REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

Kimberly-Clark Worldwide Site Upland Area, Everett, Washington

Prepared for: Port of Everett

Project No. AS190583A-08 • May 21, 2025 • Final

Aspect
A Geosyntec Company

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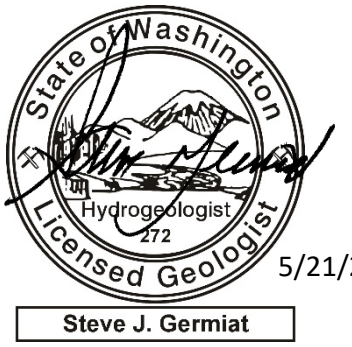

5/21/2025

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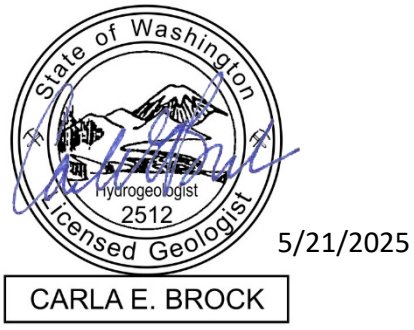

5/21/2025

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Acronyms

1,1-DCE	1,1-dichloroethene
ADC	American Distributing Company
Agreed Order	Agreed Order No. DE 9476
APH	Air-Phase Petroleum Hydrocarbons
ARA	archaeological resources assessment
ARAR	applicable or relevant and appropriate requirement
Aspect	Aspect Consulting
AST	aboveground storage tank
ASTM	American Society for Testing and Materials
BEK	BEK McDonnell Engineering
bgs	below ground surface
BMPs	best management practices
BNSF	BNSF Railway, Inc.
BTEX	benzene, toluene, ethylbenzene, and xylenes
CAP	Cleanup Action Plan
CEMEX	formerly Associated Sand and Gravel
CESCL	Certified Erosion and Sediment Control Lead
CFR	Code of Federal Regulations
City	City of Everett
CLARC	Cleanup Level and Risk Calculation
CLP	Contract Laboratory Program
CM	crushed material
cm/sec	centimeters per second
CN	Clark Nickerson
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CSGP	Construction Stormwater General Permit
CSI	City of Everett Combined Sewer Main Improvements
CSM	conceptual site model
CSO	combined sewer outfall
CWRP	Central Waterfront Redevelopment Plan
DA	discharge authorization

DAHP	Department of Archaeology and Historic Preservation
DGT	diffusive gradient in thin film gel technology
DMMP	Dredged Material Management Program
D.O.	dissolved oxygen
DOH	Washington Department of Health
East Waterway	In-Water Area seaward of mean higher high water of Site
Ecology	Washington State Department of Ecology
EHD	Environmental Health Disparities
EPA	U.S. Environmental Protection Agency
EPH	extractable petroleum hydrocarbons
ERNS	Emergency Response Notification System
ESA	Environmental Site Assessment
E1UB	estuarine subtidal unconsolidated bottom (habitat)
FS	Feasibility Study
ft^3/ft^2-year	cubic feet/square foot per year
ft^3/yr	cubic feet per year
GF	General Fill
gpm	gallons per minute
HWAU	Hazardous Waste Accumulation Unit
HDPE	high density polyethylene
HREC	historical recognized environmental condition
IA	interim action
IACL	interim action cleanup level
IDP	Inadvertent Discovery Plan
IHS	indicator hazardous substance
K	hydraulic conductivity
K-C	Kimberly-Clark Worldwide, Inc.
lb	pound
lb/day	pound per day
LG	licensed geologist
LHG	licensed hydrogeologist
LUST	leaking underground storage tank

MassDEP	Massachusetts Department of Environmental Protection
mg/kg	milligrams/kilograms
mg/L	milligrams per liter
MHHW	mean higher high water
MIE	Maritime Industrial Expansion
MLLW	mean lower low water
MNA	monitored natural attenuation
MTCA	Model Toxics Control Act
NAPL	non-aqueous-phase liquid
ncPAH	noncarcinogenic polycyclic aromatic hydrocarbon
No.	number
NOEC	no observed effect concentration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NTR	National Toxics Rule
O&M	operation and maintenance
ORP	oxidation-reduction potential
OSHA	Occupational Safety and Health Administration
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethylene (perchloroethylene)
PCL	preliminary cleanup level
PCP	pentachlorophenol
PEG	Pacific Environmental Group
pH	negative log of the hydrogen ion concentration in solution
POTW	publicly owned treatment works
PQL	practical quantitation limit
PRB	permeable reactive barrier
PSAPCA	Puget Sound Air Pollution Control Agency
PSCAA	Puget Sound Clean Air Agency
PSI	Puget Sound Initiative
PUD	Snohomish County Public Utility District
Pyron	Pyron Environmental, Inc.

QAPP	Quality Assurance Project Plan
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
REC	recognized environmental condition
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
SAP	Sampling and Analysis Plan
SEPA	State Environmental Policy Act
Site	K-C Worldwide Site
SM	Standard Method
SPLP	Synthetic Precipitation Leaching Procedure
SSL	spent sulfite liquor
SVE	soil vapor extraction
SVOC	semivolatile organic compound
SWCA	SWCA/Northwest Archaeological Associates
SWPPP	stormwater pollution prevention plan
TCE	trichloroethylene
TCLP	toxicity characteristic leaching procedure
TESC	temporary erosion and sediment control
TEE	terrestrial ecological evaluation
TEQ	total toxic equivalent quotient/concentration
TPH	total petroleum hydrocarbon
TSCA	Toxic Substances Control Act
TSDF	Treatment, Storage, Disposal Facility (RCRA)
UCL	upper confidence limit
µg/L	micrograms per liter
U.S.	United States
UECA	Uniform Environmental Covenants Act
USDOT	United States Department of Transportation
UST	underground storage tank
Upland Area	portion of Site inland of mean higher high water

VI	vapor intrusion
VOC	volatile organic compound
VPH	volatile petroleum hydrocarbon
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WISHA	Washington Industrial Safety and Health Act
WSDOT	Washington State Department of Transportation

Executive Summary

The remedial investigation and feasibility study (RI/FS) for the Upland Area of the Kimberly-Clark Worldwide Site, a former pulp and paper mill, in Everett, Washington, has been completed to address environmental contamination from decades of industrial activity. The RI/FS has been conducted in accordance with Washington State Department of Ecology (Ecology) Agreed Order No. DE 9876 (Agreed Order) and consistent with the Washington State Model Toxics Control Act (MTCA). The Site includes portions of upland and in-water areas along the East Waterway of Port Gardner Bay where hazardous substances have been deposited, stored, disposed of, placed, or otherwise come to be located. The Agreed Order specifically addresses the Upland Area; the In-Water Area, seaward of mean higher high water (MHHW), is being addressed under a separate Agreed Order for the East Waterway (Agreed Order No. DE 11350).

The Upland Area comprises approximately 54 acres located in an industrial area on the west side of downtown Everett, Washington. Since the site's initial development in the late 1800s, various industrial businesses operated on the Upland Area, most recently a pulp and paper mill. Following shutdown of the mill in 2012, all structures were demolished except for the distribution warehouse, located near the southern property boundary.

The northernmost 8.9 acres of the Upland Area contains the former mill wastewater treatment plant (WWTP) and is currently owned by the City of Everett and referred to as the City Utility Property. The remaining 46 acres of the Upland Area is owned by the Port of Everett and is currently used as a terminal cargo yard. The only mill structures remaining on the Port property are the distribution warehouse and an active Snohomish County Public Utility District (PUD) electrical substation.

Prior to the Agreed Order, independent remedial actions conducted between 1989 and 2009 included decommissioning and removal of 9 underground storage tanks (USTs) and 2 aboveground storage tanks (ASTs), localized remedial excavation of petroleum- or xylene-contaminated soils in four discrete areas, and removal of polychlorinated biphenyl (PCB)-containing transformers and underlying PCB-contaminated concrete and soil. The RI/FS report presents the results of these remedial actions, and information obtained during Upland Area investigations completed between 1989 and 2012, the first formal interim cleanup action (IA) conducted in 2013-2014, the RI characterization completed between 2013 and 2017, the second IA conducted in 2020, and the third IA conducted in 2023. The data used in the RI is representative of current conditions for the Upland Area, following completion of the IAs.

Interim Actions

The three IAs were conducted following mill demolition activities and generally consisted of the following elements:

- First IA, 2013-2014: Permanent removal and off-site disposal of approximately 38,450 tons of contaminated material from the Upland Area. Collection, treatment, and discharge of more than 5.6 million gallons of groundwater, including water with free-phase petroleum product, and confirmational groundwater monitoring following remedial excavations (2014-2016).
- Second IA, 2020. Permanent removal and off-site disposal of an additional 17,610 tons of contaminated material from the Upland Area. Collection, treatment, and discharge of an additional 2.28 million gallons of groundwater. Inspection, cleaning, and plugging of 19 shoreline pipes. Removal and off-site disposal of 252,000 tons of crushed material (CM) and associated monitoring of groundwater pH. The CM, consisting of concrete and brick debris from demolition of mill structures, was previously graded over a portion of the Upland Area where pavement had been removed
- Third IA, 2021-2023. Grading and construction of a low-permeability cap, designed to reduce surface water infiltration. Installation of subgrade utilities during earthwork for cap construction. Construction of a new stormwater drainage and conveyance system integrated into the environmental cap, a new chitosan-enhanced sand filtration treatment system for stormwater, and reconstruction of existing stormwater outfalls A and M for discharge of the treated water to the East Waterway. Installation of upgraded security fencing.

The three completed IAs successfully removed most of the identified contaminant source materials and then constructed a low-permeability environmental cap to restrict infiltration through soils containing residual low-level contamination.

Remedial Investigation

Following the removal of contaminated materials during the First and Second IAs and CM removal, concentrations of contaminants in soil are below criteria based on industrial direct contact but some are above conservatively calculated values based on the protection of leaching to groundwater. Soil with total petroleum hydrocarbons (TPH) or PCBs exceeding criteria for the protection of groundwater was left in place beyond practicable excavation limits in localized portions of the Upland Area, including soil located beneath remaining concrete foundational elements and at the top of the shoreline bank. The third IA will reduce infiltration resulting in reduced contaminant leaching to groundwater.

Although TPH contamination remains in soil beneath the distribution warehouse at concentrations that exceed criteria for unrestricted land use, the direct contact exposure pathway is incomplete because of the presence of the warehouse building. Residual TPH in soil beneath the warehouse has not resulted in accumulation of free product nor caused dissolved-phase concentrations exceeding groundwater cleanup levels. Hydrocarbon concentrations measured in indoor air and sub-slab soil gas may pose a vapor intrusion risk for potential future commercial or unrestricted use of the warehouse, but not for the current industrial use.

Because Upland Area groundwater is not considered a potential source of drinking water, the potentially complete exposure pathway for Upland Area groundwater to impact human health and the environment is discharge of contaminated groundwater to sediment and surface water of the East Waterway. While there are groundwater metals exceedances in Upland Area shoreline wells, the empirical data from intertidal porewater and seep sampling, most accurately representing groundwater at the point of discharge, indicates that dissolved metals in groundwater do not pose a risk to the East Waterway. Similarly, there are inconsistent, localized, and sporadic groundwater cleanup level exceedances of TPH and polycyclic aromatic hydrocarbons (PAHs) in monitoring wells across the Upland Area but no exceedances in shoreline groundwater or seeps.

Concentrations of un-ionized ammonia above the PCL are present in shoreline groundwater in the northern portion of the Upland Area. NH_3 concentrations were less than the PCL at the six intertidal seep locations sampled, and at the three surface water locations sampled immediately offshore of the Log Pond Area, consistent with those waters being exposed to the atmosphere and thus oxygenated.

Feasibility Study

The FS is used to develop an appropriate final cleanup action for the Upland Area, based on evaluation of a range of cleanup alternatives identified as applicable and technically feasible approaches to achieve the applicable MTCA-required cleanup standards, taking into account the effect of the prior interim actions. The FS follows a streamlined approach in accordance with WAC 173-340-360(3)(d) and identifies a preferred Cleanup Alternative that includes the completed interim actions plus targeted new components, including contingent cleanup actions.

The preferred Cleanup Alternative consists of the following:

- The remedial actions already completed, and the 7.6 acres of cap remaining to be installed as originally described in the second amendment to the Agreed Order
- Capping of the City's Utility Property
- Long-term groundwater compliance monitoring in accordance with a Groundwater Compliance Monitoring Plan approved by Ecology
- Long-term inspection and maintenance of the Upland Area environmental cap in accordance with a Cap Inspection and Maintenance Plan approved by Ecology
- Institutional controls to be articulated in an environmental covenant filed with Snohomish County, which includes preparation of a Soil and Groundwater Management Plan approved by Ecology
- Financial assurances

Depending on the Port's future use of the warehouse, the preferred Cleanup Alternative also includes two contingent cleanup actions:

- If the warehouse is converted to commercial use, construction of a passive vapor barrier across the building's entire first floor; or

- If the warehouse is demolished, excavation and landfilling of TPH-contaminated soils and then capping of the building's footprint.

In addition, the preferred Cleanup Alternative includes a contingent cleanup action for the Snohomish PUD Substation area to be implemented at the time the PUD decommissions the facility.

The preferred Cleanup Alternative protects human health and the environment and complies with the MTCA threshold and additional criteria for selecting a cleanup action, including consideration of public concerns, and potentially affected Indian Tribes, vulnerable populations, and overburdened communities, and is considered permanent to maximum extent practicable, in accordance with WAC 173-340-360. The preferred Cleanup Alternative provides for monitoring to ensure that contaminants in groundwater are not discharging to surface water at concentration that pose a risk to marine receptors and provides for contingent remedial action if monitoring indicates that groundwater discharge poses a risk to the East Waterway.

This Executive Summary should only be used in the context of the full report.

1 Introduction

This report presents the remedial investigation and feasibility study (RI/FS) for the Upland Area of the Kimberly-Clark Worldwide Site, a former pulp and paper mill located at 2600 Federal Avenue in Everett, Washington (herein referred to as the Site; Figure 1-1). This report is prepared for submittal to the Washington State Department of Ecology (Ecology) in accordance with the provisions of Agreed Order No. DE 9476[1] (Agreed Order, as amended) between Kimberly-Clark Worldwide, Inc. (K-C), the Port of Everett, and Ecology. The Agreed Order can be viewed on Ecology's website using the following weblink: https://fortress.wa.gov/ecy/gsp/CleanupSiteDocuments.aspx?csid=2569. Note that all documents referenced throughout this report as being available on Ecology's website can be accessed using the weblink above.

The Site, as defined in the Agreed Order, includes portions of upland and in-water areas (consisting of intertidal and subtidal areas and adjacent marine waters) where hazardous substances have been deposited, stored, disposed of, placed, or otherwise come to be located. The Agreed Order specifically addresses the Upland Area, which is the portion of the Site inland of mean higher high water (MHHW). The In-Water Area, seaward of MHHW, is being addressed under a separate Agreed Order for the East Waterway (Agreed Order No. DE 11350). The investigation and cleanup of the Upland Area are being conducted under the *Washington State Model Toxics Control Act Cleanup Regulation* (MTCA; Chapter 173-340 of the Washington Administrative Code [WAC 173-340]). The Ecology-approved *Work Plan for Remedial Investigation/Feasibility Study for the Upland Area* (RI/FS Work Plan; Aspect, 2013c) presented the detailed scope of work for the RI/FS and can be viewed on Ecology's website.

This report presents information obtained during Upland Area investigations completed between 1989 and 2012, the first interim cleanup action (IA) conducted in 2013-2014, the RI characterization completed between 2013 and 2017 and the second IA conducted in 2020, to provide a comprehensive evaluation of the nature and extent of contamination in order to develop and evaluate appropriate cleanup action alternatives for the Upland Area The first IA, completed in 2013-2014, involved the excavation and off-Site disposal of approximately 38,500 tons of contaminated material. The second IA, completed in 2020, involved the excavation and off-Site disposal of 17,610 tons of contaminated material as well as the inspection, cleaning, and plugging of nearly 20 pipelines, including City of Everett's combined sewer outfall (CSO) pipe and outfall PS04, that discharged to the East Waterway.

In addition to the first two IAs that K-C implemented, the Port completed a third IA in May 2023 that included site grading, construction of a 33-acre low-permeability cap, utility installation, outfall reconstruction, soil and groundwater management, and security fencing installation (Landau, 2024). In addition, the City of Everett (City) constructed a

[1] Including the Second Amendment to Agreed Order No. DE 9476, executed on May 18, 2021.

combined sewer main across the Upland Area, which included the excavation of contaminated soil, geotechnically unsuitable soil, and woody debris (Landau, 2022b).The scope of the third IA and City Combined Sewer Main Improvements (CSI Project) and associated environmental information (i.e., data and observations) collected are discussed in Sections 4.7 and 4.8, respectively, and considered in the evaluation of cleanup alternatives for the Upland Area.

The data presented and evaluated herein include only those data that represent existing conditions within the Upland Area following the three IAs. The reports documenting the construction of the three IAs (Aspect, 2015a; Aspect, 2021; and Landau, 2024) are provided in Appendix A.

2 Site Background and Setting

This section presents an overview of the Upland Area location, history, cultural resources, and environmental setting.

2.1 Location Description

2.1.1 Upland Area Location

The Upland Area comprises approximately 54 acres located in an industrial area on the west side of downtown Everett, Washington (Figure 1-1). The Upland Area includes 12 contiguous tax parcels, which together encompass 54 acres of upland area and approximately 12 acres of adjacent tidelands. The tidelands are addressed as part of the East Waterway cleanup process. All the parcels were previously owned by K-C.

In July 2019, the City purchased from K-C the northernmost 8.9 acres of the Upland Area including the former mill's wastewater treatment infrastructure, referred to by the City as the Utility Property, and herein referred to as the City Utility Property. In October 2019, the Port of Everett purchased from K-C the remaining approximately 46 acres of the Upland Area and 12 acres of adjacent tidelands. Figure 2-1 depicts the current distribution of tax parcels and property ownership within the Upland Area.

In 2014, David Evans and Associates, under contract to K-C, surveyed the southwestern boundary of parcel 29051900300100 in accordance with the legal description, which confirmed that the southwestern parcel boundary has been incorrectly located in Snohomish County's online parcel database. The correct parcel boundary is coincident with the current fence line in that area. The parcel boundary, and thus the boundary of the Upland Area, are shown on figures in this report.

2.1.2 Surrounding Properties

The properties surrounding the Upland Area are briefly described in the following bullets:

- Immediately east of the Upland Area is the BNSF Railway, Inc. (BNSF) railroad mainline, and then West Marine View Drive and Lower Norton Avenue (Figure 2-1).
- The western boundary of the Upland Area is the East Waterway shoreline, which is operationally defined as MHHW. The East Waterway is a dredged waterway within the larger Port Gardner Bay, approximately 2.3 miles south of the mouth of the Snohomish River (Figure 1-1). The East Waterway contains a United States (U.S.) Army Corps of Engineers navigation channel.
- The neighboring property to the north is the U.S. Naval Station Everett.
- Adjacent to the south are multiple industrial properties owned by BNSF, Mobil Oil Corporation, the Ronan C. Bonnie Trust, and the Port of Everett, according to current Snohomish County online records.

2.2 Site History

A detailed cultural and industrial history of the Upland Area and surrounding area is provided in the *Archaeological Resources Assessment for the Kimberly-Clark Worldwide Site Upland Area, Everett, Snohomish County, Washington* (ARA; SWCA, 2013a), which can be viewed on Ecology's website. Additional historical information is available in the Phase 1 Environmental Site Assessment (ESA) conducted for the K-C property (AECOM, 2011). Using that information, and other sources, the following subsections present an overview of the development history of the Upland Area, as well as specific information regarding historical mill operations, facilities, and features of the Upland Area.

Note that the Upland Area has a century-long industrial history, and its most recent facility, K-C's pulp and paper mill, has been demolished with the exception of the distribution warehouse located near the southern property boundary, the electrical substation located in the northeastern portion of the property about 100 feet from the shoreline, and the secondary wastewater treatment area located in the northern portion of the property (Figure 2-2). Consequently, all facilities (excluding the warehouse, electrical substation, and wastewater areas) and operational areas of the Upland Area are now historical and can be referred to as "former"; however, for brevity, the adjective "former" is omitted when referring to the historical facilities and operations.

2.2.1 Early Development History

The area comprising the Upland Area was developed as early as the late 1800s. The Parminter-Robinson mill was the first documented lumber mill within the Upland Area, operating on its northern portion as early as 1892. With development of the larger Clark-Nickerson Lumber Company mill by 1901, Robinson's sash and door plant operations moved onto a parcel immediately to the north. By 1901, Everett housed 9 sawmills and 13 shingle mills; by 1910, there were 11 sawmills and 16 shingle mills. The Clark-Nickerson Lumber Company mill was initially about 46 acres in extent and built primarily on an overwater wharf structure (the approximate footprint of the Clark Nickerson lumber mill is shaded on Figure 2-2). The lumber mill subsequently dredged about 50,000 yards of sediment to create a channel around its wharf. Beginning in 1901, the lumber mill began filling the tidelands around its operations using wood waste materials from the sawmill. By 1901, the Everett Flour Mill Company filled a 50- by 225-foot area of tidelands on the east edge of the Upland Area, on which to construct its flour mill south of the Clark-Nickerson Lumber Company mill. The flour mill structures were dismantled and moved to a new location in 1926. A shipbuilding company (Norway-Pacific Construction and Dry Dock Company) reportedly built a shipyard facility by 1918, located south of the Everett Flour Mill Company's mill between Everett Avenue and 25th Avenue. Shortly following the end of World War I, the shipbuilding plant reportedly shut down without producing a ship, and was dismantled by 1925.

2.2.2 Historical Sanborn Fire Insurance Maps Review

Historical Sanborn Fire Insurance Maps for the Everett area were published for years 1902, 1914, and 1957. The maps are included as an appendix to the ARA Report, which is

included in Appendix B of the RI/FS Work Plan (Aspect, 2013c). A brief description of what is depicted on each map is described below:

1902 Sanborn Map. This map depicts that the shoreline of the Upland Area was initially several hundred feet farther east of its current position. In addition, the northern portion of the Upland Area was occupied by the Clark-Nickerson Lumber Company, and the Everett Flour Mill Company occupied a smaller area south of it. Areas south of the Everett Flour Mill Company were historically occupied by residential structures ("squatters' shacks"). Additional details regarding these facilities are provided in the ARA.

1914 Sanborn Map. This map depicts minor changes in the position of the shoreline. Additional development of both the Clark-Nickerson Lumber Company and the Everett Flour Mill Company, and removal of the majority of the residential structures on the southern portion of the Site, is also depicted. Reportedly, in 1915, the City of Everett passed an ordinance granting Standard Oil Company (now Chevron) permission to construct a fuel storage-tank farm on the south end of the Upland Area; that facility is not apparent on the 1914 Sanborn map, and the date of its construction is uncertain, but a 1930 Great Northern Railway Map shows the Standard Oil tanks present at that time (AMEC, 2010).

1957 Sanborn Map. This map depicts significant development across the Upland Area. The name of the Clark-Nickerson Lumber Company facility had been changed to North Star Lumber Company and included minor developmental changes. The Everett Flour Mill Company facility was no longer depicted on the 1957 map, but the area proximate to the central portion of the Upland Area included significant development and was identified as Soundview Pulp Company. At the south end of the Upland Area, the Associated Oil Company facility was also depicted on the 1957 map and included three aboveground storage tanks (ASTs) with unlabeled capacities located in the asphalt-paved area on the north side of K-C's warehouse building. The position of the shoreline across much of the area has extended hundreds of feet westward relative to the 1914 map, in areas identified as Scott Paper Soundview Division Pulp and Paper Mill. The major placement of dredge fill and westward extension of the Upland Area to accommodate the new mill reportedly occurred in 1929–1930 (Shannon and Wilson, 2014).

2.2.3 History of Pulp and Paper Mill Operations

The Puget Sound Pulp and Timber Company was formed in 1929 and operated the pulp mill until 1932 when the Soundview Pulp Company assumed ownership. The pulp mill produced bleached sulfite pulp and various tissue products, and consisted of five digesters and two pulp drying machines. The Soundview Pulp Company continued operations at the Site and was reportedly the largest single sulfite pulp-producing plant in the world when it merged with Scott Paper Company in 1951. Following the merger, the paper mill was constructed adjacent to the pulp mill, with construction complete in 1954. Four Scott Paper Company machines were added to the facility between 1953 and 1955.

The mill facility also originally contained a log pond that was used for temporary storage of logs that were rafted to the mill and chipped on Site for use in the pulp operations. Wood chipping and log rafting operations were discontinued at the mill in 1970, according to a 1994 Scott Paper Company letter to CH2M Hill. The log pond was reportedly filled

between 1979 and 1981 and was then used to store wood chips for use in pulp and paper operations. Scott Paper Company continued pulp and paper operations at the Upland Area through 1995 when it merged with K-C.

The distribution warehouse located on the south end of the Upland Area was originally constructed by 1959, and a southwestern extension was constructed in the 1970s. In 1974, the mill constructed a sulfite recovery boiler (Boiler No. 10) to recover spent liquor from operations and to combust it for steam generation and the conversion of sulfur dioxide, which was reused in the process. In 1995, five "Dutch Oven" wood-fired boilers were replaced with a new boiler (Boiler No. 14), which is owned by the Snohomish County Public Utility District (PUD). Also in 1995, the Snohomish County PUD built the biomass fuel shipping pier and related conveyors, which were used by the K-C mill as well. Figure 2-2 depicts primary historical features of the pulp and paper mill.

2.2.3.1 Mill Demolition and Placement of Crushed Material

The mill operations were permanently ceased in April 2012. Demolition of the K-C mill started in summer 2012 and was completed in July 2013. Demolition of the mill structures involved generation of a very large quantity of concrete and brick demolition debris (estimated 120,000 cubic yards), which was crushed on site. The crushed material (CM) was then graded across approximately 32 acres of the Upland Area where the mill pavement had been removed. The pavement was not removed within and north of the secondary wastewater treatment area on the north end of the Upland Area (now the City's Utility Property). Additional CM has been documented to have been placed in the southwest corner of the site. This CM was not visible on the surface of the ground because it was covered up with soil. The extent of the placed CM is depicted on Figure 2-4. Temporary erosion and sediment control best management practices were conducted throughout mill demolition in accordance with a Construction Stormwater General Permit and corresponding *Stormwater Pollution Prevention Plan* (David Evans and Associates, 2012).

The complete removal of the CM from the Site in 2020 is described in Section 4.5.

2.2.3.2 Pulp and Paper Mill Wastewater Management

Until 1951, wastewater from the K-C mill, consisting of concentrated spent sulfite liquor (SSL), waste bleach water, and pulp fiber wash water, was discharged untreated to the East Waterway through up to seven outfalls located adjacent to the facility (outfall locations are show in Exhibit A of the Agreed Order). In 1951, the mill constructed a deep water outfall (Outfall SW001), in conjunction with the Weyerhaeuser mill located south of the K-C mill. The Outfall SW001 discharged concentrated SSL from the K-C mill and Weyerhaeuser Mill A westward to the deep waters of Port Gardner Bay.

In 1963, the mill's sanitary effluent was separated from its process effluents and routed to the City of Everett's sanitary sewer system. The wastewater treatment facility, with two primary clarifiers and an interceptor sewer system, was constructed by Scott Paper Company in 1964. In July 1965, the mill put into operation waste sedimentation facilities with two primary clarifiers and an interceptor sewer system. An industrial wastewater treatment plant was constructed at the mill in 1979 and put online in January 1980. The

plant included two secondary clarifiers and secondary aeration basins, from which treated mill wastewater was discharged to the East Waterway through two outfalls located adjacent to the facility (Outfalls 003 and 008) and via the deep-water Outfall SW001 shared with Weyerhaeuser and located southwest of Port of Everett's Mill A Site, more than a mile south of the Upland Area.

In 2004, K-C, with the City of Everett, constructed a deep-water outfall (Outfall 100) to replace deep water Outfall SW001, which was plugged and demolished in the nearshore area. Outfall 100 is located adjacent to decommissioned Outfall SW001 and became fully operational in 2005. Under its National Pollutant Discharge Elimination System (NPDES) permit WA-000062-1, K-C was authorized to discharge treated process wastewater, stormwater, and noncontact cooling water to deep water Outfall 100. Outfall 100 also discharges regional municipal wastewater from the Cities of Everett and Marysville. On September 5, 2012, K-C sent Ecology's Industrial Section a notice of their intent to surrender their NPDES permit WA-000062-1. Ecology's Industrial Section sent K-C correspondence on September 19, 2012, that the NPDES permit was terminated. City of Everett continues their permitted discharges to Outfall 100. K-C was also authorized under the NPDES permit to discharge treated process wastewater, stormwater, and noncontact cooling water from Outfalls 003 and 008 in emergencies and shutdowns.

Figure 2-3 depicts locations of historical underground pipelines and outfalls at the K-C mill, based on an AutoCAD® file prepared by K-C in the 1990s-2000s from available historical maps, and thus representing a historical composite. Numerous changes to subsurface piping occurred at the former mill over its 80-year history, often with limited documentation of older changes, and because the mill demolition contract specifications required that all mill infrastructure in the upper 2 feet (and some at greater depths) be removed during the 2012-2013 mill demolition. Some piping shown may have been removed during mill operations, without documentation, and some piping was also removed during the two interim actions (see Sections 4.1 and 4.3). Consequently, Figure 2-3 displays piping that once existed, but it is not necessarily representative of current conditions.

2.2.3.3 Pulp and Paper Mill Hazardous Waste Management

The pulp and paper mill was a large-quantity generator of hazardous waste (Resource Conservation and Recovery Act [RCRA] ID number WAD009250820) from the early 1980s until its closure in 2012. The mill was never a hazardous waste Treatment, Storage, and Disposal Facility (TSDF) under RCRA. The mill's 90-day Hazardous Waste Accumulation Unit (HWAU, also known as "haz waste cage") was a secure storage unit in which hazardous and nonhazardous waste materials generated at the mill were temporarily stored prior to proper off-Site disposal. The HWAU is located on the southeast corner of the former log pond and is shown on Figure 2-2 (co-located with item number 12 in the legend). Prior to closure, K-C accumulated waste materials within the HWAU for periods of less than 90 days and handled and disposed of the wastes in accordance with applicable requirements of the *Washington State Dangerous Waste Regulations* (Chapter 173-303 WAC). One of the final steps in mill demolition was to conduct clean closure of the HWAU, as described in the RCRA Closure Report for the mill (Aspect, 2013b). This report can be viewed on Ecology's website using the link provided in Section 1.

In addition to describing closure of the HWAU, Appendix A to the RCRA Closure Report summarizes the mill's historical hazardous waste management, as well as Ecology's dangerous waste inspection during the mill closure activities, which concluded that waste management activities were being conducted in conformance with state Dangerous Waste Regulations requirements (Ecology, 2012b). That appendix also includes maps depicting locations of hazardous substance use/storage dating back to the early 1980s. That historical information has been incorporated into this RI/FS report. Specifically, Figure 2-2 depicts historical features of the pulp and paper mill, including labeling of the mill buildings; it also depicts locations where hazardous substances were used and/or stored within the mill, as identified from the historical maps. Appendix C of the RI/FS Work Plan (Aspect, 2013c) includes annotated copies of historical maps that were sources for the hazardous substance locations depicted on Figure 2-2.

2.2.4 History of Bulk Fuel Storage and Distribution

The southern portion of the Upland Area was partially developed by 1930, including two bulk petroleum product tank farms and smaller petroleum product storage and distribution facilities with associated railroad spurs owned by Tidewater/Associated Oil Company (predecessor to Texaco) and by Standard Oil/Chevron (Figure 2-2).

The Tidewater/Associated Oil Co. facility was located near the northwest corner of the current distribution warehouse. Several ASTs, located immediately north of the distribution warehouse, were used for the storage of gasoline and fuel oil (Figure 2-2). The Tidewater/Associated Oil Co. facility was purchased by the Scott Paper Company in 1957. Scott Paper used the ASTs for storage of Bunker C fuel oil (to fire the mill's boilers) until 1995, when K-C converted to biomass fuel for the boilers with diesel fuel as a backup fuel source. The ASTs located north of the warehouse were removed by the late 1990s. K-C's diesel fuel was stored in an AST with secondary containment just north of the warehouse's northeastern corner.

The Standard Oil facility was located south of the Associated Oil facilities, within the current distribution warehouse footprint, and included at least seven ASTs that were used for the storage and distribution of fuel oil, according to Sanborn Fire Insurance maps dated 1950 and 1957. The original distribution warehouse was constructed by 1959. The Standard Oil/Chevron property was reportedly purchased by the Scott Paper Company in 1967, after which a southwestern extension to the distribution warehouse was added in the 1970s.

2.2.5 Naval Reserve Property

In the mid-1990s, K-C made a property exchange to acquire the Naval Reserve Property, located just south of the wastewater treatment plant. The property structures, including offices, garage, boiler room, flammable storage shed, diesel underground storage tank (UST), gasoline UST, machine/wood shop, classroom, and a firing range, were removed at that time. Prior to the property exchange, the U.S. Navy identified and remediated some contaminated soil attributable to their uses of the property, as described in Section 3.1.7.

2.3 Cultural Resources

Ecology is working with landowners/stakeholders including local Native American Tribes to clean up contaminated sites and sediments in the vicinity of the Port Gardner Bay area and the Snohomish River Estuary. Port Gardner Bay is identified as a high-priority "early-action" cleanup area under the Puget Sound Initiative (PSI). The Site has been identified as a cleanup site under the PSI. Local Tribes that have been actively engaged by Ecology under the PSI at Port Gardner include the Tulalip, Suquamish, Swinomish, and Lummi. Ecology has worked with a tribal liaison to assist in developing contacts and early engagement with cultural and natural resource departments within each of the aforementioned Tribes. Engagement with the Tribes has consisted of meetings to discuss PSI cleanup sites and cultural resources, providing the Tribes with draft work products for early input, and providing them with updates containing the current status of each PSI site, near-term work products for tribal review, project schedules, and a summary of tribal engagement for the Port Gardner PSI sites.

Based on Ecology's discussion with the Tribes and information provided in a 1973 Historical Survey of Everett (Dilgard and Riddle, 1973), people have inhabited the Port Gardner Bay area for thousands of years. For centuries, the northwest point of the peninsula (i.e., Preston Point) was the site of Hibulb, the principal village of the Snohomish Tribe. The village's location near the mouth of the Snohomish River and next to Port Gardner Bay provided both abundant food and transportation. Native Tribes used the Everett shoreline in part for subsistence activities such as shellfish collection, hunting, plant gathering, and fishing. According to local Tribes, native long houses were located up and down the Everett waterfront. Local Tribes have communicated to Ecology that the Everett waterfront is a culturally sensitive area.

SWCA prepared an ARA that provides additional details regarding cultural resources in the Upland Area vicinity (SWCA, 2013a), as well as an Inadvertent Discovery Plan in support of the Upland Area IA (SWCA, 2013b). Appendix B to the RI/FS Work Plan (Aspect, 2013c) includes the ARA and Inadvertent Discovery Plan.

2.3.1 Archaeological Monitoring During Interim Actions

In accordance with the Inadvertent Discovery Plan (SWCA, 2013b), archaeological monitoring was conducted by qualified personnel during the 2013–2014, 2020, and 2021–2023 IA excavation work described in Sections 4.1, 4.3, and 4.8, respectively.

2.3.1.1 First Interim Action (2013-2014)

During the 2013-2014 IA, qualified personnel from SWCA Inc., under subcontract to Aspect, conducted archaeological monitoring during excavation of the Bunker C ASTs area located in the eastern portion of the Upland Area, where fill thickness is less and penetration into the underlying native soil was possible. The excavation appeared to remain within hydraulically placed dredge fill material, and no archaeological sites were identified by SWCA. A small, deeper excavation for installation of a dewatering sump in the northeastern corner of the excavation encountered apparent native organic-rich silt at a depth of approximately 11 to 12 feet. During excavation, a shelly deposit was observed, which required a work stoppage and further investigation by SWCA to determine if it was

an archaeological midden; however, the SWCA archaeologists on-Site determined that the shelly deposit did not contain intact midden. Nonsignificant historical remains (e.g., pilings supporting a former fuel AST) were also observed.

As documented in the Interim Action Report (Aspect, 2015a), one lithic artifact, an edge-altered cobble, associated with a few fire-modified rocks, was identified within the dredge fill, which also required a work stoppage for investigation by SWCA. Identification of the cobble and its association with fire-modified rocks warranted recording the artifact as an isolate. SWCA retained the isolate in curation until the end of the IA, and then donated it on K-C's behalf for permanent curation at the Tulalip Tribe's Hibulb Cultural Center and Natural History Preserve, which is a certified collections and archaeological repository. The isolate was also recorded with the state Department of Archaeology and Historic Preservation (DAHP), as required by law. SWCA's cultural resource monitoring report for the first IA has been provided to DAHP and Ecology; however, state law restricts public disclosure of the locational information regarding the artifact.

2.3.1.2 Second Interim Action (2020)

During the 2020 IA, archeological monitoring was conducted by Perteet Inc., under subcontract to Aspect, during excavation of the Hydraulic Barker Area and the Central Maintenance Shop Area (see Section 4.3), where penetration into underlying native soil was possible. In both excavation areas, archeological monitors observed and documented structural remains and building debris associated with historical mill operations. Identified structural remains were located within historical fill and no evidence of intact cultural remains within native sediment was observed. No precontact artifacts or buried surfaces were observed during monitoring. A cultural resource monitoring report for the second IA was provided to DAHP and Ecology (Aspect, 2021).

2.3.1.3 Third Interim Action (2021-2023)

Archaeological monitoring was conducted by Cultural Resource Consultants during portions of the 2021-2023 interim action, where there was a moderate potential for encountering buried cultural resources. A cultural resource monitoring report of the third IA is included as Appendix G to the Final Construction Report (Landau, 2024). Potential buried archaeological resources were not identified during the third IA (Cultural Resource Consultants, 2022).

2.4 Environmental Setting

This section describes the environmental setting of the Upland Area, including topography, climate, hydrogeology, and ecological setting.

2.4.1 Topography

The Upland Area topography is generally flat with a gentle westward slope toward the Waterway. Within the Port property there is centralized depression that is designed to direct stormwater inward, away from the shoreline, to infiltrate into the existing fill material (prior to completion of the third IA). Ground surface elevations within the Upland Area range from approximately 18 feet above North American Vertical Datum of 1988

(NAVD88) (20 feet above mean lower low water [MLLW][2]) along the eastern boundary to approximately 15 feet NAVD88 (17 feet MLLW) on the western boundary, with a few feet of variation across the area.

Following completion of the third IA, the site within the Port's property will be paved and graded to direct stormwater to the new stormwater filtration systems.

2.4.2 Climate

The climate of the Everett area is maritime, characterized by cool summers and mild winters influenced by ocean air. The average annual minimum temperature is 42.6 degrees Fahrenheit, and the average maximum temperature is 59.1 degrees Fahrenheit (Western Regional Climate Center, 2012). The average annual precipitation in Everett is 36.7 inches, with greater than 4 inches of precipitation per month from November through January.

2.4.3 Ecological Setting

The information regarding the Upland Area's ecological setting presented in this section was obtained from the *Habitat Assessment for the Kimberly-Clark Everett Mill Site Demolition Project*, which was prepared prior to mill demolition (Anchor QEA, 2012).

The western boundary of the Upland Area is adjacent to the marine environment of the East Waterway in Port Gardner Bay of Possession Sound, which is mapped by the U.S. Fish and Wildlife Service as E1UB (Estuarine Subtidal Unconsolidated Bottom) habitat. The Upland Area shoreline is a bulkhead comprised mostly of riprap, chunks of concrete, and large rock material, with some wood bulkhead located on the north end. Wetlands, streams, or drainage channels are not present within the Upland Area.

Upland vegetation is limited to a narrow strip of grass, trees, and shrubs associated with a former walking trail inland of the bulkhead shoreline. Plant species include western red cedar and the nonnative species Himalayan blackberry and butterfly bush. Wildlife species on the Site include bird species common in urban areas of Snohomish County: crows, house sparrows, black-capped chickadees, terns, gull species, and a nesting pair of ospreys. No amphibian, reptile, or mammal species, tracks, or signs were observed in a Site reconnaissance by Anchor QEA. Terrestrial wildlife species including rabbits, nutria, and coyotes are occasionally observed on the Site.

The adjacent East Waterway offshore of the Upland Area is identified as Dungeness crab priority habitat. Areas in Port Gardner Bay are also identified by the City of Everett and the Washington Department of Fish and Wildlife (WDFW) as haul-out areas for California sea lions and harbor seals, regular large concentrations of waterfowl (e.g., ducks, herons, gulls, and terns), and intertidal hard-shell clam areas. Harbor seals are also commonly observed on log booms located near the shoreline of the Upland Area.

No Endangered Species Act-listed animal species are known to occur within the Upland Area. The five Endangered Species Act-listed terrestrial species within Snohomish County

[2] In Everett, the MLLW datum is 2.3 feet lower than the NAVD88 datum, i.e., elevations relative to MLLW are 2.3 feet higher than relative to NAVD88.

(Canada lynx, gray wolf, grizzly bear, marbled murrelet, and northern spotted owl) are all associated with habitat that includes large undeveloped areas, which do not occur on or near the Upland Area. Based on the Washington Nature Mapping Program, potential habitat for these five species, and critical habitat for the northern spotted owl and marbled murrelet, is not present within 20 miles of the Upland Area.

Many of the twelve ESA-listed aquatic species identified in Snohomish County[3] are known to occur in Possession Sound. However, only a few of the twelve species are likely to occur within the narrow and relatively shallow water of the East Waterway. The marine mammal and sea turtle species (humpback whale, killer whale, Steller sea lion; and leatherback sea turtle, respectively) typically occur in the deep-water habitat of Puget Sound and could occur in Possession Sound offshore of the Upland Area, but are very unlikely to occur in the East Waterway adjacent to it. Chinook salmon, steelhead, and bull trout occur in Possession Sound and are likely to migrate near the East Waterway shoreline. The fish species bocaccio, canary rockfish, green sturgeon, Pacific eulachon, and yelloweye rockfish are associated with deep-water habitats of Puget Sound and typically breed and forage near the ocean floor. Adults of these species are very unlikely in the marine environment of the East Waterway. Juveniles of these species do migrate in nearshore habitats and could occur in the adjacent offshore habitat.

Overall, the Upland Area is completely developed with vegetation limited to a narrow patch of landscaped trees, shrubs, and managed grass along a shoreline walking trail. The limited vegetation represents low-quality wildlife habitat. Wildlife use of the terrestrial habitat is likely dominated by disturbance-tolerant species typical of urban areas. The adjacent marine habitat provides foraging habitat for waterfowl and other birds and aquatic species typically found in the marine environment of Puget Sound. Habitat surrounding the Upland Area includes fragmented and disturbed areas associated with industrial development.

2.4.4 Hydrogeology and Groundwater Flow

2.4.4.1 Stratigraphy

A wedge of fill, generally thickening from east to west, comprises the shallow subsurface soils across the Upland Area. Beginning in the very late 1800s, fill was placed on the East Waterway tidal flats to create new upland in the northeastern-most portion of the Upland Area, as described in Section 2.2. The vast majority of the Upland Area was created by hydraulic placement of dredged fill predominantly in 1929-1930, with placement of additional fill beneath the current dock structure in 1954. The fill thickness generally ranges from about 15 to 40 feet thick from east to west across the Upland Area (Shannon and Wilson, 2014).

Based on extensive subsurface drilling during the Phase 2 ESA and RI, and the IA excavations, the fill has variable composition, predominantly including sand and silty sand showing stratification and containing shell fragments (dredge fill), and localized

[3] Chinook Salmon, Puget Sound Steelhead, Bocaccio, Canary Rockfish, Green Sturgeon, Pacific Eulachon, Yelloweye Rockfish, Bull Trout, Orca, Leatherback Sea Turtle, Humpback Whale, and Stellar Sea Lion.

occurrences of gravel, concrete, brick, wood, and charcoal debris, and wood chips/sawdust. Figures 2-5 through 2-7 are east-west-trending geologic cross sections across the Upland Area; Figure 2-4 shows locations of the cross sections along with the Upland Area explorations used to prepare the cross sections. Explorations logs from the collective Upland Area explorations used in the RI are provided in Appendix B.

Beneath the fill is native Snohomish River alluvium, the same material (interbedded sand and silt) that was hydraulically placed as dredge fill. Glacially overridden soils are present at depths ranging from about 30 to 60 feet beneath grade in the eastern portion, and sloping to depths ranging from 90 to 120 feet below grade beneath the western portion of the Upland Area (Shannon and Wilson, 2014).

Within the west-center portion of the Upland Area, the historical Log Pond was filled between approximately 1979 and 1981 to create upland for storage of wood chips produced at Scott Paper's Riverside facility in east Everett. The subsurface explorations drilled within the Log Pond footprint indicate its fill soil is siltier than the dredge fill soil present across most of the rest of the Upland Area. A former Scott Paper employee stated that he had witnessed construction/demolition debris (originating outside the mill property), debris from the mill, and barrels (drums) be placed within the eastern portion of the Log Pond during its filling. Based on investigations within the Log Pond, the silty fill soil contains demolition debris including concrete rubble, wood (including burnt), metal, and brick. However, the collective information collected (e.g., see Section 4.2.7), including a surface geophysical survey across the entire area, test trenching in one area, drilling of 13 shallow soil borings, 13 deep borings, 4 shallow monitoring wells, and 5 deep monitoring wells, and soil and groundwater sampling and analysis provides no evidence for buried containers of chemicals within the Log Pond fill soil. Beneath the Log Pond fill, which was observed to range in thickness from 29 to 46 feet, a sawdust layer, ranging in thickness from about 2 to 10 feet, was encountered overlying native soil, as discussed further in later sections of this report. Native soil in the Log Pond was observed at depths ranging from 29 to 52 feet bgs.

2.4.4.2 Groundwater Flow System

A shallow unconfined (water table) water-bearing zone occurs within the fill, overlying the underlying siltier native tidal flat deposits. The water table within the fill is relatively shallow, generally ranging in depth from 1 to 4 feet below grade in the Upland Area's eastern areas to 6 to 12 feet below grade in its western areas. Consequently, groundwater flows generally from east to west across the Upland Area, with discharge to the East Waterway; however, depending on the alignment of the shoreline, groundwater directions may flow locally toward the northwest or southwest. For example, in the south end of the Upland Area, groundwater locally flows to the southwest toward the off-loading dock slip. Because of its geometry extending inland, the slip is an area of converging groundwater flow and thus substantial groundwater discharges to it from both the Upland Area and the Port of Everett property on its south side. During calm (not windy) conditions at lower low tide, subtidal groundwater discharge has been observed as subtle ripples on the water surface along the south end of the slip.

2.4.4.2.1 Pre-RI Water Level and Tidal Study Data

During the Phase 2 ESA (Aspect, 2013a), water level measurements were collected during February, July, and September 2012 from a variable number of Upland Area monitoring wells existing at the time. This included (elevations relative to NAVD88 vertical datum):

- A low-tide set of groundwater level measurements was collected in the existing six monitoring wells on February 17, 2012, just before a low tide of elevation approximately -2 feet;
- A low-tide set of groundwater level measurements was collected from 35 wells on July 3, 2012, shortly after a low tide of elevation approximately -5 feet, and a high-tide set of measurements was collected on July 6, 2012, shortly after a high tide of elevation of approximately 10 feet; and
- A low-tide set of groundwater level measurements was collected from 49 wells on September 14, 2012, shortly after a low tide of elevation approximately -1 feet, and a high-tide set of measurements was collected on September 13, 2012, shortly before a high tide of elevation approximately 8 feet.

Table B-1 in Appendix B presents the collective groundwater level data, along with monitoring well survey data, for the Upland Area monitoring wells.

Groundwater in the fill is hydraulically connected to the East Waterway, and tidally induced water table fluctuations near the East Waterway range between about 2 and 7 feet depending on the location, based on data from the tidal study data conducted in 2012 as part of the independent Phase 2 ESA (Aspect, 2013a).

The Upland Area tidal study was conducted over a period of large tidal fluctuations (maximum of approximately 15 feet) to evaluate effects of tidal fluctuations on nearshore groundwater levels, and thus flow directions, throughout the tidal cycle. The tidal study was conducted July 3 through 6, 2012, and involved the collection of continuous water level measurements throughout a 72-hour period at 12 upland monitoring wells (Figure 2-4): shoreline wells REC7-MW-1, REC7-MW-2, MW-6, UST70-MW2, REC7-MW-3, and REC7-MW-4, and inland wells NRP-MW-4, UST69-MW-1, AP-MW-1, REC5-MW-1, UST68-MW-1, and UST-68-MW-5. Tidal fluctuations in the East Waterway were also measured throughout the 72-hour period (station TM-1 depicted on Figure 2-9). Figure 2-8 depicts the tide and groundwater elevations over time collected during the 72-hour tidal study.

During that 72-hour tidal study, wells located within about 100 feet of the shoreline showed clearly identifiable tidal response, with average tidal efficiencies[4] ranging from 0.08 to 0.69, and tidal lag times[5] ranging from 0.6 to 2.5 hours (Table 2-2). The tidal efficiencies and lag times presented in Table 2-2 represent the arithmetic average of water level responses measured during one major falling tide, one major rising tide, one minor

[4] "Tidal efficiency" is the ratio of the groundwater elevation change to corresponding tide elevation change.
[5] "Tidal lag time" is the time difference between tide elevation peak and corresponding groundwater elevation peak.

falling tide, and one minor rising tide during the three-day monitoring period. Wells located 200 feet or more from the shoreline did not show a significant tidal response. Well NRP-MW-4, located roughly 400 feet from the shoreline, exhibited small-scale cyclical water level fluctuations (Figure 2-8). However, the fluctuations do not appear to be in response to tides since there is no consistency in timing of groundwater level peaks compared to tide peaks (in fact, there are more groundwater level peaks than tidal peaks in the period of monitoring), and the groundwater level fluctuations are uniform in magnitude regardless of the magnitude of tidal fluctuation (e.g., between low tide and lower-low tide).

Of the six shoreline wells monitored for the tidal study, the largest groundwater fluctuations (greatest tidal efficiencies) were observed in the southernmost wells REC7-MW-4 and REC7-MW-3 located adjacent to the slip (approximately 6.9 and 5.1 feet of fluctuation, respectively). Groundwater levels in both wells show a gradual draining as the tide recedes and a rapid rise as the tide rises above the respective water table elevations (Figure 2-8). To the north along the shoreline, maximum groundwater fluctuations of approximately 1.2, 1.1, and 1.9 feet were measured in shoreline wells UST70-MW-2, REC7-MW-2, and REC7-MW-1, respectively. Shoreline well MW-6, located within the footprint of the former Log Pond, showed little fluctuation (approximately 0.3 feet) and with no apparent tidal signature (Figure 2-8). Likewise, well REC6-MW-2, located within the Log Pond footprint north of MW-6 exhibited water level changes of less than 0.2 feet between low-tide and high-tide measurements made in both July and September 2012 (full water level data presented in Table B-1 of Appendix B). The lack of tidal response in shoreline wells MW-6 and REC6-MW-2 is consistent with the low permeability of the Log Pond fill.

The tidal study data were analyzed using the method of Serfes (1991) to derive a 72-hour tidally averaged groundwater elevation for each monitoring location. The tidally averaged groundwater elevations, mapped on Figure 2-8, were then used to assess the net (tidally averaged) groundwater flow direction and hydraulic gradients. While nearshore groundwater flow directions reverse diurnally with the tide, the tidally averaged groundwater flow directions along the shoreline of the Upland Area are toward the west with the expected net discharge to the East Waterway (Figure 2-9).

Since that study, numerous additional monitoring wells have been installed in the Upland Area and more robust groundwater elevation contour maps developed from the more recent data, as described below.

2.4.4.2.2 RI Water Level Data

As part of the RI data collection, groundwater level measurements were collected from all accessible Upland Area monitoring wells during the middle of the tidal range during two different seasonal conditions: from 71 existing monitoring wells on November 26, 2013, and from 103 wells on May 8, 2014 (after installation of the 36 new wells for IA confirmation groundwater monitoring). A supplemental round of Site-wide water levels was also collected from 102 wells on February 8, 2016. In March 2017, during the wettest wet season on record, water level measurements were collected in 68 wells during a groundwater sampling event representing extreme wet season conditions. Figures 2-10,

2-11, 2-12, and 2-13 are water table elevation contour maps with inferred groundwater flow directions from the November 2013, May 2014, February 2016, and March 2017 and March 2017 measurements, respectively. Given the large number of wells measured, these data sets provide the most complete picture of water table elevations and thus interpreted groundwater flow directions for the fill aquifer system within the Upland Area.

