ferrous iron, sulfate, chlorides, methane, dissolved organic carbon, alkalinity, and oxidation-reduction potential) as specified in Table A.2. Water levels will be measured at accessible Property wells during each event in order to establish post-remedy flow patterns as further described in Section 3.2.

During short-term performance monitoring, wells that are not long-term compliance wells and have sample results for relevant IHSs at concentrations less than the CULs for three consecutive events may be omitted from further sampling or sampled at a lesser frequency (refer to Section 6.0 for additional details regarding modifications to sampling). Additional contingency performance monitoring wells or other wells in the existing network, as shown on Figure A.2, may be sampled for performance monitoring as needed to assess remedy performance. Wells that may be affected by property development during the short-term performance monitoring period will be assessed on a case-by-case basis; the Owner may elect to replace the well or monitor an alternate nearby well if additional data are necessary to assess short-term remedy performance, or the Owner may elect to decommission the well without replacement if performance data are no longer needed at that location.

3.1 SHORT-TERM PERFORMANCE MONITORING WELL NETWORK

Short-term performance monitoring on the Bulk Terminal parcel will include the following:

- Quarterly monitoring of wells downgradient of the property at the edges of the current total petroleum hydrocarbon (TPH) plume (01MW35 and 01MW84) and adjacent to the ISS monolith (01MW19R) for eight quarters followed by 2 years of semiannual monitoring;
- Semiannual monitoring of wells within the groundwater contaminant plumes and downgradient of planned ISS and excavation areas (01MW24R, 01MW40, and 01MW90R); and

- Contingency monitoring of wells in the downgradient edges of the TPH plume (01MW42, 01MW105, and 01MW86) and within the on-property penta groundwater plume (01MW66) as needed to assess performance.

Short-term performance monitoring on the ASKO parcel will include the following:

- Quarterly monitoring of wells downgradient of the property at the edges of the current chlorinated volatile organic compound (cVOC) plume (01MW53 and 01MW85) and adjacent to the ISS monolith and downgradient of the permeable reactive barrier (PRB) wall located on the northern parcel boundary (01MW58) for eight quarters followed by 2 years of semiannual monitoring;
- Semiannual monitoring of wells upgradient and adjacent to planned ISS treatment area, downgradient of interceptor trench (01MW60), and immediately downgradient of planned treatment areas (01MW45R, 01MW56, 01MW108, MW03R, and MW04R); and
- Contingency monitoring of other wells within the groundwater contaminant plume (01MW80 and MW06) and downgradient of the contaminant plume (01MW89, 01MW112, 01MW113, MW02) as needed to assess performance. It is expected that groundwater samples would be collected from the contingency wells located closest to the in situ remedial areas during the initial short-term monitoring event to evaluate baseline conditions for the post-remedy plume.

Monitoring wells in the BNSF Railway Company (BNSF) AOC (refer to Figure A.2) will also be maintained and monitored under a separate Ecology agreement with BNSF. Monitoring data from BNSF AOC wells may also be used as needed to assess upgradient groundwater quality and remedy performance on the ASKO parcel.

Short-term performance monitoring on the East Waterfront parcel will include the following:

- Quarterly monitoring of wells within the groundwater contaminant plumes and downgradient of the planned excavation areas (02MW04R and 02MW19) and other wells within the groundwater TPH plume (02MW07) for eight quarters; and
- Contingency monitoring of property wells outside the contaminant plumes (02MW03, 02MW17, and 02MW20) as needed to assess performance.

3.2 GROUNDWATER FLOW PATTERN ANALYSIS

Groundwater flow directions and gradients will be evaluated by collecting depth to groundwater measurements in accessible Shallow WBZ and Intermediate WBZ wells during short-term performance monitoring. If changes to flow patterns are observed, or it is determined that additional data are needed to understand flow patterns and potential contaminant migration with respect to the CPOC or other characteristics of the aquifer, additional elevation measurements will be collected as needed during long-term monitoring.

4.0 Long-Term Compliance Monitoring

After completion of the short-term post-remediation performance monitoring, Shallow and/or Intermediate WBZ wells will be sampled for long-term compliance monitoring throughout the restoration time frame, which is estimated to be 5 years for the Shoreline AOC and 15 years for the Upland AOC. Long-term compliance monitoring will be conducted semiannually during the dry and wet season, or annually if individual wells demonstrate stable or decreasing trends in IHS concentrations during short-term monitoring. Additional wells will be transitioned to annual monitoring during the long-term monitoring as they achieve stable or decreasing IHS trends. Annual monitoring will be performed during the season (wet or dry) that had overall greater contaminant concentrations during semiannual performance monitoring, or if there do not appear to be seasonal trends, then the annual sampling will be completed in the early part of the dry season (i.e., May or June). A SAP/QAPP will be prepared as part of the LTCMP and will include specific details regarding sample collection procedures and analytical methods and reporting limits for long-term monitoring.

Long-term compliance monitoring samples will consist of both performance and confirmation monitoring and will be analyzed for the Site IHSs identified in the CAP. The proposed long-term compliance monitoring plan is presented in Table A.3 and summarized below.

