REMEDIAL INVESTIGATION REPORT
South Park Marina Site

Prepared for:

City of Seattle, Seattle City Light,
The Port of Seattle, and
South Park Marina Limited Partnership

Project No. AS190293A • February 4, 2026 • Public Review Draft

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For Submittal to:

Washington State Department of Ecology

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Acronyms and Abbreviations

AO	Agreed Order
AECOM	AECOM Environment
Aspect	Aspect Consulting
BEHP	bis(2-ethylhexyl)phthalate
bgs	below ground surface
BYGP	Boatyard General Permit
CB	catch basin
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
City	City of Seattle
CLARC	Cleanup Levels and Risk Calculation
cm	centimeters
COC	contaminants of concern
COPC	contaminants of potential concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CSL/2LAET	cleanup screening level/second lowest apparent effects threshold
CSM	Conceptual Site Model
CUL	cleanup level
CWD	Commercial Waterway District #1 of King County
cy	cubic yards
DIY	do-it-yourself
DMMP	Dredged Material Management Program
DOH	Washington State Department of Health
DOT	United States Department of Transportation
EAA	early action area
Eco-SSL	Ecological Soil Screening Levels (EPA)
Ecology	Washington State Department of Ecology
EF	exceedance factor
EHD	Environmental Health Disparities Index
EIM	Environmental Information Management
EPA	U.S. Environmental Protection Agency

FS	Feasibility Study
GAC	granular activated carbon
HA	hand auger
HCID	hydrocarbon identification
Holt	Holt Services Inc.
HPAH	high molecular-weight polycyclic aromatic hydrocarbon
IDW	investigation-derived waste
Integral	Integral Consulting
LAET	lowest apparent effects threshold
LANL	Los Alamos National Laboratory
LDW	Lower Duwamish Waterway
LDWG	Lower Duwamish Waterway Group
LNAPL	light nonaqueous-phase liquid
LPAH	low molecular-weight polycyclic aromatic hydrocarbon
MHHW	mean higher-high water
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
ug/m^3	micrograms per cubic meter
ug/L	micrograms per liter
uS/cm	microsiemens per centimeter
MTCA	Model Toxics Control Act
MW	monitoring well
NAVD88	North American Vertical Datum of 1988
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
NTCRA	non-time-critical removal action
NTU	nephelometric turbidity units
OC	organic carbon
ORNL	Oak Ridge National Laboratory
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyls

PCE	tetrachloroethene
PCUL	preliminary cleanup level
PCUL Workbook	Lower Duwamish Waterway Preliminary Cleanup Level Workbook
PFAS	per- and polyfluoroalkyl substances
PID	photoionization detector
PLP	Potentially Liable Party
Port	Port of Seattle
ppb	parts per billion
ppm	parts per million
PQL	practical quantitation limit
QAPP	Quality Assurance Project Plan
RAIS	Risk Assessment Information System
RAL	remedial action level
RBTC	Risk-Based Threshold Concentration
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
RI	Remedial Investigation
RIWP	Remedial Investigation Work Plan
ROD	Record of Decision
ROW	right-of-way
RvALs	removal action levels
SAIC	Science Applications International Corporation
SAP	Sampling Analysis Plan
SB	soil boring
SCO	sediment cleanup objectives
SCUM	Sediment Cleanup User’s Manual
SL	screening level
SMS	Sediment Management Standards
SPM	South Park Marina
SPU	Seattle Public Utilities
SVOC	semivolatile organic compounds

SWAP	Source Water Assessment Program
SWPPP	Stormwater Pollution Prevention Plan
T-117	Terminal 117
TBT	tributyl tin
TCE	trichloroethene
TEE	terrestrial ecological evaluation
TEQ	toxic equivalency
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TPH-D	diesel-range total petroleum hydrocarbons
TPH-D+O	diesel- and oil-range total petroleum hydrocarbons
TPH-G	gasoline-range total petroleum hydrocarbons
TSCA	Toxic Substances Control Act
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
UST	underground storage tank
VI	vapor intrusion
VOC	volatile organic compound
WAC	Washington Administrative Code
Windward	Windward Environmental, LLC
WSPCC	Washington State Pollution Control Commission

Executive Summary

In compliance with Agreed Order No. DE 16185 (AO), a remedial investigation (RI) was conducted for the 3.7-acre South Park Marina Site (SPM; Site) located at 8604 Dallas Avenue South, in the South Park neighborhood of Seattle, Washington (Figure 1.1). The AO was executed on April 3, 2019, between the Washington State Department of Ecology (Ecology) and the Potentially Liable Parties (PLP) Group, which consists of South Park Marina Limited Partnership, the Port of Seattle, and the City of Seattle.

The Site is located on the west[1] bank of the Lower Duwamish Waterway (LDW) Superfund Site between River Miles 3.3 and 3.5, to the south of the South Park Bridge, to the east of Dallas Avenue South, and to the north of Duwamish River People's Park, formerly Terminal 117 (T-117), as shown on Figure 1.1. The Site includes three King County tax parcels that are collectively referred to in this RI Report as the SPM Property (Figure 2.1). As established in the AO, the Site is "defined by where a hazardous substance, other than a consumer product in consumer use, has been deposited, stored, disposed of, or placed, or otherwise come to be located" from historical and current operations located on the SPM Property and is not limited by property boundaries.

As established in the AO, the purpose of the RI is to determine the origin, nature, distribution/fate and transport, and extent of contamination exceeding preliminary Model Toxics Control Act (MTCA) cleanup levels, and other regulatory requirements. As described under MTCA, an RI "is conducted at a site to identify the sources of contamination; to characterize the nature, extent, and magnitude of contamination; and to assess the threats posed by the contamination to human health and the environment" (Washington Administrative Code [WAC] 173-340-350).

RI data collection was conducted in three phases between 2021 and 2023, each in accordance with the RI Work Plan, RI Work Plan Addendum, and additional memoranda approved by Ecology. The RI data collection included sampling of soil, groundwater, soil gas, indoor air, stormwater, and catch basin solids. Historical and current operations at the Site were used to inform sample analyses. Historical data collected by others, prior to the AO, were also included in the RI. This RI Report also includes an evaluation of existing LDW sediment data collected adjacent to the SPM Property to evaluate the relationship between the Site and the LDW Superfund Site. The information in this RI defines the nature and extents of contamination and provides sufficient information to develop and evaluate cleanup alternatives and select a cleanup action, in accordance with the AO and MTCA.

Following submittal of the draft of this RI Report to Ecology, Ecology identified characterization of per- and polyfluoroalkyl substances (PFAS) as a data gap requiring additional investigation. To address that data gap, Aspect prepared the PFAS Groundwater Sampling Plan Memorandum (Aspect, 2025a), and groundwater sampling

[1] For this RI Report, a project-specific directional reference is established in which Project North is aligned downriver within the LDW.

for PFAS was conducted in April 2025. PFAS sampling results were reviewed and approved by Ecology and are documented in the RI Report Addendum for PFAS in Groundwater Memorandum (Aspect, 2025b). Based on the results and subsequent data evaluation, PFAS compounds were not identified as contaminants of potential concern (COPCs) for the Site.

As required by the AO, the data collected as part of the RI were also used to complete a source control review for the Site—evaluating whether contaminants at the Site pose a near-term risk of recontaminating LDW sediments—as a component of Ecology's Source Control Strategy for the LDW Superfund Site. These findings were documented and approved by Ecology in the Source Control Review Memorandum and the associated Addendum (Task 2a of the AO). Based on the conclusions of the source control review and the draft RI reviewed by Ecology, no interim action (Task 3 of the AO) is proposed ahead of developing and evaluating cleanup alternatives and selecting a final cleanup action.

Historical and Current Uses of SPM Property

Figure 2.2 shows the Historical Site features. The earliest identified use of the SPM Property included a gasoline service station and automobile repair shop constructed in 1918 in the northwest corner of the Site. The gasoline service station and automobile repair shop were replaced in 1974 by the current structure which has operated as a tire store that also provides automobile repair services. Residential buildings were located in the northeast corner by the mid-1930s and were replaced in the late 1980s by a boat/marine supply retailer and boat repair facility that has operated continuously since 1990.

In addition to the residential structures in the northeast corner, a mobile home park existed within the northern half of the SPM Property as early as 1946. For an unknown duration in the early 1950s, a boat manufacturing facility operated in the south-central portion of the property, adjacent to the LDW shoreline.

In the southernmost portion of the SPM Property, the A&B Barrel Co. operated a drum reconditioning facility from 1946 to 1960, which included an unlined pond used for liquid waste disposal. The facility was destroyed by a fire in 1960, after which the waste disposal pond was filled and the area was regraded with a combination of soil and debris.

The predominant use of the SPM Property has been and remains marina operations, which have occurred continuously since 1961. These include boat repair, maintenance, and washing; upland boat storage; boat haul-out services; a boat-launch ramp; and moorage slips in the LDW. The area of marina-related operations has gradually expanded over time, replacing the mobile home park between the 1980s and 2010.

Between 1969 and 1985, three structures were constructed along the southern SPM Property boundary, which were used for various marine and storage activities including wood working, boat painting, and boat exterior refurbishing. On September 2, 2021, a fire destroyed these three structures along with several vessels.

The current marina facilities include secured docks, parking, dry boat storage, a boat ramp, maintenance buildings, an office, restrooms and laundry facilities, and a designated boat wash area (Figure 2.1). Current uses of the SPM Property include boat storage (80-100 boat capacity), bottom cleaning of boats, and do-it-yourself boatyard maintenance activities, as well as an automotive repair shop (the Tire Factory) and marine motor service shop/specialty boat manufacturing business (Legacy Master Marine).

Environmental Setting

The 3.7-acre SPM Property is relatively flat, sloping from Dallas Avenue South on the west to the shoreline on the east. Approximately 2.6 acres of the property is covered by pavement or buildings, with the remainder covered by a combination of soil, gravel, or grass (Figure 2.1). The property's LDW shoreline is armored with an ecology block retaining wall and riprap along its base. The top of the block wall is above the ground surface inland of it and currently prevents direct overland flow of stormwater into the LDW. Stormwater at the SPM Property infiltrates or is collected and discharged to the LDW through several outfalls. Stormwater is managed under South Park Marina's National Point Discharge Elimination System (NPDES) Boatyard General Permit, which requires pre-treatment and monthly monitoring.

Beneath most of the SPM Property, a pair of groundwater-bearing zones (shallow and deeper) are present, vertically separated by a native silt unit (termed the Tidal Flat Unit) that restricts but does not prevent vertical flow of groundwater. The shallow water-bearing zone, termed the Fill Unit, is comprised of man-made fill materials (sand, silt, and debris) with an average thickness of approximately 10 feet. The deeper water-bearing zone, termed the Alluvial Unit, is comprised primarily of sand with thickness ranging between 5 and 17 feet in borings where the entire thickness was observed.

Where saturated, the Fill Unit occurs under unconfined (water-table) conditions with a water table depth ranging from approximately 6 to 14 feet below ground surface. Where the Tidal Flat Unit is present, the underlying Alluvial Unit occurs under confined conditions. Along the westernmost portion of the Site and in a limited area along the south-central shoreline with the LDW (Figure 3.2), the Tidal Flat Unit is absent, and a single water-bearing zone occurs under water table conditions.

The Fill Unit and Alluvial Unit are both in hydraulic connection with LDW surface water, and groundwater levels in both units fluctuate in response to changes in LDW tidal stage. The tidal fluctuations create temporary variations in the groundwater flow direction within both units near the LDW shoreline, but all groundwater in both units discharges to the LDW, which can be observed as seeps on the shoreline during lower-low tidal stages. Based on the characteristics of the two water-bearing units, a greater quantity of groundwater discharges to the LDW from the Alluvial Unit than from the Fill Unit.

Nature and Extent of Contamination

Numerical Screening Levels and Proposed RI Cleanup Levels

To assess the types and distribution of contamination in Site environmental media, the chemical concentrations measured in samples of environmental media were compared against numerical screening levels. The screening levels represent concentrations that Ecology has determined do not pose a threat to humans or ecological species, collectively termed "receptors."

The RI initially applied Ecology's most stringent numerical screening levels for upland soil, groundwater, and indoor air, and for LDW sediment adjacent to the Site. The screening levels address potential pathways (e.g., direct contact, ingestion, inhalation) for human and ecological exposure to contaminants in upland soil, groundwater, and indoor air, and in the adjacent LDW sediment and surface water. The screening levels also assume that upland contaminants migrate between environmental media (e.g., leaching from soil to groundwater), and from the upland to the LDW sediment (via soil erosion) and surface water (via groundwater discharge). The screening levels developed in this RI include specific transport and exposure assumptions. These pathways and receptors for contaminant transport and exposure are hypothetical, and not all of them may be complete or of concern at the Site.

In accordance with Ecology's MTCA, the RI refined the initial screening levels for selected contaminants in upland soil and/or groundwater based on data collected that demonstrate that the contaminant was not migrating from one environmental media to another (e.g., contaminants in soil not leaching into groundwater). The refined screening levels were termed Proposed RI Cleanup Levels and were then used to define contaminant nature and extent in upland soil and groundwater.

Types and Distribution of Contaminants

COPCs at the Site were identified based on comparison of contaminant concentrations to Proposed RI Cleanup Levels, and include metals, polychlorinated biphenyls (PCBs), polychlorinated dioxins and furans (dioxins/furans), polycyclic aromatic hydrocarbons (PAHs), petroleum hydrocarbons (TPH), semivolatile organic compounds (SVOCs), volatile organic compounds (VOCs), and chlorinated pesticides as shown by environmental media in Table 6.6. Based on the historical and current Site uses and general characteristics of contaminant occurrences across different portions of the Site, the RI divides the Site into three "Site Areas" (the South Area, Central Area, and Northwest Area; Figure 7.0) for purposes of describing contaminant nature and extent. The types and spatial distribution of contaminants in each Site Area are described below.

South Area

The South Area includes the area where the A&B Barrel Co. historically conducted barrel reconditioning and cleaning and since then has been used for boat maintenance and other marina activities for more than 60 years. Within the South Area, the area around the former A&B Barrel Co. disposal pond (Former A&B Barrel Co. Pond) is the most highly contaminated area of the Site. Relative to the other areas, the Former A&B Barrel Co. Pond contains the widest range of COPCs (including all Site COPCs), generally the highest COPC concentrations, and the deepest extent of COPCs that exceed Proposed RI Cleanup Levels, including exceedances in both Fill Unit and Alluvial Unit groundwater and exceedances in soil to a depth of 18 feet. A sheet pile wall and granular activated carbon (GAC) treatment mat were installed along the shoreline adjacent to the Former A&B Barrel Co. Pond in 2014 as an interim action to mitigate potential discharge of contaminated Former A&B Barrel Co. Pond groundwater to the LDW. Groundwater COPC concentrations in the Former A&B Barrel Co. Pond generally attenuate to below Proposed RI Cleanup Levels before reaching the shoreline, except for copper, dieldrin, and (inconsistently) arsenic, chromium, and PCBs.

West of the Former A&B Barrel Co. Pond, PCBs, select metals, TPH, PAHs, and VOCs exceed Proposed RI Cleanup Levels in soil, primarily above the water table, with the highest concentrations in the upper 2 feet.

Central Area

The Central Area encompasses the majority of the SPM Property and includes the historical boat manufacturing area, the historical mobile home park, the historical and current boat maintenance and storage areas, the current boat wash area, and the Legacy Master Marine facility. PCBs and metals, most commonly copper, were detected at concentrations above Proposed RI Cleanup Levels in shallow soils (typically less than 2 feet in depth) across the Central Area. Other metals, TPH, dioxins/furans, select pesticides, and select SVOCs were also detected above Proposed RI Cleanup Levels in shallow soils, but more sporadically. A localized area of high PCB and PAH concentrations was identified along the western edge of the SPM Property, adjacent to Dallas Avenue South.

In Fill Unit groundwater across the Central Area, including at the shoreline, concentrations of several metals (arsenic, chromium, copper, and nickel) and pesticides (aldrin and alpha-BHC) were detected at concentrations above Proposed RI Cleanup Levels, although exceedances were inconsistent. In Alluvial Unit groundwater, only copper exceeded Proposed RI Cleanup Levels, at concentrations less than 2 times the Proposed RI Cleanup Level.

Three chlorinated VOCs—tetrachloroethene (PCE), trichloroethene (TCE), and vinyl chloride—were detected in deeper soil and/or groundwater in a portion of the Central Area, including along the LDW shoreline. These VOCs are believed to emanate from a former dry-cleaning operation upgradient of the Site, which is a separate MTCA cleanup site (listed as "Dallas Ave S PCE"; Ecology Cleanup Site ID 16765[2]). PCE, TCE, and vinyl chloride in the Central Area are attributable to migration of the Dallas Ave S PCE plume onto the SPM Property. Because of the depth and location of these occurrences, vapor intrusion (VI) of VOCs is not a concern under current Site conditions in the Central Area.

Northwest Area

The Northwest Area encompasses the northwest portion of the SPM Property that historically included a fueling station and radiator shop and is currently occupied by the Tire Factory, which operates as an auto repair shop. COPCs in the Northwest Area include metals (copper and zinc), PAHs, and benzene in soil, and TPH and chlorinated VOCs in soil and groundwater.

Based on the distribution of chlorinated VOCs in the Northwest Area, these appear to be associated with the upgradient dry-cleaner MTCA site—located directly west of the Northwest Area—rather than the Site.

[2] Ecology issued an Early Notice Letter Regarding a Release of Hazardous Substances to the Dallas Ave S PCE site property owner, MDY Enterprises LLC, on May 17, 2023, but the owner has not responded.

The primary exceedance for COPCs other than chlorinated VOCs was a localized detection of TPH in saturated soil in one sample collected near the suspected former location of the former service station underground storage tanks.

Transport of contaminants from the Northwest Area to the LDW via groundwater is generally not a concern due to the relatively low concentrations and low mobility of most COPCs and the distance to the LDW from this area. The exception is for chlorinated VOCs associated with the upgradient dry-cleaner MTCA site, which extend in groundwater to the LDW shoreline.

Because of the presence of VOCs in shallow soil and groundwater, a VI assessment was conducted as part of the RI. The assessment concluded that VI was not a current concern over most of the Site; however, it could not be assessed inside the Tire Factory due to solvent use by the current tenant. Further assessment of the VI pathway may be warranted if Site conditions change.

RI Conclusions

Based on the results of the RI, the Site data (a combination of historical data and data collected for this RI) is of sufficient quantity and quality to characterize the nature and extent of the Site-related chemicals, understand the potential threat that these chemicals may pose to human health and the environment, and develop cleanup standards and cleanup action alternatives for the Site. As such, the RI has met the requirements of MTCA (WAC 173-340-350) and the AO.

Based on the RI results, Site areas of environmental media with relatively greater magnitudes of contamination are as follows (Figure 9.1):

- South Area
  - Soil and groundwater to depths up to 18 feet in the Former A&B Barrel Pond.
  - Soil surrounding and west of the Former A&B Barrel Co. Pond, generally limited to depths of 2 feet but with localized occurrences to 6 feet.
- Central Area
  - Soil at depths of approximately 1.5 feet adjacent to Dallas Avenue South.
- Northwest Area
  - Gasoline-range TPH in soil to 15 feet.
  - Chlorinated solvents in groundwater. These contaminants are attributable to the upgradient dry cleaner, a separate MTCA site with a footprint that extends onto the Site in the Northwest and Central Areas. These contaminants were not fully characterized outside of the SPM Property because they are not part of the Site; as such, the incomplete characterization is not a data gap for this RI.

Outside of those areas, lower-magnitude contamination is present in shallow soil and Fill Unit groundwater across much of the SPM Property.

Contaminant transport and exposure pathways of potential concern include human and terrestrial ecological direct contact with soil, VI into indoor air, leaching from soil to groundwater, and discharge of groundwater and eroded soil to LDW surface water and sediment. Under current Site conditions, these pathways are largely mitigated by a variety of engineering controls including pavement/gravel cover, stormwater collection and treatment, shoreline block wall, and a sheet pile wall/GAC mat. The soil-direct contact exposure pathways do not currently represent an imminent threat to human or ecological receptors because much of the soil is covered and there is limited use of the Site by the human and ecological receptors that are the basis for the Proposed RI Cleanup Levels. Likewise, VI does not pose an imminent threat based on the RI data collected. However, any of these pathways may potentially be complete if Site conditions or uses change in the future.

At a few shoreline wells, sporadic and generally low-level exceedances of select metals, pesticides, and chlorinated VOCs have been detected in groundwater above Proposed RI Cleanup Levels based on surface water protection. However, groundwater data from shoreline wells is a conservative measure of contaminant concentrations in surface water because concentrations decline as groundwater approaches the point of discharge, due to a combination of tidal-induced physical mixing and geochemical processes in the subsurface prior to discharge. Furthermore, almost all exceedances were in Fill Unit groundwater, which contributes a relatively small fraction of Site groundwater discharge to the LDW compared to the Alluvial Unit. The primary exceptions are exceedances of chlorinated VOCs in Alluvial Unit groundwater associated with the upgradient MTCA dry cleaner site.

The RI has collected sufficient data to adequately characterize the Site and select a cleanup action, and the RI meets the requirements of MTCA (WAC 173-340-350) and the AO (Task 2). This data was used as part of the source control review conducted under the AO (Task 2a), which concluded that the Site does not present a risk of recontaminating LDW sediments in the near-term. Therefore, an interim action, as defined in the AO (Task 3), is not required at the Site to either (a) achieve source control sufficiency as defined in Ecology's Source Control Strategy for the LDW or (b) to reduce a threat to human health or the environment.

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

1 Introduction

This Remedial Investigation (RI) Report has been prepared for the South Park Marina Site (Site) located at 8604 Dallas Avenue South in Seattle, Washington[3] (Figure 1.1). The RI Report has been prepared to meet the requirements of Agreed Order No. DE 16185 (the Agreed Order; AO) executed on April 3, 2019, between the Washington State Department of Ecology (Ecology) and the Potentially Liable Parties (PLP) Group, which consists of South Park Marina Limited Partnership (SPM), the Port of Seattle (Port), and the City of Seattle (City). The purpose of the RI is to collect sufficient data and determine the nature and extent of contamination in environmental media at the Site to enable the development and analysis of cleanup alternatives in a future feasibility study (FS) for the Site.

The Site is located on the west[4] side of the Lower Duwamish Waterway (LDW) between River Miles 3.3 and 3.5, to the south of the South Park Bridge, to the east of Dallas Avenue South, and to the north of Duwamish River People's Park, formerly Terminal 117 (T-117) (Figure 1.1). The Site includes three King County parcels totaling approximately 3.7 acres that are collectively referred to in this RI Report as the SPM Property. The Ecology Facility ID is 44653368, and the Ecology Cleanup Site ID is 2858.

In accordance with the AO, the Site is "defined by where a hazardous substance, other than a consumer product in consumer use, has been deposited, stored, disposed of, or placed, or otherwise come to be located" from historical and current operations located on the SPM Property and is not limited by property boundaries.

1.1 Purpose and Objectives

This RI has been conducted in accordance with the Washington State Model Toxics Control Act (MTCA) in Chapter 70A.305 of the Revised Code of Washington (RCW) and the MTCA regulations set forth in Chapter 173-340 of the Washington Administrative Code (WAC). This RI is intended to collect, develop, and evaluate sufficient information regarding the Site to select a cleanup action under WAC 173-340-360 through 173-340-390.

RI data collected under the AO were transmitted to Ecology for their use to support their Source Control Strategy for the LDW Superfund Site (Ecology, 2016). The Source Control Strategy addresses existing, ongoing sources of contaminants to the LDW so as to minimize the near-term risk of recontaminating sediments (after future remediation) to levels requiring active remediation and to minimize the long-term risk of recontaminating sediments above the sediment cleanup levels established in the LDW Record of Decision

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[3] The Site encompasses multiple parcels with various addresses as discussed in Section 2.1, but the main address associated with the Site is 8604 Dallas Avenue South, Seattle, Washington.

[4] For this RI Report, Project North is aligned downriver with the LDW along the SPM Property, and Project North is to the west-northwest relative to True North as shown on the Figures. Within this report, all cardinal directions are in relation to Project North.

(ROD; United States Environmental Protection Agency [EPA], 2014). With respect to the Site, the near-term goal of the Source Control Strategy was addressed in the Source Control Review Memorandum (Aspect, 2022c) and Addendum to the Source Control Review Memorandum (Aspect, 2024b), which concluded the Site does not pose a recontamination risk in the near-term. This RI Report supports the long-term goal of minimizing the risk of recontaminating sediments above the sediment cleanup levels established in the LDW ROD (EPA, 2014).

To that end, the RI Work Plan for the Site (RIWP; Aspect, 2021) established the following specific objectives for the RI:

- Obtain data of sufficient quality and quantity to describe the physical setting and physical properties of Site soil, groundwater, stormwater, catch basin solids, and soil gas.
- Determine the nature and extent of contamination in Site soil, groundwater, and indoor air.
- Evaluate potential pathways of hazardous substances from the Site to the LDW.
- Characterize the fate and transport of identified contaminants, including how contaminants migrate between media and possibly between properties.
- Use the information collected to assess the potential risk to human health and the environment through complete exposure pathways under the current and potential future land use(s).
- Determine Site Contaminants of Concern (COCs)[5] and unacceptable risks that will be carried forward into a future FS.
- Report the methods and findings of the RI to Ecology and project stakeholders, including the local community.
- Determine appropriateness of an Interim Action.

To accomplish these objectives, a phased investigation approach was designed: Phase 1 focused on identifying and characterizing sources and their pathways to the LDW, and Phase 2 focused on characterizing the Site and defining the nature and extent of contamination (Aspect, 2021). Following the Phase 1 field investigation, the RIWP Addendum (Aspect, 2022b) summarized results from the first phase of investigation, identified data gaps, and identified investigation activities to address those data gaps. After completing Phase 2 of the RI, two data gaps related to groundwater quality and vapor intrusion (VI) were identified, and further sampling was recommended as a third phase (Phase 3) of the RI to address those data gaps. In total, three phases of investigations were implemented; the scope of each phase is detailed in the documents listed below:

[5] This RI Report uses the term Contaminants of Potential Concern (COPCs) rather than COCs used in the RIWP.

- Phase 1 – RIWP (Aspect, 2021) – February to May 2021 – Focused on characterizing potential sources of contamination, identifying Site Contaminants of Potential Concern (COPCs), and evaluating potential migration pathways to the LDW.
- Phase 2 – RIWP Addendum (Aspect, 2022b) – September to November 2022 – Conducted additional sampling to address the data gaps (primarily related to vertical and horizontal delineation) identified following Phase 1 and thereby better define the nature and extent of contamination.
- Phase 3 – Proposed Indoor Air Sampling Plan Memorandum (Aspect, 2023a) and Proposed Phase 3 Groundwater Sampling Memorandum (Aspect, 2023b) – March to May 2023 – Collected additional groundwater data to address data gaps identified following Phase 2 and collected soil gas and indoor air data to characterize the VI exposure pathway.

In a meeting in October 2023, following completion of the RI investigations identified in the RIWP and addenda, Ecology requested that the Site RI also include an evaluation of existing sediment data near the SPM Property and discuss the relationship between the Site and the LDW Superfund Site. The approach to the sediment data evaluation was further discussed in subsequent meetings in October and November 2023. A draft sediment data evaluation was prepared and submitted to Ecology for review in March 2024 and revised following discussions with Ecology in April and May 2024. The sediment data evaluation has been integrated into this RI Report, and sediment data is tabulated in Appendix H.

In December 2024, following submittal of the draft of this RI Report to Ecology, Ecology identified characterization of per- and polyfluoroalkyl substances (PFAS) as a data gap requiring additional investigation. To address that data gap, Aspect prepared the PFAS Groundwater Sampling Plan Memorandum (Aspect, 2025a), which was approved by Ecology on April 3, 2025, and groundwater sampling for PFAS was conducted in April 2025. PFAS sampling results were reviewed and approved by Ecology and are documented in the RI Report Addendum for PFAS in Groundwater Memorandum (Aspect, 2025b). Based on the results and subsequent data evaluation, PFAS compounds were not identified as Site COPCs.

1.2 Report Organization

This RI Report includes 11 sections, supporting tables, figures, and multiple appendices. The main text is organized as follows:

- **Section 1 – The Introduction** presents regulatory status of the Site and information regarding the objectives and approaches for the RI.
- **Section 2 – The Site Background** section describes the Site location, ownership, zoning, operational history, existing infrastructure, and current and future land use of the SPM Property and summarizes adjacent sites.

- **Section 3 – The Environmental Setting** section describes the Site physical conditions including topography and surface drainage, the regional geology of the LDW, and Site hydrogeologic conditions.
- **Section 4 – The Environmental Investigations and Cleanup Actions on SPM Property Outside of the AO** section summarizes investigations and cleanup actions that were conducted on the SPM Property prior to finalizing the AO, as well as investigations that were completed concurrently with, but independent of, the AO RI.
- **Section 5 – The Agreed Order Environmental Investigations** section provides a description of the Site investigation work completed under the AO (November 2019 through May 2023) for the RI and to support the source control review.
- **Section 6 – The Screening/Cleanup Levels and Analytical Data Screening** section describes the process for screening sediment data adjacent to the SPM Property and upland media at the Site. The section describes how screening levels (SLs) were developed and established, presents the methodology behind refining SLs to develop the Proposed RI Cleanup Levels (CULs), and evaluates whether analytes are Site COPCs.
- **Section 7 – The Nature and Extent of Site COPCs** section describes the distribution of Site COPCs in environmental media.
- **Section 8 – The Conceptual Site Model (CSM)** synthesizes the collective information to describe potential sources of contamination and the mechanisms of contaminant fate and transport, evaluates potential exposure pathways, and summarizes areas and media of concern.
- **Section 9 – Conclusions** of the RI are summarized.
- **Section 10 – The References** cited in this report are provided.
- **Section 11 – Limitations** for the use of this report is included at the end of the main report text.

Tables and figures are located at the end of the RI Report text after Section 11 and before the Appendices. Appendices to the RI Report support the analyses and discussions presented in the main body of the text and tables and include:

- **Appendix A – Key Historical Document Excerpts** includes select information from historical documents referenced in this report to provide additional context regarding the basis for work performed during the RI related to historical operations.
- **Appendix B – Boring Logs** includes historical logs available from previous subsurface investigations and boring logs/monitoring well as-builts for the borings completed under the AO.
- **Appendix C – Groundwater Elevation Studies** presents hydrographs and water level vs. conductivity charts from the Phase 1 and Phase 2 tidal studies and dry

well datalogger study, presents groundwater elevation contour maps for various tidal stages in both the unconfined and confined groundwater units, and provides groundwater elevations collected at monitoring wells throughout the RI.

- **Appendix D – Cultural Resources Monitoring Reports** contains the results of monitoring conducted under the Archeological Monitoring and Inadvertent Discovery Plan for the Site.
- **Appendix E – Wet Weather Site Walk and Seep Observations** presents field notes and photographs from a wet weather site walk and observations of seeps at the SPM Property during extremely low tides.
- **Appendix F – Investigation-Derived Waste (IDW) Disposal Records** includes the final hazardous and nonhazardous waste manifests documenting the transportation and disposal of investigation-derived waste generated throughout the RI.
- **Appendix G – Laboratory Analytical Reports and Data Validation Reports** presents the laboratory analytical data reports and data validation reports for soil, groundwater, soil gas, air, stormwater, and catch basin solids samples collected as part of the RI.
- **Appendix H – Sediment Analytical Data and Data Screening** provides the following:
    - Data from sediment sampling adjacent to the SPM Property.
    - Sediment Initial SLs used to evaluate the sediment dataset.
    - Derivations of Sediment Selected SLs based on the criteria established for refining SLs.
    - Summary statistics for concentrations of analytes retained for further evaluation as part of the CSM.
    - Figures showing analytical results for select analytes in sediment adjacent to the SPM Property
- **Appendix I – Upland Media Analytical Data and Data Screening** provides the following:
    - Summaries of detected analytes in upland media.
    - Derivations of Preliminary RI SLs that were selected for initially screening the historical and RI analytical data.
    - Analytical data summary tables that screen analytical data relative to Preliminary RI SLs to narrow analytes retained for further evaluation.
    - Derivations of Proposed RI CULs based on the criteria established for refining screening levels.

  - Summary statistics for concentrations of COPCs in each media relative to the Proposed RI CULs.
  - Tabulation of individual and total polychlorinated biphenyl (PCB) Aroclors and congeners.

- **Appendix J – Summary Statistics for COPCs by Area and Media** provides summary statistics, by Site Area, for concentrations of COPCs in each media relative to the Proposed RI CULs.
- **Appendix K – Vapor Intrusion Assessment Memorandum** contains a copy of the memorandum documenting evaluation of the VI exposure pathway at the Site.

Information contained in tables and figures in the appendices are referenced throughout this RI Report. To improve readability, these tables and figures are referenced only by their number (e.g., Table H.2.A is located in Appendix H).

2 Site Background

This section presents an overview of the Site location, historical and current operations, utilities, and easements.

2.1 Site Location and Zoning

The Site (Ecology Facility ID 44653368 / Cleanup Site ID 2858) is located in the South Park neighborhood, which consists of mixed residential, commercial, and industrial zoning approximately 5.5 miles south-southeast of downtown Seattle (Figure 1.1). It borders the City of Seattle city limits and is part of unincorporated King County. The Site is located along the west side of the LDW between River Miles 3.3 and 3.5, south of the South Park Bridge, east of Dallas Avenue South, and north of Duwamish River People's Park. As established in the AO, the Site is defined "by where a hazardous substance, other than a consumer product in consumer use, has been deposited, stored, disposed of, or placed, or otherwise come to be located," and the SPM Property is defined as three current King County tax parcels from south to north (Figure 2.1):

- South Parcel (No. 0001600001): 8544, 8546, and 8604 Dallas Avenue South
- Central Parcel (No. 2185600025): 8510 and 8522 Dallas Avenue South
- North Parcel (No. 2185600070): 8500 Dallas Avenue South

The SPM Property and the properties to the north (Parcel No. 2185001045, a vacant commercial lot) and to the south (Parcel No. 001600044, Duwamish River People's Park) are all located in unincorporated King County and are zoned as industrial. Dallas Avenue South borders the SPM Property to the west. The properties west of Dallas Avenue South are within the limits of the City of Seattle and zoned as industrial or mixed-use residential and commercial.

The SPM Property totals approximately 3.7 acres, and 70.5 percent of that area is impervious (building roofs, asphalt, concrete, and brick). The remaining 29.5 percent of land area is pervious and generally covered with a combination of soil, grass, planters, and/or gravel.[6] A retaining wall made of ecology blocks runs along the west bank of the LDW shoreline. At low tide, riprap at the base of the ecology block wall is exposed.

No changes in land use or zoning are currently planned for the SPM Property.

2.2 SPM Property History and Historical Land Use

This section provides a summary of the development and operational history of the SPM Property, including a review of available historical records.

The development history of the Site and surrounding properties, including specific information regarding historical operations, facilities, and features, is described in detail in several previous environmental reports (Washington State Pollution Control

[6] Land areas and pervious/impervious surfaces are from a 2022 topographical survey provided in Appendix A.10.

Commission [WSPCC], 1955; Science Applications International Corporation [SAIC], 2004, 2007a, 2007b; Windward Environmental, LLC [Windward], 2010b). In addition to the previous environmental reports, a variety of historical information was reviewed during development of the AO and preparation of the RIWP (Aspect, 2021), including aerial photographs, facility diagrams, current and historical tax assessor records, deeds, and utility maps. Figure 2.2 depicts the locations of key historical features including former underground storage tanks (USTs), process areas, manufacturing areas, and shoreline configurations. Select historical records are included in Appendix A.

Shoreline modifications along the parcels comprising the SPM Property generally involved the dredging and removal of material from the bank, with the exception of the 1981 dredging event. The 1981 dredging event mostly involved removal of the material from the bank, except at the very southern end where material was added to straighten the shoreline (Figure 2.2). Further information on dredging events is provided in Section 3.1. Based on aerial photographs, modifications (including modifications to dock structures) appear to have been conducted around at least 1952, 1957, 1959, 1961, 1981, and 1992 (Appendix A.1). There were also modifications to the LDW channel in this area that predate the earliest available aerial photographs in 1936. Available records suggest that the 1981 dredging event involved disposal of 26,742 cubic yards (cy) of material at a deep-water disposal site and that the 1992 dredging event involved disposal of 5,688 cy of material at a deep-water disposal site (Appendix A.2). It is unknown if any material from shoreline modification/dredging events in 1952, 1957, 1959, 1961, or 1981 was placed on the SPM Property. Additional detail on the dredging events is presented in Section 3.1.

Historically, the SPM Property comprised three individual tax parcels with a variety of operational uses. These historical parcels, identified as Historical Parcel B, Historical Parcel C, and Historical Parcel D[7] on Figure 2.2, are based on information provided to EPA as part of a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) section 104(e) information request that is included in Appendix A.3.[8] Historical Parcels B and C, as indicated by the Sanborn and Kroll maps (Appendix A.4), were subdivided into smaller residential lots. In 1993, the parcels were consolidated to their current three-parcel configuration (North, Central, and South).

The following sections provide a summary of the operational history on each of the historical parcels. Appendix A contains the following information used in assessing the history and historical land use of the SPM Property:

- Appendix A.1 – Aerial and Oblique Photographs
- Appendix A.2 – Dredge Event Records
- Appendix A.3 – Excerpts from CERCLA 104(e) 2008 and 2011 Responses
- Appendix A.4 – Sanborn and Kroll Maps

[7] Historical Parcel D is identified in the AO as the “A&B Barrel Parcel.”
[8] Historical Parcel A identified in the CERCLA section 104(e) information request was located north of the South Park Bridge and is not part of the Site.

- Appendix A.5 – Title Records Searches
- Appendix A.6 – Select City Directories
- Appendix A.7 – Select Tax Assessor Records

2.2.1 Historical Parcel D

The following ownership information was gathered from title records searches included in Appendix A.5. Historical Parcel D was purchased by Alfred and Helga Sannes in 1943 (Appendix A.5) and subsequently by John R. Angle and R.W. Butz in 1946 (Appendix A.5; Ecology, 2019). In August 1959, Historical Parcel D was purchased in fee simple by the Commercial Waterway District #1 of King County (CWD) and leased to the A&B Barrel Co. (Appendix A.5), who had operated on the parcel beginning in 1946, as described further below. This "C.W.D. Lease" area is depicted on the 1966 Kroll Map (Appendix A.4), totaled approximately 0.71 acres, and included an easement for the South Park Boat Haven docks. In 1963, the Port passed a resolution agreeing to assume the CWD's assets, liabilities, and functions, including Historical Parcel D (Ecology, 2019). In 1978, the Port sold Historical Parcel D to the Gary Merlino Construction Company, who subsequently sold the parcel to Willard S. and Rose Marie Crow in 1980. In 1993, Historical Parcel D was quitclaimed to SPM and merged with Historical Parcel C and a portion of Historical Parcel B to form the current South Parcel of the SPM Property, which is currently owned by SPM (Ecology, 2019; Appendix A.5).

Based on aerial photographs (Appendix A.1), a small dock with vessels moored in the LDW extending offshore from the southeast corner of Historical Parcel D was installed at some point between 1947 and 1952. The dock appears to have been expanded between 1952 and 1956 and again between 1956 and 1959, and then remained in a similar configuration until approximately 1981 (Appendix A.1).

From 1946 to 1960, the A&B Barrel Co. operated a drum reconditioning facility on Historical Parcel D, which included a building and a waste disposal pond (herein referred to as the Former A&B Barrel Pond), whose former locations are as shown on Figure 2.2. The Former A&B Barrel Pond is first identifiable in an aerial photograph from 1956 but was present prior to 1955 (WSPCC, 1955). According to the 1955 WSPCC report, the A&B Barrel Co. used approximately one ton per month of sodium hydroxide as a cleaning agent. That report states, "Liquid waste, including oils, grease, and sodium hydroxide, is discharged to a small pond and thence to the LDW" and it references an outfall that presumably connected the Former A&B Barrel Pond to the LDW (WSPCC, 1955). In September 1960, a large fire destroyed the A&B Barrel Co. building, barrels, and nearby utility poles. In late 1960 or early 1961, the Former A&B Barrel Pond was reportedly filled, and the area regraded using a combination of anthropogenic debris and soil fill from an unknown source (SAIC, 2008a; Ecology, 2019). In the 1961 aerial photograph (Appendix A.1), a few small structures are present adjacent to the dock ramp at the southeast corner of Historical Parcel D, while the remainder of the parcel appears to have recently been graded compared to earlier and later aerials.

Since the 1960s, Historical Parcel D has been used continuously for marina activities, including boat maintenance that continues today. Between 1969 and 1974 (Appendix

A.1), two workshop/storage structures were constructed along the southern parcel boundary, which were used for various marina and storage activities until they were destroyed in the 2021 fire (see additional discussion in this section, below). Between 1982 and 1985 (Appendix A.1), another structure was built between the two workshop/storage structures. Information regarding historical uses of these buildings is limited. More recently, site walks conducted in 2015 by TIG Environmental (2020) and in 2019 as part of the AO RI documented wood working, boat painting, and boat exterior refurbishing in these workshops. These three buildings are identified on Figure 2.2 by their use during the 2019 site walk; the buildings were destroyed as part of the 2021 fire (described in further detail below). Historical boat maintenance activities included limited outdoor sandblasting (reportedly 10 events; TIG Environmental, 2020). Vacuum sanders were implemented beginning in approximately 2005.

Ecology's UST database indicates that a leaded gasoline UST was installed along the shoreline on Historical Parcel D and subsequently removed. Based on anecdotal evidence, the UST was installed around 1970 and was presumed to support the marina activities. During shoreline reconfiguration in 1981, the UST from Historical Parcel D was reportedly moved to a location on the South Parcel near the current dock (TIG Environmental, 2020; Figure 2.2).

Other historical marina activities included boat washing (which continues today, but under different conditions as described in Section 2.3.1.1). Until 1993, vessel pressure washing was conducted on Historical Parcel D in the outdoor area southeast of the historical boat manufacturing building (which is on Historical Parcel C; Section 2.2.2), and washwater was discharged (untreated) to the LDW (Figure 2.2). Vessel pressure washing continued after 1993 but used a wash water recycling system, which by 2016 was a fully closed-loop system (discussed further in Section 2.3.1.1).

On September 2, 2021, a fire (2021 fire) destroyed several vessels on the south end of the SPM Property and three structures (identified by their use during a 2019 site walk; TIG Environmental, 2020): the lumber storage building, woodworking shop, and a building used for boat storage and maintenance (Figure 2.2). SPM removed the fire debris and demolished the remaining unstable structures and disposed of materials from the fire between March 17 and March 24, 2022, after receiving permits from King County (TIG Environmental, 2022; Section 4.3.3). The area beneath the former buildings primarily consists of impervious surfaces (concrete slab or asphalt pavement) with limited areas of exposed soil.

The RIWP and RIWP Addendum identified the following potential contaminant sources associated with historical operations on Historical Parcel D (Figure 2.2):

- The historical operations of the former A&B Barrel Co., particularly the discharge of chemically diverse wastes into the Former A&B Barrel Pond in the southern portion of Historical Parcel D
- The 1960 fire associated with the former A&B Barrel Co. in the southern portion of Historical Parcel D
- The historical presence of a 1,000-gallon UST located adjacent to the shoreline (1970–1981) along the central-eastern portion of Historical Parcel D

- Historical outdoor vessel pressure washing, wherein untreated washwater was discharged to ground surfaces and to the LDW in the central-eastern portion of Historical Parcel D
- Historical boat bottom cleaning throughout Historical Parcel D
- Do-it-yourself (DIY) boat maintenance, including surface preparation (e.g., scraping, sanding) and refinishing throughout Historical Parcel D
- Potential leaks or spills of chemicals used by tenants throughout Historical Parcel D, including those from the former woodworking shop on the southern portion of Historical Parcel D containing paints and enamels documented in a 2016 chemical inventory update (Appendix A.8)
- The 2021 fire associated with marina operations on the southern portion of Historical Parcel D, which destroyed numerous boats and buildings, including the former woodworking shop

2.2.2 Historical Parcel C

Based on the information reviewed, Historical Parcel C encompassed several private residences, and was later used for boat manufacturing and marina activities. An aerial photograph from 1936 indicates limited land use on Historical Parcel C (Appendix A.1). The 1951 Sanborn map depicts houseboats off the shore of the South Parcel in the LDW, along with several dwellings, and a boat manufacturing building (Appendix A.4). Boatyard activities began on Historical Parcel C sometime between 1936 and 1946 (Appendix A.1), when a dock appeared offshore of Historical Parcel C. Between 1946 and 1952, the dock appears to have been moved to Historical Parcel D. The 1951 Sanborn map (Appendix A.4) labels the building near the shoreline as boat manufacturing (Figure 2.2), which operated for an unknown length of time. The marina began operating as South Park Boat Haven in 1961 (South Park Boat Haven also operated on the Historical Parcel D, as described in the section above). In 1970, Willard Crow acquired the business and changed the name of the marina from South Park Boat Haven to South Park Marina (SAIC, 2004). Since the 1960s, Historical Parcel C has been used continuously for marina activities, including South Park Boat Haven (1961 to 1970), and South Park Marina and Evergreen Boat Transport (1970 to present).

During shoreline reconfiguration in 1981, a dock was placed on Historical Parcel C, where it remains in use today. During that same time period, a UST from Historical Parcel D was reportedly moved to a location on Historical Parcel C near the current dock and remained in operation in this area until 1991 (TIG Environmental, 2020; Figure 2.2). Further information about the UST is provided in Sections 2.2.1 and 4.2.2.

Other historical activities included boat maintenance, which continues today (Section 2.3.1.1), but historical boat maintenance activities included limited outdoor sandblasting (reportedly 10 events; TIG Environmental, 2020). Vacuum sanders were implemented in approximately 2005. In 1993, Historical Parcel C was combined with Historical Parcel D and a portion of Historical Parcel B to form the current South Parcel.

The RIWP and RIWP Addendum identified the following potential contaminant sources associated with historical operations on Historical Parcel C (Figure 2.2):

- Historical boat manufacturing (1950s) on the southeast portion of Historical Parcel C
- Historical single 1,000-gallon UST that was located proximal to the existing dock access (1981-1991) on the northeast portion of Historical Parcel C
- DIY boat maintenance, including sanding and refinishing throughout Historical Parcel C
- Treated boat washwater in an infiltration sump within the Harbormaster shop[9] on the southeast portion of Historical Parcel C / northeast portion of Historical Parcel D

2.2.3 Historical Parcel B

Starting at some point prior to approximately 1918 and continuing through 1941, lots on Historical Parcel B were acquired by various owners (Appendix A.5). The northwest portion of Historical Parcel B was purchased sometime prior to 1929 by James M. and Edna K. Ferguson, by Thomas W. Secrest in 1929, by Samuel and Annie Trenholme in 1930, and by William S. and Susie McGee in 1936. It was leased to Williard S. and Rose Marie Crow beginning in 1962, and subsequently purchased by them in 1983 (Appendix A.5). The remaining lots on Historical Parcel B were acquired by J.R. Johnson (and Ida Myrtle Johnson) from various owners between 1918 and approximately 1947 (Appendix A.5). These lots were purchased by Willard S. and Rose Marie Crow in 1952. In 1993, Willard S. and Rose Marie Crow conveyed Historical Parcel B to SPM as part of parcel boundary adjustments:

- A portion of Historical Parcel B was added to Historical Parcels C and D to form the current South Parcel
- The remainder of Historical Parcel B now forms the current Central and North Parcels

The earliest available operational records for Historical Parcel B include title records from 1929 (Appendix A.5), an aerial photo from 1936 (Appendix A.1), and historical tax assessment records dated as early as 1937 (Appendix A.7), which show Historical Parcel B developed with a gasoline service station and automobile repair shop in the northwest corner and residential buildings in the northeast corner (Figure 2.2). Historical use is described below for Historical Parcel B for three areas based on the activities that occurred in each of the following:

- The northeast corner, which was used for residential structures prior to being redeveloped in 1986

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[9] See Figure 2.1 for the location of the Harbormaster Shop. The infiltration sump is not identified as a current potential source of contaminants because a closed loop system for treatment of boat washwater has been implemented, as described in Section 2.3.1.1.