Apart from the Site-wide measurements, water level data were also collected in wells being sampled during quarterly groundwater monitoring events for the IA confirmation groundwater monitoring program (August and November 2014, February and November 2015, and May and August 2016) and in July and September 2017. Water levels were also measured in the five monitoring wells sampled at the end of September 2015. These data are presented in Table B-1 of Appendix B. However, data during the groundwater sampling events were collected over a few days and at variable tidal stages, so were not a Site-wide "snapshot" of water levels like the November 2013, May 2014, February 2016, and March 2017 data sets.

Consistent with the prior data, the recent groundwater elevation contour maps indicate the expected general east-to-west groundwater flow directions across the Upland Area, with discharge to the East Waterway, but with localized flow direction variations.

SEASONAL AND LONGER-TERM GROUNDWATER LEVEL CHANGES

The groundwater levels across the Site show significant seasonality, with approximately 1- to 3-foot higher water levels in the wet season than occur in the dry season. Figure 2-14 depicts the measured change in water levels relative to a September 2012 baseline for five wells that are distributed throughout the inland portion of the Upland Area and having long-term monitoring records[6]. Because some wells were decommissioned during mill demolition, data from proximate paired wells are combined to achieve the long-term record (e.g., wells MW-4 and BCT-MW-108).

In addition to seasonal changes, the water table beneath the Upland Area has risen somewhat following completion of mill demolition in 2013. The water table rise is attributable to the Spring 2013 removal of approximately 32 acres of impervious surfaces that covered the mill property (impervious surface remains in the northern part of the property). Precipitation that prior to demolition ran off impervious surfaces as stormwater now infiltrates into the permeable surface of crushed material covering the 32 acres.

The longer-term rise is more apparent in wet season (high) water levels, whereas dry season levels appear more consistent over time. Wet season water level data collected prior to demolition are only available for two inland wells[7]: February 2012 measurements from former wells MW-3 and MW-4 located in the former Bunker C Above Ground Storage Tank (AST) area immediately north of the warehouse (their data are the two dashed lines on Figure 2-14).

[6] Shoreline wells are excluded from the analysis since their measurements were commonly collected at variable low tide levels (for sampling), which introduces bias when evaluating a long-term change for the Upland Area average condition.
[7] And from four shoreline wells (MW-1, MW-2, MW-5, and MW-6; Table B-1 in Appendix B).

As an illustration of the rise in wet season water levels following mill demolition, the top plot on Figure 2-15 depicts wet season water levels for those two wells from February 2012, 2015, and 2016, and March 2017. Between February 2012 and March 2017, the wet season groundwater level in the area of those wells rose on average about 1.4 feet.

There are multiple wells with wet season water level data over time following demolition that, on average, also illustrate the long-term water level rise. The bottom plot on Figure 2-15 depicts changes in wet season water levels relative to the first wet season measurements following demolition (February 2014) for ten wells having data from February 2014, February 2016, and March 2017; there are no wells with data for those events plus February 2015. The magnitude of change varies between wells, but, on average, groundwater levels across the Upland Area are approximately 0.7 feet higher in March 2017 (44 months after removal of Site impervious surfaces) than in February 2014 (8 months after impervious removal). Note that the March 2017 data were collected toward the end of the wettest wet season on record for the Puget Sound region, which is reflected by the increased rates of rise between February 2016 and March 2017.

WATER LEVELS WITHIN LOG POND FILL

Within the footprint of the former Log Pond, the water level data from wells LP-MW-1 and LP-MW-2 demonstrate significantly higher water table elevations than in surrounding wells during wet-season measurement events (Figures 2-10 through 2-13). The apparent cause for the water table mound is that the Log Pond fill is considerably siltier, and thus considerably lower permeability, than the dredge fill throughout much of the rest of the Upland Area, as documented by the numerous subsurface explorations drilled in, and by hydraulic conductivity testing of, the Log Pond fill soils (discussed in Section 2.4.4.2.3). The low permeability of the fill is also consistent with lack of tidal response[8] observed in shoreline wells within the Log Pond footprint.

The water levels in wells LP-MW-1 and LP-MW-2 exhibit considerable seasonality over the complete period of monitoring: for example, maximum fluctuations of 5.5 and 7.7 feet in wells LP-MW-1 and LP-MW-2 respectively, compared to 2.1 feet of maximum fluctuation in well GF-MW-2 located just south of the Log Pond (data in Table A-1). It appears that the low permeability of the Log Pond fill reduces the rate of recharge infiltration, reflected as high (mounded) groundwater elevations in the wet season, which then decline greatly by the peak dry season.

Vertical hydraulic gradients between the uppermost part of the Log Pond fill and the underlying sawdust unit can be calculated using 2017 water level data from two pairs of wells: LP-MW-1 (fill) and LP-MW-3 (sawdust) near the center of the Log Pond, and MW-6 (fill) and LP-MW-7 (sawdust) located at the shoreline. The vertical gradients are calculated as the differences in groundwater elevations divided by the difference in midpoint elevations of the well screens for the paired shallow/deep wells at each location. Following installation of the deep wells in June 2017, water level data are available from

[8] The magnitude of tidally induced groundwater level fluctuation ("tidal efficiency") in a well is proportional to the hydraulic conductivity of the aquifer between the well and the tidal interface (Ferris, 1963).

July and September 2017 and the following vertical gradients calculated within the Log Pond (Table 2-1):

- Inland well pair (LP-MW-1/LP-MW-3). Downward vertical gradients are calculated during both monitoring events (0.17 ft/ft and 0.06 ft/ft downward in July and September, respectively), with an average of 0.12 ft/ft downward; and
- Shoreline well pair (MW-6/LP-MW-7). Vertical gradients change from upward (0.014 ft/ft) in July 2017 to downward (0.0026 ft/ft) in September 2017; the average of the two values is 0.006 ft/ft in an upward direction.

The lower-magnitude vertical gradients relative to the inland location, and the change from slight upward to very slight downward gradients, measured at the shoreline is consistent with groundwater approaching the surface water interface.

2.4.4.2.3 Hydraulic Conductivity Estimates

TIDAL STUDY-BASED ESTIMATES FOR FILL OUTSIDE OF LOG POND

Hydraulic conductivity (K) of the fill unit outside of the Log Pond was estimated from the tidal study data, using the stage ratio and time lag methods of Ferris (1963). The Ferris (1963) methods are intended to provide a K estimate representing the entire fill unit between the well and the tide (area of groundwater discharge to the East Waterway). The Ferris methods were developed for confined aquifer conditions, but can be applied for unconfined aquifers if the observed tidal fluctuation in the aquifer is relatively small compared to the aquifer thickness, and the observation well is far enough from the submarine outcrop so that vertical flow is not a significant component of the flow path (Millham and Howes, 1995). Because the fill unit is on the order of 40 feet thick along the shoreline, these conditions are considered to be met sufficiently to use the methods to estimate K. Groundwater levels within the Log Pond show negligible tidal influence, so this method could not be applied to the Log Pond fill.

The stage ratio method uses the tidal efficiency measured at a well and the distance between the well and the tide (point of discharge) as key input data. The time lag method uses the tidal lag measured at a well and the distance between the well and the tide as key input data. In each calculation, the tidal period for the semidiurnal Puget Sound tides is 12.4 hours, and the aquifer thickness at each well was estimated as an assumed 40-foot depth for the bottom of fill (near the shoreline, based on the geologic cross sections) minus the average measured depth to water below grade for the various water level measurements at the well. The aquifer storage coefficient (specific yield for unconfined aquifer) for the reworked alluvial materials was estimated as 0.1 based on the following literature estimates and best professional judgement:

- United States Geological Survey (USGS, 1966) estimates for various facies of unconsolidated alluvium: 0.04 for silt; 0.16 for very fine sand; 0.23 for fine sand.
- A model-calibrated value (0.02) for dredge fill at the Port of Seattle's Terminal 30 (S.S. Papadopoulos and Associates, 2006).
- A USGS (2003) estimate (0.13) for an alluvial aquifer in California.

Tidal study data from nearshore monitoring wells REC7-MW-1, REC7-MW-2, REC7-MW-3, REC7-MW-4, UST68-MW-5, and UST70-MW-2 (Figure 2-8) were determined to exhibit suitable tidal response to allow application of the Ferris (1963) methods. Because Upland Area groundwater's highest beneficial use is discharge to the East Waterway, it is appropriate to focus the K estimates on the shoreline area. Table 2-2 presents the input data and the resulting K estimates for the six wells. The average (geometric mean) of the K estimates from the two methods represents a best-estimate K value for each well.

The estimated K ranges from 5×10^{-4} centimeters per second (cm/sec) at REC7-MW-1 in Unit E to 3×10^{-2} cm/sec at UST70-MW-2 in Unit B[9] (Table 2-2). This K range, and a site-wide geometric mean K of 5×10^{-3} cm/sec from the six wells' estimates, are considered reasonable for the sandy dredge fill comprising the bulk of the Upland Area fill unit.

SLUG TESTING FOR LOG POND FILL AND SAWDUST UNIT

Because tidal response was not observed in Log Pond shoreline wells, the tidal study method for estimating K specific to the Log Pond fill could not be conducted, as stated above. Therefore, slug tests were performed to estimate K for subsurface materials in the Log Pond area, in accordance with Aspect (2017b). Slug tests were conducted in wells LP-MW-2, LP-MW-4, and REC6-MW-2 screened in the Log Pond fill, and wells LP-MW-3, LP-MW-5, LP-MW-6, and LP-MW-7 screened across the deep sawdust layer. Except for well LP-MW-2, two or three tests (rising and falling head) were conducted in each well and the average K from the replicate tests were used to represent K for that location. Because of the very long water level recovery during testing of well LP-MW-2, only one test was conducted for that well. A geometric mean K was then calculated for the Log Pond fill and for the sawdust layer hydrostratigraphic units using the respective well estimates. Table 2-3 presents the slug test analysis parameters and results for the Log Pond wells.

The geometric mean K for the Log Pond fill is 8×10^{-5} cm/sec, approximately 70 times lower than the Site-wide average K for the dredge fill outside of the Log Pond. The low K is consistent with the generally siltier fill material observed within the Log Pond.

2.4.4.2.4 Groundwater Velocity Estimates

The K estimates can be used, with measured nearshore tidally averaged hydraulic gradient and estimated effective porosity, to estimate horizontal average linear (seepage) groundwater velocities for the nearshore portion of the Upland Area. A groundwater seepage velocity for the shoreline area is calculated using Darcy's Law of the form:

$v = K * I / n_e$, where:

- v = seepage velocity (feet/year);
- K = hydraulic conductivity (feet/year);

[9] For purposes of the RI/FS data analysis as described in Section 6.2, the Upland Area is divided into five Units A through E, from south to north (see Figure 2-3).

- I = tidally averaged horizontal gradient (feet/foot); and
- n_e = effective porosity (dimensionless).

A groundwater seepage velocity is calculated for fill unit within each Unit, and for the Log Pond fill and sawdust layer, using the average K value and hydraulic gradient for the Unit, as presented in Table 2-4. A Darcy velocity (also known as specific discharge), for use in volumetric flux calculations, is also calculated for each Unit by not including effective porosity in the equation. The average K values by Unit were derived as described above and are presented in Tables 2-2 and 2-3. An average hydraulic gradient along the shoreline of each Unit was calculated based on the tidally averaged (net) groundwater elevation contours presented on Figure 2-9. To calculate an average gradient for each Unit, the horizontal distance between the tidally averaged groundwater elevation contour located closest to the shoreline and the next groundwater elevation contour inland was calculated at 25-foot increments along the higher groundwater elevation contour. The gradient for each point was then calculated as the 1-foot elevation difference divided by the horizontal distance, and the average of the 25-foot point measurements within each Unit is applied as the average gradient for the Unit. The nearshore gradient within the Log Pond fill was calculated as the average of the tidally averaged groundwater elevations for wells REC6-MW-2 and MW-6 as depicted on Figure 2-9. The nearshore gradient for the Log Pond sawdust layer was calculated the difference between shoreline well LP-MW-7 groundwater elevation and the average tide elevation for a 2-day period in which the groundwater measurement was collected, averaged for the July and September 2017 groundwater measurements. Table 2-4 presents the tidally averaged hydraulic gradient for the fill unit in each Unit and for the Log Pond hydrostratigraphic units.

Applying the Unit-specific average K and gradient estimates, and an assumed site-wide effective porosity of 0.2 based on literature values, the Upland Area groundwater seepage velocities in the fill unit outside of the Log Pond are estimated to range from 3 feet/year in Unit E to 100 feet/year in Unit B, with the variation due primarily to the K difference. The corresponding Darcy velocity estimates range from 1 cubic feet/square foot per year (ft^3/ft^2-year) in Unit E to 20 ft^3/ft^2-year in Unit B. Within the former Log Pond, the estimated groundwater seepage velocities in the lower-permeability Log Pond fill and sawdust unit are 0.8 and 5 feet/year (Darcy velocities of 0.2 and 0.9 ft^3/ft^2-year, respectively) (Table 2-4).

2.4.4.2.5 Estimates of Groundwater Flux to East Waterway

The volumetric flux of groundwater (cubic feet per year [ft^3/year]) from the fill aquifer to the East Waterway is also estimated for each Unit. To do so, the Unit-specific cross sectional area for flow perpendicular to the groundwater flow direction is estimated as the shoreline length multiplied by the aquifer thickness along the shoreline (thickness estimated as described above). The volumetric groundwater flux from each Unit is then calculated by multiplying the respective Darcy velocity by the shoreline cross sectional area.

The estimated groundwater fluxes from the fill unit (excluding the Log Pond) to the East Waterway range from 10,000 ft^3/year in Unit E to 420,000 ft^3/year in Unit B. Within the Log Pond, the estimated groundwater fluxes from the Log Pond fill and sawdust unit are

1,500 and 2,200 ft^3/year (3,700 ft^3/year combined). For the entire Upland Area shoreline, the estimated total groundwater flux to the East Waterway is 624,000 ft^3/year (Table 2-4). The estimated groundwater discharges from the Log Pond area fill and sawdust layer represent approximately 0.2 and 0.4 percent, respectively, of this total flux.

2.4.5 Storm Water Management

As discussed in Section 2.2.3.1, the CM generated during mill demolition was graded to infiltrate storm water across the 32 acres on which it was placed. While some localized ponding was observed within the CM area during unusually heavy rain events, no runoff from the CM area was observed while the CM was in place. Likewise, precipitation falling on the unpaved areas where CM was not placed (e.g., along shoreline) also infiltrates.

A small, paved area associated with the covered loading docks on the west side of the remaining warehouse building is serviced by three catch basins which combine to discharge to the nearby embayment[10]; however, this paved area is largely covered by overhanging building structure and, therefore, receives very little rainfall and produces negligible runoff.

Three additional catch basins[11] exist west of the warehouse building and combine to discharge to the nearby embayment. They were originally retained during demolition for emergency storm water management. However, their elevation was previously established by asphalt that has now been removed. As a result, while the CM was in place, that surrounding area is now lower in elevation than the catch basin grates, and it generally infiltrates rather than running off into the catch basins.

Following the CM removal action in 2020, K-C imported and placed highly permeable, non-silty sand ("Parcel O sand") across the 32 acres from where CM was removed. The imported sand was graded with gentle slopes including a broad north-south-aligned depression approximately 200 feet inland from the shoreline to ensure that any runoff from the sand surface did not flow overland into the East Waterway.

As part of the third IA, a new storm drainage system was installed to convey stormwater to new treatment infrastructure. In addition, historical stormwater outfalls A and M were reconstructed as part of the third IA for discharge from the new stormwater system (Landau, 2024). Additional information regarding these activities is provided in Section 4.8.

Most of the ground surfaces within the City's Utility Property at the northern end of the Upland Area remain paved and serviced by a series of on-property storm water catch basins. Runoff entering those catch basins is conveyed via underground pipes to and infiltrated through a pair of drainage swales located along the northern and southern edges of the property. The northern swale also serves portions of Naval Station Everett's paved parking areas. The City filled the southern swale in December 2020 and will eventually pave it, as discussed in Section 4.4.

[10] Identified as Pipe A for purposes of the Second IA (Aspect, 2021).
[11] Catch basins B1, B2, and B3 as identified for purposes of the Second IA (Aspect, 2021).

As a result of these combined conditions, no surface runoff was observed leaving the Upland Area property from the time that demolition activities concluded in 2013 until 2023. Upon completion of the third IA in mid-2023, the new storm drainage system manages surface runoff.

3 Previous Remedial Actions

This section summarizes previous remedial actions, including environmental investigations and independent cleanups separate from this RI/FS, conducted at the Upland Area prior to the Agreed Order. The summary is based on reports provided by K-C supplemented by information summarized in the Phase 1 ESA for the property (AECOM, 2011) where the original documents were not available. This Phase 1 ESA can be viewed on Ecology's website using the link provided in Section 1. The UST investigations described below are associated with Ecology UST ID 5351 and release ID 1624. For reference, Figure 2-2 depicts historical Site features, including labeling of the pulp and paper mill buildings, and locations of hazardous substance use/storage within the mill based on historical maps.

3.1 Independent Remedial Actions During Mill Operations

This subsection summarizes the various independent investigations and cleanups conducted between 1989 and 2011, while the pulp and paper mill was operational.

3.1.1 Removal of Gasoline UST No. 69 (1989)

UST No. 69, originally installed around 1966, was formerly located between Buildings 29 and 37 (Figure 2-2). This UST is part of Historical Recognized Environmental Condition (HREC) 1 as identified in the Phase 1 ESA (refer to Section 3.1.14). During removal of this 260-gallon leaded-gasoline UST in 1989, six soil samples and one groundwater sample were collected for chemical analysis. Ethylbenzene was detected in one soil sample and xylenes were detected in four soil samples, all at concentrations less than MTCA Method A soil cleanup levels for unrestricted use. Concentrations of benzene, toluene, ethylbenzene, and xylenes (BTEX) were not detected in the groundwater sample (Scott Paper, 1989). Scott Paper Company reported the findings to Ecology (AECOM, 2011).

3.1.2 Heavy Duty Shop Soil Removal (1991)

In 1990, oily water from the Heavy Duty Shop sump was reportedly diverted to the hog fuel pile area north of the Shop. The Heavy Duty Shop Sump is identified as Recognized Environmental Condition (REC) 3 in the Phase 1 ESA. A test pit excavated to a 6-foot depth in the release area encountered "oil-saturated wood chips and soil" to a depth of 3 feet. Total petroleum hydrocarbon (TPH) was detected at a concentration of 2,200 milligrams per kilogram (mg/kg) in a sample of the oily soil. TPH was not detected in two soil samples collected below the oily soil layer.

In 1991, an estimated 40 to 50 cubic yards of visibly stained soil was removed from the release area. The memorandum describing the soil removal (EcoChem, 1991) was submitted to Ecology. No verifications of groundwater quality data were collected as part of the cleanup.

3.1.3 Removal and Investigation of Five USTs (1989-1990)

Five USTs at the mill property were permanently decommissioned by removal in November and December 1989 (Landau, 1991). The USTs below are depicted on Figure 2-2. The capacity and contents of the USTs reportedly included the following:

- One 250-gallon unleaded-gasoline UST (Tank No. 68);
- One 1,000-gallon diesel-fuel UST (Tank No. 70); and
- Three 12,000-gallon Bunker C fuel-oil USTs (Tanks No. 71, 72, and 73).

As part of the UST decommissioning activities, soil and groundwater samples were collected and submitted for laboratory analysis. The laboratory analytical results indicated that releases of petroleum hydrocarbons had occurred at each of the UST locations. Based on the data, contaminated soil was excavated from each UST pit location.

Following removal of the five USTs, Landau conducted a subsurface investigation in November and December 1990 to further assess soil and groundwater quality in the vicinity of the USTs. The investigation consisted of advancing seven soil borings, three around UST No. 68 and four around UST No. 70; collecting soil samples for laboratory analysis; completing the seven borings as groundwater monitoring wells; and conducting a groundwater sampling event. During the 1990 investigation, petroleum-related compounds were detected in soil and/or groundwater in these areas, as summarized in the Phase 2 ESA (Aspect, 2013a). During the Phase 2 ESA, residual petroleum contamination was identified in the UST 70 and USTs 71/72/73 areas, but not in the UST 68 area. In 2013–2014, K-C's IA accomplished removal of contaminated material from the UST 70 and USTs 71/72/73 areas, as described in Section 3.4.

3.1.4 Investigation in Vicinity of Old Paint Shop (1994)

In June 1994, a strong solvent odor and a thin floating layer of a viscous, brown-black substance were observed within a localized length of utility trench excavated proximate to the Central Maintenance Shop (also known as the salvage warehouse). The location is reportedly near a historical paint shop that operated until the early 1970s. This area is identified as HREC 5 in the Phase 1 ESA (AECOM, 2011). A grab sample of water within the trench was collected for chemical analysis of gasoline-, diesel-, and oil-range TPH, volatile organic compounds (VOCs), and polychlorinated biphenyls (PCBs). One VOC, p-isopropyltoluene (i.e., 4-isopropyltoluene or p-cymene), was detected in the water sample at a concentration of 11,000 micrograms per liter (µg/L), along with 380 µg/L gasoline-range TPH. Landau interpreted the p-isopropyltoluene to be a component of turpentine solvent used in the historical paint shop (Landau, 1994b). There are no marine-based or vapor intrusion (VI)-based groundwater screening levels for 4-isopropyltoluene. However, isopropylbenzene (cumene) has been used a surrogate compound for p-isopropyltoluene, based on similar chemical structure, in regulatory programs outside Washington State (Fehling et al, 2011).

Subsequently, Landau conducted an investigation in August 1994 to assess soil and groundwater quality in the vicinity of the solvent occurrence. The subsurface investigation consisted of advancing seven soil borings and collecting soil samples and reconnaissance

groundwater samples[12] for laboratory analysis of gasoline-range TPH/BTEX and diesel-range TPH. In addition, the groundwater sample from the boring located west (downgradient) of the solvent occurrence was analyzed for the full suite of VOCs. The location of the solvent occurrence is identified as hazardous substance location 18 on Figure 2-2.

The soil samples and the reconnaissance groundwater samples from the seven borings did not contain detectable concentrations of gasoline-range TPH or BTEX. In addition, no VOCs were detected in the downgradient groundwater sample. The only detectable soil TPH in the eleven soil samples collected was diesel-range TPH (less than 140 mg/kg), in the boring located southwest of the observed release.

The 1994 investigation results indicate a highly localized historical release of paint thinner, with no evidence for migration of contaminated groundwater at that time. Further investigation of this area was conducted as part of the RI.

3.1.5 UST No. 29 Xylene Release and Independent Cleanup (1989-1994)

A release of xylene to soil and groundwater was identified during removal of USTs No. 29 and 67 in 1989 (Landau, 1989). The USTs were positioned end to end and were located immediately west of the Paper Machine Building. UST No. 29 was a 12,500-gallon, single-walled UST used to store xylene, which was used as a solvent for cleaning certain machinery in the paper mill. UST No. 67 was a 12,500-gallon, single-walled UST used to store kerosene (hazardous substance location 22 on Figure 2-2).

The xylene release was first identified by solvent odors observed during the initial excavation conducted on November 7, 1989. USTs No. 29 and 67 were subsequently removed on November 8, 1989, and excavated soil was stockpiled on-Site. No release of kerosene was observed during decommissioning of UST 67; however, the xylene release from UST No. 29 was apparent in the UST No. 67 excavation location. During the 1989 UST decommissioning, removal of contaminated soil on the excavation's north wall was restricted by the tank pad and secondary containment wall for the Pulp Chests located immediately north of the USTs, and currently in place.

During the 1989 tank removal activities, a process water drain line was broken and approximately 15,000-gallons of wastewater from the No. 1 and No. 2 paper machines filled the excavation. An oily sheen was observed on the water surface within the excavation. Water sample TS-29 was collected from the excavation for laboratory analysis, and absorbent pads were applied to limit oil material from entering the broken water line. The water line was subsequently repaired on November 9, 1989. After notifying Ecology, approximately 15,000 gallons of water were pumped from the excavation into a Baker tank for temporary storage and subsequent treatment on-Site.

Water sample TS-29, collected from the excavation, was submitted for laboratory analysis of TPH and VOCs. A TPH concentration of 310,000 µg/L was detected in the water

[12] Grab groundwater samples collected from the soil borings during drilling; no monitoring well was installed.

sample tested by the U.S. Environmental Protection Agency (EPA) 418.1 method, which is not specific to petroleum. Subsequent analysis of water sample TS-29 by Modified EPA Method 8015 detected a concentration of 1,900,000 µg/L gasoline-range hydrocarbons, while kerosene was not detected. Total xylenes, ethylbenzene, and toluene were also detected in excavation water sample TS-29 at concentrations of 770,000 µg/L, 160,000 µg/L, and 4,800, µg/L, respectively. Benzene was not detected. Ethylbenzene and toluene are reportedly impurities in technical grade xylene (Landau, 1989).

In addition, Landau collected a sample of water stored in the Baker tank (BT-1) for analysis of BTEX. Detected concentrations in water sample BT-1 were 120,000 µg/L total xylenes, 20,000 µg/L ethylbenzene, and 2,100 µg/l toluene; benzene was not detected.

Following testing to confirm that the mill's wastewater treatment system could adequately treat the contaminated water, and after receiving verbal approval from Ecology, the Baker tank water was discharged to the mill's secondary wastewater treatment plant at a maximum feed rate of 15 gallons per minutes (gpm) for treatment (Scott Paper, 1990).

Within the final limits of the UST No. 29/67 excavation, four discrete soil samples were collected from each of the excavation sidewalls at a depth of approximately 4 feet below ground surface (bgs). A composite soil sample was also collected from the stockpile of excavated soil. The five soil samples were submitted for laboratory analysis of TPH by EPA Method 418.1, and BTEX.

As observed with the water data, the soil analytical data showed highest concentrations of xylenes with lower concentrations of ethylbenzene and much lower concentrations of toluene. In the four excavation sidewall soil samples, the lowest concentrations were detected in the eastern sidewall (0.75 mg/kg xylenes, 0.048 mg/kg ethylbenzene; and nondetect TPH, benzene, and toluene), and the highest concentrations were detected in the northern sidewall (37,000 mg/kg xylenes; 6,600 mg/kg ethylbenzene; 5,700 mg/kg TPH; and nondetect benzene and toluene). The sample of stockpiled soil contained 2,800 mg/kg xylenes, 590 mg/kg ethylbenzene, and no detectable benzene or toluene. The UST No. 29 excavation was backfilled with the stockpiled soil removed from the UST excavation (Landau, 1989).

Landau then installed a test soil vapor extraction (SVE) system on top of the impacted backfill soil to passively remove vapors and for potential use as an active vacuum extraction system. The SVE piping was encased in an approximately 2-foot layer of pea gravel placed on top of the soil backfill, which was covered with a high-density polyethylene (HDPE) liner and resurfaced with asphalt. Scott Paper Company informed Ecology of the SVE system operation plans (Scott Paper, 1991).

Landau initiated startup of the SVE system with two 4-hour tests conducted on November 22 and December 2, 1991. The primary purpose of the tests was to measure the expected mass discharge rate of xylenes from the SVE system to assess compliance with a 15-pound-per-day (lb/day) rate dictated by the Puget Sound Air Pollution Control Agency (PSAPCA). Based on the tests, Landau calculated an expected mass flow rate of 1.3 lbs/day from the SVE system. Following review of those results, Landau initiated continuous operation of the SVE system on January 10, 1992, and recommended that

operation of the SVE system continue until the mass discharge flow rate fell below 0.1 lbs/day (Landau, 1992).

The SVE system operated on a near-continuous basis from startup in November 1991 through January 1993. From January 1993 through mid-1994, the SVE system was periodically shut down for 1- to 3-month periods and then restarted to operate on a pulsing basis. In mid-1994, laboratory analytical results indicated that the mass flow rate generated from the SVE system no longer warranted continued operation, and Landau initiated a compliance monitoring investigation of the tank area to assess whether the cleanup action had attained applicable cleanup standards.

The June 1994 compliance monitoring investigation (Landau, 1994a) consisted of the following:

- Advancing nine direct-push soil borings to a depth of approximately 9 feet bgs in areas adjacent to and within 100 feet west (downgradient) of the UST No. 29/67 excavation;
- Collecting and analyzing for BTEX six soil samples from five borings located around and downgradient of the excavation;
- Collecting and analyzing for BTEX grab groundwater samples from five downgradient borings; and
- Collecting and submitting vapor samples from the SVE system for laboratory analysis of BTEX.

In soil borings located immediately north of the excavation, detected concentrations of total xylenes ranged from 123 mg/kg in the vadose zone to 2,990 mg/kg in the saturated zone. In 1989, prior to operation of the SVE system, xylenes had been detected at 26,000 mg/kg in soil sample collected from the north excavation sidewall, and located adjacent to the 123 mg/kg sample, suggesting a substantial concentration decline in vadose zone soil at the excavation location. Within 10 feet west of the excavation, detected soil xylenes concentrations declined to less than 7 mg/kg. Xylenes were not detected in the soil sample collected approximately 50 feet west of the excavations.

Concentrations of total xylenes detected in the grab groundwater samples declined with increasing downgradient distance. Xylenes were detected at a concentration of 30,560 µg/L in the groundwater sample collected about 35 feet west of the excavation's western end. Approximately 60 feet west of the excavation, the detected groundwater xylenes concentration was 315 µg/L. In borings positioned 25 to 30 feet north and south of that location, xylenes were detected in groundwater at 5.1 µg/L and 1.5 µg/L, respectively. Approximately 90 feet west of the excavations, xylenes were not detected in the groundwater sample collected. Ethylbenzene concentrations in the groundwater samples were lower than detected xylenes concentrations. Low-level concentrations of benzene and/or toluene were also detected in the groundwater samples collected.

Based on the collective data collected during the 1989 UST removal and in 1994, Landau (1994a) concluded the following:

- In 2.5 years of operation, the SVE system had been effective in reducing xylene concentrations in soil located above the water table in the excavation area.
- Further operation of the SVE system was not warranted since vapor-phase VOC concentrations generated by the system were no longer detectable.
- Residual xylene-contaminated soil may be concentrated on the north side of the tank excavation area, beneath the adjacent tank pad.
- The downgradient extent of xylene and ethylbenzene in groundwater was defined within approximately 100 feet of the excavation area, and the contamination was not impacting downgradient receptors. Additional groundwater monitoring would be required to demonstrate conclusively that natural attenuation of residual xylene is occurring.
- More aggressive remedial measures for the xylene release would require removal of operating infrastructure, the cost of which was not warranted because the plume was contained and appeared to be attenuating naturally.

Scott Paper Company submitted to Ecology the Landau reports regarding the UST No. 29 release identification and independent cleanup activities. In August 1994, Scott notified Ecology of plans to shut down the SVE system and requested Ecology authorization to do so (Scott Paper, 1994). Ecology responded that the cleanup was an independent action taken by Scott Paper and thus made no determination on sufficiency of the cleanup (Ecology, 1994a). In 2002, Ecology listed the Facilities Leaking Underground Storage Tank (LUST) ID No. 1627 as inactive.

3.1.6 Independent Soil Cleanup in Bunker C Fuel Oil AST Area (1995)

Under the terms of Regulatory Order DE 93-AQI064 for Scott Paper's cogeneration boiler, the mill needed to convert from Bunker C fuel oil to diesel as a backup fuel source. At the time of the conversion in 1995, two ASTs remained in the Bunker C fuel oil AST farm on the north side of the distribution warehouse: one 1,596,000-gallon Bunker C fuel-oil tank and one 211,000-gallon caustic-soda tank (which historically also contained oil). These ASTs were identified as being part of REC 2 in the Phase 1 ESA (AECOM, 2011). The tank farm area had an earthen surface enclosed by a tall concrete wall. Shallow soil samples collected at that time "show oil contamination next to the tank, which decreases rapidly when moving away from it" (Scott Paper, 1995a).

Prior to decommissioning and removal of the Bunker C fuel-oil and caustic-soda ASTs, surface soil from around the standing tanks was excavated and disposed of at Associated Sand and Gravel[13] , an off-Site facility in Everett licensed for the handling of soil containing Bunker C fuel oil. Visual inspection indicated that the oil contamination had been removed, and none of the soil removed contained elevated pH (Scott Paper, 1995b). CH2M Hill reportedly was to collect soil samples following soil removal within the tank farm area, but a report documenting such activities has not been found. A 1997 letter to Ecology (K-C, 1997a), following removal of the ASTs, concluded, based on hydrocarbon

[13] Subsequently CEMEX and then Cadman.

fingerprinting soil sampling results, that the hydrocarbon in the AST area is likely not the same material present at the ExxonMobil ADC site south of K-C's warehouse; the letter also indicates the intent to further characterize hydrocarbon contamination in the area.

3.1.7 U.S. Navy's Independent Cleanup of Naval Reserve Parcel (1996-1998)

K-C engaged in a land exchange with the U.S. Navy in the mid-1990s. The land exchange deeded K-C land at the north end of the mill property to the U.S. Navy in exchange for a Naval Reserve property located between the paper mill and the new secondary treatment plant. According to Mr. Robert Waddle, formerly of K-C, the land deeded to K-C from the U.S. Navy in the property transaction included Tax Parcel No. 29051900201300 (Figure 2-1). As part of the exchange agreement, the U.S. Navy agreed to remediate contamination previously identified on that parcel (K-C, 1997b). This area was identified as HREC 2 in the Phase 1 ESA (AECOM, 2011).

Foster Wheeler (1998) documents the U.S. Navy's independent cleanup of the Naval Reserve Parcel as part of the land exchange. According to the report, the Naval Reserve Center was commissioned in 1949 and served as the administrative and operations center for local naval reserve activities. From 1947 to about 1981, naval vessels regularly docked at the Naval Reserve Center dock, which remains in place. The Naval Reserve Center included a combined garage/shop, boiler room, and diesel generator room (Building 1); and to the east, a Firing Range (Building 2). Two diesel USTs (5,000-gallon Tank 1 and 3,000-gallon Tank 2) were located immediately south of the boiler room and supplied fuel for the steam boiler and electrical generator.

The two diesel USTs were removed in July 1996. A hole was observed in Tank 1 during its removal. No visible flaws were documented for Tank 2 during its removal. Following removal of the USTs, Foster Wheeler collected confirmation soil samples from the excavation. Diesel-range TPH soil contamination was detected within the excavation around each of the tanks, with detected TPH concentrations up to 16,000 mg/kg.

Based on that first round of confirmation sampling, the excavation pits were overexcavated and sampled again. The excavation depth was approximately 12 feet bgs, extending below the water table. In addition to the tank pits, an exploratory test pit was excavated and sampled approximately 5 feet south of the southern excavation limit. The petroleum hydrocarbon-contaminated soil was removed for off-Site thermal desorption.

Following over-excavation, a second round of excavation verification soil samples indicated residual diesel contamination present on the excavation bottom and south of the excavation. Diesel-range TPH was detected at 42,000 mg/kg in the sample of soil from the bottom of the excavation near its center. TPH was not detected in samples collected on the south, north, and west sidewalls, respectively, of the excavation. The soil sample collected on the east sidewall contained 260 mg/kg diesel-range TPH.

Three soil samples were collected from different depths in the exploratory test pit just south of the excavation. Detected diesel-range TPH was not detected in the 5-foot sample,

but was detected at concentrations of 53,000 mg/kg and 7,000 mg/kg in the 7.5-foot and 9-foot soil samples, respectively.

According to the report, "groundwater and pilings driven randomly spaced at about 8-feet bgs impeded further excavation; therefore, soil excavation was suspended, and the pits backfilled with pea gravel to approximately 1 foot above groundwater. The remaining excavations were filled to grade with clean backfill material."

The report also states that additional TPH-contaminated soil identified beneath the boiler room was removed, but does not provide location information or verification soil sample data for the excavation. Likewise, the report states that 15 cubic yards of lead-contaminated soil was removed from beneath the Firing Range building, but does not provide location information or verification soil sample data for the excavation.

In August 1997 through October 1998, following demolition of the facility structures, Foster Wheeler conducted characterization soil sampling and analysis from the USTs area, adjacent bilge water tank location and flammable material storage shed, and the Firing Range area. Twenty-four drilled soil borings were advanced to depths of approximately 10 feet bgs in the Building 1 area to characterize soil quality around the USTs, bilge water tank location, and flammable material storage shed. Four additional hand-augered borings were also sampled to depths of 1.25 feet bgs around the flammable material storage shed. Twenty-one hand-augered borings were sampled to depths of 3 feet bgs at the Firing Range. The first 14 borings were sampled in September 1997, and the last seven in October 1997; the report presents locations only for the first 14 borings.

Following soil removal and site restoration, two monitoring wells were installed in the most contaminated areas to monitor groundwater quality as a reflection of the soil removal effectiveness. The wells were identified as North Well and South Well, but the report does not present locations for them. The January 1998 groundwater samples collected from the two wells contained no detectable TPH or BTEX, and concentrations of the polycyclic aromatic hydrocarbons (PAHs) acenaphthene, fluorene, and naphthalene (up to 4 µg/L) were less than respective groundwater screening levels.

3.1.8 Investigation of Bulk Fuel Facilities (1998)

On behalf of K-C, Chevron, Texaco, and BNSF, Pacific Environmental Group (PEG) conducted a subsurface investigation to assess petroleum hydrocarbon contamination previously encountered adjacent to the City of Everett Combined Sewer Outfall (CSO) line which runs east-west immediately south of the K-C distribution warehouse in the southeast corner of the mill property, within the Everett Avenue easement. In 1995, petroleum product had been observed discharging from the CSO line into the East Waterway. Investigation determined that petroleum product was entering a segment of the CSO line that was constructed of clay tiles that had settled and cracked. In summer 1996, portions of the CSO line were replaced, and the remaining portions of it were slip-lined. Reportedly, 1,450,800 gallons of water and 23,050 gallons of petroleum product were removed by dewatering conducted during the construction (AMEC, 2010).

The purpose of the PEG (1998) investigation was to evaluate soil and groundwater quality in the vicinity of petroleum product bulk facilities located north of the CSO (Standard Oil

and Tidewater/Associated Oil Company facilities on K-C property) and south of it (on ExxonMobil/American Distributing Company [ADC] site) to assess whether the historical facilities contributed to petroleum hydrocarbon contamination documented at the CSO line. In the Phase 1 ESA for the mill property (AECOM, 2011), the facilities on the K-C property constituted Recognized Environmental Condition (REC) 2, whereas the facilities on the ExxonMobil/ADC Site constituted REC 1.

The 1998 investigation consisted of advancing 17 soil borings; collecting and analyzing soil samples from three borings based on field screening; collecting and analyzing reconnaissance groundwater samples from 14 borings; completing two borings as groundwater monitoring wells inside of the K-C warehouse; and collecting groundwater samples from the wells.

Concentrations of TPH and BTEX detected in the three soil samples were well less than unrestricted soil screening levels (TPH less than 150 mg/kg, and negligible BTEX). The highest groundwater concentrations of diesel-range plus oil-range TPH (91,000 to 100,000 µg/L) were detected in groundwater samples collected from two locations adjacent to the CSO line. Those two groundwater samples also contained gasoline-range TPH (327 µg/L and 736 µg/L, respectively), but BTEX concentrations were less than groundwater screening levels for marine protection and VI protection.

Much lower groundwater TPH concentrations (nondetect to 430 µg/L) were detected at the two wells located within the footprint of the K-C warehouse. These low, dissolved-phase groundwater concentrations are not indicative of free-phase petroleum product in the vicinity. As such, the data indicated that the source of TPH encountered along the CSO line did not migrate from beneath the K-C warehouse to the north.

TPH concentrations exceeding respective screening levels were detected in selected wells located in the area of the Associated Oil Company fuel facilities, and to the west along a Bunker C fuel-oil pipeline that reportedly ran from the slip shoreline to the tank farm. No PAH analyses were conducted in the investigation.

The cover letter transmitting the PEG (1998) report to Ecology states, “Based on the results of this investigation, we believe it is impossible to conclude that the free product found in the CSO Line is the result of operations at the Chevron and Tidewater properties, now owned by Kimberly-Clark. In addition, fuel fingerprinting analysis, conducted during the CSO Line repairs, showed a strong correlation between the fuel oil from the CSO Line and the free product recovered from wells at the Mobil/American Distributing site. Based on these results, we believe there is no reason to maintain any link between the bulk plants and the Mobil/American Distributing/CSO problem” (Texaco, 1998).

3.1.9 PCB Decontamination of Substations (1995-2004)

K-C removed PCB-containing equipment from the mill between 1995 and 2004 (AECOM, 2011). After cleaning concrete pads beneath electrical transformers 5 and 6 within Screen/Bleach Unit 2, the concrete was found to contain residual PCB concentrations greater than the EPA cleanup level based on wipe sampling. The concrete was removed, and soils beneath them sampled for PCBs. PCB concentrations in the subgrade soils contained 1.4 and 3.4 mg/kg, greater than the 1 mg/kg unrestricted soil screening level and

less than the 10 mg/kg industrial soil screening level. Appendix C to the RI/FS Work Plan (Aspect, 2013c) provides a discussion of PCB management at the mill since the 1980s, including agency inspections, based on available information. PCB-containing transformer locations are depicted on Figure 2-2.

3.1.10 Removal of UST No. 68R (1999)

In November 1999, BEK McDonnell Engineering (BEK) conducted a site assessment during the permanent decommissioning by excavation and removal of a 500-gallon unleaded-gasoline UST and associated dispensing pump located northwest of the K-C distribution warehouse (hazardous substance location 10 on Figure 2-2). BEK's site assessment consisted of collecting and analyzing three soil samples from the final limits of the UST excavation, one sample from under the pump island, and completing Ecology's site assessment checklist.

BEK reported that the removed UST was in very good condition, with no visual evidence of corrosion or holes. BEK reported that groundwater was not observed in the tank pit prior to removal of the tank; however, a slight gasoline sheen was observed on pea gravel at the base of the tank pit. A pressurized water line was present within the tank pit and was supported beneath by gravel fill. To avoid disturbance of the water line, the fill was not removed; therefore, soil sampling beneath it was not conducted.

Gasoline-range TPH and BTEX were not detected in the four soil samples collected from the tank pit. Based on the results of the site assessment, BEK concluded that contamination was not present in the tank pit or adjacent pump island area. Although the base of the tank pit was reportedly above the water table, gasoline sheen was reportedly observed at the pit base, but there were no data to verify whether groundwater had been impacted.

3.1.11 Bunker C Fuel Oil Soil Removal, Bleach Unit 2 (1999)

During the 1999 construction of Screen/Bleach Unit 2 and associated relocation of a water line at the northeast corner of Screen/Bleach Unit 1, soil contaminated with Bunker C fuel oil was reportedly encountered (HREC 3 in AECOM, 2011). The inferred source was an abandoned fuel pipeline between the fuel tank farm on the south and the boiler house on the north. An estimated 15 cubic yards of contaminated soil was removed and disposed of during the 1999 construction project. No sampling was conducted within the excavation following soil removal (K-C, 1999).

3.1.12 Latex Spill Investigation (2009)

Aspect (2009) conducted an investigation to evaluate a release of latex product (AIRFLEX® EN1165) that occurred proximate to the southwest corner of the tissue mill between September and November 2008 (immediately east of hazardous substance location 22 on Figure 2-2). The latex product contained less than 1 percent vinyl acetate and less than 0.1 percent acetaldehyde, 1,4-dioxane, ethylene oxide, and formaldehyde. K-C used the latex in manufacture of household paper towels and unloaded it from tank cars at the terminus of a rail spur that runs along the loading dock.

K-C discovered the spill when latex was observed seeping out of the ground next to the loading dock during pumping operations. The spill occurred from subsurface piping, which may have been damaged when a tank car derailed at the spur terminus in September 2008. Upon discovery of the spill, the subsurface pipeline was immediately taken out of service and replaced with a temporary above-grade pipeline. Based on unloading records, K-C estimated that up to 250,000 pounds (roughly 28,000 gallons) of product were spilled.

After learning of the release, K-C notified Ecology regarding the spill and conducted an investigation into the chemical properties of the latex product to determine its hazard potential. Using data supplied by the vendor, and confirmatory laboratory analysis of the as-delivered product for formaldehyde content, K-C determined that the spill did not constitute a reportable quantity under 40 Code of Federal Regulations (CFR) 302 and 40 CFR 355. Between February and April 2009, K-C removed approximately 15,500 gallons of the spilled product from beneath the mill using vacuum extraction (vactor truck). During the final removal effort, the flow of product from beneath the tissue mill building dissipated to a trickle.

Based on an evaluation of the collective information, Aspect (2009) concluded that the residual latex product poses negligible environmental concern and no adverse threat to industrial workers at the mill property, and that it would be impracticable to attempt removal actions more aggressive than ongoing vactor truck recovery of visible product.

3.1.13 Characterization of Soil Removed from Sand Filter 1 Foundation (Old Boiler House) (2011)

In 2011, CRETE Consulting conducted sampling and analysis of stockpiled soil to profile it for off-Site disposal. The soil had been excavated from within the 7, 8, and 9 Old Boiler House Building (Steam Plant), adjacent to Dutch Ovens 1 through 5, to allow construction of the foundation for new Sand Filter 1 (REC 5 in AECOM, 2011).

A composite sample of the stockpiled soil was collected for analysis of gasoline-, diesel- and oil-range TPH, Resource Conservation and Recovery Act (RCRA) 8 metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver), and lead (by the toxicity characteristic leaching procedure [TCLP]). In addition, a discrete soil sample was collected for VOC analysis, and a discrete sample of soil suspected of containing spent sulfite liquor (SSL) was analyzed for RCRA 8 metals.

Concentrations of arsenic (35.4 mg/kg) and cadmium (5.2 mg/kg) in the composite soil sample exceeded the respective soil screening levels for unrestricted site use. The sample containing suspect SSL had no detected concentrations greater than unrestricted soil screening levels, and VOCs were not detected in the discrete sample. The 57 tons of stockpiled soil was properly disposed of at Roosevelt Regional Landfill (CRETE, 2011).

3.1.14 Phase 1 ESA (2011)

In April 2011, AECOM conducted a Phase 1 ESA for the mill property, in accordance with American Society for Testing Materials (ASTM) Standard E 1527-05 (AECOM, 2011). Based on the results of the Phase 1 ESA, AECOM identified the following seven recognized environmental conditions (RECs) at the mill property:

- **REC 1: ExxonMobil/ADC Site**, a portion of which is on the property (Everett Avenue easement). Prior independent remedial actions for this area are described in Section 3.1.8;
- **REC 2**: **Oil House and Gasoline/Bunker C Fuel Oil ASTs**. Prior independent remedial actions for this area are described in Sections 3.1.6 and 3.1.8;
- **REC 3: Heavy Duty Shop Sump**. Prior independent remedial actions for this area are described in Section 3.1.2;
- **REC 4: Rail Car Dumper Hydraulic System Building**. Aspect is aware of no prior investigation activities for this area;
- **REC 5: Dutch Ovens 1 through 5**. Prior independent remedial actions for this area are described in Section 3.1.13;
- **REC 6: Latex Spill Area**. Prior independent remedial actions for this area are described in Section 3.1.12; and
- **REC 7: East Waterway**. The East Waterway, which includes the In-Water Area of the Site, is outside of the Upland Area addressed in this RI/FS. The East Waterway will be addressed in its own RI/FS under a separate Agreed Order with Ecology.

The Phase 1 ESA also identified six HRECs, which "in the past would have been considered a REC but may or may not be considered a REC currently." The six identified HRECs are as follows:

- **HREC 1: UST Removals (UST Numbers 29, 67, 68, 68R, 69, 70, 70R, 71, 72, and 73)**. The ten USTs were removed and reported, including any detected releases, to Ecology. Ecology inactivated the LUST ID number for the mill property in 2002. There are reportedly no active USTs currently on the mill property (AECOM, 2011). Prior independent remedial action activities for these USTs are described in Sections 3.1.1, 3.1.3, 3.1.5, and 3.1.10. UST No. 70R was reportedly a 2,000-gallon diesel UST installed in 1989 (double-walled tank, cathodic protection, overflow sensor) in the same location as UST No. 70; it was decommissioned by removal in 1995 (AECOM, 2011);
- **HREC 2: Naval Reserve Property**. Prior independent remedial actions for this area are described in Section 3.1.7;
- **HREC 3: Bleach Unit 2 (area of Bunker C fuel oil soil removal)**. Prior independent remedial actions for this area are described in Section 3.1.11;
- **HREC 4: PCB Transformer**. Prior independent remedial actions for this area are described in Section 3.1.9;
- **HREC 5: Paint Shop**. Prior independent remedial actions for this area are described in Section 3.1.4; and
- **HREC 6: Rail Car Dumper Containment Vault Valve**. This area was defined based on a valve failure which allowed release of 2 gallons of hydraulic fluid to the East

Waterway in 1995. The spill was contained, cleaned up, inspected by Ecology, and the matter closed (Emergency Response Notification System [ERNS] No. 547098).

3.2 Independent Phase 2 ESA (2012)

Aspect (2013a) performed an independent Phase 2 ESA in 2012 to address data gaps identified from the prior environmental investigations summarized in Section 3.1, including the RECs/HRECs identified in AECOM's (2011) Phase 1 ESA. The Phase 2 ESA report can be viewed on Ecology's website using the weblink provided in Section 1. K-C completed the Phase 2 ESA as an independent remedial action prior to execution of the Agreed Order; however, it was conducted with informal consultation from Ecology, and it was intended to meet the requirements for substantial equivalence under WAC 173-340-515 involving independent remedial actions. Samples were taken and laboratory analyses were conducted consistent with MTCA requirements. The independent Phase 2 ESA supported, and did not foreclose, selection of a cleanup action consistent with MTCA requirements. The Phase 2 ESA was conducted as a phased investigation program in three rounds (February, May–July, and August–September of 2012).

In February 2012, Aspect conducted Round 1 of the Phase 2 ESA to initiate the evaluation of environmental conditions in three areas of the Upland Area. A Work Plan for the independent Phase 2 ESA was subsequently prepared (Aspect, 2012a). This Work Plan can be viewed on Ecology's website using the weblink provided in Section 1. The objectives of the Work Plan were to:

- Synthesize the prior environmental investigation and cleanup information for the Upland Area (including the Round 1 data);
- Identify data gaps in the prior environmental investigation/cleanup information and other historical information; and
- Define an environmental assessment scope of work to address the identified data gaps.

K-C submitted a draft Work Plan to Ecology for review and comment. Ecology provided expedited review and written comments on the draft Work Plan (Ecology, 2012a). Many but not all of the comments were incorporated, and a final Work Plan was prepared (Aspect, 2012a). The assessment scope of work included in the Work Plan constituted Round 2 of the independent Phase 2 ESA. The Work Plan acknowledged that, following completion of the assessment scope of work it defined, an additional round of data collection may be warranted to further define the contaminant nature and extent in the Upland Area.

Based on findings from Rounds 1 and 2, an Addendum to the Phase 2 ESA Work Plan (Aspect, 2012b) was prepared, which outlined the rationale and scope of work for an additional round (Round 3) of assessment. The Round 2 data and proposed Round 3 scope of work were discussed with Ecology at that time.

In total, the Phase 2 ESA included completion of 106 soil borings, 49 of which were completed as groundwater monitoring wells, completion of about 1,200 chemical analyses of soil and 570 chemical analyses of groundwater, and collection of site-wide hydrogeologic information including completion of a tidal study. The soil data collected

were compared against soil screening levels for both industrial and unrestricted land uses. The results of the Phase 2 ESA are presented in the *Data Report for Phase 2 Environmental Site Assessment* (Aspect, 2013a). The scope and results of the Phase 2 ESA are summarized briefly below.

- Investigated the presence of petroleum hydrocarbons in soil and groundwater within the Standard Oil bulk fuel facilities located beneath and west of the distribution warehouse. Documented TPH concentrations in soil greater than screening levels at several of the locations, and TPH concentrations in groundwater less than screening levels at all locations.
- Investigated the extent of petroleum hydrocarbons in soil and groundwater within the Associated Oil ASTs area (REC 2, immediately north of the distribution warehouse). K-C recommended that an IA soil removal be conducted in this area.
- Installed one boring to investigate potential impacts to soil and groundwater in the Heavy Duty Shop Sump area (REC 3), where previous soil excavation was conducted to address a discharge of oily water from the sump. The investigation did not identify petroleum hydrocarbon impacts to soil or groundwater.
- Identified elevated concentrations of metals (arsenic, copper, lead, mercury, nickel, and zinc) in groundwater downgradient of the Old Boiler/Dutch Ovens (REC 5), and investigated for a potential source of metals in upgradient soils. Metals were not detected at concentrations greater than the screening levels in soil and the source of metals to groundwater at this location was not identified.
- Investigated the extent of xylenes in soil and groundwater, associated with a release from xylene UST 29 (HREC 1), and a co-located release of latex product (REC 6). K-C recommended that an IA soil removal be conducted in this area.
- Investigated soil and groundwater quality in the vicinity of USTs (No. 68, 68R, 69, 70/70R, 71/72/73; HREC 1) removed in the 1980s to1990s, to document current conditions where petroleum hydrocarbon releases were previously reported to have occurred. K-C recommended that an IA soil removal be conducted for the USTs No. 70/70R and USTs No. 71/72/73 areas.
- Investigated the nature and extent of TPH in soil and groundwater in the vicinity of the USTs along with metals in shallow soil in the Firing Range area of the Naval Reserve Parcel (HREC 2).
- Investigated the quality of fill in the Log Pond Area and groundwater quality at the shoreline immediately downgradient of the Log Pond fill. Hazardous substances were not detected in soil exceeding unrestricted screening levels, and only low-level metals (arsenic, copper, and nickel) and ammonia were detected in groundwater greater than screening levels.
- Investigated potential impacts to soil and groundwater associated with the Acid Plant; the results indicated near-neutral pH of both soil and groundwater and no other indication of an acidic release.