- Petroleum compounds including GRO, Total DRO and ORO, and benzene are present in the Shallow WBZ and Intermediate WBZ Property-wide and will be analyzed in samples from confirmation monitoring wells during the first 2 years of long-term monitoring to determine compliance.
- TCE and vinyl chloride exceed CULs in the Shallow WBZ and Intermediate WBZ on the ASKO portion of the Upland AOC.[1] These compounds will be analyzed in samples collected from confirmation monitoring wells at the CPOC on the ASKO parcel.
- Arsenic exceeds the CUL in the Shallow WBZ in the Shoreline AOC. Arsenic will be analyzed in samples collected from Shallow WBZ shoreline confirmation monitoring wells in the Shoreline AOC.
- Penta exceeds the CUL in the Shallow WBZ on the Bulk Terminal portion of the Uplands AOC. Penta will be analyzed in samples collected from select Shallow WBZ confirmation monitoring wells at the CPOC on the Bulk Terminal parcel.

Sentinel monitoring wells, which lie upgradient of areas of contamination or outside the anticipated lateral and vertical post-remediation groundwater contaminant plume boundaries, may also be monitored to further assess remedy performance or boundary conditions if determined to be necessary by the Owner. Sentinel wells will be maintained to the extent practical but may be decommissioned by the Owner if they are determined not necessary to evaluate remedy performance or as a BMP if future development would render them

[1] These compounds also exceed Site CULs on the BNSF AOC, which will be addressed under a separate Agreed Order issued to BNSF.

inaccessible. Sentinel wells will not be replaced if decommissioned. The proposed confirmation, performance, and sentinel well networks are described in the following sections and shown on Figure A.3.

Water levels may also be measured at accessible wells as needed during each monitoring event to determine ongoing groundwater flow patterns.

4.1 LONG-TERM MONITORING WELL NETWORK

Long-term monitoring will be performed annually, or semiannually if needed as described above, to confirm that the remedy results in groundwater quality that meets the Site cleanup standards within the predicted restoration time frame. The long-term monitoring well network includes wells at the CPOC in the Upland AOC, wells downgradient of the CPOC in the Shoreline AOC, and key wells upgradient of the CPOC that yield information about remedy performance. Long-term performance monitoring will be conducted until cleanup standards have been attained and will be followed by confirmation monitoring to confirm that IHS concentrations remain less than the CULs at the CPOC and downgradient of the CPOC. Sequencing from performance monitoring to confirmation monitoring will occur throughout long-term compliance monitoring on a well by well basis.

The CPOC adjacent to the western portion of the Bulk Terminal parcel is the centerline of W. Commodore Way, and the CPOC adjacent to the eastern portion of the Bulk Terminal parcel is the northern parcel boundary as shown on Figure A.3. A confirmation monitoring well network will be established to the south of the centerline of W. Commodore Way and will include the following monitoring wells:

- Shallow WBZ: 01MW03, 01MW09, 01MW11R, 01MW86, and 01MW87R
- Intermediate WBZ: 01MW51

The CPOC adjacent to the ASKO parcel is the centerline of W. Commodore Way. A confirmation monitoring well network will be established along this property line and will include the following wells:

- Shallow WBZ: 01MW53, 01MW85, and 01MW89
- Intermediate WBZ: 01MW112

Downgradient of the CPOC in the Shoreline AOC (East Waterfront parcel) long-term confirmation monitoring wells are located in the Shallow WBZ along the shoreline and in the property interior:

- 02MW04R, 02MW07, 02MW17, 02MW19, and 02MW20

Additional key wells for performance monitoring upgradient and downgradient of the CPOC include the following:

- Shallow WBZ well 01MW58 on the ASKO parcel downgradient of the PRB
- Shallow WBZ wells adjacent to excavation and ISS areas on the Bulk Terminal parcel (01MW90R, 01MW19R) and downgradient of the excavation area in W. Commodore Way (01MW84)

The compliance monitoring well network will be maintained throughout long-term monitoring to the extent practical. If a confirmation monitoring well at the CPOC or downgradient of the CPOC is deemed to be no longer necessary, it may be removed from the long-term monitoring program and decommissioned with Ecology concurrence as further described in Section 6.0.

Sentinel monitoring wells are not designated for regular long-term monitoring but may be sampled as necessary to assess the extents of contaminant plumes and remedy performance. Sentinel wells are summarized in Table A.3, shown on Figure A.3, and include the following:

- Wells in the Shallow WBZ on the upgradient portion of the Bulk Terminal parcel at the edges of the pre-remediation contaminant plume (01MW17, 01MW39, 01MW42, 01MW115, 01MW110) and downgradient of the CPOC north of the Bulk Terminal parcel boundary in the Shallow WBZ (01MW30, 01MW34, 01MW35, 01MW101, 01MW102, 01MW103, 01MW109, 01MW110) and the Intermediate WBZ (01MW48, 01MW104, 01MW111);
- Wells in the Shallow WBZ on the upgradient portion of the ASKO parcel (01MW61), Shallow WBZ wells along the western ASKO parcel boundary (01MW113, MW02), and Shallow WBZ wells downgradient of the CPOC north of the ASKO parcel boundary (01MW83, 01MW106, 01MW107); and
- Wells in the Shallow WBZ on the upgradient portion of the East Waterfront parcel along the edge of the pre-remediation contaminant plume on the Bulk Terminal parcel (02MW08), Shallow WBZ wells along the East Waterfront parcel boundaries (02MW14, 02MW16, 02MW18) and Intermediate WBZ wells along the shoreline of the East Waterfront parcel (02MW21 and 02MW22).