- The northwest corner, which has been used for a variety of automative-related operations prior to and after redevelopment in 1972
- The remainder of the parcel, which was primarily used for residential purposes (mobile home/trailer park) and subsequently marina operations

The RIWP and RIWP Addendum identified the following potential contaminant sources associated with historical operations on Historical Parcel B (Figure 2.2):

- Engine maintenance and repair operations at Legacy Master Marine in the northeast corner of Historical Parcel B
- The historical operation of a gasoline service station, including two 550-gallon USTs and a hydraulic hoist in the northwest corner of Historical Parcel B
- The historical operation of a radiator repair shop in the northwest corner of Historical Parcel B
- The historical and current operation of an automotive service station with in-ground hydraulic hoists in the northwest corner of Historical Parcel B
- DIY boat maintenance, including sanding and refinishing throughout the remainder of Historical Parcel B
- Potential heating-oil USTs and septic systems associated with former residences throughout Historical Parcel B

2.2.3.1 Northeast Corner of Historical Parcel B

The residential structures in the northeast portion of Historical Parcel B were demolished in 1986 (Appendix A.3), and the current structure on the parcel was built in 1987. Legacy Master Marine (which formerly operated as Rick's Master Marine) leases this building from SPM and has operated continuously since 1990 (Appendix A.3). Legacy Master Marine historically operated as a boat and marine supply retailer and boat repair facility, but recent changes in ownership have resulted in the business focusing on production of specialty watercraft. Further information on Legacy Master Marine is included as part of current operations in Section 2.3.1.1.

2.2.3.2 Northwest Corner of Historical Parcel B

In the northwest portion of Historical Parcel B, historical tax assessment records indicate that the former gasoline service station and automobile repair shop building was constructed in 1918 (Appendix A.7). The Polk City Directories list the former building as Luard A. Spurlock's gas station in 1942, Crow South Park Service in 1954, March's South Park Service from 1954 to 1956, and Pumphrey's Flying A Service from 1958 to 1962 (Environmental Coalition of South Seattle [ECOSS], 2016). According to historical tax assessor records, the former gasoline station and automobile repair shop had two 550-gallon USTs and a hydraulic hoist. Beginning in approximately 1969, the building was operating as the Big "O" Tire Store (Appendix A.3 and A.6).

The building to the south of the former gasoline service station and automobile repair shop building was built in 1940, based on a review of historical aerial photographs

(Appendix A.1) and tax assessor records (Appendix A.7). From a review of the historical information, it appears the building was primarily used as a café throughout most of its existence, but a 1970 city directory lists the address of the building associated with A-1 Radiator Service and Harvey's Auto Resuild [sic] (Appendix A.6).

By 1972, the gasoline service station and automobile repair shop building and south-adjacent building in the northwest corner of Historical Parcel B had been removed. The current building was constructed in 1974 and has operated as the Big "O" Tire Store and South Park Tire Factory (Tire Factory) to present (SAIC, 2007a). The two USTs discussed above that may have been associated with the former service station were reportedly encountered and subsequently removed in 2014 during preparations to replace the South Park Bridge (TIG Environmental, 2020). These USTs are discussed further in Section 4.2.2.

2.2.3.3 Remainder of Historical Parcel B

In addition to the residential structures in the northeast corner, a mobile home park (referred to as a trailer camp on the 1950/1951 Sanborn map; Appendix A.4) occupied the majority of Historical Parcel B from as early as 1946 (SAIC, 2007a; Port, 2003) until 2010 based on review of aerial photographs (Appendix A.1). Historical tax assessor records for the residential homes did not indicate the presence of heating oil tanks (Appendix A.7). The residential homes and trailers may or may not have had associated septic systems. A review of historical aerial photographs and knowledge of site operations indicate that some limited boat storage had begun on Historical Parcel B as early as 1946 (SAIC, 2007a). The gradual transition of parcel use from primarily residential to recreational boat storage and maintenance began in 1980 and continued until 2010, when the remaining mobile homes were removed, and predominant parcel use became marina-related activities.

2.3 Current Use of the SPM Property

This section discusses the current land use of the SPM Property, including existing infrastructure, property access, and easements. Currently, no changes in future use or zoning are planned.

Discussion in this section is generally organized by the current SPM Property parcels (South, Central, and North) that were established as historical parcel boundaries and reconfigured in 1993. The current SPM Property parcels and features are shown on Figure 2.1. Additional detail on the current use of each parcel is provided below.

SPM's marina facilities include secured docks, parking, dry boat storage, a boat ramp, maintenance buildings, a residential duplex, office, restrooms and laundry facilities, and a boat wash area. The current uses of the SPM Property include boat storage, bottom cleaning of boats, and DIY boatyard maintenance activities, as well as an automotive repair shop (the Tire Factory) and Legacy Master Marine. The boatyard is capable of storing between 80 and 100 boats (based on available aerial photography).

There are residences on the South and Central Parcels, and therefore the Site does not meet Ecology's characteristics for an industrial property as specified in WAC 173-340-745(1)(a)(i). The South Parcel includes a small duplex unit, adjacent to the marina office, which is currently occupied by two tenants under month-to-month rental agreements.

Two structures on the Central Parcel have been informally occupied on an occasional basis but this practice has been discontinued, and the structures are no longer occupied.

2.3.1 Current Land Use

The following subsections describe the current land use of the 3.7-acre SPM Property.

2.3.1.1 South Parcel

The primary use of the 1.7-acre South Parcel is for boat haul-outs, bottom cleaning of boats, boat storage, and DIY maintenance activities. As shown on Figure 2.1, this parcel also includes the following:

- Access to the SPM dock and parking
- The east residential duplex (the main residence)
- The SPM Main shop
- The Harbormaster shop
- The SPM office
- A storage shed adjacent to the SPM office
- The restroom, shower, and laundry building that is used by tenants of SPM
- The boat wash area (including the washwater treatment Conex box)
- The StormwateRx™ pre-fabricated aboveground treatment unit (Section 2.3.2.2)

DIY boat maintenance activities include bottom scraping and sanding; refinishing including the use of solvents, thinners, and acetone; and engine maintenance and repair (SAIC, 2004). SPM reports that maintenance activities are performed on top of plastic tarps and in temporary plastic tents using vacuum sanders to reduce fugitive dust and liquid emissions.

In the southeastern corner of the South Parcel, a 35-ton crane is situated and used for hoisting boats into/out of the water or moving boats onto transportation trailers for either transport or dry storage in the boatyard.

The marina's current policy, which has reportedly been in place since 1992 or 1993 (TIG Environmental, 2020), requires that boats are pressure-washed by authorized marina personnel only in the dedicated boat wash area located east of the SPM shop using a high-pressure, closed-loop washwater system. Abrasives are not used. Two catch basins are located in the boat wash area: one serves as a vault for collecting the boat washwater (that then discharges into a closed-loop system) and the other is a stormwater catch basin (CB-08), which is connected to the StormwateRx™ treatment system prior to discharge to the LDW. During boat wash activities, the stormwater catch basin (CB-08) is covered with a plywood cover intended to prevent boat washwater from entering the stormwater system. The boat washwater is pumped from the closed-loop system vault to a treatment system that removes suspended solids through a series of weirs prior to treating the water with a flocculent to help further bind solids and remove metals. Solids are collected, dried, and disposed of as regulated waste; washwater is recirculated into the system. A diagram of the closed-loop treatment system is included in Appendix A.9. The washwater recirculation system was not installed until 1993 (King County, 1993; SAIC, 2007a) and, until 2016, it was not a closed-loop system, as a portion of the partially treated washwater discharged via a small drain line to an unnamed outfall to the LDW, Unnamed Outfall No. 2, which is located near the current Harbormaster shop (TIG Environmental, 2019). This is discussed further in Section 4.1.3.

The RIWP and RIWP Addendum identified the following potential contaminant sources associated with current operations on the South Parcel (Figure 2.1):

- Leaks of oil from the SPM crane or other equipment to pervious ground surfaces along the eastern shoreline in the southern portion of the South Parcel
- Potential leaks or spills of chemicals used by tenants throughout the South Parcel
- DIY boat maintenance, including sanding and refinishing throughout the South Parcel
- Operations at the SPM Main shop in the central-eastern portion of the South Parcel, including the use of small volumes of petroleum-based lubricants, adhesives, degreasers, paints, waste oil, and antifreeze documented during a chemical inventory in 2016 (Appendix A.8)

2.3.1.2 Central Parcel

The majority of the 1.36-acre Central Parcel is used for boat storage and DIY maintenance activities. It contains three residential structures (the West Residential structure, which is currently used for storage, and the East and North Residential structures, which are currently occupied) and a shed used for storage by tenants (Figure 2.1); the shed is primarily used for boat storage and maintenance activities (see Section 2.3.1.1 for a description of boat maintenance activities). The northwest corner of the Central Parcel houses the Tire Factory, which operates as an auto repair service station. Activities associated with the Tire Factory include tire and wheel services, brake service, suspension repairs, transmission repairs, oil changes, and automobile electric repairs. The Tire Factory building houses a used oil aboveground storage tank in the northeast area of the building in addition to an in-ground hydraulic hoist.

The RIWP and RIWP Addendum identified the following potential contaminant sources associated with current operations on the Central Parcel (Figure 2.1):

- Repair operations at the Tire Factory in the northwest portion of the Central Parcel, including the use of automotive engine oil, waste oil, antifreeze, and small quantities of automotive-related chemicals documented during a chemical inventory in 2016 (Appendix A.8)
- DIY boat maintenance, including sanding and refinishing throughout the remainder of the Central Parcel

2.3.1.3 North Parcel

The 0.38-acre North Parcel has been occupied by Legacy Master Marine continuously since 1990. Legacy Master Marine primarily operated as a marine motor maintenance, service, and repair shop, providing service of outboard, inboard, and sterndrive marine engines. Service was performed on both gasoline and diesel engines. While historical operations at Legacy Master Marine were dominated by marine supplies retail, maintenance, and repair, recent changes in ownership have resulted in an increased focus on the manufacture of specialty high density polyethylene small craft.

The building and a fenced boat parking area occupy the majority of this parcel, except for a small portion of the southwest corner of the parcel under the Tire Factory and an asphalt driveway to the east of the building that provides access to the SPM Property from South Thistle Street.

The RIWP and RIWP Addendum identified the following potential contaminant sources associated with current operations on the North Parcel (Figure 2.1):

- Engine maintenance and repair operations at Legacy Master Marine in the North Parcel, including the use of engine gear oil, antifreeze, waste oil, waste mixed solvents, and miscellaneous boat maintenance and cleaning products documented during a chemical inventory in 2016 (Appendix A.8)

2.3.2 Existing Infrastructure

2.3.2.1 Structures

Structures on the SPM Property are shown on Figure 2.1. Six structures are currently present on the South Parcel: the SPM Main shop, the Harbormaster shop, the SPM office, the East Residential structure, a small storage shed, and the restrooms/laundry building. The Central Parcel contains the North and West Residential structures, a storage shed, and the building occupied by the Tire Factory.[10] The North Parcel includes the building associated with Legacy Master Marine.

2.3.2.2 Utilities

This section describes utilities observed during a site walk on November 21, 2019, as well as utilities identified in previous reports and through publicly available information. Figure 2.3 depicts utility information gathered from the City of Seattle (City Development Service Office's [DSO], 2020) and as modified by TIG Environmental through camera and topographic surveys and a dye tracer investigation (TIG Environmental, 2019 and 2024; Appendix A.11).

Power

Electricity to the SPM Property is provided via overhead power lines with pole-mounted transformers. The pole-mounted transformers contain less than 1 part per million (ppm) total PCBs according to their labels (The Intelligence Group, 2016f). Generally, the buildings on the South and Central Parcels (except the Tire Factory) are serviced by

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[10] As of late 2024/early 2025, the Tire Factory now operates as South Park Point S Tire Factory; no changes in operations or activities have been documented, and the business will be referred to as the Tire Factory throughout this report.

overhead lines from Dallas Avenue South. The Tire Factory and Legacy Master Marine (on the North Parcel) are serviced through overhead power lines from South Thistle Street.

Water Supply

Water service to the SPM Property is provided through Seattle Public Utilities (SPU). According to the City's Development Service Office web viewer, the water main for the SPM Property enters from Dallas Avenue South near the middle driveway before splitting into service lines which run to the west toward the Tire Factory and Legacy Master Marine (City DSO, 2020). The water service lines for the East Residential structure, the restroom/laundry building, the SPM office, and the individual service lines throughout the boatyard have not been mapped. There are no known water supply connections to the North or West Residential structures.

Sanitary Sewer & Former Septic

Subsurface features of the former septic systems and sanitary sewers associated with the historical mobile home park, historical residences, current residences, and current restroom, laundry, and shower building have not been completely mapped (TIG Environmental, 2019). However, readily apparent surface features, such as some historical sanitary sewer hookups, are mapped throughout the Central and South Parcels (Figure 2.3). A septic tank may have been historically present near the center shoreline of the South Parcel, as depicted on Figure 2.3. The location of this potential septic tank was noted from a 1968 King County permit, but the tank could not be located using ground-penetrating radar (TIG Environmental, 2017). There is still some uncertainty regarding the connections and locations of the sanitary sewer system (including the historical sanitary sewer hookups throughout the Central and South Parcels), but sufficient data has been collected to characterize the Site and assess preferential pathways as discussed in Sections 7 and 8 of this report.

Two floor drains, which contain surface packers, are present in Legacy Master Marine shop. It is presumed that these floor drains are connected to the sanitary sewer system, but this has not been confirmed through dye testing (TIG Environmental, 2020). During the November 21, 2019, PLP site walk, it was noted that the floor drains were covered with hydrophobic adsorbent pads to capture minor spills of fuel and oil.

Based on previous surveys, the East Residential structure and SPM office are inferred to connect directly to the sanitary sewer. There are no known connections to water supply or sanitary sewer services to the North or West Residential structures.

Stormwater

The age of the stormwater catch basin system is unknown. The original National Pollution Discharge Elimination System (NPDES) permit for SPM was issued in February 1993. Based on a review of available information, the stormwater system has existed in its current configuration since at least 2007 (SAIC, 2007a; Leidos, 2015). Upgrades and modifications to the stormwater system included installation of the StormwateRx™ treatment system in 2009 (Section 4.1.3; Appendix A.9), installation of catch basin CB-10 in 2014 to 2015, decommissioning of Unnamed Outfall No. 2 in 2016, and decommissioning of catch basin CB-01 in 2019 (TIG Environmental, 2018a and 2019).

As shown on Figure 2.4, the stormwater system at the SPM Property is generally divided into four main areas and three smaller areas, which are based on the topographic survey performed by Axis Survey and Mapping in 2017 that was updated in 2022[11] (Appendix A.10) and dye tracer testing performed by TIG Environmental (2019). TIG Environmental also performed video camera surveys of the catch basins and stormwater lines to aid in identifying the drainage pathways; however, some blockages and broken pipes prevented identifying all connections (TIG Environmental, 2019). Specifically, the piping downstream of catch basins CB-02, CB-05, and CB-06 could not be verified, but all three are assumed to convey stormwater to the SPM Outfall (Figure 2.4).

Additional video camera surveys of catch basins CB-10 and CB-11 were performed by TIG Environmental in 2024 (TIG Environmental, 2024). The drainage connections that remain unknown are depicted as dashed lines on Figure 2.4. The TIG Environmental report (2019) detailing the mapping of the stormwater system is included in Appendix A.11, along with the updates resulting from the 2024 camera survey.

The following is a general discussion of the stormwater drainage at the SPM Property based on information provided by TIG Environmental (2019 and 2024) and observations Aspect made during the PLP site walk conducted on November 21, 2019.[12] The main areas are as follows:

- The majority of the central portion of the entire SPM Property (termed the Central Catchment Area) drains to the SPM Outfall (Figure 2.4). Stormwater within this catchment area flows overland to a series of catch basins (CB-04, CB-03, CB-02, CB-05, and CB-06) that then discharges to the SPM Outfall. The SPM Outfall is inaccessible, and its general discharge location north of the marina dock has only been determined by dye testing. The end of the outfall pipe is buried under the shoreline riprap, which is submerged during high tide.

  CB-01, also located within the central catchment area, was formerly connected to a sanitary sewer vault that drained to the municipal sewer system near the restroom facility, which has since been decommissioned; based on the topography, stormwater from CB-01 now flows overland to CB-05. A topographic survey is provided in Appendix A.10. The roof drain in the southwest corner of Legacy Master Marine discharges to the ground surface, where it infiltrates; during high-intensity rain events, some of this discharge may flow overland to CB-03 and subsequently to the SPM Outfall (TIG Environmental, 2019). The two southern roof drains on the Tire Factory building also discharge to the ground surface, and any resulting overland flow would be captured by CB-03 or CB-04 and subsequently to the SPM Outfall. Approximately 61 percent of the total SPM Property drains to the SPM Outfall (Figure 2.4).

[11] The 2017 topographical survey also includes a survey of pervious areas at the SPM Property, which were updated in a 2022 topographical survey following demolition of the buildings affected by the 2021 fire.

[12] No precipitation was observed during the November 21, 2019, site walk, so observations were limited to physical features and not flow patterns.

- The Southern Catchment Area within the southern portion of the SPM Property drains to a series of catch basins near the boat wash area (CB-07 through CB-09 and CB-11[13]) and into a stormwater vault before being pumped into the StormwateRx™ system for treatment (Figure 2.4). CB-07 is located upgradient of the boat wash pad, CB-08 is located in the boat wash pad, and CB-09 is located near the StormwateRx™ system (Figure 2.4). The StormwateRx™ system was installed in 2009 (Appendix A.9). After treatment, the stormwater in this catchment area discharges through the Unnamed Outfall No. 1 (UOF-1) to the LDW. During large storm events, stormwater bypasses the treatment system via an overflow pipe and discharges to a separate outfall (OF-2214) adjacent to UOF-1 as untreated stormwater. Additionally, stormwater from the SPM office building roof discharges to the ground surface and enters CB-08 as sheet flow, before being treated by the StormwateRx™ system and discharged to the LDW through Outfall UOF-1 or, in overflow events, Outfall OF-2214 (TIG Environmental, 2019). Approximately 21 percent of the total SPM Property drains to Outfall UOF-1.
- Along the northern side of the SPM Property, the Northern Catchment Area drains to CB-10, which is connected to a stormwater system operated by King County that flows north down South Thistle Street before discharging through Outfall OF-2215 (Figure 2.4). The two northern roof drains on the Legacy Master Marine building and the northwest roof drain on the Tire Factory building drain to OF-2215 via the 14th Avenue South curb drains (Figure 2.4). The northeast roof drain from the Tire Factory building also discharges to CB-10 and subsequently Outfall OF-2215 (TIG Environmental, 2019). Approximately 9 percent of the total SPM Property drains to Outfall OF-2215.
- The shoreline portion of the SPM Property immediately bordering the LDW (Shoreline Area) is generally unpaved gravel, and stormwater is assumed to infiltrate through this pervious surface (Figure 2.4). The roof drain in the northeast corner of Legacy Master Marine discharges to the subsurface, where water is allowed to infiltrate; during high intensity rain events, some of this discharge may daylight at the ground surface before flowing overland and reinfiltrating in the Shoreline Area (TIG Environmental, 2019). Approximately 8 percent of the total SPM Property infiltrates through this pervious surface.

The minor stormwater areas on the SPM Property are as follows:

- Stormwater in the northwest corner of the SPM Property, along Dallas Avenue South and South Thistle Street, flows into an unnamed catch basin on the SPM Property line, which discharges to the City's combined sewer system in Dallas Avenue South (City DSO, 2020). Approximately 0.5 percent of the total SPM Property drains to the City's combined sewer (area labeled "City Sewer System Area" on Figure 2.4).

[13] CB-11 was discovered during a site visit in 2024; TIG Environmental and SPM staff confirmed that water from CB-11 is conveyed to CB-08 (and ultimately the StormwateRx™ system).

- TIG Environmental reported that a sliver of land in the southwest corner of the SPM Property along Dallas Avenue South drains off the property and into the stormwater project associated with T-117 (TIG Environmental, 2019). Based on available LiDAR data and visual observations, it appears the land surface elevation in this corner of the SPM Property may be higher than and slopes to the Dallas Avenue South roadway. If this is the case, overland flow would be captured by the green stormwater infrastructure (bioretention/infiltration) installed in Dallas Avenue South, with overflow discharging to the LDW through the newly installed 17th Avenue South Storm Drain Outfall located in the Duwamish River People's Park (area labeled "17th Avenue S Storm Drain Area" on Figure 2.4). This drainage pathway is based on available topographic information but has not been confirmed via observation. This sliver of land represents approximately 0.3 percent of the total SPM Property.
- The boat ramp in the northeast corner of the SPM Property drains directly to the LDW and represents approximately 0.1 percent of the total SPM Property (area labeled "Boat Ramp Area" on Figure 2.4). During multiple wet-weather site visits, only de minimis amounts of stormwater (i.e., insufficient for sampling as described in Section 5.2.1.2) have been observed flowing down the boat ramp from precipitation that landed directly on the area. No overland flow from the other drainage areas has been observed to flow down the boat ramp during these multiple wet-weather site visits (Section 5.2).

The SPM facility discharges stormwater under a Boatyard General Permit (BYGP; Permit No. WAG030045), which is both a NPDES Permit and State Waste Discharge General Permit. The BYGP sets forth the requirements for stormwater runoff monitoring, boat wash water monitoring, discharge limits, reporting, and best management practices (BMPs). The current version of BYGP was issued on July 20, 2022; it became effective September 1, 2022, and expires on August 31, 2027.

As detailed below in Section 4.3.1, as of the date of this RI Report, SPM is constructing and implementing the stormwater treatment alternative selected in the Level Three Engineering Report approved by Ecology on August 19, 2022. The new infrastructure will include a second aboveground filtration system (StormwateRx™) and catchment area infrastructure upgrades, which will consist of the removal and replacement of catch basins CB-02, CB-05, and CB-06; decommissioning and replacement of existing stormwater conveyance lines between each of the basins; and replacement of the SPM Outfall. Discussions regarding final design and permitting are ongoing.

2.3.3 Property Access and Other Agreements

This section describes current access to the SPM Property and other agreements related to SPM Property maintenance.

2.3.3.1 Property Access

Presently, the South Parcel and the majority of the Central Parcel can be accessed through three driveways connected to Dallas Avenue South or through a driveway that traverses the east side of the North Parcel from South Thistle Street (Figure 2.1). These portions of the SPM Property are not secured. Parking and roll-up doors for garage bays for the Tire Factory are accessible from both Dallas Avenue South and South Thistle Street. Additionally, a small, chain-link fenced area is present on the south side of the Tire Factory building, which can be accessed through a locked gate from Dallas Avenue South.

A driveway off South Thistle Street on the north side of the North Parcel provides access to the front door and parking area associated with Legacy Master Marine. The remainder of the North Parcel is enclosed with a locking chain-link fence, which can be accessed through a gate from the driveway present in the east portion of this parcel.

The boat ramp is accessible from South Thistle Street at the north corner of the North Parcel. The docks associated with the SPM are accessible through a locked gate from the South Parcel.

2.3.3.2 Other Agreements

The Port and SPM entered into an agreement in 2015 for the care and maintenance of the southeast corner of the SPM Property (Figure 2.1). As part of the cleanup for the T-117 Early Action Area (EAA; Section 4.2.3), a granular activated carbon (GAC) geocomposite mat, sheet pile wall, riprap slope, and fencing were installed in this area. This work is further described in Section 4.2.3. The agreement states that the following activities at the property southeast corner shall be prohibited:

- Construction of new structures or uses causing surface surcharge loads exceeding 220 pounds per square feet applied to the area on, around, and upland of the embankment, especially on the portion of the sheet pile wall exposed above ground surface
- Construction of permanent or occupied structures without additional seismic assessment
- Vertical loads on protruding portions of the sheet pile wall exceeding 500 pounds
- Soil stockpiling

2.4 Adjacent Sites

Based on review of historical environmental data and records for nearby properties, four adjacent sites were identified as having potential relevance to the Site: the LDW to the east, the T-117 EAA to the south and west (subdivided as T-117 Adjacent Streets and Yards Removal Area, T-117 Upland Removal Area, and T-117 Sediment Removal Area), the former dry cleaner operations to the northwest, and the South Park Bridge replacement to the north. These sites are shown on Figure 2.5 and discussed below.

2.4.1 Lower Duwamish Waterway

The in-water portion of the LDW Superfund Site borders the SPM Property to the east. The LDW is the receiving body for stormwater, groundwater, and soil eroding from the Site. In accordance with the AO, evaluating the Site as a potential source of contamination to the LDW is a primary objective of this RI. The LDW has been the subject of numerous environmental investigations and characterization efforts. A detailed analysis of the contamination associated with the LDW can be found in the "Lower

Duwamish Waterway Remedial Investigation" (Windward, 2010). The information contained in this subsection is a summary of that work.

Before the 1850s, the LDW was historically occupied by Native American tribes who used the LDW for fishing, hunting, gathering, and some limited farming. As nonnative settlers moved to the area in the 1850s, the LDW shorelines were cleared, and wetlands were drained for agricultural and industrial purposes (Windward, 2003).

A cultural resource assessment for the south-adjacent T-117 Upland Property was performed by Cultural Resource Consultants, Inc. in 2011. They reported that this area of the LDW was traditional territory for the Duwamish Tribe of Southern Lushootseed speakers. Archaeological artifacts in this area may include basketry; wood; foodstuffs; fish weirs and other permanent constructions; hunting, fishing, and food processing tools; bone and shell implements; and midden deposits (CRC, 2011). There is a record of a Lushootseed place name in the wide flat of the abandoned river channel between Dallas Avenue South and the LDW shoreline, which is named *hwa'pitc1d*, translated as "where one throws something" (CRC, 2011). The nearest recorded Duwamish Tribe village is ^{Tu}*qwe'Ltid* (translated as "large open space" or "place of the fish spear"), which consisted of two longhouses located approximately 1 mile north of the SPM Property.

Dredging to transform the meandering Duwamish River into the straightened, engineered LDW to facilitate navigation began in the early 1900s, including the dredging of the historical tide flats where the mouth of the Duwamish River met Puget Sound. Dredged material from the tide flats and LDW was used to create Harbor Island and as part of channelization efforts along the waterway. The straightening and dredging of the LDW, which included deepening the channel to 50 feet from the mouth near Harbor Island at the Puget Sound to River Mile 4.5, was completed by 1920 (Windward, 2003). The upland areas along the LDW underwent heavy industrialization during the Industrial Revolution in the late 1800s to early 1900s as railroad and shipping improvements were made to service surrounding areas. During this time, many of the historical LDW mudflats were filled with soil from hills throughout Seattle. By the mid-1900s, heavy industry became the dominant land use in the vicinity of the LDW. In the vicinity of the SPM Property, the LDW had been channelized by the time of the 1940 aerial photograph, and the bank on the west side of the LDW appears to be unreinforced (Appendix A.1).

The LDW was formally added to the Superfund National Priorities List by the EPA in September 2001. Ecology subsequently listed the LDW under the authority of MTCA in February 2002. The Phase 1 RI for the LDW consisted of synthesizing existing environmental data and identifying candidate EAAs for targeted, expedited cleanup (Windward, 2003). The Port's T-117 Upland Property, the in-water Sediment Area adjacent to it, and an area of streets and yards adjacent to the T-117 Upland Property were identified as the "T-117 EAA" and subsequently remediated via a CERCLA non-time-critical removal action (NTCRA) (Section 2.4.2). The Phase 1 RI for the LDW was completed in 2010, and the final Feasibility Study for the LDW was completed in 2012. Following completion of the RI and Feasibility Study, the LDW ROD was issued by EPA in 2014. Since that time, additional investigations have been conducted along the Upper Reach of the LDW as part of the remedial design, including work near SPM (Sections 4.1.5 and 4.3.2). The basis of the remedial design was finalized in January 2024

(Windward and Anchor QEA, 2024), and cleanup construction of the Upper Reach began in fall 2024.

As described in the finalized remedial design, there is only one limited sediment remedial action area in the Marina Basin; the Marina Basin is referred to herein as the area along the SPM Property shoreline between the mean higher-high water (MHHW) line and the western boundary of the federal navigation channel, between River Mile 3.3 and 3.5. The limited sediment remedial action area in the Marina Basin is identified as Remedial Action Area 13, as shown on the map in Appendix A.12. The selected remedy for Remedial Action Area 13 is enhanced natural recovery, which includes the placement of a thin layer (nominally, 6 to 9 inches) of clean material. Remedial Action Area 13 is on a steep slope, and coarse material (gravelly sand) will be used in this area (Windward and Anchor QEA, 2024). Investigations in and near the Marina Basin are further described in Sections 4.1.5 and 4.3.2.

2.4.2 T-117 Early Action Area and Surrounding Rights-of-Way

The T-117 EAA borders the SPM Property to the south and west. The Duwamish Manufacturing Company and Malarkey Asphalt businesses operated from 1937 to 1978 and 1978 to 2000, respectively, and manufactured asphalt roof materials and tar from around 1937 to 1993 on what is today the Duwamish River People's Park. The Port acquired the property in 2000 and designated it "T-117" (Figure 2.5). During the Duwamish Manufacturing Company's operation of the asphalt manufacturing facility from the late 1960s through the mid-1970s, used oils,[14] some of which contained PCBs, were used as fuel for the asphalt manufacturing process. During Duwamish Manufacturing Company's and Malarkey Asphalt's use of the T-117 Upland Property as an unpaved industrial site, trucks exiting the property tracked PCB-contaminated dust and dirt onto Dallas Avenue South, as well as adjacent rights-of-way (ROWs), roadways (some unpaved), and residential properties (Windward et al., 2010).

Characterization and cleanup activities in and around the T-117 EAA were conducted from 1997 through 2017. The T-117 EAA (the Port's T-117 Upland Property in combination with the adjacent streets and yards) was identified in 2003 as an EAA for cleanup within the LDW Superfund Site to address PCB-contaminated LDW sediments and upland PCB sources impacting those sediments. The T-117 EAA NTCRA was performed as a joint response by the Port and the City in accordance with an Administrative Settlement Agreement and Order of Consent and under oversight by EPA with assistance from the United States Army Corps of Engineers (USACE). The NTCRA was completed in two coordinated phases, Phase 1 and Phase 2, as briefly described below, and focused on actions adjacent to the SPM Property. Following completion of the EAA work (including NTCRA), the Port constructed the Duwamish River People's Park, a habitat restoration and public access area, on the T-117 Upland Property.

During investigation activities conducted by the Port in March and December 2003 in preparation for the Phase 1 Sediment and Upland Area removal action, soil samples from ROWs on the neighborhood streets adjacent to the T-117 Upland Property were found to contain elevated concentrations of PCBs. Additional soil sampling, as well as sampling of street dust and catch basin solids, was performed by SPU and the King County Health

[14] Some used oils were obtained from Seattle City Light.

Department in 2004 and 2005 (Integral Consulting, Inc. [Integral], 2006). SPU completed a series of independent interim cleanup actions between December 2004 and October 2005 to address PCB-impacted soil in the streets, ROWs, and yards. Portions of those cleanup areas where soil was removed that are adjacent to the SPM Property are shown on Figure 2.5, and further described in Section 2.4.2.1. Following the interim actions, supplemental soil characterization was performed in 2006.

As part of the T-117 EAA characterization, a groundwater monitoring program was established in 2008 that continued until 2012 (Sealaska Environmental and Crete Consulting, Inc., 2012). Groundwater monitoring and sampling was conducted on a quarterly basis between the first quarter of 2008 and the third quarter of 2011, with one additional event in the second quarter 2012 (16 groundwater monitoring events total). The period of groundwater monitoring corresponds to the time frame between the independent SPU interim actions and the NTCRA Phases 1 and 2. A map showing the locations of groundwater monitoring wells and a table summarizing the groundwater analytical results is included in Appendix A.13.

2.4.2.1 SPU Independent Interim Actions

SPU's independent interim actions in the ROWs surrounding the T-117 Upland Property and SPM Property included the following elements, as summarized in Integral, 2006 (of which portions adjacent to the SPM Property are shown on Figure 2.5):

- Shallow excavation (6 to 12 inches) and placement of new gravel in the road shoulder along selected portions of Dallas Avenue South between 14th Avenue South and 17th Avenue South
- Grading and paving the City's ROW surrounding the triangle area bounded by Dallas Avenue South, 17th Avenue South, and South Donovan Street
- Removal of PCB-contaminated soil from residential yards at 8601 and 8609 17th Avenue South (0.5 to 8.5 feet below ground surface [bgs]), the SPM Storage Yard[15] at 8603 Dallas Avenue South (2 to 4.5 feet bgs), and from along the west side of 16th Avenue South (less than 0.5 feet bgs)

Additionally, SPU's independent interim actions included the following elements, which are not shown on Figure 2.5:

- Catch basin cleaning and removal
- Removal of PCB-contaminated street dust from the ROW along South Cloverdale Street east of 16th Avenue South and on South Donovan Street between 16th Avenue South and 17th Avenue South

[15] The SPM Storage Yard is another parcel of land (King County tax parcel No. 7884100490) owned by SPM on the southwest corner of 16th Avenue South and Dallas Avenue South. The SPM Storage Yard has reportedly only been used for storage activities.

- Installation of a temporary stormwater collection and treatment system to capture runoff from the newly paved roads, which ultimately discharged to the sanitary sewer system following treatment

Following the independent interim actions, additional soil investigations were completed to delineate the lateral and vertical extent of PCB-contaminated soils within the neighborhood streets and ROWs in 2006. Select maps from the Integral 2006 report summarizing the analytical results from the characterization conducted on behalf of SPU (both prior to and following the independent interim actions) and the areal limits and depths of independent interim actions are included in Appendix A.14.

2.4.2.2 Phase 1 Sediment and Upland Area Removal Action

The Port and City's Phase 1 removal action for the T-117 EAA, completed between March 2013 and January 2015, encompassed a 2.1-acre in-water sediment area (the T-117 Sediment Removal Area) and a 3.3-acre upland area (the T-117 Upland Removal Area), as shown on Figure 2.5. The in-water T-117 Sediment Removal Area was subdivided into three dredge units (DUs): DU1, DU2, and DU3 from south to north. The bank area was subdivided into three subareas: South Bank, Mid Bank, and North Bank from south to north. The North Bank borders the southern boundary of the SPM Property (AECOM Environment [AECOM], 2016).

Select maps and tables from the T-117 Revised Engineering Evaluation / Cost Analysis (Windward et al., 2010) and T-117 Removal Action Construction Report (AECOM, 2016) are provided in Appendices A.15-A.18, and include the following:

- Pre-removal sediment analytical data for the T-117 Sediment Removal Area (A.15)
- Post-removal confirmation and perimeter sediment sampling in the T-117 Sediment Removal Area (A.16)
- Pre-removal soil analytical data for the T-117 Upland Removal Area (A.17)
- Post-removal confirmation soil sampling in the T-117 Upland Removal Area (A.18)

The Phase 1 removal action for the T-117 EAA included the removal and off-site disposal of approximately 76,000 tons of upland soil and debris and 22,000 tons of in-water sediment and debris. Performance standards included bathymetric and topographic surveying, sediment confirmation sampling, soil confirmation sampling, and groundwater monitoring. Following excavation of soils and sediments (including localized over-excavation and resampling), concentrations of COCs for the T-117 EAA detected in soil and sediment confirmation samples complied with respective removal action levels (RvALs). In addition, based on statistical evaluation of groundwater quality data collected from the T-117 EAA Upland Property between 2008 and 2012 and from monitoring wells located upgradient of it, groundwater concentrations at the T-117 EAA were determined to meet groundwater RvALs (Integral, 2018). Phase 1 removal activities also included installation of a sheet pile wall along the southeast corner of the SPM Property. Additional information regarding this can be found in Section 4.2.3.

2.4.2.3 Phase 2 Residential Yards and Adjacent Streets Removal Action

The City completed the Phase 2 removal action for the T-117 EAA with an objective to reduce soil PCB concentrations in upland soils to ensure protection of LDW sediment. The Phase 2 cleanup was accomplished in two parts: the Residential Yards cleanup completed in 2013, and the Adjacent Streets and Stormwater cleanup completed in 2016. Together, the soil excavations during Phase 2 of the T-117 EAA for Residential Yards cleanup and the Adjacent Streets and Stormwater cleanup are referred to herein as the T-117 Adjacent Streets and Yards Removal Area. For both projects, the lateral and vertical extents of soil excavation for the Phase 2 removal action were determined and approved by EPA based on an extensive pre-design sampling program conducted to support the removal action design, which is summarized in the T-117 Revised Engineering Evaluation / Cost Analysis (Windward et al., 2010). Select maps from that report displaying pre-removal soil analytical data for the T-117 Adjacent Streets and Yards Removal Area are included in Appendix A.19.

Soil excavation occurred where total PCB concentrations exceeded a 1-milligram per kilogram (mg/kg) RvAL. For removal area decision units that had been characterized using multi-incremental sampling, an RvAL of 0.5 mg/kg total PCBs was used to define soils to be removed. The predefined lateral and vertical extents of excavation units were confirmed by survey with acceptance by USACE or EPA on-site representative. Post-excavation confirmation sampling was not conducted within the excavations. The completed excavations were backfilled with imported granular backfill to restore grades; import material analytical test results were approved by EPA prior to use (Integral, 2013 and 2017). Post-excavation site restoration was specific to residential yards and streets. Additional information specific to each of the T-117 EAA Phase 2 projects is provided below.

Residential Yards Cleanup

The Residential Yards removal action included removal of PCB-contaminated soils from eight residential properties, from the planting strips along South Cloverdale Street, and from the alleyway between South Cloverdale Street and South Donovan Street located west and south of the SPM Property; selected areas near the SPM Property are shown on Figure 2.5. The primary construction elements of the removal action included stripping and removal of residential sod, vegetation, and structures within the removal area footprint, excavation and off-site disposal of residential yard and alleyway soil and debris, placement of clean backfill and topsoil materials, and restoration and landscaping of all disturbed areas. A map showing the areal limits of the Residential Yards excavations and a table showing the planned vertical extents of each excavation area from the Removal Action Design Report–Residential Yards Area (Integral, 2012) is included as Appendix A.20. The removal action achieved the removal goals within the boundaries and depths of all the designated yards, planting strips, and the southern alleyway. In total, approximately 2,187 tons of PCB-contaminated soil were removed and disposed of during this removal action (Integral, 2013).

Restoration of the properties included placement of sod in lawn areas, planting of trees, shrubs and other plants in designated locations, and the construction of fences, sidewalks, and other hardscape features in accordance with the contract documents (Integral, 2013).

Adjacent Streets and Stormwater Cleanup

The Adjacent Streets and Stormwater cleanup included both active remediation and infrastructure improvements completed in 2015 and 2016, as well as long-term monitoring and maintenance that is ongoing, as described in the subsections below.

2015 and 2016 Soil Removal and Infrastructure Upgrades

The Adjacent Streets cleanup removed PCB-contaminated soil from portions of the City ROWs of 16th Avenue South, 17th Avenue South, Dallas Avenue South, and South Donovan Street; selected areas near the SPM Property are shown on Figure 2.5. A map showing the areal limits of the Adjacent Streets excavations and a table showing the planned vertical extents of each excavation area from the Removal Action Design Report–Adjacent Streets and Stormwater (Integral et al., 2014) is included as Appendix A.21. In total, the Adjacent Streets cleanup permanently removed approximately 28,000 tons of non-Toxic Substances Control Act (TSCA)-regulated soil (total PCB concentrations less than 50 mg/kg) and approximately 240 tons of TSCA-regulated (greater than 50 mg/kg total PCBs) soil and debris (Integral, 2017).

This project also included construction of new stormwater infrastructure for the Adjacent Streets Area of the EAA. The new stormwater management system comprises structures such as catch basins and maintenance holes, storm drainpipe, the 17th Avenue South Storm Drain Outfall (Figure 2.3), Filterra® tree box units, and vegetated bioretention cells. At the conclusion of the removal action, restoration of the streets included installation of curbs and gutters, asphalt pavement, sidewalks, plantings, and other features in accordance with the construction documents (Integral, 2017).

Long-Term Monitoring and Maintenance

The City is monitoring and maintaining the new stormwater system in accordance with an EPA-approved Long-Term Monitoring and Maintenance Plan (Integral and AECOM, 2016). In October 2022, as part of a long-term monitoring program, SPU collected an annual sample from a sediment trap near the end of the pipe at the 17th Avenue South Storm Drain Outfall (SPU, 2023). The sediment trap contained only limited settled solids material, which were analyzed for PCBs. Concentrations of PCBs were above the cleanup screening level /second lowest apparent effects threshold (CSL/2LAET), and targeted screening of the Adjacent Streets and Residential Yards section of the T-117 EAA was conducted in January, February, and March of 2023.

Seventeen samples of settled solids were collected from catch basins in January and February 2023 and analyzed for PCBs; concentrations of PCBs in each sample were below the CSL/2LAET. Samples near the Duwamish River People’s Park and Dallas Avenue South (south of the SPM Property along the Duwamish River People’s Park) did not contain detectable concentrations of PCBs; PCBs were detected at concentrations less than the CSL/2LAET in samples collected from runoff from 16th Avenue South (SPU, 2023).

In March 2023, SPU contracted a company to use canine scent detection of PCBs to further determine the locations of potential sources of PCBs in the Adjacent Streets and Residential Yards section of the T-117 EAA. Jasper, the PCB-detecting canine, screened the entirety of the publicly accessible areas served by the 17th Avenue South Storm Drain Outfall. Jasper showed interest in the following areas (SPU, 2023):

- A vegetated area between the roadway and swales on the north side of 16th Avenue South
- Between two buildings on the south side of 16th Avenue South
- A vegetated area on the residential property in the northwest corner of 16th Avenue South and Dallas Avenue South

Jasper indicated PCB presence by “hitting” on the following areas (SPU, 2023):

- Along the east side of Dallas Avenue South in the southwest corner of the SPM Property
- Along the fence line of the SPM Storage Yard on the southwest corner of Dallas Avenue South and 16th Avenue South

As described in SPU’s report, interest indicates that the dog is investigating the odor of PCBs but may not be able to identify the location where the odor is coming from, whereas the dog “hitting” on a source indicates it is confident they have identified where the PCB odor is coming from (SPU, 2023).

SPU’s source tracing efforts concluded that PCBs were present in some surface soil on private property and vegetated areas primarily along 16th Avenue South and Dallas Avenue South. The tracing efforts found very low volumes of settled solids in the stormwater infrastructure in this area. SPU determined that weekly to biweekly street sweeping and annual cleaning of catch basins and inlet structures should reduce material loading to the drainage system, and SPU planned to reconduct targeted source trace sampling and near end-of-pipe sampling to track changes in PCB concentrations (SPU, 2023).

During this time, SPU also collected underdrain samples from a Filterra® box located on the southwest corner of 16th Avenue South and Dallas Avenue South, near the SPM Storage Yard. PCBs were detected in several samples throughout 2023, and SPU removed and replaced the filter material and tree in March 2024 (SPU, 2025). PCBs were intermittently detected in the underdrain water samples between May and June 2024, and SPU decided to perform further maintenance on the Filterra® box, which included removal of the filter material and tree, pressure washing the Filterra® vault, and replacement of the filter material and tree.

SPU collected another annual sample from the sediment trap near the end of the pipe at the 17th Avenue South Storm Drain Outfall on April 10, 2024. There was only minimal sediment accumulation, with approximately 3 tablespoons of material in the sediment trap. PCBs were once again detected at concentrations above the CSL/2LAET (SPU, 2025). SPU collected an additional 10 samples of settled solids from the catch basins upstream of the 17th Avenue South Storm Drain Outfall in January and March 2024. SPU concluded that PCB concentrations were elevated in two locations: the soil surrounding a tree at the intersection of 16th Avenue South and South Donovan Street (which was not remediated during the initial Adjacent Streets Area cleanup to avoid damaging the tree that had since died), and in surface soil that was present on the driveway cut to the SPM Storage Yard (SPU, 2025). SPU also concluded that while concentrations of PCBs remained elevated from samples collected within the basin, the volume of settleable solids reaching the 17th Avenue South Storm Drain Outfall was very low due to filtration occurring in the bioswales and Filterra® boxes.

In 2025, SPU will once again sample the sediment trap near the end of the 17th Avenue South Storm Drain Outfall. SPU is coordinating the removal and replacement of the dead tree and soil at the end of 16th Avenue South and South Donovan Street. SPU is also planning to collect additional surface soil samples adjacent to the SPM Storage Yard and additional underdrain water samples from the Filterra® box in this area that underwent cleaning and filter media replacement in 2024 (SPU, 2025).

2.4.3 Former Dry Cleaners

Multiple dry cleaners historically operated west of the SPM Property, across Dallas Avenue South (Figure 2.2), on King County tax parcel 7883608688. The building is associated with multiple addresses including 8500, 8506, and 8510 14th Avenue South currently and 8502, 8507, and 8508 historically. Property records indicate the building was constructed in 1940 (King County, 2023). A historical photograph from 1941 shows the building branded as Night Cap Tavern (ECOSS, 2016). Research into the history of the tax parcel (TIG Environmental, 2023b) identified the following businesses that were likely to use solvents, including known dry-cleaning operations that may have used tetrachloroethene (PCE), at the property during the following time frames:

- Kleen Rite Cleaners, 1951 to 1955
- Marshall Dick Furs ret sls, 1973
- Sun Painting, 1978
- Grent’s New or Renew Furniture, 1979-1981
- Whitney R T uphol. / R T Whitney Co. 1982-1983, 1985
- Regency II Cleaners, 2006-2014
- Dry Cleaning Solutions, 2010-2013

The building appears vacant (based on observations made in 2023 and 2024), and the owner is listed as MDY Enterprises, LLC (King County, 2023). Based on information collected during the RI, Ecology completed an initial investigation in early 2023 and added the property to its confirmed and suspected contaminated site list. The site is identified as the Dallas Ave S PCE Site, Facility/Site ID 99999008, and Cleanup Site ID 16765. Ecology transmitted an Early Notice Letter to the property owner on May 17, 2023, informing them that the site had been listed. No additional actions have been taken in regard to the site by the property owner or Ecology since that time.