- Investigated soil and groundwater quality at the Central Maintenance Shop (also known as the salvage warehouse) which, according to the 1994 facility drawing, included a PCB-waste accumulation area on its south side. This structure is also labeled as the Auto Shop on the 1996 facility drawing (see Appendix C to RI/FS Work Plan; Aspect, 2013c). The investigation identified total PCBs in shallow soil beneath the building at concentrations greater than the unrestricted screening level and less than the industrial soil screening level, and groundwater petroleum hydrocarbon and PAH concentrations (suggestive of creosote) greater than respective groundwater screening levels. PCBs were not detected in either soil sample collected from the General Fill boring installed on the south side of the Shop, where PCB wastes were reportedly accumulated.
- Investigated soil and groundwater quality at the Old Machine Shop. The investigation identified total PCBs and lead in shallow soil beneath the building at concentrations greater than unrestricted screening levels and less than industrial soil screening levels, and dissolved nickel and ammonia concentrations greater than respective groundwater screening levels. In addition, copper was detected at 265 mg/kg in one soil sample, above a preliminary unrestricted soil screening level based on leachability to groundwater (defaults to 36 mg/kg natural background soil concentration); however, groundwater copper concentrations in the Old Machine Shop monitoring well were below the conservative groundwater screening level.
- Investigated soil and groundwater quality in the Boiler/Baghouse Area. Metals (arsenic, copper, lead, mercury, and zinc), diesel- and oil-range TPH, naphthalene, carcinogenic polycyclic aromatic hydrocarbons (cPAHs), and dioxins/furans were detected in one or more soil samples at concentrations greater than respective unrestricted screening levels; lead concentrations also exceeded the industrial soil screening level. The groundwater sample from well Boiler-MW-1 contained only a marginal exceedance for total cPAHs, as well as dissolved copper concentrations greater than its screening level. The high concentrations of Bunker C fuel oil in soil in this area were interpreted to be associated with the adjacent Bunker C fuel oil USTs No. 71/72/73, possibly indicating a subsurface pipeline from the USTs to the boiler. K-C recommended removal of the oil-contaminated soil and subsurface fuel pipeline(s), if present, as well as removal of metals-contaminated soil in this area, in conjunction with the USTs No. 71/72/73 IA.
- Investigated soil and groundwater quality at the Hazardous Waste Cage located on the north side of the Log Pond fill. The investigation identified lead in one soil sample greater than the unrestricted soil screening level and less than the industrial screening level; detected arsenic and total cPAH concentrations in soil also exceeded respective unrestricted soil screening levels. Soil concentrations of copper, nickel, and zinc also exceeded respective unrestricted soil screening levels based on groundwater protection—screening levels that are equal to natural background concentrations and thus very conservative. Concentrations of dissolved arsenic, copper, and nickel were detected in groundwater at concentrations greater than respective groundwater screening levels.

- Investigated soil and groundwater quality at the Diesel AST Area just north of the northeast portion of the distribution warehouse; the area includes the AST (within secondary containment structure) and associated diesel pump station that began operation in the mid-1990s. The investigation identified oil-range TPH in surficial soil west of the Diesel AST, which did not appear to be related to it. The groundwater sample at that location had no exceedances. Detected concentrations of TPH in soil from borings next to the AST and diesel pump house were less than screening levels, while total cPAHs and naphthalene were greater than unrestricted screening levels in one or more soil samples. The groundwater sample from that location contained no exceedances for TPH or naphthalene, and a marginal exceedance for total cPAHs.
- Investigated potential impacts to soil and groundwater associated with the Hydraulic Barker Building. The results identified concentrations of oil-range TPH and cPAHs in soil exceeding unrestricted soil screening levels. Soil concentrations of copper, mercury, and zinc also exceeded respective unrestricted soil screening levels based on groundwater protection, but detected groundwater concentrations were less than respective groundwater screening levels.
- Conducted Upland Area-wide sampling and analysis of the fill soil at 15 accessible locations outside of distinct operational areas ("General Fill"). The results detected diesel- and oil-range TPH, cPAHs, lead, and/or dioxins/furans greater than the screening levels at one or more of 15 locations. Follow up assessment included the following:
  - Additional investigation was conducted to further delineate the petroleum exceedance detected in saturated soil at the GF-B-9 location. TPH exceedances were not detected in immediately downgradient groundwater, but the lateral extent of soil TPH exceedances was not defined. The distribution of PAHs in the 10- to 11-foot soil sample from GF9-MW-1 suggested a creosote-like source.
  - Additional investigation was conducted to further delineate the shallow soil lead concentration (659 mg/kg) exceeding the unrestricted screening level at the GF-B-11 location, which was recommended for IA removal.
  - Oil-range TPH detected in shallow soil at the GF-B-14 location was attributed to adjacent contamination from the Associated Oil Company ASTs area, and was recommended for removal as part of the IA for that area.
- Evaluated groundwater quality in monitoring wells located on the upgradient (east) side of the Upland Area and along the shoreline downgradient (west) of it (most wells were sampled twice; some shoreline wells had one sample and some had three samples). It was noted that most wells were sampled only during the dry season between June and September 2012 (only six of the wells had both wet and dry season sampling). Metals (arsenic, copper, nickel, and/or zinc) and ammonia were the only constituents detected exceeding respective screening levels in groundwater collected from the 15 shoreline wells. Arsenic, copper, nickel, and ammonia exceedances were commonly detected in groundwater across the Upland Area, and may be influenced by geochemically reducing conditions in the organic-rich fill from which the uplands were created. However, the 2012 groundwater metals analyses did not include

reductive precipitation (EPA Method 1640) to minimize analytical interferences due to salinity. In accordance with the RI/FS Work Plan, that procedure was applied for the RI/FS analyses of brackish groundwater samples (discussed further in Section 6). The detected un-ionized ammonia groundwater concentrations in three of the 15 shoreline wells— REC1-MW-9, MW-06, and REC6-MW-6—exceeded the 0.035 µg/L screening level based on chronic exposure for aquatic organisms in surface water. Detected metals concentrations were less than screening levels in groundwater from the two upgradient wells.

3.3 Hazardous Waste Accumulation Unit Closure (2012)

In association with mill demolition, Aspect oversaw and documented RCRA clean closure of the mill's 90-day HWAU ("haz waste cage"), in accordance with the state Dangerous Waste Regulations (WAC 173-303-610) and Ecology implementation guidance for clean closure (Ecology, 2005). The structure was not a RCRA Treatment, Storage, and Disposal Facility, and was, therefore, exempt from requirements in WAC 173-303-610 (closure and postclosure) and 173-303-620 (financial assurances), except for WAC 173-303-610(2) and 173-303-610(5). The HWAU is located on the southeast corner of the former log pond and is shown on Figure 2-2 (co-located with item number 12 in the legend).

Following the demolition contractor's final removal of waste materials from the accumulation unit, but prior to its demolition, Aspect conducted a visual inspection of the unit to document cracks in the structure and observe for evidence of a release from it. Aspect also collected four fully penetrating core samples of the concrete floor slab for analysis of gasoline-, diesel-, and oil-range TPH, RCRA 8 metals, semivolatile organic compounds (SVOCs), VOCs, and PCBs. Detected concentrations in the concrete were less than Method A soil screening levels and Method B direct contact-based soil screening levels for unrestricted use (see Table 3-1 of the RCRA Closure Report discussed in the paragraph below); however, analytical reporting limits for cPAHs exceeded unrestricted cleanup levels for the concrete samples. The structure's concrete demolition debris was disposed of at CEMEX's landfill in Everett. Following removal of the structure, Aspect sampled soil within the footprint of the structure for analysis of gasoline-, diesel-, and oil-range TPH, RCRA 8 metals, SVOCs, VOCs, and PCBs. Soil concentrations were less than respective unrestricted soil screening levels.

Following the mill closure, and demolition and soil testing of the accumulation unit, Aspect prepared a RCRA Closure Report for the mill (Aspect, 2013b). The RCRA Closure Report can be viewed on Ecology's website using the weblink provide in Section 1. The Closure Report documents the waste management history of the mill, and describes the disposal of remaining chemical inventory during the mill closure/demolition, the inspection, analytical testing and proper disposition of the 90-day hazardous waste accumulation unit structure, and analytical testing of the underlying soil. Finally, the RCRA Closure Report summarizes Ecology's November 2012 hazardous waste inspection conducted during the mill closure/demolition process, during which Ecology concluded that the waste management activities were being conducted in accordance with the requirements of Chapter 173-303 WAC (Ecology, 2012d).

Based on the closure work completed and Ecology's November 2012 inspection, the RCRA closure activities for the mill achieved compliance with Chapter 173-303 WAC requirements for clean closure (Aspect, 2013b). Ecology approved the Closure Report on November 12, 2013 (Ecology, 2012d).

4 Remedial Investigation Activities

In accordance with the RI/FS Work Plan (Aspect, 2013c) and subsequent Work Plan Addenda described in Section 4.2, soil, groundwater, intertidal porewater, and air sampling was conducted as part of the RI data collection program to assess the nature and extent of contamination in the Upland Area. Aspect subcontracted with a Washington-licensed resource protection well driller from Holt Services, Inc., to complete the soil borings and monitoring wells in accordance with the requirements of Chapter 173-160 WAC. Soil samples were obtained using direct-push drilling methods, and groundwater samples were obtained from monitoring wells using low-flow sampling techniques. Soil boring, monitoring well installation and development, and soil and groundwater sample collection were completed in accordance with the Sampling and Analysis Plan (SAP; Appendix A to the RI/FS Work Plan).

For the RI characterization (2013–2017), a total of 88 borings and 44 new monitoring wells were completed. Six of the monitoring wells installed during the Phase 2 ESA and damaged during mill demolition were also decommissioned and replaced for groundwater sampling during the RI. In addition, collocated indoor air and sub-slab air samples were collected two times at three locations within the warehouse along with samples of ambient air from locations upwind of the warehouse. Over the course of four monitoring events of variable scope, samples of intertidal porewater and seepage were collected at ten locations, and water quality field parameters were collected at ten additional intertidal seepage locations, along the Upland Area shoreline.

Demolition of the pulp/paper mill structures generated a very large quantity of concrete and brick demolition debris, most of which was crushed to produce CM and then graded as a surface veneer across roughly 32 acres of the Upland Area; all of the CM was subsequently removed in 2020 as confirmed by DEA and as discussed in Section 4.5. A substantial quantity of demolition debris was also profiled and disposed of off-Site, including 552 tons of hazardous waste disposed of at the Chemical Waste Management Subtitle C landfill in Arlington, Oregon, 6,884 tons of solid waste disposed of at Roosevelt Regional Subtitle D landfill in Roosevelt, Washington, and 52 tons of concrete disposed of at the CEMEX Glenwood Landfill in Everett Washington (subsequently purchased by Cadman Inc.). In addition, 8,437 tons of asphalt was separated and recycled at Granite Construction's Smith Island Recycle facility in Everett, Washington, and a large quantity of metals (steel, copper, titanium, aluminum, stainless steel) was separated and recycled.

The incorporation of the CM into the Site was conducted independently by K-C and was not part of the work to be performed under Agreed Order No. DE 9476. However, sampling of the demolition debris was included in the RI/FS Work Plan because it was introduced to the Site as a new exposed environmental medium during mill demolition. Following grading, 42 samples of the in-place CM (RM- series samples) were collected on a systematic grid in accordance with the RI/FS Work Plan. In addition, seven samples of stockpiled CM (CONC- series samples) were collected before the material was placed at the surface within the footprint of the Bunker C AST IA excavation area, providing 49 samples of the CM. Because that material was intended for use for backfill/grading in the

first interim action, its sampling and analysis was conducted in accordance with the Interim Action Plan (Aspect, 2012c). Analytical results of the CM showed concentrations of chemicals above MCTA cleanup levels including metals, PCBs, TPH, and cPAHs. Following complete removal of the CM in 2020, as required by Ecology, those sampling data are no longer representative of current Site conditions and are not further discussed in this RI/FS.

In total, 390 soil samples, 208 groundwater samples, 14 air samples, 19 intertidal porewater/seep samples, six surface water samples, and two seawater reference samples were collected and analyzed during the RI data collection effort, in accordance with the RI/FS Work Plan and several subsequent addenda to that Work Plan described below. Additional field parameter measurements, without laboratory analysis, were also made at numerous groundwater locations in February, May, and August 2016, and March, July, and September 2017, and at several intertidal seep locations in August and October 2016. In addition, monitoring for pH in groundwater was conducted across the Site during complete removal of the CM in 2020.

The full data set used in the RI/FS, incorporating data collected during the 2012 Phase 2 ESA, 2013 RCRA closure, both interim actions, CM removal, and the RI activities spanning several years, is described in Section 6.1.

The samples of soil, groundwater, air, porewater/seeps, and surface water were submitted for chemical analyses using analytical methods specified in the Quality Assurance Project Plan (QAPP; part of the Appendix A to Aspect, 2013c) or subsequent Work Plan Addenda. Pyron Environmental (Pyron) or Laboratory Data Consultants, Inc. (LDC), under subcontract to Aspect, completed independent Level III data quality validation of the analytical data generated during most of the RI, RCRA closure, and both IAs following procedures specified in EPA Contract Laboratory Program (CLP) functional guidelines. Aspect conducted independent validation of analytical data collected during the IA groundwater monitoring and supplemental RI data collection, excluding PCB congener analyses which were validated by Pyron. Based on the validation, all analytical data were of acceptable quality for their intended purposes. The data qualifiers resulting from the validation are included in the data tables in this report and are included in the data uploaded to Ecology's Environmental Information Management (EIM) database. The data validation reports for the RI data collection program are provided in Appendix C. Aspect maintains copies of the numerous raw laboratory reports, and they are available upon request.

Site-wide groundwater level monitoring was conducted in each accessible monitoring well in the Upland Area on four occasions, using an electric well sounder graduated to 0.01 foot. Each of the four rounds was completed within an approximately 2-hour period ("snapshot") during a middle tidal stage to avoid low and high tide conditions. The first Site-wide snapshot of water level measurements (71 wells) was conducted in November 2013. The second round (103 wells) was conducted in May 2014 and included the additional monitoring wells that had been installed that month for IA confirmational monitoring. The third round (102 wells) was conducted in February 2016, in conjunction with the IA confirmational groundwater monitoring event. The third round (68 wells) was

conducted during the March 2017 groundwater monitoring event. Water level measurements were also collected in selected wells during 16 other monitoring events between 2012 and 2017, as described in Section 2.4.4.2.

Section 6.1 describes the collective analytical data set evaluated to document the current (post-IA) contaminant nature and extent in this RI/FS, which includes data from the Phase 2 ESA, both IAs, RCRA closure, and RI characterization work. Appendix B includes the boring/well construction logs for the collective explorations. Table B-1 in Appendix B includes the collective water level data collected from 2012 through 2017. A discussion of the RI activities is provided in the following sections.

4.1 First Interim Action (2013-2014)

In accordance with the Agreed Order, an IA was conducted between August 2013 and May 2014, following mill demolition activities. The IA represented a proactive early cleanup of contaminated soils identified from the Upland Area Phase 2 ESA and RI sampling and analysis, with the goal of expediting the overall Upland Area cleanup process. The IA did not conflict with or eliminate reasonable alternatives for the Upland Area final cleanup action in accordance with WAC 173-340-430(3)(b).

The IA involved excavation and proper off-Site disposal of contaminated soil with the goal of meeting IA soil cleanup levels (IACLs) to the maximum extent practicable. In late September 2013, shortly after the IA excavation program began, K-C contracted to sell the property to a maritime shipbuilding company, with a planned water-dependent industrial redevelopment consistent with City zoning and meeting MTCA requirements to qualify as an industrial property. In light of the anticipated future use as an industrial shipyard with no public access, K-C communicated to Ecology on October 7, 2013, requesting use of industrial-based IACLs, which Ecology agreed to – with the understanding that additional cleanup may be required in these areas (based on unrestricted cleanup levels) if the sale did not go through. From that point forward, the IAs were conducted applying industrial-use IACLs[14].

The IA Plan (Aspect, 2012c), which is included as Exhibit C of the Agreed Order, presents the general IA approach. The IA methods and results are detailed in the IA Report (Aspect, 2015a), and are summarized below, followed by a discussion of the IA confirmational groundwater monitoring program. The IA Report is included in Appendix A.

4.1.1 Soil Removal during First Interim Action

The IA was conducted in the 15 discrete areas of the Site, which are identified on Figure 2-4. In total, the IA achieved permanent removal of approximately 38,450 tons of contaminated material from the Upland Area (Aspect, 2015a).

[14] The soil IACLs identified for industrial use at the K-C site accounted for both human-direct contact and the protection of groundwater beneficial uses (i.e., soil leaching protective of the marine environment).

Throughout the IA, Aspect collected verification soil samples for chemical analysis from the sidewalls and bottoms of the excavations to assess compliance with IACLs. Chemical analyses for the verification soil samples specific to each interim cleanup area were as approved by Ecology. If the excavation verification sampling results indicated that IACLs were not achieved in an area of the excavation, that portion of the excavation was extended (overexcavated) to remove additional soil to meet IACLs to the extent practicable. Soil impacted by petroleum hydrocarbons was left in place beneath very large foundation elements within the USTs 71, 72, and 73 area, and beneath the distribution warehouse (Bunker C ASTs area). In addition, residual soil concentrations of selected metals (primarily copper, mercury, and zinc) within the excavation areas exceed IACLs based on leaching to groundwater for protection of the marine environment.

The first IA included excavation dewatering as needed to facilitate excavation/handling of soil. Water produced during dewatering was treated on-Site using a temporary water treatment system prior to discharge of the treated water to the City's sanitary sewer and publicly owned treatment works (POTW) for further treatment, in accordance with City Discharge Authorization (DA) number 254-13 granted to K-C in July 2013. More than 5.6 million gallons of groundwater were removed from the collective excavation areas for treatment and discharge to the POTW, and more than 6,200 gallons of water with free-phase petroleum product were collected and properly disposed of off-Site.

Monitoring was conducted by qualified archeological personnel from SWCA during excavation within the Bunker C ASTs area, where penetration into underlying native soil was considered possible. The archeological monitoring methods and findings are summarized above in Section 2.3.1.1.

Approximately 24,650 cubic yards of imported aggregate were chemically tested and then used for excavation backfill during the IA. In addition, approximately 1,700 cubic yards of geotechnically suitable overburden soil were excavated from the Bunker C ASTs, Heavy Duty Shop Sump, Naval Reserve Parcel UST, and Naval Reserve Parcel South areas and temporarily stockpiled for sampling and analysis. To satisfy compaction criteria, the overburden soil was used as backfill only above the water table.

All IA data representing in-place soil (i.e., representing current conditions) are incorporated into this RI/FS.

4.1.2 Interim Action Confirmational Groundwater Monitoring (2014-2016)

Postconstruction confirmational groundwater monitoring was conducted for the IA areas, in accordance with the Ecology-approved Confirmational Groundwater Monitoring Work Plan (Aspect, 2014d). The goal of the groundwater monitoring is to assess whether the completed IA soil cleanup activities are protective of groundwater (i.e., whether sources of leachable contaminants have been eliminated). The monitoring program included the monitoring of 38 wells, 36 of which were newly installed, at 14 excavation areas.[15]

[15] Groundwater monitoring was not conducted at the Heavy Duty Shop Sump area since soil contamination was not encountered (refer to IA Report; Aspect, 2015a).

Monitoring was conducted on a quarterly basis for one year (May, August, and November 2014, and February 2015).

The data from the first four quarterly rounds of groundwater monitoring are presented in the *Interim Action Confirmational Groundwater Monitoring Report* (Aspect, 2015d), which recommended ongoing monitoring in some, but not all, of the wells. Both the Work Plan and the Report can be viewed on Ecology's website using the weblink provided in Section 1.

The eight rounds of IA confirmational groundwater monitoring data (May 2014 through August 2016) are incorporated into this RI/FS. Additional groundwater monitoring requirements for the IA areas will be incorporated into the future long-term groundwater monitoring plan for the Site. Additional results from subsequent groundwater monitoring would be summarized and presented to Ecology in annual report(s) in accordance with the future long-term groundwater monitoring plan for the Site.

4.2 Additions to RI/FS Work Plan

While the RI data collection program was underway, additional data collection was completed in accordance with several Ecology-approved addenda to the RI/FS Work Plan (Aspect, 2014b, 2014c, 2015b, 2016a, 2017a, 2017c; Aspect and Anchor QEA, 2015a). These addenda can be viewed on Ecology's website using the weblink provided in Section 1. Those additional data collection activities are described in the following subsections.

4.2.1 Vapor Intrusion Assessment for Distribution Warehouse (March and November 2014)

Petroleum-contaminated soil is present beneath the distribution warehouse located in the southeast corner of the Upland Area. Sampling was conducted in March and November 2014 to evaluate the potential for intrusion of petroleum hydrocarbon vapors (vapor intrusion [VI]) from subgrade soil into the warehouse. In both sampling events, three pairs of collocated sub-slab air samples[16] and indoor air samples were collected and analyzed in accordance with the Ecology-approved sampling plan (Aspect, 2014b). The sampling locations were chosen based on prior sub-slab soil sampling results indicating areas of lighter-range petroleum hydrocarbon releases. In the initial (March 2014) sampling event, indoor air samples were collected prior to sub-slab vapor point installation to avoid potential introduction of sub-slab vapors into the building, which could bias the indoor air sample results. Those sub-slab vapor point installations were then used in the follow-up (November 2014) sampling event as well. Outdoor air samples were also collected at locations upwind of the warehouse at the time of each sampling event to document the ambient background air quality.

Samples were submitted to ALS Environmental for laboratory analysis using a combined Massachusetts Department of Environmental Protection (MassDEP) Air-Phase Petroleum Hydrocarbons (APH) method for petroleum fractions, and EPA Method TO-15 for VOCs as described in the MassDEP APH method standard. Sub-slab vapor samples were also

[16] Samples collected from the void space beneath the distribution warehouse floor slab.

analyzed for helium, which was used as a tracer gas during leak testing to evaluate potential dilution of the sub-slab samples from indoor air intrusion at the sample point locations.

4.2.2 Intertidal Porewater and Seep Sampling (February and August 2014)

Groundwater in the Upland Area discharges to the marine environment of the East Waterway. The results of groundwater sampling at upland monitoring wells located along the Upland Area shoreline indicate concentrations of cPAHs, select metals, un-ionized ammonia, and sulfide that exceed the screening levels based on protection of marine surface water. However, attenuation of constituent concentrations can occur within the tidally influenced nearshore groundwater/surface water mixing zone (transitional zone) prior to discharge to the sediment bioactive zone and then the marine water column. Therefore, intertidal sediment porewater sampling was conducted to evaluate the quality of groundwater entering the East Waterway marine environment in accordance with an Ecology-approved Addendum to the RI/FS Work Plan (Aspect, 2014c). Porewater sampling locations were positioned downgradient of upland shoreline wells where the highest concentrations of metals and/or un-ionized ammonia had been detected in prior groundwater sampling.

Porewater sampling was completed in late February 2014 (wet season) and mid-August 2014 (dry season). Seven sampling locations (PW-1 through PW-7) were proposed; however, PW-1, PW-2, and PW-6 could not be sampled because shoreline armoring (riprap) extended well below the tide level, and there was no accessible intertidal substrate from which to sample porewater during the lower low tidal stages. A substantial surface seep (Seep-1) was observed emanating from the riprap up the shore slope from proposed location PW-1 during both sampling events. Samples of sediment porewater were, therefore, collected from Seep-1, PW-3, PW-4, PW-5, and PW-7 on exposed intertidal beach during lower low tide conditions. The samples were collected during the last 3 hours of the ebb tide and up to 1 hour past the lower low water slack tide. No sample locations were inundated at time of sampling. (Although surface flow was observed at the Seep-1 sample location, the water sample was collected from below the sediment mudline to avoid contact with the atmosphere, using the procedure described below.)

The porewater wellpoint assembly proposed in the Work Plan Addendum (Aspect, 2014b) had insufficient open area to produce measurable water over a period of nearly 20 minutes, despite attempts in multiple locations. Therefore, porewater samples were collected by inserting the proposed sample tubing directly into the substrate to a depth of 4 to 10 inches below mudline. This collection method avoided sample contact with the atmosphere and produced a steady low flow sufficient for sample collection. Porewater from the intertidal sediment was pumped at a rate of less than 0.25 liter per minute through a flow-through cell with continuous reading of field parameters (temperature, pH, specific conductance, oxidation-reduction potential (ORP), and dissolved oxygen). Once the field parameters had stabilized, the flow-through cell was disconnected, and the sample was collected directly from the tubing. In-line filtering (0.45-micrometer [µm] filter) was used for samples to be analyzed for dissolved metals and dissolved sulfide.

During the February and August 2014 porewater sampling events, a sample of surface water (EWW-1) from the East Waterway was also collected to represent local reference water quality. This sample was collected from a depth of approximately 3 feet below the water surface at the barge unloading dock immediately offshore of the Upland Area.

The porewater samples were submitted to ALS Environmental laboratory for analysis of total ammonia, dissolved sulfide, and dissolved metals (arsenic, copper, mercury, and nickel) using analytical methods specified in the QAPP (Aspect, 2013c), and, in the first sampling event, for salinity using Standard Method SM 2520B and total metals. Dissolved lead and zinc analyses were also conducted for the second (August 2014) sampling event.

4.2.3 Supplemental Intertidal Porewater Sampling for Free Sulfide (February 2015)

Following discussion with Ecology regarding the dissolved sulfide concentrations detected during the February and August 2014 porewater monitoring events, a modified sampling and analysis approach to specifically quantify free sulfide, the bioavailable and toxic form of sulfide, was proposed in a Work Plan (Aspect and Anchor QEA, 2015a) reviewed and approved by Ecology. The supplemental porewater sampling was performed in February 2015 using the passive, *in-situ* diffusive gradient in thin film (DGT) gel technology, to obtain tidally averaged concentrations of free sulfide. Sampling probes were advanced during lower low tide conditions at the four intertidal porewater sampling locations (PW-3, PW-4, PW-5, and PW-7) that had detected dissolved sulfide concentrations during the February and/or August 2014 sampling events, and were allowed to equilibrate *in situ* for approximately 49 hours. Anchor QEA (2015) presents the method for calculation of free sulfide concentrations in porewater from the laboratory-measured masses of free sulfide in each sample, along with a discussion of the results and water quality benchmarks for free sulfide.

4.2.4 Supplemental Data Collection Supporting FS (September 2015)

Following Ecology review of the RI Data Report (Aspect, 2014f), additional data collection was conducted to further refine contaminant nature and extent in support of the Upland Area FS, in accordance with an Addendum to the RI/FS Work Plan which can be viewed on Ecology's website (Aspect, 2015b). The supplemental data collection included drilling and soil sampling from 16 new soil borings; soil sampling, installation, and development of two new monitoring wells; and sampling of groundwater from the two new wells and three existing ones. The supplemental data collection was completed in September 2015. In addition, Site-wide water level measurements, and groundwater pH measurements in selected wells, were collected in February 2016 in conjunction with the IA confirmational groundwater monitoring event.

4.2.5 Supplemental Intertidal Seep Sampling (October 2016)

During an August 16, 2016, meeting to discuss preliminary Ecology comments on the draft RI/FS, Ecology expressed concerns that pipes and holes/discontinuities in the Upland Area shoreline bulkhead may represent uncharacterized preferred pathways for upland groundwater to reach the East Waterway. In response, on August 31, 2016, representatives

of K-C and Ecology conducted an initial reconnaissance of the shoreline intertidal area during lower low tide stage. The initial reconnaissance included visual observation and documentation of pipe conditions, pipes discharging water, bulkhead conditions, and diffuse seepage emanating from the intertidal beach. Measurements of water quality field parameters (EC, pH, and temperature) were collected for most of the observed water discharges, and multiple field parameter measurements were collected from select discharge locations during outgoing (ebb) and incoming (flood) tidal stages. Using that information, an Addendum to the RI/FS Work Plan (Aspect, 2016a) was prepared and approved by Ecology to conduct a supplemental round of intertidal seep sampling and analysis. Because the intent was to characterize the quality of upland groundwater discharge, not tidal water, the Addendum required sampling of water discharges with EC less than 25 millisiemens per centimeter (mS/cm).

The supplemental seep sampling program was conducted during lower low tide stages on two nights: October 18 and 20, 2016. On the first night, field parameter measurements were conducted at visible seepage locations across the entire accessible intertidal shoreline. Any seep locations with measured EC below 25 mS/cm were designated for subsequent sampling on the second night. Also at those locations, passive *in situ* diffusive gradient in thin film (DGT) samplers were deployed at a depth of approximately 6 inches below mudline to measure free sulfide concentrations within the sediment bioactive zone, in accordance with the Work Plan Addendum. In total during August and October 2016, field parameters were measured at 16 intertidal locations: 14 beach seeps, an uncapped pipe on the beach under the north end of the (labeled Discharge 4A), and a hole in the timber bulkhead in the timber bulkhead several feet above mudline near the north end of the shoreline (former Naval Reserve parcel), labeled Discharge 1A.

Based on the first night's field measurements, seep samples were collected during the second night at five locations with EC measured below 25.0 mS/cm: Seep-3 located next to the former barge unloading dock near the south end of the former Log Pond, and Seeps-10, -11, -12, and -13 located at the base of the former Naval Reserve parcel timber bulkhead. The field parameter data from saline seeps not sampled for chemical analysis are also presented in this RI/FS. The seep samples were collected using a PushPoint™ stainless steel sampler inserted generally horizontally into the beach to submerge its 4-cm stainless steel mesh screen within the upper 10 cm of sediment. Sampling of the last location (Seep-10) was conducted as the tide water was encroaching on the location, but the sampler remained submerged in sediment[17]. The DGT samplers were also retrieved during the second night, after approximately 48 hours immersion. Ecology participated in both night's activities, and collected split samples for chemical analysis at the Manchester Environmental Laboratory.

Each of the seep water samples were submitted for analysis of total ammonia and dissolved metals (arsenic, copper, lead, mercury, nickel, and zinc) using analytical methods specified in the QAPP (Aspect, 2013c), and for salinity using Standard Method SM 2520B. In addition, the Seep-3 sample was analyzed for low-level PAHs.

[17] Sample Seep-10 was inundated by the tide at the time of sampling.

In addition, the accumulated sulfide mass in the DGT gel samplers was measured using purge-and-trap followed by the colorimetric method (methylene blue) in accordance with Aspect and Anchor QEA (2015a). The accumulated sulfide measured in the DGT and length of sampler deployment were used to calculate porewater concentrations based on diffusive flux relationships presented in Anchor QEA (2015a).

4.2.6 Supplemental Site-Wide Groundwater Sampling (March 2017)

Based on elevated pH and associated metal concentrations in groundwater due to placement of the Crushed Material (see Section 6.3), an additional round of Site-wide wet-season groundwater sampling and analysis was conducted in early March 2017, near the end of the wettest wet season on record for the Puget Sound region. During this event, 56 wells were sampled for field parameter measurements and chemical analysis. Of the 56 groundwater samples collected, all were analyzed for dissolved metals, 6 were analyzed for PAHs, and 8 were analyzed for PCB congeners. The wells selected for PAH and PCB congener analyses were generally positioned to be at or immediately downgradient of areas where those constituents were detected at higher concentrations in the Crushed Material and/or soil. Aspect submitted to Ecology a memorandum summarizing the March 2017 groundwater quality data, as well as groundwater pH data collected subsequently in July and September 2017 (Aspect, 2017e). This memorandum can be viewed on Ecology's website using the weblink provided in Section 1.

4.2.7 Supplemental Investigation of Log Pond (March-July 2017)

Additional investigation of the Log Pond Area was conducted in response to information provided to Ecology in March 2016 by a former Scott Paper employee stating that they had witnessed the placement of demolition debris originating outside the mill property, and debris and barrels (drums) from the mill, during filling of the Log Pond in the late 1970s. A phased investigation was, therefore, conducted between March and July 2017 to supplement the previously collected data from the Log Pond (soil sampling at 18 locations and groundwater sampling from five wells) in accordance with an Ecology-approved Addendum to the RI/FS Work Plan (Aspect, 2017c).

The first step of the investigation was a surface geophysical survey, employing both electromagnetic and magnetometer methods, conducted on north-south transects spaced at 5-foot intervals across the entire footprint of the Log Pond to assess presence of subsurface anomalies potentially representing buried drums or debris (Figure 2-4 shows the extent of the geophysical survey). Based on the geophysical survey results, eight soil borings and two test trenches were advanced at locations of identified geophysical anomalies, with locations agreed to by Ecology. The borings were advanced to depths ranging from 40 to 70 feet, penetrating the entire thickness of Log Pond fill into underlying native soil, using rotosonic methods. The rotosonic drilling method provided continuous, 6-inch-diameter soil cores for field screening and visual observation of non-soil material, and based on that information, soil sampling for chemical analysis. In addition, two test trenches (approximately 25 to 30 feet long) were excavated to expose the former conveyor foundation identified by the geophysical survey and sample soil adjacent to it. In total, 25 soil samples were collected from the borings and trenches for analysis a broad suite of chemicals (gasoline-range total petroleum hydrocarbons

(TPH-Gx), diesel- plus oil-range total petroleum hydrocarbons (TPH D+O) with silica gel cleanup, semivolatile organic compounds (SVOCs) with low-level polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), priority pollutant metals, and polychlorinated biphenyl (PCB) Aroclors. PCB congener analysis was subsequently performed on the three soil samples with the highest total PCB Aroclor concentrations.

Based on observations from the geophysical survey and confirmatory soil borings/trenches, five new monitoring wells were installed at targeted locations, as outlined in Aspect (2017c), and approved by Ecology. Groundwater samples from the new wells and the existing four wells[18] within the Log Pond footprint were collected in July 2017 and analyzed for TPH-Gx, TPH D+O with silica gel, SVOCs with low-level PAHs, VOCs, dissolved priority pollutant metals, PCB congeners, ammonia, dissolved sulfide, and (using DGT methodology) free sulfide. In conjunction with the July 2017 groundwater sampling, groundwater field parameter measurements were also completed in 45 additional wells (65 wells total) to support evaluation of groundwater pH changes over time. Also in conjunction with the July 2017 groundwater sampling, a snapshot set of water levels were collected from the nine wells within the Log Pond footprint and 11 wells located around the perimeter of the Log Pond to provide supplemental water level data to assess groundwater flow directions and groundwater continuity between the Log Pond fill and the fill outside of it.

In addition, because sampling of intertidal porewater/seeps cannot be conducted along the Log Pond shoreline because it is armored with rip rap, surface water samples were collected in three locations (LP-SW-1, LP-SW-2, and LP-SW-3) along the shoreline of the Log Pond in late July 2017. The surface water samples were analyzed for dissolved metals, ammonia, dissolved sulfide, and free sulfide by DGT methodology. The DGT sampler at the LP-SW-2 location was damaged during deployment, preventing collection of free sulfide data for that location. During this sampling, a DGT sample of sediment porewater at the PW-5 location was also collected for analysis of free sulfide.

Finally, slug testing to estimate hydraulic conductivity was conducted in eight wells in the Log Pond footprint, as described in Section 2.4.4.2.3.

4.3 Second Interim Action (2020)

Between May and November 2020, Ecology and K-C executed an amendment to the Agreed Order to allow completion of a second IA. K-C and Ecology agreed to undertake the second IA to remove additional contaminated soils and associated groundwater with a primary goal to control sources of leachable contaminants to groundwater while the rest of the Upland Area MTCA process proceeds.

A *Work Plan for Second Interim Action* (Aspect, 2019b; 2019 IA Work Plan) was prepared as Exhibit A to the Agreed Order amendment, which went through a 30-day public comment period prior to Ecology approval and finalization. The 2019 IA Work Plan presented the approach to remove impacted soil from nine areas of the Site, as well as

[18] Well HW-MW-1, installed at the hazardous waste cage within the Log Pond footprint, was decommissioned during mill demolition so was not available for sampling.

plug upland pipes from the former mill that were open to the East Waterway and thus represented potential conduits for groundwater discharge to the Waterway. In addition, the 2019 IA Work Plan included a plan for monitoring groundwater pH throughout the removal of CM on the Site (discussed in Section 4.5), and potential implementation of contingency action(s) to neutralize groundwater pH if the removal action creates an increase in groundwater pH that poses a risk to the adjacent East Waterway.

The second IA employed the same general procedures for excavation dewatering and soil removal/handling as the first IA and achieved permanent removal of an additional 17,610 tons of contaminated material from the Upland Area. In addition, approximately 2.28 million gallons of contaminated groundwater were removed from the collective excavation areas for treatment and discharge to the POTW via sanitary sewer, in accordance with a City DA. Finally, 18 inactive shoreline pipes were either removed, plugged, or capped at the shoreline and at a distance approximately 75 feet inland (if present) to prevent discharge to the East Waterway. In addition, in September 2019, the City decommissioned their CSO pipe (via filling accessible portions [i.e., manholes] with a low density flowable concrete mix) that traversed the Upland Area and discharged via outfall PS04 beneath K-C's pier in the southwest portion of the Site; the City completed the process by placing a plug in the end of the pipe under the pier in March 2021. All excavations produced during the IA were backfilled with uncontaminated sand backfill and compacted. The second IA procedures and data are detailed in the *Report for Second Interim Action* (Aspect, 2021), which is included in Appendix A.

The second IA did not conflict with or eliminate reasonable alternatives for the Upland Area final cleanup action in accordance with WAC 173-340-430(3)(b). All data representing in-place soil (i.e., representing current conditions) generated during the second IA are incorporated into this RI/FS.

4.4 City of Everett Investigation and Cleanup of Drainage Swale on their Property (2019-2021)

In July 2019, City purchased from K-C the approximately 10 acres containing the former mill wastewater treatment plant portion at the north end of the Upland Area which corresponds to RI Unit E discussed in Section 6 of this RI/FS. The City purchased the property (termed "Utility Property") to repurpose the wastewater treatment plant facility (WWTP) for operation by the City's Public Works Department as an element of the City's combined sewer overflow (CSO) control program. The existing WWTP will be integrated into the City's wastewater system by converting the existing infrastructure into a combined sewage storage facility and constructing new sewers to convey wastewater to and from the facility. The new facility, named the Port Gardner Storage Facility (PGSF), will be used to temporarily store combined sewer flows until the collection system has the available capacity to convey flows to the Everett Water Pollution Control Facility. The PGSF is scheduled to be put into active service by December 31, 2027.

In October 2019, Floyd|Snider, under contract to the City, conducted soil sampling in four test pits excavated to depths up to 6 feet within the shallow drainage swale located along the southern boundary of the Utility Property. The goal of the sampling was to inform

whether there is contaminated soil that requires excavation and off-Site disposal prior to the City's filling and abandonment of the swale. In one test pit, the excavator bucket broke an 8-inch-diameter concrete pipe at approximately 3 feet below ground surface. The pipe, which ran from east to west, appeared to contain a small amount of water. This broken pipe was decommissioned using procedures described in the *Work Plan for Second Interim Action* (Aspect, 2019b).

The sampling results documented concentrations of selected metals (Arsenic, copper, nickel, and zinc) in soil exceeding preliminary cleanup levels (PCLs) applied in this RI/FS. However, there were no exceedances of MTCA industrial PCLs based on human direct contact at any location in the swale. Concentrations of TPH and PAHs in the samples were below respective PCLs.

Following discussion with Ecology, the City agreed with Ecology to take the following remedial actions—documented in a Cleanup Action Plan (CAP) Memorandum (Floyd|Snider, 2021)—to ensure that the conditions at the Utility Property are protective of human health and the environment and will be included in the K-C Upland Area CAP as the only remedial requirements applicable to the Utility Property. The CAP Memorandum for the City Utility Property is included as Appendix D.

The City grubbed the swale area to remove vegetation and then backfilled it with the uncontaminated sand. A temporary earthen berm was then constructed along the southern property boundary to separate drainage on the Utility Property from the Port's property to the south. The entire Utility Property, including the swale, will eventually be paved except for areas of landscaping or open space and the stormwater and combined sewer treatment and storage structures. Any areas that are not contained under paving must have data showing that surface materials (within the top 3 feet) meet MTCA Method A industrial cleanup standards. The City will apply an Environmental Covenant on the Utility Property requiring its use remain industrial and requiring maintenance of pavement and clean surface materials in landscaped areas (Floyd|Snider, 2021; Appendix D).

In 2024, the City is undertaking demolition of selected existing waste treatment infrastructure, including the above-grade portions of the effluent pump station building, the gravity thickener buildings, metal-frame storage building, process mechanical infrastructure, chemical storage tanks, above-grade conveyance pipes, and other interior fixtures throughout the facility. The project includes pre-demolition abatement of regulated building materials identified in the City's regulated building materials assessment for the facility. Subgrade pipelines and tanks to be retained will be video-inspected and cleaned to remove residual process materials or scale, with chemical testing and proper disposition of materials removed. Likewise, soils requiring excavation to accomplish demolition or utility replacement will be chemically tested and disposed of properly. The parking lot on the northeast side of the parcel will remain largely unchanged. Areas disturbed by demolition will be repaved following construction to

achieve the environmental cap requirements prescribed in the CAP Memorandum for the Utility Property.[19]

4.5 Groundwater pH Monitoring during CM Removal

In January 2018, Ecology notified K-C of its determination that the CM placed across 32 acres of the Site in 2013 (see Section 2.2.3.1) violated state and/or local regulations pertaining to solid waste handling and groundwater quality. Ecology further determined that the CM could not remain on-Site and comply with applicable local, state, and federal laws, and requested K-C to respond as to its willingness to remove all of the material (Ecology, 2018). In response to Ecology's determination that the CM cannot remain on-Site, K-C indicated its willingness to remove it subject to development of a feasible local off-Site disposition plan (K-C, 2018b).

The CM removal did not constitute a MTCA remedial action and was not completed under the Agreed Order for the Site. Rather, it was completed as a solid-waste removal project in accordance with the *Plan of Operations for Crushed Material Removal* (K-C, 2018c) that K-C prepared in consultation with the local solid waste authority, Snohomish Health District (SHD). *The Plan of Operations* described guidance and procedures for excavation, transportation, and disposition activities throughout complete removal of the CM. The CM removal project went through SEPA review by the City, and the City then issued permits to K-C authorizing the CM removal work.

Between June and October 2020 and concurrent with the second IA, K-C conducted complete removal and off-Site disposition of nearly 252,000 tons of CM. Of the 252,000 tons of CM removed, approximately 249,000 tons (almost 99 percent) were recycled for resale by Snohomish County facilities regulated by SHD, and 3,000 tons were deemed a non-recyclable mixed waste that was properly disposed of at the Roosevelt Regional Subtitle D landfill in Roosevelt, Washington. Following removal of the CM, K-C imported approximately 150,000 tons of uncontaminated dredge sand[20] for placement, grading, and compaction across the 32 acres from where CM was removed.

The SHD oversaw and reviewed the removal action over its 6-month duration, including conducting visits to the local recycling facilities that processed and recycled the CM for resale. Once all CM was removed, the Engineer of Record, John N. Smith, PE, with David Evans and Associates, Inc., issued a Certification of Completion to confirm that the CM Removal Project was complete (DEA, 2020). At the end of the project, SHD provided to K-C confirmation (SHD, 2021) that the CM removal project was completed in accordance with the conditions agreed to in the *Plan of Operations*.

[19] Based on project plans and specifications http://www.bxwa.com/bxwa_toc/pub/263/ev33_port_gardner_storage_faci_92395/info.php

[20] The backfill material used on the site is from the Port of Everett's Parcel O Dredge Sand generated by the U.S. Army Corp of Engineers from navigational dredging of the Snohomish River. Analytical testing of this material showed that it is below preliminary soil cleanup levels for the contaminants of potential concern identified at the site (Aspect, 2019a).

Monitoring of groundwater pH throughout the CM removal project was conducted as a component of the second Interim Action to assess whether the action created an increase in groundwater pH that posed a risk of migration to the East Waterway. The pH monitoring was conducted in general accordance with the pH monitoring plan included as Appendix E to the Work Plan for Second Interim Action (Aspect, 2019b).

Monitoring of 35 wells positioned downgradient of the active CM excavation work over more than 4 months of CM removal documented no pH increase attributable to the CM removal action. The collective pH monitoring data demonstrate that removing the more than 250,000 tons of CM from the Site did not create migration of high-pH groundwater toward the East Waterway. The pH monitoring is detailed in Appendix F to the Report for Second Interim Action (Aspect, 2021).

4.6 MIE Geotechnical Explorations (2020-2022)

Between September 2020 and August 2022, Landau Associates completed three separate phases of geotechnical investigation of the Upland Area on behalf of the Port to support the MIE project. The work included advancement of 10 soil borings (MIE-SB-1 through MIE-SB-10) to 30 feet bgs, 3 soil borings (B-1-2022 through B-3-2022) to 80 feet bgs and excavation of 12 exploratory test pits to evaluate groundwater pH (TP-1 through TP-8) or to evaluate subsurface conditions to inform structural design (TP-1-2022, TP-2-2022, TP-2R-2022, and TP-3-2022). During advancement of the borings, soil was field screened and select soil samples were collected for chemical analysis. The results of this work are summarized in the July 15, 2021, memorandum regarding Maritime Industrial Expansion Project Geotechnical Borings (Landau, 2021a) and the January 3, 2023, memorandum regarding K-C Warehouse Seismic Assessment (Landau, 2023). The sample locations are identified on Figure 2-4.

Field screening did not indicate potential contamination at any soil from the MIE- series borings (Landau, 2021a). Odors, elevated PID measurements, or sheen were noted in borings B-2-2022 and B-3-2022 (Landau, 2023). Soil samples collected from the borings were screened against the IACLs established for the K-C Second IA. Most of the analytical data from the soil samples were either nondetect or detected at concentrations below the IACLs, with a few minor exceedances noted for TPH, cPAHs, and metals (Landau, 2021a and 2023). Investigation-derived waste from the exploration programs was profiled and properly disposed of.

4.7 Combined Sewer Main Improvements (2022)

Between March and June 2022, the City constructed their Combined Sewer Main Improvements (CSI Project) that involved excavating an approximately 3,300-foot-long deep utility trench aligned south to north through the middle of the Upland Area, from the Federal Avenue right-of-way (within the ExxonMobil/ADC cleanup site) south of the Upland Area to the City's Utility Property on the north end of the Upland Area (alignment shown on Figure 2-4).

Intrusive activity in both the ExxonMobil/ADC and K-C Sites were conducted in accordance with the Soil and Groundwater Management Plans for the ExxonMobil/ADC

Site (Landau, 2021c) and for the K-C Upland Area (Landau, 2021d). Both plans were prepared by the Port to guide intrusive activities during the Norton Terminal MIE project and were adopted by the City for their CSI Project. Each trench section was shored using slide rails and steel sheets and left open while crews completed installation of each pipe section; final excavation depths ranged between approximately 10 and 18 ft below existing grade.

All material excavated from the ExxonMobil/ADC Site was exported for landfill disposal (Landau, 2022b). Material excavated from the K-C Upland Area was field-screened and segregated into four categories: soil suitable for reuse, potentially contaminated soil, geotechnically unsuitable soil that did not have field-screening indications of contamination, and concrete and treated wood debris (Landau, 2022b). Materials deemed unsuitable for reuse were stockpiled, chemically tested for waste profiling, and properly disposed of offsite. As documented in the CSO Construction Report (Landau, 2022b), quantities of materials excavated and disposed offsite included:

- 7,962 tons of potentially contaminated soil from the combined Exxon/Mobil Site and K-C Upland Area were thermally treated and landfilled at the Cadman Delta Remediation Facility in Everett, Washington.
- 11,254 tons of soil from the Upland Area deemed to be geotechnically unsuitable and not potentially contaminated was disposed of at the OMA Construction Mountain Loop Mine located in Maple Valley, Washington.
- 125 tons of treated wood from the Upland Area was disposed at the Columbia Ridge Subtitle D landfill in Arlington, Oregon.

Concrete rubble excavated from the trench was recycled at a permitted recycling facility. The excavated soil reused as backfill material is now located under the low-permeability cap installed during the Port's third IA.

During trenching and pipe installation, approximately 11,884,200 gallons of groundwater were pumped from the shored trench areas, treated to remove settleable solids in weir tanks, and then discharged to the City's sanitary sewer system under a Discharge Authorization. No additional treatment or removal of NAPL or other contaminants was necessary to meet City discharge criteria before being discharged to the sanitary sewer.

Nine pipes encountered during trenching were cut, water in them was pumped out, treated, and discharged to sewer, and both open ends of the pipe were grouted.

Prior to placement in the trench, the imported aggregate backfill was chemically tested to document compliance with PCLs (Landau, 2022b).

4.8 Third Interim Action (2021-2023)

In May 2021, Ecology, the Port, and K-C executed a second amendment to the Agreed Order to allow for the performance of a third IA, to be completed concurrently with the MIE project. The third IA was led by the Port and performed in conjunction with initial site development to put the Site back into productive use to support the Port's marine terminal activities. The third IA was performed in accordance with the Interim Action

Work Plan (Landau, 2021b; 2021 IA Work Plan), which included a Soil and Groundwater Management Plan to outline procedures for managing soil, groundwater, and stormwater during implementation of the third IA, and Interim Action Work Plan Addendum No. 1 (Landau, 2022a). The third IA consisted of site grading, cap construction, utility installation, outfall reconstruction, soil and groundwater management, and security fencing installation.

Site grading included importing, grading, and compacting clean fill to support construction of the low-permeability cap, which was designed to reduce surface water infiltration and prevent terrestrial ecological exposure to contaminated soil. The low-permeability cap is constructed of 9 inches of asphalt pavement (Landau, 2024). During the earthwork, subgrade utilities were installed to minimize future disturbance of the cap. The IA included construction of a new stormwater drainage and conveyance system integrated into the environmental cap, a new chitosan-enhanced sand filtration treatment system for stormwater, and reconstruction of existing stormwater outfalls A and M for discharge of the treated water to the East Waterway. The Site was previously fenced, but the Port required that upgraded security fencing be installed to support the MIE project.

The third IA was successfully completed in May 2023. The construction report for the third IA is included in Appendix A.

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5 Preliminary Cleanup Levels (PCLs)

This section describes development of the numerical screening levels, also known as preliminary cleanup levels (PCLs), developed in accordance with MTCA, which are used for comparison with Upland Area soil, groundwater, and air data. The following subsections describe the Upland Area land-use assumptions, the means by which human or ecological receptors may be exposed to soil or groundwater contamination (exposure pathways), and the resulting derivation of numerical PCLs and points of compliance for use in the RI.

5.1 Current and Future Land and Water Uses

5.1.1 Land Use

Except as described in Section 5.1.1.2 for the Warehouse Subarea, the current and future land use of the Upland Area meets MTCA criteria for an industrial property (WAC 173-340-200 and -745(1)). The Upland Area is located within a long-term industrial area, and it has historically been zoned Industrial, M-2 Heavy Manufacturing. In January 2013, after the City completed its Central Waterfront Planning which included coordination with K-C, the City reaffirmed the Upland Area's industrial zoning, but with modifications as discussed below. At that time, the City adopted a new land-use plan, the Central Waterfront Redevelopment Plan (CWRP), as a Subarea Plan of the Everett Comprehensive Plan. The CWRP imposes a modified M-2 zoning on the Central Waterfront Planning Area, which includes the Upland Area property. The approved alternative allows for water-dependent uses within the shoreline jurisdiction (i.e., minimum of 200 feet from the Ordinary High Water Mark), and, outside of the shoreline jurisdiction, a mix of water-dependent and non-water-dependent uses, both industrial and nonindustrial.

As described in Section 2.1, the City owns the northernmost approximately 9 acres of the Upland Area (Utility Property) for stormwater management purposes. The future land use of the City Utility Property is described Section 5.1.1.1. The Port owns the remaining approximately 46 acres that it has designated for maritime industrial use (Maritime Industrial Expansion – Norton Terminal) under its Marine Terminal Master Plan except for the existing Warehouse, which may be repurposed for commercial use, as discussed in Section 5.1.1.2. The future land use of the Upland Area is depicted on Figure 5-1.

Consistent with these planned uses, the Upland Area excluding the Warehouse Subarea meets the MTCA requirements for an industrial property designation in MTCA (WAC 173-340-745(1)(a)(i)):

> (A) People do not live on the Upland Area property. The property is currently unoccupied, and the primary future exposure will be to adults engaged in industrial work activities on the property.
>
> (B) Access to the Upland Area property by the general public is not allowed currently, and it will be limited in the redeveloped condition. The City has preliminary plans to

establish a public access corridor from Norton Avenue to the East Waterway along the southern boundary of its Utility Property. The access path will be paved to prevent exposure to underlying soils and will be fenced on both sides for physical safety reasons. There will be no public access to the Port's Norton Terminal.