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5.0 Data Evaluation and Reporting

After 5 years following remedy implementation Ecology will perform the first 5-year periodic review for the Property. The need for contingency actions will be evaluated at that time, as described in Section 5.5. After 10 years following remedy implementation, Ecology will perform the 10-year periodic review, consistent with the 5-year review. Annual monitoring and periodic 5-year reviews will be performed until cleanup standards are achieved and Ecology determines that the Property is eligible for closure. Modifications to the monitoring well network or monitoring frequency may be adjusted at any time throughout this process in coordination with Ecology (refer to Section 5.5) and may include increased monitoring (locations or frequency) or discontinuing monitoring of compliance wells with three or more consecutive results less than CULs.

For each periodic review, Ecology will be provided with comprehensive data as well as analysis of current and predicted future groundwater quality trends. Data evaluation will be performed to assess compliance with cleanup standards, determine whether indications of organic contaminant degradation are present, and identify long-term groundwater quality trends and flow patterns as described in the following sections.

5.1 COMPLIANCE WITH CLEANUP STANDARDS

Cleanup standards are defined as a CUL combined with a POC where the CUL applies. Compliance with the CULs will be assessed for all confirmation monitoring wells at the CPOC and downgradient of the CPOC. The Property will be determined to be in compliance for an IHS when groundwater concentrations are less than the CUL at all confirmation monitoring well locations for three consecutive events or when statistical compliance is achieved for each IHS in accordance with the Model Toxics Control Act (WAC 173-340-740(7)(c)).

It is expected that wells located in the Shoreline AOC will achieve CULs within a restoration time frame of 5 years. Compliance will be assessed separately for this AOC, and confirmation monitoring will be discontinued in the Shoreline AOC once compliance is achieved as described above. The anticipated restoration time frame for the Upland AOC is 15 years, and Property-wide compliance with cleanup standards will be determined when groundwater in the Upland AOC also achieves compliance.

5.2 ASSESSMENT OF NATURAL ATTENUATION

Natural attenuation parameters do not have applicable CULs and are not used to determine compliance, but rather are a tool to gather geochemical information to evaluate remedy performance. The occurrence of natural attenuation will be assessed by measurement of chemical parameters associated with the microbial degradation of organic contaminants in accordance with Ecology's *Guidance on Remediation of Petroleum-Contaminated Ground Water*

by Natural Attenuation (Ecology 2005).[2] It is assumed that the primary method of contaminant degradation is anaerobic due to the low-to-moderate porosity of Property soils and depth to groundwater. The following parameters may indicate the occurrence of natural attenuation:

- reduced DO and nitrate (DO <0.5 milligrams per liter [mg/L] and nitrate <1 mg/L)
- conversion of ferric to ferrous iron (ferrous iron >1 mg/L)
- depletion of sulfate and creation of sulfides (sulfate <20 mg/L)
- creation of methane (methane >0.5 mg/L)
- increasing alkalinity (>2x background)
- lower oxidation-reduction potential values in the downgradient portion of the plume versus upgradient (<-100 millivolts)
- chloride (for chlorinated organics; >2x background)

Measurement of natural attenuation parameters will help inform the assessment of the need for contingency actions as described in in Section 5.5. Additional detail regarding natural attenuation assessment and site-specific performance metrics will be included in the LTCMP.

5.3 CONCENTRATION TREND ANALYSIS

Concentration trends for IHSs will be assessed for compliance monitoring wells at the CPOC and downgradient of the CPOC. Trends will be assessed by plotting the natural log of the contaminant concentrations versus time and using statistical software to determine a line of best fit. The trendline will be projected in the future to determine whether compliance with the cleanup standards is predicted within the 15-year restoration time frame predicted in the Feasibility Study. Additional trend analyses may be performed, as warranted, and will be reported in the LTCMP Annual Monitoring Reports described in Section 5.5.

5.4 CONTINGENCY ACTIONS

The necessity for contingency actions at the Property will be assessed during the 5- year, 10-year, and all additional Ecology periodic review periods. Contingency remedial actions for groundwater may be considered in coordination with Ecology if long-term trend analysis indicates that one or more IHSs will not reach CULs within the restoration time frame at the relevant POC. Contingency actions may also be evaluated if one or more of the following criteria are true:

- The CULs have been achieved at few locations at the CPOC and downgradient of the CPOC and 95 percent upper confidence limits for IHSs remain significantly elevated relative to the CUL.
- Monitored natural attenuation parameters indicate that the geochemical conditions of groundwater may limit further microbial degradation of organic IHSs.

[2] This guidance concerns remediation of sites that are contaminated primarily with TPH and associated petroleum constituents; however, the principles of natural attenuation are also applicable to other organic compounds such as cVOCs.

Contingency actions are more fully described in the CAP and may include focused groundwater treatment or enhanced natural attenuation and will be more specifically described in the LTCMP.

5.5 REPORTING

Groundwater monitoring data evaluation results will be presented to Ecology in LTCMP Annual Monitoring Reports and will include assessment of compliance with CULs and cleanup standards, indications of organic contaminant degradation, and long-term groundwater quality trends and flow patterns. LTCMP Annual Reports will be submitted on March 1 for the prior year and will also include a summary of other monitoring components described in the LTCMP. Eventually, and with Ecology concurrence, the reporting frequency could be reduced to every 5 years, to coincide with Ecology periodic reviews.