2.4.4 South Park Bridge

The new South Park Bridge north of the Site was constructed between August 2011 and June 2014 and involved substantial earthwork and regrading along 16th Avenue South between Dallas Avenue South and the LDW. Environmental sampling of soil and groundwater was conducted to support bridge construction activities, and two USTs in the vicinity of the SPM Property were encountered and removed (see Section 4.2.2). The project also included installation of a large-scale rain garden and other new stormwater infrastructure along the 16th Avenue South corridor, providing stormwater infiltration north of the SPM Property.

Other nearby properties not listed in this report were deemed unlikely sources to the upland Site.

2.5 Environmental Justice Screening

Washington state is committed to reducing environmental and health disparities in the state and improving the health of all its residents. State and national studies have found that people of color and low-income people continue to be disproportionately exposed to environmental harms in the places they live. As a result, there is a higher risk of adverse health outcomes for those communities. This risk is amplified when overlaid on communities with preexisting social and economic barriers and environmental risks, creating cumulative environmental health impacts.

In order to address and prevent such environmental health disparities, Ecology requires RIs to include a determination of whether the population threatened by a contaminated site includes a likely vulnerable population or overburdened community (WAC 173- 340-350(6)(h)(iii)).

- Vulnerable populations are groups that are more likely to be at higher risk for poor health outcomes in response to environmental harms, due to: (i) adverse socioeconomic factors, such as unemployment, high housing and transportation costs relative to income, limited access to nutritious food and adequate health care, linguistic isolation, and other factors that negatively affect health outcomes and increase vulnerability to the effects of environmental harms; and (ii) sensitivity factors, such as low birth weight and higher rates of hospitalization. Vulnerable populations include, but are not limited to, racial or ethnic minorities, low-income populations, populations disproportionately impacted by environmental harms, and populations of workers experiencing environmental harms.
- An overburdened community is defined as a geographic area where vulnerable populations face multiple, combined environmental harms and health impacts and includes, but is not limited to, highly impacted communities. Highly impacted communities are communities designated by the Washington State Department of Health (DOH) based on cumulative impact analyses or a community located in census tracts that are fully or partially on "Indian country" as defined in 18 U.S.C. Sec. 1151.

In accordance with the legislation, this RI includes an environmental justice screening to determine whether the potentially exposed population includes a likely vulnerable population or overburdened community. This screening is conducted in accordance with the Healthy Environmental Act for All Act, Chapter 70A.02 RCW, WAC 173-340-200. Tools identified in Ecology’s guidance (Ecology, 2024a) were used to complete the environmental justice screening, including the Environmental Health Disparities (EHD)

Index from the EHD Map maintained by the DOH (2022) and the EJScreen tool from the EPA[16] (EPA, 2023).

2.5.1 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 SPM Property is contained within census tract 53033026400, whose boundary runs along Dallas Avenue South. To the west of Dallas Avenue is census tract is 53033011200.

Both communities had an overall environmental health disparity ranking of 10, which is the highest ranking. This ranking is calculated based on environmental exposures, environmental effects, socioeconomic factors, and sensitive populations:

- Environmental exposures had a high ranking (10 for the SPM Property and 9 for the west side of Dallas Avenue), due to the proximity to heavy industry and Boeing Field / King County International Airport, associated diesel PM2.5 emissions, and toxic releases from facilities along the LDW.
- Environmental effects had a high ranking (10 for both census tracts) due to the proximity to an EPA Superfund site (the LDW); proximity to hazardous waste treatment, storage, and disposal facilities; proximity to facilities with risk management plans; and proximity to wastewater discharges.
- Socioeconomic factors had a high ranking (10 for both census tracts) due to limited English speaking, lack of high school diplomas, unaffordable housing, unemployment, percent of population living in poverty, and percentage of people of color (64 to 70 percent, depending on census tract).
- Sensitive populations had a high ranking (9 for the SPM Property and 10 for the west side of Dallas Avenue) due to high death rates from cardiovascular disease and high percentages of low birth weight.

2.5.2 EJ Screen Results

The EJScreen tool from EPA is divided into census block groups similar to the communities in the EHD Map. The SPM Property is in block group 530330264001 and is bordered to the west side of Dallas Avenue by block group 530330112003. Both of these block groups were selected for the environmental justice screening in order to capture all areas of the community that may be affected.

The EJScreen tool was used to assess socioeconomic indicators including the Demographic Index (low income and people of color) and the Supplemental Demographic Index (low income, unemployment, lack of English proficiency, less than high school education, and low life expectancy). The results are summarized below:

[16] Since the time of the initial analysis using the EJScreen tool in 2024, the tool has been removed from the EPA's website.

- Demographic Index:
  - The Demographic Index for the SPM Property block group is within the 97th percentile for the state and the 87th percentile for the nation.
  - The Demographic Index for the block group to the west of Dallas Avenue is within the 82nd percentile for the state and the 78th percentile for the nation.
- Supplemental Demographic Index:
  - The Supplement Demographic Index for the SPM Property block group is within the 98th percentile for the state and the 94th percentile for the nation.
  - The Supplemental Demographic Index for the block group to the west of Dallas Avenue is within the 95th percentile for the state and the 86th percentile for the nation.

2.5.3 Overall Environmental Justice 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 Department of Health'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, 2024a). The Site is located in two census tracts that each have a ranking of 10 on the EHD Map, are within the 80th percentile of the Demographic Index for the state, and are within the 80th percentile of the Supplemental Demographic within the state. Therefore, the potentially exposed population includes a likely vulnerable population or overburdened community, and MTCA would require an assessment of the impact of potential cleanup actions on vulnerable populations be included when evaluating remedial alternatives.

2.6 Regulatory Site History

The first environmental investigations of the SPM Property were conducted in 2002, beginning with the collection of limited surface soil samples in the area of the former A&B Barrel Co. operations (Windward, 2006). In 2004, the SPM Property was identified for further investigation because of concern that it could potentially recontaminate sediments in the LDW (SAIC, 2004). On behalf of Ecology, additional environmental investigations of the SPM Property were completed in 2007 and 2008, specifically for the former A&B Barrel Co. operations as a Recontamination Assessment Area (SAIC, 2008a). Those investigations documented contamination of soil and groundwater in the southeast portion of the Property, near the Former A&B Barrel Pond, exceeding applicable MTCA cleanup levels. Due to the documented soil and groundwater contamination on the SPM Property, Ecology performed a site hazard assessment in 2015 and assigned the Site an overall hazard ranking of 2, where 1 represents the highest relative risk and 5 the lowest.

In 2016, Ecology issued three determinations establishing the PLPs for the Site (Ecology, 2019):

- SPM was determined to be a PLP based on being the owner and operator of the existing facility where a release has occurred.
- The Port was determined to be a PLP based on the CWD being an owner of a facility (i.e., Historical Parcel D) at the time of a release associated with former A&B Barrel Co. operations.
- The City was determined to be a PLP based on being the current owner and operator of the ROW (a MTCA "facility") adjacent to SPM where hazardous substances were released. The City was also an arranger who owned or possessed hazardous substances and who, by contract, agreement, or otherwise, arranged for disposal or treatment of hazardous substances.

On April 3, 2019, the three PLPs entered into the AO with Ecology to complete an RI for the Site. The AO identified the following deliverables to be prepared:

- The RIWP, which was approved by Ecology on February 8, 2021. Addenda to the RIWP (which were not explicit deliverables of the AO), included
  - the RIWP Addendum, approved by Ecology on August 25, 2022;
  - the Proposed Indoor Air Sampling Plan Memorandum, approved by Ecology on February 16, 2023; and
  - the Proposed Phase 3 Groundwater Sampling Memorandum, approved by Ecology on March 9, 2023.
- The Source Control Review Memorandum, which was approved by Ecology on September 2, 2022, and its addendum (which was not an explicit deliverable of the AO), which was approved by Ecology on February 26, 2024.
- This RI Report.

In addition to the AO deliverables, in October 2023, Ecology requested an evaluation of existing sediment data near the SPM Property. That evaluation was presented in the draft Sediment Data Evaluation Memorandum and reviewed with Ecology in a meeting on May 20, 2023. As requested by Ecology, the sediment evaluation is included in this RI Report, with the content of the draft Sediment Data Evaluation Memorandum integrated into various sections of this RI Report.

3 Environmental Setting

This section provides a summary of the SPM Property's physical characteristics, including topography, adjacent surface water features, geology, and hydrogeology.

3.1 Upland Topography, Surface Drainage, and Shoreline Modifications

The upland portion of the SPM Property is relatively flat and varies in elevation between 14 and 20 feet (NAVD88).[17] Generally, the SPM Property grades gently from Dallas Avenue South towards the LDW. South Thistle Street, on the northern edge of the SPM Property, grades downward from an approximate elevation of 20 feet at the northwest corner of the SPM Property to an elevation of 14 feet at the northeast corner. The South Thistle Street ROW drains to stormwater catch basins and conveyance piping which flows east to an outfall into the LDW (OF-2215; Figure 2.4). The residential area to the west of the SPM Property is generally flat at an approximate elevation of 20 feet. The ROWs along Dallas Avenue South were redeveloped by the City to drain to bioswales with overflow directed to the 17th Avenue South Storm Drain Outfall (Figure 2.4).

The shoreline along the eastern boundary of the SPM Property consists of an ecology block retaining wall and riprap along the eastern base of the wall (within LDW intertidal zone). The top of the ecology block retaining wall varies between elevations of 12 and 14 feet, based on topographic survey information collected during the RI. The riprap and bank soils on the waterward side of the ecology blocks are typically submerged, as the LDW fluctuates in elevation between an approximate MHHW of 8.95 feet and a mean lower-low water (MLLW) of -2.35 feet.

Shoreline modifications along the SPM Property generally involved the dredging and removal of material from the bank, with the exception of the 1981 dredging event (Figure 2.2). Based on historical aerial photographs, modifications appear to have been conducted around 1952, 1957, 1959, 1961, 1981, and 1992 (Appendix A.1). Three documented dredging events have occurred in-water along the SPM Property, and at least one of these events included shoreline modification (TIG Environmental, 2020):

- In 1957, General Construction Company was authorized to dredge approximately 8,400 cy. The area to be dredged was part of a CWD lease area that had been leased to the owner of South Park Boat Haven. There is no documentation that the permitted dredging was completed.
- In 1981, SPM contracted General Construction Company to dredge and dispose of material along the shoreline, which was permitted by the USACE. Records indicate that approximately 26,742 cy of material were dredged and disposed (Appendix A.2). The permitted disposal location was the Four Mile Rock Deep Water Disposal Site or the SPM Property upland, but no final disposal records were identified to confirm the disposal location (TIG Environmental, 2020). In

[17] All elevations in this RI Report are relative to the North American Vertical Datum of 1988 (NAVD88).

addition to dredging, this project entailed excavation of near-shore upland soils to move the bank approximately 15 feet farther west.

- In 1992, SPM contracted AH Power Co. and Industrial Pond Services to dredge the Marina Basin to restore moorage depth, which was permitted by the USACE. The dredged materials were authorized to be disposed of at the Elliot Bay Puget Sound Dredge Disposal Analysis Open-Water Disposal Site. A total of 5,688 cy of material were dredged.
- In 2014, during the T-117 EAA Phase 1 cleanup, the southeast corner of the SPM Property was modified by removal of sediment and bank soil and installation of a sheet pile wall and subsurface GAC mat (refer to Section 4.2.3).

3.2 Geology and Hydrogeology

The general description of the regional geology and hydrogeology for the LDW basin is primarily adapted from Booth and Herman (1998). Site-specific geology, hydrostratigraphy, and groundwater conditions are adapted from environmental characterizations performed on the SPM Property as part of the RI, the south-adjacent T-117 Upland Property, and the South Park Bridge replacement project to the north.

3.2.1 Regional Geology

The Duwamish valley was formed between 10,000 and 15,000 years ago during the latest period of glaciation. As the ice sheets retreated, the Duwamish arm of the Puget Sound extended as far south as Auburn until approximately 5,700 years ago. Concurrently, the Osceola Mudflow traversed from Mount Rainier along the White River valley. The mudflow sediments spread along the Duwamish arm of the Puget Sound, including submarine deposits as far north as Kent. The White River subsequently eroded and redeposited these mudflow sediments farther downstream in the Green River and Duwamish valleys into the Puget Sound over thousands of years (Booth and Herman, 1998).

The Seattle Fault, oriented east-west and extending beneath the mouth of the LDW, ruptured about 1,100 years ago and resulted in an approximately 20-foot uplift on the south (LDW-upstream) side of the fault. This uplifting would have resulted in a marked decrease of the river's depth, potentially raising its riverbed and floodplain above the sea level at that time. The Duwamish River subsequently eroded and formed the channel that is mapped as the "historical" river channel prior to subsequent anthropogenic interference (Booth and Herman, 1998).

Historically, the Duwamish River's major tributaries included the Green, Black, and White Rivers. By the 1900s, flooding became a concern for settlers around the river, and a combination of levees, dams, and channelization of the river was used for flood control. In the Great Flood of 1906, the White River became diverted by natural log/debris jams from the Green River into the Puyallup River. Continued diversion in the Duwamish watershed for both flood control and irrigation resulted in an approximately 70 percent reduction of flow in the LDW throughout the 1900s. The Black River, one of the Duwamish River's major tributaries, was fed by Lake Washington and the Cedar River. In 1916, Lake Washington was connected to Lake Union, the Cedar River was rerouted to Lake Washington, and the subsequent reduction in the lake elevation resulted in the elimination of the Black River (Windward et al., 2010).

Deepening and straightening of the Duwamish River to create the LDW, and thereby facilitate navigation, began in 1913. Dredged material from the tide flats and LDW was used to create Harbor Island and in channelization efforts along the LDW. Booth and Herman (1998) note that the nature of the fill material, a heterogenous mix of silts and sands sourced from the LDW for the channelization effort, often makes it difficult to distinguish from native alluvium. The heterogenous nature of fill soil can create complex hydrogeologic interactions, including the development of preferential flow paths.

3.2.2 Site Geology

The interpretation of the Site geology presented below is based on geologic mapping (Troost et al., 2005) and available boring logs for the Site, including those explorations completed during the RI. Historical boring logs from SAIC (2008a) and TIG Environmental (2019) are included as Appendix B.1; boring logs completed as part of the AO RI (Section 5) are included as Appendix B.2. Locations of subsurface explorations are shown on Figure 3.1.

Based on explorations completed to date, soils at the SPM Property are generally divided into five distinct units based on their depositional characteristics, outlined here from top to bottom:

- **Fill Unit**. The Fill Unit consists of anthropogenic fill material, likely a result of the dredging of the LDW and/or regrading of nearby hills, and it is present throughout the Site. The fill material generally consists of sand, silty sand, or sandy silt and has been documented to depths between 5.25 and 15.5 feet (at SB-33 and MW-14, respectively) and to an average depth of approximately 10 feet. The anthropogenic fill material also includes a layer of base course that is present just beneath the paved portions of the SPM Property. The base course primarily comprises gravel/crushed rock with varying amounts of sand and silt and has been documented at thicknesses up to 1 foot.

- **Pond Fill Unit.** The Pond Fill Unit also consists of anthropogenic fill material but of unique origin and composition. Based on available historical data, the Former A&B Barrel Pond was allegedly filled with debris from the 1960 fire that destroyed the former A&B Barrel Co. facility. Pond fill material was observed during Phase 2 of the RI to a depth of 10 feet at boring SB-42, located in the Former A&B Barrel Pond footprint. The Pond Fill material consists of silty sand and gravelly silt with anthropogenic debris, which was easily recognizable in the field, and had chemical sheens and strong chemical odor during drilling. The anthropogenic debris included brick and charcoal fragments, plastic sheeting and other plastic debris, and pieces of wood.

- **Tidal Flat Unit.** The Tidal Flat Unit consists of tidal flat deposits that can be characterized by their distinctive coloration (gray to red-brown), grain size, and/or sulfur-like odor. The Tidal Flat Unit generally consists of organic silt, silt, sandy silt, and silty sand and frequently contained woody, organic matter. These deposits were present in 39 of the 47 borings drilled as part of the Phase 1 and

Phase 2 RI fieldwork, except in two areas of the Site as shown on Figure 3.2: in the vicinity of the historical boat manufacturing building along the shoreline (SB-27, SB-41, MW-08, and MW-08D) and along Dallas Ave (MW-17, MW-18, MW-18D, and MW-20). Troost et al. (2005) mapped most of the SPM Property as within a historical meander/oxbow of the Duwamish River (Figure 3.2) and identified the Tidal Flat Unit as a younger alluvium that can locally contain soft peat lenses and woody debris, which is consistent with the organic material encountered in the RI borings. This unit has been documented at thicknesses up to 10.5 feet in the northwest corner of the SPM Property. The top of the Tidal Flat Unit has been observed at depths of 5.25 to 15 feet bgs (SB-33 and SB-30, respectively), and the bottom of the Tidal Flat Unit has been observed at depths of 6.5 to 22 feet bgs (SB-33 and MW-13, respectively). Where the Tidal Flat Unit is absent, the Fill Unit directly overlies the Alluvial Unit described below.

- **Alluvial Unit.** The Alluvial Unit consists of alluvial deposits that were present in all borings advanced during the RI (except for MW-16 and MW-19, which were too shallow to reach the Alluvial deposits). The Alluvial Unit is typified by a poorly graded, fine- to medium-grained, subangular sand with trace to little fines. The alluvial deposits varied in color between gray-brown to black. These deposits have been documented at thicknesses up to 17 feet (MW-08D), but it is important to note that the bottom of these deposits was not observed in the majority of borings at the Site, except in the select borings where the Glacial Till Unit was encountered. The top of the Alluvial Unit has been observed at depths of 6.5 to 22 feet bgs (SB-33 and MW-13, respectively), and where borings extended deep enough to encounter the underlying Glacial Till Unit, the bottom of the Alluvial Unit has been observed at depths of 20 to 34.5 feet bgs (MW-16D and MW-13D, respectively.
- **Glacial Till Unit.** The Glacial Till Unit is typified as a low plasticity sandy silt to silt containing fine-grained sand and fine, rounded gravel, which appeared to be very stiff and graded downward to a gray, stiff silt. The Glacial Till Unit is inferred to be present beneath the Alluvial Unit across the entire Site, but was only observed in the following three areas of the SPM Property where drilling extended deep enough:
  - The southeast corner of the SPM Property (at MW-04D, MW-05, MW-05D, MW-06D, and MW-16D) at depths of 20 to 22 feet bgs
  - The southwest corner of the SPM Property (at MW-18D) at a depth of 23.5 feet bgs
  - The northwest corner of the SPM Property (at MW-13D) at a depth of 34.5 feet bgs

  The Glacial Till Unit was not encountered in the northeast corner of the SPM Property at the maximum depth explored in that area (25 feet bgs; MW-11D); however, geotechnical borings advanced as part of the South Park Bridge replacement suggest that glacial till is present near this portion of the SPM Property and dips to the north to depths greater than 60 feet bgs. South of the

SPM Property at the T-117 property, glacial till was encountered at a depth of approximately 50 feet bgs in a shoreline boring located approximately 290 feet south of the SPM Property boundary (Windward et al., 2010) indicating the Glacial Till Unit, on a local scale, may dip southwards from a local maximum near the southern SPM Property boundary.

The current understanding of shallow subsurface geologic conditions at the Site is depicted in cross section view on Cross Sections A-A’ through E-E' (Figures 3.3 through 3.7), and the cross section transect locations are shown on Figure 3.1. Key observations for each cross section are described below.

- **Cross Section A-A’ (Figure 3.3).** Cross Section A-A’ is aligned generally west-east along the southern SPM Property boundary and transects the Former A&B Barrel Pond, as well as the southeast SPM Property corner where shoreline work was performed as part of the T-117 EAA cleanup in 2014 (described in detail in Section 4.2.3). As shown on the cross section, the sheet pile wall in the southeast SPM Property corner fully penetrates the Fill Unit and Tidal Flat Unit. The reported depth of installation of the sheet pile wall was between 20 and 22 feet bgs, which penetrates into the Alluvial Unit. The sheet pile wall penetrates most of the Alluvial Unit thickness, but it is uncertain whether the sheets fully penetrate the Alluvial Unit and terminate in the Glacial Till Unit (Figure 3.3). The Glacial Till Unit was encountered in the southeast corner of the SPM Property at depths of 20 to 22 feet bgs and along Dallas Avenue at a depth of 23.5 feet bgs, which is consistent with geotechnical borings performed nearby in Dallas Avenue. The Tidal Flat Unit was not observed at MW-18 and MW-18D in the southwest corner of the SPM Property.

- **Cross Section B-B’ (Figure 3.4).** Cross Section B-B’ is aligned north-south along the SPM Property shoreline. In the vicinity of the historical boat manufacturing building, the Tidal Flat Unit was not encountered in shoreline borings SB-27, SB-41, MW-08, and MW-08D. This unit was observed at SB-28 located slightly further inland, but at a higher elevation and thinner than in other borings throughout the SPM Property. The Tidal Flat Unit may have been disturbed/removed in this area during the historical shoreline improvements described in Section 3.1 above. The Glacial Till Unit was only encountered in deeper borings installed in the southeast corner of the SPM Property, but it is depicted as dipping to the north in this north-south orientation because it was not observed until depths of at least 60 feet bgs in geotechnical borings performed as part of the South Park Bridge replacement to the north of this transect.

- **Cross Section C-C’ (Figure 3.5).** Cross Section C-C’ is aligned west-east along the northern portion of the SPM Property. The Tidal Flat Unit was observed at its greatest thickness (10.5 feet) at MW-13 and MW-13D located near the northwest corner of the SPM Property, but it was not observed in Dallas Avenue at MW-20. It should be noted that the Tidal Flat Unit was much thinner (0.5 feet) at MW-12 in the north-central portion of the Property. This change in thickness may be due to the alignment of the historical Duwamish River oxbow in this portion of the SPM Property (Figure 3.2).

- **Cross Section D-D' (Figure 3.6).** Cross Section D-D' is aligned west-east through the central portion of the SPM Property. The Tidal Flat Unit was observed in the middle portion of this transect on the SPM Property, but it was not observed along the shoreline to the east of the historical boat manufacturing building or in the boring closest to Dallas Avenue South.
- **Cross Section E-E' (Figure 3.7).** Cross Section E-E' is aligned north-south through the southeast SPM Property corner and extends onto the Duwamish River People's Park. This cross section displays the current conditions in this area following the remedial efforts for the T-117 Sediment Area and T-117 Upland Area (sheet pile wall, GAC mat; Sections 2.4.2.2 and 4.2.3) and the habitat restoration conducted to establish the Duwamish River People's Park.

3.2.3 Site Hydrostratigraphy and Groundwater Conditions

Groundwater occurs in the Fill, Tidal Flat (where present), Alluvial, and Glacial Till Units at the Site, but groundwater flow is primarily limited to the Fill and Alluvial Units. The Tidal Flat and Glacial Till Units are aquitards that limit groundwater flow due to the grain size and compaction (and therefore lower hydraulic conductivity) of those two Units. This section describes the occurrence and characteristics of groundwater in the two primary hydrostratigraphic units (the Fill and Alluvial Units), the interconnectivity of those units throughout the Site,[18] and a CSM specific to groundwater occurrence and flow in the southeast corner of the SPM Property where a sheet pile wall was installed as part of the T-117 EAA cleanup (further described in Section 4.2.3). This interpretation of hydrostratigraphy at the Site is based on the following data collected as part of the RI, which are further detailed in Section 5.1 below:

- Lithology observed during soil borings and monitoring well installations (Appendix B)
- The Phase 1 tidal study (Section 5.1.1.5), which included groundwater elevation readings from pressure transducers installed in nine Fill Unit monitoring wells for 10 days in March 2021 (Figures C.1.A through C.1.C and Figure C.2)
- The Phase 2 tidal study (Section 5.1.2.5), which included groundwater elevation and quality measurements from combination pressure transducers and conductivity sensors installed in all 27 Site monitoring wells for 7 days in October 2022 (Figures C.3.A through C.3.D, C.4.A through C.4.R, and C.5.A and C.5.B)
- The dry well datalogger study (Section 5.1.2.9), which included groundwater elevation and quality measurements from combination pressure transducers and conductivity sensors installed in four monitoring wells (three Fill Unit wells and one Alluvial Unit well) to monitor changes in groundwater occurrence as a result of precipitation during the rainy season between November 2022 and January 2023 (Figure C.6)

[18] Where the Tidal Flat Unit (aquitard) is absent, a single unconfined water-bearing unit exists within the combined fill and alluvial deposits (namely along the western edge of the Site), as described above.

- Groundwater elevations as measured throughout various stages of Phases 1, 2, and 3 of the RI (Table C.1)

3.2.3.1 Fill Unit Groundwater Occurrence and Specific Conductivity

A shallow, unconfined (water table) water-bearing zone occurs within the Fill Unit overlying the siltier, native Tidal Flat Unit, which, where present, acts as an aquitard. The depth to the groundwater in the Fill Unit at the Site varies from approximately 6 to 14 feet bgs, at elevations ranging from 3.92 (MW-12) to 8.92 (MW-14) feet.[19] Groundwater conditions in the Fill Unit are affected by tidal changes, seasonal changes, geological variability, and surface and subsurface structures. The following observations regarding groundwater occurrence and specific conductivity (surrogate for salinity) in the Fill Unit were noted:

- Shoreline wells (MW-07, MW-08, MW-09, MW-10, and MW-11): During the Phase 1 (March 2021, wet-season) and Phase 2 (October 2022, dry-season) tidal studies, Fill Unit wells MW-07, MW-08, MW-09, MW-10, and MW-11, which span the SPM Property shoreline except the southeast corner, went dry at low tide stages. Tidal efficiency is the measure of the change in maximum and minimum groundwater elevations relative to the change in maximum and minimum surface water elevations during the tide cycle. Tidal efficiencies for the Fill Unit were not calculated for the low tide stages because the monitoring wells went dry, but tidal efficiencies based on the high tide varied between 0.05 and 0.34 (MW-07 and MW-08, respectively). The higher tidal efficiency calculated for MW-08 may be due to the lack of the Tide Flat Unit in this portion of the shoreline. MW-08 is screened at a slightly lower elevation than other shoreline monitoring wells (Figure 3.4) since the Tidal Flat Unit was not observed at the time of drilling. Likewise, the higher tidal efficiency at MW-08 may be due to a temporary, upward vertical hydraulic gradient that induces recharge to MW-08 from the deeper Alluvial Unit well during the higher portions of each tide cycle (discussed further in Section 3.2.3.2, below). During the Phase 2 tidal study, the maximum specific conductivities recorded in groundwater at each of these five Fill Unit shoreline wells varied between approximately 12,000 microsiemens per centimeter (uS/cm) and 20,000 uS/cm (Figures C.4.D through C.4.H) demonstrating transitional zone[20] conditions.
- Southeast SPM Property corner wells (MW-04, MW-05, and MW-06): During the Phase 1 tidal study (wet-season), none of these three Fill Unit monitoring wells in the southeast corner of the SPM property went dry. However, during the Phase 2 (dry season) tidal study, MW-06 (located on the shoreline at the north end of the sheet pile wall in the southeast SPM Property corner) was observed to go dry during the lowest tide cycles (i.e., lower-low tides below elevation -2 feet as shown on Figure C.4.C). Groundwater elevations in monitoring wells MW-04

[19] The maximum and minimum groundwater elevations observed in the Site wells throughout all tidal studies and groundwater gauging events.

[20] The portion of an aquifer adjacent to a surface water body in which groundwater is mixed with surface water. Water in the transitional zone is groundwater by MTCA definition (WAC 173-340-200) and by Ecology (2017) policy.

and MW-05, located inland from the sheet pile wall, showed very little to no variation relative to tidal stage even though these wells are relatively close to the shoreline (Figures C.1.A and C.3.A). Specific conductivity in groundwater in Fill Unit monitoring wells in the southeast corner of the SPM Property showed a large difference from other shoreline wells during the tidal studies:

- MW-04: During both the Phase 1 tidal study (Figure C.2) and Phase 2 tidal study (Figure C.4.A), the specific conductivity in groundwater at MW-04 showed little variation based on either tidal stage or precipitation (ranged from approximately 200 to 800 uS/cm). The lack of variability in the specific conductivity in groundwater at MW-04 indicates that Fill Unit groundwater in this location is minimally influenced by transitional zone mixing with LDW surface water.
- MW-05: No datalogger was installed in MW-05 during the Phase 1 tidal study. During the Phase 2 tidal study, the specific conductivity sensor at MW-05 recorded a reading near zero for the first 6 days of the 7-day study before slowly rising to approximately 250 uS/cm (Figure C.4.B). This may have been caused by light nonaqueous-phase liquid (LNAPL) coating the conductivity sensor. Based on specific conductivity readings collected during groundwater sampling events, the specific conductivity in groundwater at MW-05, like MW-04, is also very stable given its relative proximity to the LDW shoreline (ranged from approximately 250 and 850 uS/cm over all measurements[21]).
- MW-06: During the Phase 2 tidal study, the maximum observed conductivity[22] in groundwater at shoreline well MW-06 was approximately 8,500 uS/cm, which indicates some mixing with LDW surface water. However, the maximum conductivities measured at MW-06 and the conductivity trend showed the conductivity of groundwater at MW-06 remained lower relative to other shoreline monitoring wells (Figure C.4.C).

- Inland wells: Groundwater elevations at MW-12, located approximately 130 feet from the LDW, showed up to approximately 2.5 feet of water level variation based on tidal stage, and the specific conductivity in groundwater showed some variability during the Phase 1 and Phase 2 tidal studies, indicating mixing with saline water (Figures C.2 and C.4.I). The relatively large water level change at a distance of 130 feet from the LDW may be due to the thinness of the aquitard (0.5 feet) at this location. At distances greater than 170 feet from the shoreline, at MW-13, MW-14, MW-19, and MW-22, no tidal response was observed based on specific conductivity measurements in groundwater, though groundwater elevations at MW-13 did show up to a 0.10-foot change corresponding to tidal fluctuations (Figures C.4.J, C.4.K, C.4.P, and C.4.R). It should be noted that MW-13 is screened within the Tidal Flat Unit, and the tidal change in pressure is

[21] Measurements of field parameters, including specific conductivity, were collected during well development and the various phases of groundwater sampling, as described in Section 5. Specific conductivity at the time of sampling during each event is shown in Table I.3.A.
[22] The temperature sensor on the datalogger installed at MW-06 failed, so the conductivity presented is the actual measured conductivity and not specific conductivity.

likely propagated upwards from the confined Alluvial Unit (as observed in MW-13D, described in the section below). During the Phase 1 tidal study, an approximately 0.5-foot change in groundwater elevation at MW-14 corresponding to precipitation was noted (Figure C.1.C); this is likely an effect of infiltration recharge occurring at the adjacent bioswale located along Dallas Avenue, as shown on Figure 2.3.

Following installation, three Fill Unit monitoring wells remained dry at all tidal stages throughout the Phase 2 tidal study: MW-16, MW-18, and MW-21. To evaluate seasonality of Fill Unit groundwater occurrence at the three dry monitoring wells, combination pressure and conductivity dataloggers were installed for a nearly 3-month period at the beginning of the wet season (November 1, 2023, through January 24, 2023). The dataloggers were installed in the three dry wells and also in MW-18D (screened deeper in Alluvial Unit) to observe water level changes due to precipitation during the wet season. At MW-18, the Tidal Flat Unit is not present, and groundwater occurs only in the Alluvial Unit where it exists under unconfined conditions; MW-18 was screened at a similar elevation as the Fill Unit monitoring wells across the Site. The Tidal Flat Unit was observed during drilling of MW-16 and MW-21. Hydrographs from the dry well datalogger study are provided on Figure C.6, and results from the study are summarized as follows:

- At MW-16, the saturated thickness of the Fill Unit increased from less than a half a foot following installation in September 2022 to more than 3 feet over the following rainy season, likely due to infiltration of precipitation. As described in further detail in Section 5.1.2.9, the well contained sufficient groundwater during the rainy season to be developed and sampled.
- MW-18 remained dry during the dry well datalogger study (and is therefore not included on Figure C.6).
- At MW-21, groundwater was only intermittently recorded by the datalogger during late December 2022 to early January 2023. Based on the MW-21 hydrograph, it appears that the well screen was intermittently saturated only during a period of extreme precipitation, which coincided with widespread flooding in the South Park neighborhood (Figure C.6). When the well screen was saturated, tidal fluctuations were observed in the groundwater elevation recorded by the datalogger (Figure C.6). The intermittent saturation (and tidal fluctuations that were observed when saturated) are likely caused by the proximity of MW-21 to the stormwater infiltration area immediately to the north of the monitoring well, which is connected to the LDW by outfall OF-2215 (Figure 2.4). The intermittent saturation observed at MW-21 may be due to “ponding” of stormwater and/or groundwater in the bioswale to the north of Thistle Street. During high tides, Outfall OF-2215 is submerged, and a backflow preventer precludes discharge from the stormwater infiltration area to the LDW. The “tidal efficiency” observed at MW-21 (Figure C.6) is potentially caused by groundwater in the infiltration area rising to elevations similar to the LDW as discharge is limited by the backflow preventer. However, the extremely quick recharge and subsequent discharge of groundwater from the well indicate there is a preferential

flowpath that limits the presence of Fill Unit groundwater in this area, as Fill Unit groundwater likely drains to the infiltration area/stormwater system north of Thistle Street. It should be noted that the bioinfiltration area receives stormwater from a 12-inch stormwater main that runs along Dallas Avenue South to the north of 14th Avenue South, from the South Park bridge, and from 12-inch stormwater main that runs along 14th Avenue South to the west of Dallas Avenue South.

3.2.3.2 Alluvial Unit Groundwater Occurrence and Specific Conductivity

Groundwater occurs in the Alluvial Unit throughout the Site, and where the Tidal Flat Unit is present, the Alluvial Unit groundwater is under confined conditions as discussed within this section. The potentiometric surface of groundwater within the Alluvial Unit has been observed to occur between elevations 0.19 feet at MW-06D to 9.48 feet at MW-05D (Table C.1). The following observations regarding Alluvial Unit groundwater occurrence and specific conductivity were noted:

- Shoreline wells (MW-08D, MW-09D, and MW-11D): Hydrographs from the shoreline monitoring wells are typical of a confined aquifer (Figure C.3.B); however, there were slight differences between MW-08D, where the Tidal Flat Unit is not present, and the other two shoreline Alluvial Unit monitoring wells.
    - MW-09D and MW-11D: Tidal efficiencies were calculated to be 0.51 and 0.54, respectively, for these two monitoring wells. Confined aquifers propagate tidal pressure changes much more efficiently than unconfined aquifers like the Fill Unit. Higher tidal efficiencies are observed in confined aquifers due to the changing load on the confining unit (in this case the Tidal Flat Unit); the observed water level increases in a confined unit well are the result of both groundwater backflowing into the unit and the increased pressure head in the aquifer caused by tidal loading (United States Geological Survey [USGS], 1962). Similarly, confined aquifers have much lower storage coefficients (the volume of water released from an aquifer per unit decline in hydraulic head per unit area of aquifer) than unconfined aquifers, which results in higher tidal efficiencies. During the Phase 2 tidal study, the maximum specific conductivities recorded at MW-09D and MW-11D was approximately 8,000 uS/cm and 11,000 uS/cm (Figures C.4.F and C.4.H). These are approximately half of the maximum specific conductivities measured in each of the respective paired Fill Unit monitoring wells.
    - MW-08D: The tidal efficiency measured at MW-08D was 0.46, slightly lower than the other shoreline Alluvial Unit monitoring wells. While the hydrograph for MW-08D is similar to those from MW-09D and MW-11D, there are some slight differences in the maximum groundwater elevation observed with each tide cycle. The water level at MW-08D generally lags slightly behind the other Alluvial Unit shoreline monitoring wells and reaches a greater maximum. This effect may be due to vertical drainage of groundwater from the Fill Unit following a high tide. Additionally, the chosen elevations for each of the well screens at MW-08 and MW-08D are relatively close together compared to other paired shoreline monitoring wells. Water levels at MW-08D behave similarly to other shoreline Alluvial Unit monitoring wells due to the close proximity to the shoreline and the elevation of the well screen. While the Tidal Flat Unit is

absent in the immediate vicinity of MW-08D, tidal loading on the Tidal Flat Unit, where it is present outside of this relatively localized area, may also contribute to the pressure increases observed at MW-08D, similar to other confined Alluvial Unit monitoring wells. Similarly, the maximum specific conductivity recorded at MW-08D was approximately 10,000 uS/cm, which is comparable to the other Alluvial Unit shoreline monitoring wells.

- Southeast SPM Property corner wells (MW-04D, MW-05D, MW-06D,[23] and MW-16D): As expected for a confined aquifer, each of the Alluvial Unit monitoring wells in this area showed a larger variation in groundwater elevation than the paired Fill Unit monitoring wells, with tidal efficiencies ranging between 0.51 to 0.74. Specific conductivity in Alluvial Unit monitoring wells in the southeast corner of the SPM Property showed some differences compared to shoreline Alluvial Unit monitoring wells:
    - MW-04D (Figure C.4.A): MW-04D, located at the upgradient (west) edge of the sheet pile wall, showed the largest variation in specific conductivity during the Phase 2 tidal study, with measured values varying between approximately 1,000 and 4,500 uS/cm. As discussed further in Section 3.2.3.4 below, MW-04D is tidally influenced, and the relatively large fluctuations of specific conductance observed at MW-04D indicate that some portion of groundwater is intermixing with surface water from the LDW. Its location (relative to MW-04) is farther from the western edge of the southern section of the sheet pile wall, and the sheet pile wall does not preclude intermixing with surface water in the Alluvial Unit at this location. Likewise, the area to the south of the southern sheet pile wall is part of the habitat restoration area on the Duwamish River People's Park that was excavated as part of the T-117 Upland Removal Area cleanup and partially backfilled to create a channel that is inundated at higher-high tides (Figure 3.7). This provides a more direct pathway for exchange of LDW water with Alluvial Unit groundwater in the MW-04D area.
    - MW-05D (Figure C.4.B): While some variation in specific conductivity was noted based on tide cycle, the response was muted compared to most other shoreline and southeast SPM Property corner monitoring wells. The specific conductivity at MW-05D varied between approximately 675 and 1,100 uS/cm during the Phase 2 tidal study. This indicates that the sheet pile wall at the southeast SPM Property corner almost fully penetrates the Alluvial Unit, and groundwater in the portion of the Alluvial Unit bounded by the wall to the east and south is not significantly mixing with LDW surface water.
    - MW-06D (Figure C.4.C): During the Phase 2 tidal study, specific conductivity in groundwater at shoreline well MW-06D was much lower and varied less than other Alluvial Unit monitoring wells, with a specific conductivity ranging between approximately 700 and 2,400 uS/cm. MW-06D is located much closer to the LDW than MW-04D and represents a shoreline monitoring well; however, the specific conductivity measured at MW-06D was lower than that

[23] MW-06D is a shoreline well within the southeast SPM Property corner near the sheet pile wall.

measured at MW-04D. It is presumed that the lower specific conductivity measured at MW-06D is due to a larger amount of fresher, Alluvial Unit groundwater discharging at this location (because it is in the direct flow path from both Alluvial Unit water in the upland to the LDW and from Alluvial Unit groundwater that is retained behind the sheet pile wall at MW-05D and redirected around the north end of the sheet pile wall to discharge near MW-06D).

  - MW-16D (Figure C.4.M): The specific conductivity in groundwater at MW-16D, which is upgradient of the Former A&B Barrel Pond, showed a small variation due to tidal stage, ranging between approximately 700 and 1,100 uS/cm. Groundwater elevations at MW-16D did show significant change, varying approximately 5.5 to 6.5 feet between high and lower tide cycles, which is a result of tidal pressures propagating inland in the confined unit. While MW-16D is tidally influenced, the small changes in specific conductivity indicate that intermixing of LDW surface water this far inland is minimal.

- Inland wells (MW-13D, MW-17, MW-18D, MW-19D, and MW-20; Figures C.4.J and C.4.N through C.4.Q): Groundwater at the inland Alluvial Unit monitoring wells showed little change in specific conductivities with tidal stage, and the maximum observed specific conductivity at each well was low as compared to other Fill and Alluvial Unit monitoring wells throughout the Site:
  - MW-13D: specific conductivity ranged between 231 and 248 uS/cm (17 uS/cm)
  - MW-17: specific conductivity ranged between 483 and 500 uS/cm (17 uS/cm)
  - MW-18D: specific conductivity ranged between 463 and 520 uS/cm (57 uS/cm)
  - MW-19D: specific conductivity ranged between 357 and 383 uS/cm (26 uS/cm)
  - MW-20: specific conductivity ranged between 238 and 241 uS/cm (3 uS/cm)

  This lack of variability and low specific conductivity indicates these wells are all outside of the mixing range of LDW surface water. It should be noted that groundwater elevations in these wells did show some fluctuations, which is the result of tidal pressures propagating inland through the confined aquifer at distances greater than measured in the Fill Unit, as expected. The groundwater elevation at MW-19D varied slightly more than the other inland Alluvial Unit monitoring wells since that well is located closer to the shoreline.

3.2.3.3 Groundwater Flow in Fill and Alluvial Units – Site-Wide

To determine the tidally averaged groundwater elevation surface and resulting flow directions in each unit at the Site, the Phase 2 tidal study data from each well were analyzed using the method of Serfes (1991). The Serfes method uses a moving average across a 72-hour period; for Fill Unit shoreline monitoring wells that go dry, half the distance between the bottom of the screen and the top of the Tidal Flat Unit was used to calculate heads during the lowest part of the tide cycle. This approach introduces uncertainty to the analysis, but it is considered conservative because it assumes the Fill Unit remains at least partially saturated at the shoreline throughout the tide cycle. If the top of the Tidal Flat Unit was instead used in the analysis, the average hydraulic head at the shoreline would be lower, thereby indicating more groundwater discharge across the tidally averaged period. The tidally averaged groundwater elevation contours for both the Fill Unit and Alluvial Unit are shown on Figure 3.8. Additionally, groundwater elevation contours for both the Fill Unit and Alluvial Unit during a high tide, an outgoing tide, and at low tide are shown for both the Fill Unit and Alluvial Unit on Figures C.5.A. and C.5.B, respectively.

Based on the tidally averaged groundwater elevations, the horizontal flow direction in both the Fill Unit and Alluvial Unit is towards the LDW, as expected (Figure 3.8). During a portion of each tide cycle, as the tide is approaching and receding from high tide, groundwater flow along the shoreline is reversed, and groundwater temporarily migrates from the shoreline into the SPM Property. This effect is localized to a small area along the length of the shoreline extending inland from the LDW, as illustrated in the difference between groundwater elevations at MW-09/MW-10/MW-11 and MW-12. As discussed in Section 3.2.3.1, tidal fluctuations are observed at inland Fill Unit monitoring well MW-12, with groundwater elevations varying approximately 2.5 feet over the Phase 2 tidal study. However, it does not completely dewater like the nearby shoreline Fill Unit monitoring wells MW-09, MW-10, and MW-11. The tidally averaged groundwater elevation for MW-12 (4.60 feet) may be slightly lower than the shoreline monitoring wells MW-09 through MW-11 (4.89 to 5.46 feet) because the Serfes analysis conservatively assumes that a portion of the Fill Unit at the shoreline stays saturated as groundwater elevations drop below the shoreline monitoring well screen intervals. Regardless, the flow reversal does not propagate as far inland as other Fill Unit monitoring wells, MW-14, MW-15, and MW-19 (Figure C.5.A). However, as shown in the tidally averaged figures, the net flow of groundwater across the entire tidal cycle results in discharge to the LDW from both the Fill and Alluvial Units as expected.

Groundwater Discharge From The Fill Unit and Alluvial Unit to the LDW

As described by Darcy's law,[24] three factors affect the quantity and rate of groundwater discharge from the upland to the LDW: hydraulic conductivity, hydraulic gradient, and the cross-sectional area to flow within (discharge from) each unit.

- Hydraulic conductivity has not been measured at the Site, but the relative magnitudes of the hydraulic conductivity in each unit can be approximated from grain size and relative compaction. Both the Fill Unit and the Alluvial Unit are relatively uncompacted and loose and are fairly equivalent in terms of density; however, the Alluvial Unit generally contains fewer silt-size fines within the matrix, and therefore the hydraulic conductivity is expected to be greater in the Alluvial Unit. This is supported by hydraulic conductivity testing performed in fill and alluvial materials in nearby localities along the LDW. For example, the average hydraulic conductivity for a deeper alluvial unit was eight times higher

[24] Darcy's law is $Q = K * i * A$, where Q = discharge flux (volume per time), K = hydraulic conductivity (length per time), I = hydraulic gradient (dimensionless), and A = cross sectional area through which discharge occurs (length squared).

than for a shallow fill unit[25] when measured for a utility improvement project approximately half a mile northwest of the Site (Richard Martin Groundwater, 2019).

- Hydraulic gradients were calculated using the tidally averaged groundwater elevations (Figure 3.8). In the Fill Unit, the horizontal hydraulic gradient varied between approximately 0.014 foot/foot on the north end of the SPM Property and 0.007 foot/foot towards the south end of the SPM Property. In the Alluvial Unit, the horizontal hydraulic gradient varied from 0.003 foot/foot on the north end of the SPM Property to 0.010 foot/foot near the south end of the SPM Property. While the hydraulic gradient is higher in the Fill Unit, the effect of hydraulic gradient on discharge is linear, and therefore the limited difference in gradients (less than a factor of 2) only marginally affects groundwater discharge between the Fill and Alluvial Units.

- Discharge areas cross-sectional to groundwater flow towards the LDW can be visualized on Cross Section B-B' (Figure 3.4). The tidally averaged saturated thickness of the Fill Unit varies from approximately 3.7 feet on the north end of the SPM Property at MW-11 to 0.7 feet on the south end of the SPM Property at MW-07. At the shoreline, the Alluvial Unit remains saturated throughout the tide cycle (except at MW-08/MW-08D where the Tidal Flat Unit is absent), and therefore the saturated thickness is the same at the formation thickness. The saturated thickness of the Alluvial Unit varies from approximately 7.5 feet at the south end of the SPM Property at MW-06D, to 12 to 18 feet at MW-08D (where the Tidal Flat Unit is absent), and to greater than 40 feet at the north end of the SPM Property at MW-11D (where the bottom of the Alluvial Unit was not confirmed but is expected to be 60 feet bgs or greater based on nearby geotechnical borings for the South Park Bridge [Wilbur Consulting, 2004]). Therefore, the Alluvial Unit saturated thickness is at least an order of magnitude greater than the Fill Unit saturated thickness.

Based on all three of these factors, the groundwater discharge to the LDW at the Site is assumed to be an order of magnitude or greater in the Alluvial Unit than the Fill Unit. This is supported by visual observations of seeps at low-low tide emanating from the Alluvial Unit at substantial flowrates, whereas no seepage from the Fill Unit elevations was observed.