(C) Food is not currently grown/raised on the Upland Area property, nor will it be in the redeveloped condition.

(D) Operations at the Upland Area property will be characterized by truck traffic, noise and, potentially, the use and storage of chemicals.

(E) The surface of the Upland Area property will be mostly covered by buildings and paved parking lots and access roads that minimize potential exposure to the soil.

(F) Apart from the City's potential public access corridor, the redeveloped Upland Area property will not contain facilities serving the general public.

An environmental covenant will be executed as a component of the Cleanup Action Plan (CAP) requiring that the Upland Area be used only for industrial uses, as defined in MTCA, unless additional remedial actions are conducted to meet cleanup standards for unrestricted use, as approved and formally documented by Ecology. The environmental covenant will also include other cleanup-related restrictions, including ensuring protections within the Warehouse Subarea if developed for non-industrial (commercial) use. Section 8.6.5 provides additional detail regarding the environmental covenant.

5.1.1.1 City Utility Property

The Utility Property includes the former Kimberly Clark industrial WWTP (Figure 5-1) and qualifies as traditional industrial use under MTCA. The City intends to redevelop and reuse the majority of existing infrastructure following a selective demolition process occurring in 2024. Additional infrastructure will be constructed, as needed, and the Utility Property will be repaved following construction activities to meet requirements in the property's CAP Memorandum. As agreed to with Ecology, the City will record a restrictive environmental covenant for its Utility Property to ensure that its land use remains industrial (Floyd|Snider, 2021).

5.1.1.2 Distribution Warehouse Subarea

The Port may consider repurposing the distribution warehouse for commercial use in the future. The viability of this option has yet to be determined but the RI has been prepared to address potential commercial receptors and exposure pathways under the assumption that the warehouse may be used in the future for commercial use purposes and will not include any full-time residents.

In accordance with MTCA, land uses other than residential and industrial (e.g., commercial, recreational, etc.) shall not be used as the basis for establishing cleanup levels (WAC 173-340-708(3)(d)(ii). The potential future commercial land use scenario associated with the Distribution Warehouse Subarea is identified as an alternate reasonable maximum exposure (RME) scenario for the purposes of assessing the protectiveness of the remedy. Except for soil gas and indoor air media associated with the vapor intrusion pathway, PCLs for commercial workers are conservatively based on

standard Method B exposure assumptions and may be applied as cleanup levels as part of the FS and CAP. If the warehouse is redeveloped for commercial use, remediation levels for soil gas and indoor air media based on adult commercial worker exposure (not residential) will be applied for assessing the protectiveness of the remedy. However, the cleanup levels for soil gas and indoor air will be established under Method B for the commercial worker scenario. The development of PCLs and commercial-use remediation levels is discussed in Section 5.3.

5.1.2 Water Use

The Upland Area is within the City's municipal water service area and is supplied with potable water from the City. There are no operational groundwater supply wells on the property; water wells historically used for the mill's water supply have been properly decommissioned. The availability of municipal water supply, and City ordinances requiring entities within the water service area to connect to the municipal water supply, effectively preclude the use of groundwater within the Upland Area as a potable water supply. Ecology has determined that groundwater within the Upland Area is not a reasonable future source of drinking water given proximity to marine surface water (also see Section 5.2.2).

5.2 Potential Receptors and Exposure Pathways

An exposure pathway describes the mechanisms by which human or ecological exposure to contaminants can occur assuming no remedial action or protective control is in place. An exposure pathway is considered complete if a human or ecological receptor can be exposed to a contaminant via that pathway. Potential pathways for receptors to be exposed to Upland Area contaminants in soil, groundwater, and the marine environment (through groundwater discharge) are outlined below. As discussed in Section 1, the Site includes a portion of the East Waterway termed the In-Water Area, and there are potential exposure pathways associated with sediment and surface water in the In-Water Area; however, those pathways will be addressed as part of the RI/FS for the East Waterway.

5.2.1 Soil Exposure Pathways

Current and future potentially complete exposure pathways for soil under the planned future site use are identified below:

- Worker[21] incidental ingestion and dermal contact with contaminants in soil;
- Worker exposure through inhalation of soil contaminants (as particulates) that have migrated to air as windblown or fugitive dust; and
- Worker exposure through inhalation of soil contaminants (as soil vapor) that have migrated to indoor and/or outdoor air.

[21] "Worker," as referenced under the Soil Exposure Pathways section, includes both adult industrial workers in the Upland Area industrial-use area and adult commercial workers in the Warehouse Subarea if it is redeveloped for commercial use.

In addition to these pathways, contaminants in soil can leach to groundwater, acting as a secondary source.

The K-C Upland Area qualifies for an exclusion from conducting a terrestrial ecological evaluation (TEE) in accordance with WAC 173-340-7491(1)(b). That exclusion specifies that no TEE is required if:

> "All soil contaminated with hazardous substances is, or will be, covered by buildings, paved roads, pavement, or other physical barriers that will prevent plants or wildlife from being exposed to the soil contamination. To qualify for this exclusion, an institutional control shall be required by the department under WAC 173-340-440. An exclusion based on planned future land use shall include a completion date for such development that is acceptable to the department."

These conditions will be met for the planned future use of the Upland Area. Under the planned future land use, soil across the entire Upland Area, contaminated or not, will be covered by pavement, buildings, and/or landscaped areas (soil covers) that provide an effective physical barrier to prevent plants or wildlife from being exposed to underlying soil contamination where present.

In conjunction with the environmental capping, an institutional control (environmental covenants) would be executed by the City and by the Port, in accordance with WAC 173-340-440, requiring the periodic inspection and maintenance of the environmental caps after the cleanup action is implemented. These cleanup elements would be incorporated into the CAP for the Upland Area. The completion date for achieving the required containment of the Upland Area soil will be determined with Ecology by the time the CAP is executed.

5.2.2 Groundwater Exposure Pathways

Section 5.1 of the RI/FS Work Plan (Aspect, 2013c) explains the rationale for classifying the Upland Area groundwater as nonpotable water in accordance with WAC 173-340-720(2). That information is not reiterated herein. Because of this classification, potable use of groundwater is not considered a potentially complete exposure pathway.

Current and future potentially complete exposure pathways for groundwater include the following:

- Construction or utility workers contacting contaminated groundwater during excavation or other construction-related activities;
- Industrial or commercial workers (including construction workers) inhaling indoor or outdoor air containing contaminants that have volatilized from shallow groundwater;
- Marine ecological receptors receiving direct exposure to groundwater contaminants discharged to sediment or surface water; and
- Higher-trophic-level marine organisms or humans consuming marine ecological receptors contaminated by groundwater discharges to sediment or surface water.

5.3 Development of Soil, Groundwater, and Air Preliminary Cleanup Levels

Sections 5.3.1, 5.3.2, and 5.3.3 describe the derivation of PCLs for groundwater and soils, and air, respectively. In accordance with MTCA, PCLs are not set at concentrations less than the analytical practical quantitation limit (PQL) or natural background conditions. Points of compliance where the PCLs apply are discussed in Section 8.

5.3.1 Groundwater PCLs

Because drinking water is not a practicable future use for groundwater at the Upland Area, the groundwater PCLs address the most stringent criteria for protection of the adjacent marine water body (East Waterway) and protection from VI into current and future structures (indoor air) on the property. However, for the purposes of the RI, groundwater cleanup levels based on drinking water (potable) use are applied if surface water quality criteria are not available, in accordance with WAC 173-340-720(6)(b)(i). Sections 5.3.1.1 and 5.3.1.2 describe the criteria for marine protection and protection against VI, respectively, which are incorporated into the groundwater PCLs. Section 5.3.1.3 describes the application of potable groundwater criteria. For arsenic, a Site-specific background concentration was established at 9 µg/L and this background value is used as the groundwater PCL for the RI (Appendix E).

Based on an evaluation of the metals data from unfiltered groundwater samples versus filtered groundwater samples ("total" versus "dissolved" metals data, respectively) (Aspect, 2014e), Ecology determined that dissolved metals are the appropriate measurement to represent groundwater quality for the Upland Area. Consequently, for this RI/FS, the groundwater PCLs for metals apply to dissolved metals data. In accordance with the RI/FS Work Plan prepared prior to Ecology's determination, the RI groundwater samples were analyzed for total metals, and unfiltered samples with total metal(s) detected at concentrations greater than the PCLs were subsequently also analyzed for dissolved metals. The concentration resulting from a total metals analysis will generally be greater than the concentration resulting from a dissolved metals analysis of the same groundwater sample. Therefore, for samples lacking a dissolved metals analysis, total metal(s) concentrations less than the PCL for that dissolved metal comply with the PCL. The data tables and mapping in this report apply that convention.

The federal and state water quality criteria for ammonia are established for the un-ionized form (toxic form); therefore, groundwater PCLs apply to un-ionized ammonia not total ammonia.

Table 5-1 presents the water quality criteria incorporated into the groundwater PCL derivation, and the resulting most stringent groundwater PCLs to be applied for the RI to the industrial use area of the Upland Area, including the City Utility Property and Norton Terminal. Table 5-2 presents the water quality criteria incorporated into the groundwater PCL derivation for the Warehouse Subarea, which considers protection of vapor intrusion for unrestricted land use in consideration of potential future repurposing of the warehouse for commercial uses. Note that Tables 5-1 and 5-2 only include constituents that were detected in samples of either soil or groundwater collected from the Upland Area;

constituents not detected in either medium are not presented to make the table more manageable.

5.3.1.1 Protection of Marine Water Quality

In accordance with MTCA, groundwater PCLs protective of surface water incorporate MTCA surface water cleanup levels, including criteria from applicable state and federal laws (WAC 173-340-730). For the protection of marine water quality, the PCLs are the most stringent of the following aquatic life criteria (marine chronic) and human health criteria for consumption of aquatic organisms under state and federal laws:

- MTCA standard Method B surface water cleanup levels based on human consumption of fish (human health only);
- Washington State Water Quality Standards (WAC 173-201A-240);
- National Recommended Water Quality Criteria pursuant to Section 304(a) of the Clean Water Act;
- Clean Water Act Section 303(c) (40 CFR 131.45) human health surface water criteria; and
- MTCA Method B predicted protective concentrations of petroleum hydrocarbons developed by Ecology under WAC 173-340-730.

5.3.1.2 Protection from Vapor Intrusion

Volatilization of contaminants in shallow groundwater is a potential issue in terms of VI to current and future structures (indoor air). For the purposes of the RI, the MTCA Method C groundwater VI screening criteria for industrial use[22] are used for the area outside of the Warehouse Subarea (Table 5-1). For the Warehouse Subarea, the MTCA Method B groundwater VI screening criteria for unrestricted use are used (Table 5-2). Air sampling results can also be used to empirically assess the groundwater-to-air pathway, in accordance with Ecology (2022).

5.3.1.3 Other PCLs

Many chemicals for which samples were analyzed as part of the RI do not have groundwater PCLs based on either marine surface water protection or VI protection. For those chemicals, MTCA standard Method B groundwater cleanup levels (based on potable groundwater use), if available, are applied as groundwater PCLs for the purposes of the RI, in accordance with WAC 173-340-720(6)(b)(i).

5.3.2 Soil PCLs

Consistent with the projected and/or potential future use of the Upland Area, soil PCLs for unrestricted land uses are applied to the Warehouse Subarea and soil PCLs for industrial land uses are applied to the rest of the Upland Area. The unrestricted soil PCLs are the most stringent concentrations that are protective of direct contact by any human receptors and soil leaching to groundwater. The industrial soil PCLs are the most stringent

[22] From Ecology's Cleanup Level and Risk Calculation (CLARC) database (February 2023). https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx

concentrations that are protective of direct contact by industrial workers and soil leaching to groundwater.

The values considered for each exposure pathway are described in the following subsections. Table 5-3 presents the criteria incorporated into the soil PCL derivation for the protection of industrial workers and the resulting PCLs applied for the RI. Table 5-4 presents the criteria incorporated into the soil PCL derivation for the Warehouse Subarea for the protection of commercial workers and the resulting PCLs applied for the RI. Note that Tables 5-3 and 5-4 only include constituents that were detected in samples of either soil or groundwater collected from the Upland Area; constituents not detected in either medium are not presented to make the table more manageable.

5.3.2.1 Direct Contact Exposure Pathway

Soil concentrations protective of direct human contact under industrial land use are the more stringent of the MTCA standard Method C soil cleanup levels[23] and, as described below, selected MTCA Method A industrial soil cleanup levels. For the Warehouse Subarea, soil concentrations protective of direct human contact for unrestricted land use are the standard MTCA Method A or Method B unrestricted land use soil cleanup levels.

Most MTCA Method A soil cleanup levels are based on either direct contact using the standard Method B equations (WAC 173-340-745[5][b]) or protection of groundwater for drinking water (potable) use. The highest beneficial use of Upland Area groundwater is discharge to marine water, not drinking water. Therefore, the Method A soil cleanup levels based on groundwater protection are not applicable, and this pathway is addressed separately using the most stringent groundwater criteria in accordance with MTCA (described below). In addition, the Method A industrial soil cleanup levels based on direct contact are covered by including standard Method C cleanup levels in the PCL derivation. For the purposes of the RI, the Method A industrial soil values that were included in the derivation of soil PCLs include arsenic (background-based), lead (no Method C value), total PCBs (an applicable or relevant and appropriate requirement [ARAR] from the federal Toxic Substances Control Act [TSCA]), and petroleum mixtures (TPH-G, TPH-D, and TPH-O).

5.3.2.2 Soil Leaching to Groundwater Exposure Pathway

Soil concentrations protective of the highest beneficial use of groundwater were calculated conservatively using Ecology's variable parameter three-phase partitioning model (WAC 173-340-747(5)) and the most stringent groundwater criteria for protection of VI and marine water quality (described above). Separate values were developed for unsaturated and saturated soil (MTCA-default dilution factors of 20 and 1, respectively), in accordance with WAC 173-340-747(4)(e). MTCA-default parameters (WAC 173-340-747(4) and (5)) were used in the three-phase model, except that a Site-specific soil fractional organic carbon content (f_{oc}) of 0.0079 (0.79 percent) was used for calculating soil-water partition coefficients ($K_d = K_{oc} \times f_{oc}$) for organics, in accordance with WAC 173-340-747(5)(b)(i). This is the average f_{oc} value from 24 Upland Area soil samples collected during the 2012

[23] From Ecology's Cleanup Level and Risk Calculation (CLARC) database (February 2023). https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx

independent Phase 2 ESA. Two sample f_{oc} values were excluded from the calculation of the site-wide average f_{oc}: the 0.0564 foc measurement in sample GF-B-3-11-12.5 was determined to be a statistical outlier (high), and sample GF-B-9-7.5-9 (f_{oc} = 0.0048) contained an elevated diesel-range TPH concentration (6,400 mg/kg). In addition, two soil samples that were subsequently removed during interim action excavations—thus are not representative of current Site soil conditions—were excluded from the calculation. Although large quantities of aggregate were imported to the Site for use as excavation backfill during the interim actions, these materials are not contaminated and were, therefore, excluded from the determination of Site-specific soil f_{oc} in accordance with MTCA (WAC 173-340-747(5)(b)(i)). Table 5-5 presents the Site-specific soil f_{oc} data used in the calculation, and the excluded values. Because Ecology's CLARC database does not define a soil organic carbon-water partition coefficient (K_{oc}) or Henry's Law constant for cPAH mixtures, the values for those parameters assigned for total cPAHs in the calculations was the average of CLARC's listed values for the seven individual cPAH compounds.

As agreed to with Ecology, the soil-to-groundwater pathway is not considered for constituents that have not been positively identified in groundwater at concentrations exceeding groundwater PCLs. Constituents for which the soil-to-groundwater pathway is considered in the derivation of soil PCLs are presented in Tables 5-3 and 5-4 ("Y" in the column labeled "Groundwater Exceedances Confirmed Empirically for Analyte?").

The soil concentrations predicted by this MTCA-default methodology are intentionally conservative for the purposes of data screening in the RI. Because this default methodology is a conservative predictive model rather than an empirical measurement, it is possible that soil concentrations greater than these PCLs are not actually leaching contaminants to groundwater at concentrations exceeding groundwater PCLs. MTCA provides a range of options to evaluate Site-specific soil concentrations protective of groundwater, including the use of soil leaching tests and empirical groundwater quality data, as outlined in WAC 173-340-747. Empirical groundwater data indicating that groundwater meets PCLs is the strongest and most reliable evidence that soil concentrations in that vicinity (upgradient) are protective of groundwater. The demonstration of whether soil concentrations are protective of groundwater is evaluated based on all RI data (Section 6.3), which factors into soil cleanup levels established for the Upland Area.

5.3.2.3 Risk-Based Soil PCLs for Petroleum Mixtures

Site-specific, risk-based Method C soil PCLs can be calculated for TPH mixtures, addressing all exposure pathways (including soil leaching to groundwater) using volatile petroleum hydrocarbon (VPH) and/or extractable petroleum hydrocarbon (EPH) data to quantify concentrations of aromatic and aliphatic hydrocarbons in specific carbon ranges for the specific petroleum product, in accordance with MTCA (WAC 173-340-745(5)(b)(iii)(B)(III)). This approach is implemented for specific areas of industrial land use in the Upland Area where residual petroleum remains in place following interim actions as presented in Section 6.5, and the MTCA calculations are detailed in Appendix F. Because of the multiple petroleum types beneath the warehouse building, MTCA

Method A soil cleanup levels are applied for TPH irrespective of future land use within the Warehouse Subarea.

5.3.3 Air PCLs and Screening Levels

For the potential future commercial use of the distribution warehouse, default indoor air and sub-slab soil gas screening levels for the protection of adult commercial workers are applied for indoor air and crawl space soil gas samples collected from the distribution warehouse. Table 5-6 lists the unrestricted Method B PCLs for indoor air and screening levels for sub-slab air as well as the commercial screening levels for indoor air and sub-slab soil gas. For future industrial land use of the distribution warehouse, PCLs for indoor air are the MTCA standard Method C air cleanup levels. The indoor air data and PCLs were evaluated for compliance purposes, whereas the sub-slab air data and screening levels were used for informative/diagnostic purposes with respect to VI contribution to concentrations detected in the indoor air samples.

6 Remedial Investigation Results

6.1 Data Set Used for Remedial Investigation

Site characterization activities supporting the RI/FS were conducted as described in Section 4. Data used in the RI/FS include those collected during numerous phases of investigation as well as planning for and/or implementation of three IAs, as described in Section 4, between February 2012 and early 2021. The data used in the RI/FS represent current conditions for the Upland Area, following the IAs and removal of the crushed material (CM). Soil and groundwater samples from locations that were subsequently excavated during the IAs are not included in the data set used in the RI/FS. Likewise, because all CM has been removed from the Site, data characterizing the chemical composition of the CM are not included in the RI/FS data set; however, the RI Data Report (Aspect, 2014f) presents those data.

Therefore, the RI/FS data set provided and discussed herein includes the following approximate numbers of samples and chemical analyses by media:

- 1,486 samples and 10,705 analyses for soil
- 626 samples and 4,155 analyses for groundwater
- 46 samples and 142 analyses for intertidal porewater/seeps and surface water
- 14 samples and 48 analyses for air

6.2 Site Units for Remedial Investigation

As detailed in the RI/FS Work Plan (Aspect, 2013c), the site characterization activities supporting the RI/FS were conducted based on the potential for hazardous substances to be present within the historical operational areas of the Upland Area. Because of the proximity of many of the historical operational areas, the site characterization explorations targeting some areas often overlap with other areas; therefore, some explorations provide useful information for the assessment of more than one operational area, particularly for monitoring groundwater quality.

Hence, for the purposes of compiling, depicting, and evaluating data in the RI, the Upland Area has been divided into five site units (A through E, from south to north) based primarily on historical operations and site conditions. Unit A has further been segregated to discuss data collected from within the Warehouse Subarea (commercial land use) separately from the rest of Unit A (industrial land use), and Unit C has further been segregated to discuss subsurface conditions and data collected inside of the Former Log Pond separately from the rest of Unit C. The unit boundaries and the extent of the Warehouse Subarea are depicted on Figure 2-4. The unit boundaries and the extent of the Former Log Pond are also depicted on Figure 2-4. As described in Section 2.4.4, groundwater within the Upland Area flows generally from east to west and discharges to the East Waterway. Each unit spans the east to west extent of the Upland Area (i.e., the upgradient to downgradient extent), facilitating an assessment of potential groundwater

contaminant transport along the complete groundwater flow path within the Upland Area. The individual units are described in the following subsections.

6.2.1 Unit A

The boundaries, current and historical features, IA excavation areas, and collective explorations for Unit A are depicted on Figure 6-A1. The warehouse is the only building remaining within Unit A. The historical operational areas identified within Unit A are the following:

- Former Bulk Fuel Storage Facilities (Standard Oil and Associated Oil)
- Old Machine Shop area

During the first IA, the only IA area within Unit A was the Bunker C ASTs area (Aspect, 2015a). The second IA included soil removal within the Old Machine Shop area (Aspect, 2021).

6.2.2 Unit B

The boundaries, current and historical features, IA excavation areas, and collective explorations for Unit B are depicted on Figure 6-B1. Currently, no structures remain within Unit B. The historical operational areas identified within Unit B are the following:

- Acid Plant
- Boilers area
- Pulp Mill area
- Hog Fuel Pile
- Old Paint Shop area (location 18 on Figure 2-2)
- Central Maintenance Shop area

During the first IA, the IA areas within Unit B were the following (Aspect, 2015a):

- Bunker C USTs 71, 72, 73 area
- Boiler/Baghouse area
- GF-11 area
- Heavy Duty Shop Sump area
- Rail Car Dumper area
- UST 70 area
- REC2-MW-5 area (near Diesel AST)
- BA-MW-6 area

During the second IA, the IA areas within Unit B were as follows (Aspect, 2021):

- Central Maintenance Shop (CMS) area
- PM-B-6 area

- Additional soil from the Boiler-Baghouse area, which also included the GF-B-12 area
- REC5-MW-1 area
- BA-MW-7 area
- Digester Trench area

6.2.3 Unit C

The unit boundaries, current and historical features, IA excavation areas, and collective explorations for Unit C are depicted on Figure 6-C1. The historical operational areas identified within Unit C are the following:

- Former Log Pond
- Hydraulic Barker Building area
- Engineering/Maintenance Building area
- Chip Screen Building area
- Small Hydraulic Barker Building area

During the first IA, the only IA area within Unit C was the SHB-MW-1 area (Aspect, 2015a). During the second IA, the IA areas within Unit C were as follows (Aspect, 2021):

- Log Pond Chip Conveyor area
- Hydraulic Barker area

The northern boundary for Unit C has been slightly adjusted from its previous configuration defined in Aspect (2013c) to include the entire extent of the Former Log Pond. Given this adjustment, a portion of Snohomish PUD's electrical substation is located within Unit C. The electrical substation is not currently in operation. No other structures remain within Unit C.

6.2.4 Unit D

The unit boundaries, current and historical features, IA excavation areas, and collective explorations for Unit D are depicted on Figure 6-D1. Currently, no structures from the mill remain within Unit D. The only existing structure within Unit D is a portion of Snohomish PUD's electrical substation, which is not currently in operation. The historical operational areas identified within Unit D are the following:

- Main operational area of the Clark-Nickerson (CN) Lumber Mill
- Former Naval Reserve Property
- Tissue Mill area of the K-C Mill

During the first IA, the IA areas within Unit D were the following (Aspect, 2015a):

- Naval Reserve Parcel UST area
- Naval Reserve Parcel South area
- CN-B-2 area

- UST 29/Latex Spill area
- Hydraulic Barker Vault area

The second IA included additional soil removal from the CN area (East and West), adjacent to the CN-B-2 excavation, within Unit D (Aspect, 2021).

6.2.5 Unit E

The unit boundaries, current and historical features, and collective explorations for Unit E are depicted on Figure 6-E1; no IA work was conducted in Unit E. Historically, the primary use of Unit E was for timber storage by the Clark-Nickerson Lumber Company mill (late 1800s through early 1930s) (Figure 2-2). The area was later developed as the pulp/paper mill's Wastewater Treatment Plant, and a portion of the area was used as a parking lot; the wastewater treatment plant infrastructure and the parking lot pavement remain in place. Unit E is the entirety of the City Utility Property as described in Section 2.1.1.

6.2.6 Data Presentation

As described in Section 6.1, a very large RI data set is available from the combined Phase 2 ESA, RCRA closure, two IAs, and RI data collection efforts. Sample data representing soil or groundwater removed during the two IAs are not representative of current Upland Area conditions and are not included in the RI data set.

Tables 6-1 and 6-2 are statistical summaries of the collective soil and groundwater data, respectively, representing current conditions for the Upland Area. The two tables present, for each constituent analyzed, the number of sample locations, the number of samples analyzed, the number of samples with detectable concentrations, the detection frequency (percent), the maximum detected concentration, and the number of samples with detected concentrations exceeding the PCL. Table 6-1 compares the soil data for each constituent against the PCL, which is the most stringent value addressing both industrial direct contact and groundwater protection as described in Section 5.3.2. However, the table also presents in a separate column the comparison of soil data to the industrial direct contact criteria. Distinguishing between criteria based on direct contact and groundwater protection (based on MTCA's conservative predictive analysis) is pertinent to the data evaluation presented in Section 6.5 and to development and evaluation of remedial alternatives in the FS.

Tables 6-3 and 6-4 are statistical summaries of the soil and groundwater data that represent conditions within the Warehouse Subarea. Table 6-3 compares the soil data for each constituent against the PCL, which considers commercial worker exposure (direct contact – unrestricted use) and groundwater protection. Table 6-4 compares the groundwater data for each constituent against the PCL, which considers protection of vapor intrusion for unrestricted land use.

Based on the statistical summaries, Tables 6-7 through 6-22 present the soil, groundwater, sub-slab soil gas, indoor air, and beach porewater/seep data for analytes that were detected in samples of any Upland Area medium representing current conditions. The media-specific data tables include data for the entire Upland Area, organized by constituent group and by Site unit. The data for the Warehouse Subarea are presented separately, with

the collective data provided on Tables 6-7 and 6-8 for soil and groundwater, respectively. The sub-slab and indoor air data (all constituents) for the warehouse (in Unit A) are presented by themselves (Tables 6-15a through 6-15d). In addition to presenting them in unit-specific data tables, the data from the shoreline monitoring wells, intertidal porewater/seep samples, and the surface water samples are presented by themselves (Table 6-22) for presentation of shoreline water quality (Section 6.5.7). For each constituent, the tables provide the medium-specific PCLs, and concentrations exceeding respective PCLs are highlighted. Table 6-6 provides explanatory notes and defines the abbreviations used in Tables 6-7 through 6-22.

As described in Section 5.3.2, the soil PCLs based on groundwater protection are different for unsaturated soil versus saturated soil (see Tables 5-3 and 5-4). Each soil sample in the data set has been designated as either unsaturated or saturated soil based on a conservatively high water-table condition measured in May 2014. The soil data tables referenced in this section present the designation for each soil sample as saturated or unsaturated soil, and the exceedance designations in the data tables account for that difference.

The soil data tables present each soil sample's depth interval below the future grade that is currently provided for in design specifications for the third IA (refer to Section 4.7). A vast majority of the soil samples were collected when the CM was in place, and the boring logs in Appendix B, and prior documents for the Site, include sample depths relative to the grade existing at the time they were collected, which are different than presented in this report. Accordingly, the soil data tables in this document also include the elevation[24] for each soil sample interval to provide an absolute reference.

In accordance with MTCA, the PCLs for cPAHs and dioxins/furans are based on the total toxic equivalent quotient/concentration (TEQ) of the most carcinogenic compound in those constituent groups, as follows:

- Total cPAHs (TEQ) is the toxic equivalent concentration of benzo(a)pyrene calculated in accordance with MTCA (WAC 173-340-708[8][e]) to evaluate the human health toxicity of cPAH mixtures. Nondetected values are included in the summation at one-half the laboratory's analytical reporting limit.
- Total 2,3,7,8-TCDD (TEQ) is the toxic equivalent concentration of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) calculated in accordance with MTCA (WAC 173-340-708[8][d]) to evaluate the human health toxicity of dioxin/furan mixtures. Nondetected values are included in the summation at one-half the reporting limit.

In addition, the total toxic mobility equivalent concentration (TMEQ) for total cPAHs was calculated to evaluate the potential for cPAH mixtures in soil to impact groundwater through the leaching pathway. The total cPAH (TMEQ) was calculated in accordance with the procedures outlined in Ecology's Implementation Memorandum #10 (Ecology, 2015c). The total cPAH (TMEQ) is compared to soil PCLs for the protection of groundwater (Section 5.3.2.2) while the total cPAH (TEQ) is compared to soil PCLs for

[24] Elevations relative the NAVD88 vertical datum.

direct contact exposure. The data tables include both the total cPAH (TEQ) and total cPAH (TMEQ).

In accordance with MTCA (WAC 173-340-708[8][f]), multiple PCB Aroclors are assessed as a single hazardous substance by calculating the total PCB concentration for the mixture. As agreed to by Ecology,[25] only detected Aroclor concentrations are included in the total PCB concentration summation.

For evaluation of diesel-range and oil-range TPH data (from NWTPH-Dx analytical method), Ecology policy requires summing the diesel-range TPH (TPH-D) and oil-range TPH (TPH-O) results to represent a single petroleum product, unless it is clear that more than one product is present (Ecology, 2004). For purposes of this report, we term the summed value "TPH-D+O," which is used for comparison against PCLs. TPH-D and TPH-O are both commonly detected in Upland Area soil samples but, in the RI groundwater data set including more than 300 samples, TPH-O is not detected except at one well (UST71-MW-102, which has high turbidity groundwater samples). Because detectable TPH-O is essentially not present in Upland Area groundwater, the TPH-D+O summation for soil and groundwater includes one-half the reporting limit ("1/2U") for nondetected TPH-D values but only detected values for TPH-O.

The chemical data maps included in this section show, for each constituent with exceedances in soil or groundwater, the combined soil and groundwater sample locations where detected concentrations in both media exceed the PCLs. On these "exceedance maps," explorations with soil data for the constituent are depicted as a square, and explorations with groundwater data for the constituent are depicted with a circle. Explorations that had detected exceedances in soil or groundwater have the respective symbol color coded on these exceedance maps. Constituents with exceedances detected at only one location within the unit are not plotted on the maps, except in specific instances described in the text. However, all exceedances are highlighted in the data tables and are mentioned in the narrative for each unit. Because there are no total cPAH (TEQ) soil exceedances of the industrial direct contact value, the chemical data maps for cPAHs depict data for total cPAH (TMEQ) except for the Warehouse Subarea of Unit A where the total cPAH (TEQ) data for vadose zone soil is compared to the MTCA Method B soil cleanup level for direct contact and the total cPAH (TMEQ) data is compared to the soil-leaching-to-groundwater value. As discussed in Section 5.3, if results of a dissolved metals analysis are not available, a concentration of total metals less than the PCL for that dissolved metal complies with the PCL and that convention is applied in the exceedance maps. The figure numbers for the unit-specific figures include the unit designation in them for ease of reference (e.g., Figures 6-A2 through 6-A12 for Unit A, etc.).

6.3 Alkaline-pH Groundwater Produced by Crushed Material

As discussed in Section 2.2.3.1, approximately 252,000 tons of CM was placed across approximately 32 acres of the Upland Area during mill demolition by the end of June

[25] Andy Kallus (Ecology) email to Steve Germiat (Aspect Consulting), June 18, 2018.

2013. As discussed in Section 4.5, all the CM was removed from the Site in 2020, in accordance with the *Plan of Operations for CM Removal* (K-C, 2018c) that was prepared and then implemented in consultation with the SHD. Figure 6-P1 depicts the footprint of the CM when it was in place between 2013 and 2020.

The groundwater quality data collected during the RI indicate that, following placement of the CM in spring of 2013, groundwater pH increased within portions of the Upland Area where the CM was present. Figures 6-P1 through 6-P6, respectively, present groundwater pH data collected across the Upland Area in November 2013, February 2014, February 2016, August 2016, March 2017, and September 2017. Figures 6P-7 and 6-P8, respectively, present the average groundwater pH from multiple sets of measurements conducted in 2017 and then throughout the CM removal action in 2020. During the CM removal action, groundwater pH monitoring was conducted in accordance with the Work Plan for the Second Interim Action (Aspect, 2019b), and the results are presented in the Completion Report for the Second Interim Action (Aspect, 2021). Most of the Upland Area monitoring wells located outside of the Warehouse were decommissioned prior to the CM removal, so there is no groundwater pH data from wells after 2020. There is some limited pH data from exploratory test pits excavated in 2021, which is discussed herein.

Figure 6-P9 presents groundwater pH data collected in June 2021, approximately 8 months after completion of the CM removal action. Table 6-11 includes the Site groundwater data set for field parameters including pH collected between 2012 and 2017. Appendix G to this report includes a tabulation of the 2020 groundwater pH data.

Figure 6-P2 shows that by February 2014, approximately 8 months after placement of the CM, groundwater pH had increased throughout much of the eastern half of the Upland Area and extending farther west in the Boilers area (area of BBH-, UST71-, and UST70-series wells) and the eastern half of the Log Pond (well LP-MW-1).

The pH of water infiltrating through the CM increased because calcium hydroxide [$Ca(OH)_2$] dissolves from freshly exposed cement within the CM; the calcium hydroxide readily disassociates to produce hydroxide ions [OH^-] in solution, which raises the pH of the water. Although the CM was reportedly placed above the water table during facility demolition, the removal of pavement from 32 acres of the Site resulted in increased infiltration across the surface of CM and a corresponding rise in the water table, as described in Section 2.4.4.2.2. While the water table has always been relatively shallow within the Upland Area, the water table rose enough to saturate the bottom of the CM layer during the wet season in some areas of the Site. In addition, the resulting thinner layer of unsaturated soil separating the CM and water table had limited capacity to buffer pH, thus allowing high pH infiltration to reach the water table. During the 2020 CM removal project, it was also discovered that CM had been used to fill some vaults and other subsurface structures that extended beneath the water table, particularly within the footprint of the former Tissue Mill in the northeastern portion of the Upland Area.

The highest groundwater pH occurred in those areas where CM was in direct contact with groundwater. This occurred seasonally across parts of the Upland Area and occurred year-round in the northeastern portion of the site where CM filled deeper subsurface structures.

The pH effect of groundwater seasonally coming into and out of contact with CM is illustrated clearly by data collected from Log Pond well LP-MW-1. Well LP-MW-1 historically had the highest pH readings measured on the Site (up to 13.0 in November 2013) due to the facts that (1) its well screen was shallow enough that it intercepted the thick layer of CM in that area, and (2) the Log Pond fill has low enough permeability that precipitation does not infiltrate there nearly as readily as the dredge fill outside of the Log Pond (refer to Section 2.4.4.2.3). Consequently, when the seasonal rains began, the groundwater level within the Log Pond footprint "mounded up" because infiltration is so slow. The mounded groundwater submerged CM within the well's screened interval, which created very high pH groundwater in the shallow depth interval screened by LP-MW-1. Figure 6-P10 illustrates the relationship of groundwater level and pH measured at well LP-MW-1 over time. The bottom of the CM at that well is depicted for comparison with groundwater elevations on the figure.

Between February and August 2016, the groundwater level at well LP-MW-1 dropped approximately 3.5 feet, to below the bottom of the CM at that location, with a corresponding groundwater pH drop from 11.2 to 8.6 in that well. By March 2017, the groundwater level at LP-MW-1 rose nearly 4 feet relative to August 2016 and was 0.4 feet higher than that measured in February 2016. In the peak dry-season conditions of September 2017, the water level was again below the bottom of the CM and the groundwater pH was 8.15—the same phenomenon observed in the dry season of 2016.

During groundwater pH monitoring conducted for the CM removal project, the pH readings in LP-MW-1 ranged from 7.0 to 7.5 between August 31 and September 22, 2020. During this period, on September 3, the water level was measured to be 7.0 feet below the well's top of casing and thus below the base of the CM. Between September 24 and 26, 2020, approximately 1.6 inches of rain fell in Everett. By September 28, the pH in LP-MW-1 had risen to 9.7; the water level was not measured that day. On September 29, when a pH of 10.5 was measured, the water level had risen to 3.3 feet below top of casing. Comparing the September 3 and September 29 readings, the water level rose about 3.7 feet, submerging the base of the CM, and the pH increased about 3.3 standard units in response (Figure 6-P10). These data, in combination with low pH measured in the deeper wells installed in 2017 within the Log Pond (LP-MW-3 through LP-MW-7), indicate that the elevated groundwater pH was limited to a shallow depth interval beneath the CM layer.

In areas where the CM did not contact groundwater, relatively higher groundwater pH occurred where the thickness of the CM layer was greatest and where the water table was shallowest. The depth of the water table generally increases from east to west across the Upland Area. Apart from the localized CM-filled subsurface structures, the thickest occurrences of CM—greater than 5 feet—were generally present within the center of the Log Pond and within the Tissue Mill areas.

6.3.1 Time Trends for Groundwater pH

While there is seasonality in the groundwater pH, the data collected between 2013 and 2021 also demonstrate that, prior to CM removal, the elevated pH was gradually declining

on average across the Upland Area, and as expected, it has declined further following completion of the CM removal.

It is well documented that, over time, exposed cement "carbonates" naturally—converting calcium hydroxide to calcium carbonate [$CaCO_3$]—as it is exposed to carbon dioxide [CO_2] in air or water via the reaction:

$$Ca(OH)_2 + CO_2 => CaCO_3 + H_2O$$

Exposed cement surfaces become mineralized with calcium carbonate, preventing leaching of hydroxide ions that result in increased pH. Therefore, the potential for CM, or any cementitious material, to produce high pH infiltration gradually dissipates over time.

Table 6-5 presents a comparison of the average pH for the wet season and for the dry season between 2016 and 2017, when measurements were collected from numerous wells across the Upland Area in both seasonal conditions. Note that the 2017 measurements were collected during a year of record-setting precipitation (2016-2017 water year). Table 6-5 also includes dry-season measurements collected between June and October 2020 for the CM removal project.

Of the 59 wells measured across the Site in March 2017, 35 were also measured in February 2016 (22 inland, 13 shoreline wells[26]). Of the 22 inland wells with both sets of wet-season measurements, eight wells had a higher pH and 14 wells had a lower pH; the average pH for the 22 inland wells declined 0.9 pH units[27]. The wet-season pH measured at 10 of 13 shoreline wells also declined between the two monitoring events, with an average decline of 0.8 pH units (Table 6-5).

Of the 26 inland wells with pH measurements in August 2016 and September 2017, 10 wells had a higher pH and 16 had a lower pH in 2017 than in 2016. The magnitude of pH declines was generally larger than the pH increases at individual wells, such that the average dry-season pH for the 26 inland wells declined approximately 0.2 pH units over the 1-year period. The average pH in the 13 shoreline wells measured in both events declined 0.3 pH units (Table 6-5).

The data indicate that, despite the record-setting amount of precipitation falling in the 2016–2017 water year, the average groundwater pH across the Site was gradually declining due to carbonation of the CM.

The lower portion of Table 6-5 compares dry-season measurements collected in 2016, 2017, and 2020 from 12 inland wells. For this subset of wells, which includes many of the highest-pH wells on Site, the average pH declined 0.2 pH units between 2016 and 2017 and an additional 0.2 pH units between 2017 and 2020. The diminishing extent of higher-pH groundwater between 2017 and 2020 is also apparent from comparing Figures 6-P7 (2017 average pH) and 6-P8 (2020 average pH)—notably the extents of pH

[26] Designated as 'shoreline wells' if located within 200 feet of the shoreline.

[27] Because pH is a logarithmic term, the pH values were converted to hydrogen ion concentration (= 10^[-pH]), the geometric mean calculated (data span orders of magnitude), and then that mean value converted back to pH units.

greater than 10 that are shaded in blue. Despite the Site-wide average declines in groundwater pH, Figure 6-P8 also illustrates that high-pH groundwater persisted into the fall of 2020, 7 years after placement of the CM, in areas where CM was seasonally or perennially in contact with groundwater.

6.3.1.1 pH Trends at Inland High-pH Wells

Figure 6-P11 depicts the measured groundwater pH trends between 2016 and (post-CM removal) 2021 for high-pH wells in areas where CM occurred beneath the water table either seasonally or perennially (wells GF9-MW-2, PM-MW-4, TM-MW-3, TM-MW-4, and UST29-MW-101). The trend for high-pH well LP-MW-1 is shown on Figure 6-P10. so is not repeated on Figure 6-P11. Each of the five high-pH wells on Figure 6-P11 had pH measurements collected in 2016, 2017, 2020, and 2021 except for TM-MW-3 and TM-MW-4, in the northeast portion of the Site, which were decommissioned prior to the start of the CM removal project. The post-CM-removal groundwater pH measurements were collected by Landau Associates from exploratory test pits in June 2021. The test pits were generally positioned adjacent to decommissioned monitoring wells where the highest groundwater pH had been measured in prior monitoring events to assist with siting of locations to temporarily infiltrate stormwater during construction of Port's third IA. Figure 6-P9 shows the test pit locations and pH measurements with the prior monitoring wells for reference.

The 2016-2017 data show substantial seasonal variability as described above, with generally lower pH in 2020 and then considerably lower pH in June 2021, roughly 8 months after completion of CM removal. As shown on Figure 6-P9, the pH measured in test pit LA-TP-4, located next to former high-pH well LP-MW-1, was at pH 7.8.

As of the June 2021 measurements, only the central inland area adjacent to former well GF9-MW-2 remains above pH 8.5 (Figure 6-P9).

6.3.1.2 pH Trends at Shoreline Wells

Despite the widespread groundwater pH increases where CM was placed across the interior of the Upland Area, the data indicate that high-pH groundwater did not migrate to the groundwater discharge zone at the shoreline, with one localized short-term exception. Figure 6-P12 illustrates groundwater pH trends measured at wells across the entire Upland Area shoreline from 2012, prior to CM placement, through 2020 when the CM removal was occurring (the 2020 data points are the average of measurements collected over multiple days). The shoreline groundwater data show temporal variability but no clear trends over the 8-year period of monitoring. Exceptions are the measurements greater than pH 9.0 collected in February 2016 from four wells in Site Unit B (PM-MW-8, REC3-MW-1R, UST70-MW-102, and UST70-MW-2). Figure 6-P3 shows the locations of these wells and the February 2016 data. In May 2016, the pH readings were 8.9 at the two UST70 wells and were 7.2 or below at the other two wells. By August 2016, those four wells were below pH 8.0 and they remained below pH 8.0 thereafter (Figure 6-P12; Table 6-11).

6.4 Ammonia and Sulfide in Groundwater

As discussed in the following sections, un-ionized ammonia and hydrogen sulfide—the toxic forms of ammonia and sulfide—are present at select Upland Area groundwater and intertidal sediment porewater/seep locations at concentrations exceeding screening levels based on marine surface water protection. Both compounds persist in geochemically reducing conditions and are quickly transformed to less-toxic compounds in the presence of oxygen. Appendix H presents background information regarding the environmental geochemistry of ammonia and sulfide, and discusses the methods used to calculate, from analytical data, the concentrations of un-ionized ammonia and hydrogen sulfide.

As described in Appendix H, the dredged marine sediments that were used historically to create most of the soil within the Upland Area commonly contain between 0.01 percent and 1 percent (100 to 10,000 mg/kg) bulk sulfide, largely in the form of insoluble iron and manganese sulfide minerals. Sulfides in mineral form are considered generally nontoxic. Conversely, hydrogen sulfide (H_2S) is highly toxic to benthic and aquatic organisms and, therefore, federal/state water quality standards are based on H_2S. The detected concentrations of dissolved sulfide[28] in field-filtered water samples collected at the Upland Area between 2012 and 2014 may include significant amounts of colloidal sulfide minerals that can pass through a 0.45-micron filter, and, therefore, greatly overstate the concentration of H_2S that is the measure of sulfide toxicity in water. Therefore, starting in 2015, sampling of groundwater and intertidal seeps and porewater was conducted using the *in situ* diffusive-gradients-in-thin-films (DGT) passive sampling protocol that is designed specifically to quantify free H_2S concentrations, as outlined in Appendix H. Consequently, for water sample locations with older data from the dissolved sulfide analysis (quantifying sulfide in all forms) and newer data from the DGT analysis (quantifying H_2S), the latter data are used in this RI to assess nature and extent of sulfide in the form of H_2S.

A draft memorandum presenting the collective Upland Area ammonia and sulfide data and associated information was transmitted to Ecology in January 2018 (Aspect and Anchor QEA, 2018). Ecology provided comments on the draft document in March 2018 (Ecology, 2018). During a follow-up meeting on June 19, 2018, Ecology and K-C agreed that an in-water cap constructed of granular materials allowing oxygenation of groundwater discharge along affected portions of the shoreline would be included as a component of Ecology's selected cleanup action for the East Waterway site. Ecology agreed that the in-water granular cap may be an effective remedy for treating un-ionized ammonia and hydrogen sulfide discharging from the Upland Area. Any requirements for engineering design analysis or modeling to demonstrate its treatment effectiveness will be included as a component of the selected cleanup action for the East Waterway site. The parties agreed that the Upland Area sulfide and ammonia data would be included and discussed in this Upland Area RI, but that remediation of those compounds would not be addressed in the Upland Area FS.

[28] Analyzed using Standard Method 4500-S2-D.

6.5 Nature and Extent of Contamination by Unit

The nature and extent of contamination under current (post-IA) Upland Area conditions is presented for Units A through E in Sections 6.5.1 through 6.5.5, respectively.

As presented in Table 6-1, following completion of the two IAs, there are no constituent concentrations in Upland Area soil exceeding criteria based on industrial direct contact. For those portions of the Upland Area outside of the Warehouse Subarea, the evaluation of contaminant nature and extent in soil focuses solely on the soil-to-groundwater pathway—i.e., whether current concentrations of a constituent in soil are leaching to the extent of causing exceedances of the respective PCL in groundwater. In accordance with MTCA (WAC 173-340-747(9)), if groundwater contaminant concentrations meet the applicable groundwater cleanup level, concentrations of that contaminant in adjacent soil are determined to be protective of groundwater, as long as all requirements of WAC 173-340-747(9)(b) are met. To that end, viewing the soil and groundwater data together on the exceedance maps is a primary basis for evaluation of the soil-to-groundwater pathway for each constituent in each unit.

For metals in soil, the RI data is evaluated by unit using statistical methods to determine compliance with MTCA cleanup levels. To confirm compliance with MTCA cleanup levels, the following three criteria must be met (WAC 173-340-740(7) and -745(8)):

1. The 95 percent upper confidence limit (UCL) on the mean concentration is below the PCL.
2. No single concentration can be greater than two times the PCL, or if the PCL is based on natural background, a higher exceedance factor (also referred to as the magnitude of exceedance) can be calculated based on Site-specific data and used instead per Ecology, 1992.
3. Less than 10 percent of sample concentrations can exceed the PCL, or if the PCL is based on natural background, a higher exceedance frequency can be calculated based on Site-specific data (per Ecology, 1992) and used instead of the default 10 percent.

Modifications to the magnitude and frequency of exceedance were made to account for background for copper, mercury, nickel, and zinc in accordance with Attachments 1 and 2 of Ecology's 1992 statistical guidance (Ecology, 1992). The statistical evaluation for metals in soil was completed using EPA's ProUCL 5.1 to evaluate data distribution and calculate statistics for each data set, including outliers and nondetect results. The ProUCL backup is provided in Appendix I.

6.5.1 Unit A

The IAs completed within Unit A have consisted of:

- Removal of approximately 9,700 tons of soil contaminated with petroleum hydrocarbons, primarily TPH-O (Bunker C fuel oil) with lesser quantities of TPH-G, from the Bunker C ASTs area. The south and east ends of the Bunker C ASTs area excavation were advanced as close as feasible to the edges of the warehouse structure.

- Removal of approximately 1,079 tons of soil contaminated with copper, mercury, and PCBs.

The IA excavation areas are depicted on Figure 6-A1.

For Unit A, data collected from within the Warehouse Subarea are compared to the PCLs derived for protection of commercial workers and data collected from outside of the Warehouse Subarea are compared to the PCLs derived for protection of industrial workers, as described in Section 5.3.

The unexcavated area within the western portion of the Bunker C ASTs area is where Scott Paper conducted an independent soil cleanup in 1995, in conjunction with decommissioning of the fuel ASTs (Scott Paper, 1995b). The geotextile placed beneath import fill during the 1995 cleanup work was visible on the edges of the first IA excavation. There were no soil TPH exceedances detected in samples collected within that area during the Phase 2 ESA (Aspect, 2013a), or in the verification soil data collected on the excavation sidewalls surrounding that area (Figures 6-A2 and 6-A3). During the Phase 2 ESA, prior to the first IA, groundwater TPH exceedances were detected in well MW-3, but not in well MW-4; both wells are located within that unexcavated area. Large quantities of groundwater were pumped from the Bunker C ASTs excavation during the first IA, so the pre-IA groundwater data from this area are not representative of current conditions.

During the first IA excavation, nonaqueous-phase liquid (NAPL) Bunker C oil was observed amongst wood pilings that historically supported one of the fuel oil ASTs (see photographs 5 and 6 in Appendix B to the IA Report; Aspect, 2015a). Residual NAPL was also observed within the former oil conveyance pipeline that was removed. The observed NAPL was removed as part of the first IA cleanup. A total of 170 verification soil samples were collected within the Bunker C ASTs excavation area for analysis as part of the first IA (Figure 6-A1).

As part of the shoreline pipe plugging effort during the second IA, a fuel line was encountered during the removal of a stormwater catch basin west of the IA excavation area (Fuel Line W shown on Figure 6-A1). The fuel line was capped beneath the catch basin and determined to be an abandoned fuel-oil line that historically was connected to the Bunker C ASTs area (Aspect, 2021). The entire 60-foot length of fuel pipe was removed, and a total of 12 verification soil samples were collected from the sidewalls and base of the trench excavation completed to remove the pipe. Also, during the second IA, soil containing copper, mercury, and PCBs above their respective PCLs was removed from the OMS area to a total depth of 5 feet bgs. The excavation was limited to the south by the steep shoreline bank and a 36-inch-diameter wood stave pipe that is in the upper portion of that bank. A total of 21 verification soil samples were collected from the limits of the OMS area excavation (Aspect, 2021).

In addition to sampling and analysis conducted for the two IAs, soil and groundwater samples were collected from 55 borings and monitoring wells completed within Unit A (Figure 6-A1). Drill bit refusal occurred during the drilling of proposed monitoring well REC1-MW-13, located inside the warehouse. The drill bit refusal prevented the

installation of the planned monitoring well, but soil sampling was still completed at this location to a depth of 6 feet (exploration location was renamed REC2-B-22 when the well was not completed). Two samples of porewater were also collected from an intertidal seep location (SEEP-1) along the shoreline of the off-loading dock slip (Figure 6-A1).

Collocated samples of indoor air and sub-slab air[29] were collected during two sampling events from three locations within the warehouse and were analyzed to evaluate the potential VI risk within the warehouse attributable to concentrations of petroleum hydrocarbons in shallow subsurface soil and groundwater. Because a building of concern exists within which indoor air sampling could be conducted, the sampling was conducted to determine what impact VI was having on its indoor air, thus constituting a Tier 2 VI evaluation in accordance with Ecology (2022) VI guidance. An ambient outdoor air sample was also collected at a location upwind of the warehouse to measure area background air quality during both sampling events, in accordance with Ecology (2022); because of differences in wind direction at the times of the two sampling events, the locations of these background samples differed between events (Back-AA-1 and Back-AA-2; Figure 6-A1).

The sample locations for constituents detected at concentrations exceeding the PCLs in Unit A following the two IAs are presented on Figures 6-A2 through 6-A11. The Warehouse Subarea occupies approximately half of Unit A, as depicted on Figure 6-A1. As discussed in Section 5.1.1.2 and Section 5.3, a potential future change in land use from industrial to commercial is considered for the warehouse. Given the different exposure scenario and PCLs for the Warehouse Subarea if that land use conversion occurs, it is discussed on its own in Section 6.5.1. Section 6.5.2 describes the portion of Unit A that is outside, and downgradient of, the Warehouse Subarea.

6.5.1.1 Warehouse Subarea of Unit A

The Warehouse Subarea of Unit A consists of those portions of land that are covered by the warehouse structure, which sits on the property line to the east, and on the Site boundary to the south (Figure 6-A1). The north and west extent of the Warehouse Subarea is defined by the 30-foot lateral distance for evaluating vapor intrusion into an existing structure. The constituents that were detected in one or more samples of Warehouse Subarea soil or groundwater at concentrations exceeding their respective PCLs are as follows:

- TPH-G in soil and groundwater
- Diesel- and/or oil-range total petroleum hydrocarbons (TPH-D+O[30]) in soil
- Xylenes in soil
- Total cPAHs in soil
- Naphthalene in soil

[29] Air in void space beneath warehouse floor slab.
[30] In the tables and figures, "TPH (D+O)" refers to the sum of detected diesel- and oil-range TPH concentrations as described in Section 6.2.6.