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6.0 Plan Finalization and Modification

This draft GMP presents the proposed groundwater monitoring that has been determined to be necessary to monitor the effectiveness of the remedy for the Property and long-term compliance with groundwater cleanup standards. It was prepared using the hydrogeologic and chemical data available at the time of the preparation of the CAP. The final GMP will be presented as an appendix to a Long-Term Monitoring Plan, which will be prepared after remedy implementation. The final GMP will consider additional groundwater modeling and hydrogeologic studies that will be completed for remedial engineering design and/or during remedy implementation. As such, monitoring well locations and frequencies presented in this draft GMP may be adjusted in the final GMP to account for potential flow pattern changes that may result from remedy implementation, such as ISS monoliths. In addition, Ecology has not fully concurred with the number and location of monitoring wells subject to performance monitoring or the sampling frequency outlined in this draft plan. The draft GMP will, therefore, likely see some modifications based on future Ecology input.

Additionally, throughout all phases of monitoring, adaptive management of the Property will be performed. Data will continually be assessed to ensure that the monitoring program fulfills the goals of assessing remedy performance and evaluating compliance with cleanup standards. The Owner may elect to adjust the performance monitoring program as needed to assess remedy performance (i.e., sample contingency or sentinel wells) without Ecology concurrence, however, reduction of sampling frequency or elimination of a performance or confirmation well from the monitoring plan will require Ecology notification. Ecology may also require modifications to the compliance monitoring plan if increased frequency or locations are warranted (i.e., increasing trend in IHS concentrations). Notification of modifications to the compliance monitoring plan will be included in the LTCMP Annual Reports prior to implementing the change.

Lastly, the LTCMP is intended to be a living document that may warrant revisions if conditions at the Property change, such as changes in Property use or Property ownership. The LTCMP, including the GMP, will be reviewed and updated as needed if any significant change occurs.

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7.0 References

Washington State Department of Ecology (Ecology). 2005. *Guidance on Remediation of Petroleum-Contaminated Ground Water by Natural Attenuation.* Toxics Cleanup Program. Publication No. 05-09-091. July.

Time Oil Bulk Terminal Site

Groundwater Monitoring Plan

Tables

Draft

Table A.1
Well Decommissioning and Installation Plan

Well ID	Water-Bearing Zone	Location	Screened Interval (feet below TOC)	Rationale
Wells to be Decommissioned				
01MW01	Shallow	BT	10–25	Remediation Area
01MW02	Shallow	BT	10–25	Remediation Area
01MW04	Shallow	BT	10–25	Remediation Area
01MW05	Shallow	BT	10–25	Remediation Area
01MW10	Shallow	BT	10–25	Remediation Area
01MW13	Shallow	BT	5–20	Remediation Area
01MW16	Shallow	BT	10–20	Remediation Area
01MW18	Shallow	BT	5–20	Remediation Area
01MW19	Shallow	BT	5–20	Remediation Area
01MW20	Shallow	BT	5–20	Remediation Area
01MW24	Shallow	BT	4–19	Remediation Area
01MW27	Shallow	BT	4–19	Remediation Area
01MW28	Shallow	BT	5–22	Remediation Area
01MW29	Shallow	BT	5–19	Remediation Area
01MW33	Shallow	BT	5–20	Remediation Area
01MW43	Shallow/Intermediate	BT	7–22	Remediation Area
01MW59	Shallow/Intermediate	BT	13–28	Remediation Area
01MW67	Shallow	BT	9–24	Remediation Area
01MW68	Shallow	BT	6.5–22	Remediation Area
01MW69	Shallow	BT	9–24	Remediation Area
01MW72	Shallow	BT	3–12	Remediation Area
01MW73	Shallow	BT	2.5–21	Remediation Area
01MW75	Shallow	BT	3–18	Remediation Area
01MW87	Shallow	BT	11–21	Remediation Area
01MW90	Shallow	BT	3–18	Remediation Area
01MW91	Shallow	BT	3–18	Remediation Area
01MW07	Shallow	ASKO	8–18	Remediation Area
01MW44	Shallow	ASKO	15–30	Remediation Area
01MW45	Shallow	ASKO	12–27	Remediation Area
01MW54	Intermediate	ASKO	38–43	Remediation Area
01MW55	Shallow	ASKO	16–31	Remediation Area
01MW62	Shallow	ASKO	24–39	Remediation Area
01MW63	Shallow	ASKO	19.5–31.5	Remediation Area
01MW64	Shallow	ASKO	25–40	Remediation Area
01MW65	Deep	ASKO	52–62	Remediation Area
01MW70	Perched	ASKO	5–20	Remediation Area
01MW71	Perched	ASKO	5–20	Remediation Area
01MW76	Intermediate	ASKO	35–40	Remediation Area
01MW77	Intermediate	ASKO	36–41	Remediation Area
01MW78	Intermediate	ASKO	45–50	Remediation Area
01MW79	Perched	ASKO	4–19	Remediation Area
MW03	Perched	ASKO	7–13.5	Remediation Area
MW04	Shallow	ASKO	18–28	Remediation Area
02MW04	Shallow	EW	10–20	Remediation Area
02MW06	Shallow	EW	9–19	Remediation Area
01MW06	Shallow	BT	10–25	BMP
01MW08	Shallow	BT	9–25	BMP
01MW12	Shallow	BT	4–19	BMP
01MW36	Shallow	BT	10-20	BMP
01MW47	Shallow	BT	6–21	BMP
01MW74	Shallow	BT	4–21.5	BMP
01MW88	Shallow	BT	11–21	BMP
01MW99	Shallow	BT	20–30	BMP
01MW100	Shallow	BT	20–30	BMP
01MW15	Shallow	ASKO	10–30	BMP
01MW46	Shallow	ASKO	13–28	BMP
01MW52	Shallow	ASKO	14–24	BMP
01MW57	Intermediate	ASKO	35.5–40.5	BMP
01MW81	Shallow	ASKO	19.5–28.5	BMP
01MW82	Shallow	ASKO	19–27	BMP
MW01	Shallow	ASKO	18–28	BMP
MW05	Shallow	ASKO	19–29	BMP
02MW01	Shallow	EW	10–20	BMP
02MW05	Intermediate	EW	20–35	BMP
02MW10	Shallow	EW	2.5–7.5	BMP
02MW13	Shallow	EW	5–15	BMP
02MW15	Shallow	EW	5–15	BMP