Vertical Gradients Between Fill Unit and Alluvial Unit

The tidally averaged hydraulic heads at each of the paired Fill/Alluvial Unit monitoring wells were used to determine the vertical gradient between the two units, across the Tidal Flat Unit. The difference in the averaged groundwater elevation was divided by the thickness of the Tidal Flat Unit at each paired location to calculate the vertical gradient for that location. The tidally averaged vertical gradient values are shown in the lower panel on Figure 3.8[26] and in Table C.3. The average vertical gradient varies depending on

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[25] Geometric mean hydraulic conductivities of 0.001 centimeter/second for the fill unit, and 0.008 centimeter/second for the alluvial unit.

[26] Downward vertical gradients have a negative (-) value, and upward vertical gradients have a positive (+) value.

location at the Site, but generally, the vertical gradient is downward from the Fill Unit to the Alluvial Unit (except at MW-13/MW-13D):

- MW-13 is screened within the Tidal Flat Unit, and the vertical gradient was calculated at 0.01, which indicates a negligible difference in the gradient between the Tidal Flat Unit and the Alluvial Unit in the northwest corner of the SPM Property. The MW-13/-13D well pair is also located near the western termination of the Tidal Flat Unit where a single unconfined water-bearing unit is present.
- At the paired inland wells (MW-19/-19D and MW-16/-16D), the vertical gradient is greater than -1.0, indicating a strong downward driving force from the Fill Unit to the Alluvial Unit.
- Along the shoreline north of the southeast SPM Property corner, the vertical gradient varies between -0.21 to -0.22 at well pairs MW-09/MW-09D and MW-11/MW-11D; the decreased gradient relative to the inland wells is likely the result of how quickly the Fill Unit drains during falling tides. If the elevation for the top of the Tidal Flat Unit was used for Fill Unit wells, which go intermittently dry in the Serfes analysis, the vertical gradients would be slightly larger (approximately -0.30) between the Fill and Alluvial Units.
- Within the southeast corner of the SPM Property, the vertical gradient measured at the edges of the sheet pile wall (-0.38 at MW-04/MW-04D and -0.35 at MW-06/MW-06D) is less than within the corner of the sheet pile wall (-0.52 at MW-05/MW-05D). The larger gradient of -0.52 at MW-05/MW-05D is likely due to the limited discharge of groundwater in the corner of the sheet pile wall, resulting in higher groundwater elevations in the Fill Unit behind the sheet pile wall.

Overall, these net negative vertical gradients indicate that the average driving force for groundwater migration is downward from the Fill Unit through the Tidal Flat Unit into the Alluvial Unit across nearly all of the Site. The Tidal Flat Unit represents a leaky aquitard that limits but does not prevent groundwater flow between the Fill Unit and the Alluvial Unit; however, it impedes flow enough that the Fill Unit maintains markedly higher average groundwater elevations than the Alluvial Unit. This is particularly illustrated by the hydrographs for MW-19 and MW-19D (Figure C.4.P) which demonstrate that Fill Unit groundwater is not tidally influenced but Alluvial Unit groundwater is. The pressure propagation observed that far inland at MW-19D in the Alluvial Unit is a direct result of the Alluvial Unit being a confined or semi-confined aquifer (beneath the Tidal Flat Unit aquitard) throughout most of the Site, and it does not reflect direct exchange with LDW surface water. The Alluvial Unit is unconfined in areas where the Tidal Flat Unit is absent; the Tidal Flat Unit is not continuous across the SPM Property (Figure 3.2) and acts as a leaky aquitard in areas where it is thin, as shown by the groundwater elevation at MW-12 throughout all tide cycles (Figure C.5.A).

3.2.3.4 Groundwater Flow – Southeast SPM Property Corner with Sheet Pile Wall

As discussed in Section 4.2.3 below, a sheet pile wall was installed at the southeast corner of the SPM Property in the vicinity of the Former A&B Barrel Pond to stabilize the bank for geotechnical purposes. The reported depth of installation of the sheet pile wall was 20 to 22 feet bgs, which is at or near the depth of the top of the Glacial Till Unit observed in borings drilled in the southeast SPM Property corner as shown on Cross Sections A-A' and B-B' (Figures 3.3 and 3.4). Weep holes were reportedly installed in the sheet pile wall, and the seams between individual sheets were not sealed, so it is not impermeable to groundwater flow. However, based on the tidal studies and observations of groundwater quality to date, it is apparent that the sheet pile impedes and redirects the bulk of groundwater flow in this corner of the SPM Property.

In the Fill Unit, the sheet pile is fully penetrating based on both the reported installation depth and groundwater conductivity measured at MW-04, MW-05, and MW-06. As shown on the inset map in the upper pane on Figure 3.8, groundwater in the Fill Unit is ponded at a higher elevation behind the sheet pile wall than at other shoreline locations throughout the Site, and flow in the Fill Unit occurs around the north end of the sheet pile wall in the area of MW-06. Conductivities measured at MW-06 do show significant variation that indicates mixing with LDW surface water, but the maximum conductivities measured at MW-06 are less than other shoreline wells, indicating the predominant discharge of the groundwater in the Fill Unit is around the north end of the sheet pile wall. Likewise, the low and stable specific conductivities at MW-05 measured during groundwater sampling events (Section 5.1), combined with the minimal amount of tidal influence on groundwater elevation there (Figure C.4.B), indicate very limited to no mixing of Fill Unit groundwater and LDW surface water within the corner bounded by the sheet pile wall. It does not appear that any significant intermixing of groundwater and LDW surface water occurs in the Fill Unit near the southwest end of the sheet pile at MW-04, as evidenced by the water level vs. specific conductivity charts on Figures C.2 and C.4.A. Specifically, the following differences between groundwater discharge and the potential for intermixing with LDW surface water were noted around the north and southwest ends of the sheet pile wall at MW-06 and MW-04, respectively:

- At all shoreline monitoring wells, in both the Alluvial and Fill Units where there is discharge directly to the LDW, there are large fluctuations in groundwater levels and specific conductivity that are caused by intermixing with LDW surface water. Given that the restoration channel to the south of the sheet pile wall (Figure 3.7) is tidally inundated at higher-high tides and the flow path would be relatively short, direct discharge from MW-04 would be expected to show direct communication with surface water from the LDW (in terms of water level and conductivity changes).

- The bottom of the well screen at MW-04 is at approximate elevation 4.5 feet compared to the bottom of the well screen for MW-06 at approximate elevation 6 feet. Therefore, surface water elevation in the LDW is above the bottom of the well screen interval for a longer duration at MW-04 than it is at MW-06, which would allow for more intermixing of groundwater and LDW surface water if the groundwater at the MW-04 and the southwest corner of the sheet pile wall was in direct communication with the LDW.

- The specific conductivity did not vary over time during either the Phase 1 or Phase 2 tidal studies at MW-04; the specific conductivity values are indicative of fresher water (as opposed to the brackish/saline water of the LDW) like those measured at MW-06 during each tidal study.

- Following installation of the GAC mat and backfilling as part of the T-117 Sediment Removal Area (Section 2.4.2.2), no seeps (and no sheens on the LDW surface water) have been observed to be discharging from the slope on the south side of the sheet pile wall in the vicinity of MW-04 or from the east side of the sheet pile wall towards the LDW. Additionally, as part of the T-117 EAA Long-Term Monitoring and Maintenance Plan, routine, annual inspections are conducted in the vicinity of the southeast SPM Property corner. No seeps have been noted following either the T-117 Upland Removal Area cleanup or the restoration work to complete the Duwamish River People's Park (SPU et al., 2023).

There is uncertainty in exactly where the divide occurs between upland groundwater discharging around the south end of the sheet pile wall and groundwater that flows around the north end of the sheet pile wall (after being impeded and redirected by the sheet pile wall itself). However, the conductivity data indicate that groundwater at MW-04 is not in direct communication with LDW surface water, and therefore this dividing point in the Fill Unit is likely to the upgradient, west side of MW-04. Because there is no intermixing of LDW surface water and groundwater at MW-04, it is not considered a shoreline well for the purposes of evaluating the nature and extents of contamination (Section 7). However, given the uncertainty around where the groundwater divide occurs in the Fill Unit and the potential for impacted groundwater to discharge around the southern side of the sheet pile wall, the FS will need to evaluate if potential cleanup remedies will need to include controls for groundwater use in this area.

The sheet pile also may fully penetrate the Alluvial Unit based on the reported installation depth, the observed depth to the top of Glacial Till Unit in the southeast corner borings, and the limited tidal variation observed in Alluvial Unit groundwater at MW-05D. As shown on the inset map in the middle pane on Figure 3.8, groundwater in the Alluvial Unit is at a slightly higher elevation behind the sheet pile wall than at other shoreline locations such as MW-08D and MW-09D. Unlike the Fill Unit, flow in the Alluvial Unit appears to occur around both the north and the southwest end of the sheet pile wall. The primary line of evidence for this flow pattern is the specific conductivity patterns noted at MW-04D and MW-06D (maximums of 4,500 and 2,400 uS/cm; Figures C.4.A and C.4.C, respectively), both of which show evidence of mixing with LDW surface water. However, the maximum specific conductivities at MW-04D and MW-06D are lower than those observed at the other shoreline wells (maximums of 8,000 to 11,000 uS/cm at MW-08D, MW-09D, and MW-11D). The data indicate the Alluvial Unit groundwater discharging on both sides of the sheet pile wall is predominantly (lower conductivity) inland groundwater that is restricted in its exchange with the brackish LDW water, consistent with the Alluvial Unit groundwater elevations measured behind the sheet pile wall. At MW-05D, the specific conductivity (maximum 1,100 uS/cm) shows limited variation and is much lower than at MW-04D and MW-06D in the southeast SPM Property corner and the other Alluvial Unit shoreline wells. This limited variation indicates that Alluvial Unit groundwater within the southeast SPM Property corner bounded by the sheet pile wall is not significantly mixing with the LDW surface water.

As noted above, the specific conductivities in groundwater at MW-04D were larger than those observed in groundwater at MW-06D. This is likely due to a combination of two factors:

- As part of habitat restoration on the south-adjacent Duwamish River People's Park, a channel running east-west along the south side of the sheet pile wall was excavated to an elevation lower than the ecology block wall to the east of the sheet pile wall (Figure 3.7). The channel is designed to be inundated at higher-high tides for the purposes of habitat restoration, and thereby provides a more direct exchange of LDW water with Alluvial Unit groundwater (at high tides) in the MW-04D area.
- Greater discharge of less saline groundwater is occurring along the north end of the sheet pile wall, since this section of the sheet pile is more perpendicular to the groundwater flow path from the upland to the LDW, and more groundwater is redirected around the north end of the sheet pile wall as compared to the southwest end.

Based on the collective information, the sheet pile wall is not completely impermeable to seepage—a small quantity of groundwater flows through seams between the individual steel sheets comprising the wall and through weep holes drilled through the wall. However, it does restrict flow enough to limit groundwater discharge (resulting in higher groundwater elevations as compared to other shoreline Alluvial Unit monitoring wells) and locally alter flow directions as described above.

3.3 Current and Future Climate

This section discusses the current climate of the region in the vicinity of the SPM Property and potential future climate changes which may affect the current characterization of the Site or a selected cleanup remedy in the FS.

3.3.1 Current Climate

According to the Western Region Climate Center (WRCC), the climate of the Puget Sound lowlands is characterized as maritime, as the prevailing westerly winds move moist air from the Pacific Ocean inland over the region, resulting in moderate temperatures. Based on data compiled from the nearby Seattle-Tacoma International Airport between 1945 and 2016 (WRCC, 2024), average temperatures range between 35 to 49 degrees Fahrenheit in the winter and 51 to 75 degrees in the summer.

Average total precipitation over the period of record is 38.3 inches annually. May to September is generally the dry season, with July being the driest month of the year (average 0.75 inches of precipitation). October to March is generally the rainy season, with more than 75 percent of the average annual precipitation falling during that time with November being the wettest month of the year (average 6.11 inches of precipitation).

3.3.2 Potential Future Climate Changes

Ecology has identified environmental trends in the Pacific Northwest to assist in the evaluation of climate change projections relevant to the vulnerabilities of contaminated cleanup sites and has identified that preparing and adapting to climate change impacts, including rising sea levels, extreme precipitation events, and other changes, is a critical challenge for Washington State (Ecology, 2023a). The effects of these climate change impacts were assessed as part of the RI:

- **Sea level rise.** Projections of sea level rise due to changing climate continue to evolve. Based on work conducted by the Washington Coastal Resilience Project (Miller et al., 2019), sea level rise in Washington State due to thermal expansion of the sea and melting of glaciers is estimated to be from 0.4 to 0.9 feet by 2050, 1 to 2.8 feet by 2100, and 1.5 to 4.9 feet by 2150 (depending on the greenhouse gas scenario used). Based on that study, relative sea level rise (which includes projected sea level rise and vertical land movement) was estimated for a variety of locations throughout Washington State. Along the LDW near the SPM Property, relative sea level rise is projected to be from 0.5 to 1.2 feet by 2050, 1.1 to 3.5 feet by 2100, and 1.5 to 6.2 feet by 2150. As discussed in Ecology's guidance document (2023a), rising sea levels can affect environmental sites due to the increased depth and extent of inundation along shorelines, amplification of the inland reach of high tides, and movement of the saltwater wedge further upstream in tidally influenced rivers such as the LDW.

- **Precipitation.** Total precipitation throughout the region is projected to increase between 3.8 and 9.3 percent (depending on the greenhouse gas scenario used). Likewise, precipitation events are projected to increase in intensity in terms of both frequency and the rate of precipitation. These larger, harder precipitation events may result in more leaching of contaminants through the vadose zone and/or increased potential for erosion of contaminated soil to the LDW.

- **Other changes.** Other climate changes in Ecology's guidance (2023a) include warming air temperatures, increases in wildfire frequency and intensity, increasing drought risk, and increasing landslide and erosion risk. Based on the Site location and topography, these potential climate change impacts are not anticipated to have a significant effect on Site environmental conditions.

4 Environmental Investigations and Cleanup Actions on SPM Property Outside of the AO

This section summarizes previous environmental investigations and independent cleanup actions conducted on the SPM Property prior to finalizing the AO, as well as investigations that were conducted concurrently with, but independent of, the AO RI.

4.1 Environmental Investigations Prior to the AO

At least 10 separate environmental investigations were completed at the SPM Property before the AO was finalized, beginning in 2002 and ending with sampling completed in 2019. Figure 4.1 depicts historical sample locations from these historical investigations. The investigations were conducted by a variety of entities over the years, and as such the findings are documented in multiple reports. Table 4.1 provides a chronological summary of the documents containing data collected on the SPM Property that are referenced below.

The following subsections present a summary of the previous investigations at or near the Site. Each subsection includes a summary of key features of each investigation.

A summary of historical data usability and Preliminary RI SL exceedances for data collected on the SPM Property is presented in Section 6. Analytical results are summarized in Tables H.3.A through H.3.D (for sediment, organized by type of contaminant and sample depth as described further in Section 6) and Tables I.3.A through I.3.E (for groundwater, vadose soil, saturated soil, catch basin solids, and stormwater, respectively).

4.1.1 T-117-Related Soil Sampling on SPM Property

This section presents a summary of environmental investigations and historical data collected on the SPM Property during the T-117 EAA investigations. The T-117 EAA investigations on the SPM Property were focused on the southeast corner of the property adjacent to T-117 Upland Property.

Windward Environmental LLC (Windward) 2006, T-117 Upland Area Soil Investigation Field Sampling and Data Report, Submitted to US Environmental Protection Agency, July 7, 2006.

- Four surface soil samples from locations A10, A11, and A12 were collected in 2002 from the southeast corner of the SPM Property in the vicinity of the Former A&B Barrel Pond. Surface soil samples were collected from ground surface up to 1.5 feet bgs and were analyzed for PCBs and total organic carbon (TOC) at all locations and were also analyzed for polycyclic aromatic hydrocarbons (PAHs) and diesel- and oil-range total petroleum hydrocarbons (TPHs) at location A10. Analytical results included detections of PCBs (0.088 to 3.2 mg/kg) and TPH (194 mg/kg), but no detectable PAHs. Full analytical results for the samples are presented in Table I.3.B.

4.1.2 SPM Investigations – Former A&B Barrel Co. Operations

This section documents investigations conducted in the vicinity of the former A&B Barrel Co. operations on the SPM Property prior to finalization of the AO in April 2019.

SAIC, 2008a, South Park Marina Seattle, Washington, Additional Site Characterization Activities Data Report Final, Prepared for Washington State Department of Ecology, June 30, 2008.

- Site walk and underground utilities location occurred on September 25, 2007.
- Installation of 16 soil borings (SB-1 through SB-16) and three monitoring wells (MW-01 through MW-03 installed in SB-1 through SB-3) occurred on September 26, 27, and 28 and October 1, 2007. The three monitoring wells were installed in the vicinity of the Former A&B Barrel Pond. Boring depths ranged from 2.5 to 20 feet bgs. Twenty-one soil samples were collected from depths ranging from 1 to 15.5 feet bgs. Soil samples were analyzed for semivolatile organic compounds (SVOCs), PCB Aroclors, Resource Conservation and Recovery Act (RCRA) 8 metals, organochloride pesticides, hydrocarbon identification (HCID), volatile organic compounds (VOCs) in select samples only, and gasoline- and diesel-range TPHs[27] when HCID identified detections. Analytical results indicated the highest detected soil concentrations occurred in the location of the Former A&B Barrel Pond. COPCs in with high concentrations vadose zone soils included select metals, total PCBs, select SVOCs, select VOCs, select pesticides, and TPH. In saturated zone soils, relatively high concentrations were detected for many of the same organic COPCs but not for any of the metals. Analytical results for the soil samples are presented in Tables I.3.B and I.3.C.
- Well surveying and a short-term tidal study occurred on October 1, 2007.
- Riverbank transect soil and sediment sampling occurred on October 8 and 9, 2007, and March 12, 2008, respectively. A total of four soil samples and two in-water sediment samples were collected along two transects (TRANS-A and TRANS-B) perpendicular to the shoreline, east of the southeast corner of the SPM Property, as depicted in the SAIC map included as Appendix A.22. All soil and sediment samples were collected at depths from 0 to 4 inches below the surface of the soil or sediment. Each transect included one soil sample from above the retaining wall (top of bank), one soil sample from just below the base of the wall, and one sediment sample a few inches below the water surface at low tide.[28] Soil and sediment samples collected along the transect were analyzed for the same constituents as the soil boring samples described above, with the exception of VOC analysis. Analytical results for the soil samples indicated high concentrations of select metals, select SVOCs, and TPH. Soil analytical results are included in Table I.3.B.

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[27] Using silica gel cleanup.

[28] SAIC concluded that, due to limited presence of soil on the banks, it likely did not represent eroded bank soil, but rather LDW sediment settled from upstream.

- Groundwater sampling occurred on October 8 and 9, 2007, and March 12, 2008. Groundwater was collected from the three monitoring wells (MW-01 through MW-03) after a significant low tide. The October 2007 groundwater samples were analyzed for PAHs, SVOCs, VOCs, PCBs, RCRA 8 metals (total and dissolved), chlorinated pesticides, and HCID.[29] Based on the October 2007 results, the March 2008 analyte list was reduced to VOCs, chlorinated pesticides, and RCRA-8 metals (total only). The sample analytical results indicated relatively high concentrations for select pesticides and select VOCs. Full analytical results for the groundwater samples are presented in Table I.3.A.
- A seep investigation was conducted in 2007 and 2008. The banks of the LDW were inspected for seeps along the SPM Property shoreline but no seeps were observed. Therefore, no seep samples were collected for characterization.

SAIC, 2008b, Final Technical Memorandum Subject: Transmittal of Low-Level Mercury Results, July 2008 Groundwater Sampling Round, South Park Marina Site, Seattle, Washington, Prepared for Mark Edens Washington State Department of Ecology, December 31, 2008.

- Resampling of groundwater from monitoring wells MW-01 through MW-03 for low-level mercury analysis was performed in July 2008. Analytical results, indicating trace-level detections, are presented in Table I.3.A.
- Groundwater monitoring wells MW-01 through MW-03 were decommissioned after the last sampling event in July 2008 (SAIC, 2009).

Farallon Consulting, LLC, 2011, Analytical Data for Project 289-001, Prepared by OnSite Environmental Inc. August 2011.

- Soil and groundwater investigations were conducted on July 27 and 28, 2011. Farallon did not prepare a report documenting the investigation; only the laboratory data reports were available.
- Six soil borings (SB-17 through SB-22) were advanced in the vicinity of the Former A&B Barrel Pond, and eight soil samples were collected from depths ranging from 1 to 18 feet bgs and analyzed for gasoline- and diesel-range TPH; samples of saturated soil from SB-21 and B-22 were also analyzed for VOCs, SVOCs, PCB Aroclors, organochlorine pesticides, and total metals. Three soil borings (SB-23 through SB-25) were advanced to the north and west of the Former A&B Barrel Pond, and four soil samples collected from depths ranging from 1 to 10 feet bgs were analyzed for diesel-range TPH. The sample results indicated high concentrations of TPH in vadose soils, and high concentrations of TPH, PCBs, and select pesticides in saturated soils. Analytical results for the soil samples are presented in Tables I.3.B and I.3.C.
- Two grab groundwater samples were collected from temporary well screens inside soil borings SB-21 and SB-22 and were analyzed for gasoline- and diesel-

[29] No detections in the HCID analysis, so gasoline- and diesel-range TPH were not analyzed using the NWTPH-Gx and NWTPH-Dx methods.

range TPH, VOCs, SVOCs, PCB Aroclors, organochlorine pesticides, and total metals. The analytical results from the grab samples indicated low-level detections of PCBs and select pesticides. Analytical results are presented in Table I.3.A.

4.1.3 SPM Investigations – Stormwater NPDES

The following references document investigations conducted of the stormwater and washwater-related systems prior to finalization of the AO in April 2019. The investigation locations for related stormwater and catch basin solids sampling referenced in this section are shown on Figure 4.1.

Ecology, 2005, Stormwater Compliance Inspection Report, July 2005.

- A surprise stormwater inspection was conducted by Ecology on June 7, 2005.
- The inspection noted that the NPDES permit and Discharge Monitoring Reports were available for review by Ecology.
- The inspection noted the following deficiencies:
  - No tarping was found with upland boatyard activities.
  - There were visible spills under the crane.
  - Paints and solvents needed to be stored in a covered, bermed, and impervious area.
  - There was concern over the proximity of a stormwater catch basin (CB-07) to the boat wash pad and associated pump vault (also referred to as a sump) and concern regarding the condition of the asphalt surrounding the catch basin.

Leidos, Inc. (Leidos), 2015, NPDES Inspection Sampling Support 2014/2015, Prepared for Washington State Department of Ecology, June 2015.

- Inspection of select stormwater conveyance structures occurred on October 8, 2014, at catch basins CB-02, CB-04, CB-05, and CB-09; manhole 5; and a feature referred to as an oil/water separator.[30]
- Stormwater and solids samples were collected from the StormwateRx™ pump vault (mis-identified as an oil/water separator by Leidos; SWRX-PRE in Tables I.3.D and I.3.E), and a solids sample was collected from catch basin CB-09. The stormwater sample was analyzed for total metals, PCB congeners, PAHs, SVOCs, dioxins/furans, alkalinity, pH, specific conductivity, anions, TOC, dissolved organic carbon, total suspended solids, turbidity, and oil and grease. Low concentrations of metals, PCBs, dioxins/furans, select PAHs, and select other SVOCs were detected in the sample. Solids samples were analyzed for the same analytes as the stormwater sample, plus PCB Aroclors; diesel-, motor oil-

[30] TIG Environmental's 2018 and 2019 stormwater investigations did not verify the location of manhole 5. It is also presumed that the oil/water separator identified by Leidos (2015) was in fact the StormwateRx™ pump vault as there are no oil/water separators on the SPM Property.

and gasoline-range TPH; grain size; and VOCs. The samples contained detectable concentrations of all metals, PCBs, dioxins/furans, each TPH fraction, select PAHs, select other SVOCs, and select VOCs. The catch basin solids and stormwater analytical results are presented in Tables I.3.D and I.3.E, respectively.

TIG Environmental, 2018a, Stormwater and Boat Wash Water Systems Evaluation South Park Marina, Prepared for South Park Marina Limited Partnership, February 2018.

An investigation was conducted into potential sources of contaminants in stormwater discharging to the LDW and resulting in non-compliance with SPM's NPDES Boatyard General Permit. Conclusions of the investigation included the following:

- TIG Environmental reported 69 percent of the SPM Property's stormwater runoff is untreated and contains detectable concentrations of metals and PCBs.
- The StormwateRx™ treatment system received 22 percent[31] of the SPM Property's stormwater. This stormwater was treated for metals. Reportedly, some PCBs and other contaminants were removed with moderate success.
- Untreated stormwater could overflow the pump vault and bypass the treatment system to discharge directly to the LDW if the pump failed or the capacity of the vault was exceeded.
- Some co-mingling of boat washwater with stormwater could occur prior to being pumped to the StormwateRx™ treatment system.
- Two catch basin stormwater samples (CB-02 and CB-06), one roof drain water sample (SRC-01), three boat washwater treatment samples (pre-, mid-, and post-treatment), and three stormwater treatment water samples (pre-, mid-, and post-treatment) were collected in June 2017 and analyzed for metals, PCB Aroclors and congeners,[32] PAHs, SVOCs, alkalinity, hardness, TOC, total dissolved solids, total suspended solids, and field parameters. One or more chemicals in each analyte group were detected in the water samples, including relatively high concentrations of total copper and zinc. Laboratory data collected was validated by an independent data validator using EPA stage 2B validation. The validated results for these samples are presented in Tables I.3.D and I.3.E, respectively.

TIG Environmental, 2019, Results of Drainage Pathway Investigation, January 16, 2019.

- The report summarized previous drainage investigations including a ground-penetrating radar survey in February 2016, a topographic survey in March 2017, sampling of a stormwater drain at Legacy Master Marine (SRC-01) in June 2017, camera surveys within stormwater and sewer pipes in September 2017, and a stormwater drainage investigation conducted in 2018 to address pathway data gaps resulting from the previous historical drainage investigations in order to identify discharge points.

[31] Area based on TIG Environmental's drainage pathway investigation (2019).
[32] The roof drain water sample SRC-01 was not analyzed for PCBs.

- The identified data gaps included locating the SPM Outfall discharge point; tracing the network of piping connected to catch basin CB-01; tracing downgradient piping pathway from catch basins CB-02 and CB-05; tracing the connection between CB-05 and CB-06; tracing subsurface piping from roof drains on Legacy Master Marine shop; and identifying the discharge path for roof drains from the Tire Factory and the woodworking shop.
- Five roof drain water samples (SRC-01 through SRC-05; Figure 4.1) were collected on October 25, 2018, and analyzed for copper and zinc. For each sample, detected copper concentrations were less than, and detected zinc concentrations were greater than, the respective NPDES daily benchmarks. The stormwater analytical results are presented in Table I.3.E.
- Dye tracer studies were conducted in February, November, and December 2018 to trace the drainage pathways for catch basins CB-01, CB-02, CB-05, and CB-06 and roof drains attached to Legacy Master Marine shop, the Tire Factory, and the woodworking shop.

Some components of the drainage system, such as precise pipe connections and discharge points, remain unknown, but findings from these investigations helped refine the stormwater drainage pathway understanding as depicted on Figures 2.3 and 2.4. Details of the findings of the investigation and the follow-up activities are detailed in TIG Environmental (2019).

4.1.4 SPM Investigations – Site-Wide

This section summarizes investigations conducted across the entire SPM Property prior to finalization of the AO in April 2019. The soil, groundwater, stormwater, and catch basin solids investigation locations referenced in this section are shown on Figure 4.1.

The Intelligence Group,[33] *Various field reports documenting site investigations (The Intelligence Group, 2016a through 2016g and 2017).*

- Between September 20, 2016, and February 23, 2017, The Intelligence Group conducted eight site visits to investigate various conditions at the SPM Property. The intent of the site visits was to
  - inventory chemicals and hazardous material use on the SPM Property by all operators;
  - inspect pole-mounted transformers;
  - inspect compressors;
  - observe and inspect the boat washwater and the StormwateRx™ treatment systems; and

[33] The Intelligence Group changed its name between 2017 and 2018 to TIG Environmental and is now part of Verdantas, LLC. Both names are used in this report to reflect the authors of the referenced reports.

- investigate drainage pathways and the potential for septic tanks through ground penetrating radar surveys.

None of these site visits included subsurface investigations or sample collection but provided the basis for the investigations conducted by The Intelligence Group in 2016 and in 2018 (as TIG Environmental).

The Intelligence Group, 2016h, Data Report, 2016 Soil, Sediment and Catch Basin Sampling and Analysis, Lower Duwamish Superfund Site, September 20, 2016.

- Collected 27 surface soil samples (SS-01 through SS-27) in February 2016 across the SPM Property.[34] Surface soil samples were collected to 1.5 feet bgs. Samples were analyzed for PCB Aroclors and PCB congeners. Detected concentrations of total PCBs in the 27 samples ranged from 0.0059 to 0.93 mg/kg.
- Collected nine catch basin solids samples from CB-01 through CB-09 in February 2016. Visible sheen was observed on standing water in all catch basins, except CB-01. Samples were analyzed for PCB Aroclors and PCB congeners. Detected concentrations of total PCBs in the nine samples ranged from 0.0507 to 1.19 mg/kg.
- Laboratory data collected were validated by an independent data validator using EPA stage 2B validation. The soil and catch basin solids validated results for these samples are presented in Tables I.3.B through I.3.D, respectively.
- Sediment samples collected as part of this investigation are discussed below in Section 4.1.5.

TIG Environmental, 2018b, South Park Marina (Facility/Site ID 44653368) Supplemental PCB Investigation Memorandum, September 11, 2018.

- Collected 23 surface and subsurface soil samples across the SPM Property in November 2017. Surface soil samples were collected near locations that previously exhibited high PCB concentrations, while subsurface soil samples focused on the area of the former A&B Barrel Co. operations. Surface soil samples (SS-31 through SS-39) were collected up to 1.5 feet bgs and subsurface samples (from borings B-01 through B-04) were collected from a maximum depth of 10 feet bgs.
- Samples were analyzed for PCB Aroclors and a subset of samples were analyzed for PCB congeners. Detected concentrations of total PCBs in the 23 samples ranged from 0.064 to 131 mg/kg. Laboratory data were validated by an independent data validator using EPA stage 2B validation. The validated results for these soil samples are presented in Tables I.3.B and I.3.C.
- PCB Aroclor profiles and congener fingerprints were developed and evaluated for source identification.

[34] Three surface soil samples were also collected on property owned by South Park Marina on the west side of Dallas Avenue South.

4.1.5 Sediment Investigations In and Near the Marina Basin

The following documents summarize sediment sampling and analysis conducted in the LDW in and near the Marina Basin. The investigations summarized below were conducted as part of the LDW Superfund Site, the T-117 EAA, or on behalf of SPM, and reports for these data are summarized in Table 4.1. Sediment sample locations (including those collected concurrently with the AO, Section 4.3.2) based on Ecology's Environmental Information Management (EIM) database are shown on Figure 4.2; sediment analytical data is summarized in Tables H.3.A through H.3.D (organized by contaminant and sample depth as described in Section 6.1).

Windward et al., 2010, Revised Engineering Evaluation/Cost Analysis for T-117, June 3, 2010.

- Twenty-four surface and subsurface in-water sediment samples were collected in 2004 and 2008 adjacent to the SPM Property as part of the T-117 EAA engineering evaluation/cost analysis investigation. The surface sediment sample depths were 0 to 10 cm, and subsurface sediment depths were variable and extended to 543 cm below mudline. The primary focus of the sediment investigation was PCB Aroclor analysis; however, some samples were also analyzed for dioxins/furans, SVOCs, organochlorine pesticides, metals, tributyltin (TBT), ammonia as nitrogen, total volatile solids, total solids, total organic carbon, and grain size. Analytical results indicated PCB concentrations up to 2.2 mg/kg and other analytes detected at varying concentrations. Except for one sample collected from a depth of 300 to 543 cm below mudline, the sediment represented by these samples was removed during the T-117 Phase 1 cleanup action (see Section 2.4.2.1).

The Intelligence Group, 2016h, Data Report, 2016 Soil, Sediment and Catch Basin Sampling and Analysis, Lower Duwamish Superfund Site, September 20, 2016.

- From February 24 to February 26, 2016, 48 sediment samples were collected from 16 locations (SC-01 through SC-16) between the MHHW line along the SPM shoreline and the navigation channel. A sediment core from the upper 200 cm of sediments was removed from each sample location and the core divided into three segments: 0 to 10 cm (surface), 10 to 100 cm (middle), and 100 to 200 cm (bottom). The core from each segment was then homogenized for chemical analysis. Each of the 16 sample locations had one sample from each of the three depth segments (surface, middle, and bottom) submitted for laboratory analysis. Sediment samples were analyzed for PCB Aroclors and PCB congeners. Detected concentrations of total PCBs in the 16 samples ranged from 0.05 to 0.197 mg/kg. Sediment analytical results are presented in Tables H.3.A and H.3.B.

AECOM Environment (AECOM), 2016, Removal Action Construction Report Terminal 117 Sediment and Upland Cleanup, March 31, 2016.

- Two surface (0 to 10 cm) sediment samples were collected from the perimeter of the T-117 EAA Dredge Unit 3, in-water between two of the floating SPM boat docks. One sample was collected before dredging (PERIM-5-PRE) and one collected after the dredging and in-water backfilling was completed (PERIM-5-POST).

- Sediment samples were analyzed for T-117 EAA sediment COCs including dioxins/furans, carcinogenic polycyclic aromatic hydrocarbons (cPAHs), SVOCs, metals, PCBs, and TOC. Analytical results indicated a general decline in detected COC concentrations in the post-dredge sample compared to the pre-dredge one.

These sediment data, along with other data retrieved from Ecology's EIM database are further discussed in Section 6.1 below.

4.2 Previous Cleanup Actions on SPM Property

Cleanups relating to past fuel spills, two UST removals, and T-117 EAA remediation have been conducted at the SPM Property. The following provides a summary describing these previous cleanup actions.

4.2.1 Spills and Leaks

Over the course of marina operations, spills and leaks of fuels and oil have occurred periodically. Spills and leaks of notable quantities are reportedly addressed by marina staff and reported to the appropriate regulating agency. Records of spills dating back to 1996 are maintained on Worksheet 6 in the marina's Stormwater Pollution Prevention Plan (SWPPP; SPM, 2020). Likewise, the U.S. Coast Guard's National Response Center maintains records of incidents that occurred between 1990 to the present (TIG Environmental, 2020).

4.2.2 Underground Storage Tank Removals

One UST with an unknown installation date was registered and recorded with Ecology's UST Program as "removed" at some date prior to 1996. The size and content of this UST (UST ID 853) is not included in the UST Program's records (SAIC, 2007a and Ecology, 2015a). However, anecdotal evidence provided by the SPM Property owner/operator and TIG Environmental (2020) indicates that this UST had two historical placements near the shoreline (Figure 2.2), both of which served marina fueling operations at separate points in time. Reportedly, a 1,000-gallon UST operated along the shoreline of Historical Parcel D from approximately 1970 to 1980 and was removed in approximately 1981 to allow for the excavation and dredging that modified the shoreline (TIG Environmental, 2020). This UST was then reinstalled on Historical Parcel C (Figure 2.2). The UST operated in this second location until approximately 1991, when it was decommissioned and removed (Burlington Environmental, 1991). As part of the UST removal, Burlington Environmental collected soil samples for benzene, toluene, ethylbenzene, and xylenes, but there were no detectable concentrations of these contaminants in soil above respective laboratory reporting limits.

King County tax assessor records document two 550-gallon USTs associated with the former gasoline service station that was located at the northwest corner of the Central Parcel (Figure 2.2). Tax assessor records do not specify the location or contents of the tanks. In 2014, a general contractor for King County's South Park Bridge replacement construction activities discovered and removed two USTs at the northwest corner of the Central Parcel, west of the Tire Factory (TIG Environmental, 2020). King County's contractor collected soil samples after UST removal for chemical analysis. Laboratory results indicated concentrations of PCE up to 0.789 mg/kg in soil collected from the bottom of the UST excavation. The detections of chlorinated solvents were, at the time, attributed to potential releases from historical dry-cleaning operations, formerly located upgradient and south across Dallas Avenue South from the Tire Factory (Figure 2.5). Reports related to the removal action for the USTs have been requested from King County, but no records related to the UST removal were located. It is unknown if these were the two tanks noted in the King County tax assessor records related to operation of the former gasoline service station, as those records indicated 550-gallon USTs, and Ecology's records indicate that the two removed by King County's contractor in 2014 had capacities of 2,100 gallons and 1,100 gallons (Ecology, 2024b).

4.2.3 T-117 EAA Cleanup – Marina Corner

A small portion of the T-117 EAA Phase 1 North Bank soil excavation and sediment DU3 areas occurred near and on the southeast corner of the SPM Property. These areas are referred to as the T-117 EAA "Marina Corner" (AECOM, 2016). The Marina Corner Removal Area included shallow sediment removal from interstitial openings in existing riprap using a vactor truck from an area of approximately 33 feet by 35 feet (AECOM, 2016). Final bank transect samples collected in this area were collected below MHHW and thus represent in-water LDW sediment.

Prior to the start of bank and sediment removal, a sheet pile wall was constructed in an "L" shape extending approximately 18 feet laterally on both the eastern and southern sides of the SPM Property's southeast corner and to depths of 20 to 22 feet below grade (to elevation -5 to -6 feet; see drawing presented in Appendix A.23). Near the start of DU3 dredging, on February 1, 2014, sheen was noted on the LDW water surface near the Marina Corner, although observation of a specific source was obscured by presence of geotextile fabric used to prevent soil erosion (AECOM, 2014a; included as Appendix A.24). During the subsequent February 2014 dredging in DU3, the SPM Property bank immediately east of the new sheet pile wall sloughed (slope failed) from the top of bank down to below the low tide water line (slough location shown on Figure 1 in Appendix A.24).

Subsequently, during low-tide conditions on March 6, 2014, groundwater seepage was observed discharging from the exposed Tidal Flat Unit (elevations approximately 4 to 5 feet) along the eastern sloughed bank and along the south side of the sheet pile wall (see Figure 2 in Appendix A.24), which resulted in a sheen on the LDW surface water. A sample of the surface water with rainbow sheen was collected on March 6, 2014, and submitted for analysis of TPH using the HCID method. A six-point composite bank sediment sample was also collected from the intertidal eastern riverbank on the SPM Property for analysis of TPH-HCID and PCB Aroclors. Analytical results indicated 3.0 mg/kg total PCBs and 250 mg/kg oil-range TPH. The memorandum documenting this work is presented in Appendix A.24 and includes photographs, data summary tables, and a sample location figure.

On March 17, 2014, AECOM resampled the same exposed intertidal bank sediment for analysis of gasoline-, diesel-, and oil-range TPH, PCB Aroclors, chlorinated pesticides/herbicides, metals, and VOCs. Analytical results indicated 5.4 mg/kg total

PCBs, 2,000 mg/kg TPH (diesel- plus oil-range), and detections of select pesticides (up to 0.345 mg/kg) and select metals (up to 66 mg/kg) (see Table 2 in Appendix A.24). That same day, AECOM also sampled groundwater seepage emanating south of the sheet pile wall on the T-117 Upland Property at an elevation of approximately 2.5 feet (see sample location depicted on Figure 1 in Appendix A.24). The seep sample was analyzed for gasoline-, diesel-, and oil-range TPH, PCB Aroclors, chlorinated pesticides/herbicides, metals, and VOCs. Analytical results indicated 0.11 milligram per liter (mg/L) TPH (diesel- plus oil-range), 0.062 mg/L total PCBs, and detections of select dissolved metals (up to 1.54 micrograms per liter [ug/L] chromium; see Table 3 in Appendix A.24).

Based on the sheen observed on groundwater discharging from the bank east and south of the sheet pile wall, the Phase 1 removal action design was modified to install a high-permeability, approximately 1/4-inch-thick GAC geocomposite layer along the east and south sides of the sheet pile wall (Figure 2.1). The GAC layer was placed over imported gravel borrow backfill and extended vertically between elevations approximately 0 and 8 feet. The GAC layer was covered with additional gravel borrow and then riprap armoring up to mean high water. Above mean high water, an ecology block wall was constructed on the water side of the sheet pile, with crushed rock backfill between the sheet pile wall and ecology block wall (AECOM, 2014b). As-builts for the sheet pile wall, excavation and dredging elevations,[35] and GAC geocomposite mat are provided in Appendix A.23. In March 2015, the Port and SPM drafted a legal agreement that acknowledges the sheet pile will remain in place permanently, restricts surcharge/loading of the embankment around the wall, and designates SPM as responsible to maintain and repair the wall.

No seeps were observed following the installation of the GAC layer and completion of the T-117 Sediment Removal Area and Upland Removal Area actions. Likewise, the shoreline bank is monitored for seeps as part of the T-117 EAA Long-Term Monitoring and Maintenance Plan, which prescribes visual inspections during low tide conditions when the shoreline bank, nearshore sediments, and any potential seeps can be directly observed. No seeps have been observed during any of the annual monitoring events (SPU et al., 2023).

4.3 Environmental Investigations and Cleanups Conducted Concurrently with the AO

The following subsections describe environmental investigations that were conducted on the SPM Property after the AO was finalized in April 2019 but were not part of the AO Scope of Work.

4.3.1 SPM Investigations – Stormwater NPDES

The following references document investigations conducted of the stormwater and washwater-related systems since finalization of the AO in April 2019.

March 2021 NPDES Inspection

- On March 11, 2021, Ecology conducted an announced stormwater compliance inspection of the SPM Property to review site conditions and documentation with

[35] Relative to mean lower low water (MLLW) vertical datum.

respect to the BYGP. On behalf of SPM, TIG Environmental accompanied Ecology and SPM for the inspection. Regarding SPM's documentation for stormwater management, Ecology's 2021 inspection concluded that

  - the site map needs to be revised to meet current requirements;
  - the SPM SWPPP must be updated and include the gated storage area south of Dallas Avenue South near the south end of the SPM Property, unless the storm drain in that area discharges to the combined sewer; and
  - SPM needs to begin sampling the SPM outfall and, if it drains to the SPM stormwater system, the gated storage area south of Dallas Avenue South.

- Regarding SPM's operations, Ecology's inspection concluded that SPM
  - must begin sampling at each unique sample point as described in the permit conditions;
  - must sample both the outlet of the StormwateRx™ system and the overflow or move the sample port to after the overflow;
  - should conduct cleanup and general housekeeping to remove paints and other debris from pavement;
  - must maintain tarps under vessels to keep them in better condition; and
  - must correct secondary containment issues throughout the Site.

Following receipt of Ecology's inspection report, SPM has been conducting management activities in accordance with the SWPPP and addressing action items identified in Ecology's inspection report. These activities have included

- contracting with Applied Professional Services in March 2021 to conduct additional investigation of the stormwater infrastructure configuration. This included tracing the drain line from CB-02 southward toward the CB-05/CB-06 area, uncovering the SPM Outfall within the shoreline riprap, and documenting that the catch basin within the gated storage area west of Dallas Avenue South drains northward to the combined sewer line at the intersection of 16th Avenue South and South Cloverdale Street;
- reconfiguring the StormwateRx™ system overflow piping in April 2021 to prevent LDW intrusion into the system while maintaining overflow functionality;
- contracting with Marine Vacuum Service, Inc. (MarVac) in June 2021 to vacuum accumulated solids from the catch basins and cleaned and replaced the screen baskets used to capture solids in the catch basins;
- installing custom-manufactured catch basin treatment inserts in basins CB-02, CB-03, CB-04, CB-06, CB-07, CB-08, CB-09 in November 2021;
- adding additional BMPs including restricting any boat maintenance work to the area of the Site that drains to the Stormwater Rx™ treatment system and more stringent vacuum sander requirements; and

- fully replacing the treatment media within the Stormwater Rx™ system in October 2021.

February 2022 NPDES Inspection

- On February 25, 2022, Ecology conducted an announced stormwater compliance inspection of the SPM Property to review site conditions and documentation with respect to the BYGP. On behalf of SPM, TIG accompanied Ecology and SPM for the inspection. SPM and Ecology began the inspection by discussing documentation and changes made since the March 2021 Site inspection. Regarding documentation, the Ecology site inspector concluded that SPM needed to complete the following:
    - Update the site map and SWPPP to include two new sampling points at CB-02 and either CB-05 or CB-06.
    - Begin sampling stormwater in CB-02 and either CB-05 or CB-06 to characterize stormwater reaching the South Park Marina outfall.
    - Correct secondary containment issues identified in the gated storage area west of Dallas Avenue South from the south end of the SPM Property.
    - Conduct a Level 2 response for copper and a Level 3 response for zinc based on catch basin stormwater results collected in April and May 2021.
    - Submit catch basin sampling results collected in April and May 2021.

Following the inspection, SPM conducted a Level Three Response for zinc and copper, and sampling and reporting stormwater analytical results for samples collected from CB-02 and CB-06:

- On May 20, 2022, a Level Three Response for copper and zinc was officially initiated in the untreated portion of the SPM Property (catch basins CB-02 and CB-06) during the April 2022 discharge monitoring period. Per Ecology's request, SPM submitted the April and May 2021 catch basin results with the electronic discharge monitoring report for the April 2022 monitoring event on May 20, 2022, triggering the Level Three Response. According to the 2016-2022 BYGP Sections S7(a)(2) and S7(a)(3), the Level Three Response includes the preparation of an Engineering Report that summarizes stormwater treatment alternatives and recommendation of a preferred treatment method. TIG Environmental submitted the Level Three Engineering Report to Ecology on August 19, 2022, and Ecology approved the final report on February 7, 2023 (TIG Environmental, 2023a).

May 2024 NPDES Inspection (Ecology, 2024c)

- On May 7, 2024, Ecology conducted an announced stormwater compliance inspection of the SPM Property to review site conditions and documentation with respect to the BYGP. On behalf of SPM, TIG Environmental accompanied Ecology and SPM for the inspection. Regarding SPM's documentation for stormwater management, Ecology's 2024 inspection concluded that

  - documentation was not kept on-site for water quality lab report data, solids sampling, weekly inspection reports, wash pad decontamination documents, or BMP maintenance records;
  - SPM needs to sample the wash pad solids to verify dangerous waste regulations are being met when disposing of solids; and
  - vessel maintenance is occurring in no work areas, despite signage stating its prohibition.
- Regarding SPM’s operations, Ecology’s inspection concluded that SPM
  - should conduct cleanup and general housekeeping to remove paints and other debris from pavement;
  - should survey the pipe depicted on the site map between the Tire Factory and the Legacy Master Marine property, as well as survey the two floor drains observed inside Legacy Master Marine garage and add to the site map;
  - must maintain and replace tarps under vessels as needed to keep them in better working condition; and
  - must correct secondary containment issues throughout the site.

Following receipt of Ecology’s inspection report, SPM has been conducting management activities in accordance with the SWPPP and addressing action items identified in Ecology’s inspection report. These activities include

- contracting with MarVac in June 2024 to vacuum wash water and accumulated solids from the boat washwater treatment storage tank as well as the Stormwater Rx™ intake vault and arrange for disposal of the water and solids;
- cleaning and replacing the screen baskets used to capture solids in the catch basins CB-02, CB-05, and CB-09;
- completing a full replacement of the treatment media within the StormwateRx™ system in July 2024;
- replacing tarps under specific vessels and at several additional vessel spaces;
- restocking dock-side spill kit supplies and materials; and
- confirming drainage from the previously unmapped catch basin to the StormwateRx™ catchment area and added to site maps labeled as CB-11.