- Arsenic and copper in groundwater
- Mercury and zinc in soil

Constituents that were not detected at concentrations greater than the PCLs in soil or groundwater samples collected within the Warehouse Subarea of Unit A include benzene, ethylbenzene, and toluene, and metals, VOCs, and SVOCs, which are not included in the list above.

The soil and groundwater data for the Warehouse Subarea are summarized on Tables 6-7 and 6-8, respectively. The sample locations for constituents detected at concentrations exceeding the PCLs in the Warehouse Area of Unit A are presented on Figures 6-A2 through 6-A11. The data for constituents detected at concentrations exceeding the PCLs are summarized by constituent group in the following subsections.

6.5.1.1.1 Petroleum Hydrocarbons, BTEX, and PAHs

As described in Section 2.2.4, Unit A includes a pair of historical bulk fuel storage/distribution facilities operated by the Standard Oil and Associated Oil companies prior to construction of the warehouse. The former Associated Oil bulk fuel storage facility encompassed land beneath the western portion of the warehouse and immediately north of it. The area north of the warehouse included large ASTs for Bunker C fuel oil and smaller ASTs for gasoline in the northwesternmost part of the area (area addressed by Bunker C ASTs IA). The Standard Oil facilities were located beneath the eastern and central portions of the warehouse, as shown on Figure 6-A2.

The IA successfully removed accessible TPH-contaminated soil within the area of the former Bunker C ASTs located immediately north of the warehouse. Additional soil excavation in this area was precluded by the presence of the warehouse foundation. Detected concentrations of TPH-G and/or TPH-D+O exceeded soil PCLs in sidewall soil samples collected at the southern edge of the IA excavation (north edge of warehouse) at depths ranging from 2 to 8 feet bgs, which extends into the saturated zone (Figures 6-A2 and 6-A3; Table 6-7). Concentrations of TPH-G and/or TPH-D+O exceeding PCLs were also detected in soil samples collected within the areas of the historical bulk fuel facilities beneath the warehouse (within the saturated zone; Figures 6-A2 and 6- A3).

Two total xylenes detections in soil exceeded the PCL (Figure 6-A4 and Table 6-7). The soil PCL is based on leaching to groundwater and considers volatilization from groundwater to indoor air (VI). However, there are no xylene exceedances in sub-slab or indoor air in that area (WH-North collocated sub-slab air and indoor air sample location; Figure 6-A1; Tables 6-15a, 6-15b, and 6-15c). Also, there are no exceedances of xylenes in groundwater in this area (Table 6-8). The air and groundwater data, described above, empirically demonstrate that the soil xylene concentrations in that area, as long as the warehouse remains as an effective cap, are protective of groundwater and air.

Total cPAH (TMEQ) concentrations exceed the soil leaching PCL in samples of soil contaminated with Bunker C oil located along the north edge of the warehouse (Figure 6-A5). Maximum cPAH TMEQ concentrations in the saturated zone of the Warehouse Subarea exceeded 2 mg/kg at several locations (one location has concentrations greater than 7 mg/kg), which is greater than 10 times the saturated soil

leaching value. However, the soil PCL for total cPAH (TMEQ) is based on protection of groundwater (with groundwater protective of discharge to the East Waterway), and following completion of the interim action, there are no groundwater cPAH exceedances in wells downgradient of these soil exceedance locations, nor anywhere in Unit A (Figure 6-A4). The groundwater data demonstrate empirically that the cPAH concentrations in Unit A soil, as long as the warehouse remains as an effective cap, appear to be protective of groundwater in accordance with MTCA, subject to future long-term groundwater monitoring.

Naphthalene was detected in four Unit A soil samples at concentrations exceeding the soil PCL (Figure 6-A6; Table 6-7). Two of these soil samples were located on the IA excavation sidewall along the warehouse north wall, where inaccessible TPH-impacted soil remains in place. The soil PCL for naphthalene is based on groundwater protection. However, there are no naphthalene exceedances detected in groundwater from monitoring wells located within or downgradient of the Warehouse Subarea during four or eight rounds of monitoring following the IA soil excavation (Table 6-8). The groundwater data demonstrate empirically that the naphthalene concentrations in soil, as long as the warehouse remains as an effective cap, beneath the warehouse appear to be protective of groundwater in accordance with MTCA, subject to long-term groundwater monitoring.

Although soil TPH concentrations exceed soil PCLs, groundwater TPH concentrations in monitoring wells beneath, adjacent, and downgradient of the warehouse do not have corresponding groundwater TPH exceedances with one exception:

- Along the south edge of the Bunker C ASTs Area IA excavation, the first groundwater sample collected from well BCT-MW-103 following the IA contained TPH-G at a concentration of 1,100 µg/l, which slightly exceeds the PCL of 1,000 µg/l. Detected TPH-G concentrations in the subsequent seven samples collected from that well were well below the PCL.

This groundwater data suggests that the initial exceedance is likely attributable to hydrocarbons mobilized during the large-scale excavation that preceded the first round of confirmational groundwater sampling.

The current groundwater TPH data appear to indicate empirically that the soil TPH concentrations in the Warehouse Subarea, as long as the warehouse remains as an effective cap, are protective of groundwater in accordance with MTCA (WAC 173-340-747(9)). Any additional groundwater monitoring requirements for this area will be incorporated into the future long-term groundwater monitoring plan for the Site.

6.5.1.1.2 Warehouse Subarea Vapor Intrusion Assessment

The data collected as part of the VI assessment in the warehouse is provided on Tables 6-15a–6-15d. Tables 6-15a, 6-15b, and 6-15c present the sub-slab soil gas and indoor air data compared to industrial, commercial, and unrestricted screening levels, respectively. Hydrocarbon concentrations detected during both rounds of indoor air sampling within the ground floor of the Warehouse meet MTCA Method C indoor air PCLs for industrial use (Table 6-15a). Hydrocarbon concentrations detected in samples of sub-slab air collected below the floor slab also meet screening levels for industrial use.

Table 6-15d uses the highest detected indoor air concentration of each constituent of the TPH mixture to calculate the total TPH concentration and site-specific TPH cleanup levels for commercial and unrestricted use.

Because of the prevalence of hydrocarbon concentrations in urban air, Section 4.7 of Ecology's (2022) VI guidance recommends that measured indoor air concentrations be corrected for contribution from area background sources, when site-specific concurrent ambient air measurements are available as part of a Tier 2 VI assessment. Hydrocarbons from vehicle exhaust and other sources are ubiquitous in urban air, and the concentrations detected in the indoor air samples are comparable to those detected in samples of ambient outdoor air collected away from the warehouse (outdoor air sample locations BACK-AA-1 and BACK-AA2 shown on Figure 6-A1). Tables 6-15a, 6-15b, and 6-15c present the average measured indoor air and ambient air concentrations[31] for each constituent, and their calculated differences (indoor minus ambient). The differences are very small, and for some constituents are negative, indicating that the VI contribution to indoor air concentrations within the warehouse is likewise very small.

For assessing risk from petroleum mixtures, Ecology guidance requires evaluation of the additive effects of non-carcinogenic petroleum fractions and VOCs, individual carcinogenic compounds, and cumulative cancer risk. Each of these requirements is discussed below (Ecology, 2022).

Ecology's guidance (Ecology, 2022) establishes a generic Method B (unrestricted land use) air cleanup level for TPH based on noncarcinogenic effects, as well as an adjusted air cleanup level for Method C (industrial land use), but also allows for the calculation of a Site-specific total TPH cleanup level using Site-specific data. The indoor air data was used to calculate a total TPH concentration (summation of all constituents) using the highest concentration of each compound detected in any indoor air sample. The total TPH concentration for the warehouse, calculated using the maximum detected concentration of each compound from the existing indoor air data, is 106 $\mu g/m^3$ (Table 6-15d). The same data were used to calculate Site-specific cleanup levels for unrestricted and commercial uses. The Site-specific TPH air cleanup levels are 110 $\mu g/m^3$ to 938 $\mu g/m^3$ for unrestricted and commercial uses, respectively (Table 6-15d). The maximum detected indoor air total TPH concentration is below the Site-specific TPH cleanup level for both potential use scenarios, indicating that the additive effects of non-carcinogenic TPH in indoor air do not exceed the MTCA hazard index threshold of 1, and do not pose an unacceptable risk to human health (Table 6-15d).

Carcinogenic TPH compounds that are potentially present at the Site consist of benzene and naphthalene. Tables 6-15b and 6-15c present the direct comparison of the reported carcinogen concentrations in indoor air to their individual PCLs based on carcinogenic risk for commercial, and unrestricted land uses, respectively. Naphthalene was not detected in any of the indoor air samples at concentrations above the laboratory reporting limits, which ranged from 0.67 to 0.78 $\mu g/m^3$; however, the reporting limits are above the indoor air PCLs for naphthalene under commercial (0.34 $\mu g/m^3$) and unrestricted

[31] Assuming ½ the reporting limit for nondetects.

(0.074 µg/m^3) land use scenarios (Tables 6-15b and 6-15c). Benzene was detected in all the indoor air samples and in one of the ambient air samples at concentrations exceeding the PCL for the unrestricted land use; however, the concentration of benzene detected in the November 2014 ambient air sample (1.3 µg/m^3; collected downwind of Marine View Drive and BNSF mainline, but upwind of the warehouse) is similar to those detected in indoor air samples (1.2 µg/m^3 to 1.3 µg/m^3; Table 6-15c) suggesting that benzene in indoor air has the potential to be influenced by area background sources, such as Marine View Drive, diesel locomotives on the BNSF mainline, and/or neighboring industrial operations. However, the degree to which background sources may influence benzene concentrations inside the warehouse, if any, is unknown. For example, the ambient air sample collected west of the warehouse in February 2013, during onshore winds, was nondetect for benzene.

Tables 6-15a, 6-15b, and 6-15c also calculate the cumulative carcinogenic risk represented by the combined concentrations of benzene and naphthalene, which is compared against MTCA's 1 x 10^{-5} (1E-05) acceptable cumulative risk threshold. The calculated cumulative carcinogenic risk for each future use scenario is less than the MTCA risk threshold.

Hydrocarbon concentrations detected in samples of sub-slab air collected below the floor slab also meet screening levels for commercial and unrestricted uses. However, naphthalene was detected in one sub-slab soil gas sample, at a concentration of 13 µg/m^3, which exceeds the soil gas PCLs for unrestricted and commercial land use of 2.5 µg/m^3 and 11 µg/m^3, respectively.

In conclusion, for commercial and unrestricted use scenarios, hydrocarbon concentrations in sub-slab air samples collected beneath the warehouse meet screening levels based on VI, and those in indoor air samples collected within the warehouse meet PCLs and are comparable to ambient air samples collected outside the warehouse. However, benzene and/or naphthalene were detected in indoor air or sub-slab soil gas at concentrations exceeding the risk threshold for individual chemicals under commercial and unrestricted land use scenarios. Therefore, VI is considered an exposure pathway of concern for commercial and unrestricted land uses.

6.5.1.1.3 Metals

Arsenic and copper were detected above the groundwater PCLs in monitoring well BCT-MW-103, located within the Warehouse Subarea (Table 6-8). Dissolved arsenic was detected in the only groundwater sample analyzed for arsenic from well BCT-MW-103 at a concentration of 9.61 µg/l, which is only slightly above the PCL of 9 µg/l, based on Site background. Copper was detected above the PCL in groundwater at well BCT-MW-103 in two of four sampling events (Table 6-8). There are no detected concentrations of arsenic or copper in soil above the PCLs, which are based on natural background.

6.5.1.1.4 Warehouse Subarea Summary

Petroleum-impacted soil remains beneath the warehouse, where historical bulk storage facilities existed, but the soil does not pose a direct contact risk (i.e., it's not accessible because it's covered by the warehouse) and empirical data demonstrate that the soil, which is currently capped by existing warehouse, is not creating exceedances of PCLs for groundwater. For commercial and unrestricted use scenarios, hydrocarbon concentrations

in sub-slab air samples collected beneath the warehouse meet screening levels based on VI, and those in indoor air samples collected within the warehouse meet PCLs and are comparable to ambient air samples collected outside the warehouse. However, benzene and/or naphthalene were detected in indoor air or sub-slab soil gas at concentrations exceeding the risk threshold for individual chemicals under commercial and unrestricted land use scenarios. Therefore, VI is considered an exposure pathway of concern for commercial and unrestricted land uses.

6.5.1.2 Unit A Outside Warehouse Subarea

This section discusses the portion of Unit A that is outside of the Warehouse Subarea. For current conditions following the IA, the constituents that were detected in one or more samples of Unit A media at concentrations exceeding their respective PCLs are as follows:

- TPH-G in soil
- TPH-D+O in soil
- Total cPAHs in soil
- Naphthalene in groundwater
- Copper and mercury in soil and groundwater
- Lead and zinc in soil
- Nickel in groundwater
- PCBs in soil
- Un-ionized ammonia in groundwater.

The data for constituents detected at concentrations exceeding the PCLs are summarized by constituent group in the following subsections.

6.5.1.2.1 Petroleum Hydrocarbons and PAHs

Concentrations of TPH-G and/or TPH-D+O exceeding PCLs were detected in soil samples collected at the REC1-MW-5 and REC1-MW-8 locations along the southern property boundary to the west of the warehouse (within the saturated zone; Figures 6-A2 and 6-A3) but were not detected above PCLs in groundwater (Table 6-14).

Total cPAH (TMEQ) exceedances were detected in three Unit A soil samples including a 25-foot-deep sample from GF-B-15A, located west of the warehouse (0.28 mg/kg). At GF-B-15A, the shallower four soil samples had no cPAH exceedances, and the 25-foot sample (with cPAH exceedance) had no detectable TPH (Table 6-13); those data suggest that the low-level cPAH exceedance at depth is not attributable to the Upland Area historical industrial operations. The soil PCL for total cPAH (TMEQ) is based on protection of groundwater (with groundwater protective of discharge to the East Waterway), and following completion of the interim action, there are no groundwater cPAH exceedances in wells downgradient of these soil exceedance locations, nor anywhere in Unit A (Figure 6-A4). The groundwater data demonstrate empirically that the cPAH concentrations in Unit A soil appear to be protective of groundwater in accordance with MTCA, subject to future long-term groundwater monitoring.

Naphthalene was not detected above the groundwater PCL in groundwater in Unit A with one exception:

- Along the north edge of the Bunker C ASTs Area IA excavation, the first groundwater sample collected from well BCT-MW-108 following the IA contained a naphthalene concentration (130 µg/L) exceeding the 89 µg/L VI-based PCL. Detected naphthalene concentrations in the subsequent seven samples collected from that well were below the PCL.

This groundwater data suggests that the exceedance is likely attributable to hydrocarbons mobilized during the large-scale excavation that preceded the first round of confirmational groundwater sampling.

The current groundwater TPH data appear to indicate empirically that the soil TPH concentrations beneath (as long as the warehouse remains as an effective cap) and west of the warehouse are protective of groundwater in accordance with MTCA (WAC 173-340-747(9)). Any additional groundwater monitoring requirements for this area will be incorporated into the future long-term groundwater monitoring plan for the Site.

6.5.1.2.2 Metals

Copper, mercury, and nickel were each detected in Unit A groundwater samples at concentrations greater than their respective PCLs (Figures 6-A7, 6-A9, and 6-A10, respectively; Table 6-9). During the Phase 2 ESA, prior to the first IA, groundwater lead exceedances were also detected in well MW-4 located within the Bunker C ASTs IA area. However, given the large quantities of groundwater pumped from that area during the first IA, those pre-IA groundwater data are no longer representative of current conditions.

Lead was detected above the soil PCL based on groundwater protection in two saturated soil samples collected from boring GF-B-15A (Table 6-9; Figure 6-A8). Zinc was also detected in one or more Unit A soil samples at concentrations exceeding soil PCLs based on groundwater protection (Figure 6-A11; Table 6-9). However, lead and zinc exceedances are not detected in Unit A groundwater (Figure 6-A11; Table 6-10), indicating that lead and zinc concentrations in Unit A soil are protective of groundwater in accordance with MTCA.

At each of the 10 wells with copper, mercury, and/or nickel exceedances in groundwater, the exceedances were not consistently replicated in repeated sampling. In fact, the exceedances were rarely detected in more than half the samples collected over time at a well (Table 6-10). The copper, mercury, and nickel data are described below.

6.5.1.2.2.1 COPPER

Copper is present in soil above the PCL, which is based on natural background concentrations, at five locations within Unit A (Figure 6-A7; Table 6-9). A statistical evaluation of all copper soil data from Unit A[32] indicates a 95 percent UCL of 18 mg/kg, which is below the PCL of 36 mg/kg, with 9 percent of the samples (7/78) exceeding the PCL. The compliance statistics requirements that take into account the natural background level for copper (Appendix I) indicate that the magnitude of exceedance can be three times

[32] This includes the Warehouse Subarea

the PCL (108 mg/kg). The highest detected concentration of copper in Unit A is 87 mg/kg. The results of the statistical analysis indicate that the copper in Unit A soils are in compliance with the PCL since the 95 percent UCL of 18.mg/kg is below the PCL of 36 mg/kg, less than 10 percent of samples exceed the PCL, and no samples contain copper at a concentration greater than three times the PCL.

The groundwater copper exceedances are scattered and generally low level, with all but two exceedances less than two times the stringent 3.1 µg/L PCL (Table 6-10). One groundwater sample collected from each of BCT-MW-106 and BCT-MW-107 contained dissolved copper at concentrations of 13.3 µg/l and 13.8 µg/l, respectively, which are more than four times higher than the PCL (Table 6-10). Only one out of six samples from one Unit A shoreline well marginally exceeded the copper PCL (4.35 µg/L in MW-01) (Figure 6-A7; Table 6-10). Dissolved copper concentrations were below the PCL in both samples collected from the SEEP-01 located within the intertidal shoreline (Table 6-22).

Based on the spatial distribution of soil and groundwater exceedances for copper in Unit A, there are not clearly identifiable soil sources for the groundwater copper exceedances. For example, the highest soil copper concentrations (up to 265 mg/kg) were historically detected in the area of the Old Machine Shop (OMS-series explorations), but there are no groundwater copper exceedances detected historically in groundwater at either of wells OMS-MW-01 or OMS-MW-02 in that area.

6.5.1.2.2.2 MERCURY

The soil mercury PCL based on leaching is the 0.1 mg/kg PQL, which is slightly above the 0.07 mg/kg natural background soil concentration (Table 5-3). Therefore, any detection of mercury in soil is an exceedance, and soil mercury exceedances are scattered across Unit A with no particular association to historical operations, as depicted on Figure 6-A9.

A statistical evaluation of all mercury soil data from Unit A indicates a 95 percent UCL of 0.07 mg/kg, which is below the soil PCL of 0.1 mg/kg, with 10.3 percent of the samples exceeding the PCL (8/78), and one concentration that exceeds two times the PCL. Revised compliance statistics that take into account the natural background level for mercury indicate that the frequency of exceedance can be 15 percent, but the magnitude of exceedance remains at two times the PCL. Mercury was not detected above the laboratory reporting limit in 89.7 percent of the soil samples collected from Unit A and the 90th percentile of the population has a concentration of 0.07 mg/kg, which is below the soil PCL of
0.1 mg/kg and equal to natural background for the Puget Sound region.

Consistent with the low mercury concentrations in soil, dissolved mercury was detected above the groundwater PCL in only one of 18 wells located in Unit A (well BCT-MW-105; Figure 6-A9), in only one of five samples collected from that well, and at a concentration (0.0255 µg/L) that only marginally exceeds the groundwater PCL of 0.025 µg/L (Table 6-10). No dissolved mercury exceedances were detected in wells downgradient of BCT-MW-105, or in the SEEP-01 samples (Table 6-22).

6.5.1.2.2.3 NICKEL

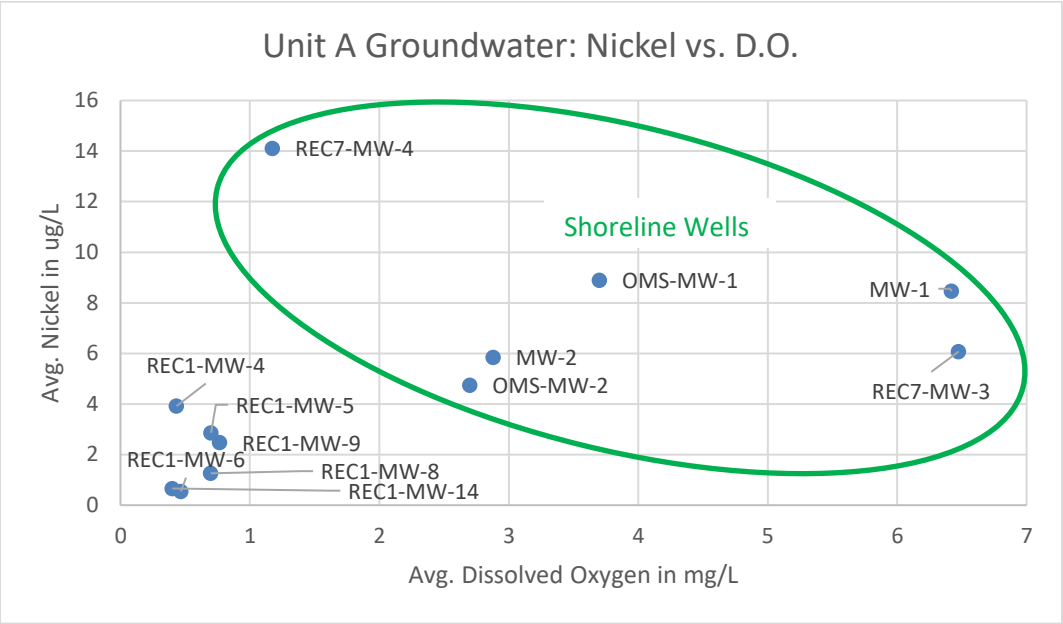
Dissolved nickel concentrations exceeding the 8.2 µg/L groundwater PCL were detected in four of five Unit A shoreline well locations but not in any of the Unit A wells located inland (Figure 6-A10). At each of the shoreline wells, the nickel exceedances were only detected in a single groundwater sample collected in 2012 and subsequent sampling results did not detect nickel in groundwater above the PCL (Table 6-10).

Soil nickel concentrations throughout Unit A are less than the 48 mg/kg soil PCL (based on natural background concentrations) in all samples (Table 6-9; Figure 6-A10). For Unit A, there is no apparent correlation between nickel concentrations in groundwater versus soil, and thus no identifiable soil sources for the groundwater exceedances in shoreline wells (Figure 6-A12).

Given the lack of identifiable sources of nickel in Unit A soil, and the fact that higher groundwater nickel concentrations are detected at shoreline wells than inland wells, a possible cause for elevated groundwater nickel in shoreline groundwater is release of nickel from oxidation of naturally occurring, nickel-containing iron sulfide minerals (pyrite or amorphous forms) in the dredge fill matrix. Sulfides are unstable in oxidized conditions, and release of nickel from pyrite oxidation is a phenomenon reported in the literature (Larsen and Postma, 1997; Kjoller, 2001). Both pyrite- and nickel-bearing ore minerals (e.g., limonite) are known to exist, and have been commercially mined in some localities[33] of the very large Snohomish River watershed, which supplied the sediment that became Upland Area dredge fill. Relatively high concentrations of total sulfide (up to 3,800 mg/kg), albeit not mineral-specific, are documented in sediments of Port Gardner Bay and specifically the East Waterway (SAIC, 2009; Ecology, 2013).

Groundwater in the Unit A shoreline wells has generally higher dissolved oxygen (D.O.) than in inland wells, which is indicative of seawater intrusion into the nearshore portion of the fill. An exception is shoreline well REC7-MW-4, located at the east end of the slip, which has relatively low D.O. (Table 6-11). The chart below shows the relationship of average nickel and average D.O. measured in Unit A groundwater wells, which shows the generally higher D.O. and generally higher nickel concentrations in the shoreline wells.

[33] For example, mined in the Sultan and Index Mining Districts (Washington Department of Conservation and Development, 1942).



Again, well REC7-MW-4 does not fit the pattern (average nickel in REC7-MW-4 is driven by one high detection; Table 6-10); however, there is not another reason apparent for the shoreline groundwater nickel exceedances based on the other Unit A soil and groundwater data. This phenomenon of higher dissolved nickel with higher D.O. is also observed in Unit B shoreline wells, as described below in Section 6.4.2.2.6.

No dissolved nickel exceedances were detected in the SEEP-1 samples (Table 6-22). Contaminant transport modeling indicates that a groundwater nickel concentration of approximately 380 µg/L in Unit A shoreline monitoring wells is estimated to be protective of intertidal sediment and surface water quality (Table 6-22). All detected dissolved nickel concentrations in Unit A shoreline wells are considerably less than that value (Table 6-10).

6.5.1.2.3 Polychlorinated Biphenyls

There are two Unit A exceedances of total PCBs in soil: a single sample collected from boring GF-B-15A, where total PCBs were reported at a concentration of 0.22 mg/kg in saturated soil, and a sidewall sample collected from second IA OMS area where total PCBs were reported at a concentration of 24 mg/kg, above the MTCA and federal EPA (40 C.F.R. 761.61) industrial land use soil standard of 10 mg/kg, in unsaturated soil (Table 6-18). The soil that contains total PCBs (which is composed entirely of Aroclor 1254) at the southeast corner of the OMS area excavation is located near the top of the steep shoreline bank of the off-loading dock slip and next to a 36-inch diameter wood stave pipe that is located within the upper portion of that bank. Based on consultation with Ecology during the second IA, the OMS area excavation was completed to its maximum practicable limits and further excavation was deemed not feasible without potentially compromising the stability of the bank and risking slope failure into the East Waterway (Aspect, 2021). There is limited groundwater data for PCBs in Unit A but a single sample collected from historical OMS area well OMS-MW-02 in 2015 did not contain PCBs above the laboratory reporting limits, indicating empirically that PCBs may not be

leaching from the OMS area soil at levels that result in exceedances of the groundwater PCLs, subject to long-term groundwater monitoring.

6.5.1.2.4 Un-Ionized Ammonia

One sample of groundwater collected from Unit A contained a concentration of un-ionized ammonia slightly greater than the 0.035 mg/L PCL (0.068 mg/L in September 2012 sample from well REC1-MW-09); however, the concentrations of un-ionized ammonia detected in this well during the two subsequent sampling events were less than the PCL (Table 6-22). The highest detected concentration was less than the biological no observable effects concentration (NOEC) of 0.46 mg/L for un-ionized ammonia used in the Dredged Material Management Program (DMMP) (Kendall and Barton, 2004). The detected concentration is within the range of background concentrations for Puget Sound sediments (up to 0.2 mg/L; USGS, 2010).

Detected concentrations of un-ionized ammonia were below the PCL in all samples from the other Unit A shoreline wells MW-01, MW-02, REC7-MW-03, and REC7-MW-04, and in samples collected from SEEP-01 (Table 6-12; Figure 6S-3).

6.5.1.3 Summary for Unit A

Unit A Groundwater PCL exceedances are detected for copper, mercury, and nickel at scattered locations across Unit A. None of the exceeding metals are consistently detected in any well, and the magnitudes of exceedance are generally low. Notably, a low-level mercury exceedance was detected in only one groundwater sample across the entire unit, and not at a shoreline well. A marginal copper exceedance was detected inconsistently in groundwater samples from one of six shoreline monitoring wells, whereas nickel exceedances are detected consistently in groundwater samples from five of six shoreline monitoring wells. There are not elevated nickel concentrations detected in Unit A soil, and the detected groundwater nickel concentrations are higher in shoreline wells than in inland wells. The collective data suggest that the elevated shoreline groundwater nickel concentrations may be attributable to release of naturally occurring nickel from sulfide minerals interacting with oxygenated seawater within the aquifer's tidal mixing zone. There are no source concentrations of these metals identified in Unit A soil.

The highest concentration of total PCBs in soil in the Upland Area is located in a small volume of soil at the southeast corner of the OMS area IA excavation that could not practicably be removed during the second IA. Groundwater data collected from nearby historical OMS area well OMS-MW-02 did not identify detectable PCB concentrations indicating that, despite the small residual area with relatively high concentration in soil, the leaching to groundwater pathway may not be a concern for PCBs in Unit A, subject to long-term groundwater monitoring.

A low-level exceedance of un-ionized ammonia is detected in one of 23 shoreline groundwater samples collected from Unit A, but the detected concentration was not reproduced in subsequent sampling.

The existing analytical data for Unit A soil and groundwater provide sufficient information for the development and evaluation of cleanup action alternatives in accordance with MTCA.

6.5.2 Unit B

The explorations and IA areas within Unit B, including IA compliance soil sample locations, are depicted on Figure 6-B1. For current conditions following the IA, the constituents detected in one or more samples of Unit B media at concentrations exceeding their respective industrial PCLs are as follows:

- TPH-D+O in soil and groundwater
- Total cPAHs (TEQ) in soil and groundwater
- Arsenic, copper, lead, mercury, nickel, and zinc in soil and groundwater
- Naphthalene in soil and groundwater
- The following SVOCs in groundwater at a single location for each: 2-methylnaphthalene, 2,4,6-trichlorophenol, dibenzofuran, fluorene, and pentachlorophenol
- Vinyl chloride in groundwater
- Total PCBs in soil
- Un-ionized ammonia in intertidal porewater

Constituents that were not detected at concentrations greater than the industrial PCLs in soil or groundwater samples collected within Unit B include TPH-G, BTEX, dioxins/furans, metals, VOCs, and SVOCs, which are not included in the list above.

The sample locations for constituents detected at concentrations exceeding the PCLs in Unit B are presented on Figures 6-B2 through 6-B18. The data for constituents detected at concentrations exceeding the PCLs are summarized by constituent group in the following subsections.

6.5.2.1 Total Petroleum Hydrocarbons and PAHs

Gasoline-range TPH and BTEX were not detected above the PCLs in soil or groundwater samples collected from within Unit B (Tables 6-13 and 6-14). Following the two IAs, concentrations of TPH-D+O (as Bunker C fuel oil) remain in soil and groundwater above the PCLs only within the USTs 71, 72, 73 IA area of Unit B (Figure 6-B2).

6.5.2.1.1 Soil TPH and PAH Data

Within Unit B, seven IA areas focused on the removal of TPH-contaminated material: the Rail Car Dumper area, the BA-MW-6 area, the UST 70 area, the Heavy Duty Shop Sump area, the USTs 71, 72, 73 area, the REC2-MW-5 area, and the Digesters Trench area (Figure 6-B1). While the CMS area was remediated in the second IA primarily to address PCBs in soil that were a source to groundwater, it also removed localized naphthalene exceedances in groundwater and segments of historical Bunker C fuel lines with associated soil contamination. The CMS area excavation was completed over a total duration of approximately 7 weeks, during which time, construction dewatering was conducted frequently to remove accumulated groundwater to facilitate soil removal. The groundwater removed from the CMS area excavation was combined with groundwater extracted from other excavations happening concurrently during the second IA, so the

specific volume extracted from the CMS area is unknown, but it was not insignificant. Oil-range TPH was the inferred constituent targeted for IA in the Heavy Duty Shop Sump area based on oily material observed within the sump structure during the Phase 1 ESA (AECOM, 2011). However, during the first IA, the results of field screening and soil sampling following removal of the sump structure did not indicate a release from the structure; therefore, no soil was removed in this area.

Following the first IA, TPH and PAH IA soil cleanup levels were met in the Rail Car Dumper area, BA-MW-6 area, UST 70 area, and the REC2-MW-5 area (Figures 6-B2, 6-B3, and 6-B4, and Aspect, 2015a). Four quarterly rounds of postexcavation confirmation groundwater monitoring at those four areas demonstrated that groundwater meets PCLs for TPH and PAHs, and Ecology agreed that no further groundwater monitoring for those compounds is required for those areas (Aspect, 2015d).

Likewise, during the second IA, TPH and PAH IA soil cleanup levels were met for the CMS excavation area (Figures 6-B2, 6-B3, and 6-B4, and Aspect, 2021). TPH soil cleanup levels were also met following removal of oily waste material from the Digesters Trench area (Figure 6-B2). Prior to the second IA, when the oily material remained in place, no TPH or PAH exceedances were detected in groundwater from well PM-MW-1 located near the western (downgradient) end of the Digesters Trench area; the groundwater data demonstrate limited leachability of hydrocarbons from the oily materials that were subsequently removed (Aspect, 2021). Well PM-MW-1 was excavated during the GF-B-12 excavation and is thus not displayed on Section 6 figures.

Within the USTs 71, 72, 73 IA area, concentrations of TPH-D+O (Bunker C fuel oil) exceeded the 2,000 mg/kg PCL in five sidewall soil samples (remaining concentrations range up to 28,000 mg/kg TPH-D+O as measured by NWTPH-Dx) collected from two areas of the excavation (Figure 6-B2). In addition, concentrations of total cPAHs (TMEQ) exceeding the PCLs were reported in five of the compliance soil samples (located in the saturated zone) collected at the limits of the excavation (Figure 6-B3). Further soil excavation in those areas was impracticable due to the presence of massive concrete foundation structures (Aspect, 2015a). Samples of the inaccessible TPH-impacted soil were also analyzed for petroleum fractions (EPH analysis) to allow calculation of an area-specific soil TPH PCL for that soil, as presented below.

6.5.2.1.1.1 SITE-SPECIFIC SOIL TPH PCL FOR USTS 71, 72, 73 EXCAVATION AREA

Four samples of the residual TPH-contaminated soil that could not be removed from the USTs 71, 72, 73 IA excavation area were submitted for laboratory analysis of hydrocarbon fractions using the EPH Method to allow the calculation of risk-based soil cleanup levels in accordance with MTCA (WAC 173-340-745(5)(b)(iii)(B)(III)). The TPH concentrations measured by the EPH analysis ranged from 16 to 88 percent of those measured by the NWTPH analysis for the four samples, and the distribution of petroleum fractions indicates Bunker C fuel oil. The results of the MTCAtph calculations for this area are detailed in Section F.1.1 of Appendix F.

As discussed in Appendix F, the residual TPH concentrations in this area's inaccessible soils are protective of industrial direct contact and leaching to groundwater. However, the

TPH concentrations in three samples (8,400 to 28,000 measured by NWTPH-Dx) exceed the proposed area-specific PCL based on residual saturation (7,700 mg/kg).

6.5.2.1.2 Groundwater TPH and PAH Data

Outside of the USTs 71, 72, 73 IA area, TPH-D+O and naphthalene concentrations in Unit B groundwater samples were less than PCLs (Figures 6-B2 and 6-B4). Low-level total cPAH (TEQ) exceedances occurred sporadically in wells throughout Unit B (Figure 6-B3).

Within the USTs 71, 72, 73 IA area, the results from two years of quarterly post-IA groundwater monitoring at wells UST71-MW-103 and -104, located directly downgradient of the residual inaccessible TPH-impacted soils on the south and north ends of the excavation, respectively, did not identify concentrations of TPH-D+O in groundwater above the PCL. However, concentrations of total cPAHs (TEQ) were detected above the PCL in the groundwater samples collected from well UST71-MW-103 during each post-IA groundwater sampling event and naphthalene was detected above the PCL in one of eight post-IA groundwater samples collected from well UST71-MW-103 (Table 6-14). At well UST71-MW-102, located downgradient of the central portion of the IA excavation, away from the residual inaccessible soil, motor oil-range TPH exceedances (up to 2,200 µg/L) and total cPAHs (TEQ) exceedances (up to 0.136 µg/L) were each detected in post-IA groundwater samples collected; the TPH and total cPAHs TEQ exceedances occurred in different sampling rounds. In addition, naphthalene exceeding its PCL (based on VI) was reported in one of eight groundwater samples collected from well UST-MW-103 (Table 6-14).

In this area, the two wells with detected TPH and/or PAH exceedances in groundwater—UST71-MW-102 and -103—hit refusal on buried structure during drilling, so the well screens could not be placed to the depth planned and they thus intercepted a limited saturated thickness. The wells recovered slowly and could not be developed to the degree desired following installation, and consequently their groundwater samples were consistently more turbid than observed in the other wells in this area (Aspect, 2015d). For example, over the 2-year period of monitoring, wells UST71-MW-102 and -103 had the average turbidities of 47 and 95 NTU, respectively, compared to 8 and 7 NTU in wells UST71-MW-101 and -104, respectively, suggesting that turbidity bias contributed to the detected groundwater TPH/PAH exceedances in wells UST71-MW-102 and -103 (turbidity data in Table 6-11).

Outside of the USTs 71,72, 73 IA area, total cPAHs (TEQ) were detected above the PCL in groundwater at five monitoring wells within Unit B (Figure 6-B3). For each of those five wells (BA-MW-03, BA-MW-05, PM-MW-02, PM-MW-03, and PM-MW-05), the total cPAHs (TEQ) exceedances were very low—below 0.04 µg/L (4 in 100 billion)—and were not reproduced in repeated sampling (Table 6-14).

The cPAHs are hydrophobic compounds with low mobility in groundwater, particularly within the organic-rich dredge fill that largely makes up the Upland Area. Therefore, the concentrations of total cPAHs (TEQ) in Unit B groundwater samples may be influenced by small quantities of solids that are suspended in the groundwater samples. In accordance with the RI/FS Work Plan, the 2013 through 2015 groundwater samples were centrifuged

prior to analysis of cPAHs if turbidity was measured in the field to be greater than 25 NTU. Within Unit B, this included some of the samples collected from wells RCD-MW-101, UST71-MW-101, -102, and -103 (centrifuged samples are noted in Table 6-14). The wells with the highest detected total cPAHs (TEQ) concentrations—UST71-MW-102 and UST71-MW-103, which could not be effectively developed as described above—also have the highest turbidities measured, but the high-turbidity samples were centrifuged prior to PAH analysis. There is a reasonable weight of evidence to indicate that sample turbidity contributed to the cPAH exceedances in wells UST71-MW-102 and -103, but the data are inconclusive as to whether the sporadic cPAH exceedances elsewhere in Unit B groundwater samples can be attributed to high turbidity.

At well BA-MW-05, the detected groundwater concentrations of the 2-methylnaphthalene and fluorene (Table 6-14) and dibenzofuran (Table 6-17) exceeded their PCLs. Naphthalenes and dibenzofuran are PAHs commonly associated with creosote-treated wood. Concentrations of dibenzofuran and 2-methylnaphthalene are below the PCLs in both groundwater samples collected from historical shoreline well BA-MW-07, located downgradient of well BA-MW-05. There are no surface water criteria for 2-methylnaphthalene or dibenzofuran; therefore, the groundwater PCLs are based on potable water (Table 5-1). Note that 2-methylnaphthalene is not routinely reported as part of the laboratory's PAH analysis, and there are very limited soil data for it in Unit B. No concentrations of fluorene in Unit B soil exceeded the PCL (Table 6-13). Dibenzofuran was detected in 1 out of 85 Unit B soil samples analyzed for it, at a trace concentration (0.04 mg/kg) (Table 6-16). Given the very low frequency and magnitude of exceedance, limited to groundwater at a single location, dibenzofuran, fluorene, and 2-methylnaphthalene are not considered contaminants of concern within Unit B.

6.5.2.2 Metals

Five IA areas within Unit B focused on the removal of soil contaminated with metals: Boiler/Baghouse area, GF-11 area (lead), GFB12 area (mercury), PM-B-6 area (copper and mercury), and REC5-MW-01 area (arsenic, copper, and lead) (Figure 6-B1). The Boiler/Baghouse area was initially excavated as part of the first IA, primarily because lead concentrations were detected above the industrial PCL in soil samples collected as part of the Phase 2 ESA (Aspect, 2013a). The Boiler/Baghouse area was further excavated during the second IA to remove copper, mercury, and zinc that were a suspected ongoing source to groundwater (Aspect, 2021). Approximately 11,200 tons of metals-contaminated soil were excavated from these five IA areas in total. The soil excavated from the GF-11 area was designated as characteristic hazardous waste and was treated and disposed of at a Subtitle C landfill, as described by Aspect (2015a). The 1,000 mg/kg IA soil cleanup level for lead (based on industrial) in unsaturated soil, equivalent to the PCL, was met at the limits of both of these excavation areas (Aspect, 2015a; Figure 6-B7). Concentrations of copper, mercury, and zinc exceeding the soil PCLs were detected in soil remaining at the limits of these excavation areas.

Arsenic, copper, lead, mercury, nickel, and zinc are detected exceeding the PCLs in groundwater samples collected from select Unit B wells. The metals exceedances were detected primarily within the northwest area of Unit B, within the area of the former boilers/steam plant, baghouse, and hog fuel storage. The following sections describe the

metals data from well REC5-MW-01 (distinct and somewhat anomalous data as described by Aspect (2013a)), followed by the metals data for the rest of Unit B.

6.5.2.2.1 Groundwater Metals at Well REC5-MW-1/-1R

The highest concentrations of dissolved arsenic, copper, and lead in Upland Area groundwater were historically detected at well REC5-MW-01, located on the downgradient edge of the former steam plant. Well REC5-MW-01 was damaged during mill demolition and replaced during the RI by REC5-MW-1R, located a few feet from the original well. The arsenic concentrations detected in groundwater samples collected from replacement well REC5-MW-1R exceeded the PCL in both groundwater samples collected, but the concentrations were substantially lower (less than 30 µg/L) than those measured in 2012 in original well REC5-MW-1.

Although no elevated soil metals concentrations were detected in the area around wells REC5-MW-1 and -1R, it was inferred that a highly localized metals source existed in their vicinity. Therefore, during the second IA, a total of 368 tons of soil was excavated from the REC5-MW-1 area, and reported concentrations of arsenic, copper, and lead were below the soil PCLs in all of the excavation verification samples (Aspect, 2021).

Apart from well REC5-MW-1/-1R, groundwater concentrations of arsenic, copper, lead, mercury, and nickel exceeding their PCLs are relatively widespread within Unit B, with somewhat different distributions as depicted on Figures 6-B5 through 6-B9, respectively. Zinc exceedances in groundwater are limited to one well in Unit B (Figure 6-B10). The Unit B metals data other than those from the REC5-MW-1/-1R area are described below.

6.5.2.2.2 Arsenic

Arsenic is present above the soil PCL of 20 mg/kg in two soil samples collected from within Unit B (Figure 6-B5). A statistical evaluation of all arsenic soil data from Unit B indicates a 95 percent UCL of 5.1 mg/kg, which is below the soil PCL of 20 mg/kg, with less than 1 percent of the samples (2/229) exceeding the PCL. None of the reported concentrations of arsenic in soil in Unit B exceed two times the PCL (40 mg/kg). Therefore, Unit B arsenic soil concentrations are in compliance with the PCL.

Arsenic has been detected in groundwater above the 9 µg/L PCL, which is based on natural background, in five Unit B well locations (Figure 6-B5). There is no apparent spatial correlation between arsenic exceedances in soil versus those in groundwater within Unit B (Figure 6-B5). With one exception, the concentrations of arsenic reported exceeding the 9 µg/L PCL range from 14.7 µg/L to 17.5 µg/L (Table 6-10). The March 2017 sample collected from well PM-MW-04 contained dissolved arsenic at 86.1 µg/L, which is significantly higher than concentrations of total arsenic previously reported in well PM-MW-04, due to the groundwater pH increase from 7.7 or less to 11.6 created by the CM placement (Table 6-10).

There are no groundwater arsenic exceedances at any of the six shoreline wells in Unit B (Table 6-22). Dissolved arsenic concentrations were also less than the PCL in samples of intertidal porewater collected immediately west of Unit B (locations PW-03 and PW-04 on Figure 6-B5).

6.5.2.2.3 Copper

Copper concentrations that exceed the PCL of 36 mg/kg, which is based on natural background, are widespread within Unit B soil (Figure 6-B6). Historically, the highest concentrations of metals, including copper, were detected in soil in and around the BBH area that was removed as part of the second IA (Aspect, 2021). A statistical evaluation for all remaining copper soil data from Unit B indicates a 95 percent UCL of 22 mg/kg, which is below the PCL of 36 mg/kg, with 10.4 percent of the samples exceeding the PCL (34/328), and three samples that contain copper at more than two times the PCL. The MTCA compliance statistics requirements that take into account the natural background level for copper indicate that the frequency of exceedance can be 13 percent, and the magnitude of exceedance can be 3.6 times the PCL (130 mg/kg). The highest detected concentration of copper in Unit B is 99.2 mg/kg. Therefore, the results of the statistical analysis indicate that the copper data for Unit B soils are in compliance with the PCL since the 95 percent UCL is below the PCL, less than 13 percent of the samples exceed the PCL, and no samples contain copper at a concentration greater than 3.6 times the PCL.

Groundwater copper concentrations exceeding the stringent 3.1 µg/L PCL are widespread throughout Unit B, as depicted on Figure 6-B6. The highest concentrations of copper in groundwater in Unit B are reported in well UST71-MW-103 (up to 66.5 µg/L when pH was 12.1) and PM-MW-04 (68.6 µg/L when pH was 11.6) (Table 6-10). As shown on Figure 6-B6, groundwater copper concentrations are below the PCL in shoreline well PM-MW-07 located downgradient of PM-MW-04. Groundwater copper concentrations at the REC3-MW-01/01R shoreline location, downgradient of well UST71-MW-103, were low, ranging from 0.3 to 4.95 µg/L in the original and replacement well (Table 6-10). No dissolved copper exceedances were identified in intertidal porewater samples from the PW-03 location downgradient of REC3-MW-01/01R (Figure 6-B6; Table 6-10) even though the maximum total concentration of copper at PW-03 exceeded its PCL by five times (15.8 ug/L). Likewise, no dissolved copper exceedances were detected in the PW-04 porewater sample location downgradient of shoreline wells in the UST 70 IA area where groundwater copper exceedances were detected (Figure 6-B6).

6.5.2.2.4 Lead

Lead was detected above the PCL in one soil sample from the GF-B-13 location near the eastern (upgradient) side of Unit B (Table 6-9; Figure 6-B7) and inconsistently in groundwater at four wells (Table 6-10; Figure 6-B7). Lead concentrations are below the PCL in all groundwater samples collected from the shoreline wells and in the PW-03 and PW-04 intertidal porewater samples (Table 6-22).

A statistical evaluation of all lead soil data from Unit B indicates a 95 percent UCL of 51 mg/kg for unsaturated soil and 17 mg/kg for saturated soil, which are below the soil PCLs of 1,000 mg/kg and 81 mg/kg, respectively, with less than 1 percent of samples (1/247) exceeding the PCL. One concentration of lead in saturated soil in Unit B, reported at 115 mg/kg, exceeds two times the PCL (112 mg/kg). Unit B lead soil concentrations are in compliance with PCLs for unsaturated soil but not for saturated soil. However, groundwater data from wells positioned downgradient of the GF-B-13 location demonstrates empirically that lead is not leaching from saturated soil exceeding the PCL at those locations (Figure 6-B7).

6.5.2.2.5 Mercury

As with copper, mercury concentrations that exceed the PCL of 0.1 mg/kg[34] are widespread within Unit B soil (Figure 6-B8). A statistical compliance evaluation for all mercury soil data from Unit B indicates a 95 percent UCL of 0.11 mg/kg, with more than 10 percent of the reported concentrations exceeding the PCL, and 14 samples that contain mercury at more than two times the PCL. The compliance statistics requirements that take into account the natural background level for mercury indicate that the frequency of exceedance can be 13 percent, but that the magnitude of exceedance is still two times the PCL. Because the 95 percent UCL is above the PCL, 21 percent of samples exceed the PCL, and 14 samples have mercury concentrations that are more than two times the PCL, Unit B mercury soil concentrations are not in compliance with the PCLs.

Groundwater dissolved mercury concentrations above the stringent 0.025 µg/L PCL were detected in several wells within the central and western portions of Unit B, but there are no dissolved mercury exceedances detected at shoreline wells or the intertidal PW-03 and PW-04 porewater sample locations (Figure 6-B8; Tables 6-10 and 6-22). Inland from the shoreline, exceedances of mercury are sporadic, and the magnitude of exceedances are relatively small in most samples (Table 6-10). The highest concentration of mercury reported in Unit B groundwater is 0.286 µg/L at well PM-MW-04 when its pH had increased to 11.6 (Table 6-10; Figure 6-B8).

6.5.2.2.6 Nickel

Dissolved nickel concentrations exceeding the 8.2 µg/L groundwater PCL were detected in seven Unit B wells, including four shoreline well locations (Figure 6-B9). However, soil nickel concentrations greater than the 48 mg/kg PCL (based on natural background) were detected in only two inland locations, Boiler-B-04 and REC5-HA-02 (Table 6-9). A statistical compliance evaluation for all nickel soil data in Unit B indicates a 95 percent UCL of 27 mg/kg, with less than 10 percent of samples exceeding the PCL, and no concentrations that exceed two times the PCL (96 mg/kg). Based on the results of this evaluation, Unit B nickel concentrations are in statistical compliance with the PCL.

The highest concentrations of nickel detected in Upland Area groundwater are at Unit B shoreline wells RCD-MW-101 (6.9 to 159 µg/L, average 59 µg/L), UST70-MW-02 (2 to 308 µg/L, average 44 µg/L), and REC3-MW-01/01R (5 to 83 µg/L, average 37 µg/L) (Table 6-10). The wide range of detected concentrations at each of these wells may be attributable to geochemical influences related to nearshore seawater mixing.

The most reliable data regarding dissolved nickel transport to the marine environment are the empirical dissolved nickel results from intertidal porewater samples PW-03 and PW-04, collected in the intertidal zone immediately west of Unit B, which were consistently less than the PCL (Table 6-22; Figure 6-B9).

As described for Unit A (Section 6.5.1.2.4), the lack of nickel sources in Unit B soil, and higher groundwater nickel occurring in shoreline wells than in inland wells, suggests that the elevated groundwater nickel concentrations in shoreline groundwater may be due to release of naturally occurring nickel in the presence of more oxidizing groundwater along

[34] Based on natural background and adjusted for the practical quantitation limit (PQL).

the shoreline. In particular, the groundwater at shoreline well RCD-MW-101 is oxygenated (measured D.O. of 5.4 to 11.1 mg/L; Table 6-11). This contrasts with the anaerobic (reducing) groundwater in the dredge fill throughout most of the Upland Area and is indicative of seawater intrusion into the nearshore portion of the fill. Wells UST70-MW-02 and REC3-MW-01 have lower D.O. than RCD-MW-101, but some measured values at those wells (up to 6.7 mg/L and 2.8 mg/L, respectively) are higher than typically measured farther inland (Table 6-11). Although it is a hypothesis, as discussed for the Unit A nickel data, there is not another reason apparent to explain the elevated nickel concentrations in Unit B shoreline groundwater.

6.5.2.2.7 Zinc

Soil zinc concentrations greater than PCLs (PCLs equal to and slightly above natural background concentrations for saturated and unsaturated soil, respectively) are scattered throughout Unit B (Figure 6-B10; Table 6-9). A statistical evaluation of all Unit B zinc soil concentrations indicates a 95 percent UCL of 64 mg/kg for unsaturated soil and 40 mg/kg for saturated soil, which are below the soil PCLs of 100 mg/kg and 85 mg/kg, respectively, with 4.2 percent of samples (12/288) exceeding the PCL, and no saturated soil samples with zinc concentrations that exceed two times the PCL. There are five unsaturated soil samples that contain zinc at concentrations greater than two times the PCL so unsaturated soils in Unit B are not in compliance with the soil PCLs for zinc.

Although zinc concentrations in unsaturated soils statistically do not comply with the PCL, the Unit B groundwater data empirically demonstrate those soil concentrations are not a significant source to groundwater. Dissolved zinc concentrations exceeding the 81 µg/L groundwater PCL were detected in a single Unit B well (UST70-MW-02) during a single sampling event and were below the PCL in eight subsequent samples collected from that well (Table 6-10). Historically, the highest Unit B groundwater zinc concentrations were reported in well BBH-MW-104 located on the south edge of the Boiler/Baghouse first IA excavation. The second IA at the BBH area removed an additional 7,500 tons of metals-contaminated soil to address the soil leaching to groundwater pathway. However, even before the second IA, no groundwater zinc exceedances were detected at historical well BBH-MW-102 located downgradient of well BBH-MW-104 or the further downgradient REC3-MW-01/01R shoreline well location, indicating limited downgradient migration of dissolved zinc (Figure 6-B10). Furthermore, dissolved zinc concentrations were less than 1 µg/L in the PW-03 and PW-04 intertidal porewater locations (Table 6-22).

6.5.2.3 Polychlorinated Biphenyls (PCBs)

The second IA included excavation and removal of approximately 6,700 tons of PCB-contaminated soil from the CMS area (Aspect, 2021). Concentrations of total PCBs in soil are below PCLs in Unit B except for three saturated soil samples collected at the limits of the second IA CMS area and the first IA DAST area (Figure 6-B11). The concentrations of total PCBs exceeding the saturated soil PCL of 0.12 mg/kg, based on the protection of groundwater, range from 0.2 mg/kg to 0.3 mg/kg (Table 6-18).