Table A.1
Well Decommissioning and Installation Plan

Well ID	Water-Bearing Zone	Location	Screened Interval (feet below TOC)	Rationale
Wells to be Decommissioned (cont.)				
01MW11	Shallow/Intermediate	BT	15–30	2-zone well
01MW31	Shallow	BT	5–15	Dry Well
01MW32	Shallow/Intermediate	BT	17–27	2-zone well
01MW37	Shallow/Intermediate	BT	7.5–22.5	2-zone well
01MW38	Shallow/Intermediate	BT	7.5–22.5	2-zone well
01MW49	Shallow/Intermediate	BT	15–25	2-zone well
01MW50	Shallow/Intermediate	BT	15–25	2-zone well
02MW09	Shallow	EW	7–12	Damaged
Wells to be Installed				
01MW11R	Shallow	BT	10–20 (approx)	Replace 01MW11
01MW19R	Shallow	BT	10–20 (approx)	Replace 01MW19
01MW24R	Shallow	BT	10–20 (approx)	Replace 01MW24
01MW49R	Intermediate	BT	24–34 (approx)	Replace 01MW49
01MW87R	Shallow	BT	10–20 (approx)	Replace 01MW87
01MW90R	Shallow	BT	5–15 (approx)	Replace 01MW90
01MW45R	Shallow	ASKO	12–27 (approx)	Replace 01MW45
01MW112	Intermediate	ASKO	30–35 (approx)	New downgradient well
01MW113	Shallow	ASKO	12–27 (approx)	New downgradient well
MW03R	Perched	ASKO	7–13.5 (approx)	Replace MW03
MW04R	Shallow	ASKO	18–28 (approx)	Replace MW04
02MW04R	Shallow	EW	10–20 (approx)	Replace 02MW04

Abbreviations:

ASKO	ASKO Hydraulic parcel
BMP	Best Management Practice
BT	Bulk Terminal parcel
EW	East Waterfront parcel
TOC	Top of casing

Table A.2
Short-Term Monitoring Plan

Well ID	Water-Bearing Zone	Screened Interval (feet below TOC)	Frequency	Proposed Monitoring							
				MNA Parameters	Arsenic	GRO	Total DRO+ORO	Benzene	TCE	Vinyl Chloride	Penta
Bulk Terminal Parcel Wells											
01MW35	Shallow	10–20	Quarterly (1)	X		X	X	X			
01MW84	Shallow	17–23	Quarterly (1)	X		X	X	X			
01MW19R	Shallow	new	Quarterly (1)			X	X	X			
01MW24R	Shallow	new	Semiannual	X		X	X	X			
01MW40	Shallow	7–22	Semiannual	X		X	X	X			
01MW49R	Intermediate	new	Semiannual			X	X	X			
01MW90R	Shallow	new	Semiannual			X	X	X			
01MW42	Shallow	7–22	Contingency	X		X	X	X			
01MW66	Shallow	12–22	Contingency			X	X	X			X
01MW86	Shallow	14–24	Contingency			X	X	X			
ASKO Parcel Wells											
01MW53	Shallow	16–26	Quarterly (1)	X					X	X	
01MW85	Shallow	18–27	Quarterly (1)	X					X	X	
01MW58	Shallow	25.5–35.5	Quarterly (1)	X					X	X	
01MW45R	Shallow	new	Semiannual	X		X	X	X	X	X	
01MW56	Shallow	16–26	Semiannual	X					X	X	
01MW80	Shallow	20–28	Semiannual						X	X	
01MW108	Intermediate	30–35	Semiannual						X	X	
MW03R	Perched	new	Semiannual		X	X	X	X	X	X	
MW04R	Shallow	new	Semiannual		X	X	X	X	X	X	
01MW60	Shallow	24.5–39.5	Contingency	X					X	X	
01MW89	Shallow	18–26	Contingency	X					X	X	
01MW112	Intermediate	new	Contingency						X	X	
MW02	Intermediate	18-28	Contingency						X	X	
MW06	Shallow	18–28	Contingency						X	X	
BNSF Wells (2)											
01MW98	Perched	5–15	--	--	--	--	--	--	--	--	--
01MW97	Perched	5–15	--	--	--	--	--	--	--	--	--
01MW96	Perched	5–15	--	--	--	--	--	--	--	--	--
01MW95	Shallow	27–37	--	--	--	--	--	--	--	--	--
01MW94	Shallow	28–40	--	--	--	--	--	--	--	--	--
01MW93	Shallow	23.5–38.5	--	--	--	--	--	--	--	--	--
01MW92	Perched	6–16	--	--	--	--	--	--	--	--	--
East Waterfront Parcel Wells											
02MW04R	Shallow	new	Quarterly (1)	X		X	X	X			
02MW19	Shallow	3–13	Quarterly (1)		X	X	X	X			
02MW07	Shallow	1.5–11.5	Quarterly (1)	X	X	X	X	X			
02MW03	Shallow	10–20	Contingency	X		X	X	X			
02MW17	Shallow	1–11	Contingency		X	X	X	X			
02MW20	Shallow	new	Contingency	X	X	X	X	X			