As of the date of this RI Report, Verdantas is managing the implementation of the selected stormwater treatment alternative at the SPM Property. The new infrastructure will include a second aboveground filtration system and catchment area infrastructure upgrades, which will consist of the removal and replacement of catch basins CB-02, CB-05, and CB-06; decommissioning existing lines running between each of the basins and replacement with functional lines; and replacement of the SPM Outfall (TIG

Environmental, 2023a). TIG Environmental has since selected a stormwater vendor to install the new treatment system at SPM and is working with a civil engineer, geotechnical engineer, electrical engineer, archeological monitoring consultant, and construction contractor to provide civil and stormwater design services in support of TIG Environmental's Level Three Response. Discussions regarding final design and permitting are ongoing.

4.3.2 Sediment Investigations In and Near the Marina Basin

This section describes sediment data acquired (or reported) in or near the Marina Basin since the AO was finalized in April 2019. Table 4.1 provides a chronological summary of the documents containing data that are summarized below. A total of 63 locations were sampled (Figure 4.2):

- Two locations were sampled in 2018 for LDW pre-design studies in accordance with the third amendment to the LDW Agreed Order on Consent, with analyses for the full suite of LDW COCs (Windward, 2019). The two samples were collected between 0–10 cm in depth.
- Thirty-four locations were sampled in 2020 as part of the LDW Phase I Pre-Design Investigation, with analyses for the full suite of LDW COCs (Windward 2020). Fifteen of these locations were sampled between 0-10 cm in depth, and the remaining nineteen locations were subsurface sediment cores (greater than 10 cm in depth). During this investigation, split samples from 14 locations were collected by The Intelligence Group and analyzed for PCB congeners. Seven split samples were acquired from surface samples (0-10 cm in depth), and seven split samples were acquired from the subsurface sediment cores (greater than 10 cm in depth).
- Nine locations were sampled in 2021 as part of the LDW Phase II Pre-Design Investigation, with analysis for PCB Aroclors (Windward and Anchor QEA, 2022). Three of these locations were sampled between 0-10 cm in depth, and the remaining six locations were subsurface sediment cores (greater than 10 cm in depth).
- One location was sampled in 2021 as part of the Year 6 long-term monitoring for the T-117 removal action, with analyses for PCBs, dioxins/furans, select PAHs, arsenic, and phenol (Anchor QEA, 2021).
- Four locations were sampled in 2022 as part of the LDW Phase III Pre-Design Investigation, with analysis of PCB Aroclors and 4-methylphenol (Windward and Anchor QEA, 2024). All four locations were surface sediment grab samples (0 to 10 cm in depth).

The sediment data (including sediment data gathered prior to the AO; Section 4.1) is presented in Appendix H and further discussed in Section 6.1.

4.3.3 SPM Fire (2021), Investigation, and Cleanup

On September 2, 2021, a fire destroyed several vessels and three structures on the south end of the SPM Property: the lumber storage building, the woodworking shop, and a building used for boat storage and maintenance. Firefighting crews from the North Highline Fire Department and City of Tukwila Fire Department responded using a combination of water and firefighting foam to suppress the fire, which was fully contained within six hours. The North Highline Fire Department stated that the firefighting foam used was Novacool Class A and B foam, which does not contain per- or polyfluorinated substances (TIG Environmental, 2023d). There was evidence of overland flow of fire-fighting water to the LDW in the southeast corner of the Site and onto the T-117 property.[36]

On September 14, 2021, TIG Environmental collected two soil samples to characterize surface soil quality post fire. The samples were collected along the shoreline, from outside of the burned debris area but where evidence of firefighting liquid runoff was present (TIG Environmental, 2023d). Results of the two surface soil samples are included in the analytical dataset in Table I.3.B and are identified as samples 20210914 SS-1 and 20210914 SS-2 (collected at locations 21F-SS-01 and 21F-SS-02, respectively; Figure 5.1) to avoid naming conflicts with previous surface soil samples and locations SS-1 and SS-2 collected in 2016 (The Intelligence Group, 2016h; Figure 4.1). The soil samples were analyzed for gasoline-, diesel-, and heavy oil-range TPH, PAHs, SVOCs, PCB Aroclors, pesticides, metals, and VOCs.

Fire Research and Technology completed its investigation of the cause of the fire on October 19, 2021. The Site owner contracted directly with Rivers Edge Environmental Services, Inc. in November 2021 to remove the fire debris and demolish the remaining unstable structures. After acquiring a demolition permit from King County on February 24, 2022, removal of debris, demolition of buildings, and disposal of materials took place from March 17 to March 24, 2022. Rivers Edge Environmental Services, Inc. disposed of 179.11 tons of non-metal waste and recycled 9.24 tons of metal waste as part of the overall demolition effort (TIG Environmental, 2022). After completion, the site underwent final inspections, and the permit was closed out on March 1, 2023.

The area beneath the former buildings primarily consists of impervious surfaces (concrete slab or asphalt pavement) with limited areas of exposed soil.

4.3.4 SPM Investigation – Congener and Dioxins/Furans Soil Sampling

Concurrent with the Phase 2 RI soil investigation (described below in Section 5.1.2), TIG Environmental collected soil samples for analysis of PCB congeners and dioxins/furans between September 12 and 26, 2022. These samples were collected from the soil cores produced during Phase 2 drilling efforts after the primary soil samples identified in the RIWP Addendum (Aspect, 2022b) had been collected by Aspect. The purpose of the additional sampling was to "bolster the anticipated RI dataset and improve TIG's ability to evaluate the sources of contamination at the Site" (TIG Environmental, 2023c).

TIG Environmental collected 17 soil samples (excluding field duplicates) from 15 locations as part of their investigation. The naming convention for the samples was the

[36] Email correspondence from TIG Environmental to Priscilla Tomlinson (Ecology), dated September 2, 2021.

same as was used during the RI, and several of the samples had the same name as the primary sample collected by Aspect. These samples are included in the analytical dataset in Table I.3.B and Table I.3.C, and are identified with the sample suffix "-TIG" to avoid naming conflicts with the primary samples collected by Aspect as part of Phase 2 of the RI from the same locations. The PCB congener data were included as part of the RI dataset and are evaluated as part of the nature and extents of the Site in Section 7.

5 Agreed Order Environmental Investigations

This section provides a description of work completed between November 2019 and May 2023 as required under the AO. Investigation activities were conducted in support of the Site RI and the source control review to

- characterize soil, groundwater, soil gas, indoor air, and hydrogeologic conditions for the RI; and
- characterize stormwater and catch basins solids quality for the source control review.

All work was completed in accordance with the AO and with Ecology approval, as summarized in the monthly progress reports. Exploration locations identified in investigations under the AO and prior investigations outside the AO are depicted on Figure 4.1. Boring logs and well completion diagrams are provided in Appendix B.

The Site is within an area considered sensitive for precontact archaeological resources. Therefore, the RI subsurface exploration work was conducted with archaeological monitoring by a professional archaeologist in accordance with Site-specific Monitoring and Inadvertent Discovery Plans prepared as part of the RIWP and RIWP Addendum. No evidence of potential cultural resources or human skeletal remains were encountered during the Phase 1 or Phase 2 field investigations. The Cultural Resources Monitoring Reports are included as Appendix D (Willamette, 2021 and 2023).

RIs are by nature iterative processes, and to enable efficient and focused data collection, the RI was performed in a phased approach that allowed the initial phase to inform the scope of data collection in the next phase. The investigations for this RI consisted of three main phases of work:

- Phase 1 focused on: (a) characterizing potential sources of contamination, as identified by the review of historical and prior investigation documents; (b) identifying COPCs; and (c) sampling selected media to evaluate potential contaminant migration pathways from the Site to the LDW.
- Phase 2 used the historical and Phase 1 characterization data to identify data gaps. Phase 2 focused on: (a) refining the identified nature and extent of contamination, (b) further evaluating potential transport and exposure pathways and risks, and (c) confirming Site COPCs.
- Phase 3 focused on: (a) additional characterization of the VI pathway; and (b) refining the transport pathways with supplemental shoreline groundwater data.

In the RIWP, the basis for investigation was historical and current property operations and the available historical analytical data. The RIWP Addendum further refined investigation areas based on the Phase 1 analytical data and the 2021 fire, which occurred after Phase 1 data collection. The RIWP (Phase 1) developed the following data quality objectives for the RI:

- Delineate contaminant nature and extent (lateral and vertical) and identify areas and media (soil and groundwater) requiring remediation.
- Characterize site physical characteristics that influence contaminant fate and transport.
- Characterize the potential for contamination in Site soil and groundwater to migrate to LDW sediment or surface water.
- Characterize the potential for contamination to migrate via Site stormwater to sediment or surface water.
- Characterize the potential for contamination to migrate via soil vapor to indoor air.

The RIWP Addendum identified data gaps related to these data quality objectives and detailed the characterization approach to fulfill the data quality objectives for the Site RI during Phase 2.

Outside of the scopes of work defined in the RIWP and RIWP Addendum, in a meeting on October 12, 2023, Ecology requested an evaluation of all sample data for sediment within the LDW Superfund site adjacent to the Site, with a focus toward constituents not identified as COCs in the LDW ROD (e.g., TBT). The approach to the sediment data evaluation was further discussed in subsequent meetings on October 31 and November 9, 2023, and agreed upon by Ecology via email on November 16, 2023. No sediment sampling was conducted for the evaluation. The evaluation of existing sediment data culminated in transmittal to Ecology of a draft memorandum with a review of available sediment data (Review of Available Sediment Data in Proximity to South Park Marina; Aspect, 2024a). Based on subsequent discussions with Ecology, it was decided to not finalize the memorandum but rather integrate the data and evaluation into this RI. The sediment data reviewed are tabulated in Appendix H and are incorporated into this report accordingly.

5.1 Remedial Investigation Data Collection

The following subsections provide a timeline and description of activities completed under the AO for the purposes of characterizing soil, groundwater, soil gas, indoor air, and hydrogeologic conditions for the RI under Phases 1, 2, and 3. Analytical results from these investigations are summarized and discussed in Section 6.

5.1.1 Phase 1

The Phase 1 field activities, as prescribed in the RIWP (Aspect, 2021), were conducted between February and June 2021 and consisted of the following activities, further detailed in the subsections below:

- February 2021 – Conducted a site walk to mark locations for soil borings and monitoring wells, coordinated access to the locations with SPM, and conducted a private utility locate.

- March 2021 – Completed soil borings and installed monitoring wells as identified in the RIWP and installed and retrieved pressure transducers to monitor tidal responses at monitoring wells.
- April 2021 – Conducted groundwater monitoring and sampling (except for PCB congeners) at all existing SPM Property monitoring wells.
- May 2021 – Collected groundwater samples from select monitoring wells for PCB congener analysis based on the analytical results for PCB Aroclors from the April 2021 groundwater sampling event.
- June and July 2021 – Removed IDW for proper disposal and documented and measured approximate elevations and locations of seeps observed at extreme low tides along the shoreline.

5.1.1.1 Initial Site Walk and Private Utility Locate

An initial site walk was conducted on February 3, 2021, to mark locations of soil borings, monitoring wells, and hand augers as proposed in the RIWP. During this Site walk, a conflict with an overhead utility was identified at proposed soil boring location SB-31; this boring was shifted approximately 12 feet to the east to accommodate the drill rig's mast. Public utility locate tickets for the SPM Property parcels were submitted to the Washington Utility Notification Center on February 9, 2021. On February 26, 2021, a private locate of conductible utilities was performed by Applied Professional Services, Inc. of North Bend, Washington, to clear the boring locations of private utilities. During the private utility locate, potential subsurface utilities were detected near locations SB-32, MW-12, and MW-14. At these locations, borings were shifted less than 5 feet each, and a vactor truck was used to clear the first 5 feet of the MW-14 boring.

5.1.1.2 Soil Borings and Hand Augers

Soil sampling was conducted throughout the advancement of 21 soil borings (MW-04 through MW-14 and SB-26 through SB-34) and 2 hand augers (HA-01 and HA-02) between March 1 and March 9, 2021 (Figure 5.1). Location information is presented in Table 5.1 (including historical sample information), and boring logs are included as Appendix B.2. Borings were advanced by Holt Services, Inc. (Holt) of Puyallup, Washington, using a truck-mounted Geoprobe 7800 drill rig.

Borings were advanced to 20 feet bgs, with the following exceptions:

- MW-10, MW-13, and SB-30 were advanced to 25 feet bgs. SB-30 was the first boring drilled as part of the Phase 1 field program and the boring was advanced an additional 5 feet to confirm the alluvial deposits observed at 20 feet bgs were consistent with those previously described by SAIC (2008a). At locations MW-10 and MW-13, the Alluvial Unit was not observed at 20 feet bgs, so these borings were extended to identify the contact of the Tidal Flat and Alluvial Units in these portions of the SPM Property.
- MW-05 was advanced to 30 feet bgs to address historical data gaps related to vertical delineation of soil contaminant concentrations in the area of the Former A&B Barrel Pond.

At locations SB-26, MW-04, MW-05, and MW-06, which are in the area of the Former A&B Barrel Pond, drilling was conducted using conductor casing methods to minimize the potential for carry-down of contaminants. At these locations, drilling progressed through the fill material using 3.75-inch outer diameter tooling to identify the top of the contact between the Fill Unit and the Tidal Flat Unit. Once the contact was identified, a 5-inch-outer-diameter direct push tooling was advanced in the same borehole approximately 1 foot into the Tidal Flat Unit, and bentonite chips were placed at the bottom of the core barrel and hydrated to ensure a proper seal was formed. Following hydration of the bentonite, 2.25-inch outer diameter direct push tooling was then advanced through the 5-inch outer casing (and bentonite seal) to the planned sampling depth.

During advancement of soil borings, all soil cores were field screened, which included an examination to note sheens and staining, olfactory observations, volatile organic vapor screening with a photoionization detector (PID), and water sheen testing. Field screening observations are documented on the boring logs (Appendix B.2). Most soil borings did not have field screening indications of contamination with the following exceptions:

- Southeast SPM Property Corner:
    - MW-04: A moderate chemical-like odor and heavy, iridescent coloration were noted at 7 feet bgs, above the Tidal Flat Unit. The heavy, iridescent coloration was not apparent on the top of water during the sheen test, but it was observed coating the bottom of the sheen pan as the water used to conduct the sheen test was poured out for disposal. Additionally, a moderate petroleum-like odor and heavy sheen were noted at approximately 13 feet bgs in stratified silt and silty sand sequences in the Tidal Flat Unit.
    - MW-05: Similar to MW-04, a moderate chemical-like odor and heavy, iridescent coloration were noted at 9.5 feet bgs, above the Tidal Flat Unit. Beneath the Tidal Flat Unit, a slight petroleum-like odor with a heavy sheen was noted at 15 feet bgs in the Alluvial Unit.
- Near the Former Service Station:
    - SB-31: No field screening indications of contamination were present in the vadose zone (Fill Unit). The observed depth of groundwater at the time of drilling was 10.5 feet bgs, at the contact between the Fill Unit and Tidal Flat Unit. At 14.5 feet bgs, a strong petroleum-like odor and heavy sheen were noted in a sand lens within the Tidal Flat Unit.

During Phase 1, shallow (less than 3 feet bgs), anthropogenic debris was noted at locations HA-02, MW-04, MW-10, MW-15, SB-26, and SB-27. The debris included brick, charcoal, and metal fragments. At MW-07, at approximately 10 feet bgs at the base of the Tidal Flat Unit, trace wood debris was noted in the sampler. Due to the size of the sampler, it could not be determined if the wood debris was anthropogenic in origin or if it was an artifact of the former, natural land surface.

Further details regarding soil sampling and laboratory chemical analysis are included in Section 5.1.1.4. Each soil boring not completed as a monitoring well (Section 5.1.1.3) was decommissioned using hydrated bentonite chips by Holt, in accordance with requirements of Chapter 173-160 WAC.

Due to limited access to the southern SPM Property boundary prior to the 2021 fire, hand-auger borings HA-01 and HA-02 were advanced manually to depths of 3 feet bgs on March 11, 2021. Soil samples were field screened and collected in accordance with the RIWP Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP), and the boreholes were decommissioned with hydrated bentonite chips.

5.1.1.3 Monitoring Well Installation and Development

Twelve of the 21 soil borings were completed as Fill Unit monitoring wells MW-04 through MW-15 (Figure 3.1). Well construction details are included in Table 5.1; well completion diagrams are included on the boring logs in Appendix B.2. Monitoring wells were constructed in accordance with Chapter 173-160 WAC using 2-inch-diameter threaded Schedule 40 PVC casings and pre-packed screens. The pre-packed monitoring well screens consisted of 5-foot-long, 0.010-inch (10 slot) slotted screens with a filter pack consisting of 10/20 silica sand. Additional 10/20 silica sand was placed approximately 0.5 to 1 foot above each of the pre-packed screens, and the annular space above the sand was sealed using 3/8-inch hydrated bentonite chips. Each monitoring well was completed at the surface with an 8-inch-diameter, steel, truck-rated, flush-mount monument set in high-strength concrete.

The depth interval for the well screen at each monitoring well location was chosen based on the conditions observed at the time of drilling and followed the procedures outlined in the RIWP SAP/QAPP:

- “If greater than 5 feet of saturated zone is present in the Fill Unit, the top of the screen will be placed 1.5 feet above the water table and 3.5 feet below to allow for seasonal fluctuations.
- If less than 5 feet of but greater than 2 feet of groundwater saturation is present in the Fill Unit at the time of drilling, the 5-foot screen will be placed within the Fill Unit directly on top of the Silt Unit [Tidal Flat Unit].
- If 2 feet or more of saturation is not present in the Fill Unit, the screen will be placed in the Alluvial Sand Unit at a depth interval such that a minimum of 2 feet of bentonite annular seal is present between the top of the screen’s filter pack and the top of the Silt Unit [Tidal Flat Unit].
- If there is an unsaturated zone in the Alluvial Unit greater than 5 feet thick, the top of the screen will be placed approximately 2 feet above the water table to allow for seasonal fluctuations.”

Greater than 2 feet of saturation in the Fill Unit was observed during drilling of all 12 monitoring wells, and therefore all 12 monitoring wells were screened within the Fill Unit during Phase 1. All monitoring wells were generally installed with the bottom of the well screen at or near the top of the Tidal Flat Unit, with the following exceptions:

- MW-06: At MW-06, soil appeared to be saturated at 4 feet bgs at the time of drilling, and the Tidal Flat Unit was identified in the field by an organic silt layer at 10 feet bgs. The well was screened from 3.5 to 8.5 feet bgs. Upon review of the soil descriptions while the boring logs were being produced, the top of the Tidal Flat Deposits Unit was interpreted as 7 feet bgs based on the consistency of those soils with other borings in this portion of the SPM Property. The well screen penetrates the top of the Tidal Flat Unit, but there is an additional 2 feet of separation in the Tidal Flat Unit between the bottom of the well screen and the top of the Alluvial Unit.
- MW-08: At MW-08, the Tidal Flat Unit was not observed during drilling. The depth to water at the time of drilling was 8.5 feet bgs, and the well was screened from 7 to 12 feet bgs to accommodate fluctuations in groundwater elevations and based on the screen intervals selected for other shoreline monitoring wells.
- MW-11: At MW-11, greater than 5 feet of saturation was present in the Fill Unit soils, and the well was screened from 5 to 10 feet bgs based on observed depth to water of 7 feet bgs at the time of drilling. This screen interval is solely within the Fill Unit with the screen bottom approximately 2 feet above the top of the Tidal Flat Unit.
- MW-13: MW-13 was the first monitoring well installed during RI Phase 1. Based on descriptions of the Tidal Flat Unit by SAIC, the composition of the unit was expected to contain less sand than observed at borings in this northwest portion of the SPM Property. Groundwater was observed at a depth of 10 feet bgs during advancement of the boring, but strong field indications of volatile contamination were present at 14.5 feet bgs in the previously drilled adjacent soil boring SB-31, indicating that there may be significant seasonal fluctuations in groundwater elevations resulting in a “smear zone.” A well screen interval from 10 to 15 feet bgs was therefore selected to accommodate these potential seasonal fluctuations and characterize groundwater quality in the zone where field screening at SB-31 indicated the highest potential for petroleum impacts. Based on the cumulative observations of all soil borings installed as part of Phase 1 of the RI, the top of the Tidal Flat Unit was later interpreted to be 10 feet bgs at this location, and MW-13 is screened within it. There is 6.5 feet of separation between the bottom of the well screen and the top of the Alluvial Unit.

The apparent depths to water at the time of drilling were greatly affected by the tidal stage at locations close to the LDW shoreline. Generally, during the week of Phase 1 well installations, the tide cycles during the day when drilling was occurring were high-high, high-low, and low-high tides (i.e., not the low-low part of the tide cycle).

The monitoring wells were developed between March 10 and March 12, 2021, to remove fine-grained material from inside the well casing and filter pack to the extent practical, and to improve hydraulic communication between the well screen and the surrounding water-bearing formation. Well development was performed by means of a surge block and a 12-volt submersible pump. During development, the surge block was gently surged through the entire length of the well screen. Each well was developed until visual turbidity was reduced to minimal levels (below 10 nephelometric turbidity units [NTU] if practical) or until a maximum of 15 casing volumes of water had been removed:

- Monitoring wells MW-04, MW-12, MW-13, and MW-14 were developed until turbidity was measured at less than 10 NTU.
- Turbidity at monitoring wells MW-05, MW-06, MW-07, MW-08, MW-10, MW-11, and MW-15 was still greater than 10 NTU after purging a minimum of 15 casing volumes from each. Turbidity for these wells at the end of well development was greatly improved from the time of installation, and the turbidity criterion was achieved at each well during groundwater sampling, except for MW-07 and MW-10. Turbidity in groundwater at MW-07 and MW-10 at the time of sampling remained above the sampling criterion of 25 NTU (further discussed in Section 5.1.1.6); elevated turbidities in groundwater samples may cause interference with select laboratory analyses, such as those for metals, PCBs, and pesticides.
- Insufficient groundwater was present at MW-09 to develop it in conjunction with the other monitoring wells. Aspect returned during a high-tide cycle on March 23, 2021, and developed it; 15 casing volumes were removed and the turbidity at the conclusion of development was measured at 12 NTU. However, at the time of groundwater sample collection, turbidity in groundwater at MW-09 was above the sampling criterion of 25 NTU (further discussed in Section 5.1.1.6).

Monitoring wells MW-04 through MW-15 were surveyed by Apex Engineering, LLC, of Tacoma, Washington, on March 15, 2021. Coordinates of monitoring wells were reported to within 0.1 foot in the North American Datum of 1983 (NAD83)/2011 Washington State Plane horizontal datum, and elevations were reported to within 0.05 feet in NAVD88 vertical datum. Monitoring well locations and elevations are included in Table 5.1.

5.1.1.4 Soil Sampling for Chemical Analysis

During the advancement of soil borings, continuous soil cores, depending on soil recovery, were collected throughout the length of each boring. Recovery in each 5-foot core retrieved is displayed on the boring logs in Appendix B.2.

To complete the number of chemical analyses required, a significant volume of soil was required for each sample interval, particularly for surface soils (0 to 1 feet bgs), which generally were analyzed for the most chemical constituents. At locations SB-29, SB-30, SB-31, and MW-14, recovery in the first direct-push interval from 0 to 5 feet bgs was poor and resulted in insufficient soil volume for chemical analysis. At these locations, an additional soil core was advanced from 0 to 5 feet bgs within a few feet adjacent to the boring to collect sufficient volume of soil for discrete samples. These soil samples are identified by the suffix “A” (e.g., MW-14A-0-1) as shown on analytical data tables and in the boring logs in Appendix B.2.

At soil boring SB-34, two shallow soil samples from 0-1 and 3-5 feet bgs were inadvertently submitted as archived and were not corrected in time to meet 14-day analytical hold times for all analyses except metals and PCBs. This would have resulted in the data being flagged and failing to meet data quality objectives. It was decided to recollect the two soil samples via hand auger on March 23, 2021, from a location immediately adjacent to the original boring. The samples are identified by the suffix "R" (e.g., SB-34R-0-1).

The RIWP SAP/QAPP identified the use of 2.25-inch-outer-diameter tooling, which uses 1.5-inch-inner diameter plastic liners for collecting soil cores. During the Phase 1 RI fieldwork, the volume of soil from these 1.5-inch cores was insufficient to fill all the containers requested by the analytical laboratory. Therefore, 3.75-inch-outer-diameter tooling was used with 3-inch-inner-diameter liners to increase soil volume for chemical analysis. Sample core diameters are noted on the boring logs in Appendix B.2.

Three soil samples were collected from each of the two hand auger locations, and a minimum of four soil samples were collected from each drilled boring location. In total, 108 soil samples (not including field duplicates) were collected from the 23 locations in Phase 1. The depth intervals of these soil samples are shown on the boring logs in Appendix B.2 and are included in the analytical data tables.

As outlined in the RIWP, a minimum of two soil samples (not including field duplicates) from each location were submitted for chemical analysis. Generally, the planned sample depths were based on the location of each boring relative to the historical and current uses of the SPM Property and the objective of the investigation in that area, as summarized in Tables E.2 and E.5 of the RIWP (Aspect, 2021). Two additional soil samples were also collected from each of the borings and archived for potential future analysis based on analytical results from the two samples analyzed, in accordance with the RIWP.

Additional soil samples, beyond those identified in the RIWP SAP/QAPP, were submitted for chemical analysis based on the field screening indications in borings SB-31, MW-04, and MW-05, described in Section 5.1.1.2 above. Once the initial laboratory analytical results were received and compared to the RIWP SLs, archived samples were released for analysis. However, only soil samples for analysis of metals (other than mercury), PCB Aroclors, PCB congeners, and dioxins/furans were still within hold time. Where available, deeper soil samples were released for analysis of metals and PCB Aroclors for the purposes of vertical delineation. Soil samples for analysis of PCB congeners and dioxins/furans were selected based on the first round of PCB Aroclors analytical results. In total, 79 unique soil samples (45 vadose soil samples and 34 saturated soil samples[37]) were analyzed for a wide variety of chemical analyte classes in accordance with the RIWP.

The RIWP anticipated that soil recovery may be insufficient to provide adequate soil volume for all analyses at all planned locations and depth intervals. At intervals where there was insufficient sample volume to analyze for all planned constituents, the analyte list was prioritized as described in Table E.6 of the RIWP for each investigation area with instructions documented on the chain-of-custody form. In general, limited sample recovery did not preclude meeting the analysis objectives at each boring outlined in Table

[37] For the purposes of this report, the vadose soil samples are defined as 0 to 6 feet bgs, and saturated soil samples are defined as greater than 6 feet bgs.

E.1 of the RIWP, except in a few locations which are specifically discussed in Section 5.3 below.

5.1.1.5 Phase 1 Groundwater Tidal Study

Prior to groundwater sampling, pressure transducers were installed at select monitoring wells throughout the SPM Property to determine the optimal tidal-stage window for collecting low-salinity groundwater samples. The transducers were deployed in wells MW-04, MW-06, MW-07, MW-08, MW-09, MW-11, MW-12, MW-13, and MW-14 (Figure 3.1) for 10 days between March 13 and March 23, 2021, prior to retrieval and analysis. The hydrographs for all monitoring wells are included in Appendix C.1.

The lowest conductivity and water level measurements at each well were correlated with the low tide recorded at the National Oceanographic and Atmospheric Administration's (NOAA) station number 9447130, which is located in Elliott Bay. For each well, the average lag time between the tidal minimums observed at the NOAA gauge and the water level minimums in each well were used to determine the optimal timing of the groundwater sampling event to minimize influence of saline water mixing in the transitional zone.

Based on the results of this analysis, the following observations were noted and formed the basis for establishing lag times (or lack thereof) in the newly installed Fill Unit monitoring wells:

- Shoreline Wells:
  - MW-07: The average of the calculated lag times for minimum groundwater elevation and conductivity with respect to the tide height was 2 hours and 13 minutes.
  - MW-08, MW-09, and MW-11 went dry during lower-low tides. However, their responses to tidal fluctuations appeared nearly instantaneous. A datalogger was not installed in MW-10, but it was also assumed to go dry based on the elevation of the screen. Therefore, the approximate bottom elevation of the wells screens was used to determine when each well would go dry during upcoming tides. The sampling window was calculated as 1.5 hours before the predicted time for the groundwater elevation to reach the bottom of each well screen and for the well to become dry.
- Southeast SPM Property Corner Wells:
  - Lag times were calculated for MW-04 and MW-06 as 2 hours and 46 minutes and 2 hours and 36 minutes, respectively.
- Inland Wells:
  - MW-12 is located approximately 130 feet inland from the LDW shoreline and is therefore outside the 100-foot buffer from the LDW that the RIWP SAP/QAPP established for sampling during lowest period of tidal influence. However, the well still showed a measurable response to tidal fluctuations, so a lag time of 45 minutes was calculated and used for groundwater sampling.

  - MW-13 is approximately 320 feet from the LDW shoreline and well outside the 100-foot buffer from the LDW. This well showed a slight response to tidal fluctuations, but the groundwater elevation varied by less than 0.10 foot. Therefore, no lag time relative to tide cycles was used during the timing of groundwater sampling at MW-13.
  - MW-14 is approximately 215 feet from the LDW shoreline and showed no tidal response, so no lag time was calculated.

- Wells without Transducers:
  - MW-05: The lag time was estimated at approximately 2 hours and 30 minutes based on adjacent wells MW-04 and MW-06 in the southeast SPM Property corner.
  - MW-10: The monitoring well was expected to go dry, and a minimum screen elevation and sampling window was applied as with other shoreline wells.
  - MW-15: Monitoring well MW-15 is well outside the 100-foot buffer and at a similar distance as MW-14, and therefore no tidal influence was expected.

5.1.1.6 Groundwater Sampling – Site-Wide

Site-wide groundwater sampling was conducted at monitoring wells MW-04 through MW-15 on March 29 to March 31, 2021. Except for monitoring wells MW-13, MW-14, and MW-15, which are inland wells that are not tidally influenced, sampling was conducted during the optimal tide windows as established in Section 5.1.1.5 above. Prior to beginning the multi-day groundwater sampling event, depth to water was measured at each monitoring well[38] during a 45-minute window between approximately 7:30 a.m. and 8:15 a.m. on March 29, 2021, which was during an outgoing tide.

Based on field observations at the time of drilling, an oil-water interface probe was used to measure water levels at MW-04, MW-05, and MW-06 to evaluate whether either light or dense non-aqueous phase liquids (LNAPL or DNAPL, respectively) were present in the monitoring well. At location MW-04, the oil-water interface probe indicated LNAPL may be present in the monitoring well, but the thickness was not measurable (i.e., the interface probe produced a distinct auditory signal, but the signal was not consistent).

Due to the limited amount of groundwater present in the Fill Unit at shoreline monitoring wells, several monitoring wells were either completely dewatered during purging and/or drawdown was significant even with a 100 milliliters per minute purge rate. The following observations were noted for each monitoring well:

- MW-04, MW-05, MW-06, MW-11, MW-12, MW-13, MW-14 and MW-15: All field parameters stabilized in accordance with the RIWP SAP/QAPP; turbidities were less than 25 NTU; and electrical conductivity was less than 1,000 uS/cm. All planned analyses for each location were completed in accordance with the RIWP.

[38] All wells were gauged except for MW-12, which could not be accessed due to a boat blocking the vault lid.

- MW-07, MW-09, and MW-10: At each of these locations, the monitoring well purged dry during low-flow sampling while waiting for field parameters to stabilize. In accordance with the RIWP SAP/QAPP, the monitoring wells were allowed to recharge prior to sample collection. Even after allowing the monitoring wells to recharge, there was insufficient volume to fill all the required sample bottles for the analyses identified in Table E.3 of the RIWP; therefore, priority of the analyses conducted on groundwater samples collected at these locations was established as prescribed in Table E.6 of the RIWP. Additionally, the electrical conductivity was greater than 1,000 uS/cm, and the turbidity was greater than 25 NTU at these locations, which may cause interference during analysis of metals and PCBs, respectively. Based on the limited volume of recovered groundwater, very few analyses were able to be conducted on Phase 1 samples collected from MW-09 and MW-10.
- MW-08: At MW-08, field parameters stabilized during purging associated with the low-flow sampling. However, electrical conductivity was measured at 2,166 uS/cm at the time of sampling, which may cause interference with analysis for metals. Turbidity at the time of sampling was measured at 3.5 NTU.

After sample collection was complete, the depth to the bottom of the monitoring well was measured to evaluate potential siltation of the monitoring well casing. In addition, based on field-screening observations during drilling, an oil-water interface probe was used at monitoring wells MW-04, MW-05, and MW-06 to evaluate whether DNAPL was present in the bottom of the well casing; there were no indications of DNAPL at these locations.

5.1.1.7 Groundwater Sampling – PCB Congeners

As prescribed in the RIWP, four monitoring wells representing a range of highest to lowest (including non-detected) PCB Aroclor concentrations were selected for PCB congener analysis. A total of five monitoring wells were sampled for PCB congeners based on the following rationale:

- MW-04: A sample from MW-04 contained a relatively high concentration of PCB Aroclors as compared to other monitoring wells (except MW-05). However, the mixture of Aroclors was unique in that MW-04 was the only location where Aroclor 1242 was detected. Therefore, it was added as an additional location for PCB congener groundwater sampling and analysis.
- MW-05: A sample from MW-05 contained the highest concentration of PCB Aroclors detected in the Phase 1 groundwater samples.
- MW-08: A sample from MW-08 contained the lowest, yet still detectable, concentrations of PCB Aroclors in the Phase 1 groundwater samples.
- MW-13: A sample from MW-13 did not contain detectable concentrations of PCB Aroclors and was selected due to its location in the northwest corner of the SPM Property.
- MW-15: A sample from MW-15 contained detectable concentrations of PCB Aroclors and is in the upgradient portion of the SPM Property.

PCB congener groundwater sampling was conducted on May 27, 2021. The RIWP SAP/QAPP identified the use of non-recycled, thin-walled, flexible copper tubing down well with platinum-cured silicone tubing through the pump head in accordance with the sampling methodology established in Leidos (2016 and 2017). However, a source for non-recycled, thin-walled, flexible copper tubing could not be identified. Therefore, platinum-cured silicone tubing was used both down well and through the pump head during low-flow sampling conducted for PCB congener analysis.

5.1.1.8 IDW Disposal

Soil cuttings from borings were placed in labeled United States Department of Transportation-(DOT) approved drums pending the analytical results to determine appropriate disposal. IDW water generated during equipment decontamination and monitoring well development and sampling was placed in labeled DOT-approved drums pending the analytical results to determine appropriate disposal. The drums were temporarily stored on-site, profiled based on available analytical data, and disposed appropriately at a permitted off-site disposal facility.

A total of six 55-gallon drums of IDW were produced during the Phase 1 RI field activities: three drums of soil cuttings and three drums of decontamination water and purged groundwater. Based on the analytical data, two of the soil drums were managed as D008 dangerous waste due to lead concentrations from toxicity characteristic leaching procedure analysis. Due to the suspected source of PCE in soil originating from the historical, upgradient dry-cleaning operations, the remaining two soil drums were managed as F002-listed dangerous waste, as were the two water drums. DH Environmental, Inc. of Seattle, Washington, was responsible for profiling the waste and hauling the drums to the selected disposal facility. The IDW drums were removed from the SPM Property by DH Environmental, Inc. on May 28, 2021, and transported to Waste Management, Inc. facilities in Arlington, Oregon. The dangerous waste drums were disposed of at Waste Management, Inc.'s Chemical Waste Management, which is a Subtitle C treatment, storage, and disposal facility approved for dangerous waste. Disposal records are included in Appendix F.1.

5.1.1.9 Seep Observations

The IDW pickup on May 28, 2021, occurred during an extreme lower-low tide which reached an elevation of -6.2 feet. During this visit, seeps were observed daylighting at the base of the riprap slope along the SPM Property shoreline. Prior to this visit, no site visits had been conducted at low tides below elevation approximately -1 foot. The seeps were numerous and warranted further evaluation.

Additional evaluation of the seeps was conducted on June 25, 2021, during a lower-low tide that reached an elevation of approximately -6.4 feet. A total of 37 unique seeps were identified; the locations of the northernmost 23 seeps were recorded using a GPS unit with submeter accuracy (Figure E.2.A). The southern seeps were observable from the top of the ecology retaining block wall but could not be safely accessed due to the steep slope and slick, thick layer of silty sediment. An informal survey (using a transit and stadia rod) was also conducted to measure the elevation of seeps for the purposes of displaying them on cross-sections and evaluating interconnectivity with upland groundwater. The elevations of two seeps were measured at -2.3 and -2.7 feet. Careful observations were made to distinguish whether the seeps were daylighting behind the riprap or where the slope of the riprap meets the relatively flat sediment deposits in the Marina Basin. All of the seeps appeared to daylight at similar elevations to the two that were informally surveyed and not further up the slope behind the riprap. Photographs of the seeps are included in Appendix E.2.B.

On July 22 and 23, 2021, conductivity dataloggers were installed at six seep locations along the SPM Property shoreline in the flowing water where the seeps originated. Water quality parameters were recorded, and representative flow rates were measured at six select seep locations. Field parameters measured at these locations indicated that water discharging from the seeps was much more saline than water observed in Fill Unit shoreline monitoring wells, with seep specific conductivity ranging between approximately 25,000 and 40,000 uS/cm. Additionally, flow rate approximations were made at the six seep locations using a stopwatch and stainless-steel bowl which was decanted to a graduated cylinder. Approximate discharge rates from the seeps were measured between 12 to greater than 44 liters per minute; however, due to the elevation of the seeps and limited access, accurate measurements were difficult to obtain and are considered approximations. Charts showing seep specific conductivity versus surface water elevation, seep temperature versus surface water elevation, and seep specific conductivity and temperature during a falling tide are included as Figures E.2.C.1 through E.2.C.3, respectively. Field parameters and flow rate measurements are summarized in Table E.2.C.

5.1.2 Phase 2

Field activities for Phase 2 of the RI were completed between August 2022 and February 2023 and consisted of the following activities per the RIWP Addendum, further detailed in the subsections below:

- August 2022 – Conducted a site walk to mark locations for soil borings and monitoring wells, coordinated access to the locations with SPM, and conducted a private utility locate.
- September 2022 – Completed soil borings and installed monitoring wells as identified in the RIWP Addendum (Aspect, 2022b) and developed monitoring wells.
- October 2022 – Installed and retrieved pressure and conductivity dataloggers in all Site wells, conducted sub-slab soil gas sampling at the Tire Factory, reinstalled and developed monitoring well MW-13D (described in Section 5.1.2.3), and conducted Site-wide groundwater monitoring and sampling.
- November 2022 – Completed a building evaluation and chemical inventory of the Tire Factory to further assess potential VI.
- December 2022 to January 2023 – Installed and retrieved pressure and conductivity dataloggers in wells that were dry following installation, monitored seasonal changes in groundwater elevation, and developed a well that had previously been dry.

- February 2023 – Removed IDW drums that were generated during Phase 2 of the RI for disposal at a permitted facility.

5.1.2.1 Site Walk and Private Utility Locate

A site walk was conducted on August 22, 2022, to mark locations of Phase 2 soil borings, monitoring wells, and hand augers as proposed in the RIWP Addendum (Aspect, 2022b). During this site walk, several boring locations were shifted up to 7 feet to avoid conflicts with overhead or underground utilities, trees, and other obstructions. Public utility locate tickets for the SPM Property parcels were submitted to the Washington Utility Notification Center on August 23, 2022. On August 29, 2022, a private locate of conductible utilities was performed by Applied Professional Services to clear the boring locations of private utilities. During the private utility locate, a representative from Holt also reviewed the marked boring locations, particularly those which required additional access for the larger footprint of the sonic drill rig. Based on the size of the drill rig and access, locations MW-04D, MW-05D, and MW-06D were all shifted up to 6 feet. Additionally, based on the presence of utilities, a vactor truck was required to clear the first 5 feet of the MW-09D, MW-17, MW-19, MW-19D, MW-20, and MW-21 borings.

5.1.2.2 Soil Borings and Hand Augers

Soil sampling was conducted throughout the advancement of 26 soil borings (MW-04D, MW-05D, MW-06D, MW-08D, MW-09D, MW-11D, MW-13D, MW-16, MW-16D, MW-17, MW-18, MW-18D, MW-19, MW-19D, MW-20, MW-21, MW-22 and SB-35 through SB-43) and completion of 5 hand augers (HA-03 through HA-07) between September 12 and September 26, 2022 (Figure 3.1). Location information is presented in Table 5.1, and boring logs are included as Appendix B.2. Borings were advanced by Holt using either a truck mounted Geoprobe 7822DT drill rig or a Terra Sonic 150CC drill rig.

The soil borings were advanced in accordance with the RIWP Addendum (Aspect, 2022b) to depths ranging from 20 to 40 feet bgs except at locations MW-16, MW-18, and MW-19, which were colocated with deeper explorations and only advanced to the top of the Tidal Flat Unit (10.5, 15, and 8 feet bgs, respectively). An additional soil boring, SB-43, which was not included in the RIWP Addendum (Aspect, 2022b), was advanced to delineate the extent of Pond Fill material better horizontally.

At Alluvial Unit monitoring well locations MW-04D, MW-05D, MW-06D, and MW-16D, which are in or adjacent to the Former A&B Barrel Pond, drilling was conducted using conductor-casing methods to minimize the potential for carry-down of contaminants through the Tidal Flat Unit. At these locations, sonic drilling progressed through the fill material using a 4-inch-inner-diameter core barrel tooling to identify the top of the contact between Fill material and the Tidal Flat Unit, with drilling advancing at 2 feet intervals at the expected depth of the contact between the Units. Once the depth of the Tidal Flat Unit was verified, an 8-inch-outer-diameter core barrel was advanced in the same borehole approximately 1 to 2 feet into the Tidal Flat Unit, and bentonite chips were placed in the core barrel and hydrated to ensure a proper seal was formed. Following hydration of the bentonite, the 4-inch-inner-diameter core barrel was then advanced through the 8-inch outer casing (and bentonite seal) to the planned sampling depth. Sonic drilling methods were also utilized at the SB-42 and SB-43 borings based on their proximity to the Former A&B Barrel Pond, as the sonic drill rig was already occupying nearby locations. Sonic drilling methods were also used to drill MW-13D based on drill rig availability.

During advancement of soil borings, all soil cores were field screened, which included an examination to document sheens and staining, olfactory observations, volatile organic vapor screening with a PID, and water sheen testing. Field screening observations are documented on the boring logs (Appendix B.2). Most soil borings did not have field screening indications of contamination with the following exceptions:

- Near the Former A&B Barrel Pond:
  - MW-04D: A moderate hydrocarbon-like odor and heavy sheen were noted at 5 feet bgs in the Fill Unit, and a moderate sheen was noted throughout the Fill Unit to the top of the Tidal Flat Unit at 10.5 feet bgs. Within the Tidal Flat Unit, a strong, hydrocarbon-like odor and moderate to heavy sheen were noted throughout from 10.5 to 17 feet bgs. No sheens or odors were noted throughout the Alluvial Unit from 17 to 21 feet bgs and in the Glacial Till Unit from 21 to 30 feet bgs.
  - MW-05D: No sheens or chemical-like odors were noted in the Fill Unit from the ground surface to 9.5 feet bgs. Directly above the Tidal Flat Unit at 10 feet bgs, a strong chemical-like odor and heavy sheen were noted. Within the Tidal Flat Unit, a hydrocarbon-like odor and moderate sheen were noted in a lens of silty sand at 13 to 14 feet bgs. No chemical-like odors or sheens were noted throughout the remainder of the boring in the Alluvial or Glacial Till Units.
  - SB-42: A strong, hydrocarbon-like odor and heavy sheen were noted starting at 2.5 feet bgs and extending to 8 feet bgs. Additionally, anthropogenic debris, including plastic and wood debris and a rubber sheet, was noted to depths of 5 feet bgs. This material was interpreted as Pond Fill based on previous descriptions by SAIC. A strong chemical-like odor and moderate sheen were noted in the Tidal Flat Unit at 10 feet bgs.
  - SB-43: No chemical-like odor was noted, but a slight sheen was present in the vadose zone between 2 and 8 feet bgs in the fill material. No sheens or chemical-like odors were noted in the remainder of the boring in the Tidal Flat Unit (8.5 to 11 feet bgs) or in the Alluvial Unit (11 to 12 feet bgs).
- Near the Former Service Station:
  - MW-13D: No chemical-like odors or sheens were noted throughout the Fill Unit from 0 to 9.5 feet bgs. Within the Tidal Flat Unit, a slight chemical-like odor was noted consistently from 15 to 26 feet bgs; generally, no sheen was observed in this interval except for a slight sheen that was observed at 17 feet bgs. No sheens or chemical-like odors were noted throughout the Alluvial Unit (26 to 34.5 feet bgs) or the Glacial Till Unit (34.5 to 40 feet bgs).

During Phase 2, anthropogenic debris was noted in the following borings:

- At HA-03, HA-04, HA-05, HA-07, MW-04D, MW-15, MW-17, MW-18D (burned wood), MW-22, and SB-36, shallow (less than 3 feet bgs), anthropogenic debris was noted that included wood, brick, and glass fragments.
- At MW-04D at 10 feet bgs, trace burnt wood fragments were noted and at 12 feet bgs, trace friable blue-white material was noted.
- At MW-05D at 10 feet bgs and at MW-06D at 8 feet bgs (both at the top of the Tidal Flat Unit), wood debris was noted. Due to the size of the sampler, it could not be determined if the wood debris was anthropogenic in origin or if it was an artifact of the former, natural land surface.
- At SB-35 at 2 feet bgs, yellow paint-like material and asphalt debris were noted.
- At SB-37 at 2 feet bgs, charred wood debris and clumps of paint-like material were noted.
- At SB-38 at 6 inches bgs, orange paint-like material was noted.
- At SB-42 at depths up to 5 feet bgs, plastic debris, rubber sheeting, and large wood debris were noted.

Further details regarding soil sampling and laboratory chemical analysis are included in Section 5.1.2.4. Each soil boring not completed as a monitoring well (Section 5.1.1.3) was decommissioned using hydrated bentonite chips by Holt, in accordance with requirements of Chapter 173-160 WAC.

Hand-auger borings HA-03 through HA-07 were advanced manually by Aspect on September 20, 2022. Soil samples were field screened and collected in accordance with the RIWP SAP/QAPP, and the locations were sealed with hydrated bentonite chips.

5.1.2.3 Monitoring Well Installation and Development

Seventeen of the 26 soil borings were completed as monitoring wells MW-04D, MW-05D, MW-06D, MW-08D, MW-09D, MW-11D, MW-13D, MW-16, MW-16D, MW-17, MW-18, MW-18D, MW-19, MW-19D, MW-20, MW-21, and MW-22 (Figure 3.1). Well construction details are included in Table 5.1; well completion diagrams are included on the boring logs in Appendix B.2. Monitoring wells were constructed by Holt in accordance with Chapter 173-160 WAC using 2-inch-diameter threaded Schedule 40 PVC casings and pre-packed screens. The pre-packed monitoring well screens consisted of 5-foot-long, 0.010-inch (10 slot) slotted screens with a filter pack consisting of 10/20 silica sand. Additional 12/20 silica sand was placed approximately 0.5 to 2 feet above the top of the pre-packed screens, and the annular space above the sand was sealed using 3/8-inch hydrated bentonite chips. Each monitoring well was completed at the surface with an 8-inch-diameter, steel, truck-rated, flush-mount monument set in high strength concrete.