Concentrations of PCBs were reported above the groundwater PCL in samples collected from historical wells CMS-MW-1R and DAST-MW-101 within the CMS excavation

footprint prior to the second IA. The second IA removed the presumptive source of PCBs to groundwater in that area while also removing a large quantity of contaminated groundwater during dewatering of the large excavation.

In accordance with the RI/FS Work Plan (Aspect, 2013c), three soil samples collected during the RI with the highest concentrations of total PCBs were also submitted for analysis of PCB congeners to support future work in the East Waterway RI/FS; each of the three samples was collected from Unit B (from explorations BA-MW-02, PM-B-06, and PM-B-07; Figure 2-4). Of these, only the soil sample collected from BA-MW-02 is representative of current conditions; the soil PCB congener data for this sample is provided on Table 6-19. Figure 6-B14 presents histograms of PCB congener composition (as weight percent of total PCB congener concentration) for the three soil samples. The sample histograms can be compared to plots of congener composition (by weight percent) for the common PCB Aroclors,[35] including the three Aroclors detected in Upland Area soil (Aroclors 1016, 1254, and 1260), which are presented in Appendix J. In Figure 6-B14, nondetected congeners are plotted as zero, so the histogram pattern is not obscured by numerous nondetections (if plotted as one-half the reporting limit). The distribution of PCB congeners appears generally consistent with the detected Aroclors in the samples: lighter molecular weight congeners constitute a greater percentage of the total PCB concentration in the BA-MW-02 sample (with detectable Aroclor 1016), whereas the PM-B6 and PM-B7 samples (with detectable Aroclors 1254 and 1260) both have a greater percentage of moderate-molecular-weight congeners.

6.5.2.4 Un-Ionized Ammonia

Un-ionized ammonia was not detected above the 0.035 mg/L PCL in groundwater samples collected from any of the shoreline wells in Unit B (Figure 6-S3). Un-ionized ammonia was detected above the PCL in one of two porewater samples collected from the PW-03 location (0.14 mg/L; Table 6-12). Each of the un-ionized ammonia concentrations detected in Unit B intertidal porewater was less than the NOEC of 0.46 mg/L (Kendall and Barton, 2004), and they are in the range of background concentrations in Puget Sound sediments (USGS, 2010).

6.5.2.5 Sulfide

Total dissolved sulfide concentrations in groundwater were below the PCL at each of the six Unit B shoreline wells. High total dissolved sulfide concentrations were detected in three of four intertidal porewater samples collected from two locations beneath the dock and downgradient of the former Boilers area in February and August 2014 (8.8 to 23.5 mg/L at PW-03; nondetect to 9.1 mg/L at PW-04). However, applying the more reliable DGT sulfide sampling methodology in February 2015, hydrogen sulfide (H_2S) was not detected at either porewater sample location (Table 6-12). The data indicate that the prior variable detections of total dissolved sulfide are attributable to mineral sulfides in the samples, not H_2S.

[35] Obtained from http://www.epa.gov/epawaste/hazard/tsd/pcbs/pdf/aroclorplots.pdf.

6.5.2.6 Other Constituent Exceedances

Other constituent exceedances in Unit B groundwater consist of the following:

- At well PM-MW-05, pentachlorophenol (PCP) and its degradation daughter product 2,4,6-trichlorophenol were detected in groundwater at concentrations exceeding their PCLs (Table 6-17). There is no documentation of historical usage of PCP in the pulp mill area or anywhere in the former mill. PCP has never been detected above the laboratory reporting limits in 215 soil samples analyzed for SVOCs (Table 6-1), including those collected from PM-MW-05 (Table 6-16). PCP was not detected in groundwater samples collected from downgradient wells PM-MW-02, PM-MW-04, PM-MW-07, and PM-MW-08, located between well PM-MW-05 and the shoreline (Figure 6-B1), indicating an incomplete transport pathway to marine surface water.
- Vinyl chloride was detected above the groundwater PCL of 0.2 µg/L in both samples collected from well OPS-MW-01, at concentrations of 0.23 µg/L and 0.28 µg/L (Table 6-17). This well is located more than 800 feet from the shoreline. Vinyl chloride was not detected anywhere in Upland Area soil above the laboratory reporting limits (Table 6-1), and was not detected exceeding the PCL in any other Unit B groundwater samples indicating an incomplete transport pathway to marine surface water (Table 6-17). The detected concentrations at well OPS-MW-01 were also an order of magnitude below the 3.4 µg/L screening level for vapor intrusion.

6.5.2.7 Summary for Unit B

The IA successfully removed TPH-contaminated soil from Unit B to meet the default soil industrial PCLs; however, soil TPH concentrations in two portions of the USTs 71, 72, 73 excavation exceed the proposed area-specific PCL. Groundwater immediately downgradient of both inaccessible soil occurrences had no detected TPH exceedances, but well UST71-MW-103 downgradient of the southern occurrence had consistent cPAH exceedances. In addition, TPH and cPAH exceedances were detected inconsistently in well UST71-MW-102 located on the downgradient edge of the middle of the excavation. The detections at UST71-MW-102 and -103 may be attributable to elevated turbidity of the groundwater samples. Outside of the two areas of inaccessible soil within the USTs 71, 72, 73 excavation area, there are no detected TPH soil exceedances remaining in Unit B

Outside of the UST 71 area locations, cPAHs were detected sporadically in Unit B soil and groundwater at concentrations greater than the PCLs.

In groundwater, concentrations of the metals arsenic, copper, lead, mercury, nickel, and zinc greater than the PCLs were detected throughout Unit B, with the most consistent and higher-magnitude exceedances detected in the Boilers area. At most other Unit B wells, the groundwater metals exceedances were inconsistently detected and relatively low-level in magnitude, although some exceed by 3 to 5 times the cleanup level. Of those dissolved metals, copper, nickel, and zinc exceeded PCLs in shoreline wells; and of those, copper and nickel were detected at concentrations greater than PCLs more than once only at shoreline wells RCD-MW-101, REC3-MW-1R, PM-MW-07 and UST70-MW-02. As observed in Unit A, there are not elevated soil nickel concentrations detected in Unit B and the detected dissolved nickel concentrations are higher in shoreline wells than in inland wells. The collective data suggest that the elevated shoreline groundwater nickel

concentrations may be attributable to release of naturally occurring nickel due to geochemical interactions from anaerobic Upland Area groundwater mixing with oxygenated seawater within the nearshore fill material. No metals exceedances were detected in intertidal porewater samples collected on the downgradient edge of Unit B.

The existing analytical data for Unit B soil and groundwater provide sufficient information for the development and evaluation of cleanup action alternatives in accordance with MTCA.

6.5.3 Unit C

The Former Log Pond occupies a large proportion of Unit C, as depicted on Figure 6-C1. As discussed in Section 2.4.4.1, the Former Log Pond fill materials are markedly different from the dredge fill placed across most of the rest of the Upland Area. Given the distinct nature of the Former Log Pond fill and its contamination characteristics relative to the rest of Unit C, the Former Log Pond area of Unit C is discussed on its own in Section 6.5.4. This section discusses the portion of Unit C outside of the Former Log Pond. The explorations and IA areas within Unit C, including IA compliance soil sample locations, are depicted on Figure 6-C1. For current conditions following the IAs, the constituents detected in one or more samples of Unit C media outside of the Former Log Pond at concentrations exceeding their respective industrial PCLs are as follows:

- TPH-D+O in soil and groundwater
- Total cPAHs and naphthalene in soil and groundwater
- Lead and zinc in soil
- Arsenic, copper, and mercury in soil and groundwater
- Vinyl chloride in groundwater

Constituents that were not detected at concentrations greater than the industrial PCLs in soil or groundwater samples from Unit C, outside of the Former Log Pond, include TPH-G, BTEX, PCBs, VOCs except vinyl chloride, dioxins/furans, and the SVOCs and metals not specifically included in the previous list.

The sample locations for constituents detected at concentrations exceeding the PCLs in Unit C are presented on Figures 6-C2 through 6-C11. The data for constituents detected at concentrations exceeding PCLs are summarized by constituent group in the following subsections.

6.5.3.1 Total Petroleum Hydrocarbon and PAHs

During the first IA, TPH (gasoline- and oil-range) and copper were the contaminants targeted for removal from the SHB-MW-1 (Small Hydraulic Barker) area located within Unit C (Figure 6-C1). The SHB-MW-1 area IA removed 210 tons of contaminated soil, and the IA soil cleanup levels for TPH and PAHs were met at the limits of the excavation (Figures 6-C2 and 6-C3). Four quarterly rounds of postexcavation confirmation groundwater monitoring for the area demonstrated that groundwater meets PCLs for TPH. However, groundwater concentrations of total cPAHs (TEQ) exceeding the PCL were detected in one of the SHB-MW-1 area compliance wells (SHB-MW-101, Figure 6-C3) during the first of eight groundwater sampling events; the concentrations were below the

PCLs in seven subsequent sampling events (Table 6-14). In addition, groundwater samples collected from well SHB-MW-101 have shown sporadic exceedances of copper and mercury (Table 6-10).

Outside of the SHB-MW-1 IA area, gasoline-range TPH and BTEX were not detected above the PCLs in soil or groundwater. However, concentrations of TPH-D+O, total cPAHs (TEQ), and naphthalene above respective PCLs were detected in soil and groundwater in other localized, discrete areas of Unit C (Figures 6-C2, 6-C3, and 6-C4, respectively), as discussed below.

6.5.3.1.1 GF-9 Area

Along the southeast corner of the former Log Pond in Unit C, TPH and PAH exceedances were detected in soil and groundwater within the GF-9 area identified (based on boring GF-B-9) during the Phase 2 ESA (Aspect, 2013a), and investigated further as part of the RI/FS. Although the TPH detected in groundwater in this area is within the diesel range (C10 to C25 carbon range), the groundwater samples' chromatographic pattern does not resemble a diesel fuel standard (indicated by the laboratory's X qualifier; Table 6-14). This fact, with the relatively higher detected concentrations of noncarcinogenic PAHs (ncPAHs) (naphthalene, along with anthracene, fluorene, fluoranthene, phenathrene, and pyrene), indicate a creosote/coal tar source rather than fuel source for the detected hydrocarbons.

Detected concentrations of TPH-D+O (up to 680 µg/L) and naphthalene (up to 210 µg/L) in groundwater from well GF9-MW-03 exceeded respective PCLs when sampled in 2013–2014. However, when sampled again in March 2017, naphthalene was well below the PCL; TPH was not analyzed for (Table 6-14). Naphthalene is readily degradable, particularly in aerobic conditions, and the groundwater field parameter data from well GF-MW-03 may suggest slightly more oxidizing conditions (change from negative to positive ORP; Table 6-11) starting in 2017 following years of infiltrating oxygenated water in the absence of pavement. The fact that the elevated naphthalene concentrations were more than a quarter of the TPH concentrations is consistent with a creosote/coal tar, not fuel, source. No groundwater exceedances for TPH or naphthalene were detected in wells GF9-MW-01 or GF9-MW-02 located on the downgradient side of GF9-MW-3, nor in well GF9-MW-04 located upgradient of it, indicating a relatively limited area of groundwater impact (Figures 6-C2 and 6-C4). Note that the naphthalene groundwater PCL is based on VI, and the maximum detected groundwater concentrations in the area are an order of magnitude below the 4,700 µg/L surface water quality standard (Table 5-1).

6.5.3.1.2 Hydraulic Barker Area

Total PCBs were the contaminants targeted for removal from the Hydraulic Barker area during the second IA (Figure 6-C1). However, the area also included petroleum contamination, with a TPH-D+O concentration of 7,710 mg/kg detected in a sample of saturated soil (12-foot depth) collected at the HB-MW-1R replacement well location. No soil TPH exceedances were detected at the original well HB-MW-1, located several feet away. The second IA removed 268 tons of PCB-contaminated soil and the IA soil cleanup levels for PCBs were met at the limits of the excavation (Figure 6-C12). Final excavation verification samples from the Hydraulic Barker area were also analyzed for TPH and

metals for purposes of this RI/FS, but the interim action excavation was not expanded based on the record sample results (Aspect, 2021). One saturated, excavation base sample (HBX-B-02) located within a few feet of the HB-MW-1R location contained TPH-D+O at a concentration of 19,100 mg/kg (without silica gel cleanup), which is well above the 2,000 mg/kg PCL that is based on accumulation of free-phase petroleum product on groundwater. A slight petroleum sheen was observed on water in the Hydraulic Barker area excavation while it was open, but no sheen was observed at the sample location and no free product accumulation was observed anywhere in the open excavation.

6.5.3.1.2.1 SITE-SPECIFIC SOIL TPH PCL FOR HYDRAULIC BARKER AREA

The 12-foot soil sample from HB-MW-1R was submitted for laboratory analysis of hydrocarbon fractions using the EPH Method to allow the calculation of risk-based soil cleanup levels in accordance with MTCA (WAC 173-340-745(5)(b)(iii)(B)(III)), using the same methodology as described in Section 6.4.1.1.1 above. The TPH concentration detected by that method was 4,210 mg/kg, 54 percent of the 7,710 mg/kg TPH concentration measured by the NWTPH-Dx analysis. The results of the MTCAtph calculations for this area are detailed in Appendix F.

As discussed in Appendix F, the elevated residual TPH concentration at the base of the IA 2 excavation is protective of industrial direct contact and leaching to groundwater, but exceeds the proposed area-specific PCL based on residual saturation (7,700 mg/kg).

6.5.3.2 Metals

Within Unit C, the SHB-MW-1 IA successfully removed the high soil copper concentration (565 mg/kg) targeted for removal, but soil concentrations of copper, mercury, and zinc greater than default soil PCLs based on groundwater protection remain in the excavation sidewalls (Aspect, 2015a). Following the IA, arsenic, copper, and mercury were detected in Unit C soil and groundwater samples at concentrations exceeding respective PCLs.

Lead and zinc were also detected in one or more Unit C soil samples at concentrations exceeding default soil PCLs based on groundwater protection (Figure 6-C7 and -C10, respectively; Table 6-9). However, lead and zinc exceedances are not detected in Unit C groundwater (outside of the Former Log Pond), indicating that lead and zinc concentrations in Unit C soil are protective of groundwater in accordance with MTCA (Table 6-10).

The data for metals in Unit C media are depicted on Figures 6-C5 through 6-C10, and the data for the three metals that exceed the PCL in groundwater are discussed in the following subsections.

6.5.3.2.1 Arsenic

A statistical evaluation of all arsenic soil data from Unit C (including the Log Pond) indicates a 95 percent UCL of 7.2 mg/kg, which is below the soil PCL of 20 mg/kg, with 3 percent of samples (3/107) exceeding the PCL, and no samples with concentrations greater than two times the PCL. Arsenic soil concentrations within Unit C comply with the PCL.

Groundwater arsenic concentrations exceeding the 9 µg/L PCL were detected in two of the GF-9 area wells and in well SHB-MW-101 (Figure 6-C5), at concentrations ranging from 10.6 µg/L to 15.1 µg/L (Table 6-10). Well GF9-MW-03 is located downgradient of GF9-MW-04, which is the only location within Unit C (outside of the Log Pond Area) with arsenic in soil at concentrations above the soil PCL (Figure 6-C5).

Dissolved arsenic concentrations were less than the PCL in the sample from intertidal Seep-3 collected west of Unit C (Figure 6-C5) (Table 6-22).

6.5.3.2.2 Copper

Similar to adjacent Units B and D, copper is present in soil and groundwater throughout Unit C, outside of the Log Pond Area, at concentrations exceeding the PCLs (Figure 6-C6). Historically, the highest copper concentrations in Unit C groundwater were reported at well HB-MW-1R (up to 152 µg/L). Although there was no soil metals data for HB-MW-1R, copper was reported up to concentrations of 143 mg/kg in soil samples collected from original well HB-MW-01 (Aspect, 2013a). That soil was removed as part of the second IA at the Hydraulic Barker area (Aspect, 2021). Seven soil samples analyzed for metals from the final excavation limits of the Hydraulic Barker area contained copper above the PCL of 36 mg/kg, based on natural background, with concentrations ranging from 39.6 mg/kg to 64.4 mg/kg, indicating that the relatively high concentration of copper that was likely acting as a source to groundwater was removed (Table 6-9).

A statistical evaluation of all soil copper data from the Hydraulic Barker area indicated a 95 percent UCL of 41 mg/kg, which is just above the natural background-based PCL of 36 mg/kg, and no individual concentration is more than two times the PCL (Aspect, 2021).

Outside of the Hydraulic Barker area, copper concentrations in groundwater exceed the PCL at four locations: two GF9- wells, SHB-MW-101 and SHB-MW-02 (Figure 6-C6). Of these locations, there are only single exceedances of the PCL except at well SHB-MW-101 where copper was detected above the PCLs in 3 of 9 groundwater samples (Table 6-10). Downgradient of this location, the dissolved copper concentration collected from the intertidal Seep-03 location were below the PCL (Figure 6-C6; Table 6-22).

6.5.3.2.3 Mercury

As with arsenic and copper, the highest historical Unit C groundwater concentrations of mercury (up to 0.41 µg/L) were detected consistently in well HB-MW-1R prior to its removal in the second IA area. Five soil samples collected at the final limits of the second IA at the Hydraulic Barker area contained mercury exceeding the PCL with concentrations that range from 0.15 mg/kg to 0.34 mg/kg (Table 6-9). A statistical evaluation of all mercury soil data from the Hydraulic Barker area indicated a 95 percent UCL of 0.14 mg/kg, which is only slightly above the soil PCL of 0.1 mg/kg (Aspect, 2021).

Wells GF9-MW-02 and SHB-MW-101 also had groundwater mercury exceedances (Table 6-10). Of these locations, there is only a single exceedance of the PCL at well GF9-MW-02 (Table 6-10). Mercury was detected above the PCL in 3 of 9 groundwater samples collected from well SHB-MW-101 (at concentrations less than 1 in 10 billion), but was not reported above the PCL in the last four sampling events (Table 6-10).

Downgradient of this location, dissolved mercury concentrations in the sample collected from the Seep-03 location were below the PCL (Figure 6-C8; Table 6-22).

6.5.3.3 Un-ionized Ammonia

Detected concentrations of un-ionized ammonia were below the PCL in both groundwater samples collected from shoreline well SHB-MW-2 and the intertidal Seep-03 sample (Table 6-12).

6.5.3.4 Sulfide

Total dissolved sulfide was not detected in either groundwater sample collected from shoreline well SHB-MW-2 (Table 6-12).

6.5.3.5 Other Constituent Exceedances

Vinyl chloride was detected above the PCL in groundwater collected from Unit C well SHB-MW-02 both times it was sampled for VOCs (Figure 6-C12). Vinyl chloride has otherwise not been reported above the PCL in any of the shoreline groundwater or intertidal porewater/seep samples (Table 6-22). The vinyl chloride groundwater PCL is based on protection of human health for exposure to groundwater discharging as surface water. Vinyl chloride in groundwater at well SHB-MW-02 is further discussed in the shoreline water quality section (Section 6.5.7).

6.5.3.6 Summary for Unit C Outside of Former Log Pond

Within Unit C outside of the Former Log Pond, the IAs successfully removed TPH-contaminated soil from the SHB-MW-01 area to meet the soil PCLs for TPH and PAHs, and PCB-contaminated soil from the Hydraulic Barker area to meet the soil PCL for PCBs. The Hydraulic Barker IA also removed TPH contamination, but the residual soil TPH concentration at the base of that excavation exceeds the 7,700 mg/kg area-specific PCL based on residual saturation. In addition, residual soil metals concentrations (copper, mercury, and zinc) at the limits of both excavation areas are greater than soil PCLs.

Naphthalene in the area of well GF9-MW-03 does not pose a risk to the East Waterway and, based on the most recent sample data, no longer poses a risk with respect to VI.

The sample of intertidal seepage along the Unit C shoreline contained concentrations of metals, PAHs, and NH_3 less than respective PCLs based on surface water protection.

The existing analytical data for Unit C outside of the Log Pond provide sufficient information for the development and evaluation of cleanup action alternatives in accordance with MTCA.

6.5.4 Log Pond Area of Unit C

Investigation of the Log Pond Area of Unit C was performed in phases beginning in 2012 and ending as one of the last phases of work conducted for the RI in March through July 2017, as described in Section 4.2.7. Appendix K includes the geophysical survey report, test pit exploration logs and select photos of soil cores depicting subsurface conditions in the Log Pond Area. Explorations completed in 2017 (including the LP-B- explorations and wells LP-MW-03 through LP-MW-07; Figure 6-C1) were advanced through the entire thickness of fill in the former log pond to native estuarine/alluvial soil, which was

encountered at depths ranging from 37 to 52 feet bgs in all borings, except the easternmost boring location (LP-B-06), where it was encountered at 29 feet bgs.

In all borings except LP-B-06 and LP-MW-04, a layer of sawdust was observed on top of native soil, at thicknesses ranging generally from 2 to 10 feet. The sawdust contained petroleum-like odors and sheen, which is interpreted to be attributable to lube oil used in historical operations of the Clark-Nickerson Mill. Deep monitoring wells (LP-MW-03, LP-MW-05, LP-MW-06, and LP-MW-07; Figure 6-C1) were installed with screens installed across the sawdust layer to evaluate potential impacts to groundwater from detected TPH in sawdust, as discussed further below.

The fill soil that overlies the sawdust or is present overlying native soil in areas where sawdust was not observed, consists predominantly of silty sand and sandy silt with debris (concrete, brick, asphalt, wire, woody debris) and shell fragments. The Log Pond fill soil is siltier than the dredge fill soil that is present across most of the rest of the Upland Area.

One IA area is located within the Log Pond Area (Figure 6-C1). Test trenches, excavated in the location of a geophysical anomaly detected in the southcentral portion of the former log pond, identified the buried concrete foundation and footings of the former chip conveyor. A petroleum sheen was observed on shallow seepage in one of the exploratory trenches, and soil samples collected from the trenches contained TPH-G, TPH-D+O, total cPAHs, and mercury above the PCLs. During the second IA, the Log Pond Chip Conveyor area was excavated to remove concentrations of TPH and total cPAHs in soil, as well as mercury, that exceeded the PCLs on the east side of the concrete foundation. The IA removed approximately 403 tons of contaminated soil from the Log Pond Chip Conveyor Area (Aspect, 2021).

For current conditions, the constituents detected in one or more samples of the Log Pond Area media at concentrations exceeding their respective PCLs are as follows:

- TPH-D+O and total xylenes in soil
- Total cPAHs in soil and groundwater
- Naphthalene, 2-methylnaphthalene, acenaphthene, and dibenzofuran in soil
- Arsenic, copper, lead, mercury, and nickel in soil and groundwater
- Zinc in soil
- PCP in groundwater
- Total PCBs in soil
- Vinyl chloride in groundwater

Constituents that were not detected at concentrations greater than the PCLs in soil or groundwater samples from Log Pond Area include TPH-G, BTEX, VOCs, dioxins/furans, and the SVOCs and metals not specifically included in the previous list.

The sample locations for constituents detected at concentrations exceeding the PCLs in the Log Pond Area of Unit C are presented on Figures 6-C2 through 6-C11. The data for

constituents detected at concentrations exceeding PCLs are summarized by constituent group in the following subsections.

6.5.4.1 Total Petroleum Hydrocarbons and PAHs

There are six locations within the Log Pond where TPH-D+O remains in soil at concentrations exceeding the PCLs (Figure 6-C2). Five of these locations (LP-B-01, LP-B-03, LP-B-07, LP-B-08, and LP-MW-07) contain TPH-D+O above the PCLs in the sawdust layer, sampled at depths ranging from 35 to 41 feet bgs, with concentrations ranging from 6,300 mg/kg to 14,500 mg/kg. Concentrations of total cPAHs, total xylenes, naphthalene, 2-methylnaphthalene, acenaphthene, and dibenzofuran were also reported above their respective PCLs in one or more samples collected from the deep sawdust layer where TPH-D+O was reported above the PCL (Table 6-13) (naphthalene exceedance locations shown on Figure 6-C4). Groundwater samples collected from the deep wells, screened across the sawdust layer, did not contain TPH, PAHs, xylenes, or dibenzofuran above the PCLs, demonstrating empirically that those contaminants are not leaching from the sawdust layer to groundwater at levels that result in exceedances of the PCLs.

The fill soil sample collected from boring LP-B-06 also contains TPH-D+O and total cPAHs (TMEQ) at concentrations above the PCLs (Table 6-13). Groundwater collected from downgradient well LP-MW-04 does not contain TPH-D+O above the PCLs but does contain total cPAH (TEQ) above the PCLs (Table 6-14).

Total cPAH (TMEQ) concentrations exceeding but less than two times the PCL were left in-place in five locations at the limits of the Log Pond Chip Conveyer IA area (Figure 6-C3), with concentrations ranging from 0.127 mg/kg to 0.192 mg/kg relative to the PCL of 0.12 mg/kg (Table 6-13). Total cPAH (TEQ) concentrations were reported above the PCL in groundwater samples collected from two of the Log Pond wells (Figure 6-C3). Regardless of these and other cPAH exceedances in the Log Pond fill (Figure 6-C3), total cPAH (TEQ) concentrations were not reported above the PCL in groundwater samples collected from any of the shoreline wells or in the Seep-3 sample of intertidal seep discharge (Figure 6-C3).

6.5.4.2 Metals

Within the Log Pond Area of Unit C, arsenic, copper, lead, mercury, and nickel are present in soil and groundwater at concentrations exceeding the PCLs. The data for those metals in Log Pond Area media are depicted on Figures 6-C5 through 6-C9 and are discussed in the following subsections.

Zinc was also detected in one or more Log Pond Area soil samples at concentrations exceeding the soil PCL based on groundwater protection (Figure 6-C10; Table 6-9). However, zinc exceedances are not detected in Log Pond groundwater, indicating that zinc concentrations in the soil are protective of groundwater in accordance with MTCA (Figure 6-C10; Table 6-10).

6.5.4.2.1 Arsenic

Arsenic above the PCL in Log Pond Area soil is limited to two locations in the Hazardous Waste Cage area (up to 26 mg/kg) and one location near the Log Pond's center (21 mg/kg

at MIE-SB-3) (Figure 6-C5; Table 6-9). As discussed in Section 6.5.3.2.1, arsenic soil concentrations within Unit C as a whole are in compliance with the PCL.

In groundwater, arsenic is detected above the PCL in well HW-MW-01 at the Hazardous Waste Cage, and in shoreline well LP-MW-02 (Figure 6-C5). Arsenic was not detected exceeding the PCL in any of the other shoreline wells or in either of the porewater samples collected at PW-5 located offshore from well LP-MW-02.

6.5.4.2.2 Copper

As observed in Unit C outside of the Log Pond and in other Site Units, dissolved copper concentrations exceeding the 3.1 µg/L groundwater PCL are widespread in shallow groundwater across the Log Pond area of Unit C (Figure 6-C6). The highest reported concentrations of copper in groundwater (up to 31.6 µg/L) are in well LP-MW-01 and correlate to high groundwater pH (up to pH 13; Table 6-10). The elevated groundwater pH at the well was likely a result of the locally higher water table saturating the lower portion of the CM that was in place in this area at the time of sampling as described in Section 6.3.

At two of three shoreline wells, REC6-MW-02 and MW-06, concentrations of copper in groundwater exceeding the PCL were reported in samples collected in 2012 but four subsequent sampling events at each well did not identify copper above the PCL (Table 6-10). Dissolved copper was detected above the PCL at well LP-MW-02 during two of three sampling events but concentrations in intertidal porewater samples from the PW-5 location, located downgradient of well LP-MW-02, were less than the PCL (Figure 6-C6; Table 6-22).

The highest concentrations of copper in soil are reported in the sawdust layer, which is located at depths greater than 30 feet bgs. Except for a single soil sample collected from fill soil at boring LP-B-06, the concentrations of copper reported above the soil PCL in the sawdust layer are all above 100 mg/kg (ranging from 105 mg/kg to 141 mg/kg), while the concentrations of copper reported in overlying fill soil are all below 100 mg/kg (ranging from 36.8 mg/kg to 81.9 mg/kg) (Table 6-9). However, copper was not reported above the groundwater PCL in samples collected from deep wells in the Log Pond (Table 6-10), which demonstrates empirically that copper is not leaching from the sawdust layer at concentrations that pose a risk to the East Waterway.

6.5.4.2.3 Lead

Lead was detected in Unit C groundwater above the PCL in the Log Pond at shoreline well LP-MW-02 (Figure 6-C7), however, only one of three dissolved groundwater lead concentrations at well LP-MW-02 are above the groundwater PCL and that sample also had a high groundwater pH (Table 6-10). Lead was not detected in soil at well LP-MW-02 above the soil PCL of 81 mg/kg established for the protection of groundwater. The maximum soil detection of lead within the Log Pond Area (303 mg/kg) occurs at the HW-MW-01 location, where dissolved lead concentrations were less than the PCL in groundwater (Table 6-10); the groundwater data appear to indicate empirically that soil lead concentrations are protective of groundwater in accordance with MTCA.

The intertidal porewater lead concentration detected at the PW-5 location was less than the PCL (Table 6-22).

6.5.4.2.4 Mercury

Prior to the second IA, concentrations of mercury up to 3.8 mg/kg were present in soil on the east side of the chip reclaim conveyor foundation (Aspect, 2019b). As discussed above, the second IA removed more than 400 tons of contaminated soil from the Log Pond Chip Conveyor Area. Four of 13 compliance soil samples collected at the limits of the second IA Log Pond Chip Conveyor area contained mercury above but less than two times the soil PCL of 0.1, with concentrations ranging from 0.11 mg/kg to 0.17 mg/kg (Table 6-9).

Similar to copper, of the 17 locations where mercury is reported in soil at concentrations above the PCL, five contain exceedances only in the sawdust layer. However, mercury is not present at concentrations above the groundwater PCL in groundwater samples collected from deep wells LP-MW-03, LP-MW-05, LP-MW-06, or LP-MW -07, empirically demonstrating that mercury is not leaching to groundwater from the sawdust layer at concentrations of concern (Table 6-10).

Dissolved mercury exceeds the groundwater PCL of 0.025 µg/L in Log Pond wells LP-MW-01 and LP-MW-02, with concentrations ranging from 0.033 µg/L to 0.248 µg/L and positive correlations between elevated mercury concentrations and elevated groundwater pH (Table 6-10). Dissolved mercury concentrations in intertidal porewater samples from the PW-05 location were less than the PCL (Figure 6-C8; Table 6-22).

6.5.4.2.5 Nickel

The only soil exceedance for nickel in Unit C is the 48.5 mg/kg detection at the HW-MW-01 location, relative to the 48 mg/kg PCL based on natural background concentrations. A statistical evaluation of all nickel soil data from Unit C indicates a 95 percent UCL of 27 mg/kg, which is below the soil PCL of 48 mg/kg, with 1.1 percent of samples (1/93) exceeding the PCL, and no samples with concentrations greater than two times the PCL. Nickel soil concentrations within Unit C are in compliance with the PCL.

Groundwater nickel exceedances occur in the same wells as the other groundwater metals exceedances occur including shoreline wells MW-06 and LP-MW-02 (Figure 6-C9). Nickel exceedances were inconsistently detected at all Log Pond Area wells and were only detected above the PCL during a single sampling event in the two shoreline wells (Table 6-10). Dissolved nickel concentrations in intertidal porewater samples from the PW-5 location were less than the PCL (Figure 6-C9; Table 6-22).

Shoreline groundwater in Unit C is generally not as aerobic (less than 1 mg/L on average) as measured at multiple shoreline wells in Units A and B (Table 6-11). The low D.O. is a further indication of the lack of tidal exchange with shoreline groundwater zone within the Log Pond (discussed in Section 2.4.4). These data are consistent with the hypothesis for higher nickel concentrations present in aerobic shoreline groundwater in Units A and B: that phenomenon is not occurring in the largely anaerobic shoreline groundwater within the Log Pond Area of Unit C.

6.5.4.3 PCBs

Concentrations of total PCB Aroclors exceed the saturated soil PCL at six locations within the Log Pond (Figure 6-C12). At five of these locations, the PCB exceedances are reported

in samples collected from the sawdust layer at depths of 31 to 49 feet bgs (Table 6-18). The highest detected concentration of PCB Aroclors in soil in the Former Log Pond is 5.4 mg/kg, in a sample collected at a depth of 23 feet bgs from boring LP-B-06; the sample collected at a depth of 31 feet from this boring had no detectable PCBs (Table 6-18). All other soil PCL exceedances are at or below 0.6 mg/kg.

There is no PCB Aroclor groundwater data for the Former Log Pond; however, concentrations of total PCB Congeners are above the PCL in groundwater samples collected from four of eight wells (Table 6-20). The total PCB congener exceedances are in both shallow (LP-MW-01 and LP-MW-04) and deep wells (LP-MW-03 and LP-MW-06). Concentrations of total PCB congeners were not reported above the PCL in the groundwater samples collected from the shoreline wells (Figure 6-C12).

6.5.4.4 Other Constituents

PCP was detected at a concentration of 1.7 µg/L in a groundwater sample collected from well LP-MW-01, which is just slightly above the PCL of 0.5 µg/L, (Table 6-17). PCP has not been detected above the reporting limit in any of the 46 soil samples collected from the Log Pond Area (Table 6-16). PCP has not been detected above reporting limits in groundwater samples collected from shallow well MW-06, located downgradient of well LP-MW-01 and along the shoreline (Figure 6-C1).

Vinyl chloride has been detected in groundwater at two Log Pond Area wells (LP-MW-04 and LP-MW-06; Figure 6-C12) at concentrations exceeding the 0.2 µg/L PCL, ranging from 0.7 to 0.96 µg/L (Table 6-17). Monitoring wells LP-MW-04 and LP-MW-06 are located more than 500 feet from the shoreline and vinyl chloride has not been detected in any of the groundwater samples collected from downgradient wells (Table 6-17; Figure 6-C1).

6.5.4.5 Un-Ionized Ammonia

Un-ionized ammonia (NH_3) was detected at concentrations greater than the 0.035 mg/L PCL in one or more groundwater samples collected from each of the nine Log Pond Area monitoring wells (Table 6-12; Figure 6-S3). The elevated NH_3 concentrations are likely attributable to a combined decomposition of the large quantities of wood chips stored at the surface for decades during mill operations and the buried woody debris.

Within the inland portion of the Former Log Pond, the highest groundwater concentrations of NH_3 (up to 13.0 mg/L) have been detected at inland well LP-MW-01. The high NH_3 concentrations in the LP-MW-01 well are a result of high groundwater pH, which favors the un-ionized form of ammonia (refer to Appendix H), at the time of the measurements. Notably, the NH_3 concentration detected in LP-MW-01 in July 2017 (0.89 mg/L; Table 6-12 was ten times lower than the average concentration measured in 2013–2014 (9.0 mg/L; Table 6-12). This suggests water quality improvement in the center of the Former Log Pond area during the five years following removal of the wood chips from there.

Substantially lower concentrations of NH_3 were detected at the shoreline wells within the Log Pond Area, but they all exceeded the PCL (0.36 mg/L or less at wells LP-MW-02, MW-06, and REC6-MW-02; Table 6-12 and Figure 6-S3).

Within the deep sawdust layer beneath the Former Log Pond, the 2017 groundwater NH_3 concentrations at inland wells LP-MW-03, LP-MW-05, and LP-MW-06 ranged from 0.036 mg/L to 0.11 mg/L, and 0.36 mg/L NH_3 was detected at shoreline well LP-MW-07. The elevated NH_3 concentrations in these wells are attributable to decomposition of the sawdust.

One of two 2014 samples of intertidal porewater collected from the PW-5 location contained a concentration of un-ionized ammonia (0.19 mg/L) exceeding the PCL (Table 6-12). However, NH_3 concentrations were below the PCL in the three surface water samples LP-SW-01, LP-SW-02, and LP-SW-03 collected at the base of the rip rap along the Log Pond Area shoreline, which is consistent with the high dissolved oxygen content of the surface water.

6.5.4.6 Sulfide

Groundwater H_2S concentrations in the Log Pond Area shoreline wells and in most inland wells exceeded the 0.002 mg/L PCL (0.007 to 0.087 mg/L; Table 6-12). Shoreline well REC6-MW-02 has the highest detected H_2S concentration (0.087 mg/L), consistent with the most strongly reducing groundwater conditions observed in this well. In contrast to NH_3, H_2S is not stable at pH values greater than approximately 8 (refer to Appendix H), and, therefore, the lowest reported H_2S concentration occurs in high-pH well LP-MW-01 in the Log Pond interior (7×10^{-8} mg/L; Table 6-12).

Concentrations of total dissolved sulfide, which can include mineral sulfides in colloidal form, were typically greater than H_2S concentrations in the groundwater samples. This was particularly notable in the July 2017 sample from well REC6-MW-02 (16.2 mg/L total dissolved sulfide vs. 0.087 mg/L H_2S; Table 6-12).

One of two 2014 samples of intertidal porewater collected from the PW-05 location contained a H_2S concentration (0.005 mg/L) slightly exceeding the PCL. Concentrations of H_2S were below the PCL in surface samples LP-SW-01 and LP-SW-03[36], which is consistent with the high dissolved oxygen content of the surface water (Table 6-12).

6.5.4.7 Summary for Log Pond Area of Unit C

Within the Log Pond Area, hydrogeologic data indicate that groundwater has limited hydraulic connection with the East Waterway due to the low permeability of the log pond fill. Groundwater exceedances for the metals arsenic, copper, lead, mercury, and nickel are inconsistently detected at shoreline wells LP-MW-02, MW-06, and REC6-MW-02 (Figure 6-S2). Unlike elevated nickel concentrations observed in Units A and B shoreline wells, nickel concentrations in the Log Pond Area shoreline wells are low, consistent with low groundwater D.O. attributable to the groundwater's limited tidal exchange.

Total cPAHs (TEQ) in groundwater exceed the PCL at inland wells, but not at the shoreline wells or in the sample of intertidal seep discharge. It is noted that the reporting

[36] Free sulfide data for the LP-SW-02 location could not be collected because the DGT cartridge was damaged during deployment (see Section 4.1.7).

limits for cPAHs at shoreline wells at LP-MW-02 and MW-06 were elevated during initial sampling events, but subsequent sampling events had reporting limits below the PCL.

The deep sawdust layer contains TPH-D+O, PAHs, and PCBs at concentrations exceeding the soil PCLs. However, groundwater samples collected from deep wells screened across the sawdust layer do not contain TPH-D+O or PAHs exceeding the groundwater PCLs, indicating that these contaminants are not leaching from the organic-rich sawdust at levels that result in exceedances of the PCLs. PCB congeners were detected above the groundwater PCL in four Log Pond Area wells, including both shallow and deep wells, but are not present in shoreline wells above the PCL.

The highest concentrations of NH_3 in Upland Area groundwater were detected at inland well LP-MW-01 within the Log Pond Area, which was a large storage area for wood chips for decades during mill operations; this well also had the highest groundwater pH measured on Site[37]. Subsurface wood waste also exists in the Log Pond fill from past filling activities. Considerably lower-level NH_3 exceedances were detected at the Log Pond shoreline wells LP-MW-02 and MW-06, but they are still three times the PCL based on surface water exposure.

Within the intertidal zone adjacent to Unit C, NH_3 and H_2S were each detected at concentrations exceeding PCLs in one of two porewater samples. No NH_3 or H_2S exceedances were detected in samples of East Waterway surface water collected along the toe of the Log Pond Area's rip rap slope, demonstrating the rapid attenuation of these compounds within oxygenated water.

The existing analytical data for soil and groundwater within the Log Pond Area of Unit C provide sufficient information for the development and evaluation of cleanup action alternatives in accordance with MTCA.

6.5.5 Unit D

The explorations and IA areas within Unit D, including IA compliance soil sample locations, are depicted on Figure 6-D1. For current conditions following the IA, the constituents detected in one or more samples of Unit D media at concentrations exceeding their respective PCLs are as follows:

- TPH-D+O in soil
- Total cPAHs (TEQ) in soil and groundwater
- Total xylenes in soil
- Arsenic, copper, mercury, and nickel in soil and groundwater
- Lead and zinc in soil
- Dissolved sulfide in groundwater and intertidal porewater/seeps

[37] NH_3 concentrations correlate directly with pH (refer to Appendix H).

Constituents that were not detected at concentrations greater than the PCLs in soil or groundwater samples collected within Unit D include TPH-G, dioxins/furans, and VOCs, metals, and SVOCs that are not included in the list above.

The sample locations for constituents detected at concentrations exceeding the PCLs in Unit D are presented on Figures 6-D2 through 6-D10. The data for constituents detected at concentrations exceeding the PCLs are summarized by constituent group in the following subsections.

6.5.5.1 Total Petroleum Hydrocarbons and PAHs

During the first IA, four IA areas within Unit D focused on the removal of TPH-contaminated soil: the Naval Reserve Parcel UST area, the Naval Reserve Parcel South area, the CN-B-2 area, and the Hydraulic Barker Vault area (Figure 6-D1). During the second IA, relatively high concentrations of cPAH left in-place in soil at the limits of the CN-B-2 area excavation were removed from the CN West and CN East areas (Figure 6-D1). Xylenes were the primary constituent targeted for IA in the UST 29/Latex Spill area; however, TPH and cPAHs were also present in soil in this area at concentrations exceeding the IA cleanup levels. The two IAs resulted in the removal of approximately 10,700 tons TPH- and cPAH-contaminated soil and 5,440 tons xylene-contaminated soil from the IA areas within Unit D (Figure 6-D1), as described by Aspect (2015a; 2021).

Following the soil removals, the TPH PCLs are met in the Naval Reserve Parcel UST area, the Naval Reserve Parcel South area, the CN-B-2 area, and the Hydraulic Barker Vault area (Aspect, 2015a). In the Naval Reserve Parcel UST area and the CN-B-2/CN west area, soil concentrations of total cPAHs (TMEQ) meet the soil PCLs except for three samples in the saturated zone (Figure 6-D3). Following the first IA, four quarterly rounds of postexcavation confirmation groundwater monitoring at these four areas demonstrated that groundwater meets PCLs for TPH and PAHs, demonstrating the soil quality is protective of groundwater, and Ecology agreed that no further groundwater monitoring for those compounds was required for those areas (Aspect, 2015d).

The PCL for xylenes were met in the UST 29/Latex Spill area except for two bottom samples, where the reported concentrations of total xylenes exceed the 0.23 mg/kg PCL based on soil leaching (Table 6-13; Figure 6-D4). Four quarterly rounds of postexcavation groundwater monitoring at the UST 29/Latex Spill area demonstrated that groundwater meets PCLs for TPH, xylenes, and ethylbenzene (Table 6-14). The confirmation groundwater data indicate that the residual soil xylenes concentrations are protective of groundwater in accordance with MTCA. However, low-level total cPAHs (TEQ) exceedances (up to 0.05 µg/L) have been reported in six of eight groundwater samples collected from well UST29-MW-101 (Figure 6-D3). West of well UST29-MW-101, no cPAH (TEQ) exceedances were detected in groundwater at shoreline monitoring wells REC6-MW-02 (within Unit C) or TM-MW-06 (Figure 6-S1). The combined removal of highly contaminated soil plus dewatering of the excavation throughout soil removal successfully remediated the high xylene concentrations in groundwater present at the UST29 location prior to the first IA.

Outside of the IA excavation areas, the results of soil and groundwater sampling within Unit D indicated no concentrations of TPH in soil or groundwater above the PCLs, with one exception. A single soil sample collected from a depth of 15 feet bgs at well TM-MW-05 contained TPH-O at a concentration greater than the PCL (4,325 mg/kg); soil samples collected from depths of 5 and 18 feet bgs in this same location did not contain detectable TPH (Table 6-13). TPH was not detected in either of the groundwater samples collected from well TM-MW-5, which is screened across the depth interval of the impacted soil (Table 6-14). Those groundwater data indicate empirically that the detected soil TPH concentration is protective of groundwater in accordance with MTCA.

Besides the UST 29/Latex Spill area, low-level total cPAHs (TEQ) exceedances were detected above the PCL in groundwater collected from two monitoring wells within Unit D: up to 0.033 µg/L at TM-MW-01 and up to 0.019 µg/L at TM-MW-02 (Figure 6-D3; Table 6-14). Total cPAHs (TMEQ) were detected at concentrations exceeding the PCL in soil samples collected across Unit D as shown on Figure 6-D3.

Total cPAHs (TEQ) have not been detected above the PCL in any of the groundwater samples collected from the four wells located at the CN-B-2 excavation area, or downgradient of wells TM-MW-01 and TM-MW-02 where groundwater cPAH exceedances are detected, or in any of the 10 shoreline wells located within Unit D (Figure 6-D3). These data indicate that cPAH concentrations in groundwater above its PCL have not migrated to the shoreline in Unit D.

6.5.5.2 Metals

Soil concentrations in exceedance of PCLs for arsenic, copper, lead, mercury, nickel, and zinc were detected at sampling locations scattered across Unit D. Lead and zinc were not detected in Unit D groundwater at concentrations exceeding the PCL. The metals detected in groundwater at concentrations above PCLs—arsenic, copper, lead, mercury, and nickel—are described below.

6.5.5.2.1 Arsenic

Arsenic was detected in groundwater at concentrations greater than the PCL at three monitoring wells but was not detected above the PCL in groundwater at the Unit D shoreline wells or in intertidal porewater/seep samples (Figure 6-D5).

Soil arsenic exceedances (up to 43 mg/kg) were detected at four locations within Unit D (Figure 6-D5). A statistical evaluation of all arsenic soil data from Unit D indicates a 95 percent UCL of 7.1 mg/kg, which is below the soil PCL of 20 mg/kg, with 3 percent of samples (4/147) exceeding the PCL, and no concentrations of arsenic that are greater than two times the PCL. Based on these results, Unit D arsenic soil concentrations are in compliance with the PCL.

6.5.5.2.2 Copper

There are numerous locations with detected copper exceedances in Unit D soil and groundwater, but there is little if any correlation in the locations of the exceedances for soil versus groundwater (Figure 6-D6).

A statistical evaluation of Unit D soil copper concentrations indicates that the 95 percent UCL of 24 mg/kg is below the PCL of 36 mg/kg, 11.8 percent of samples (17/144) exceed the PCL, and two samples have copper concentrations that are more than two times the PCL. With revised compliance statistics that take into account the natural background level for copper, the frequency of exceedance can be 14 percent and the magnitude of exceedance can be 3.3 times the PCL (118 mg/kg). One soil result from Unit D contains copper at a concentration that is more than 3.3 times the PCL (166 mg/kg). However, a sample hypothesis test with a confidence of 95 percent, using the Wilcoxon-Mann-Whitney test, indicates no statistical difference between Ecology's natural background data set for copper and the data set for Unit D. Considering these results, copper soil concentrations within Unit D achieve statistical compliance.

On the north end of Unit D, shoreline wells MW-05 and NRP-MW-03 each had one or more copper exceedances in groundwater during the 2012 sampling events (up to 3.6 and 15.9 µg/L, respectively), but no exceedances were detected in either well during the 2013 and 2014 sampling events (Table 6-10). The concentrations of dissolved copper detected in intertidal porewater sample PW-07 and in seep samples Seep-10, -11, and -12, all located downgradient of the two shoreline wells with groundwater exceedances (MW-05 and NRP-MW-03), were less than the PCL (Table 6-22).

6.5.5.2.3 Mercury

Mercury was detected exceeding the groundwater PCL of 0.025 µg/L in two Unit D locations (Table 6-10; Figure 6-D8). The highest reported concentration of mercury in groundwater in Unit D is at well UST-29-MW-101 where dissolved mercury was detected at a concentration of 0.199 µg/L.

Mercury was detected in Unit D soil at concentrations exceeding the PCL at six locations (Figure 6-D8). A statistical evaluation of Unit D mercury soil concentrations indicates a 95 percent UCL of 0.06 mg/kg, which is below the PCL of 0.1 mg/kg, 4.1 percent of the samples (6/147) exceed the PCL, and there are two samples that contain mercury at more than two times the PCL. Based on this data, Unit D mercury concentrations do not comply statistically with the PCL.

There is no apparent spatial correlation between mercury exceedances in soil versus in groundwater (Figure 6-D8). The highest concentration of mercury in soil in Unit D is located at well TM-MW-04, where groundwater data collected during three separate sampling events does not contain mercury above the groundwater PCLs (Table 6-10), demonstrating empirically that mercury is not leaching to groundwater at levels that result in exceedances of the PCLs. Mercury is below the PCLs in groundwater collected from shoreline monitoring wells, including well REC6-MW-02, which is in Unit C, but downgradient from well UST29-MW-101, or in intertidal porewater or seep samples (Figure 6-D8).

6.5.5.2.4 Nickel

Three groundwater nickel exceedances were detected in Unit D groundwater, at inland wells TM-MW-02, TM-MW-04, and UST29-MW-101 (Figure 6-D9; Table 6-10). There is only one location within Unit D where soil nickel concentrations exceed the PCL, at boring TM-B-02 (Figure 6-D9). However, Unit D nickel concentrations do not statistically

comply with the PCL because that one reported concentration (135 mg/kg) is more than two times the PCL (96 mg/kg). No dissolved nickel exceedances were detected in well TM-MW-05 located generally downgradient of that soil location (Figure 6-D9).

No dissolved nickel exceedances were detected in shoreline groundwater, including well REC6-MW-02, which is in Unit C, but downgradient of well UST29-MW-101, in porewater sample PW-07, or in any of the four seep samples collected from Unit D (Table 6-22; Figure 6-D9).

6.5.5.3 Un-ionized Ammonia

No NH_3 exceedances were detected in samples of groundwater collected from five shoreline monitoring wells, one intertidal porewater location, and four intertidal seep locations in Unit D.

6.5.5.4 Sulfide

H_2S concentrations exceeding the 0.002 mg/L PCL were detected in three of four intertidal seep locations (Seep-10, -11, and -13) and in the intertidal porewater location PW-07 adjacent to Seep-10 and -11 (Table 6-12; Figure 6-S1). Each of these intertidal water samples were collected within a few feet of the wooden bulkhead constructed for the former Naval Reserve facility. The surface sediments in this area contain abundant wood fragments and dimensional lumber, the decomposition of which may contribute to the observed elevated H_2S concentrations.

Total dissolved sulfide concentrations in the five shoreline wells commonly exceed the 0.05 mg/L PQL-based PCL, but there are no corresponding DGT data from which to document H_2S concentrations in groundwater. The PW-07 porewater data provide an indication of the high bias in the total dissolved sulfide data for Unit D: total dissolved sulfide detections ranged from 2.7 to 15 mg/L compared with 0.114 mg/L H_2S measured by DGT, although the samples were not concurrent (Table 6-12).

6.5.5.5 Summary for Unit D

The IA excavations successfully removed petroleum-, cPAH-, and xylene-contaminated soil from Unit D (Naval Reserve Parcel UST area, the Naval Reserve Parcel South area, CN-B-2 area, Hydraulic Barker Vault area, and UST 29/Latex Spill area). Postexcavation confirmation groundwater monitoring for the five areas demonstrated that groundwater meets PCLs for TPH and xylenes, demonstrating that the IA's intended source control was accomplished.

Following the IA, only a single TPH-D+O soil exceedance remains (greater than 4,000 mg/kg at well TM-MW-05 south of the CN-B-2 IA area), and the empirical groundwater data indicate that the soil is protective of groundwater quality. Low-level exceedances of total cPAHs (TEQ) are detected in three inland wells within Unit D, but not in any of the wells positioned downgradient of them (and no exceedances in 10 shoreline wells).

Groundwater exceedances for the metal's arsenic, copper, mercury, and nickel are detected in one or more wells across Unit D; however, the groundwater exceedances were generally not consistent over time, and their locations indicate little, if any, correlation

with the locations of soil exceedances for those metals. In the six shoreline wells with groundwater metals data, there are no detected exceedances of arsenic, lead, mercury or nickel, and only inconsistent low-level exceedances are detected for copper. Most importantly, no exceedances for dissolved metals or NH_3 are detected in the samples of porewater and seeps collected in the intertidal zone adjacent to Unit D.

The existing analytical data for Unit D provide sufficient information for the development and evaluation of cleanup action alternatives in accordance with MTCA.

6.5.6 Unit E

Within Unit E, 29 soil samples were collected from 8 soil borings and 10 groundwater samples were collected from 4 monitoring wells (Figure 6-E1). In addition, 11 soil samples were collected by Floyd|Snider in October 2019, on behalf of the City, from four test pits excavated in a stormwater swale along the southern boundary of Unit E (FS9-TP-01 through FS9-TP-04; Figure 6-E1) to characterize soil quality at the bottom of the swale as part of a plan to decommission it (Floyd|Snider, 2020).

For current conditions, the constituents detected in one or more samples of Unit E media at concentrations exceeding their respective PCLs are as follows:

- TPH-D+O in soil
- Total cPAHs (TEQ) in soil
- Copper in soil and groundwater
- Arsenic, nickel, and zinc in soil
- Dissolved sulfide in groundwater

Constituents that were not detected at concentrations greater than the PCLs in soil or groundwater samples collected from Unit E include TPH-G, VOCs, SVOCs other than cPAHs, metals that are not included in the list above, PCBs, and dioxins/furans.