Notes:

-- Not accessible for sampling.

1 Quarterly monitoring will be performed for eight quarters (2 years). In the Upland Area of Concern, quarterly monitoring will be followed by 2 years of semiannual performance monitoring; in the Shoreline Area of Concern, quarterly monitoring will be followed by long-term annual confirmation monitoring.

2 It is assumed that wells on the BNSF Propery will be maintained and sampled under a separate agreement with the Washington State Department of Ecology. Data from these wells may be used to assess remedy performance, if available.

Abbreviations

DRO Diesel-range organics
GRO Gasoline-range organics
MNA Monitored Natural Attenuation
ORO Oil-range organics
penta Pentachlorophenol
TCE Trichloroethylene
TOC Top of casing

Table A.3
Long-Term Monitoring Plan

Well ID	Water-Bearing Zone	Screened Interval (feet below TOC)	Designation	Proposed Monitoring						
				Arsenic	GRO	Total DRO+ORO	Benzene	TCE	Vinyl Chloride	Penta
Bulk Terminal Parcel Wells										
01MW03	Shallow	10–25	Confirmation		X	X	X			X
01MW09	Shallow	17–23	Confirmation		X	X	X			X
01MW11R	Shallow	new	Confirmation		X	X	X			
01MW51	Intermediate	29–39	Confirmation		X	X	X			
01MW86	Shallow	14–24	Confirmation		X	X	X			X
01MW87R	Shallow	new	Confirmation		X	X	X			
01MW19R	Shallow	new	Perforamnce		X	X	X			
01MW84	Shallow	17–23	Performance		X	X	X			
01MW90R	Shallow	new	Performance		X	X	X			
01MW17	Shallow	20-30	Sentinel							
01MW30	Shallow	15-28	Sentinel							
01MW34	Shallow	10-20	Sentinel							
01MW35	Shallow	10–20	Sentinel							
01MW39	Shallow	7-22	Sentinel							
01MW42	Shallow	7–22	Sentinel							
01MW48	Intermediate	28-32	Sentinel							
01MW101	Shallow	17-21	Sentinel							
01MW102	Shallow	10-20	Sentinel							
01MW103	Shallow	7-17	Sentinel							
01MW104	Intermediate	28-33	Sentinel							
01MW105	Shallow	5-15	Sentinel							
01MW109	Shallow	8-18	Sentinel							
01MW110	Shallow	11-21	Sentinel							
01MW111	Intermediate	30-35	Sentinel							
ASKO Parcel Wells										
01MW53	Shallow	14–24	Confirmation		X	X	X	X	X	
01MW85	Shallow	15–25	Confirmation		X	X	X	X	X	
01MW89	Shallow	17–27	Confirmation		X	X	X	X	X	
01MW112	Intermediate	new	Confirmation					X	X	
01MW58	Shallow	25.5–35.5	Performance					X	X	
01MW61	Shallow	22-37.5	Sentinel							
01MW83	Shallow	14-24	Sentinel							
01MW106	Shallow	15-25	Sentinel							
01MW107	Shallow	17-27	Sentinel							
01MW113	Shallow	new	Sentinel							
MW02	Shallow	18-28	Sentinel							
East Waterfront Parcel Wells										
02MW04R	Shallow	new	Confirmation		X	X	X			
02MW07	Shallow	1.5–11.5	Confirmation	X	X	X	X			
02MW17	Shallow	1–11	Confirmation	X	X	X	X			
02MW19	Shallow	3–13	Confirmation	X	X	X	X			
02MW20	Shallow	1–11	Confirmation	X	X	X	X			
02MW08	Shallow	13-22	Sentinel							
02MW14	Shallow	5-15	Sentinel							
02MW16	Shallow	5-15	Sentinel							
02MW18	Shallow	4-14	Sentinel							
02MW21	Intermediate	18-28	Sentinel							
02MW22	Intermediate	17-27	Sentinel							

Note:

Sentinel wells are not designated for routine monitoring and may be sampled for indicator hazardous substances as needed to assess remedy performance.