The interval for the well screen at each monitoring well location was chosen based on the conditions observed at the time of drilling, and followed the procedures outlined in the SAP/QAPP of the RIWP Addendum:

- "Fill Unit monitoring wells (MW-16, MW-17, MW-18, MW-19, MW-20, MW-21, and MW-22):

  - If the Tidal Flat Unit is encountered, the 5-foot screen will be placed in the Fill Unit directly on top of the Tidal Flat Unit.
  - If the Tidal Flat Unit is not encountered, and the Fill Unit is saturated, the top of the screen will be placed just below the water table at the time of drilling.[39] If the Fill Unit is not saturated, the screen will be placed in the Fill Unit directly on top of the Alluvial Unit (as typified by a sand with only a trace amount of fines).

- Alluvial Unit monitoring wells (MW-04D, MW-05D, MW-06D, MW-08D, MW-09D, MW-11D, MW-13D, MW-16D, MW-18D, and MW-19D):
  - If the Tidal Flat Unit is encountered and the Alluvial Unit is saturated, the 5-foot screen will be placed a minimum of 2 feet below the bottom of the Tidal Flat Unit to ensure the bentonite annular seal separates the well screen's filter pack from the shallower water bearing zone in the Fill Unit.
  - If the Tidal Flat Unit is not encountered, the 5-foot screen will be placed at a similar elevation to other nearby Alluvial Unit monitoring wells to characterize groundwater quality within the same water bearing zone. For paired Fill-Alluvial monitoring wells, if the Tidal Flat Unit is not encountered, and a monitoring well is installed in the Fill Unit, the Alluvial Unit monitoring well will be screened in a distinctly different vertical interval from the Fill Unit monitoring well with a minimum vertical separation of three feet between the bottom of the Fill Unit monitoring well screen and the top of the Alluvial Unit monitoring well screen.
  - If there is an unsaturated zone in the Alluvial Unit greater than 5 feet thick, the top of the screen will be placed approximately 2 feet above the water table to allow for seasonal and/or tidal fluctuations."

The monitoring wells were generally installed with the screen intervals planned in the RIWP Addendum with the following exceptions where the Tidal Flat Unit was not observed:

- MW-13D: Based on the soil cores collected during sonic drilling, the planned screen interval for MW-13D was 29 to 34 feet bgs. However, during development of the monitoring well, it was discovered that a 10-foot section of blank well casing had mistakenly not been installed by the drillers, and the total depth of the well was only 24 feet bgs. On October 14, 2022, the well was re-drilled approximately 2.5 feet to the west of the original well using a hollow-stem auger drill rig (a sonic rig was originally used based on already being mobilized to the Site for other monitoring well installations). The new well was screened from 29

[39] If there are field screening indications of gross petroleum contamination, the top of the screen will be placed 1.5 feet above the water table at the time of drilling and 3.5 feet below to allow for seasonal fluctuations.

to 34 feet bgs. The original MW-13D well was decommissioned in accordance with WAC 173-360 requirements, and the well vault was removed.

- MW-17 and MW-20: The Tidal Flat Unit was not observed at these locations. The screen intervals for monitoring wells MW-17 and MW-20 were completed 0.5 feet below the observed water level at the time of drilling and are predominantly screened within the Alluvial Unit; the elevations of their screens are similar to other Alluvial Unit monitoring wells.
- MW-18 and MW-18D: The Tidal Flat Unit was not observed at these locations. At MW-18D, the screen was placed within the Alluvial Unit from 15 to 20 feet bgs based on the observed water level at the time of drilling. To provide separation from the deeper well, the screen for monitoring well MW-18 was placed at 7 to 12 feet bgs. While this interval is within the Alluvial Unit, it is at a similar elevation to other Fill Unit monitoring wells.

Following installation, Fill Unit monitoring wells MW-16, MW-18, and MW-21 remained dry. The remaining monitoring wells (except for the original MW-13D) were developed between September 27 and 29, 2022 to remove fine-grained material from inside the well casing and filter pack to the extent practical, and to improve hydraulic communication between the well screen and the surrounding water-bearing formation. Well development was performed by means of a surge block and a 12-volt submersible pump. During development, the surge block was gently surged through the entire length of the well screen. Each well was developed until visual turbidity was reduced to minimal levels (below 10 NTU if practical) or until a maximum of 15 casing volumes of water has been removed:

- Monitoring wells MW-04D, MW-05D, MW-06D, MW-08D, MW-09D, MW-16D, MW-17, MW-18D, MW-20, and MW-22 were developed until turbidity was measured at less than 10 NTU.
- Turbidity at monitoring wells MW-11D, MW-19, and MW-19D was still greater than 10 NTU after purging a minimum of 15 casing volumes from each. Turbidity for these wells at the end of development was greatly improved from the time of installation, and the turbidity criterion (25 NTU) was achieved at MW-11D and MW-19D during groundwater sampling. Turbidity in groundwater at MW-19 during groundwater sampling remained elevated above the sampling criterion of 25 NTU (Section 5.1.2.7).

Development of monitoring wells MW-16, MW-18, and MW-21 was not completed due to an insufficient amount of groundwater. Monitoring well MW-16 was developed on January 24, 2023, prior to sampling as part of Phase 3 of the RI (Section 5.1.2.9).

The Phase 2 monitoring wells were surveyed by Apex Engineering, LLC, of Tacoma, Washington, on October 14, 2022. The monitoring wells were surveyed using the NAD83/2011 Washington State Plane horizontal datum and NAVD88 vertical datum. Phase 2 monitoring well locations and elevations are included in Table 5.1.

5.1.2.4 Soil Sampling for Chemical Analysis

During the advancement of soil borings, continuous soil cores, depending on soil recovery, were collected throughout the length of each boring. Recovery is documented on the boring logs in Appendix B.2.

A minimum of four soil samples were collected from each soil boring, and three samples were collected from each of the five hand auger locations. In total, 141 soil samples (including archive samples but not including field duplicates) were collected from the 31 locations. The depth intervals of these soil samples are shown on the boring logs in Appendix B.2.

As outlined in the RIWP Addendum, samples from each location were submitted for chemical analysis based on location-specific data quality objectives. Additional soil samples were also collected from the borings and archived pending potential future analysis based on preliminary analytical results, in accordance with the RIWP Addendum. Once the initial laboratory analytical results were received and compared to the RIWP Addendum SLs, archived samples were analyzed for the purposes of vertical delineation. Soil samples for analysis of PCB congeners and dioxins/furans were selected based on the first round of PCB Aroclors analytical results. In total, 129 discrete soil samples were analyzed for a wide variety of chemical analyte classes in accordance with the RIWP Addendum.

5.1.2.5 Phase 2 Tidal Study

Prior to Phase 2 groundwater sampling, combination pressure transducer and specific conductivity dataloggers were installed at all 29 Site wells and in a stilling well in the LDW placed at the end of the SPM dock on October 4, 2011 (Figure 5.1). The purposes of the Phase 2 tidal study included determining the optimal tide window for collecting groundwater samples, the tidally averaged hydraulic gradient, and evaluation of interconnectivity between the Fill and Alluvial Unit water bearing zones including the tidally averaged vertical gradients between them (across the Tidal Flat Unit). The dataloggers were deployed for one week between October 4 and October 11, 2022. The hydrographs for all monitoring wells are included on Figures C.3.A through C.3.D, and the electrical conductivity vs. water level charts for individual and paired Fill Unit-Alluvial Unit monitoring wells are included on Figures C.4.A through C.4.R.

The lowest conductivity and water level measurements at each well were correlated with the low tide recorded at NOAA station number 9447130, which is located in Elliott Bay. For each well, the average lag time between the tidal minimums observed at the NOAA gauge and the water level minimums in each well were used to determine the optimal timing of the groundwater sampling event to minimize influence of saline water mixing in the transitional zone.

Based on the results of this analysis, the following observations were noted and formed the basis for establishing lag times (or lack thereof):

- Fill Unit Wells:
  - Shoreline: MW-06, MW-07, MW-08, MW-09, MW-10, and MW-11 went dry during lower-low tides, as expected based on the Phase 1 tidal study. Therefore,

the approximate bottom elevations of the well screens were used to determine when each well would go dry during upcoming tides. The sampling window was expanded from 1.5 hours before the predicted time for the well to go dry (based on Phase 1) to 2.5 hours to ensure sufficient volume was collected for all analyses from each well.

- Southeast SPM Property Corner Wells: MW-04 and MW-05 showed less than 1 foot of variation in water level and little to no variation in conductivity. Therefore, no specific sampling window was dictated for these locations.
- Inland Wells: MW-12 exhibited similar behavior to the Phase 1 tidal study, and a similar lag time of 2 hours and 35 minutes was used to determine the sampling window. Monitoring wells MW-13, MW-14, MW-15, MW-17, MW-19, and MW-22 showed little (less than half a foot) to no variation in groundwater elevation during the tidal study; therefore, sampling times were not tied to tidal stage.

- Alluvial Unit Wells:
  - Shoreline Wells: Monitoring wells MW-08D, MW-09D, and MW-11D showed typical variability with respect to tidal stage. Well-specific lag times were evaluated based on both water level in each well and the timing of minimum specific conductivity. The calculated lag time varied from 27 minutes at MW-11D to 1 hour and 13 minutes at MW-08D, based on groundwater elevations recorded at each location.
  - Southeast SPM Property Corner Wells: MW-04D, MW-05D, MW-06D, and MW-16D showed similar variability in water level elevation and conductivity as other Alluvial Unit wells along the shoreline, and the minimum specific conductivity measured at each of these wells was used to calculate well-specific lag times. Based on that analysis, calculated lag times for this area were calculated between 25 minutes at MW-04D and 1 hour and 1 minute at MW-05D.
  - Inland Wells: While the remaining Alluvial Unit wells were outside of the RIWP's 100-foot buffer of the LDW, specific lag times for each were still calculated. MW-13D, MW-17, MW-18D, and MW-20 each showed little (less than half a foot) to no variation in groundwater elevation, and therefore no specific sampling window was developed. At monitoring well MW-19D, which is located approximately 175 feet from the LDW, a lag time of 2 hours and 10 minutes was calculated.

These well-specific lag times were used to determine the optimal sampling time for each monitoring well based on the predicted tide stage. Sampling at monitoring wells generally targeted a 2-hour window bracketing the calculated time of minimal tidal influence.

5.1.2.6 Sub-slab Soil Gas Sampling

Two sub-slab soil gas samples were obtained from beneath the concrete slab of the Tire Factory building on October 7, 2022, at locations SG-01 and SG-02 as shown on Figure

3.1. The sub-slab soil gas samples were obtained using temporary soil gas Vapor Pins® installed in the slab of the lobby using a rotary hammer drill. Based on data obtained from an on-Property weather station, the barometric pressure at the time of sampling was falling from a high of 30.24 inches of mercury (in Hg) at 5:00 a.m. to 30.13 in Hg at 1:00 p.m. when sampling had concluded. Sub-slab soil gas samples were collected in accordance with the procedures outlined in the RIWP Addendum SAP/QAPP.

5.1.2.7 Groundwater Sampling

Site-wide groundwater sampling was conducted at all Site monitoring wells (except MW-16, MW-18, and MW-21, which remained dry during Phase 2) on October 24 through October 31, 2022. For those wells which are tidally influenced (including intermittently dry Fill Unit shoreline wells), sampling was conducted during the optimal tide windows as established in Section 5.1.2.5 above. Prior to beginning the multi-day groundwater sampling event, depth to water was measured at each monitoring well during an approximately 90-minute window between approximately 3:25 p.m. and 4:55 p.m. on October 24, 2022, during a high tide.

Based on field observations during Phase 2 well development (Section 5.1.2.3), LNAPL was expected to be present in MW-04 and MW-05 during the Site-wide groundwater sampling event. An oil-water interface probe was used to measure water levels at MW-04, MW-05, and MW-06 to evaluate potential accumulation in each well. On October 24, 2022, approximately 0.03 feet of LNAPL was present in MW-04, and 0.02 feet of LNAPL was present in MW-05 (LNAPL was not present in MW-06). A sample of LNAPL from each well was collected for analysis by the laboratory to determine characteristic composition (i.e., relative concentrations of Site contaminants of potential concern). However, only an extremely limited volume of product was recovered from each of these two monitoring wells, and therefore only a limited number of analyses could be performed.

The following observations were noted for each of the monitoring wells:

- MW-04: LNAPL was measured at a thickness of 0.03 feet on the first day of groundwater sampling. After collecting a sample of LNAPL, low-flow sampling was attempted at the well. The well purged dry during low-flow stabilization, and the well was allowed to recharge overnight before being sampled the following day.
- MW-05 (after collecting LNAPL sample), MW-05D, MW-12, MW-15, MW-16D, MW-17, MW-18D, MW-19D, MW-20, and MW-22: Turbidities were less than 25 NTU, and specific conductivities were less than 1,000 uS/cm.
- MW-04D, MW-06, MW-06D, MW-07, MW-08, MW-08D, MW-09D, MW-10, MW-11, MW-11D, and MW-13D: Turbidities were less than 25 NTU, but specific conductivities were greater than 1,000 uS/cm.
- MW-09: MW-09 purged dry immediately after starting low-flow purging for parameter stabilization. The well was allowed to recharge during the high tide cycle and sampling commenced when there was sufficient water to begin filling sample bottles. Turbidity was elevated above 25 NTU, and conductivity was

elevated above 1,000 uS/cm at the time of sampling. Sufficient volume was collected for all analyses.

- MW-13: MW-13 purged dry shortly after parameter stabilization and shortly after starting low-flow sampling. The well was slow to recharge, and the well went dry multiple times and allowed to recharge to collect sufficient volume for all analyses. The turbidity was greater than 25 NTU during sampling collection.

- MW-19: Turbidity stabilized at 63 NTU after 75 minutes of low-flow purging. During this time, the purge water was noted to be cloudy and gray with a very slight sheen present. At 75 minutes, the turbidity had stabilized, and sampling was conducted. While filling sample bottles, the water clarity improved, and turbidity at the end of sampling was measured at 16.5 NTU. During well development, this well only had approximately 1.5 feet of water present. Groundwater elevations were similar during sampling as during well development. The turbidity at this well may be due to only a portion of the filter pack being developed.

After sample collection was complete, the depth to the bottom of the monitoring well was measured to evaluate potential siltation of the monitoring well. An oil-water interface probe was used at monitoring wells MW-04, MW-04D, MW-05, MW-05D, MW-06, and MW-06D to evaluate whether dense NAPL was present in the bottom of the well casing; there were no indications of dense NAPL at these locations.

Monitoring wells MW-16, MW-18, and MW-21 contained insufficient (less than 0.5 feet) to no groundwater during October 2022 and therefore were not sampled.

5.1.2.8 Tire Factory Building Inspection and Chemical Inventory

In preparation for indoor air sampling (Section 5.1.3.1), an evaluation of the Tire Factory building construction characteristics and a chemical inventory was performed on November 29, 2022. The following observations related to potential VI were noted during this site visit:

- The Tire Factory building is constructed as slab-on-grade.

- Electrical power is supplied to the building from overhead lines. Natural gas and sanitary sewer enter the parcel from the west on Dallas Avenue. Natural gas runs underground to the meter on the west side of the building before being plumbed overhead throughout the building. The sanitary sewer lines run from Dallas Avenue to the restrooms in the southwest portion of the building.

- The Tire Factory owner did not believe any PCE-containing products were in use.

- An old parts washer was documented in the service area of the warehouse; according to the Tire Factory owner, the parts washer had reportedly not been in use in over a decade. The parts washer was removed prior to the Phase 3 sampling (Section 5.1.3).

- The chemical inventory did not document any PCE-containing products, but access to certain portions of the warehouse were precluded due to general housekeeping.

The building inspection and chemical inventory formed the basis for the indoor air sampling conducted as part of Phase 3 of the RI (Section 5.1.3) as reported to Ecology (Aspect, 2023a).

5.1.2.9 Dry Well Datalogger Study

To evaluate seasonality of Fill Unit groundwater occurrence at the three dry monitoring wells (MW-16, MW-18, and MW-21), combination pressure transducer and specific conductivity dataloggers were installed for a nearly 3-month period between November 1, 2022, and January 24, 2023. The dataloggers were installed in the three dry wells and also in MW-18D to observe any changes in the surficial aquifer at the Site due to precipitation during the rainy season. Hydrographs are provided on Figure C.6. Manual water level measurements were also conducted during routine site visits on December 9, 2022, December 29, 2022, January 10, 2023, and January 24, 2023. The following was noted for each of the three wells:

- MW-16: Less than half a foot of groundwater was present in MW-16 when the dataloggers were deployed on November 1, 2024. Over the study period, the groundwater elevation increased from approximately 7.3 feet to 9.1 feet, likely due to infiltration of precipitation. As shown on the hydrograph on Figure C.6., the water level at MW-16 varies by approximately a quarter of a foot or less in relation to the tidal stage in the LDW. Because of the accumulation of groundwater in the Fill Unit at this location, the well contained sufficient groundwater for development and sampling. The monitoring well was developed on January 24, 2023. Turbidity after development remained at 40 NTU, but more than 25 casing volumes were removed.

- MW-18: No water was recorded at MW-18 by the transducer during the rainy season study period. At MW-18D, the groundwater elevation increased from approximate elevation 6.4 to a maximum of approximately 8.5 over the rainy season. Based on the lack of Tidal Flat Unit in this area, the groundwater at MW-18D in the Alluvial Unit is representative of the shallowest water-bearing zone.

- MW-21: Groundwater was only intermittently recorded by the datalogger during late December 2022 to early January 2023. Likewise, groundwater was only observed in the well via manual measurements on the December 29, 2022, and January 10, 2023, site visits, when up to 1.3 feet of water was present in the well. However, when the dataloggers were retrieved on January 24, 2023, the well was dry and well development was not possible. Based on the hydrograph from the datalogger, it appears that the well screen was intermittently saturated only during a period of extreme precipitation and king tides in the LDW, which coincided with widespread flooding in the South Park neighborhood. As discussed below in Section 5.1.3.2, this well remained dry during Phase 3 of the RI.

5.1.2.10 IDW Disposal

Soil cuttings from borings installed during Phase 2 were placed in labeled DOT-approved drums pending the analytical results to determine appropriate disposal. IDW water generated during equipment decontamination, monitoring well development, and groundwater sampling was placed in labeled DOT-approved drums pending the analytical results to determine appropriate disposal. The drums were temporarily stored on-site, profiled based on available analytical data, and disposed appropriately at a permitted off-site disposal facility.

A total of thirty-nine 55-gallon drums of IDW were produced during the Phase 1 RI field activities:

- Nine drums of soil cuttings were managed as state-only toxic (WT02) dangerous waste based on the state book designation procedure (WAC 173-303-100(5)(b)).
- Seven drums of soil were managed as F002-listed dangerous waste due to the presumed historical dry cleaner source of the PCE.
- One drum of soil was managed as TSCA-regulated waste due to concentrations of PCBs.
- Ten drums of soil, PPE, and core liners were generated and disposed of as non-hazardous waste.
- Seven drums of water were managed as F002-listed dangerous waste due to the presumed historical dry cleaner source of the PCE.
- Five drums of water were managed as nonhazardous waste.

DH Environmental Inc. was responsible for profiling the waste and hauling the drums to the selected disposal facility. The IDW drums were removed from the SPM Property on February 22, 2023, and transported to Waste Management, Inc.'s facilities in Arlington, Oregon. All waste drums were disposed of at Waste Management, Inc.'s Chemical Waste Management, which is a Subtitle C treatment, storage, and disposal facility approved for dangerous waste. IDW disposal records from Phase 2 are included as Appendix F.2.

5.1.3 Phase 3

Field activities for Phase 3 of the RI were completed between March and May 2023 and consisted of the following activities per the memoranda reviewed and approved by Ecology (Aspect, 2023a and 2023b), further detailed in the subsections below:

- March 2023 – Conducted indoor air sampling and sub-slab soil gas sampling at the Tire Factory and performed groundwater sampling at select Site monitoring wells.
- April 2023 – Disposed of IDW generated during Phase 3 groundwater sampling.
- May 2023 – Performed an additional chemical inventory, building inspection, parts-per-billion PID (PPB PID) screening, and Gastec air sampling within the Tire Factory building to complete the VI assessment.

5.1.3.1 Indoor Air and Sub-slab Soil Gas Sampling

Indoor air and additional sub-slab soil gas sampling at the Tire Factory building was conducted on March 21, 2023, and consisted of the following activities:

- Indoor Air Sampling:

  - One indoor air sample (IA-01) was collected in the lobby, adjacent to the sub-slab soil gas locations SG-01 and SG-02, where PCE was previously detected in soil gas at concentrations exceeding the MTCA Method B commercial screening level during Phase 2 of the RI (October 2022).
  - One indoor air sample (IA-02) was collected in the western restroom to assess a potential preferential pathway for vapor migration from reported recent sewer repairs.
  - One indoor air sample (IA-03) was collected in the garage, which is on the western side of the Tire Factory building and closest to the presumed dry-cleaner source (located upgradient of the SPM Property across Dallas Avenue South to the west) and highest concentrations of PCE in groundwater (at MW-13 and MW-20).
  - One indoor air sample (IA-04) was collected in the eastern portion of the warehouse, which is near where a parts washer was formerly located and farthest from the presumed off-Property source and low concentrations of PCE in groundwater (at MW-12).
  - Two ambient air samples (AMB-01 and AMB-02) were collected outside of the east and west sides of the building to assess potential VOC contributions outside of the Tire Factory building. Wind direction varied from northeast to southeast during air sampling.

- Sub-slab Soil Gas Sampling: Four sub-slab soil gas samples were collected from Vapor Pins® installed immediately following air sampling at locations SG-01 and SG-02 (Phase 2 locations) and SG-03 and SG-04, which were colocated with the indoor air samples in the restroom and warehouse to allow direct comparison of results.

The sampling was conducted in accordance with the RIWP Addendum SAP/QAPP with one modification: the SAP/QAPP identified collection of samples over a 24-hour period; however, given the commercial use of the Tire Factory building, the samples were collected over an 8-hour period to assess the potential for VI to affect indoor air quality under the conditions that workers are commonly using the building.

According to Tire Factory staff, they generally operate with the doors to the garage space open; however, it could not be verified that this is always the case when employees are on site. In the service area of the warehouse, the overhead door is frequently opened as vehicles are moved into and out of the service area. Observations during the VI assessment visits indicated that the overhead door in the service area of the warehouse is generally closed while employees are servicing vehicles. As part of the VI assessment, the indoor air samples were collected as close as possible to normal operating conditions to evaluate the potential exposure to workers during routine business operations (e.g., with the heating system operating) while providing a conservative assessment of potential worker exposure if workers were present with the garage doors closed.

Based on discussions with Ecology, to meet these requirements, the indoor air samples were collected for a period of 8 hours starting approximately 2 hours before the Tire Factory opened the garage and service area doors for the day. This resulted in indoor air samples that represented air quality for a period of time encompassing approximately 25 percent during a closed-door condition after the roll up doors had been closed for an extended period of time, and 75 percent during normal business operations with (a) roll-up doors in the garage open, and (b) rollup doors in the warehouse service area generally closed, but with periodic openings throughout the day.

5.1.3.2 Groundwater Sampling

Based on the results of Phase 1 and Phase 2, additional groundwater sampling for select wells was recommended as part of Phase 3 to support the RI for the Site. The recommendations and rationale for each sampling location were presented to Ecology in the Proposed Phase 3 Groundwater Sampling Plan Memorandum (Aspect, 2023b). The goals for Phase 3 groundwater sampling included collecting additional data for metals, dioxins/furans, and PCBs; evaluation of seasonal variability in PCE concentrations for the purposes of VI assessment; evaluation of variability in groundwater at shoreline wells during low and high tides (MW-10); and characterization of Fill Unit groundwater quality at MW-16, which had previously not contained sufficient groundwater to sample during Phase 2.

Site-wide groundwater elevations were measured on March 21, 2023, and groundwater sampling for Phase 3 was conducted between March 22 and March 24, 2023. The following observations were noted for each of the monitoring wells sampled during Phase 3 of the RI:

- MW-05: A thin sheen of LNAPL (0.01 feet) was measured prior to sampling. The sample tubing had remained submerged in the well since the prior sampling event and was used to conduct low-flow sampling from below the LNAPL-groundwater interface. Turbidity at the time of sampling was 2.69 NTU, and specific conductivity was less than 1,000 uS/cm at the time of sampling.
- MW-09D, MW-13, MW-13D, MW-14, MW-15, MW-16, MW-16D, MW-19D, and MW-20: Turbidities were less than 25 NTU, and specific conductivities were less than 1,000 uS/cm.
- MW-06, MW-07, MW-08, MW-09, MW-11: Turbidities were less than 25 NTU, but specific conductivities were elevated above 1,000 uS/cm.
- MW-10: Two samples were collected: a low tide sample and a high tide sample. For the low tide sample, MW-10 purged dry during the falling tide cycle shortly after water quality parameters stabilized and sample collection had begun. The well was monitored until water began to re-infiltrate the well screen during the incoming tide. Turbidity at the time of sampling after recharging was 83.7 to 67 NTU, and specific conductivity was elevated above 1,000 uS/cm. The high tide sample was collected 2 days later, approximately 60 minutes following the higher-high tide peak during an outgoing tide. For the high tide sample, turbidity was 8.2 NTU and specific conductivity was elevated above 1,000 uS/cm.

- MW-19: Turbidity at this well started over 500 NTU during low-flow purging and stabilized quickly in the range of approximately 150 to 200 NTU but was still on a decreasing trend after stabilizing. The turbidity at this well during Phase 2 groundwater sampling was also elevated at the start of low-flow purging but fell to below 100 NTU more quickly than during the Phase 3 event. During the Phase 3 event, the well was purged under steady-state low-flow conditions for 2 hours and 20 minutes to minimize turbidity, and the turbidity varied from 64 NTU after low-flow purging and before sample collection to 48 NTU after sample collection.

5.1.3.3 IDW Disposal

IDW water generated during Phase 3 equipment decontamination and groundwater sampling was placed in labeled DOT-approved drums pending the analytical results to determine appropriate disposal. The drums were temporarily stored on-site, profiled based on available analytical data, and disposed appropriately at a permitted off-site disposal facility.

Two 55-gallon drums of IDW were produced during the Phase 3 RI field activities. One of the drums was managed as F002-listed dangerous waste due to the presumed dry cleaner source of PCE in groundwater in the northwest portion of the SPM Property, and one of the drums was managed as nonhazardous waste based on analytical data. DH Environmental Inc. was responsible for profiling the waste and hauling the drums to the selected disposal facility. The IDW drums were removed from the SPM Property on April 11, 2023, and transported to Waste Management, Inc.'s facilities in Arlington, Oregon. All waste drums were disposed of at Waste Management, Inc.'s Chemical Waste Management, which is a Subtitle C treatment, storage, and disposal facility approved for dangerous waste. Disposal records for IDW drums generated during Phase 3 of the RI are included in Appendix F.3.

5.1.3.4 Additional Vapor Intrusion Assessment Work at the Tire Factory

Based on the analytical results from Phase 3 indoor air and sub-slab soil gas sampling, some contribution of background, indoor VOC sources to indoor air quality appeared possible. To assess the potential for background sources of PCE inside the building, the following additional VI assessment work was recommended by the PLP group in an email to Ecology on April 17, 2023, and agreed to by Ecology in an email dated April 18, 2023:

- Interview the Tire Factory owner and workers to determine if there were any new chemical products being stored and/or in use since the November 2022 chemical inventory was completed, and if any products were in use during the Phase 3 indoor air sampling event.
- Inspect the warehouse slab for significant cracks, slab penetrations, sumps, or other potential preferential vapor migration pathways, and collect photo documentation of slab conditions.
- Conduct a chemical inventory with a particular focus on products potentially containing PCE that are common in the automotive/tire service industry (e.g.,

brake cleaners and tire cleaners). While previous chemical inventories were as thorough as practicable, general housekeeping in the Tire Factory made chemical inventories difficult. This survey included areas that had been previously inaccessible due to parts, vehicles, etc.

- Perform a building-wide survey of volatiles in air using a PID with ppb-level detection limits.
- Measure PCE concentrations in air at up to 20 locations throughout the warehouse, lobby, and garage using Gastec No. 133LL detector tubes for PCE (measurement range 0.1 to 9 parts per million [ppm]).

This additional VI assessment work was conducted on May 5, 2023.

5.2 Stormwater Investigation for Source Control Review

Additional investigation work was conducted concurrently with the RI to characterize stormwater and catch basins solids quality for the purposes of completing the Site source control review in accordance with the AO. Excess stormwater and catch basin solids samples were poured back into the structure from where it was collected.

5.2.1 Phase 1

Field activities for the purposes of the source control were conducted concurrently with field activities for Phase 1 of the RI per the RIWP:

- February 2021 – Conducted a wet weather site walk to document stormwater system conditions and the potential for overland flow and/or bank erosion.
- March 2021 – Collected the first set of stormwater samples at the locations identified in the RIWP.
- April 2021 – Collected catch basin solids samples at the locations identified in the RIWP.
- May 2021 – Collected the second set of stormwater samples.

The following subsections further describe the activities completed for the purposes of source control review during Phase 1.

5.2.1.1 Wet Weather Site Walk

The wet weather site walk was conducted during an active precipitation event on February 1, 2021. The purpose of the wet weather site walk was to observe stormwater movement on the SPM Property and the adjoining streets/ROWs, observe the shoreline bank for the presence of erodible soils and/or seeps, and observe if overland flow occurs which is not intercepted by the stormwater system and flows directly to the LDW.

The field report from the wet weather site walk, including a photographic log, is included as Appendix E.1. Primarily, the following conditions were observed:

- No runoff was observed flowing to or from Dallas Avenue and the SPM Property. Minor vehicle track-in of stormwater was observed at the three marina entrances.

- No runoff was observed from the upland SPM Property flowing directly to the LDW, other than on the boat ramp. Only a very limited amount of overland flow was observed down the boat ramp. The flow appeared to be generated primarily from the boat ramp itself and a small portion from top of ramp, all of which are paved surfaces.
- Each catch basin is of a different size, configuration, and construction. Descriptions of each catch basin's configuration is located in Appendix E.
- Shoreline banks are generally stabilized by a vertical ecology block wall. No significant erodible soils were noted above MHHW. A thin strip of vegetated sediment and gravel was observed at the base of the wall north of SPM Outfall area.
- No seeps were observed coming from the shoreline bank. Tide conditions were falling during the site visit, and low tide (+4.6 feet) was after departure. These tide elevations were higher than those during times seeps were previously observed (Section 5.1.1.9).

5.2.1.2 Stormwater Sampling Events

Two stormwater sampling events were conducted to collect samples representative of stormwater discharging from the SPM Outfall and Unnamed Outfall No. 1 (UOF-1), as shown on Figure 2.4. During the development of the RIWP, the location of the end of the SPM Outfall pipe was unknown, and therefore catch basins CB-02 and CB-06 were targeted for sampling to be representative of water discharging from the SPM Outfall. Samples were also collected from the pretreatment vault (SWRX-Pre) on the south end of the SPM Property. Stormwater accumulated in this vault is either pumped through the StormwateRx™ treatment system and discharged from UOF-1 or, in the case that stormwater volumes exceed the system capacity, untreated stormwater in the pretreatment vault is supposed to flow to the overflow outfall OF-2214. The following subsections describe observations during each of the stormwater sampling events.

First Stormwater Sampling Event (March 2021)

The first stormwater sampling event was conducted on the night of March 4 and morning of March 5, 2021, between approximately 10 p.m. and 1 a.m. and occurred after the higher-high tide peaked at approximately 10:50 p.m.

Immediately prior to the beginning of the first stormwater sampling event, rainfall intensity varied between 0.01 and 0.03 inches per hour at the nearby Boeing Field station, and the 6-hour total prior to sampling was recorded as 0.17 inches. Prior to that precipitation event, rain had not been recorded at the nearby Boeing Field station since February 27, 2021 (which recorded a total of 0.06 inches of rain over a 24-hour period).

Sampling began near the end of the rain event as runoff was diminishing, and there was insufficient flow to collect a sample from the boat ramp. There was adequate stormwater present in the system to collect the planned samples at CB-02, CB-06, and SWRX-Pre. The following observations were noted at each sample location:

- CB-02: Catch basin CB-02 was full to the rim at the time of sampling. A slight sheen[40] and some floatable materials were noted on the surface of the water. The stormwater was noted to be light brown in color, and no odor was present.
- CB-06: Similar to CB-02, CB-06 was full to the rim at the time of sampling. A slight sheen and some floatable materials were noted on the surface of the water.
- SWRX-Pre: At the time of sampling, the sump pump in the pretreatment vault appeared to not be operational. The vault was full and overflowing onto the surrounding ground surface, indicating that the overflow outfall OF-2214 also appeared to be not operating correctly. There was a sheen on the surface of the water surrounding the top of the pretreatment vault. The stormwater was noted to be light brown in color, and no odor was present at the time of sampling. The non-working pump was reported to SPM. SPM determined that a deceased rabbit had become trapped in the vault's sump pump. The rabbit was removed, a new sump pump was installed, and a more-robust plywood lid was installed to mitigate the potential for other animals to become trapped in the vault.

During the first stormwater sampling event, the following conditions were noted:

- No flowing runoff was noted on the boat ramp, and no overland flow was occurring from the surrounding area to the west of the ramp.
- The stormwater system at CB-06 was near capacity, as the vault was full to the rim at the time of sampling.
- The StormwateRx™ treatment system was not operational due to a malfunctioning sump pump, and untreated water from the Southern Catchment area may have been discharging directly to the LDW via the OF-2214 overflow outfall. Influent volumes were greater than the capacity of the SWRX-Pre vault and any discharge through the OF-2214 overflow outfall, however, and stormwater had overflowed/ponded on the ground surface surrounding the SWRX-Pre vault.

Second Stormwater Sampling Event (May 2021)

The second stormwater sampling event was conducted on May 27, 2021, between approximately 7:00 and 10:30 a.m., after the higher-high tide peaked at approximately 5:15 a.m. Prior to and during the second stormwater sampling event, rainfall intensity varied between 0.01 and 0.05 inches per hour at the nearby Boeing Field station, and the six-hour precipitation total prior to sampling was recorded as 0.11 inches. Prior to that precipitation event, rain had not been recorded at the nearby Boeing Field station since May 25, 2021 (which recorded a total of 0.01 inch of rain over a 24-hour period). Prior to that minor storm event, rain had not been recorded at the Boeing Field weather station since May 19, 2021, when a recorded 0.25 inches of rain fell over a 24-hour period.

There was adequate stormwater present in the system to collect the planned samples at CB-02, CB-06, and SWRX-Pre. A capture system was placed on the boat ramp to attempt

[40] Unless noted, all sheens referenced in this section were interpreted as chemical and not biogenic.

collection of a sample from this location, but there was insufficient runoff to collect a sample. The following observations were noted at each location:

- CB-02: Catch basin CB-02 was almost full to the rim at the time of sampling but no standing water was observed outside the catch basin. A moderate sheen and some floatable materials, which appeared to be biological/organic in nature, were noted on the surface of the water. The stormwater was noted to be light brown in color, with a pungent, earthy odor.
- CB-06: Catch basin CB-06 was not full to the rim and appeared to be actively draining through a 2-inch pipe on the northeast side of the catch basin. A slight sheen and a small amount of floatable materials (which appeared to be biological/organic in nature) were noted on the surface of the water. There was no odor noted.
- SWRX-Pre: At the time of sampling, the sump pump in the pretreatment vault was operational and cycled numerous times to pump water to the SWRX system. There was no sheen on the surface of the water in the vault, and the stormwater was noted to be light brown in color.
- Boat Ramp: At the time of arrival to conduct stormwater sampling, a de minimis amount of stormwater was noted to be running down the boat ramp. A catchment system was deployed in an attempt to collect a sufficient volume of stormwater for laboratory analysis. The catchment system was constructed of sand-filled wattles in plastic sleeves placed in a V-shape at the base of the boat ramp. Additional sandbags were used to anchor the wattles and prevent stormwater from flowing under the catchment system. The catchment system was monitored over multiple hours as sampling was conducted at the other catch basin locations. However, stormwater runoff from the boat ramp did not accumulate in sufficient quantity to collect a sample. A much higher-intensity rain event would be necessary to attempt collection of a stormwater sample from the boat ramp.

During the second stormwater sampling event, the following conditions were noted:

- Only de minimis runoff was noted on the boat ramp, and no overland flow was occurring from precipitation that did not fall directly onto the ramp.
- The stormwater system at CB-02 appeared to be near capacity, but the stormwater system at both CB-02 and CB-06 appeared to be functioning as intended.
- The StormwateRx™ treatment system was operational. The sump pump in the SWRX-Pre vault cycled often during stormwater sampling, and no bypass overflow from the StormwateRx™ system was observed (i.e., the StormwateRx™ system was operating within its capacity).

5.2.1.3 Catch Basin Solids Sampling

One catch basin solids sample was collected from catch basins CB-02 and CB-06 and the SWRX-Pre vault on April 20, 2021. These sampling locations were selected to represent different property subbasins and potential contributions to the two active property outfalls to the LDW (UOF-1 and SPM Outfall). Catch basin solids samples were collected from material accumulated in the sump at each catch basin. A telescoping extension pole with a stainless-steel cup attachment was used for scooping solids material. Prior to sampling, precipitation had not been recorded at the nearby Boeing Field weather station since April 8, 2021, when 0.08 inches were recorded over a 24-hour period. The following observations were noted at each catch basin:

- CB-02: At catch basin CB-02, a moderate sheen and some floatable materials, which appeared to be biological/organic in nature, were noted on the surface of the water, which was approximately 1.3 feet deep. There was approximately 2 to 3 inches of sediment present in the bottom of the catch basin. The sediment was noted to be brown and black; contained a pungent, earthy, and sewage-like odor; and compromised of silt-sized grains and organic material. Some pea gravel was present in the sediment and removed prior to containerizing the sample for laboratory analysis. This gravel comprised less than 1 percent of the recovered material.
- CB-06: At catch basin CB-06, a slight sheen and some floatable materials, which appeared to be biological/organic in nature, were noted on the surface of the water, which was approximately 2.2 feet deep. There was approximately 0.36 feet of sediment present in the bottom of the catch basin. The sediment was noted to be brown and black; contained a pungent and sewage-like odor; and was primarily compromised of silt-sized grains and organic material. Some pea gravel was present in the sediment and removed prior to containerizing the sample for laboratory analysis. This gravel comprised approximately 5 percent of the recovered material.
- SWRX-Pre: At the pretreatment vault, no sheen or floatable materials were noted on the surface of the water, which was approximately 1 foot deep. Sediment accumulation in the pretreatment vault was limited; due to the size and depth of the pretreatment vault, the sediment depth could not be directly measured. The recovered sediment was noted to be brown, black, and gray; contained an earthy odor; and was comprised of gravel- and sand-sized particles. The gravel-sized particles, which comprised approximately 15 to 20 percent of the recovered sediment, were removed prior to containerizing the sample for laboratory analysis. At the time of catch basin solids sampling, the sump pump appeared to be operational.

During the Phase 1 catch basin solids sampling, each of the three locations contained settled solids. However, only a few inches of material was noted in the bottom of each catch basin or vault, and each structure appeared to have additional capacity for material to settle, depending on the size of the material and the flow rate through the system.

5.2.2 Phase 2

Field activities for the purposes of the source control review were conducted concurrently with field activities for Phase 2 of the RI per the RIWP Addendum:

- August and September 2022 – Conducted site walks to evaluate catch basins and the stormwater conveyance infrastructure during the dry season after routine best management practices (including cleaning of catch basins) had been conducted by SPM

- October 2022 – Collected catch basin solids samples
- November 2022 – Collected stormwater samples

5.2.2.1 Catch Basin Reconnaissance Site Walk

Reconnaissance site walks were completed on August 22 and September 8, 2022, to evaluate the status of the stormwater system after routine best management practices (BMPs), including vactor cleaning of the catch basins, had been performed by SPM in March 2022. The following details were noted for each of the catch basin locations proposed for sampling during Phase 2 of the RI:

- CB-02: Since the Phase 1 sampling event, SPM had implemented several new stormwater control measures including surrounding CB-02 with straw wattles and placing a custom insert inside the catch basin which held treatment pillows.[41] No catch basin solids or stormwater were present in the basin during either the August or September site walks. Based on the lack of solids, sampling at the downstream catch basin, CB-05, was proposed for Phase 2 sampling.
- CB-05: CB-05 was examined for condition and sediment accumulation. The catch basin contained approximately 6 inches of standing water and 2 inches of sediment in the bottom. The catch basin itself appeared to be in excellent condition, but the covering (wood slats) was deteriorating and splintering. There was no stainless-steel insert or treatment pillow observed in the catch basin.
- CB-06: A custom insert and treatment pillow was present inside the basin. Sufficient volume of catch basin solids was observed to facilitate sampling in Phase 3.
- SWRX-Pre: There were no changes to this vault from Phase 1 noted.

5.2.2.2 Catch Basin Solids Sampling

One catch basin solids sample was collected from each of two catch basins CB-05, CB-06, and the SWRX-Pre vault on October 7, 2022. There was standing water in CB-02 but insufficient volume of catch basin solids to conduct sampling. Catch basin solids samples were collected from material accumulated in the sump at each catch basin and pretreatment vault. A telescoping extension pole with a stainless-steel cup attachment was utilized for scooping solids material. Prior to sampling, precipitation had not been recorded at the on-Property weather station (which was installed on September 15, 2020)

[41] In 2021, SPM staff placed enhanced filtration media, in the form of catch basin inserts and treatment pillows, in seven of the nine known catch basins present at the Site to collect excess sediment and debris consistent with Ecology’s recommended practices for boatyards. The sorbent media filter inserts selected by SPM were manufactured by AbTech industries and contain a proprietary sorbent material. Based on information provided by SPM, the treatment pillows are made of Smart Sponge® Heavy Metal Smart Pak® filtration media that are hydrophilic, oleophilic, and non-leaching. The Smart Sponge® media is marketed to remove total suspended solids, TPH, motor oil, and grease, and the Heavy Metal Smart Pak® variety specifically targets dissolved heavy metals and phosphates.

since August 18, 2022, when 0.03 inches was recorded over a 24-hour period. The following observations were noted at each location:

- CB-05: At catch basin CB-05, no sheen was noted on the surface of the water, which was approximately 6.5 inches deep. There was approximately 2 to 3 inches of sediment present in the bottom of the catch basin. The sediment was noted to be brown and black, contained a pungent odor, and was compromised of primarily silt-sized grains with some anthropogenic debris (cigarette butts, paper, plastic, and wood debris). No treatment pillow was present in the catch basin.
- CB-06: At catch basin CB-06, a moderate, platy sheen was noted on the surface of the water, which was approximately 19 inches deep. There was approximately 2 to 3 inches of sediment present in the bottom of the catch basin. The sediment was noted to be brown and black, contained a pungent odor, and was primarily comprised of sand-sized grains with some anthropogenic debris (plastic and paper). A treatment pillow was present in the catch basin.
- SWRX-Pre: At the pretreatment vault, a moderate, iridescent sheen was noted on the surface of the water, which was approximately 1.5 feet deep. Solids accumulation in the pretreatment vault was limited; due to the size and depth of the pretreatment vault, the solids depth could not be directly measured. The recovered solids were noted to be brown and gray, contained a strong petroleum-like odor, and were comprised of primarily sand-sized particles. At the time of catch basin solids sampling, the sump pump appeared to be operational.

5.2.2.3 Stormwater Sampling Event

One stormwater sampling event was conducted to collect samples representative of stormwater discharging from the SPM Outfall and UOF-1. Catch basins CB-02 and CB-06 were targeted for sampling to be representative of water discharging from the SPM Outfall. Samples were also collected from the pretreatment vault (SWRX-Pre) and from a post-treatment sampling port (SWRX-Post) on the south end of the SPM Property.

The stormwater sampling event was conducted on November 22, 2022. Immediately prior to the beginning of the sampling event, rainfall intensity varied between 0.24 and 0.54 inches per hour as measured by the on-Property weather station installed and operated by SPM, and the 6-hour total prior to sampling was recorded as 0.78 inches. Prior to that precipitation event, rain had not been recorded at the on-Property weather station since November 7, 2022 (which recorded a total of 0.35 inches of rain over a 24-hour period).

Sampling began in the middle of the storm event during the highest period of intensity, and there was insufficient flow to collect a sample from the boat ramp. There was adequate stormwater present in the stormwater system to collect the planned samples at CB-02, CB-06, SWRX-Pre, and SWRX-Post. The following observations were noted at each location:

- CB-02: Catch basin CB-02 was overfull when the sampling event began, and there was standing water a few inches above the top of the catch basin. As the intensity of the rainfall died down, stormwater quickly drained, and the catch basin was full to the rim at the time of sampling. A moderate sheen and some floatable materials were noted on the surface of the water. Treatment pillows were present in the catch basin prior to sampling.

- CB-06: CB-06 was noted as full to the rim at the time of sampling. A moderate sheen, a moderate earthy odor, and some floatable materials were noted on the surface of the water. A treatment pillow was present in the catch basin prior to sampling.
- SWRX-Pre: At the time of sampling, the sump pump in the pretreatment vault was operational, and the water level was only approximately to the top of the sump pump and one foot deep. No sheens or odors were noted in the pretreatment vault.
- SWRX-Post: The sample was collected from the existing sample port. Water was flowing through the system, and no flow was noted in the overflow discharge piping. No sheens or odors were noted in the water collected from the sample port.

5.2.3 Source Control Review Summary

In accordance with Scope of Work Task 2a in the AO, a source control review was completed to provide Ecology the necessary information to make a determination regarding source control sufficiency for the Site as defined in the LDW Source Control Strategy (Ecology, 2016). The Source Control Strategy identifies source control sufficiency as achieving the near-term goal to "…address existing, ongoing sources of contaminants to the LDW so that in-waterway sediment cleanup can begin without the risk of sediment recontamination above remedial action levels (RALs), as defined in EPA's Record of Decision (ROD; EPA, 2014)."

To meet that goal, a Source Control Review Memorandum (Aspect, 2022c) was prepared that

- summarized and analyzed data collected prior to and through Phase 1 of the RI to assess whether discharge of contaminants from the upland Site, via the three recontamination pathways identified in the Source Control Strategy and the AO, posed a risk of recontamination to LDW sediments at levels exceeding the RALs for surface sediment defined in the LDW ROD (EPA, 2014). The three recontamination pathways are: (1) contaminated groundwater discharging to LDW sediment, (2) contaminated soils entering the storm drain system and discharging to LDW sediment, and (3) erosion of contaminated soil and transport to LDW sediment via overland flow or riverbank sloughing;
- identified whether data gaps exist with respect to understanding each recontamination pathway that would preclude completing the source control review; and
- discussed the need for an interim action to sufficiently control potential sources or contaminant discharge pathways from the Site.