The sample locations for constituents detected at concentrations exceeding the PCLs in Unit E are presented on Figures 6-E2 through 6-E6. The data for constituents detected at concentrations exceeding the PCLs are summarized by constituent group in the following subsections.

6.5.6.1 Total Petroleum Hydrocarbons and PAHs

Gasoline-range TPH and BTEX were not detected above the PQLs in soil or groundwater samples collected from within Unit E (Tables 6-13 and 6-14). Total TPH-D+O and total cPAHs (TEQ) were not detected above the laboratory PQLs in groundwater samples collected from Unit E (Table 6-14). Some of the laboratory reporting limits for cPAHs in groundwater are higher than the PCL; however, all monitoring wells located within Unit E contain at least one-quarter of nondetect results for cPAHs with reporting limits below the PCLs (Table 6-14).

Total TPH-D+O was detected above the PCL in a single Unit E soil sample collected at boring CN-B-11 within the saturated zone (Figure 6-E2). The detected concentration of TPH-D+O (2,325 mg/kg) only slightly exceeds the PCL of 2,000 mg/kg (Table 6-13).

Total cPAHs (TMEQ) were also detected above the PCL in one soil sample each collected from borings CN-B-10 and CN-B-11, as well as in three soil samples collected at boring CN-MW-3 (Figure 6-E3). There were no detected concentrations of TPH-D+O or total cPAHs (TEQ) above the PCLs in any of the other soil samples collected from Unit E (Table 6-13).

Despite the soil concentrations exceeding PCLs, the groundwater data indicate empirically that the soil TPH-D+O and total cPAHs (TEQ) concentrations in Unit E are protective of groundwater, in accordance with MTCA.

6.5.6.2 Metals

Arsenic, copper, nickel, and zinc are detected above PCLs in Unit E soil (Table 6-9) However, copper is the only metal detected in Unit E groundwater at a concentration exceeding the PCL (in one sample) (Table 6-10).

Arsenic is present above the PCLs in a single soil sample collected from within Unit E (Table 6-9). A statistical evaluation of all soil arsenic data from Unit E indicates that the 95 percent UCL of 9.0 mg/kg is below the PCL of 20 mg/kg, 3 percent of the samples (1/39) exceed the PCL, and there are no samples that exceed two times the PCL (Appendix I). Based on the statistical evaluation, arsenic is in compliance with the soil PCL in Unit E. There are no concentrations of arsenic in groundwater from Unit E that exceed the PCLs.

Copper was detected exceeding the PCL in saturated soil at boring CN-B-13 and in three unsaturated soil samples collected from the stormwater swale test pits (Figure 6-E4). A statistical evaluation of all copper soil data from Unit E indicates that the 95 percent UCL of 29 mg/kg is below the PCL of 36 mg/kg, 15 percent of samples (6/39) exceed the PCL, and there are no samples that exceed two times the PCL. Revised compliance statistics requirements that take into account the natural background concentration for copper indicate that 18 percent of the samples can exceed the PCL. Based on the results of this evaluation, Unit E copper is in compliance with the soil PCLs.

Dissolved copper was detected in groundwater at a concentration of 4.4 µg/L, which slightly exceeds the 3.1 µg/L PCL, in a sample collected from shoreline well REC7-MW-1 in June 2012 (Figure 6-E4). Copper concentrations in the three subsequent samples collected well REC7-MW-1 were less than the PCL (Table 6-10). The shoreline well NRP-MW-3 and corresponding PW-7 porewater sample location are downgradient of the soil copper exceedances within the northern edge of Unit D (Figure 6-S1). Dissolved copper was detected above the PCL in a groundwater sample collected from well NRP-MW-3 in 2012; however, subsequent 2013–2014 sampling did not detect dissolved copper at concentrations above the PCL in groundwater collected from well NRP-MW-3 or in intertidal porewater collected from sample location PW-7 (Table 6-22).

Nickel was detected in soil exceeding the PCL at three samples collected from the stormwater swale test pits (Figure 6-E5). A statistical evaluation for all nickel soil data from Unit E indicates that the 95 percent UCL of 31 mg/kg is below the PCL of 48 mg/kg, less than 10 percent of samples (3/39) exceed the PCL, and there are no soil samples with nickel concentrations that exceed two times the PCL. Unit E nickel soil concentrations are

in compliance with PCLs, and nickel has not been detected in Unit E groundwater at concentrations exceeding the groundwater PCL.

Zinc was detected in soil exceeding the PCL at borings CN-B-11 and GF-B-2 and in three samples collected from the stormwater swale test pits (Figure 6-E5). The soil zinc exceedance at boring CN-B-11 is one of the highest detected concentrations within the Upland Area at 795 mg/kg (Table 6-9). A statistical evaluation for all zinc soil data indicates that Unit E fails statistical compliance for the PCL that is based on the protection of groundwater. However, no groundwater zinc exceedances have been detected in four groundwater samples collected from the shoreline well REC7-MW-1 (located a little over 200 feet downgradient of boring CN-B-11) (Figure 6-E5). In addition, zinc was not reported above the groundwater PCL in the shoreline well NRP-MW-3 and corresponding PW-7 porewater sample location, which are downgradient of the stormwater swale test pits (Table 6-22; Figure 6-S1).

6.5.6.3 Un-Ionized Ammonia

No NH_3 exceedances were detected in samples of groundwater collected from shoreline wells CN-MW-1 and REC7-MW-1 (Table 6-12).

6.5.6.4 Sulfide

The reported total dissolved sulfide concentrations in each of the two Unit E shoreline wells, CN-MW-1 and REC7-MW-1, vary by an order of magnitude or more over time, including results that exceed and do not exceed the 0.05 mg/L PQL-based PCL (Table 6-12). There are no corresponding DGT data from which to document H_2S concentrations in groundwater, but the data from the other Units described above indicate that H_2S concentrations are substantially below the total dissolved sulfide concentrations.

6.5.6.5 Summary for Unit E

Unit E historically had limited industrial operations—namely, the materials storage portion of the Clark-Nickerson lumber mill and then the parking and wastewater treatment plant area for the pulp and paper mill. Correspondingly, there are very limited contaminant exceedances detected in Unit E, and the Unit's groundwater is not currently posing a threat via discharge to the East Waterway.

6.5.7 Shoreline Water Quality

Water quality along the shoreline has been characterized by the collection and analysis of groundwater samples from 29 upland shoreline monitoring wells[38], intertidal porewater samples from five sample locations, and seep samples from 13 locations (Figure 6-S1). A sample of Puget Sound water was also collected just offshore (sample EWW-1 on Figure 6-S1) to provide reference data.

As described in the preceding sections, the constituents detected in groundwater from shoreline wells at concentrations exceeding the PCLs are dissolved metals, un-ionized ammonia, sulfide, and vinyl chloride. Because groundwater's highest beneficial use is discharge to the East Waterway, this section summarizes for the entire Upland Area

[38] Treating REC3-MW-1 and its replacement well REC3-MW-1R as one well location.

shoreline the shoreline groundwater and porewater/seep data from the five Site Units (as presented in Section 6.5.1 through 6.5.6).

Vinyl chloride was detected above the PCL in groundwater collected from Unit C well SHB-MW-02 both times it was sampled for VOCs but has otherwise not been reported above the PCL in any of the shoreline groundwater or intertidal porewater/seep samples (Table 6-22). The vinyl chloride groundwater PCL is based on protection of human health for exposure to groundwater discharging as surface water. Vinyl chloride is both volatile and biodegradable in aerobic conditions. Therefore, the concentrations in groundwater are expected to attenuate further between well SHB-MW-02 and the point of discharge and volatilize/degrade as soon as groundwater mixes with aerobic surface water, so that it is not expected to pose an adverse risk to the East Waterway.

The data for metals, NH_3, and sulfide detected in groundwater from shoreline wells at concentrations exceeding the groundwater PCLs are summarized by constituent group in the following subsections.

6.5.7.1 Metals

Figure 6-S2 depicts the shoreline groundwater and intertidal porewater/seep locations with metals data, color coding those locations with detected exceedances of one or more dissolved metals in one or more samples collected. Metals analyses were not conducted for groundwater samples from IA confirmation monitoring wells NRS-MW-101 and -102 and NRU-MW-101 and -102; therefore, there are groundwater metals data from 24 shoreline wells. On Figure 6-S2, the exceeding metal is listed for each location and, because the exceedances at a given location are typically inconsistent over time, the frequency of exceedance (number of exceedances/number of samples) is also presented for each exceeding metal. The corresponding data are presented in Table 6-22.

The dissolved metals frequently detected in shoreline monitoring wells at concentrations exceeding the PCLs are copper and nickel. In addition, dissolved arsenic, lead, and mercury were detected at concentrations exceeding the PCLs in one or more groundwater samples collected from well LP-MW-2, one dissolved zinc exceedance was detected once at well UST70-MW-2, and one dissolved lead exceedance was detected once at well MW-02 (Figure 6-S2).

With the exceptions of the nickel exceedances at well RCD-MW-1, metals exceedances are inconsistently detected in the shoreline monitoring wells (Table 6-22). To help illustrate that fact, the frequencies of exceedance by metal for groundwater samples collected from the 24 shoreline wells with metals analyses are presented in the following matrix (a blank indicates no exceedances were detected for that metal in that well).

	No. of Exceedances / No. of Samples					
Shoreline Well	**Arsenic**	**Copper**	**Lead**	**Mercury**	**Nickel**	**Zinc**
CN-MW-1						
LP-MW-2	3/4	3/4	1/4	2/4	1/4	
MW-1		1/8			1/4	
MW-2					1/5	
MW-5		3/5				
MW-6		3/7			1/7	
NRP-MW-2						
NRP-MW-3		1/4				
PM-MW-7					2/3	
PM-MW-8						
RCD-MW-101		1/9			8/9	
REC1-MW-9						
REC3-MW-1[a]		4/9			3/5	
REC6-MW-2		1/6				
REC7-MW-1		1/4				
REC7-MW-2						
REC7-MW-3					1/5	
REC7-MW-4					1/5	
SHB-MW-2		1/3				
TM-MW-6						
UST70-MW-2		10/13			8/13	1/9

[a] Includes data from replacement well REC3-MW-1R.

Blank cell indicates no exceedance detected for that metal at that well.

While there are groundwater metals exceedances in Upland Area shoreline wells, the empirical data from intertidal porewater and seep sampling, most accurately representing groundwater at the point of discharge, indicates that dissolved metals in groundwater do not pose a risk to the East Waterway, subject to long-term monitoring.

6.5.7.2 Un-Ionized Ammonia (NH_3)

Figure 6-S3 depicts the shoreline groundwater and porewater sample locations for NH_3. The locations with detected concentrations exceeding the groundwater PCL based on surface water protection are color-coded red. The corresponding data are presented in Table 6-22.

In the upland shoreline monitoring wells, NH_3 detections exceeding the 0.035 mg/L PCL occurred primarily within historical Log Pond footprint, where the fill material contains wood waste and wood chips, were stored from approximately 1981 until mill closure in 2012 (historical features are depicted for reference on Figure 6-S3). These include shallow wells REC6-MW-02 (up to 0.26 mg/L), MW-06 (up to 0.36 mg/L), and LP-MW-02 (up to 0.16 mg/L) screened in the Log Pond fill, and deep well LP-MW-07 screened within the underlying sawdust layer. In addition, an NH_3 exceedance was detected at well REC1-MW-09 (0.068 mg/L) located on the south end of the Upland Area, which is not downgradient of a former wood storage area (Figure 6-S3).

The NH_3 exceedances were consistently detected at Log Pond well MW-06 during each of the five sampling events, but the exceedances were less consistent in the other wells: three of five samples from REC6-MW-02, one of three samples from LP-MW-02, and one of three samples from REC1-MW-09. Sawdust well LP-MW-07 was only sampled once (Table 6-22).

For the intertidal porewater samples, the February 2014 PW-05 sample, located adjacent to the Log Pond, contained an NH_3 concentration (0.19 mg/L) greater than the PCL, but the August 2014 detection from that location (0.004 mg/L) was below the PCL. Beneath the pier and downgradient of the former hog fuel pile in Unit B, the detected NH_3 concentration in the PW-03 sample location exceeded the PCL during the August 2014 sampling (0.137 mg/L), but not during the February 2014 sampling (0.032 mg/L). In this same general area, detected NH_3 concentrations in both samples from the PW-04 location were below the PCL. The PW-07 sample on the north end of the site, and the SEEP-01 sample (sample of discharge from rip rap) on the south end of the Site, both contained NH_3 concentrations below the PCL during both sampling events.

NH_3 concentrations were less than the PCL at each of the intertidal six seep locations sampled, and at the three surface water locations sampled immediately offshore of the Log Pond Area, consistent with those exposed waters being oxygenated. Notably, the August 2014 reference surface water sample EWW-1 contained an NH_3 concentration (0.15 mg/L) greater than the PCL, whereas the February 2014 sample from that location contained no detectable NH_3 (Table 6-22). The higher concentration in the reference sample could be a result of algal or phytoplankton blooms within the shallow water column during the warm summer months.

In conclusion, the NH_3 exceedances in shoreline groundwater are inferred to be limited to the Log Pond Area as noted on Figure 6-S3.

6.5.7.3 Sulfide

Figure 6S-4 depicts groundwater and intertidal porewater/seep data for sulfide, including H_2S where those (DGT) data exist or total dissolved sulfide where there is no DGT sample data. The corresponding data are presented in Table 6-22. The inferred extent of H_2S exceedances in shoreline groundwater extends from approximately the Log Pond Area to the northern limit of the Upland Area as noted on Figure 6-S4. H_2S was not detected at two surface water locations sampled immediately offshore of the Log Pond Area, consistent with those exposed waters being oxygenated.

7 Conceptual Site Model

7.1 Residual Contaminants

Historical sources of contamination within the Upland Area include releases of fuels and other organic liquids (e.g., xylene solvent) from ASTs and USTs or from spills that occurred during handling or use. Wood treated with creosote/coal tar and used during historical mill construction is a probable source for naphthalene and other PAHs detected in groundwater at some locations. Widely distributed low concentrations of typical urban contaminants (e.g., metals and PAHs) in soil are consistent with the century-long industrial use of the Upland Area. The cementitious CM placed across approximately 32 acres at completion of K-C's mill demolition in 2013 was the source of high groundwater pH across the inland portion of the Upland Area.

The first IA, in 2013-2014, permanently removed approximately 38,500 tons of TPH- and metals-contaminated soil from the Upland Area. The second IA, in 2020, removed an additional 17,610 tons of TPH-, PAH-, metals-, and PCB-contaminated soil from the Upland Area. During the first IA, it was deemed impracticable to remove petroleum-impacted soils located beneath large foundation elements in the USTs 71, 72, 73 excavation area; therefore, that inaccessible soil remains in place. During the second IA, it was deemed impracticable to remove one soil sample location containing a high PCB concentration at the top of the slip's shoreline bank (OMS excavation area), and one soil sample location containing a high TPH concentration was left in place in the Hydraulic Barker excavation area. Also in 2020, all CM (roughly 250,000 tons) was removed from the Upland Area. During both IAs and the CM removal, substantial contaminant mass was also removed in dissolved phase during the extensive groundwater dewatering conducted to facilitate the numerous excavations. In short, the two IAs plus full removal of the CM removed the principal sources of contamination in the Upland Area. The second IA also plugged historical pipes open at the shoreline, which eliminated those features as potential conduits for groundwater discharge to the East Waterway.

While TPH contamination remains in soils beneath a portion of the warehouse, the collective data indicate that it has not resulted in an accumulation of free product (NAPL) on groundwater nor caused dissolved-phase concentrations exceeding groundwater PCLs beneath the warehouse or downgradient of it. Hydrocarbon concentrations measured in indoor air and sub-slab soil gas may pose a vapor intrusion risk for potential future commercial or unrestricted use of the warehouse, but not for the current industrial use.

Following the substantial removal of contaminated materials accomplished by the IAs and CM removal, and for the planned future Site use, the constituent concentrations detected in remaining soil throughout the Upland Area are less than the criteria based on industrial direct contact, but some are above conservatively calculated values based on protection of leaching to groundwater. Because there is not an industrial direct-contact risk, residual contaminated soils are defined as those leaching to cause exceedances of PCLs in Upland Area groundwater. The third IA will reduce infiltration through soil that contains residual contaminants, resulting in reduced contaminant leaching to groundwater. In the

Warehouse Subarea, where soil and groundwater data are compared to PCLs developed for unrestricted land use (in the event of future commercial use of the warehouse), the soil direct contact pathway is incomplete because of the Warehouse Building[39].

The high groundwater pH that occurred across much of the Upland Area as a result of the CM appears to have largely dissipated following complete removal of the CM in 2020. Based on June 2021 data, two localized of groundwater with pH exceeding the PCL (pH 8.5) are inferred to remain in the central and south-central areas of the Site, 400 or more feet inland from the shoreline. The collective groundwater pH monitoring, including extensive monitoring conducted in 2020 while the CM was being removed, indicates that elevated groundwater pH does not extend to the shoreline.

The geochemically reducing conditions naturally present in the Upland Area dredge fill increases the dissolution and mobility of metals and can create metals concentrations in groundwater exceeding PCLs even in the absence of high metals concentrations in soil (especially for copper and mercury given their very stringent groundwater PCLs). Following the CM placement in 2013, the resulting high groundwater pH further increased the mobility of metals, causing relatively high metals concentrations in groundwater across a broad portion of the Upland Area inland from the shoreline. The high metals concentrations in inland groundwater are expected to gradually decline as groundwater pH declines following CM removal. The high metals concentrations generally do not extend to shoreline wells although there are sporadic lower-level exceedances in most of those wells. Elevated dissolved nickel concentrations within Units A and B shoreline groundwater, where the greatest tidal fluctuations occur, may be due to oxidation of nickel-containing minerals in contact with more oxygenated, tidally mixed groundwater. No metals exceedances were detected in samples of intertidal porewater and seeps that best represent the quality of groundwater discharging from the Upland Area.

The lack of reproducible groundwater TPH and PAH exceedances at the IA areas following soil removal indicates empirically that the IA successfully removed TPH-contaminated soils that represented potential sources of leachable hydrocarbons to groundwater. Groundwater TPH exceedances are detected at well GF-MW-03 outside the southwest corner of the Log Pond and LP-MW01 in the center of the Log Pond, and given the PAH signatures in those samples, the hydrocarbon detections are more likely attributable to creosote than fuels. At the downgradient edge of the UST71 (Bunker C UST) IA area, TPH and/or cPAH exceedances in wells UST71-MW-102 and -103 may be related to elevated sample turbidity resulting from incomplete well development. Outside of the IA areas, low-level groundwater cPAH exceedances occur sporadically in other wells throughout the Upland Area, but corresponding soil cPAH sources are not identified. The groundwater naphthalene exceedances (based on vapor intrusion potential) detected at well GF-MW-03 in 2013-2014 were not confirmed when sampled in 2017, and the naphthalene exceedances historically detected at well CMS-MW-01 were remediated by extensive soil removal and dewatering from the CMS excavation area during the second

[39] That protection would need to be ensured for the long-term by an environmental covenant to be developed in conjunction with the Cleanup Action Plan and legal agreement for the final Upland Area cleanup.

IA. Following the IAs, there are no TPH or PAH exceedances in shoreline groundwater, or in the one intertidal seep sample (Seep-3) analyzed for PAHs.

The geochemically reducing groundwater conditions created by wood waste in the fill, plus the historical storage of wood materials during mill operation, are also amenable to generation of ammonia and hydrogen sulfide (H_2S). As a result, un-ionized ammonia (NH_3, toxic form of ammonia) is present in groundwater at concentrations exceeding its PCL. NH_3 exceedances in shoreline groundwater are inferred to be limited to the Log Pond Area. NH_3 concentrations were less than the PCL at the six intertidal seep locations sampled, and at the three surface water locations sampled immediately offshore of the Log Pond Area, consistent with those waters being exposed to the atmosphere and thus oxygenated. The inferred extent of H_2S exceedances in shoreline groundwater extends from approximately the Log Pond Area to the northern limit of the Upland Area.

7.2 Potentially Complete Exposure Pathways and Receptors

Following completion of the IAs and the CM removal, the impacted media within the Upland Area are soil, groundwater, sub-slab soil gas and indoor air. In addition to reducing infiltration and contaminant leaching to groundwater, the third IA will mitigate potential exposure to contaminated soil by terrestrial ecological receptors, manage and treat stormwater through a new stormwater management system, and mitigate potential exposure to contaminated soil by human receptors through the installation of security fencing.

With the permanent environmental cap being installed across the Upland Area as part of the third IA and the majority of the Upland Area to continue to be used for industrial purposes, direct contact exposure to soil by industrial workers is not a complete pathway. For the Warehouse Subarea, commercial worker direct contact exposure to soil is not a complete pathway because of the presence of the building.

Because Upland Area groundwater is not considered a potential source of drinking water, the potentially complete exposure pathway for Upland Area groundwater to impact human health and the environment is discharge of contaminated groundwater to sediment and surface water of the East Waterway. Following the plugging of pipes open to the shoreline during the 2nd IA, groundwater discharge is diffusely distributed along the entire shoreline. Based on the low permeability of fill materials within the Log Pond Area, groundwater discharge from that area is substantially less than occurs along other portions of the Upland Area shoreline.

Potential receptors for the groundwater to surface water migration pathway include: 1) benthic organisms present in sediment affected by discharge of Upland Area groundwater; 2) higher-trophic-level organisms in the food chain (e.g., foraging fish, aquatic birds, marine mammals, etc.) who prey on benthic organisms; and 3) humans who ingest fish and benthic organisms.

Following the IAs and based on indoor air monitoring, sub-slab soil gas sampling, and the most recent groundwater monitoring data, there is a potentially complete vapor intrusion

pathway for volatile contaminants (e.g., benzene and naphthalene) into indoor air of the warehouse structure with commercial workers as the potential receptors.

8 Feasibility Study

Under MTCA, the purpose of a FS is to develop an appropriate final cleanup action for the Site, or the Upland Area of the Site in this case, based on evaluation of a range of cleanup alternatives identified as applicable and technically feasible approaches to achieve the applicable cleanup standards. This FS is intended to comply with the MTCA requirements for performance of a FS and selection of a cleanup alternative, as specified at WAC 173-340-350 and -360.

The MTCA regulations allow Ecology to determine that a detailed analysis of certain cleanup alternatives is unnecessary if those alternatives clearly do not meet the minimum requirements specified in WAC 173-340-360, including alternatives for which costs are clearly disproportionate to environmental benefits (WAC 173-340-350(8)(b)(i)). Because the highest concentrations of soil contamination within the Upland Area was largely remediated during three separate interim actions (2013-2014, 2020, and 2021-2023 as described in Sections 4.1, 4.3, and 4.7, respectively), the magnitude and extent of residual contamination that poses a threat to human health and the environment is limited. Specifically, soils not contained beneath the warehouse building that posed a direct contact risk[40] were permanently removed, nearly all soils that were a potential contaminant source of groundwater contamination were permanently removed, and the remaining widespread lower-concentration soils were contained by a low-permeability environmental cap. Consequently, the remaining practicable cleanup action alternatives applicable to the Upland Area are very limited.

Following consultation with Ecology, this FS has, therefore, been streamlined to eliminate impracticable alternatives and instead conduct a detailed evaluation of one practicable alternative and demonstrate that it achieves the threshold requirements and other requirements specified in WAC 173-340-360. The Port and Ecology have discussed and mutually agreed that a selected cleanup alternative that includes the robust completed interim actions plus targeted new components, including contingent cleanup actions, would be permanent to the maximum extent practicable as per MTCA, and further agreed with the streamlined approach for this FS in accordance with WAC 173-340-360(3)(d).

This FS portion of the RI/FS is organized into the following sections:

- 8.1 Cleanup Standards
- 8.2 Potentially Applicable State and Federal Laws
- 8.3 Remedial Action Objectives
- 8.4 Residual Contamination
- 8.5 Screening of Cleanup Action Alternatives
- 8.6 Description of the Cleanup Alternative

[40] TPH/PAH-contaminated soils beneath the warehouse building pose a direct contact risk for future non-industrial (commercial) use of that subarea if it occurs, but not for its continued industrial use.

- 8.7 Analysis of the Cleanup Alternative
- 8.8 Preferred Cleanup Alternative

8.1 Cleanup Standards

This section proposes soil and groundwater cleanup standards for the Upland Area. Cleanup standards consist of: (1) cleanup levels defined by regulatory numerical criteria (contaminant concentrations) that are protective of human health and the environment and (2) the point of compliance at which the cleanup levels must be met. Cleanup standards are contaminant-specific and media-specific and are only proposed for hazardous substances that exceed PCLs under current conditions (following completion of IA), and are determined to be indicator hazardous substances (IHS) for the Upland Area as identified in Section 8.1.1. The cleanup standards developed in this section are used as the basis for developing media-specific remedial action objectives (RAOs) for the cleanup action in Section 8.3.

The selection of IHS and corresponding proposed cleanup standards for groundwater and soil are described in the following sections. Final cleanup standards will be selected by Ecology and presented in the Cleanup Action Plan (CAP) for the Upland Area.

8.1.1 Selection of Indicator Hazardous Substances

There are numerous hazardous substances that exceed PCLs in Upland Area soil or groundwater as described in Sections 6 and 7 of this report. For purposes of defining cleanup requirements for a site, MTCA allows eliminating from consideration those hazardous substances that contribute a small percentage of the overall threat to human health and the environment. The remaining hazardous substances then represent IHS for purposes of defining cleanup requirements including monitoring. Primary factors for selection of IHS include a substance's toxicity, persistence and mobility in the environment, and spatial extents as measured by detection frequency (WAC 173-340-703).

Following completion of the IAs, soils throughout the Norton Terminal (industrial use) portion of the Upland Area do not pose a risk via soil direct contact (see Table 6-1). In addition, the soils are contained beneath a low-permeability cap (pavement) constructed during the third IA that also prevents terrestrial ecological receptor exposure to underlying residual contamination in the soil (Landau, 2021b and 2022b). Within the Warehouse Subarea, cPAH concentrations in localized soils beneath the warehouse building would pose a direct-contact risk for a future non-industrial (commercial[41]) use if it occurs; however, as long as the warehouse structure remains in place, those soils will be contained beneath it as ensured via an environmental covenant. Residual petroleum-contamination beneath the warehouse also poses a potential VI (indoor air) risk if the warehouse were converted to commercial use. If the warehouse remains in industrial use, the underlying

[41] Soil preliminary cleanup levels for unrestricted land use are applied to the Warehouse Subarea, assuming the warehouse is converted to commercial use.

soil cPAH concentrations would not pose a direct contact risk and there is not a VI risk for workers in the warehouse.

Several contaminants remain widely distributed throughout Upland Area soils at lower concentrations exceeding conservatively calculated values based on protection of leaching to groundwater that discharges to the marine environment (Section 8.4). However, the low-permeability cap will reduce contaminant leaching from soil into groundwater.

Given that environmental exposure pathways associated with Upland Area soil have been addressed nearly completely via the completed IAs, the overall threat to human health and the environment is best represented by the nature and extent of contaminants in Upland Area groundwater. This addresses the remaining exposure pathways of contaminated groundwater discharge to sediment and surface water of the East Waterway, and VI of VOCs from shallow groundwater into future occupied structures. Use of the empirical groundwater data for selecting IHS implicitly addresses contaminant leaching from soils to groundwater.

The robust data set for groundwater is used to select IHS for the purpose of defining final cleanup requirements for the Upland Industrial Use Area. Table 8-1 presents the analysis of groundwater data used to assess contaminant toxicity, persistence, mobility, and spatial extents in groundwater and thus select the list of IHS. Table 8-1 lists statistics for all contaminants that exceed PCLs in one or more samples of Upland Area groundwater representing current conditions (refer to Table 6-2 for a statistical summary of all the groundwater data). The two criteria used to represent threat to human health and the environment for the purpose of selecting IHS are:

i. **Frequency of exceedance**. For this analysis, the number of locations (wells) with groundwater exceedances are used instead of number of groundwater samples with exceedances. This is because the number of samples collected per well is highly variable, thus potentially skewing the results, and the number of locations with exceedances better represents a contaminant's spatial extent (thus persistence and mobility indirectly) and the mass of contaminants potentially discharging to the East Waterway. Table 8-1 also presents frequency of exceedance based on number of samples, for reference.

ii. **Magnitude of exceedance.** The greater a contaminant's magnitude of exceedance (maximum detected concentration ÷ PCL), the greater its risk to human health and the environment.

For purposes of this analysis, a contaminant with a frequency of exceedance greater than 5 percent and a magnitude of exceedance greater than 2 is selected as an IHS for cleanup of the Upland Area ("Yes" in the far-right column of Table 8-1). Applying that methodology, the list of IHS for the Upland Area includes:

- Metals (arsenic, copper, lead[42], mercury, nickel)

[42] Lead does not meet both criteria, but per Ecology comments it is included as an IHS based on its large magnitude of exceedance.

- Vinyl chloride
- pH (alkaline), hydrogen sulfide,[43] and un-ionized ammonia
- Total cPAHs (TEQ)
- Total PCBs

Although TPH is not an IHS based on groundwater quality data, TPH-D+O is retained as an IHS for areas within the industrial use area where concentrations exceed the 7,700 mg/kg residual saturation limit established by Ecology (refer to Appendix F). Residual soil concentrations exceeding 7,700 mg/kg remain at the following three sample locations that were unable to be removed practicably during the IAs:

- **USTs 71, 72, 73 IA Area**. Samples BUST-B39 and BUST-S58 collected beneath massive concrete foundation structures as described in Section 6.5.2.1.1.
- **Hydraulic Barker IA Area**. Sample HBX-B-02, a record sample collected from the excavation base as described in Section 6.5.3.1.2.

8.1.1.1 Indicator Hazardous Substances for Warehouse Subarea

If the Warehouse Subarea is converted to commercial use in the future, concentrations of TPH and total cPAHs in some soils beneath the warehouse building exceed the applicable PCLs for unrestricted direct contact. Irrespective of land use, soil concentrations of acenaphthene and naphthalene exceed PCLs based on leaching to groundwater, and concentrations of TPH-G and TPH-D+O exceed MTCA Method A cleanup levels applied as PCLs.

In addition, because VI/indoor air risks for the warehouse are unique to that structure and its potential conversion to commercial use, IHS for warehouse indoor air are defined separately from the rest of the industrial use area. For potential future commercial use of the warehouse, the IHS for indoor air include naphthalene and benzene because they exceeded their respective Method B air cleanup levels (refer to Section 6.5.1.1.2). Indoor air remediation levels for these two chemicals based on a future commercial use exposure scenario will be used to assess the protectiveness to human health for the cleanup remedy.

8.1.2 Soil Cleanup Standards

8.1.2.1 Soil Cleanup Levels

Proposed soil cleanup levels have been developed for the Upland Area to address protection of the leaching-to-groundwater and direct contact exposure pathways as described in Section 5.2.1. Different soil cleanup levels are defined for the Warehouse Subarea of Unit A (if the warehouse is redeveloped for a non-industrial use) versus for Norton Terminal (industrial use area) that comprises the rest of the Upland Area. To address the soil-leaching-to-groundwater pathway, separate soil cleanup levels are

[43] The data quantifying hydrogen sulfide, not total dissolved sulfide, are representative of environmental risks attributable to sulfides in water (refer to Section 6.4 and Appendix H) and were, therefore, used for this analysis.

developed for unsaturated versus saturated soil in accordance with MTCA. Table 8-2 presents the proposed soil cleanup levels. Note that hydrogen sulfide, un-ionized ammonia, and alkaline pH are IHS based on groundwater data; however, because of the processes by which harmful concentrations of each are generated in groundwater (e.g., ammonia and sulfide by degradation of wood waste, leaching of alkaline pH from crushed concrete), no corresponding soil cleanup levels are defined for them. While TPH is not an IHS based on groundwater quality, a TPH soil cleanup level based on residual saturation (7,700 mg/kg; see Appendix F) applies for the industrial use area of the Site. Because of the multiple petroleum types beneath the warehouse building, Method A soil cleanup levels for TPH would apply for removal of TPH-contaminated soils beneath it if it is demolished, irrespective of Warehouse Subarea land use (see Section 8.6.6).

8.1.2.2 Soil Points of Compliance

For soil cleanup levels based on direct contact, the point of compliance is the upper 15 feet bgs, based on a reasonable maximum depth of excavation and assumed placement of excavated soils at the surface where contact occurs. For soil cleanup levels based on groundwater protection, the point of compliance for unsaturated soil cleanup levels is all depths above the water table, whereas the point of compliance for saturated soil cleanup levels is all depths below the water table.

8.1.3 Groundwater Cleanup Standards

8.1.3.1 Groundwater Cleanup Levels

The proposed groundwater cleanup levels for the Upland Area IHS are equivalent to the respective PCLs developed in Section 5, protective of both discharge to marine water and VI.[44] Table 8-3 presents the proposed groundwater cleanup levels.

8.1.3.2 Groundwater Point of Compliance

Under MTCA, the point of compliance (POC) is the location where the cleanup levels must be met. The final point(s) of compliance for affected media will be selected by Ecology and presented in the CAP for the Upland Area. Under MTCA, the standard POC for groundwater is throughout a site. However, as per WAC 173-340-720(8)(c), Ecology may approve a conditional point of compliance (CPOC) for groundwater as close as practicable to the source of contaminants under the following conditions:

- All practicable methods of treatment are to be used in the site cleanup.
- It is not practicable to meet groundwater cleanup levels at the standard point of compliance within a reasonable restoration time frame.

The Port owns the Upland Area and the adjacent tidelands, and, therefore, any CPOC established would be on Port property. An on-property groundwater CPOC is proposed along the Upland Area shoreline where compliance monitoring wells could be maintained and monitored outside of the primary industrial activities and traffic of Norton Terminal. A nearshore CPOC would be consistent with those approved by Ecology at other upland

[44] Upland Area groundwater is not considered a source of potable (drinking) water (Section 5.3.1).

cleanup sites on the Port Gardner waterfront (e.g., Everett Shipyard Site, North Marina West End Site, North Marina Ameron/Hulbert Site, Weyerhaeuser Everett West Site).

The MTCA (WAC 173-340-720(8)(c)) conditions for justifying a groundwater CPOC are addressed below.

8.1.3.2.1 CPOC Located as Close as Practicable to the Source of Contaminants

The vast majority of the highest-concentration source material has been permanently removed from the Upland Area. Following those removal actions, residual lower-concentration contaminants are widely distributed throughout the fill materials of the Upland Area (see Figure 8-1). Because the fill containing one or more contaminants exceeding PCLs is so widespread, including locations within the nearshore zone, wells at most locations will be within or close to contaminated material. In addition, monitoring of CPOC wells positioned along the shoreline would provide the most representative measure of the quality of groundwater discharging to the East Waterway (point of exposure for which the groundwater PCLs are established). As a practical matter, wells along the shoreline should also avoid much of the traffic occurring within Norton Terminal, thus reducing disruption to terminal operations as well as physical safety risks for personnel conducting the long-term groundwater monitoring.

8.1.3.2.2 All Practicable Methods of Treatment Are to be Used

By definition in MTCA, "All practicable methods of treatment" means all technologies and/or methods currently available and demonstrated to work under similar site circumstances or through pilot studies, and applicable to the site at reasonable cost (WAC 173-340-200).

As detailed above, substantial source control has been accomplished within the Upland Area using a combination of permanent removal of soils and CM followed by containment of soils. In addition, large quantities of contaminated groundwater were also permanently removed and treated during the IA soil excavation activities. The measurements of groundwater pH collected in June 2021, following completion of the second IA and CM removal but before start of the third IA's capping, demonstrated substantial reductions in the alkaline groundwater pH throughout most of the Upland Area (refer to Section 6.3). Because the alkaline pH was largely responsible for elevated concentrations of dissolved metals in Upland Area groundwater, it is expected that a corresponding decline in metals concentrations has begun and will continue. It is our professional judgement that the cost to conduct active treatment of groundwater throughout the Upland Area with a goal to accelerate the groundwater restoration time frame would clearly be impracticable—i.e., disproportionate to the environmental benefits achieved in accordance with WAC 173-340-360(3)(e).

Ultimately, Ecology's selected cleanup alternative will be permanent to the maximum extent practicable in accordance with MTCA. As such, the selected cleanup alternative will meet the requirement that all practicable methods of treatment are used in remediating the Site.

8.1.3.2.3 Evaluation of Restoration Time Frame for Standard and Conditional Points of Compliance

A cleanup action needs to be protective until cleanup standards are met irrespective of the restoration time frame required. Dissolved metals are the IHS with the most widespread distribution in Upland Area groundwater. Given the complex and transient geochemical relationships between metals solubility and groundwater pH in the (natural) geochemically reducing conditions, any quantitative estimation of restoration time frame for the dissolved metals throughout the Upland Area would be highly uncertain. However, even prior to the IAs and CM removal, groundwater along the shoreline was substantially less contaminated than that at inland locations. There is a high certainty that a shorter restoration time frame would be accomplished for a shoreline CPOC than at the standard point of compliance encompassing 50 acres of Upland Area.

Irrespective of any differences in estimated restoration time frame for different groundwater points of compliance, there would be negligible environmental benefit (risk reduction) from meeting marine-based groundwater cleanup levels at monitoring wells located tens to hundreds of feet inland from the point of groundwater discharge (point of exposure for which the cleanup levels were established). As such, any incremental cost to conduct remediation to achieve groundwater cleanup levels more quickly throughout the Upland Area (i.e., at the standard point of compliance) would be disproportionate to the incremental environmental benefit of doing so, relative to less-expensive alternatives that achieve groundwater cleanup levels at a shoreline CPOC.

Neither the MTCA regulation nor Ecology written policy defines a time frame (years) for determining a restoration time frame as reasonable versus not reasonable. However, WAC 173-340-360(4)(b) provides a list of nine factors to be considered in determining whether a cleanup action provides for a reasonable restoration time frame. Table 8-5 summarizes current conditions and anticipated future conditions at the Upland Area with respect to each of the nine factors. Based on the analysis, we conclude that it would be impracticable to meet groundwater cleanup levels for all IHS at the standard point of compliance within a reasonable restoration time frame.

8.1.3.2.4 Contaminant-Specific Groundwater Points of Compliance

Ecology has agreed that a CPOC at the shoreline is appropriate for broadly distributed IHS, namely metals, cPAHs, hydrogen sulfide, un-ionized ammonia, and pH. For IHS that are localized in groundwater (e.g., PCBs), groundwater cleanup standards may be achieved within a reasonable restoration time frame at the standard POC (throughout the Upland Area). For those IHS, compliance monitoring would be conducted in areas with groundwater exceedances based on the RI dataset. For example, the groundwater PCB exceedances are localized to the Log Pond fill, so compliance monitoring for PCBs would be conducted in that area.

The Upland Area well locations and other details for monitoring groundwater compliance would be specified in a Groundwater Compliance Monitoring Plan to be reviewed and approved by Ecology.

8.1.4 Air Cleanup Standards and Remediation Levels

For potential future commercial use of the warehouse within the Warehouse Subarea, the risk-based indoor air remediation level for naphthalene and benzene are 0.34 µg/m^3 and 1.5 µg/m^3, respectively, as shown in Table 8-4. These are based on a target excess cancer risk of one in a million (1 x 10^{-6}) and will be used to assess the protectiveness to human health for the cleanup remedy. However, the indoor air cleanup levels for these chemicals are based on unrestricted land use under Method B (see Table 8-4).

If the warehouse is maintained in its current traditional industrial use, Method C air cleanup levels would apply (Table 8-4).

8.2 Potentially Applicable State and Federal Laws

In addition to the cleanup standards discussed in Section 8.1, the Upland Area cleanup action must comply with applicable state and federal laws as a minimum threshold requirement. Requirements from state and federal laws that are determined to be legally applicable or relevant and appropriate are collectively referred to as applicable or relevant and appropriate requirements (ARARs). The Upland Area cleanup action will be performed pursuant to MTCA under the terms of a legal mechanism to be determined (e.g., order or decree) between Ecology and the Port. Accordingly, the cleanup action will meet the permit exemption provisions of MTCA, obviating the need to follow procedural requirements of the various state and local regulations[45] that would otherwise apply; however, the cleanup action must meet the substantive requirements of those regulations (WAC 173-340-710). Ecology will be responsible for issuing the final approval for the cleanup action, following consultation with other state and local agencies as appropriate.

Potentially applicable state and federal laws include the media- and chemical-specific cleanup standards discussed in Section 8.1 and those discussed below.

8.2.1 MTCA Requirements

The MTCA statute (Chapter 70A.305 of the Revised Code of Washington [RCW]) is the primary law that governs cleanup of contaminated sites in the state of Washington. The MTCA cleanup regulation (Chapter 173-340 WAC) specifies criteria for the evaluation and conduct of a cleanup action. The minimum threshold requirements for cleanup actions are protect human health and the environment, meet environmental standards in other applicable laws, and provide for monitoring to confirm compliance with cleanup levels. MTCA cleanup standards incorporate applicable state and federal laws including but not limited to Water Quality Standards for Surface Waters of the State of Washington (Chapter 173-201A WAC) and its authorizing state statute the Water Pollution Control Act (Chapter 90.48 RCW), as well as Sections 303(c) and 304 of the federal Clean Water Act (33 U.S.C. 1251 et seq.).

For cleanup actions involving containment of hazardous substances, MTCA has requirements that must be met for the cleanup action to be considered in compliance with

[45] MTCA cleanup actions are not exempt from obtaining applicable federal permits, which include NPDES construction stormwater permits administered by the state.

soil cleanup standards. One of these includes implementing a compliance monitoring program that is designed to ensure the long-term integrity of the containment system and applying institutional controls where appropriate to the affected areas (WAC 173-340-440).

The key MTCA decision-making document for cleanup actions is the RI/FS. After approving the RI/FS, Ecology selects a cleanup action and documents the selection in a CAP which goes through formal public review with the RI/FS. After consideration of public comment on the CAP, Ecology finalizes the CAP and the cleanup process moves forward to design, permitting, construction, and compliance monitoring.

8.2.2 Solid and Hazardous Waste Management

The Washington Dangerous Waste Regulations (Chapter 173-303 WAC) and Hazardous Waste Management statute (Chapter 70A.300 RCW)[46] would apply if dangerous wastes are generated. The United States Department of Transportation (USDOT) and Washington State Department of Transportation (WSDOT) regulations regarding transport of hazardous materials (49 CFR Parts 171-180) would apply if regulated material is transported off-site as part of the cleanup action. However, it is not anticipated that dangerous wastes would be generated during the remaining elements of the Upland Area cleanup action.

The Washington Solid Waste Handling Standards (Chapter 173-350 WAC) and Solid Waste Management statute (Chapter 70A.205 RCW) regulate handling, treatment, or off-site disposal of nonhazardous solid waste.

8.2.3 State Environmental Policy Act (SEPA)

The State Environmental Policy Act (SEPA) regulations (Chapter 197-11 WAC), SEPA procedures (Chapter 173-802 WAC), and SEPA statute (Chapter 43.21C RCW) ensure that state and local government officials consider environmental values when making decisions. The SEPA process begins when an application for a permit is submitted to an agency, or an agency proposes to take some official action, such as implementing a MTCA CAP. Completion of a SEPA checklist would be required prior to initiating remedial construction activities. Since the cleanup action will likely be performed under an order or decree, SEPA and MTCA requirements will be coordinated.

8.2.4 Washington Clean Air Act

The cleanup action would be regulated under the Washington Clean Air Act (RCW 70A.15) as implemented through Chapter 173-400 WAC and Chapter 173-460 WAC. The Puget Sound Clean Air Agency (PSCAA) regulations would also be applicable. The substantive requirements would include not creating conditions that would significantly degrade the ambient air quality or cause exceedance of applicable air quality standards.

[46] Chapter 70A.205 RCW and its implementing regulation (Chapter 173-303 WAC) are Washington State's administration of the federal Resource and Recovery Act (RCRA).

8.2.5 Washington Shoreline Management Act

The Washington Shoreline Management Act (RCW 90.58) and its implementing regulations and policies establish requirements for substantial developments occurring within 200 feet of the shoreline. The City of Everett's Shoreline Master Program is adopted under the state regulations, creating an enforceable state law. Since the cleanup action will likely be performed under an order or decree, a shoreline substantial development permit should not be required but the cleanup action will comply with its substantive requirements.

8.2.6 Construction Stormwater General Permit

If construction-generated dewatering water or stormwater from the cleanup action is discharged to surface waters of the State of Washington, such discharge would need to comply with requirements of a National Pollutant Discharge Elimination System (NPDES) Construction Stormwater General Permit (CSGP). Ecology administers the federal NPDES program in Washington State. Because soil and groundwater contamination are present within the Upland Area, Ecology would impose a project-specific Administrative Order on the CSGP that includes contaminant indicator levels, which construction-generated water must comply with prior to discharge to surface waters of the state, as well as robust monitoring requirements to verify that compliance. Operators of regulated construction sites discharging to waters of the state are required to:

- Submit a Notice of Intent (NOI) and obtain coverage under the CSGP with Administrative Order
- Develop a Stormwater Pollution Prevention Plan (SWPPP)
- Implement sediment, erosion, and pollution prevention control measures, including water quality treatment as needed, to comply with the SWPPP
- Implement monitoring of construction-generated water being discharged with reporting of the monitoring data to Ecology, in accordance with the Administrative Order on the CSGP

The permit also requires that site inspections be conducted by a Certified Erosion and Sediment Control Lead (CESCL). This is typically an individual that works for the contractor performing the construction work.

8.2.7 Other Potentially Applicable Regulatory Requirements

Other regulatory requirements that potentially would apply to the cleanup action include the following:

- Occupational Safety and Health Administration (OSHA) and Washington Industrial Safety and Health Act (WISHA) regulations (29 CFR 1910.120; Chapter 296-62 WAC) governing worker safety during cleanup action implementation. Compliance would be achieved through preparation and implementation of Site-specific health and safety plan(s) with appropriate controls, worker training and certifications, and occupational monitoring.

- City of Everett Industrial Pretreatment Ordinance #3070-08 and Wastewater Pretreatment Regulations (Chapter 14.40 EMC[47]) govern all discharges to the City of Everett (City) sanitary sewer, which would be applicable if discharge of construction-generated water is required for the cleanup action. To allow discharge to the City sanitary sewer during the cleanup action, a Discharge Authorization would be applied for, and obtained from, the City; the Discharge Authorization includes criteria for compliance with the Pretreatment Ordinance including effluent quality criteria to be met prior to discharge, flow quantity limitations (can vary seasonally), and reporting requirements.
- City of Everett Stormwater and Storm Drainage, Ordinance #2196-96 and City of Everett Stormwater Management Manual if stormwater generated during the cleanup action were discharged via the City's stormwater drain system.
- City of Everett Grading Permit (Title 18.28.200 EMC) applies to excavations exceeding 50 cubic yards, and imposes substantive requirements including temporary erosion and sediment control (TESC).
- City of Everett Traffic Code (Title 46 EMC) applies to construction-related activities such as haul-truck routes within the City and operations that would require traffic control entering or exiting the Site.
- Washington State Water Well Construction Regulations (Chapter 173-160 WAC) regulating groundwater well installation and decommissioning as part of the cleanup action.
- The Archeological and Historical Preservation Act (16 USCA 496a-1) would be applicable if cultural materials are discovered during grading and excavation activities. In 2013, an Archaeological Resources Assessment (SWCA, 2013a) was prepared for the Upland Area that mapped the estimated probabilities for areas of native soil to contain significant Native American archaeological materials (low, medium, high probability). Using that information, a Cultural Resources Monitoring and Discovery Plan (SWCA, 2013b) was implemented during IA excavation activities (described in the IA Reports; Aspect, 2015a and Landau, 2022b). The Cultural Resources Monitoring and Discovery Plan would again be applied during any future cleanup excavations extending into native soil for areas with medium or high probability of encountering archaeological materials.

8.3 Remedial Action Objectives (RAOs)

RAOs are specific goals to be achieved by cleanup alternatives that meet cleanup standards and provide protection of human health and the environment under a specified land use. The RAOs for soil and groundwater consider the applicable exposure pathways for those media (Section 7.2) and provide acceptable concentrations for COCs that are protective of receptors via the potential exposure pathways.

[47] Everett Municipal Code.

Based on the CSM for the Upland Area (Section 7), RAOs applicable to the entire Upland Area that are addressed in this FS are as follows:

- Prevent groundwater IHS from discharging to surface water and sediment of the East Waterway at concentrations above their respective groundwater cleanup levels based on marine protection.
- Prevent infiltration of stormwater through soil containing hazardous substances above the soil leaching cleanup level.
- Prevent industrial worker direct contact with soil containing hazardous substances at concentrations above the direct contact cleanup level.

If the Warehouse Subarea is converted to a non-industrial (commercial) use, the following additional RAOs are addressed:

- Prevent direct worker contact with soil beneath the warehouse building containing TPH and total cPAHs (TEQ) at concentrations above proposed soil cleanup levels for unrestricted use direct contact (applicable for commercial workers).
- Prevent VI from residual petroleum-contaminated unsaturated soils or groundwater into air above commercial remediation levels within the warehouse.

Each RAO will be achieved by terminating the associated exposure pathway. This can be done through contaminant removal or treatment to meet chemical- and media-specific cleanup standards (cleanup levels at points of compliance; Section 8.1) that are based on the specific exposure pathways, and/or by otherwise preventing exposure through engineering controls (e.g., containment) with associated institutional controls.

8.4 Residual Contamination within Upland Area

Based on the conceptual site model (CSM) for the Upland Area as discussed in Section 7, this section describes the extent of contamination that exceeds applicable cleanup levels under current conditions (post-IA) and, therefore, requires cleanup action evaluation in this FS. Figure 8-1 depicts locations of residual contaminant exceedances of cleanup levels in Upland Area soil and groundwater. The residual contamination in soil and groundwater is described below.

8.4.1 Soil

Following completion of the first and second IAs, soil concentrations of select contaminants exceeding leaching-based soil cleanup levels remain scattered throughout the Upland Area, as detailed in Section 6. The right panel of Figure 8-1 illustrates the distribution of soil sample locations with contaminant concentrations less than applicable cleanup levels[48] (green symbols), greater than but less than 2 times cleanup levels (yellow symbols), and greater than 2 times cleanup levels (red symbols). The exceedances primarily include metals (arsenic, copper, lead, mercury, and zinc), cPAHs, PCBs, and

[48] For conservatism, Figure 8-1 assumes a future commercial use of the Warehouse Subarea, dictating more stringent soil cleanup levels for unrestricted land use.

TPH beneath the warehouse. Of those, arsenic, copper, lead, mercury, PCBs, TPH, and cPAHs are selected as IHS as described in Section 8.1.1.

The soils with highest contaminant concentrations were removed during the IAs to the maximum extent practicable. The remaining soil concentrations are not expected to represent a major source to groundwater, particularly given the attenuation of high pH in groundwater following CM removal[49] in combination with the third IA's environmental cap restricting infiltration. As noted in Section 6.5.1.5, a notable residual exceedance is 24 mg/kg total PCBs in an excavation verification soil sample located at the top of bank for the off-loading dock slip (sample OMSX-S-20). That soil could not be removed without risking slope failure into the slip, as discussed by Aspect (2021), but that bank area will be evaluated further as part of the East Waterway RI/FS.

8.4.2 Groundwater

As illustrated on the left panel of Figure 8-1 and detailed in Section 6, there are widespread groundwater cleanup level exceedances—principally for metals (arsenic, copper, lead, mercury, and nickel) that have enhanced solubility in the geochemically reducing groundwater, but also for cPAHs, hydrogen sulfide, and un-ionized ammonia. Infrequent and localized exceedances also occur for the multiple other constituents listed in Table 8-1, including PCBs. Groundwater pH has declined substantially across the Upland Area following the CM removal action but, as of 2021 measurements, a localized inland area still had pH exceeding 8.5 (Figure 8-1).

Consistent with waterfront sites throughout Puget Sound, groundwater along the Upland Area shoreline is in direct hydraulic connection with, and discharges to, marine sediment and water. The portion of the aquifer in which upland groundwater mixes with the tidally influenced marine water is termed the transitional zone. The saline water in the transitional zone is groundwater by MTCA definition and guidance (WAC 173-340-200; Ecology, 2017).

8.4.3 Indoor Air within Warehouse Building

Benzene and/or naphthalene may pose a VI risk for a future commercial use of the warehouse building. There is not a VI risk for continued traditional industrial use of the warehouse.

8.5 Screening of Cleanup Action Alternatives

The three completed IAs successfully removed the vast majority of identified contaminant source materials and then constructed a low-permeability environmental cap to restrict infiltration through soils containing residual low-level contamination.

Therefore, based on the lack of remaining contaminant mass and definable source areas, the high cost of actively remediating the limited remaining groundwater pH, metals, and PAH contamination, cleanup action alternatives that rely on active groundwater remediation (e.g., treatment using permeable reactive barriers or injections, or pump and

[49] High groundwater pH was a primary cause for dissolved metals exceedances.

treat technologies) are considered impracticable[50] for the Upland Area. However, as a component of the East Waterway sediment cleanup, an in-water granular cap will be constructed along the northern portion of the shoreline to oxygenate groundwater discharge and thereby treat dissolved hydrogen sulfide and un-ionized ammonia (refer to Section 6.4).