Abbreviations:

DRO Diesel-range organics
GRO Gasoline-range organics
ORO Oil-range organics
penta Pentachlorophenol
TCE Trichloroethylene
TOC Top of casing

Time Oil Bulk Terminal Site

Groundwater Monitoring Plan

Figures

Draft

Legend

Previous Investigation Monitoring Well Locations

- Shallow WBZ Monitoring Well
- Shallow/Intermediate WBZ Monitoring Well
- Intermediate WBZ Monitoring Well
- Deep WBZ Monitoring Well
- Angled Shallow WBZ Monitoring Well
- Perched WBZ Monitoring Well

Proposed Well Network

- Decommission
- Shallow WBZ Monitoring Well to be Installed
- Intermediate WBZ Monitoring Well to be Installed
- Perched WBZ Monitoring Well to be Installed

Proposed Monitoring Plan

- Conditional Point of Compliance

Cleanup Action Remedy

- Cleanup Action Area
- Capping with Pavement or Buildings
- Excavation to CULs
- Excavation to RELs
- In Situ Stabilization/Solidification
- ERD Injection Point with Area of Influence
- Interceptor Trench
- PRB Wall for Trench

Other Site Features

- Property Boundary for the Former TOC Seattle Terminal

Notes:
· Parcel boundaries obtained from King County Geographic Information Systems Center, 2011. Lot lines are approximate. Not for legal use.
· Orthoimagery obtained from Nearmap, 2018.

Abbreviations:
AOC = Area of concern
CUL = Cleanup level
ERD = Enhanced Reductive Dechlorination
PRB = Permeable Reactive Barrier
REL = Remediation level
TOC = TOC Holdings Co. and any predecessor entity including Time Oil Company
WBZ = Water-bearing zone

0 45 90 180
Scale in Feet

N

WEST WATERFRONT
EAST WATERFRONT
ASKO HYDRAULIC
BULK TERMINAL
BNSF RAILROAD
Gilman Ave W
W. Commodore Way
W. Fort St
27th Ave W

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Cleanup Action Plan
Appendix A Draft Groundwater Monitoring Plan
Time Oil Bulk Terminal Site
Seattle, Washington

Figure A.1
Proposed Monitoring Well Decommissioning and Installation

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Legend

Previous Investigation Monitoring Well Locations

- Shallow WBZ Monitoring Well
- Shallow/Intermediate WBZ Monitoring Well
- Intermediate WBZ Monitoring Well
- Perched WBZ Monitoring Well

Proposed Monitoring Plan

- Quarterly Performance[(1)]
- Semiannual Performance
- Contingency Performance
- Conditional Point of Compliance

Cleanup Action Remedy

- Cleanup Action Area
- Capping with Pavement or Buildings
- Excavation to CULs
- Excavation to RELs
- In Situ Stabilization/Solidification
- ERD Injection Point with Area of Influence
- Interceptor Trench
- PRB Wall for Trench

Other Site Features

- Property Boundary for the Former TOC Seattle Terminal

Notes:
1. Quarterly monitoring will be performed for eight quarters (2 years). In the Upland AOC, quarterly monitoring will be followed by 2 years of semiannual performance monitoring; in the Shoreline AOC, quarterly monitoring will be followed by long-term semiannual or annual confirmation monitoring.
   - Contingency performance wells may also be sampled for performance monitoring as needed to assess remedy performance.
   - Parcel boundaries obtained from King County Geographic Information Systems Center, 2011. Lot lines are approximate. Not for legal use.
   - Orthoimagery obtained from Nearmap, 2018.

Abbreviations:
AOC = Area of concern
BNSF = BNSF Railway Company
CUL = Cleanup level
Ecology = Washington State Department of Ecology
ERD = Enhanced Reductive Dechlorination
PRB = Permeable Reactive Barrier
REL = Remediation level
TOC = TOC Holdings Co. and any predecessor entity including Time Oil Company
WBZ = Water-bearing zone

0 45 90 180
Scale in Feet

N

WEST WATERFRONT
EAST WATERFRONT
ASKO HYDRAULIC
BULK TERMINAL
BNSF RAILROAD
W. Commodore Way
27th Ave W
Gilman Ave W
W. Fort St

02MW18 02MW19 02MW07 02MW17 02MW21 02MW22 02MW20 02MW03 02MW04R 02MW16 02MW14 02MW08
01MW83 01MW106 01MW107 01MW84 01MW102 01MW104 01MW101 01MW35 01MW51 01MW48 01MW86 01MW49R
01MW113 01MW53 01MW112 01MW89 01MW30 01MW09 01MW03 01MW34 01MW87R 01MW103
MW02 01MW85 MW06 01MW80 01MW56 01MW108 01MW19R 01MW45R 01MW109 01MW111 01MW11R
MW04R MW03R 01MW24R 01MW42 01MW58 01MW105 01MW66 01MW110
01MW98 01MW94 01MW92 01MW93 01MW97 01MW96 01MW95 01MW60 01MW61 01MW40 01MW90R 01MW39 01MW17

Wells on BNSF parcel will be maintained and sampled under a separate agreement with Ecology.