The Source Control Review Memorandum concluded that the Site does not present a risk of recontaminating LDW surface sediments above RALs in the near-term time frame, and therefore an interim action is not required at the Site to achieve source control sufficiency as defined in the Source Control Strategy.

Using information presented in the Source Control Review Memorandum, Ecology's Lower Duwamish Waterway Source Control Sufficiency Evaluation Report for the LDW Upper Reach (Ecology, 2023b) concluded the following for the Site:

> *"Ecology's source control sufficiency evaluation found that contamination at this Site presents a low risk of recontaminating sediments with the COCs*[42] *identified in corresponding sediments above the RAL. Sources of LDW COCs present at this Site are sufficiently controlled."*

In addition to concluding the Site does not pose a near-term recontamination risk, the Source Control Review Memorandum presented data limitations encountered while conducting the source control review, a plan to collect supplemental data during Phase 2 of the Site RI, and the commitment to incorporate the supplemental data into an update to the Source Control Review Memorandum that is focused on discharge of from the Site's southern stormwater catchment area. Ecology's Source Control Sufficiency Evaluation Report (Ecology, 2023b) reiterated the latter commitment:

> *"Ecology expects that the PLPs will reevaluate all pathways under phase II* [Phase 2] *of the RI. This evaluation will focus on potential PCB discharges from the southern catchment area. Once the RI Phase II data are obtained and analyzed, the PLPs will coordinate with Ecology about whether the update should be provided as an addendum to the Source Control Memo (Aspect, 2022) or as a component of the Site RI. Ecology has not determined whether additional interim actions will be needed to control sources of contamination to the sediments."*

The source control review update is documented in an Addendum to the Source Control Review Memorandum (Aspect, 2024b). The Addendum presented the supplemental data for LDW sediments within the Marina Basin and the Site RI Phases 2 and 3 data collected since issuance of the Source Control Review Memorandum. The Source Control Review Addendum evaluated the new data with respect to each of the three recontamination pathways using the same technical analysis approach applied in the Source Control Review Memorandum.

The Source Control Review Addendum concluded that the supplemental data collected for marina basin sediments and for Site upland media strengthen the Source Control Review Memorandum's weight of evidence that the Site does not present a risk of recontaminating marina basin sediments in the near-term time frame, and therefore an interim action is not required at the Site to achieve source control sufficiency as defined in Ecology's Source Control Strategy (2016).

[42] Contaminants of concern for LDW sediments as identified in the LDW ROD (EPA, 2014).

5.3 Deviations from RIWP/RIWP Addendum and Data Quality Assessment

The following subsections describe the deviations from the RIWP and RIWP Addendum SAP/QAPPs that occurred during the RI field investigations and presents a summary of data quality verification and validation.

5.3.1 Deviations During RI

Phases 1, 2, and 3 of the RI were conducted in general accordance with the RIWP, RIWP Addendum, and Proposed Phase 3 Sampling Plan Memorandum except for minor deviations that did not affect the RI data quality objectives. Deviations are summarized by Phase below.

Phase 1 Deviations from the RIWP SAP/QAPP:

- During the initial site walk to mark boring locations in Phase 1, a conflict with an overhead utility was identified at SB-31 and consequently the boring was shifted approximately 12 feet to the east to accommodate the drill rig's mast.
- The RIWP SAP/QAPP identified the use of 2.25-inch-outer-diameter tooling, which uses 1.5-inch-inner-diameter plastic liners for collecting soil cores. During the Phase 1 RI fieldwork, the volume of soil from these 1.5-inch cores was insufficient to fill all the containers requested by the analytical laboratory. Therefore, 3.75-inch-outer-diameter tooling was used with 3-inch-inner-diameter liners to increase soil volume for chemical analysis. Phase 2 borings were completed using the 3.75-inch-diameter (or larger) core to collect adequate soil volume for analysis.
- During Phase 1, a vactor truck was used to clear one drilling location to prevent striking potential private electrical utilities. A hand auger was used to collect shallow samples prior to vac clearance of the borehole to avoid disturbing soil samples before collection for laboratory analysis. A modification to the RIWP SAP/QAPP was made in the RIWP Addendum so that hand auger samples were collected ahead of clearance at locations requiring a vactor truck.
- During Phase 1, several borings were drilled deeper than anticipated to characterize and confirm the contacts of stratigraphic units. Additional flexibility was incorporated into the RIWP Addendum SAP/QAPP to allow for deeper explorations than anticipated in Phase 2.
- For Phase 1, the time frame in which to sample tidally influenced monitoring wells was calculated by correlating the lowest conductivity and water level measurements at each well with the low tide recorded at the NOAA station number 9447130, which is located in Elliott Bay, rather than station number 9447029 identified in the RIWP, because station 9447130 measures actual tide fluctuations whereas 9447029 is a predictive station. The Elliott Bay station was also used in Phase 2.

- Because shoreline Fill Unit monitoring wells dried up during the lower-low tide cycle, groundwater sampling windows were adjusted to be 1.5 hours before the predicted time for the groundwater elevation to reach the bottom of each screen and for the well to go dry for Phase 1. This modification to the sampling window was discussed with and approved by Ecology during the monthly Ecology-PLP meeting on April 8, 2021. This modified sampling window did not result in sufficient groundwater volume for all laboratory analyses at certain shoreline monitoring wells during the Phase 1 sampling event (particularly MW-09 and MW-10). The sampling protocol was further revised (i.e., longer sampling window) to maximize groundwater sample volume obtained during Phase 2, as described in the RIWP Addendum SAP/QAPP.
- For Phase 1 groundwater sampling for PCB congeners, platinum-cured silicone tubing was used both down well and through the pump head during low-flow sampling conducted for PCB congener analysis, rather than using flexible copper tubing down well as identified in the Work Plan, because a source of suitable non-recycled copper tubing was not identified.

Phase 2 Deviations from the RIWP Addendum SAP/QAPP:

- During Phase 2, no catch basin solids were present in CB-02 during the dry weather site walks prior to the start of Phase 2 and after precipitation events which preceded catch basin sampling. Based on the lack of solids, CB-05, the catch basin presumably downstream of CB-02, was sampled instead. This sampling modification was reviewed and approved by Ecology in emails dated September 12, 2022.
- During drilling at MW-17 and MW-20, the Tidal Flat Unit was not observed, and the screen intervals for these monitoring wells were completed 0.5 feet below the observed water level at the time of drilling. The wells are predominantly screened within the Alluvial Unit, and the elevations of their screens are similar to other Alluvial Unit monitoring wells.
- The Tidal Flat Unit was also not observed during drilling at MW-18 and MW-18D. At MW-18D, the screen was placed within the Alluvial Unit from 15 to 20 feet bgs based on the observed water level at the time of drilling. To provide separation from the deeper well, the screen for monitoring well MW-18 was placed at 7 to 12 feet bgs. While this interval is within the Alluvial Unit, it is at a similar elevation to other Fill Unit monitoring wells.
- Groundwater from MW-18 and MW-21 was not sampled in either Phase 2 or Phase 3 of the RI. MW-18 remained dry throughout the dry well datalogger study in the rainy season (Section 5.1.2.9). At MW-21, groundwater was only intermittently recorded by the datalogger during late December 2022 to early January 2023. Similarly, groundwater was only observed in MW-21 via manual measurements on the December 29, 2022, and January 10, 2023, site visits, where up to 1.3 feet of water was present in the well. However, when the dataloggers were retrieved on January 24, 2023, the well was dry and well development could not be accomplished. Based on the hydrograph from the datalogger, it appears

that the well screen was intermittently saturated only during periods of extreme precipitation and/or tides, which coincided with widespread flooding in the South Park neighborhood in December 2022 through January 2023.

- An additional soil boring, SB-43, was added to the north of SB-42 for the purposes of further delineating the lateral and/or vertical extents of Pond Fill material.
- Dioxins/furans analysis of groundwater samples from wells MW-05 and MW-06 was planned, and the samples were collected and sent to Enthalpy Analytical, LLC (formerly Vista), for analysis. However, the lab reported significant detections of 2,3,7,8-TCDD in the method blank associated with these samples, which would have resulted in rejection of the sample analytical data during data validation. There was insufficient volume for re-extraction and analysis, and so additional groundwater sample volume was collected as part of Phase 3 for analysis of dioxins/furans at the planned locations (plus additional locations identified by the PLP Group).
- As described in Section 4.3.4 above, TIG Environmental collected additional soil samples not prescribed in the RIWP Addendum from drill cores during Phase 2 of the RI and submitted the samples for analysis of PCB congeners and dioxins/furans. This data has been integrated into the RI dataset and is included for evaluation in Section 6.

Phase 3 Deviations from the RIWP Addendum SAP/QAPP:

- As described in Section 5.1.3.1 above, the sampling interval for indoor air samples collected at the Tire Factory was modified from 24 hours to 8 hours based on the commercial use of the building. This modification was proposed to and approved by Ecology in the Indoor Air Sampling Plan (Aspect, 2023a).

5.3.2 Data Quality Verification and Validation Results

Soil, groundwater, catch basin solids, stormwater, soil gas, and air samples were submitted for laboratory analysis in accordance with the methods prescribed in the SAP/QAPPs in the RIWP and RIWP Addendum (Aspect, 2021 and 2022b). Phase 1 analytical samples were submitted to Analytical Resources, Inc. of Tukwila, Washington, for all analyses with the exception of PCB congeners and dioxins/furans. PCB congeners and dioxins/furans analysis were conducted by Vista Analytical of El Dorado Hills, California (Vista). The laboratory analytical reports for Phase 1 are included in Appendix G.1.A. Validation of analytical data from Phase 1 of the RI was performed by Ecochem, Inc. and included Level 4 validation of PCB congener and dioxins/furans data and Level 2B validation of all other analytical data. The validation reports are included in Appendix G.1.B.

Phase 2 analytical samples were submitted to three different laboratories for analysis:

- Analytical Resources Inc. analyzed soil and groundwater samples for TBT

- Vista, which was acquired in June 2021 and is now Enthalpy Analytical LLC, analyzed soil and groundwater samples for PCB congeners and dioxins/furans.
- Friedman and Bruya, Inc. analyzed soil and groundwater samples for all the remaining analyses and analyzed the soil gas samples.

In Phase 3 of the RI, samples were submitted to the following laboratories:

- Soil gas and air samples were submitted to Friedman and Bruya, Inc. for analysis of chlorinated VOCs.
- Groundwater samples were submitted to the following laboratories:
  - Friedman and Bruya, Inc. for analysis of gasoline-, diesel-, and oil-range TPH; total and dissolved metals; VOCs; SVOCs (including PAHs); pesticides: and PCB Aroclors.
  - Analytical Resources Inc. for analysis of TBT.
  - Enthalpy Analytical LLC, for analysis of PCB congeners and dioxins/furans.
  - Select groundwater samples in Phase 3 of the RI were also submitted to ALS Environmental of Kelso, Washington, for preparation using reductive precipitation and analysis of metals.

The laboratory analytical reports for Phases 2 and 3 are included in Appendices G.2.A and G.3.A, respectively. Validation of analytical data from Phases 2 and 3 of the RI was performed by Laboratory Data Consultants, Inc. and included Level 4 validation of PCB congener and dioxins/furans data and Level 2B validation of all other analytical data. The validation reports for Phases 2 and 3 of the RI are included in Appendices G.2.B and G.3.B, respectively.

The laboratory reports for Phases 2 and 3 noted that the presence of PCE was interfering with the NWTPH-Gx analysis in some soil and groundwater samples, which resulted in data qualifiers being assigned during data validation. Based on that finding, the laboratory reports for Phase 1 were reviewed and found that analyst notes had identified the same interference for some soil and groundwater samples collected during Phase 1. In January 2024, Analytical Resources Inc. provided updated case narratives based on that finding. In March 2025, Laboratory Data Consultants, Inc., revalidated and requalified NWTPH-Gx analysis for samples from Phase 1 exhibiting interference from PCE. The updated case narratives and data validation reports are provided in Appendix G.4.A and G.4.B, respectively.

Based on the results of data validation, the following data qualifiers were assigned:

- **U** - The analyte was analyzed for but was determined to be non-detect above the reported sample quantitation limit, or the quantitation limit was raised to the concentration found in the sample due to blank contamination.
- **J** - The analyte was positively identified at levels greater than the method detection limit but less than the reporting limits; the associated numerical value is an estimate of the concentration of the analyte in the sample.

- **UJ** - The analyte was not detected above the reported quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
- **R** - The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

Analytical data results, including qualifiers, are summarized in Tables I.3.A through I.3.G. Generally, the data met all of the measurement quality objectives, including the measurement quality indicators – precision, accuracy, representativeness, comparability, completeness, and sensitivity – and sample-specific RLs that were dictated by the project requirements and intended uses of the data in the SAP/QAPPs for the RI. Certain samples did contain elevated RLs due to matrix interference, sample dilution, moisture content, or other sample-specific conditions, but overall, the laboratory analyses met the method reporting limits prescribed in the RIWP SAP/QAPPs. Only a few results were rejected for two specific analytes:

- Twenty-two soil sample results for methylene chloride were rejected.
- Four stormwater sample results for 2,4-dimethylphenol were rejected.

In all instances, the results were non-detect for the analyte, and the results were rejected due to percent recovery for laboratory control samples and/or laboratory control sample duplicates being outside the acceptable quality control range.

6 Screening/Cleanup Levels and Analytical Data Screening

This section describes the development of SLs and screening of analytical data for both sediment and upland media. The processes for sediment and upland media screening are similar, but each has some unique considerations as described in Sections 6.1 and 6.2 for sediment and upland media, respectively:

- Sediment – Section 6.1 – Describes the sources of available sediment data, the basis for establishing the Initial Sediment SLs, and initial sediment analytical data screening; identifies alternative sediment SLs and establishes the Selected Sediment SLs; and develops a refined, representative sediment dataset for evaluation in the CSM.
- Upland Media – Section 6.2 – Describes the basis for Preliminary RI SLs, initial upland media analytical data screening, and development of the Proposed RI CULs, identifies Site COPCs, and establishes Key COPCs for discussion of nature and extents of contamination.

At the outcome of both of these screening processes, analytes in sediment and Site COPCs in upland media are identified and retained for discussion as part of the nature and extent of contamination (Section 7) and evaluation in the CSM (Section 8). In those sections, soil and groundwater data are compared to Proposed RI CULs and sediment data is compared to Selected Sediment SLs, except when evaluating data relative to SLs based on a specific exposure pathway.

6.1 Sediment Data Screening

This section describes the sediment data screening process, including an evaluation of available surface (0 to 10 cm depth) and subsurface (greater than 10 cm depth) sediment data within and adjacent to the Marina Basin. This process is a stepwise evaluation, which is shown as a flowchart on Figure 6.1. The steps include the following:

1. Compile available sediment data adjacent to the SPM Property.
2. Identify lowest potentially applicable sediment SLs (Initial Sediment SLs).
3. Compare available sediment data to Initial Sediment SLs and retain any analytes exceeding Initial Sediment SLs for further evaluation.
4. Consider potentially applicable alternative sediment SLs for analytes retained for further evaluation. Alternative sediment SLs that may be appropriate for this Site include those based on specific depths or potential exposure pathways that may have been established for the LDW Superfund Site.
5. Establish Selected Sediment SLs. Selected Sediment SLs are: (1) one of the applicable and available alternative sediment SLs, or (2) Initial Sediment SLs for those analytes without alternative sediment SLs.
6. Compare analytes retained from Step #3 to Selected Sediment SLs.

7. Establish a refined sediment dataset for analytes retained from Step #6 for use in the CSM. The refined sediment dataset removes data that are not representative of current conditions due to age, prior dredging activities, or newer samples from the same location (within 10 feet). If insufficient data remains for a given analyte retained from Step #6, retain the full dataset for that analyte for evaluation in the CSM (Sections 7 and 8.2).

These analyte identification and evaluation steps are described in detail in the following subsections.

6.1.1 Step #1: Full Sediment Dataset

The full sediment dataset was developed by downloading all available sediment data from Ecology's EIM database on November 7, 2023, for locations between LDW River Miles 3.3 and 3.7. Sediment sample locations in the vicinity of the SPM Property are shown on Figure 4.2. For the purposes of this evaluation, only samples from the EIM dataset within the area that included the Marina Basin and a 100-foot buffer surrounding the basin[43] (Figure 4.2) were evaluated. Two additional datasets not available in the EIM database were also included as part of the full sediment dataset: (a) split samples collected by TIG Environmental in 2020 during the Upper Reach Pre-Design Investigation Phase I performed by the Lower Duwamish Waterway Group (LDWG), and (b) samples from Upper Reach Pre-Design Investigation Phase III that were not in EIM but were obtained from the LDWG project library.[44] Available location IDs and associated EIM studies located within the Marina Basin and the 100-foot buffer are shown in Table H.1. The sediment dataset evaluated includes 115 surface sediment and 124 subsurface sediment samples[45] collected from 162 stations, with collection dates ranging from 1990 through 2022. All of the surface sediment samples are 0 to 10 cm below mudline.[46] Subsurface samples are all samples for which the sample extended below 10 cm. The bottom depth of subsurface samples ranged from 30 to 504 cm.

6.1.2 Step #2: Establish Initial Sediment SLs

The second step in the sediment data screening uses conservative Initial Sediment SLs to allow for a more focused screening and evaluation in subsequent steps. Data were conservatively compared to the Initial Sediment SLs as point-based comparisons, regardless of whether the Initial Sediment SL and/or exposure area is area-based (i.e., human health direct contact pathway), and regardless of the point of compliance (e.g., sample depth).

Initial Sediment SLs were determined based on whether analytes are or are not one of the 43 LDW COCs.[47] Initial Sediment SLs for both LDW COCs and non-LDW COCs[48]

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[43] The buffer included the area upland of the Marina Basin because two sediment samples were located in that area, likely due to inaccurate coordinates. These samples are assumed to represent sediment data in or close to the Marina Basin.
[44] https://ldwg.org/project-library/
[45] Duplicates and QA/QC samples were not included in the sediment dataset.
[46] All sediment sample depths and intervals throughout this report are below mudline.
[47] LDW COCs are those COCs identified in the LDW ROD (EPA, 2014).
[48] Non-LDW COCs refers to any chemical that is not an LDW COC; this term does not necessarily mean the chemical is a Site COPC.

consider Washington State Sediment Management Standards (SMS; WAC 173-304), including the SMS marine chemical criteria and the marine sediment dry-weight lowest apparent thresholds (LAETs) sediment cleanup objectives (SCOs) as established in the Sediment Cleanup User's Manual (SCUM, Table 8-1; Ecology, 2021). Initial Sediment SLs for LDW COCs also consider the LDW CULs established in the LDW ROD (EPA, 2014). Both of the SCOs (SMS marine chemical criteria and LAETs) and the LDW ROD CULs are included in the *Lower Duwamish Water Preliminary Cleanup Level Workbook* (PCUL Workbook; Ecology, 2025a), and the lowest value for each analyte was selected as the Initial Sediment SLs. The Initial Sediment SLs for LDW COCs and non-LDW COCs and their basis in either the LDW ROD or the Washington State SMS are summarized in Tables H.2.A and H.2.B, respectively.

As described in the SCUM (Ecology, 2021), in cases where the TOC is either greater than 3.5 percent or less than 0.5 percent, dry-weight concentrations should be compared to the SCO LAETs rather than the organic carbon-normalized (OC-normalized) SMS marine chemical criteria. Therefore, two sets of Initial Sediment SLs are presented for both LDW COCs and non-LDW COCs in Tables H.2.A and H.2.B, respectively, for samples within and for sample outside of the accepted TOC range.

6.1.3 Step #3: Compare Sediment Data to Initial Sediment SLs

Samples that contained TOC within the accepted range of 0.5 to 3.5 percent were compared to OC-normalized Initial Sediment SLs, if available:

- LDW COCs (Table H.2.A):
    - For samples of LDW COCs within the accepted TOC range, all analyte concentrations were compared to the minimum LDW ROD CUL, including OC-normalized concentrations when applicable for a given analyte.
    - For samples of LDW COCs outside the accepted TOC range, dry-weight concentrations were compared to either the minimum LDW ROD CUL or the SCO LAET (if the minimum LDW ROD CUL for that analyte was an OC-normalized value).
- For samples of non-LDW COCs, all analyte concentrations were compared to the SMS SCOs as presented in the PCUL Workbook (Ecology, 2025a), including both human health and benthic exposure SCOs (Table H.2.B):
    - For samples of non-LDW COCs within the accepted TOC range, all analyte concentrations were compared to the minimum SCOs, including OC-normalized concentration when applicable for a given analyte.
    - For samples of non-LDW COCs outside the accepted TOC range, dry-weight analyte concentrations were compared to the minimum SCOs, using the SCO LAET if the minimum SCO for that analyte was an OC-normalized value for benthic exposure. Available data for LDW COCs in surface and subsurface sediment are presented in Tables H.3.A and H.3.B, respectively, and available data for non-LDW COCs in surface and subsurface sediment are presented in Tables H.3.C and H.3.D, respectively.

Based on exceedances of the Initial Sediment SLs, analytes retained for further evaluation include the following:

- LDW COCs:
  - Surface Sediment: arsenic, mercury, 4-methylphenol, benzyl alcohol, phenol, total dioxin/furan toxic equivalency (TEQ), and total PCB Aroclors
  - Subsurface Sediment: arsenic, benzyl alcohol, total dioxin/furan TEQ, total PCB Aroclors, and total PCB congeners
- Non-LDW COCs:
  - Surface Sediment: TBT and aldrin
  - Subsurface Sediment: TBT, 4,4’-DDT, aldrin, and trans-chlordane

A statistical summary of data compared to Initial Sediment SLs for analytes retained for further evaluation is provided in Table H.4.

6.1.4 Step #4: Potentially Applicable Alternative SLs

Potentially applicable alternative SLs for sediment adjacent to the SPM Property that were considered during Step #4 of this evaluation for LDW COCs included other LDW ROD CULs (EPA, 2014) for subsurface sediments. There are multiple LDW ROD CULs based on depth and recovery category; the lowest among the three human direct contact pathway CULs (beach play, clamming,[49] or site-wide net-fishing), regardless of sample location and depth, for PCBs and dioxins/furans was selected as a potentially applicable SL. Other potentially applicable alternative SLs were identified for select LDW COCs and non-LDW COCs that may be applicable to the sediment adjacent to the SPM Property. These potentially applicable alternative SLs are based on specific assumptions or conditions (such as the alternative natural background arsenic value provided in the SCUM). Conservatively, these potentially applicable alternative SLs were not used to establish the Selected Sediment SLs, but they are presented in Section 6.1.8 for use in evaluating the sediment analytical data.

6.1.5 Step #5: Establish Selected Sediment SLs

The rationale for selecting each alternative SL as the Selected Sediment SL is as follows:

- **PCBs.** The Initial Sediment SLs for PCBs in both surface and subsurface sediment were based on the minimum LDW ROD CULs protective of human seafood consumption (0.002 mg/kg) for samples both inside and outside the acceptable TOC range and the minimum LDW ROD CULs protective of benthic invertebrates (12 mg/kg OC-normalized [mg/kg-OC]) for samples inside the acceptable TOC range. However, these SLs are only applicable to the surface

[49] Marina Basin sediments were not identified as potential beach play or clamming areas in the LDW ROD. However, the area adjacent to the south was identified as potential clamming habitat. SLs are considered conservative for the Marina Basin but allow evaluation of the potential for marina sediments to impact the adjacent habitat.

sediment interval (0 to 10 cm) based on those pathways, as per the LDW ROD. Therefore, the Selected Sediment SL for PCBs in subsurface sediment was identified as the lowest value protective of human direct contact (0.5 mg/kg, for clamming areas). The Selected Sediment SLs for surface sediment are the same as the Initial Sediment SLs (12 mg/kg-OC and 0.002 mg/kg). Note that application of the Selected Sediment SL for subsurface sediment is highly conservative for samples collected at depths below the potential points of compliance for direct contact (0 to 45 cm or 0 to 60 cm under the LDW ROD, depending on the exposure scenario). Additional evaluation and discussion of sediment data on a sample-specific basis is provided in Section 7. In addition, the direct contact SLs identified consider clamming and beach play scenarios, neither of which occurs in the Marina Basin area as documented in the LDW ROD. Furthermore, compliance with direct contact SLs is typically evaluated on an area-average basis, whereas this evaluation screens the data on a point-by-point basis for simplicity and conservatism.

- **Dioxins/furans**. The Initial Sediment SL for dioxins/furans in surface and subsurface sediment ($2x10^{-6}$ mg/kg) is the minimum ROD CUL; however, that value is based on human seafood consumption and is only applicable to the surface sediment (0 to 10 cm) interval, as per the LDW ROD. Therefore, the Selected Sediment SL for dioxins/furans in subsurface sediment was adjusted to the value protective of human direct contact ($1.3x10^{-5}$ mg/kg, for clamming areas). This Selected Sediment SL for dioxins/furans in subsurface sediment is considered highly conservative for the same reasons described above for PCBs.

For the remaining analytes retained for further analysis during Step #3, no alternative SLs were identified as more potentially applicable to sediment adjacent to the SPM Property, and therefore, the Initial Sediment SL for each of those analytes was retained as the Selected Sediment SL. Selected Sediment SLs for analytes retained for further evaluation from Step #3 are shown in Table H.5, and Selected Sediment SLs that differ from the Initial Sediment SLs are bolded.

6.1.6 Step #6: Compare Sediment Data to Selected Sediment SLs

In this step of the evaluation, the analytes retained for further evaluation in Step #3 were screened against the Selected Sediment SLs. A statistical summary of those analytes compared to the Selected Sediment SLs for the full sediment dataset is provided in Table H.6. Any analyte detected above the Selected Sediment SLs was identified for further evaluation. Based on screening against the Selected Sediment SLs, only total PCB congeners in subsurface sediment were not retained for further evaluation.

The list of analytes retained for further evaluation in this Step #6 is therefore as follows:

- LDW COCs:
  - Surface Sediment: arsenic, mercury, 4-methylphenol, benzyl alcohol, phenol, total dioxin/furan TEQ, total PCB Aroclors, and total PCB congeners
  - Subsurface Sediment: arsenic, benzyl alcohol, total dioxin/furan TEQ, and total PCB Aroclors

- Non-LDW COCs:
  - Surface Sediment: TBT and aldrin
  - Subsurface Sediment: TBT, 4,4'-DDT, aldrin, and trans-chlordane

6.1.7 Step #7: Refinement of Sediment Dataset

In this step, the sediment dataset was refined to focus on data potentially representative of current Site conditions. The refined sediment dataset was further evaluated by analyte and depth interval as part of the RI nature and extent evaluation (Section 7). The refined sediment dataset was established by retaining data (1) collected within the last 20 years, (2) not removed during the T-117 EAA dredging, and (3) not superseded by more recent, colocated data (i.e., a newer sample within 10 feet) as outlined in the procedures in the Source Control Review Memorandum (Aspect, 2022c).

The samples not retained as potentially representative of current conditions are shaded gray in Table H.1 and in the header rows of Tables H.3.A through H.3.D; the rationale for exclusion in the refined sediment dataset is included in Table H.1. The full sediment dataset contained 239 samples, including 115 surface samples and 124 subsurface samples. Of those, 50 surface samples and 17 subsurface samples were removed from the full sediment dataset; 65 surface and 107 subsurface sediment samples were retained in the refined sediment dataset, summarized as follows:

- LDW COCs, Surface Sediment (Table H.3.A): A total of 50 samples were removed from the dataset; 9 samples were over 20 years old, and the remaining 41 samples were removed during the T-117 early action and/or replaced by newer samples.
- LDW COCs, Subsurface Sediment (Table H.3.B): A total of 16 samples were removed from the dataset; 4 samples were over 20 years old, and the remaining 12 samples were removed during the T-117 early action cleanup.
- Non-LDW COCs, Surface Sediment (Table H.3.C): 16 samples were removed (overlapping with LDW COC samples).
- Non-LDW COCs, Subsurface Sediment (Table H.3.D): 9 samples removed (8 overlapping with LDW COC samples plus one additional sample that was over 20 years old).

A statistical summary of the refined dataset compared to Selected Sediment SLs is provided in Table H.7.

The discussion of the nature and extent of analytes in sediment that exceed the Selected Sediment SLs (in either the full sediment dataset or refined sediment dataset) and were identified as Site COPCs in soil or groundwater (Section 6.2, below) is provided by chemical class in Section 7.

6.1.8 Consideration of Other Potentially Applicable SLs and Upstream Background Concentrations for Sediment

The Section 7 evaluation of the nature and extent of analytes in sediment that both exceed the Selected Sediment SLs and were identified as Site COPCs in soil or groundwater also considers other potentially applicable risk-based SLs for specific exposure pathways and other available background sediment concentrations. The following sources were used to determine other potentially applicable SLs and upstream background concentrations:

- LDW COCs:
  - SCUM (Ecology, 2021) natural background concentrations developed by Ecology and different from those presented in the LDW ROD (arsenic and dioxins/furans)
  - Upstream sediment background concentrations developed and updated by LDWG (Windward, 2020) and USGS (2018)
- Non-LDW COCs:
  - Dredged Material Management Program (DMMP; USACE, 2021) marine guidelines for open-water disposal (4,4'-DDT, aldrin, and trans-chlordane)
  - Risk-Based Threshold Concentration (RBTC) for the East Waterway Superfund Site, which is immediately downstream of the LDW Superfund Site (TBT)

Based on these sources, the following potentially applicable SLs and background concentrations are considered in Section 7 for each chemical and are used in displaying the sediment analytical data on Figures H.1 through H.8:

- **Arsenic.** The Selected Sediment SL for arsenic in surface and subsurface sediment (7 mg/kg) is the minimum LDW ROD CUL, based on natural background; however, the sediment natural background value for arsenic subsequently established in SCUM is 11 mg/kg, which should be considered when evaluating sediment data. Additionally, upstream background concentrations of arsenic in suspended sediment have been documented to range between 5 and 40 mg/kg, with a mean value of 10 mg/kg being used for sediment transport modeling in the LDW (Windward Environmental, 2020). The 2018 USGS study documented concentrations of arsenic in suspended sediments from upstream between 8.3 and 27 mg/kg, with a median concentration of 20.3 mg/kg. For the purposes of evaluating and discussing arsenic sediment data within this RI, the SCUM natural background value of 11 mg/kg and the LDW ROD RAL value of 57 mg/kg are also considered (Section 7.1.4; Figure H.1).
- **PCBs.** The Selected Sediment SL for PCBs in surface sediment (0.002 mg/kg) is based on the protection of human consumption of seafood and is evaluated at the spatial scale of compliance for the whole LDW (spatially weighted average concentration, not a point-based concentration). This ROD CUL of 0.002 mg/kg is based on a background value for Puget Sound sediments; however, upstream background concentrations of PCBs in suspended sediment have been documented to range from less than 0.002 to 0.067 mg/kg. A mean value of 0.02

mg/kg is used for sediment transport modeling in the LDW (Windward Environmental, 2020). Likewise, the 2018 USGS study documented concentrations of total PCBs in suspended sediments from upstream between 0.002 and 0.051 mg/kg, with a median concentration of 0.015 mg/kg. For the purposes of evaluating and discussing PCB sediment data within this RI, the LDW ROD RAL value of 12 mg/kg-OC (or 0.13 mg/kg dry-weight) and the next lowest ROD CUL value of 0.5 mg/kg (for remedial action objective 2, protection of human health direct contact in clamming areas) are also considered (Section 7.2.4; Figure H.4.A).

- **TBT, 4,4'-DDT, aldrin, trans-chlordane.** The Selected Sediment SLs for bioaccumulative compounds TBT (0.0021 mg/kg), 4,4'-DDT (0.0001 mg/kg), aldrin (0.0001 mg/kg), and trans-chlordane (0.0001 mg/kg) were default values in the PCUL Workbook, based on the practical quantitation limit (PQL), in the absence of risk-based values developed from site-specific biota-to-sediment accumulation factors. The other potentially applicable SLs for these compounds (East Waterway RBTC for TBT [7.5 mg/kg-OC / 0.14 mg/kg], and DMMP criteria for 4,4'-DDT [0.012 mg/kg], aldrin [0.0095 mg/kg], and trans-chlordane [0.0028 mg/kg]), are risk-based and are retained for evaluation of sediment data in Section 7.

These other potentially applicable SLs are considered in the nature-and-extent discussion in Section 7 and may be further considered in a future FS for the Site in developing Site-specific cleanup levels and/or remediation levels.

6.2 Upland Media Data Screening

This section describes the upland data screening process. This process was a stepwise evaluation, which is shown as a flowchart on Figure 6.2. The steps include:

1. Determine whether each analyte was detected in upland media at the Site. Analytes which were never detected were not retained for further evaluation.
2. For analytes detected in soil, perform a Site-specific Terrestrial Ecological Evaluation (TEE) and update the values obtained from Ecology's PCUL Workbook with the Site-specific TEE values; establish Preliminary RI SLs based on lowest potentially applicable PCUL Workbook values for soil and groundwater or Ecology's Cleanup Levels and Risk Calculation (CLARC; Ecology, 2025b) values for sub-slab soil gas and indoor air.
3. Compare analytical results to the Preliminary RI SLs to identify analytes to retain for further evaluation. Analytes with at least one exceedance in a particular media were retained for that media.
4. Adjust Preliminary RI SLs that are below PQLs to the PQL, in accordance with MTCA.

5. Compare analytical results to the Refined RI SLs; analytes which do not exceed the Refined RI SLs were not retained for further evaluation in this RI.[50]
6. Evaluate if the transport pathway for which the Refined RI SL is based upon is complete based on empirical demonstration for cross-media transport pathways.
7. Establish Proposed RI CULs by removing SLs from consideration based on incomplete transport pathways and selecting the next lowest SL from the PCUL Workbook with a potentially complete pathway.
8. Compare analytical results to the Proposed RI CULs; if the analyte does not exceed the Proposed RI CULs, it was not retained as a Site COPC.
9. Evaluate if the analytical data passes the three-part MTCA statistical compliance test for Proposed RI CULs. Analytes that exceed Proposed RI CULs and do not pass three-part test were retained as Site COPCs.
10. Establish Key COPCs for each analyte class based on the frequency/magnitude of exceedances and spatial distribution relative to other COPCs within that analyte class.

A detailed discussion of each step in the COPC screening process is included in the subsections below.

6.2.1 Step #1: Analytes Detected in Upland Media

In Step #1 of the evaluation, any analyte that was not detected was not retained for further evaluation. The RIWP and RIWP Addendum identified the best available reporting limits, and most of the samples met the quality control criteria (Section 5.3.2). The reporting limits established in the RIWP Addendum SAP/QAPP meet the standards of PQLs as established in WAC 173-340-707.

Table I.1 presents a summary of detections for each analyte in groundwater, vadose soil, and saturated soil. In total, 82 analytes were eliminated from further evaluation in the upland media screening process:

- Metals (1): tetrabutyltin
- SVOCs (34):1,2-dinitrobenzene; 1,2-diphenylhydrazine; 1,3-dinitrobenzene; 1,4-dinitrobenzene; 2,3,4,6-tetrachlorophenol; 2,3,5,6-tetrachlorophenol; 2,3-dichloroaniline; 2,4,5-trichlorophenol; 2,4-dichlorophenol; 2,4-dinitrotoluene; 2,6-dinitrotoluene; 2-chloronaphthalene; 2-chlorophenol; 2-nitroaniline; 2-nitrophenol; 3 & 4 methylphenol; 3,3'-dichlorobenzidine; 3-nitroaniline; 4,6-dinitro-2-methylphenol; 4-bromophenyl phenyl ether; 4-chloro-3-methylphenol; 4-chloroaniline; 4-chlorophenyl phenyl ether; 4-nitrophenol; aniline; bis(2-chloro-1-methylethyl) ether; bis(2-chloroethoxy)methane; bis(2-chloroethyl) ether; bis(2-chloroisopropyl)ether; bis(2-ethylhexyl)adipate; hexachlorocyclopentadiene; n-nitroso dimethylamine; n-nitroso-di-n-propylamine; and pyridine

[50] Ecology has noted an expectation that PQLs would be reassessed in a future FS.

- Pesticides (12): 2,4'-DDE; beta-BHC; chlordane; cis-nonachlor; endosulfan II; endosulfan sulfate; lindane; methoxychlor; mirex; oxychlordane; toxaphene; and trans-nonachlor
- VOCs (35): 1,1,1,2-tetrachloroethane; 1,1,1-trichloroethane; 1,1,2 -trichlorotrifluoroethane; 1,1,2,2-tetrachloroethane; 1,1-dichloropropene; 1,2,3-trichlorobenzene; 1,2-dibromo-3-chloropropane; 1,2-dibromoethane; 1,2-dichloroethane; 1,2-dichloropropane; 1,3-dichloropropane; 1,4-dichloro-2-butene; 2,2-dichloropropane; 2-chloroethyl vinyl ether; 2-chlorotoluene; 2-hexanone; 4-chlorotoluene; acrolein; acrylonitrile; bromobenzene; bromochloromethane; bromodichloromethane; bromoform; carbon tetrachloride; chloroethane; cis-1,3-dichloropropene; dibromochloromethane; dibromoethane; dichlorodifluoromethane; methyl tert-butyl ether; methyliodide; n-hexane; trans-1,3-dichloropropene; trichlorofluoromethane; and vinyl acetate

6.2.2 Step #2: Establish Preliminary RI SLs

The RI soil and groundwater SLs address the environmental transport and exposure pathways applicable at the Site, as defined in Ecology's PCUL Workbook (Ecology, 2025a) and based on the Site-specific TEE. The RI sub-slab soil gas and indoor air SLs address the VI transport and exposure pathways, respectively. Two sets of Preliminary RI SLs for sub-slab soil gas and indoor air were established as reported in Ecology's CLARC compendium (Ecology, 2025b):

- The MTCA Method B standards for unrestricted land use
- Those standards adjusted for commercial worker exposure, which are only used for screening buildings with a presumed commercial use (i.e., not residential structures)

Collectively, these SLs are referred to as the Preliminary RI SLs. The Preliminary RI SLs were established in the RIWP and RIWP Addendum and have been updated in accordance with the latest versions of the PCUL Workbook, CLARC, and values from the Site-specific TEE (Section 6.2.2.2); otherwise, no adjustments have been made to the Preliminary RI SLs.

Sections 6.2.2.1, 6.2.2.2, and 6.2.2.3, respectively, describe the derivation of Preliminary RI SLs for groundwater, soil, and soil gas/indoor air. For soil and groundwater, the lower of the gasoline-range TPH (TPH-G) values presented in the PCUL Workbook and CLARC were selected because benzene is present at the Site.

6.2.2.1 Groundwater Preliminary RI SLs

This section describes derivation of Preliminary RI SLs for groundwater based on the highest beneficial use of Site groundwater and the corresponding applicable exposure pathways as detailed below.

Highest Beneficial Use of Site Groundwater

WAC 173-340-720(1)(a) states that, "Groundwater cleanup levels shall be based on estimates of the highest beneficial use and the reasonable maximum exposure expected to occur under both current and potential future site use conditions." Groundwater within the Site is classified as non-potable in accordance with WAC 173-340-720(2), as follows:

- **(2)(a) The groundwater does not serve as a current source of drinking water.** Groundwater at the Site is not used for any purpose. The Site is within City of Seattle municipal water service area and this potable water supply will continue in perpetuity. Ecology's Washington State Well Report Viewer (2025c) was used to research potential water supply wells within a half mile of the SPM Property. The well report viewer indicated up to 10 potential water supply wells within the search radius; upon further investigation: 7 wells were resource protection (monitoring) wells, and 2 wells were temporary wells for construction dewatering on the east side of the LDW. One water supply well was reported within the search radius, identified by Well Report ID 102798. The Well Report indicates this well was drilled in 1985 to 240 feet bgs, constructed with an 8-inch-diameter casing screened from 150 to 170 feet bgs, and was intended for irrigation (Appendix A.25). However, the location of the well was only recorded to the range-level, and it appears that the section may have been updated from 25, in the vicinity of the SPM Property, to 29, on Mercer Island (Appendix A.25). Therefore, the exact location of this well is uncertain. This well is not considered to preclude the determination that Site groundwater is not a source of drinking water because (a) the intended use of the well was indicated for irrigation and (b) the depth of the well is far outside the expected influence of Fill and Alluvial Unit groundwater at the Site.

  The DOH's Source Water Assessment Program (SWAP) mapping tool (2025) was also used to research potential water supply wells near the SPM Property. The SWAP mapping tool indicated two potential group B[51] water supply wells, each located approximately 1 mile from the SPM Property on the opposite side of the LDW and owned by Boeing: one to the north-northeast and one to the south-southeast. Both supply systems are listed as inactive.

- **(2)(b) The groundwater is not a potential future source of drinking water due to low yield or naturally poor water quality.** Naturally brackish groundwater conditions occur throughout the Site water-bearing units due to proximity to the LDW (saltwater intrusion) and the fact that much of the fill was likely dredged from the marine environment. Groundwater samples collected at the Site during RI activities commonly exceeded the Washington State drinking water criterion for specific conductivity (secondary maximum contaminant level of 700 uS/cm [WAC 246-290-310(3)(a)]) in almost every Site monitoring well; however, WAC 173-340-720(2)(b) establishes a total dissolved solids criterion of 10,000 mg/L to be considered non-potable. Compliance with section WAC 173-340-720(2)(b) will be established under the "Harbor Island exemption" under WAC 173-340-720(2)(d) below.

- **(2)(c) It is unlikely that hazardous substances will be transported from the contaminated groundwater to groundwater that is a current or potential future source of drinking water at concentrations which exceed groundwater**

[51] Group B water supply systems serve fewer than 15 connections and fewer than 25 people per day.

quality criteria published in chapter 173-200 WAC. Under this section, several determinations are necessary:

- (i) – The extent of affected groundwater (Section 7) does not pose a risk to any current or future water supply (per section (2)(a) above). There are no drinking water wells within the Site, and the LDW forms the downgradient limit of the shallow water-bearing units (both the Fill and Alluvial Units) at the Site.
- (ii) – The distance to existing water supply wells is at a minimum, approximately 1 mile, but likely much farther than that since those two group B wells are listed as inactive.
- (iii) – There is little likelihood of any meaningful interconnection of the relatively shallow Fill and Alluvial hydrostratigraphic units at the Site through the Till Unit to deeper, regional water-bearing zones that would be used for water supply.
- (iv) – The physical and chemical characteristics of the Site COPCs would limit any migration to a potential water source.
- (v) – The hydrogeologic characteristics of the Fill and Alluvial Units at the Site (Section 3.2.3) preclude any migration to deeper, regional aquifers. The LDW is a regional groundwater discharge area; therefore, regional groundwater flow is generally moving upward toward the discharge area (the LDW), preventing downward flow from the shallow aquifers (the Fill and Alluvial Units).
- (vi) – Regionally, the glacial till that underlies the Alluvial Unit is expected to be regionally extensive, dense, and thick. While heterogeneities in the glacial till are expected, transport through the glacial till would be exceptionally slow, even if there were a downward vertical hydraulic gradient.

- **(2)(d) There is an extremely low probability that the groundwater will be used as a source of drinking water** because of the Site's proximity to surface water that is not suitable as a domestic water supply. At such sites, groundwater may be classified as non-potable if each of the following conditions can be demonstrated:[52]
  - (i) – The conditions specified in subsections (2)(a) and (2)(c) above are met.
  - (ii) – There are known or projected points of entry of the groundwater into the surface water. Hydrogeologic data document that groundwater on the Site discharges to the LDW (Section 3.2.3).
  - (iii) –The surface water is not classified as a suitable domestic water supply source under WAC 173-201A. The LDW is a marine surface water body and does not classify as a domestic water supply in Table 602 of Chapter 173-201A WAC.

[52] These determinations must be for reasons other than that the groundwater or surface water has been contaminated by a release of a hazardous substance at the site.

- (iv) –The groundwater is sufficiently hydraulically connected to the surface water that the groundwater is not practicable to use as a drinking water source. Because of its substantial hydraulic connection with the LDW, it is not practicable to use groundwater on the Site as a drinking water source due to the potential for drawing saline water into the water-bearing zone (i.e., saltwater intrusion).

Because drinking water is not a practicable future use for groundwater at the Site, the highest beneficial use of the shallow groundwater in the Fill and Alluvial Units is considered discharge to the LDW. This is consistent with the groundwater non-potability determination made for the T-117 site immediately south of the SPM Property (Windward et al., 2010).

Groundwater Pathways and Screening Levels

The applicable transport pathways, and their corresponding PCUL Workbook codes in parentheses (Ecology, 2025a), incorporated into the Preliminary RI SLs for groundwater are as follows:

- Discharge of contaminated groundwater to LDW (marine) surface water (GW-2), incorporating the most stringent state and federal water quality standards for protection of aquatic organisms and human health.
- Partitioning of groundwater contamination to LDW (marine) sediment (GW-3), incorporating the most stringent of the minimum sediment cleanup levels in the LDW ROD (EPA, 2014) and, for contaminants not included in the ROD, SCOs in the state SMS (WAC 173-304), all expressed as dry weight values.[53]
- Groundwater VI into an occupied building assuming unrestricted land use (GW-4).
- Groundwater VI of trichloroethene (TCE) into an occupied building based on the effects on child-bearing people (VI Guidance).
- Natural background concentrations for groundwater (GW-5).

Table I.2.A presents the applicable groundwater screening levels based on these pathways, with selection of the most stringent value as the Preliminary RI Screening Level for groundwater.

6.2.2.2 Soil Preliminary RI SLs

This section describes derivation of Preliminary RI SLs for soil based on the TEE and the corresponding applicable exposure pathways, as detailed below.

Terrestrial Ecological Evaluation

In accordance with MTCA, the TEE is a process that evaluates threats posed by contaminants to terrestrial ecological receptors (WAC 173-340-7490). The TEE for this Site was performed in accordance with MTCA and Ecology’s guidance document (2017). The Site-specific TEE approach and proposed screening levels were provided to Ecology

[53] Dry-weight values are used for GW-3 because OC-normalized values cannot be used for modeling the partitioning between groundwater and sediment (Ecology, 2025a).

on October 30, 2025, and Ecology concurred with the approach (with modifications to screening levels) on November 7, 2025.

Based on the proximity of the Site to the habitat restoration that was completed at the Duwamish River People's Park to the south, the Site does not qualify for a TEE exclusion (WAC 173-340-7491) or a simplified TEE (WAC 173-340-7492). Therefore, a Site-specific TEE was performed. A Site-specific TEE involves two primary steps: the problem formulation step and the selection of an appropriate terrestrial ecological evaluation method. The following evaluations were conducted as part of each step, as established in WAC 173-340-7493(2) and (3):

- **(2) Problem formulation step.** In the problem formulation step, the chemicals of ecological concern are established, exposure pathways are assessed, and terrestrial ecological receptors of concern are identified:
  - For the purposes of this Site-specific TEE, any analyte detected in soil (Table I.2.B) was retained for evaluation as a potential chemical of ecological concern.
  - Pervious areas of soil (with potential chemicals of ecological concern) are present throughout the Site, and there are no institutional controls in place on the SPM Property to limit terrestrial ecological receptors from being exposed to the soil; therefore, no exposure pathways for terrestrial ecological receptors were eliminated.
  - Because the SPM Property is zoned industrial, is used primarily for commercial and industrial purposes[54], and is covered primarily by pavement and gravel with minimal vegetation, the potential terrestrial ecological receptors of concern were limited to wildlife (avian and mammalian herbivores, omnivores, insectivores, and carnivores). This approach is consistent with the terrestrial ecological receptors considered as part of developing the RvALs for the T-117 EAA Upland Removal Area (Section 2.4.2.2).