As a result, a single cleanup action alternative consisting of the completed (interim) cleanup actions, long-term groundwater compliance monitoring and inspection/maintenance of the environmental cap, and institutional/engineering controls are evaluated for the Upland Area (the Cleanup Alternative). A pair of contingent cleanup actions for the Warehouse Subarea, and one for the PUD electrical substation, are also included. The following sections develop and evaluate this alternative.

8.6 Description of the Cleanup Alternative

As indicated in the previous section, the Cleanup Alternative consists of the completed cleanup actions, groundwater compliance monitoring, long-term cap inspection/maintenance, and institutional/engineering controls to achieve Upland Area RAOs. The components of the Cleanup Alternative are depicted schematically on Figure 8-2 and are described below.

8.6.1 Completed Cleanup Actions

The Cleanup Alterative includes the interim cleanup actions (IAs) already completed in the Upland Area that contribute to protection of human health and the environment. As detailed in Section 4, the three previously completed IAs included:

1. **IA 1 (2013-2014):** Removed approximately 38,500 tons of contaminated soil and 5.68 million gallons of contaminated groundwater from 15 discrete areas (refer to Section 4.1).
2. **IA 2 (2020):** Removed approximately 17,600 tons of contaminated soil and 2.28 million gallons of contaminated groundwater from 12 discrete areas. In addition, inactive pipes were plugged to prevent them from serving as a potential pathway for discharge of Upland Area groundwater to the East Waterway. While not a MTCA action, approximately 250,000 tons of CM that created high-pH groundwater were also permanently removed during 2020 (refer to Section 4.3).
3. **IA 3 (2021-2023):** Construction of an approximately 41-acre low-permeability pavement cap to both reduce infiltration through soil and mitigate potential exposure to contaminated soil by terrestrial ecological receptors. Approximately 33.2 acres of environmental cap were constructed, with approximately 7.6 acres of cap remaining to be installed in accordance with the second amendment to the Agreed Order. A state-of-the-science stormwater treatment system was integrated

[50] The incremental cost to conduct such an alternative would be disproportionate to the incremental benefit achieved relative to less permanent alternatives.

into the pavement cap, with Site stormwater managed under an Industrial Stormwater General Permit (refer to Section 4.8).

Outside the extents of the IA 3 environmental cap and the City Utility Property cap (Section 8.6.2), the existing warehouse building's concrete floor slab provides effective containment of the TPH-contaminated soils beneath it. While not constructed for that purpose, it functions as a completed environmental cap within the Cleanup Alternative.

8.6.2 Environmental Capping of City Utility Property and Warehouse

The City's Utility Property at the north end of the Upland Area will be capped by pavement except for areas of landscaping or open space and the stormwater and combined sewer treatment and storage structures. Any areas that are not contained under paving must have data showing that surface materials (within the top 3 feet) meet MTCA Method A industrial cleanup standards, in accordance with the Cleanup Action Plan Memorandum for that property (Floyd|Snider, 2021).

8.6.3 Groundwater Compliance Monitoring

Long-term groundwater compliance monitoring will be conducted to ensure that groundwater cleanup levels are achieved and maintained at the conditional point of compliance. Details of the monitoring program including reporting will be defined in a Groundwater Compliance Monitoring Plan to be submitted to Ecology for review and approval following finalization of the Upland Area CAP. The Groundwater Compliance Monitoring Plan would present the monitoring locations, location-specific analytes to be monitored, monitoring frequency, analytical methods including quality control, and a decision process for evaluating data and adaptively managing the monitoring program. For the purposes of FS cost estimating, it is assumed that groundwater monitoring for IHS would be conducted at a network of 12 wells on a quarterly basis for 2 years and then semiannually (dry season, wet season) for an additional 10 years thereafter (12-year monitoring program). As discussed in Section 8.1.3.2.4, wells for monitoring the CPOC for metals, cPAHs, hydrogen sulfide, un-ionized ammonia, and pH will be positioned near the shoreline, whereas wells for monitoring PCBs at the standard POC will be positioned further inland. Specific well locations will be established in the Groundwater Compliance Monitoring Plan.

8.6.4 Long-Term Cap Inspection and Maintenance

Inspection and maintenance are required to ensure the long-term integrity of the entire Upland Area cap, which includes the Norton Terminal, City Utility Property, and Warehouse Subarea. The procedures and requirements for conducting cap inspection and maintenance activities, and for completing associated reporting to Ecology, will be defined in a Cap Inspection and Maintenance Plan to be submitted to Ecology for review and approval following finalization of the Upland Area CAP. For the purposes of FS cost estimating, it is assumed that cap inspection with reporting would be conducted annually, and maintenance repairs would occur every 3 years, in perpetuity.

8.6.5 Institutional/Engineered Controls

Institutional controls are measures undertaken to limit or prohibit activities that could interfere with the integrity of a cleanup action or that could result in exposure to hazardous

substances at a Site. Institutional controls are required for any alternative that leaves contamination in place at levels above the cleanup standards per WAC 173-340-440. The Port and City will prepare and file with Snohomish County environmental covenants for their respective portions of the Upland Area, which would prohibit activities that could interfere with the integrity of remedial actions or compromise protection of human health and the environment.

Specific use restrictions and requirements identified in the environmental covenants would likely include the following:

- Restriction on use of the Norton Terminal and City Utility Property portions of the Upland Area to industrial property uses as defined by MTCA.
- Prohibition of the use of groundwater.
- Inspection and maintenance requirements for engineered controls including the environmental cap including vegetated areas, warehouse vapor barrier, and monitoring wells.
- Implementation of a Soil and Groundwater Management Plan to provide for future construction or other intrusive activities, notification regarding the presence of contaminated media, and to specify requirements for worker health and safety and material management including procedures for testing and management of contaminated soil and groundwater. In addition, the Soil and Groundwater Management Plan would also discuss additional remedial action requirements if existing on-Site upland elements are demolished, altered, or removed in the future. Some of the existing on-Site elements include the warehouse building, the Snohomish Public Utility District's electrical power substation, the City's wastewater infrastructure, and buried structures including remaining subsurface utilities (active or inactive), pilings, or foundations. Any alteration of overwater structures would be addressed as part of the East Waterway cleanup.
- Financial assurances to ensure that the cleanup action's engineering controls and monitoring programs are maintained, as long as contamination remains in the Upland Area.

In addition to complying with applicable MTCA provisions in WAC 173-340-420 and WAC 173-340-440, institutional controls must also meet the requirements of the Uniform Environmental Covenants Act (UECA) enacted by the State of Washington in 2007 (64.70 RCW). Ecology is required to periodically review compliance with institutional control requirements under WAC 173-340-420 every 5 years, as long as the institutional controls are in effect.

8.6.6 Contingent Actions for Warehouse Subarea

The future use of the warehouse building, and thus land use within the Warehouse Subarea, remains uncertain at the time of this FS preparation. If the warehouse remains in use for traditional industrial purposes, consistent with the Norton Terminal industrial operations, no contingent cleanup action would be needed. However, if the Port chooses to

not continue to use the warehouse for industrial purposes, the Cleanup Alternative includes two contingent cleanup actions:

1. If the warehouse is converted for commercial use, retrofit vapor controls (e.g., vapor barrier) would be implemented to mitigate potential VI risk to indoor air.
2. If the Port chooses to demolish the warehouse building (including the concrete floor slab) instead of repurposing it, cleanup of the underlying TPH-contaminated soils would be implemented.

Because one contingent action applies if the warehouse stays in use (for commercial purposes), and one applies if it is demolished, the two contingent actions would not be implemented together. Each of the contingent cleanup actions is described below.

8.6.6.1 Contingent Vapor Controls for Warehouse Building

As discussed in Section 6.5.1.1.2, the residual petroleum contamination beneath the warehouse building could create a potential VI risk to indoor air if the warehouse is redeveloped for a non-industrial (commercial) use. In that future-use scenario, VI controls would be required.

For an assumed future commercial use, there are two options to control VI risk within the warehouse: 1) a chemical vapor barrier applied to the existing floor slab, or 2) an active ventilation system installed in the sub-slab void space beneath the first floor. Considerations for choosing the best control option include the low magnitude of potential indoor air contamination due to VI (Section 6.5.1.1.2), the difficult access to the sub-slab void underneath the warehouse due to the limited height (approximately 1 to 4 feet, likely representing a confined space if working within it), and the large footprint of the warehouse (roughly 3.2 acres, assuming no change to current structure) that would require multiple blower units to accomplish adequate sub-slab ventilation. Post-applied, epoxy resin-based vapor barrier coatings are designed for installation on existing concrete floors. These chemical vapor barriers can be applied to seal around existing penetrations in the concrete and will provide protection against intrusion of volatile contaminants through the concrete. Epoxy resin-based vapor barrier coatings are intended for use as the finished floor surface and can withstand foot and vehicle usage.

Based on these considerations, we assume the chemical vapor barrier option would be installed on the interior side of the first-floor concrete slab to mitigate VI risk if the warehouse is to be occupied by commercial workers. We assume substantial preparation of the warehouse's existing first floor, including removal of appurtenances and sealing of penetrations[51] no longer needed, would be required prior to application of the barrier. Examples of epoxy resin-based, post-applied vapor barrier options for this application include EPRO's Geo-Seal® EFC and Land Science's Retro-Coat™.[52] These vapor barriers consist of a primer that bonds to the concrete overlain by a 20-mil impermeable epoxy

[51] Including decommissioning of monitoring wells installed through the floor slab.
[52] A specific product would be selected during design of the vapor barrier if it is needed.

coating that provides chemical vapor protection. The coated concrete can be used as the finished floor surface, or additional flooring material can be installed over it.

After installation, there are no operations and maintenance required for a chemical vapor barrier unless it is damaged or removed, in which case it would be replaced for that area. An Indoor Air Sampling and Analysis Plan would be prepared for Ecology approval and then implemented after vapor barrier installation to assure that the commercial worker remediation levels for benzene and naphthalene (Table 8-4) are attained.

8.6.6.2 Contingent Cleanup of TPH-Contaminated Soil and Capping within Warehouse Footprint

If the warehouse building is demolished, it is assumed the demolition would include removal of the concrete floor slab and underlying concrete pile caps and grade beams; the vertical wood pilings would be cut or broken off at excavation subgrade and left in place beneath that. Removal of the floor slab would expose soils containing TPH concentrations exceeding cleanup levels based on free product generation and cPAH concentrations exceeding the cleanup level for direct contact under non-industrial (unrestricted) use.

If the warehouse is demolished, the four soil areas with TPH concentrations exceeding cleanup levels[53] within the northern portion of the warehouse footprint (see Figure 6-A3) would be excavated and properly disposed of offsite. In this scenario, we estimate that roughly 2,600 tons of TPH-contaminated soil would be removed, but that estimate may be refined as part of remedial design for the contingent action. Because the contaminated soils extend below the water table, excavation dewatering would be conducted to allow handling and transport of unsaturated soils. Soil sampling within the excavation would be conducted as performance monitoring to verify compliance with soil TPH cleanup levels. The remedial excavations would be backfilled to finish grade with imported clean aggregate.

Removal of the TPH-contaminated soils would also remove the highest cPAH concentrations within the Warehouse Subarea. Outside of the TPH soil excavation areas, residual soils containing cPAHs (and metals) concentrations greater than unrestricted cleanup levels would be capped with asphalt pavement to restrict infiltration and prevent terrestrial ecological exposure, consistent with the cap constructed for Norton Terminal.[54]

8.6.7 Contingent Action for PUD Electrical Substation

It is expected that the Snohomish PUD will eventually decommission and remove their electrical substation, which straddles the boundary between Site Units C and D near the shoreline (Figure 6-D1). At that time, the Port will prepare for Ecology review and approval a Sampling and Analysis Plan to characterize soil quality within the substation area. Based on review of data obtained during that sampling program, the Port and Ecology will determine the need for a cleanup action for that area, develop appropriate written documentation of the decision, and the Port will then implement the cleanup. For purposes of cost estimating in this FS, it is assumed that the cleanup action for this area

[53] The soil TPH cleanup levels for the Warehouse Subarea are the same irrespective of land use.
[54] Including stormwater infrastructure required to achieve drainage.

would entail capping to restrict infiltration and prevent terrestrial ecological exposure, consistent with the surrounding industrial use area (Norton Terminal).

8.6.8 Estimated Cost for Cleanup Alternative and Contingent Actions

A net present value cost (2024 dollars) was estimated for the Cleanup Alternative, including sunk costs for the completed IAs[55] plus estimated costs for remedy design/permitting, construction, and inspection/monitoring. The net present value cost applies a discount factor of 2.0 percent and represents the dollar amount that, if invested in the initial year of the remedy and disbursed as needed, would be sufficient to cover all costs associated with the cleanup action. Cost estimates for the three contingent actions were prepared. Because the two contingent actions for the Warehouse subarea may not occur and they could not occur together, each of the three contingent actions are presented individually. The FS cost estimate has an intended accuracy in the range of -30 to +50 percent.

The net present value cost for the Cleanup Alternative is estimated as $29.8 million, of which $29.1 million is sunk cost for the completed cleanup actions. Assuming redevelopment of the warehouse for commercial use, the estimated cost for contingent vapor barrier installation is $2.0 million. Assuming demolition of the warehouse, the estimated cost for contingent removal of TPH-contaminated soils and then capping the warehouse footprint is $3.2 million. The estimated cost for the assumed PUD Substation contingent action is $400,000. Appendix M provides the cost estimate detail worksheets for the Cleanup Alternative (Table L-2) and three independent contingent actions (Tables L-3, L-4, and L-5).

8.7 Analysis of the Cleanup Alternative

This section presents the analysis of the Cleanup Alternative relative to MTCA (WAC 173-340-360) criteria for selection of cleanup actions.

8.7.1 MTCA Requirements for Cleanup Actions

This section describes how the Cleanup Alternative complies with minimum requirements for cleanup actions under MTCA.

8.7.1.1 MTCA Threshold Requirements

Cleanup actions selected under MTCA must meet four “threshold” requirements identified in WAC 173-340-360(2)(a) to be accepted by Ecology. All cleanup actions must:

- Protect human health and the environment
- Comply with cleanup standards
- Comply with applicable state and federal laws
- Provide for compliance monitoring

[55] Cost information was not available for the older prior cleanup actions described in Section 3.

The following subsections evaluate the Cleanup Alternative for compliance with these threshold requirements.

8.7.1.1.1 Protection of Human Health and the Environment

The Cleanup Alternative would protect human health and the environment. The Cleanup Action, including completion of the three IAs, will be protective of the following exposure pathways:

- Human and ecological direct contact exposure to soils, subject to long-term inspection and maintenance of the environmental cap
- Worker inhalation risks to workers within the warehouse building, subject to installation of the vapor barrier
- Groundwater discharge to the East Waterway, subject to verification by long-term groundwater compliance monitoring

8.7.1.1.2 Compliance with Cleanup Standards

The Cleanup Alternative will comply with applicable MTCA cleanup standards.

The three IAs achieved compliance with industrial soil cleanup levels based on human direct contact within the 15-foot compliance depth throughout the Norton Terminal (industrial use) portion of the Upland Area. Within the Warehouse Subarea (commercial use), total cPAH (TEQ) concentrations exceeding unrestricted direct-contact soil cleanups remain in place beneath the warehouse building floor. While soils exceeding leaching-based cleanup levels will remain in place throughout the Upland Area, the Cleanup Alternative's inclusion of soil containment (capping) complies with soil cleanup standards because the cap inspection/maintenance program will ensure the cap's long-term integrity in accordance with WAC 173-340-700(4)(c), and that program will be legally enforced through institutional controls in accordance with WAC 173-340-700(4)(c).

Based on the substantial source removal and then low-permeability capping accomplished by the three IAs, and the existing groundwater quality data from shoreline monitoring wells, it is anticipated that groundwater will comply with cleanup levels based on marine protection at a shoreline CPOC described in Section 8.1.3.2. That will be verified through groundwater compliance monitoring, and contingent actions would be implemented if monitoring indicates that groundwater discharge poses a risk to the East Waterway.

8.7.1.1.3 Compliance with Applicable State and Federal Laws

The Cleanup Alternative was developed to comply with the MTCA regulation. Potentially applicable state and federal laws were identified and discussed in Section 8.2 and were considered in developing the Cleanup Alternative and its cleanup standards. The Cleanup Alternative is expected to comply with all applicable state and federal laws because the required engineering design and agency-review process would include steps to ensure compliance. The laws may affect implementation, but they do not have a significant effect on whether the cleanup action is fundamentally viable. The means of compliance would be documented in the remedial design for remaining components (warehouse chemical vapor barrier), the environmental covenant, and the various cleanup-related plans (Groundwater Compliance Monitoring Plan, Cap Inspection and Maintenance Plan, and Soil and

Groundwater Management Plan) to be prepared following finalization of the Upland Area CAP.

8.7.1.1.4 Provisions for Compliance Monitoring

The Cleanup Alternative provides for compliance monitoring. Protection monitoring would be achieved through health and safety protocols outlined in a Site-specific Health and Safety Plan for workers conducting cleanup-related work. The completed IAs involved extensive performance monitoring (sampling and analysis) to ensure compliance with the IA objectives, and construction quality control monitoring will be performed during installation of the warehouse vapor barrier. Long-term groundwater sampling and analysis and cap inspection would provide confirmation monitoring for the completed action.

8.7.1.2 Additional MTCA Requirements

In addition to meeting MTCA's threshold requirements, a selected cleanup action must meet three additional requirements defined in WAC 173-340-360(2)(b):

- Use permanent solutions to the maximum extent practicable
- Provide for a reasonable restoration time frame
- Consider public concerns

The following subsections evaluate the Cleanup Alternative relative to these additional requirements.

8.7.1.2.1 Requirement for Permanent Solutions to the Maximum Extent Practicable

As described above, the interim cleanup actions completed between 2013 and 2023 permanently removed from the Upland Area more than 56,000 tons of contaminated soil and nearly 8 million gallons of contaminated groundwater, and permanently plugged piping conduits that could have served as preferential pathways for groundwater discharge to the East Waterway. In addition, approximately 250,000 tons of CM (the source of high-pH groundwater) were also permanently removed concurrent with the second IA. The interim cleanup actions culminated with construction of a robust environmental cap across the residual widely distributed, lower-concentration contaminated soils, and the cap's effectiveness will be achieved through the environmental covenant requiring long-term inspection and maintenance.

The Port and Ecology have previously discussed and mutually agreed that the Cleanup Alternative selected, which includes the completed interim actions, would be permanent to the maximum extent practicable in accordance with WAC 173-340-360.

8.7.1.2.2 Evaluation of Reasonable Restoration Time Frame

A MTCA cleanup action is considered to have achieved restoration once cleanup standards have been met. As discussed in Section 8.1.3.2.3, WAC 173-340-360(4)(b) lists the following nine factors to be considered in determining whether a cleanup action's restoration time frame is reasonable:

i. Potential risks to human health and the environment

ii. Practicability of achieving a shorter restoration timeframe

iii. Current use of the Site, surrounding areas, and associated resources that are, or may be, affected by releases from the Site

iv. Potential future use of the Site, surrounding areas, and associated resources that are, or may be, affected by releases from the Site

v. Availability of alternate water supplies

vi. Likely effectiveness and reliability of institutional controls

vii. Ability to control and monitor migration of hazardous substances from the Site

viii. Toxicity of the hazardous substances at the Site

ix. Natural processes that reduce concentrations of hazardous substances and have been documented to occur at the Site or under similar Site conditions

Based on the analysis of those factors outlined in Table 8-5, we conclude that the restoration time frame achieved by the Cleanup Alternative with a groundwater CPOC at the shoreline would be reasonable in accordance with MTCA.

8.7.1.2.3 Consideration of Public Concerns

Consideration of public concerns is an inherent part of the MTCA cleanup process. This Draft RI/FS report will be issued for public review and comment, and Ecology will determine whether changes to the report are needed in response to public comments. In addition, prior to implementing the Cleanup Alternative, Ecology will issue a draft CAP for public comment, in accordance with WAC 173-340-360(11). Public comments will be addressed at those times but cannot be addressed in this Draft RI/FS report.

8.7.1.2.4 Indian Tribes, Vulnerable Populations and Overburdened Communities

Pursuant to the requirements of WAC 173-340-351, WAC 173-340-360, and WAC 173-340-370, remedial alternatives were evaluated for their possible effects on Indian Tribes, vulnerable populations, and overburdened communities.

8.7.1.2.4.1 IDENTIFICATION OF POTENTIALLY AFFECTED INDIAN TRIBES AND LIKELY VULNERABLE POPULATIONS AND OVERBURDENED COMMUNITIES

Indian Tribes potentially interested in, or affected by the cleanup action were initially identified based on the proximity of their reservation lands, traditional ceded lands, hunting areas, and usual and accustomed (U&A) fishing grounds and stations to the Upland Area as well as by use of the Department of Archaeology and Historic Preservation (DAHP) Map of Tribal Areas of Interest. These Indian Tribes consist of the Tulalip Tribes of Washington, Swinomish Indian Tribal Community, Suquamish Tribe, Stillaguamish Tribe of Indians, Snoqualmie Indian Tribe, Sauk-Suiattle Indian Tribe, and Muckleshoot Indian Tribe. Engagement with these Indian Tribes consistent with WAC 173-340-620 confirmed the final list of Indian Tribes considered in this Site-specific analysis, which consist of the Tulalip Tribes and Suquamish Tribe, both of which are signatories to the 1855 Treaty of Point Elliott and serve as the Tribal trustees for assessment and restoration of natural resource damages for the Port Gardner area under

the Comprehensive Environmental Response, Compensation, and Liability Act, MTCA, Chapter 90.48 RCW, the federal Clean Water Act, and the federal Oil Pollution Act of 1990. Possible impacts specific to these two Indian Tribes were evaluated primarily through review of information related to their exercise of tribal Treaty rights, reserved rights, and activities and measures identified from the Washington Department of Health (DOH) Environmental Health Disparities (EHD) Mapping Tool.[56]

Likely vulnerable populations and overburdened communities potentially affected by the Upland Area and/or cleanup action were identified using the EHD Mapping Tool and the EPA Environmental Justice Screening and Mapping Tool (EJ Screen[57]). In accordance with Ecology's Implementation Memorandum No. 25 (Ecology, 2024), a vulnerable population or overburdened community has the potential to be exposed if any one of the following three criteria is met in census tracts located at the Upland Area or along transportation routes used for the cleanup action:

- The potentially exposed population is in a census tract that ranks a 9 or 10 on the EHD Index from the EHD Map.
- The potentially exposed population is in a census tract that is at or above the 80th Washington State percentile of the Demographic Index from EJ Screen.
- The potentially exposed population is in a census tract that is at or above the 80th Washington State percentile of the Supplemental Demographic Index from EJ Screen.

Likely vulnerable populations and overburdened communities potentially affected by the cleanup action were evaluated using the EHD Index form the EHD Map, and the Demographic Index and Supplemental Demographic Index from EJScreen. An analysis of the potential impacts to potentially affected Indian Tribes and likely vulnerable populations and overburdened communities is further discussed below in Sections 8.7.1.2.4.2 and 8.7.1.2.4.3.

8.7.1.2.4.2 ANALYSIS OF POTENTIAL IMPACTS TO POTENTIALLY AFFECTED INDIAN TRIBES

The ARA provides details plan regarding cultural resources in the Upland Area vicinity (SWCA, 2013a). The completed interim actions included archaeological monitoring by qualified personnel in accordance with the Inadvertent Discovery Plan (SWCA, 2013b). The preferred cleanup alternative does not include any ground disturbing activities that would potentially uncover buried archaeological resources. However, the contingent cleanup actions may disturb subsurface soil and will be completed in accordance with an Inadvertent Discovery Plan (IDP) consistent with WAC 173-340-815.

Land use of the Upland Area will remain unchanged. As previously described, the current and future land use of the Upland Area is maritime industrial, except for potential future repurposing of the distribution warehouse for commercial use (Section 5.1.1). There are no anticipated or potential impacts to Tribes associated with implementation of the

[56] Washington Environmental Health Disparities Map - Information by Location | Washington Tracking Network (WTN)
[57] EPA Environmental Justice Screening and Mapping Tool (EJScreen) - EJScreen: Environmental Justice Screening and Mapping Tool | US EPA

preferred cleanup alternative for the Upland Area. It is anticipated that additional information regarding Tribal interests will be gathered through government-to-government consultation and public notice. The lead agency for public participation is Ecology.

8.7.1.2.4.3 ANALYSIS OF POTENTIAL IMPACTS TO LIKELY VULNERABLE POPULATIONS AND OVERBURDENED COMMUNITIES

Impacts and benefits to vulnerable populations and overburdened communities were evaluated for construction impacts, postconstruction effects, and land use impacts. The supporting figures are provided in Appendix N.

EHD Disparities Index Results

The EHD Map is divided into communities based on census tracts, which vary in size from 2,000 to 8,000 people. Communities are assigned an environmental health disparity index using a 1 to 10 ranking scale, with 1 being low risk and 10 being high risk for environmental health disparities. The Upland Area is located in census tracts 53061040100 and 53061040400 with an overall environmental health disparity of 8, which is considered high (Figure N-1). The ranking is based on environmental exposures, environmental effects, socioeconomic factors, and sensitive populations, as described below:

- Environmental exposures have a medium (7) ranking for the Upland Area, due to the proximity to ports, highways, and railyards, and the associated diesel exhaust particulate emissions.
- Environmental effects have a high (8) ranking due to lead based paint in housing and proximity to Risk Management Plan (RMP) facilities
- Socioeconomic factors were ranked medium (5) due to a high unemployment rate, unaffordable housing, a high percentage of the population living in poverty, and a high percentage of people of color (25 percent).
- Sensitive populations had a medium (5) ranking due to high percentages of low birth rate and high death rates from cardiovascular disease.

Census tract information for areas potentially affected by the Site and/or cleanup action have an EHD rank of 7 or higher and has a Washington State Demographic Index and Supplemental Demographic Index at or greater than the 80th percentile for diesel emissions from EJScreen. This census tract information indicates that potentially exposed vulnerable populations or overburdened communities are along transportation routes in accordance with Ecology Implementation Memorandum No. 25. Because County tax records indicate that parcels immediately adjacent to or overlooking the Site are industrial, this report assumes that these areas do not contain vulnerable populations and overburdened communities. As such, analysis of construction benefits and impacts was limited to transportation routes.

EJScreen Results

The EJScreen tool from EPA is divided into census block groups similar to the communities in the EHD Map. The Site is in block groups 530610401004 and

530610404003 (Figure N-2). EJScreen was used to assess socioeconomic indicators, including the Demographic Index (low income and people of color) and the Supplemental Demographic Index (low income, underemployment, lack of English proficiency, less than high school education, and low life expectancy). The Demographic Index for the Upland Area is within the 53rd percentile for the state and the 43rd percentile for the nation (Figure N-2). The Supplemental Demographic Index for the Upland Area is within the 74th percentile for the state and 63rd percentile for the nation (Figure N-2).

Overall Screening Results

Ecology considers the potentially exposed population to include a likely vulnerable population or overburdened community if: 1) the population has a ranking of 9 or 10 on the Environmental Health Disparities Index from DOH's EHD Map, or 2) the potentially exposed population is located in a census tract that is at or above the 80th Washington state percentile of the Demographic Index or Supplemental Demographic Index from EPA's EJScreen (Ecology, 2024). Based on the EHD and EJScreen data summarized above, the potentially exposed population does not include a likely vulnerable population or overburdened community.

8.8 Preferred Cleanup Alternative

Based on the analysis above, the Cleanup Alternative would comply with the MTCA threshold and additional criteria for selecting a cleanup action, and is considered permanent to maximum extent practicable, in accordance with WAC 173-340-360. As a result, the Cleanup Alternative is the preferred cleanup alternative for final cleanup for the Upland Area portion of the K-C Worldwide Site.

As detailed in Section 8.6, the preferred Cleanup Alternative includes the following components:

- The remedial actions already completed, and the 7.6 acres of cap remaining to be installed as originally described in the second amendment to the Agreed Order
- Capping of the City's Utility Property
- Long-term groundwater compliance monitoring in accordance with a Groundwater Compliance Monitoring Plan approved by Ecology
- Long-term inspection and maintenance of the Upland Area environmental cap in accordance with a Cap Inspection and Maintenance Plan approved by Ecology
- Institutional controls to be articulated in an environmental covenant filed with Snohomish County, which includes preparation of a Soil and Groundwater Management Plan approved by Ecology
- Financial assurances

Depending on the Port's future use of the warehouse, the preferred Cleanup Alternative also includes two contingent cleanup actions:

- If the warehouse is converted to commercial use, construction of a passive vapor barrier across the building's entire first floor; or
- If the warehouse is demolished, excavation and landfilling of TPH-contaminated soils and then capping of the building's footprint.

In addition, the preferred Cleanup Alternative includes a contingent cleanup action for the Snohomish PUD Substation area to be implemented at the time the PUD decommissions the facility.

8 References

AECOM, 2011, Phase I Environmental Site Assessment, Everett Pulp and Paper Mill, Everett Washington, April 2011.

AMEC, 2010, Focused Feasibility Study Work Plan, ExxonMobil/ADC Property, Ecology Site ID 2728, 2717/2731 Federal Avenue, Everett, Washington, February 26, 2010.

AMEC, 2012, Excavation Report, ExxonMobil/ADC Property, Ecology Side ID 2728, Everett, Washington, June 29, 2012.

AMEC, 2013, Draft Data Investigation Work Plan, ExxonMobil/ADC Property, Ecology Site ID 2728, 2717/2731 Federal Avenue, Everett, Washington, March 13, 2013.

AMEC, 2015, Draft Site Characterization/Focused Feasibility Study, ExxonMobil/ADC Property, Ecology Site ID 2728, Everett, Washington, April 15, 2015.

American Petroleum Institute (API), 2002, Non-Aqueous Phase Liquid (NAPL) Mobility Limits in Soil, Soil and Groundwater Research Bulleting No. 9, June 2000.

Anchor Environmental, 2008, Review of Scientific Literature and Recommended Surface Water Screening Level for Formaldehyde – GP Mill Site RI/FS, December 10, 2008.

Anchor QEA, 2012, Habitat Assessment, Kimberly-Clark Everett Mill Site Demolition Project, February 2012.

Anchor QEA, 2015, Supplemental Porewater Sulfide Sampling and Analysis, K-C Worldwide Upland Area in Everett, Washington, April 1, 2015.

Anchor QEA, 2017a, Laboratory Verification of Diffusive Gradient in Thin Film (DGT) Passive Sampling, February 8, 2017.

Anchor QEA, 2017b, Method Development and Verification Study for Sulfide Measurements in Porewater Using Diffusive-Gradient-in-Thin-Films (DGT), November 10, 2017. Included as Attachment A to Aspect and Anchor QEA (2018).

Aspect Consulting, LLC (Aspect), 2009, Latex Spill Investigation, October 28, 2009.

Aspect Consulting, LLC (Aspect), 2012a, Work Plan for Independent Phase 2 Environmental Assessment, Kimberly-Clark Mill Uplands, Everett, Washington, May 21, 2012

Aspect Consulting, LLC (Aspect), 2012b, Addendum to Work Plan for Independent Phase 2 Environmental Site Assessment, Kimberly-Clark Worldwide Site Upland Area, Everett, Washington, September 7, 2012.

Aspect Consulting, LLC (Aspect), 2012c, Interim Action Plan, Kimberly-Clark Worldwide Site Upland Area, Everett, Washington, September 20, 2012, Exhibit C to Agreed Order No. DE 9476.

Aspect Consulting, LLC (Aspect), 2013a, Data Report for Phase 2 Environmental Site Assessment, Kimberly-Clark Worldwide Site Upland Area, Everett, Washington, March 15, 2013.

Aspect Consulting, LLC (Aspect), 2013b, RCRA Closure Report for Kimberly-Clark Mill, Everett, Washington, November 12, 2013.

Aspect Consulting, LLC (Aspect), 2013c, Work Plan for Remedial Investigation/Feasibility Study, Kimberly-Clark Worldwide Site Upland Area, Everett, Washington, November 22, 2013.

Aspect Consulting, LLC (Aspect), 2014a, Design Information for Subsurface Barrier Wall Adjacent to Warehouse, K-C Worldwide Site Upland Area Interim Action, Everett Washington, January 23, 2014.

Aspect Consulting, LLC (Aspect), 2014b, RI/FS Work Plan Addendum for Warehouse Vapor Intrusion Assessment, K-C Worldwide Site Upland Area RI/FS, February 18, 2014.

Aspect Consulting, LLC (Aspect), 2014c, RI/FS Work Plan Addendum for Sediment Porewater Sampling and Analysis, K-C Worldwide Site Upland Area RI/FS, February 25, 2014.

Aspect Consulting, LLC (Aspect), 2014d, Interim Action Confirmational Groundwater Monitoring Work Plan, Kimberly-Clark Worldwide Site Upland Area, Everett, Washington, Final, June 12, 2013.

Aspect Consulting, LLC (Aspect), 2014e, Comparison of Total and Dissolved Metals Data for Groundwater Site Upland Area, Everett, Washington, July 8, 2014.

Aspect Consulting, LLC (Aspect), 2014f, Remedial Investigation Data Report, Kimberly-Clark Worldwide Site Upland Area, Everett, Washington, September 29, 2014.

Aspect Consulting, LLC (Aspect), 2015a, Interim Action Report, Kimberly-Clark Worldwide Site Upland Area, Everett, Washington, April 8, 2015.

Aspect Consulting, LLC (Aspect), 2015b, RI/FS Work Plan Addendum for Additional Focused Data Collection, Kimberly-Clark Worldwide Site Upland Area RI/FS, September 18, 2015.

Aspect Consulting, LLC (Aspect), 2015c, Delineation of Petroleum Contamination Along South End of Site, K-C Worldwide Site Upland Area, Everett, Washington, September 18, 2015.

Aspect Consulting, LLC (Aspect), 2015d, Interim Action Confirmational Groundwater Monitoring Report, Kimberly-Clark Worldwide Site Upland Area, Everett, Washington, November 11, 2015.

Aspect Consulting, LLC (Aspect), 2016a, RI/FS Work Plan Addendum: Additional Evaluation of Quality of Seep Water Discharging Along Shoreline, K-C Worldwide Site Upland Area RI/FS, October 14, 2016.

Aspect Consulting, LLC (Aspect), 2017a, RI/FS Work Plan Addendum: Wet Season 2017 Groundwater Monitoring, K-C Worldwide Site Upland Area RI/FS, March 6, 2017.

Aspect Consulting, LLC (Aspect), 2017b, Response to Water Quality Notice of Violation Docket No. 14073, Former Kimberly-Clark Pulp and Paper Mill, Everett, Washington, April 25, 2017.

Aspect Consulting, LLC (Aspect), 2017c, RI/FS Work Plan Addendum: Log Pond Area Additional Investigation, K-C Worldwide Site Upland Area RI/FS, May 12, 2017.

Aspect Consulting, LLC (Aspect), 2017d, Summary of Soil Exploration Data and Proposed Monitoring Wells, Log Pond Area Additional Investigation, K-C Worldwide Site Upland Area RI/FS, July 6, 2017.

Aspect Consulting, LLC (Aspect), 2017e, Data from March 2017 Wet Season Groundwater Monitoring, and July and September 2017 Groundwater pH Monitoring, K-C Upland Area, Everett, Washington, October 6, 2017.

Aspect Consulting, LLC (Aspect), 2019a, Analytical Data for Parcel O Dredge Sand as Backfill for Interim Action, Letter from Steve Germiat to Any Kallus, Ecology, January 15, 2019.

Aspect Consulting, LLC (Aspect), 2019b, Work Plan for Second Interim Action, Kimberly-Clark Worldwide Site Upland Area, Everett, Washington, December 13, 2019.

Aspect Consulting, LLC (Aspect), 2021, Report for Second Interim Action, Kimberly-Clark Worldwide Site Upland Area, Everett, Washington, March 3, 2021.

Aspect Consulting, LLC (Aspect) and Anchor QEA, 2015a, Plan for Supplemental Sampling and Analysis of Sulfide in Intertidal Porewater, Kimberly-Clark Worldwide Site, Everett, Washington, February 13, 2015.

Aspect Consulting, LLC (Aspect) and Anchor QEA, 2015b, Approach for Assessing the Groundwater to Surface Water/Sediment Transport Pathway, K-C Worldwide Site Upland Area RI/FS, August 14, 2015.

Aspect Consulting, LLC (Aspect) and Anchor QEA, 2018, Shoreline Un-ionized Ammonia and Hydrogen Sulfide Cleanup Approach: K-C Worldwide Site. Everett, Washington, January 2018.

BEK McDonnell Engineering, 1999, Report – Underground Storage Tank Removal Site Check/Site Assessment, Kimberly Clark Corporation Mill Site, UST ID #5351, November 23, 1999.

Carmalin, S. A. and K. Swaminathan, 2005, Leaching of Metals on Stabilization of Metals Sludge Using Cement Based Materials, Journal of Environmental Sciences, v. 17, no. 1, pp. 115-118.

Clancy, T.M., K.V. Snyder, R. Reddy, A. Lanzirotti, L. Raskin, and K.F. Hayes, 2015, Evaluating the Cement Stabilization of Arsenic-Bearing Iron Wastes from Drinking Water Treatment, Journal of Hazardous Materials, in press.

CRETE Consulting, 2011, Soil Characterization – Sand Filter 1 Foundation Excavation, January 14, 2011.

Cultural Resource Consultants, 2022, Archaeological Monitoring Report for the Norton Terminal Development & MTCA 3rd Interim Action, Everett, Snohomish County, Washington, Technical Memo 2110B-1, November 18, 2022.

David Evans and Associates, 2012, Storm Water Pollution Prevention Plan for Kimberly Clark Everett Pulp and Paper Mill Demolition and Remediation, Modification #1, September 14, 2012.

David Evans and Associates Inc., 2020, Letter regarding Certification of Completion: Crushed Material Removal Project – former Mill Site, from John N. Smith, PE, Vice President, to Bryan Lust, Kimberly-Clark Everett Infrastructure/Site Manager, December 22, 2020.

Dilgard and Riddle, 1973, Shoreline Historical Survey Report, Shoreline Master Plan Committee for City of Everett. 1973.

EcoChem, 1991, Memorandum describing soil removal.

Fehling, K.A., T.L. Copeland, J.M. Otani, and B.D. Kerger, 2011, Identification of Surrogate Reference Chemicals for Volatile Organic Compounds Commonly Encountered at Hazardous Waste Sites, http://ndep.nv.gov/bmi/docs/fehling_sot_2011-final.pdf.

Ferris, J.G., 1963, Cyclical Water-Level Fluctuations as a Basis for Determining Aquifer Transmissibility, in Methods for Determining Permeability, Transmissibility, and Drawdown, USGS Water Supply Paper 1536-I, pp. 305-318.

Floyd|Snider, 2020, Utility Property Swale Test Pit Sampling Results Memorandum, March 11, 2020.

Floyd|Snider, 2021, Utility Property Cleanup Action Plan Memorandum, February 5, 2021.

Foster Wheeler, 1998, Independent Remedial Action Closure Report, Old Naval Reserve Center, Everett, Washington, December 16, 1998.

Kavanaugh, R., S. A. Al-Abed, J. Purandare, and D. Allen, 2004, Influence of pH and Redox Conditions on Copper Leaching, Proceedings of Environmental and Waste Management: Advancements through the Environmental Management Science

Program, American Chemical Society, Anaheim, California, March 28-April 1, 2004.

Kimberly-Clark Worldwide, Inc. (K-C), 1997a, Letter from Richard Abrams to Norm Peck (Ecology) regarding soil sampling in Bunker C fuel oil AST area, June 2, 1997.

Kimberly-Clark Worldwide, Inc. (K-C), 1997b, Internal Memorandum from Dick Abrams to Cindy Jernigan (K-C) regarding Naval Reserve Site Remediation, October 29, 1997.

Kimberly-Clark Worldwide, Inc. (K-C), 1999, Letter, To Mark Dirkx, Department of Ecology, From Dick Abrams, K-C, regarding removal of Bunker C fuel oil-contaminated soil at northeast corner of new bleach building, December 13, 1999.

Kimberly-Clark Worldwide, Inc. (K-C), 2018a, Crushed Material at K-C Everett Mill Site, Letter from Lisa Morden to Andy Kallus, Ecology, February 12, 2018.

Kimberly-Clark Worldwide, Inc. (K-C), 2018b, Crushed Material at the Former Kimberly-Clark Everett Mill Site, Letter from Lisa Morden to Andy Kallus, Ecology, February 28, 2018.

Kimberly-Clark Worldwide, Inc. (K-C), 2018c, Plan of Operations, Crushed Material Removal Kimberly-Clark Former Mill Property, Everett, Washington, July 10, 2018.

Kendall, D. and J. Barton, DMMP Clarification Paper, Ammonia and Sulfide Guidance Relative to Neanthes Growth Bioassay, Final, June 15, 2004.

Kjoller, C., 2001, Nickel Mobilization in Response to Groundwater Acidification, Ph.D. Thesis, Environment and Resources DTU, Technical University of Denmark, 2001.

Landau Associates, 1989, Report of Xylene Release, Scott Paper Company, Everett, Washington, December 6, 1989.

Landau Associates, 1991, Soil and Groundwater Investigation, Former Underground Petroleum Storage Tanks, Everett Pulp and Paper Mill, Everett, Washington, April 18, 1991.

Landau Associates, 1992, Results of 8-Hour Startup Test and First Month of Operation, Xylene Vapor Extraction System, Scott Paper Company, Everett, Washington, April 1, 1992.

Landau Associates, 1994a, Former Tank No. 29 Compliance Monitoring Investigation, Scott Paper Company, Everett, Washington, August 16, 1994.

Landau Associates, 1994b, Groundwater and Soil Environmental Investigation, Vicinity of Former Paint Shop Scott Paper Company, Everett, Washington, September 20, 1994.

Landau Associates, 2021a, Technical Memorandum regarding Maritime Industrial Expansion Project Geotechnical Borings, Kimberly-Clark Worldwide Site, July 15, 2021.

Landau Associates, 2021b, Final Interim Action Work Plan, Kimberly-Clark Worldwide Site Upland, 3rd Interim Action, Port of Everett, Everett, Washington, August 5.

Landau. 2021c. Memorandum: Soil and Groundwater Management Plan—Norton Terminal MIE, ExxonMobil/ADC Site, Everett, Washington, June 15, 2021.

Landau. 2021d. Final Soil and Groundwater Management Plan, Maritime Industrial Expansion at Norton Terminal, Port of Everett, Everett, Washington, June 22, 2021.

Landau Associates, 2022a, Technical Memorandum: Interim Action Work Plan Addendum No. 1, Construction Phase 2 – Low-Permeability Cap Expansion, Kimberly-Clark Worldwide Site Upland Area, Everett, Washington, July 20, 2022.

Landau Associates, 2022b, CSI Combined Sewer Main Improvements Construction Report, City of Everett, Port of Everett-Kimberly-Clark and ExxonMobil/ADC Sites, December 30, 2022.

Landau Associates, 2023, Technical Memorandum regarding K-C Warehouse Seismic Assessment, Kimberly-Clark Worldwide Site, Everett, Washington, January 3, 2023.

Landau Associates, 2024, Final Construction Report, Kimberly-Clark Worldwide Site Upland Area, 3rd Interim Action, Port of Everett, Everett, Washington, July 30, 2024.

Larsen, F., and D. Postma, 1997, Nickel Mobilization in a Groundwater Well Field: Release by Pyrite Oxidation and Desorption from Manganese Oxides, Environmental Science and Technology, Vol. 31, No. 9.

Millham, N.P. and B. L. Howes, 1995, A Comparison of Method to Determine K in a Shallow Coastal Aquifer, Ground Water, v. 33, no. 1, January-February 1995.

Pacific Environmental Group, Inc. (PEG),1998, Environmental Investigation Report, Former Bulk Fuel Facilities, 2600 Federal Avenue, Everett, Washington, April 14, 1998.

PSM International Inc., 1988, Environmental Audit Report on Centrecon Inc. Manufacturing Plants for Pole Products Division, Ameron Corporation, October 24, 1988.

Quina, J. Q., J. Boradado, and R. Qunita-Ferreira, 2009, The Influence of pH on the Leaching Behaviors of Inorganic Components from Municipal Solid Waste APC Residues, Waste Management, v. 29, pp. 2483-2493.

Safety-Kleen, 1998, Kimberly Clark, Everett Mill PCB Decontamination Project: Substation 3 & 4 and 5 & 6 Supplemental Sampling Results, October 24, 1998.

SAIC, 2009, Sediment Characterization Study in Port Gardner and Lower Snohomish Estuary, Port Gardner, WA, Final Data Report, Ecology Publication No. 09-09-227 (retroactively assigned), July 10, 2009.

Scott Paper Company, 1989, Internal Memorandum regarding Removal of UST No. 69, December 6, 1989.

Scott Paper Company, 1990, Letter from Ann Bailey to Don Nelson (Ecology) summarizing the treatment of xylene-contaminated wastewater from UST 29, January 31, 1990.

Scott Paper Company, 1991, Letter from Richard Abrams to Don Nelson (Ecology) describing remediation approach for UST 29, June 25, 2991.

Scott Paper Company, 1994, Letter from Dick Abrams to Mark Dirkxx, Ecology, notifying of intent to discontinue operation of SVE system for xylene release, August 19, 1994.

Scott Paper Company, 1995a, Letter from Dick Abrams to Mark Dirkx (Ecology) regarding notification of planned voluntary cleanup of contaminated soil in Bunker C fuel oil tank farm, October 11, 1995.

Scott Paper Company, 1995b, Letter from Dick Abrams to Mark Dirkx (Ecology) regarding status of voluntary cleanup of contaminated soil in Bunker C fuel oil tank farm, November 10, 1995.

Serfes, M.E., 1991, Determining the Mean Hydraulic Gradient of Ground Water Affected by Tidal Fluctuations, Ground Water, vol. 29 no. 4, pp. 549-555.

Shannon and Wilson, 2014, Geotechnical Evaluation of Kimberly-Clark Site, Integrated Planning Grant Support Services, Everett, Washington, March 3, 2014.

Singh, T.S. and K.K. Pant, 2006, Solidification/Stabilization of Arsenic Containing Solid Wastes Using Portland Cement, Fly Ash, and Polymeric Materials, Journal of Hazardous Materials, v. 131, no. 1-3, pp. 29-36, April 2006.

Snohomish County, Washington (Snohomish County), 2012, Assessor's Office, Property Info, eRealProperty System Parcel Search, Accessed March 13, 2012,

Snohomish Health District (SHD), 2021, Email from Aran Enger, SHD, to Bryan Lust, K-C, regarding Completion of the K-C CM Removal Project per the Plan of Operations, January 12, 2021.

S.S. Papadopoulos and Associates, 2006, Evaluation of Tidal Mixing and Dispersion, Appendix H to Supplemental Data Report, Revision 1, Terminal 30, prepared by The RETEC Group, January 30, 2006.

SWCA/Northwest Archaeological Associates, 2013a, Archaeological Resources Assessment for the Kimberly-Clark Worldwide Site Upland Area, Everett, Snohomish County, Washington, Redacted for General Distribution, March 25, 2013.

SWCA/Northwest Archaeological Associates, 2013b, Cultural Resources Monitoring and Discovery Plan for the Kimberly-Clark Worldwide Site Upland Area, Everett, Snohomish County, Washington, August 16, 2013.

Texaco, 1998, Letter from Tony Palagyi (with Richard Abrams of K-C, Ann Marie Johnson of Chevron, and Bruce Sheppard of BNSF) to Norm Peck (Ecology) transmitting PEG's Environmental Investigation Report, April 20, 1998.

United States Environmental Protection Agency (EPA), 1995, Groundwater Issue: Light Nonaqueous Phase Liquids, EPA Publication No. EPA/540/S-95/500.

United States Geological Survey (USGS), 1966, Compilation of Specific Yield for Various Materials, USGS Open-File Report 63-59.

United States Geological Survey (USGS), 2003, Determination of Specific Yield and Water-Table Changes Using Temporal Microgravity Surveys Collected During the Second Injection, Storage, and Recovery Test at Lancaster, Antelope Valley, California, November 1996 through April 1997, USGS Water-Resources Investigation Report 03-4019.

United States Geological Survey (USGS), 2010, Sediment Toxicity Test Results for the Puget Sound Assessment and Monitoring Program (PSAMP) and the Urban Waters Study 2009, submitted to the Washington State Department of Ecology, March 12, 2010.

Washington State Department of Conservation and Development, 1942, Report of Investigations No. 6: Inventory of Mineral Properties in Snohomish County, Washington.

Washington State Department of Ecology (Ecology), 1992, Statistical Guidance for Ecology Site Managers, August 1992.

Washington State Department of Ecology (Ecology), 1994a, Letter from Mark Dirkx to Dick Abrams, Scott Paper, regarding Independent Clean-up, August 24, 1994.

Washington State Department of Ecology (Ecology), 1994b, Natural Background Soil Metals Concentrations in Washington State, Ecology publication number 94-155, October 1994.

Washington State Department of Ecology (Ecology), 2004, Determining Compliance with Method A Cleanup Levels for Diesel and Have Oil, Ecology Implementation Memorandum No. 4, June 17, 2004.

Washington State Department of Ecology (Ecology), 2005, Guidance for Clean Closure of Dangerous Waste Facilities, Ecology Publication No. 94-111, Revised May 2005.

Washington State Department of Ecology (Ecology), 2006, A Survey of Zinc Concentrations in Industrial Stormwater Runoff, Ecology Publication No. 06-03-009, January 2006.

Washington State Department of Ecology (Ecology), 2011a, Urban Seattle Area Soil Dioxin and PAH Concentrations, Initial Summary Report. Prepared for Ecology by Hart Crowser Inc., Ecology Publication No. 11-09-049. September 2011.

Washington State Department of Ecology (Ecology), 2011b, Copper and Zinc Loading Associated with Automotive Brake-Pad and Tire Wear, Ecology Publication No. 11-10-087.

Washington State Department of Ecology (Ecology), 2012a, Kimberly-Clark Pulp and Paper Mill – Draft Work Plan for Environmental Assessment. Letter to Steve Germiat, Aspect, from Andy Kallus, Ecology, April 27, 2012.

Washington State Department of Ecology (Ecology), 2012b, Trichloroethylene Toxicity Information and MTCA Cleanup Levels (TCE), CAS #79-01-6, CLARC Guidance September 2012.

Washington State Department of Ecology (Ecology), 2012c, Tetrachloroethylene Toxicity Information and MTCA Cleanup Levels (Perc, PCE, Perchloroethylene), CAS #127-18-4, CLARC Guidance September 2012.

Washington State Department of Ecology (Ecology), 2012d, Dangerous Waste Inspection Report, Letter from Robert Carruthers, Ecology, to Bryan Lust, K-C, November 13, 2012.

Washington State Department of Ecology (Ecology), 2013, Port Gardner East Waterway Sediment Monitoring, 2012, Ecology Publication No. 13-03-023, May 2013.

Washington State Department of Ecology (Ecology), 2015a, Western Washington NPDES Phase 1 Stormwater Permit, Final S8.D Data Characterization, 2009–2013, Ecology Publication No. 15-03-001, February 2015.

Washington State Department of Ecology (Ecology), 2015b, The State Solid and Hazardous Waste Plan, Moving Washington Beyond Waste and Toxics, Ecology Publication No. 15-04-019, June 2015.

Washington State Department of Ecology (Ecology), 2016, Guidance for Remediation of Petroleum Contaminated Sites, Ecology Publication No. 10-09-057, Revised June 2016.

Washington State Department of Ecology (Ecology), 2021, Concentrations of Gasoline and Diesel Range Organics Predicted to be Protective of Aquatic Receptors in Surface Waters, Ecology Publication No. 19-09-043, August 25, 2021.

Washington State Department of Ecology (Ecology), 2018, Applicable State and Federal Laws for Demolition Waste at the K-C Worldwide Site, letter to Lisa Morden of K-C, January 24, 2018.

Washington State Department of Ecology (Ecology), 2022, Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action, Ecology Publication No. 09-09-047, Final March 2022.

Western Regional Climate Center, 2012, Seattle University of Washington (457478), Period of Record Monthly Climate Summary, 1971 to 2000 Monthly Climate Summary, Accessed March 19, 2012. <http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?waever>.

Yoon, I.H., D.H. Moon, K.Y. Lee, and M.G. Kim, 2010, Mechanism for Stabilization/Solidification of Arsenic-Contaminated Soils with Portland Cement and Cement Kiln Dust, Journal of Environmental Management, v. 91, no. 11, pp. 2322-2328, November 2010.

9 Limitations

Work for this project was performed for the Port of Everett (Client), and this report was prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. This report does not represent a legal opinion. No other warranty, expressed or implied, is made.

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