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Appendix A Draft Groundwater Monitoring Plan
Time Oil Bulk Terminal Site
Seattle, Washington

Figure A.2
Proposed Short-Term Monitoring Plan

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Previous Investigation Monitoring Well Locations

- Shallow WBZ Monitoring Well
- Shallow/Intermediate WBZ Monitoring Well
- Intermediate WBZ Monitoring Well
- Perched WBZ Monitoring Well

Proposed Monitoring Plan

- Performance
- Confirmation
- Sentinel
- Conditional Point of Compliance

Cleanup Action Remedy

- Cleanup Action Area
- Capping with Pavement or Buildings
- Excavation to CULs
- Excavation to RELs
- In Situ Stabilization/Solidification
- ERD Injection Point with Area of Influence
- Interceptor Trench
- PRB Wall for Trench

Other Site Features

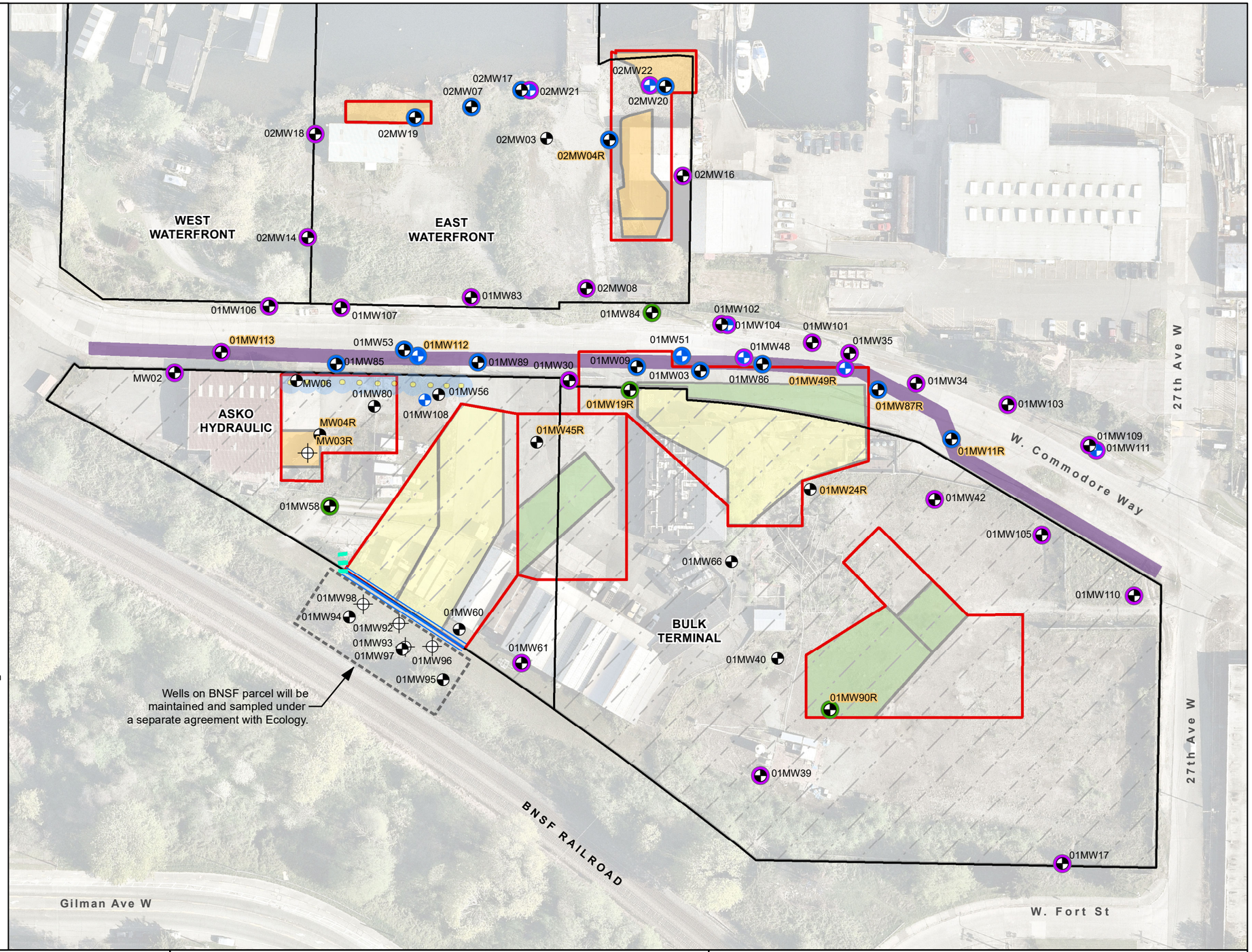
- Property Boundary for the Former TOC Seattle Terminal

Notes:
- Confirmation and sentinel monitoring wells may also be sampled for performance monitoring as needed to assess remedy performance. Confirmation wells will be used to demonstrate compliance at the CPOC and in the Shoreline AOC. These wells will transition from performance to confirmation after the CULs have been attained. Performance wells are wells that will be used to track groundwater plume conditions and trends.
- Parcel boundaries obtained from King County Geographic Information Systems Center, 2011. Lot lines are approximate. Not for legal use.
- Orthoimagery obtained from Nearmap, 2018.

Abbreviations:
AOC = Area of concern
BNSF = BNSF Railway Company
CUL = Cleanup level
CPOC = Conditional point of compliance
Ecology = Washington State Department of Ecology
ERD = Enhanced Reductive Dechlorination
PRB = Permeable Reactive Barrier
REL = Remediation level
TOC = TOC Holdings Co. and any predecessor entity including Time Oil Company
WBZ = Water-bearing zone

0 45 90 180
Scale in Feet

N



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Cleanup Action Plan
Appendix A Draft Groundwater Monitoring Plan
Time Oil Bulk Terminal Site
Seattle, Washington

Figure A.3
Proposed Long-Term Monitoring Plan

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