- **(3) Selection of an appropriate terrestrial ecological evaluation method.** In accordance with this subsection, the soil concentrations listed in WAC Table 749-3 may be used as the TEE screening level; these values are already included in the PCUL Workbook (Ecology, 2025a). For analytes that are not included in Table 749-3, screening levels may be established based on a literature review, soil bioassays, wildlife exposure model, biomarkers, Site-specific field studies, or a combination thereof. For the purposes of this Site-specific TEE, a literature survey was selected to establish TEE screening values for potential chemicals of ecological concern not included in Table 749-3. The literature survey was conducted using Oak Ridge National Laboratory's (ORNL's) Risk Assessment Information System (RAIS) – Ecological Benchmark Tool for Chemicals. Table I.2.B shows the chemicals of potential ecological concern that were researched using ORNL's RAIS. Three potential sources were included in searches of

[54] There is limited residential use of the SPM Property (see Section 2.3); therefore, soil screening levels for protection of human health consider direct contact based on unrestricted (residential) land use.

ecological benchmarks for analytes in soil without a wildlife TEE screening value in MTCA Table 749-3:

- EPA's interim ecological soil screening levels (Eco-SSLs), which were derived by EPA for many of the soil contaminants that are frequently of ecological concern for plants and animals at hazardous waste sites. Eco-SSLs were developed for avian, mammalian, soil invertebrate, and plant receptors, and only the Eco-SSLs for avian and mammalian receptors were used for this Site-specific TEE. Note that the wildlife Eco-SSL values for total low molecular weight and high molecular weight PAHs (LPAHs and HPAHs, respectively) are already included in the PCUL Workbook (Ecology, 2025a) for the TEE soil pathway. The wildlife Eco-SSL value for silver was also added.
- Los Alamos National Laboratory's (LANL) ECORISK database, which includes ecological screening levels that were developed to be protective of plants and avian and mammalian herbivores, omnivores, insectivores, and carnivores. Only the LANL ECORISK screening values for avian and mammalian receptors were used for this Site-specific TEE.
- EPA regional screening values developed by EPA Regions 4 and 5 to support ecological risk assessment at RCRA hazardous waste and Superfund sites. These EPA regional soil screening values were developed to be protective of plants, soil invertebrates, mammalian, and avian receptors. Only the EPA regional screening values for avian and mammalian receptors were used for this Site-specific TEE.

As shown in Table I.2.B, the source for each potential chemical of ecological concern was chosen on a hierarchal basis starting with the most pertinent values to the Site with the following priority: MTCA Table 749-3 wildlife screening values, EPA Eco-SSL wildlife screening values, LANL ECORISK wildlife screening values, and finally EPA Regions 4 and 5 wildlife screening values. Alternative terrestrial ecological SLs were not available for all potential chemicals of ecological concern. Based on feedback from Ecology, the total LPAH or total HPAH wildlife screening value was applied to individual LPAHs or HPAHs that did not have an alternative terrestrial ecological screening level value (Table I.2.B).

The researched ecological benchmarks from ORNL's RAIS database are shown for each potential chemical of ecological concern in Table I.2.C. To be conservative in the development of Site-specific TEE values, the lowest available ecological benchmark for wildlife receptors was selected (Table I.2.C), regardless of the receptor and whether the specific species the study was based on is present at the Site.

Soil Pathways and Screening Levels

The applicable pathways, and corresponding PCUL Workbook (Ecology, 2025a) codes (in parentheses below), incorporated into the Preliminary RI SLs for soil are based upon whether the soil is continuously saturated. Preliminary RI SLs have been developed for both vadose soil and saturated soil. Conservatively, soil was assumed to be saturated below 6 feet bgs, and concentrations from samples at depths greater than 6 feet bgs were screened against the saturated soil Preliminary RI SLs. Concentrations from soil samples above 6 feet bgs were screened against vadose soil Preliminary RI SLs.[55] The applicable pathways are as follows:

- Human direct contact with soil contamination assuming unrestricted (non-industrial) land use (SL-1)
- Leaching of contaminants from soil to groundwater followed by transport to LDW surface water (SL-3 for vadose zone soil, SL-6 for saturated zone soil)
- Leaching of contaminants from soil to groundwater followed by transport to LDW sediment (SL-4 for vadose zone soil, SL-7 for saturated zone soil)
- Erosion of contaminated soils directly to LDW sediment (SL-8), incorporating the most stringent of the sediment cleanup levels in the LDW ROD and, for contaminants not included in the ROD, SCOs in the state SMS
- Terrestrial ecological receptor (wildlife) direct contact with soil contamination (SL-9), including the additional values derived from the Site-specific TEE detailed above
- Natural background concentrations for soil (SL-10)

Table I.2.D presents the applicable soil screening levels based on these pathways, with selection of the Preliminary RI SLs for vadose soil and for saturated soil as the most stringent value for each.

6.2.2.3 Soil Gas and Indoor Air Preliminary RI SLs

Ecology has established standard MTCA Method B and C carcinogenic and non-carcinogenic indoor air CULs using the procedures set forth in WAC 173-340-750, as described in their VI guidance (Ecology, 2022a). Ecology likewise established soil gas SLs that are protective of indoor air CULs; these soil gas SLs are calculated using a default VI attenuation factor and the indoor air CULs.

For the purposes of the RI, the MTCA Method B indoor air CULs and soil gas SLs were chosen for unrestricted land use, and the more stringent of the carcinogenic or non-carcinogenic values were used when both were available for a given analyte. Additionally, for evaluating current potential exposures in the Tire Factory building where only adult workers are present and only for a portion of the week, the soil gas SLs and indoor air CULs were also applied as Preliminary RI SLs after adjusting for a commercial-worker exposure scenario as presented in CLARC (Ecology, 2025b). These commercial worker exposure SLs were only used in screening of commercial spaces (e.g., the Tire Factory).

[55] Future sea level rise, as described in Section 3.3.2, could result in soil at depths less than 6 feet bgs becoming part of the saturated zone, and the more stringent leaching-based SLs may need to be considered in identification of final cleanup levels for that portion of the subsurface. The effectiveness of potential remedial actions considering their resilience to climate change, including the potential for sea level rise, would need to be considered in a future FS, in accordance with WAC 173-340-360(5)(d)(iii)(A)(III).

Collectively, the soil gas SLs and indoor air CULs under both an unrestricted-use and commercial-use scenario were selected at the Preliminary RI SLs, and the values are presented in Table I.2.E and I.2.F for soil gas and indoor air, respectively.

6.2.3 Step #3: Preliminary Analytical Data Screening

Step #3 of the upland media screening evaluation compared all analytical data generated for the Site for MTCA-regulated media to the Preliminary RI SLs. The analytical data screening is presented in Tables I.3.A (groundwater), I.3.B (vadose soil), I.3.C (saturated soil), I.3.F (sub-slab soil gas), and I.3.G (indoor air). Analytes that exceeded the Preliminary RI SLs in any one or more upland media were retained for further evaluation. The analytes retained for further evaluation are listed by media in Table 6.1.

In total, 32 analytes were eliminated from further evaluation as part of Step #3 of the upland media screening process:

- Metals (3): silver, monobutyltin, and dibutyltin ion
- PAHs (1): acenaphthylene
- SVOCs (6): 4-methylphenol; 4-nitroaniline; carbazole; di-n-octyl phthalate; nitrobenzene; and phenol
- Pesticides (3): 2,4’-DDD; 2,4’-DDT; and endrin ketone
- VOCs (19): 1,1-dichloroethane; 1,1-dichloroethene; 1,2,4-trimethylbenzene; 1,3,5-trimethylbenzene; 2-butanone; 2-pentanone; 4-methyl-2-pentanone; acetone; carbon disulfide; chloroform; chloromethane; isopropylbenzene; n-butylbenzene; n-propylbenzene; p-isopropyltoluene; sec-butylbenzene; styrene; tert-butylbenzene; and trans-1,2-dichloroethene

6.2.4 Steps #4 and #5: Refine Preliminary RI SLs for PQLs and Analytical Data Screening

The method reporting limits established in the Ecology-approved RIWP Addendum SAP/QAPP[56] were used to adjust Preliminary RI SLs for analytes retained from Step #3 to the PQL, if the Preliminary RI SL was less than the PQL. As established in WAC 173-340-707, a cleanup level will not be established that is below the PQL. The reporting limits established in the RIWP Addendum SAP/QAPP meet the standards of PQLs as established in WAC 173-340-707. PQL adjustments were only applied to soil and groundwater results, as the reporting limits for soil gas and indoor air were all below the associated Preliminary RI SLs.

Analytes with PQL adjustments for groundwater, vadose soil, and saturated soil are shown in Tables 6.2, 6.3, and 6.4, respectively. After the Preliminary RI SLs were adjusted for PQLs, the analytical data was rescreened. As a result of PQL adjustments, five compounds were eliminated for further evaluation:

[56] Using the target MRL from the RIWP Addendum SAP/QAPP to establish the PQL was conservative for the purposes of the RI; actual MRLs for some analytes were not always able to achieve the target MRL due to variations between laboratories or sample interferences.

- 2,3,7,8-TCDD and total dioxin/furan TEQ in groundwater were eliminated.
- 1,2,4-Trichlorobenzene; 1,3-dichlorobenzene; and 1,4-dichlorobenzene in saturated zone soil was eliminated.

While these analytes were eliminated for further evaluation for these media, the PQL adjustments (including for COPCs that were not eliminated) will need to be reevaluated in the future to determine if higher-resolution analytical methods have been developed between now and that time that can achieve lower PQLs, in accordance with WAC 173-340-707(4).

6.2.5 Step #6: Evaluation of Pathways

Step #6 of the upland media screening process evaluated whether the exposure pathways that form the basis of the Refined RI SLs were complete, based on empirical demonstrations of the cross-media transport pathways[57] at the Site. Two cross-media transport pathways were evaluated:

- The groundwater-to-vapor-intrusion transport pathway was eliminated for analytes which exceeded their groundwater SLs protective of VI (GW-4) but were not detected in soil gas or indoor air above the Refined RI SLs. Based on this evaluation, the transport pathway was only removed for one analyte: cis-1,2-dichloroethene (Tables 6.2 and I.3.A).
- The soil-leaching-to-groundwater transport pathways were eliminated for analytes which exceeded their Refined RI SLs for vadose and/or saturated soil but were not detected in groundwater above their Preliminary RI SLs. Four transport pathways were included in this evaluation: protection of surface water via soil-leaching-to-groundwater for the vadose zone (SL-3) and saturated zone (SL-6) and protection of sediment via soil-leaching-to-groundwater for the vadose zone (SL-4) and saturated zone (SL-7). The vadose soil leaching transport pathways (SL-3 and SL-4) were only eliminated for a given analyte if the areas of the highest concentrations of that analyte were in pervious surfaces (Figure 5.1) or if there was only a single detection in soil and the detection was associated with a monitoring well to assess groundwater at that location, as shown in Table 6.5. Based on this evaluation, the soil leaching transport pathways were eliminated for the following analytes:
    - Vadose Soil: Cadmium; mercury; TBT; 2-methylnaphthalene; naphthalene; fluorene; 2,4,6- trichlorophenol; 2-methylphenol; benzyl alcohol; diethyl phthalate; dimethyl phthalate; butyl benzyl phthalate; di-n-butyl phthalate; hexachloroethane; isophorone; n-nitrosodiphenylamine; pentachlorophenol; 4,4’-DDD; cis-chlordane; endosulfan I; endrin; toluene; ethylbenzene; total

[57] As described in Section 8, transport pathways are a component of an exposure pathway. If a transport pathway is not complete, then the exposure pathway is not complete. If the transport pathway is complete but concentrations at the exposure point are below applicable screening levels, and this condition is considered unlikely to change in the future, then the exposure pathway is considered not of potential concern. See Section 8 for additional description of exposure pathway terminology.

xylenes; 1,1,2-trichloroethane; 1,2,3-trichloropropane; 1,2,4-trichlorobenzene; and 1,2-dichlorobenzene

- Saturated Soil: Cadmium; lead, mercury; silver; TBT; acenaphthene; anthracene; dibenzofuran; fluoranthene; fluorene; naphthalene; 1-methylnaphthalene; 2-methylnaphthalene; pyrene; 2,4-dimethylphenol; 2,4-dinitrophenol; benzoic acid; benzyl alcohol; butyl benzyl phthalate; diethyl phthalate; dimethyl phthalate; di-n-butyl phthalate; hexachlorobenzene; hexachlorobutadiene; hexachloroethane; isophorone; 2-methylphenol; n-nitrosodiphenylamine; pentachlorophenol; 4,4'-DDD; cis-chlordane; endosulfan I; endrin; endrin aldehyde; heptachlor; heptachlor epoxide; ethylbenzene; toluene; total xylenes; 1,1,2-trichloroethane; 1,2,3-trichloroprane; 1,2,4-trichlorobenzene; 1,2-dichlorobenzene; 1,3-dichlorobenzene; 1,4-dichlorobenzene; 2,4,-6-trichlorophenol; bromomethane; chlorobenzene; and methylene chloride

The eliminated transport pathways for these analytes are reflected in Tables 6.2 (groundwater), 6.3 (vadose soil), and 6.4 (saturated soil).

6.2.6 Steps #7 and #8: Establish Proposed RI CULs and Analytical Data Screening

Step #7 of the upland media screening removed the incomplete cross-media transport pathways (Section 6.2.5) to establish the Proposed RI CULs. Once the incomplete transport pathways were removed, the Proposed RI CULs for each analyte in each media defaulted to the next most stringent transport or exposure pathway in the PCUL Workbook, adjusted to the PQL if it was higher than the most stringent pathway. These adjustments are shown in red in Tables I.4.A (groundwater) and I.4.B (vadose and saturated soil).

The Proposed RI CUL for indoor air and Proposed RI SL for soil gas are based on the Preliminary RI SLs for unrestricted land use in each media. The unrestricted land use version of the Preliminary RI SLs was used to screen COPCs for soil gas and indoor air. As discussed in Sections 7 and 8 below, the only building with a potential for VI is the Tire Factory (a commercial building with commercial workers), and therefore, Preliminary RI SLs for soil gas and indoor air were adjusted for commercial worker exposure and retained as Proposed RI SLs for soil gas and Proposed RI CULs for indoor air (Table I.4.C) for the purposes of data screening in this commercial area of the Site.

Step #8 of the evaluation screened the analytes retained for evaluation from Step #5 for each medium at the Site against the respective Proposed RI CULs (or, for soil gas and commercial worker exposure indoor air, Proposed RI SLs) for groundwater (Table 6.7), vadose soil (Table 6.8), saturated soil (Table 6.9), soil gas (Table 6.10), and indoor air (Table 6.11). If an analyte was not detected above the Proposed RI CUL, it was eliminated for further evaluation in that medium.

6.2.7 Step #9: Identification of COPCs

In Step #9 of the upland media analytical data evaluation, statistical compliance with MTCA was evaluated for analytes that exceeded the Proposed RI CULs. Statistical compliance with Proposed RI CULs is established through a three-part test:[58]

- The maximum concentration of a single sample can be no greater than two times the Proposed RI CUL.
- Less than 10 percent of the total number of samples can exceed the Proposed RI CUL.
- The upper one-sided 95 percent confidence limit on the true mean concentration must be less than Proposed RI CUL.

Statistical analyses were performed using ProUCL 5.2 and were based on distribution determined by including non-detect values in accordance with Ecology's guidance document (2022b)

- when less than 50 percent of the measurements were above the PQL, non-detects below the RL were assigned a value equal to one-half the RL; and
- when more than 50 percent of the measurements were above the PQL, the largest value in the dataset was used in place of an upper confidence limit on the true mean.

The 95 percent upper confidence limit on the true mean concentration is shown for analytes which met the first two criteria in groundwater, vadose soil, and saturated soil in Tables 6.2, 6.3, and 6.4, respectively. For soil gas and indoor air, no analytes were eliminated as Site COPCs based on MTCA statistical compliance. Based on this analysis, the following analytes were determined to comply with Proposed RI CULs and therefore were not retained as Site COPCs:

- Groundwater (Table 6.2): benzo(k)fluoranthene and indeno(1,2,3-cd)pyrene
- Vadose Soil (Table 6.3): fluorene; naphthalene; total LPAHs; 4,4'-DDD; and ethylbenzene
- Saturated Soil (Table 6.4): chromium; nickel; acenaphthene; anthracene; fluorene; phenanthrene; total LPAHs; benzyl butyl phthalate; dibenzofuran; and hexachlorobutadiene

Several analytes had a calculated 95 percent upper confidence limit of the true mean above the Proposed RI CULs: 2-methylphenol and n-nitrosodiphenylamine in vadose soil (Table 6.3) and 2,4-dimethylphenol in saturated soil (Table 6.4). All three of these analytes were only detected in a single sample each at the Site and at less than two times the Proposed RI CULs (Tables I.4.B and I.4.C). Additionally, all three of these analytes were colocated with exceedances of other Site SVOC COPCs (including the Key Site

[58] WAC 173-340-720(9) for groundwater compliance; WAC 173-340-740(7) for unrestricted land use soil compliance.

SVOC COPC, bis(2-ethylhexyl)phthalate [BEHP], as described in Section 6.2.8 below). Ecology's guidance (2022b) dictates that if more than 50 percent of the measurements are above the PQL, the largest value in the dataset is to be used in place of the 95 percent upper confidence limit on the true mean, and so these three compounds were retained as Site COPCs.

Based on this multi-step analysis of Site analytical data, preliminary screening, evaluation of complete pathways, and statistical analysis for compliance, the Site COPCs for each upland media were established, as summarized in Table 6.6.

6.2.8 Step #10: Establish Key Site COPCs

Under MTCA, for a site that is contaminated with a large number of hazardous substances, hazardous substances that contribute only a small percentage of the overall threat to human health and environment can be eliminated when defining cleanup requirements, and the remaining hazardous substances shall serve as indicator hazardous substances (WAC 173-340-703(1)). In order to focus discussion on the nature and extent of contamination at the Site, Key Site COPCs were identified. Although the selection process mirrors the process for selecting indicator hazardous substances under MTCA, no COPCs for the Site are being eliminated for consideration of cleanup requirements at this stage.

Key Site COPCs were selected for each chemical class of analytes based on multiple criteria, including

- the frequence of detections, frequency of exceedances of the Proposed RI CULs, and ratio of the maximum detected concentration relative to its Proposed RI CUL (the exceedance factor [EF]);
- collocation with other COPCs from that analyte class; and
- chemical characteristics that affect contaminant fate and transport.

Summary statistics for each Site COPC are presented by media for groundwater (Table I.5.A), vadose soil (Table I.5.B), saturated soil (Table I.5.C), soil gas (Table I.5.D), and indoor air (Table I.5.E).

COPCs that exhibited relatively high magnitude and frequency of exceedances and high mobility compared to other COPCs in the same chemical class, and which were generally colocated with other COPCs in the same chemical class, were selected as Key Site COPCs. Based on the criteria above, the following COPCs were selected as the Key Site COPCs for each chemical class:

- Metals: copper, mercury, nickel, and TBT
- PCBs: total PCBs (measured as Aroclors)
- Dioxins/Furans: total dioxin/furan TEQ
- PAHs: total cPAH TEQ
- SVOCs: BEHP

- Pesticides and Herbicides: aldrin, dieldrin, and 4,4'-DDE
- TPH: diesel and oil extended-range TPH (TPH-D+O)
- VOCs: PCE

The Key Site COPCs are used to focus the data presentation (analytical data figures) and narrative discussion of COPC nature and extents in Section 7 below. However, the occurrence and nature of all Site COPCs are also discussed in Section 7.

6.2.9 Consideration of Urban Background Concentrations

The Section 7 evaluation of COPC nature and extent also considers concentrations of COPCs that are ubiquitous and persistent in urban environments and may be considered "urban background" or "area background" as opposed to Site-derived. These urban background concentrations provide important context when assessing the relative magnitude of concentrations of Site COPCs in soil and groundwater at the Site; however, they are not used in the development of the RI SLs or Proposed RI CULs.

6.2.9.1 Urban Background Soil Concentrations

In 2011, Ecology conducted extensive sampling of surface soils throughout Seattle, including South Park, for PAHs and dioxins/furans (Ecology, 2011). The stated purpose of the investigation was to "…collect sufficient data from various Seattle neighborhoods in support of determining the range and magnitude of concentrations and toxic equivalents (TEQs) of dioxins and furans in surface soils in the Seattle urban area." The investigation included collection of 120 composite soil samples from residential properties in six neighborhoods with the objective of chemically characterizing soils representative of residential properties throughout the city. Twenty of these citywide soil samples were collected in the South Park neighborhood.

PAHs

Based on the Seattle citywide 120-sample dataset, Ecology (2011) determined that the 50th percentile (median) and 90th percentile total cPAH TEQ soil concentrations were 0.084 and 0.39 mg/kg, respectively. The 90th percentile is greater than four times the 50th percentile (or 0.34 mg/kg); therefore, the latter (0.34 mg/kg) could represent a background total cPAH TEQ concentration for Seattle soils in accordance with MTCA (WAC 173-340-709(3)). Twenty of the soil samples were collected in the South Park neighborhood of Seattle, and the 50th percentile (median) and 90th percentile total cPAH TEQ soil concentrations were 0.081 and 0.18 mg/kg, respectively. Since the upper 90th percentile is less than four times the 50th percentile (or 0.324 mg/kg), the former (0.18 mg/kg) could represent the background total cPAH TEQ concentration measured in the South Park neighborhood.

Assumed background total cPAH concentrations for Seattle citywide (0.34 mg/kg) and the South Park neighborhood (0.18 mg/kg) as evaluated from Ecology (2011) are considered, for context, when discussing nature and extent of these Key COPCs in Section 7.

Dioxins/Furans

Based on the Seattle citywide 120-sample dataset, Ecology (2011) determined that the 50th percentile (median) and 90th percentile total dioxin/furan TEQ concentrations were 1.2 x 10^{-5} mg/kg and 4.6 x 10^{-5} mg/kg, respectively. Four times the 50th percentile (or 4.8 x 10^{-5} mg/kg) is greater than the 90th percentile; therefore, the latter (4.6 x 10^{-5} mg/kg) could represent a background total dioxin/furan TEQ concentration for Seattle soils in accordance with MTCA (WAC 173-340-709(3)(c)). Twenty of the soil samples were collected in the South Park neighborhood of Seattle, and the 50th percentile (median) and 90th percentile total dioxin/furan TEQ soil concentrations were 1.2 x 10^{-5} mg/kg and 1.9 x 10^{-5} mg/kg, respectively. Since the upper 90th percentile is less than four times the 50th percentile (or 4.8 x 10^{-5} mg/kg), the former (1.9 x 10^{-5} mg/kg) could represent the background total dioxin/furan TEQ concentration measured in the South Park neighborhood.

Assumed background total dioxin/furan concentrations for Seattle citywide (4.6 x 10^{-5} mg/kg) and the South Park neighborhood (1.9 x 10^{-5} mg/kg) as evaluated from Ecology (2011) are considered, for context, when discussing nature and extent of these Key COPCs in Section 7.

6.2.9.2 Urban Background Groundwater Concentrations

Several Site COPCs are ubiquitous urban contaminants. For example, copper is commonly found at elevated levels in the urban environment, with contributions to urban watersheds from brake dust and tires, and common home and garden products. Some of these may not have established urban background concentrations in groundwater, but such data does exist for other media, such as stormwater. A 2015 study by Ecology (2015b) measured concentrations of select chemicals in western Washington as part of regional baseline characterization of stormwater; these concentrations are presented below for Site Key COPCs for which background sources are discussed in Section 7.

Copper

The Ecology study (2015b) determined that total copper concentrations ranged from 0.400 to 218 ug/L in stormwater, with a median concentration of 10.4 ug/L. This median concentration is used in Section 7 to provide additional context in assessing the nature and extents of Site COPCs.

BEHP

The Ecology study (2015b) determined that BEHP concentrations ranged from 0.150 to 41.4 ug/L in stormwater, with a median concentration of 0.977 ug/L. This median concentration is used in Section 7 to provide additional context in assessing the nature and extents of Site COPCs.

7 Nature and Extent of Site COPCs

This section describes the occurrence of Site COPCs in soil, groundwater, soil gas, and indoor air.[59] Data for Site COPCs in sediment adjacent to the SPM Property are also provided for context with the upland data and evaluation of transport pathways (see Section 8). The discussion is organized by analyte group and then by the following Site Areas, based on historical and/or current uses and general characteristics of contaminant occurrences:

- **South Area.** This area comprises the Former A&B Barrel Pond, former A&B Barrel Co. building, former and current marina structures, including structures used for boat storage and woodworking activities that were destroyed in the 2021 fire, and areas used for former and current boat storage and maintenance. The Pond Area is a subarea of the South Area which includes the Former A&B Barrel Pond and immediate environs.
- **Northwest Area**. This area comprises the footprint and surroundings of a former fueling station and radiator shop that is currently occupied by a repair shop and tire warehouse.
- **Central Area.** This area comprises the remainder of the SPM Property, and includes areas used for former and current boat storage and maintenance, boat washing, marina operations, and an area formerly used for boat manufacturing.

These areas are shown on Figure 7.0 and each of the figures referenced in this section. On these figures, portions of the cleanup actions on adjacent sites (T-117 Sediment Removal Area, T-117 Upland Removal Area, T-117 Adjacent Streets and Yards Removal Area, and independent cleanup actions performed by SPU) are also shown for context (see Section 2.4.2 for additional details on those actions). Data collected in support of cleanup actions on adjacent sites are provided in Appendices A.13 through A.20.

Occurrences of Site COPCs in soil, groundwater, and vapor (soil gas and indoor air) are described for each Site Area. Following the discussion of Site Areas, sediment data adjacent to the SPM Property within and adjacent to the Marina Basin (see Section 6.1) is presented and discussed for Site COPCs that were detected above Selected Sediment SLs. A summary of the nature and extent of contamination at the Site is provided in each subsection by analyte group.

For each analyte group, the supporting figures display the data for Key Site COPCs identified in Section 6, and additional figures are also provided that identify locations where Non-Key Site COPCs were detected above Proposed RI CULs. Data for all Site COPCs are presented and discussed in the text.

Groundwater data from historical wells MW-01, MW-02, and MW-03, which is more than 15 years old (see Section 4.1.2), has been retained as suitable for identifying Site COPCs and historical occurrences of contaminants and is included on tables and figures

[59] The discussion of COPCs in soil gas and indoor air is limited to volatile COPCs (gasoline-range organics and VOCs).

for completeness; however, the data collected from wells installed and sampled during the RI is considered more representative of current Site conditions.

At a particular location shown on a supporting figure, multiple samples may have been collected (e.g., at different depth intervals for soil, or on different sampling dates for groundwater). In this case, the supporting figures display the maximum concentration detected at a particular location, or the maximum reporting limit, if there were no detections for a given analyte. The maximum reporting limits at some locations for some analytes—in particular, for cPAHs, some SVOCs, such as BEHP; and pesticides—were above the Proposed RI CULs. As discussed in Section 6.2.4, for the purposes of the RI, PQLs were conservatively set to the target laboratory reporting limit identified in the RIWP Addendum; however, due to sample and laboratory variability, the target reporting limit was not always reached. In many instances, other samples at a particular location were able to achieve target reporting limits, and in all cases, the best available reporting limit for a particular sample using standard laboratory methods was obtained. Therefore, elevated reporting limits are not considered a data gap for the RI.

Data for all COPCs, compared to Proposed RI CULs, is provided in Table 6.7 (groundwater), Table 6.8 (vadose soil60), Table 6.9 (saturated soil), Table 6.10 (soil gas), and Table 6.11 (indoor air). Soil and groundwater data for Site COPCs in these tables are grouped by Site Area for ease of reference. The occurrence of Key COPCs Site-wide compared to Proposed RI CULs for vadose soil, saturated soil, Fill Unit groundwater, and Alluvial Unit groundwater is shown on Figures 7.1.A through 7.8.G. Concentration ranges displayed on soil and groundwater data figures are based on the Proposed RI CUL and other potentially applicable pathway-specific SLs (e.g., human direct contact)61 to assist the exposure pathway discussion provided in Section 8. Multiples of the Proposed RI CUL are included on the figures if there is not an available pathway-specific SL greater than the Proposed RI CUL that provides a useful range of concentrations. For purposes of this report, the term “exceedance” means a detected concentration greater than a Proposed RI CUL (for soil and groundwater) or Selected Sediment SL (for sediment), unless otherwise referenced to a specific pathway-specific screening level.

7.1 Metals

Site COPCs include the following metals: arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, selenium, TBT, and zinc.[62] Copper, mercury, nickel, and TBT were identified as Key Site COPCs in Section 6.2.8 as the most widespread metals exceeding

[60] For simplicity, samples for which the bottom was less than 6 feet bgs were identified as vadose zone soil samples (see Section 6.2.2.2), based on the minimum depth to groundwater at the Site. This is a conservative assumption since the depth to groundwater is usually greater than 6 feet, and saturated zone SLs are equal to or less than vadose SLs.

[61] Not all potentially applicable screening levels are shown on the figures, particularly when screening levels for different pathways are similar and do not provide a sufficient range of concentrations to be meaningful to this discussion.

[62] Sampling for barium and selenium, which were not identified as COPCs in the RIWP, was limited to a few samples for IDW waste characterization purposes. Those samples exceeded potential CULs for barium and selenium and were therefore retained as COPCs. Based on the levels observed and colocated contamination, it is not expected that the distribution of these contaminants will affect the Site boundary or the evaluation of remedial alternatives in the FS. Because of the limited dataset for these compounds, they are not included in the discussion of COPC extent in this section.

Proposed RI CULs in soil and groundwater and, particularly in the case of nickel, based on its high concentrations detected in shoreline groundwater. Key Metal COPCs mercury and TBT, which were selected as Key COPCs based on their occurrence in soil, were not detected in groundwater at concentrations exceeding their respective Proposed RI CULs.

The distribution of Key Metal COPCs in vadose zone soil is shown on Figures 7.1.A through 7.1.D, and the distribution in saturated zone soil is shown on Figures 7.1.E through 7.1.H for copper, nickel, mercury, and TBT, respectively. The vertical distributions of Key Metal COPCs in soil in the Pond Area[63] are shown on Figures 7.1.I (copper), 7.1.J (nickel), 7.1.K (mercury), and 7.1.L (TBT). The approximate depths for the tops of stratigraphic units (Tidal Flat, Alluvial, and Glacial Till Units), the contact between vadose zone and saturated zone sample intervals, and the Proposed RI CUL for each COPC are also shown on Figures 7.1.I, 7.1.J, 7.1.K, and 7.1.L for reference. Locations where Non-Key Metal COPC concentrations exceeded Proposed RI CULs in vadose and saturated soil, but Key Metal COPCs did not, are shown on Figure 7.1.M.

The distribution of Key Metal COPCs is shown on Figures 7.1.N through 7.1.Q (Fill Unit groundwater) and Figures 7.1.R through 7.1.U (Alluvial Unit groundwater) for copper, nickel, mercury, and TBT, respectively. Mercury (Figures 7.1.P and 7.1.T) and TBT (Figures 7.1.Q and 7.1.U) were not detected in groundwater. Locations where Non-Key Metal COPC concentrations exceeded Proposed RI CULs in Fill and Alluvial Unit groundwater, but Key Metal COPCs did not, are shown on Figure 7.1.V.

Table J.1 contains summary statistics for metal COPCs by Site Area and media. Occurrences of metals by Site Area are described below.

7.1.1 Metals in the South Area

Soil. A total of 83 soil samples (40 vadose zone, 43 saturated zone) collected from 36 locations in the South Area were analyzed for metals (non-organic), and 64 soil samples (26 vadose zone, 38 saturated zone) collected from 17 locations in the South Area were analyzed for TBT. All metal COPCs were detected in soil above Proposed RI CULs in at least one sample in the South Area. The highest concentrations of metals were generally detected in the Pond Area[64] and west of the Pond Area at borings SB-37, SB-38, and SB-39. Maximum detected concentrations and the frequency of metals exceeding Proposed RI CULs in soil are summarized below.

Analyte	Proposed RI CUL (mg/kg)	Frequency of Exceedance	Maximum Detected Concentration				
			Conc. (mg/kg)	EF	Location	Depth (ft bgs)	Geologic Unit
Vadose Zone Soil							
Arsenic	7.3	21%	20.7	2.8	MW-05	0 - 1	Fill
Cadmium	5.1	21%	115	23	SB-37	1 - 2	Fill

[63] Vertical distribution plots use data from borings MW-04, -04D, -05, -05D and SB-13, -14, -26, -42, and -43, each of which has two or more depth-discrete soil samples; not all analytes were sampled for at each boring.

[64] As described in Section 2.2.1, the footprint of the Former A&B Barrel Pond is approximate, based on one historical aerial photograph and fill material observations in soil borings.

Analyte	Proposed RI CUL (mg/kg)	Frequency of Exceedance	Maximum Detected Concentration				
			Conc. (mg/kg)	EF	Location	Depth (ft bgs)	Geologic Unit
Chromium	67	36%	615	9.2	SB-39	5 - 6	Fill
Copper	36	52%	2,470	69	SB-26	0 - 1	Fill
Lead	120	64%	4,640	39	SB-38	0 - 1	Fill
Mercury	0.41	49%	29.5	72	SB-11	2.5 - 2.75	Fill
Nickel	48	3%	441	9.2	SB-39	5 - 6	Fill
Zinc	100	67%	41,800	418	SB-37	0 - 1	Fill
TBT	0.0039	35%	0.874	224	SB-39	5 - 6	Fill
Saturated Zone Soil							
Arsenic	7.3	9%	29.3	4	MW-04	10.5 - 11.5	Tidal Flat
Chromium	67	2%	77.3	1.1	MW-05	6 - 7	Fill
Copper	36	10%	209	5.8	SB-42	10 - 11	Tidal Flat
Lead	120	9%	586	4.9	MW-05	6 -7	Fill
Mercury	0.41	5%	3.5	8.5	SB-42	10 - 11	Tidal Flat
Nickel	48	3%	58.4	1.2	MW-05	26.5 - 28	Till
Zinc	85	17%	418	4.9	MW-05	6 -7	Fill
TBT	0.0039	11%	0.126	32	SB-42	10 - 11	Tidal Flat

Metals concentrations were generally greatest in vadose zone soil and lesser, with fewer and lower magnitude of exceedances, in the saturated zone. In the vadose zone, copper, mercury, and TBT concentrations exceeding the Proposed RI CULs (36 mg/kg, 0.41 mg/kg, and 0.0039 mg/kg, respectively) were detected across the South Area (see Figures 7.1.A, 7.1.C, and 7.1.D), whereas nickel exceeded the Proposed RI CUL of 48 mg/kg in only one sample (Figure 7.1.B).

In the saturated zone, all detected concentrations of metal COPCs exceeding Proposed RI CULs were within the Pond Area except for two samples: copper (56 mg/kg, EF = 1.6) at a depth of 9 feet at SB-02 (Figure 7.1.E), and arsenic (8.7 mg/kg, EF = 1.2) at a depth of 8 feet at SB-05, both of which are located north of the Pond Area.

Outside the Pond Area, the vertical extent of metals contamination in soil is generally limited to the upper 6 feet. In the Pond Area, the maximum depth of metals exceeding Proposed RI CULs was at MW-04, with copper (37.9 mg/kg), lead (166 mg/kg), and mercury (0.422 mg/kg) detected at a depth of 13.5 to 14.5 feet, and at MW-04D, with zinc (93.5 mg/kg) detected at a depth of 14 to 15 feet.[65] The highest concentrations in the Pond Area generally occur in the upper 2 feet of soil (Figures 7.1.I, 7.1.J, 7.1.K, and 7.1.L).

All locations in the South Area where at least one metal COPC was detected at a concentration exceeding Proposed RI CULs in one or more samples also included a

[65] Exceedances of nickel (58.4 mg/kg, compared to a Proposed RI CUL of 48 mg/kg) and TBT (0.026 mg/kg, compared to a Proposed RI CUL of 0.0039 mg/kg) were detected at MW-05 in the 26.5- to 28-foot depth interval; however, cross-contamination was suspected since the only other intervals at this location with exceedances were the 6- to7-foot and 8- to 9.5-foot intervals, with samples below the Proposed RI CUL collected at 10 to 11 feet bgs, 13 to 14 feet, bgs, 15 to 16 feet bgs, and 20 to 22.5 feet bgs. This location was re-occupied in Phase 2 at MW-05D, with a sample collected at 26 to 27 feet bgs in which no exceedances were detected.

sample with a Key Metal COPC (copper, mercury, nickel, or TBT) exceedance, with the following exceptions:

- SB-05: a sample contained arsenic (8.7 mg/kg, EF = 1.2) at 8 to 9 feet bgs.
- SB-13: a sample contained zinc (122 mg/kg, EF = 1.4) at 7 to 7.5 feet bgs.
- SB-14: a sample contained lead (198 mg/kg, EF = 1.6) and zinc (118 mg/kg, EF = 1.2) at 3 to 3.5 feet bgs.
- SB-37:
  - A sample contained chromium (246 mg/kg, EF = 3.7), lead (916 mg/kg, EF = 7.6), and zinc (175 mg/kg, EF = 1.8) at 0 to 1 foot bgs.
  - A sample contained arsenic (14.2 mg/kg, EF = 1.9), cadmium (115 mg/kg, EF = 23), chromium (212 mg/kg, EF = 3.2), lead (637 mg/kg, EF = 5.3), and zinc (41,800 mg/kg, EF = 420) at 1 to 2 feet bgs.

These locations are shown on Figure 7.1.M. SB-13 and SB-14 are located in the Pond Area and are within the area of copper and nickel exceedances. The concentration of arsenic at SB-05 is below the MTCA Method A cleanup level for unrestricted land use (20 mg/kg) for arsenic. SB-37 is in the South Area and is within the area of copper and nickel exceedances at SB-35, SB-38, and SB-39. SB-37 is bordered to the north by SB-08, where no metals exceeded the Proposed RI CULs in soil samples.

Groundwater. A total of 19 groundwater samples (8 Fill Unit, 11 Alluvial Unit) collected from 11 wells (4 Fill Unit, 7 Alluvial Unit) in the South Area (predominantly in the Pond Area) were analyzed for metals. Arsenic, chromium, copper, nickel, and zinc were detected in Pond Area groundwater above Proposed RI CULs. Maximum detected concentrations and the frequency of metals exceeding Proposed RI CULs in groundwater are summarized below.

Analyte	Proposed RI CUL (ug/L)	Frequency of Exceedance	Maximum Detected Concentration			
			Conc. (ug/L)	EF	Location	Date
Fill Groundwater Unit						
Arsenic, Total	8	13%	14.8	1.9	MW-06	10/26/22
Arsenic, Dissolved	8	11%	14.2	1.8	MW-06	10/26/22
Chromium, Total	27	11%	33.5	1.2	MW-06	10/26/22
Chromium, Dissolved	27	0%	16.4	0.6	MW-06	10/26/22
Copper, Total	3.1	33%	17.6	5.7	MW-06	10/26/22
Copper, Dissolved	3.1	33%	16.3	5.3	MW-06	10/26/22
Nickel, Total	8.2	56%	158	19	MW-06	10/26/22
Nickel, Dissolved	8.2	56%	149	18	MW-06	10/26/22
Zinc, Total	81	22%	1830	23	MW-05	03/31/21
Zinc, Dissolved	81	11%	1490	18	MW-05	03/31/21
Alluvial Groundwater Unit						
Arsenic, Total	8	10%	8.07	1	MW-02	10/09/07
Arsenic, Dissolved	8	13%	8.08	1	MW-02	10/09/07
Chromium, Total	27	10%	40.4	1.5	MW-02	10/09/07
Chromium, Dissolved	27	0%	25.2	0.9	MW-02	10/09/07
Copper, Total	3.1	80%	9.83	3.2	MW-03	03/12/08
Copper, Dissolved	3.1	75%	6.27	2	MW-02	10/09/07
Nickel, Total	8.2	50%	53.7	6.6	MW-16D	10/26/22
Nickel, Dissolved	8.2	50%	56.6	6.9	MW-16D	10/26/22

Concentrations of metals COPCs exceeding Proposed RI CULs in groundwater in the South Area are summarized as follows:

- In the Fill Unit:
  - The highest concentrations[66] of arsenic (14.8 ug/L, EF = 1.9), chromium (33.5 ug/L, EF = 1.2), copper (17.6 ug/L, EF = 5.7), and nickel (158 ug/L, EF = 19) were detected in samples from MW-06, during the October 2022 sampling event. Concentrations of these analytes were much lower during both the March 2021 and March 2023 sampling events, with only copper (3.78 ug/L, EF = 1.2) exceeding Proposed RI CULs in March 2023, and no exceedances detected in March 2021.[67]
  - The highest concentration of zinc (1,830 ug/L, EF = 23) was detected in samples from MW-05 during the March 2021 event. Zinc did not exceed the Proposed RI CUL in samples from MW-05 in the subsequent sampling events (October 2022 and March 2023).

[66] Maximum concentrations of metals in groundwater referenced in this section are generally the highest of total and dissolved concentrations, unless otherwise noted.
[67] MW-06 is a shoreline well; variability in groundwater chemistry, particularly metals concentrations, was observed in a number of shoreline wells, likely due to a combination of seasonal and tidal variability and salinity effects, as discussed in Section 7.1.2.

  - Copper and nickel exhibited the most widespread exceedances, with copper concentrations exceeding the Proposed RI CUL in samples from wells at the east (MW-06) and west (MW-16) edges of the Pond Area (Figure 7.1.J) and nickel concentrations exceeding Proposed RI CULs in samples from wells within (MW-05 and MW-05D) and at the east edge (MW-06) of the Pond Area (Figure 7.1.I).

- In the Alluvial Unit:
  - Metals concentrations were lower, and exceedances were less widespread than in the Fill Unit. During the RI field investigation,[68] only nickel and copper were detected above Proposed RI CULs, with the highest concentrations of total nickel (53.7 ug/L, EF = 6.5) and copper (4.04 ug/L, EF = 1.3) detected in samples from MW-16D. Exceedances were also identified in samples from MW-04D (20 ug/L nickel, EF = 2.4) and MW-06D (3.76 ug/L copper, EF = 1.2); no exceedances were detected in samples from MW-05D.
  - Copper was also detected (3.32 ug/L, EF = 1.1) slightly above the Proposed RI CUL in samples from MW-18D, located along the upgradient (western) edge of the SPM Property (Figure 7.1.R). Copper is a ubiquitous urban contaminant, with contributions to urban watersheds from brake dust and common home and garden products (Ecology, 2015b), and the concentration detected in the sample from upgradient MW-18D may be attributable to urban background conditions.

In general, exceedances of metal COPCs in the South Area are less extensive in groundwater than in soil. No exceedances of cadmium, lead, mercury, or TBT were detected in groundwater in the South Area, and exceedances of other metals in groundwater were generally sporadic and limited to the Pond Area, consistent with the low mobility of most metals.

Nickel was identified as a Key Site COPC based largely on its frequency and magnitude of exceedance in groundwater samples from multiple shoreline wells. This includes samples from shoreline well MW-06 (maximum EF = 19) in the South Area. It is uncertain why higher nickel concentrations were detected in Fill Unit groundwater samples from MW-06 than at inland wells in the South Area, particularly given there are very few soil nickel exceedances detected in the South Area (see Figures 7.1.B and 7.1.F). However, this same pattern was observed at a site with similar dredge fill soils on the Puget Sound shoreline in Everett, Washington. At that site, a possible cause for elevated nickel in shoreline groundwater was postulated, based on literature review, as a release of nickel from oxidation of naturally occurring, nickel-containing sulfide minerals within highly mixed transitional-zone groundwater (Aspect, 2022a). The potential for oxidizing conditions in the South Area is suggested by higher dissolved oxygen measured in groundwater at shoreline well MW-06 (5.3 to 10.5 mg/L) than in groundwater at Fill

[68] Chromium was detected above the Proposed RI CUL at well MW-02 in 2007; however, due to the age of that data, it is not considered representative of current conditions.

Unit wells just inland of it (maximums of 1.9 mg/L at MW-4 and 0.84 mg/L at MW-05; Table 6.7).

7.1.2 Metals in the Central Area

Soil. A total of 62 soil samples (39 vadose zone, 23 saturated zone) collected from 27 locations in the Central Area were analyzed for metals (non-organic), and 52 soil samples (38 vadose zone, 14 saturated zone) collected from 23 locations in the Central Area were analyzed for TBT. Maximum detected concentrations and the frequency of metals exceeding Proposed RI CULs in soil are summarized below.

Analyte	Proposed RI CUL (mg/kg)	Frequency of Exceedance	Maximum Detected Concentration				
			Conc. (mg/kg)	EF	Location	Depth (ft bgs)	Geologic Unit
Vadose Zone Soil							
Arsenic	7.3	13%	27.4	3.8	MW-14	0 - 1	Fill
Copper	36	36%	292	8.1	MW-14	0 - 1	Fill
Lead	120	13%	384	3.2	MW-17	0 - 1	Fill
Nickel	48	3%	52	1.1	MW-14	0 - 1	Fill
Zinc	86	21%	287	3.3	MW-17	0 - 1	Fill
TBT	0.0039	39%	1.12	287	SB-27	0 - 1	Fill
Saturated Zone Soil							
Chromium	67	4%	69.2	1.0	SB-27	8 -9	Alluvial
Copper	36	9%	53.5	1.5	MW-11D	10 - 11	Fill
TBT	0.0039	7%	0.01	2.6	SB-27	8 - 9	Alluvial

Most exceedances in the vadose zone were in the surface-soil interval (0- to 1-foot depth), except for the following:

- HA-03: a sample contained copper (47 mg/kg, EF = 1.3) and TBT (0.0274 mg/kg, EF = 7) at 2 to 3 feet bgs.
- HA-05: a sample contained TBT (0.00786 mg/kg, EF = 1.9) at 2 to 3 feet bgs.
- HA-07: a sample contained TBT (0.0333 mg/kg, EF = 8.5) at 2 to 3 feet bgs.
- MW-11D: a sample contained copper (47.7 mg/kg, EF = 1.3) at 5 to 6 feet bgs.
- MW-12: a sample contained arsenic (10. 3 mg/kg, EF = 1.4), copper (88.1 mg/kg, EF = 2.4), lead (332 mg/kg, EF = 2.8), and zinc (134 mg/kg, EF = 1.3) at 5 to 6 feet bgs.
- SB-33: a sample contained TBT (0.00567 mg/kg, EF = 1.5) at 3 to 5 feet bgs.

In the vadose zone, copper and TBT concentrations exceeded the Proposed RI CUL in samples across the Central Area (Figures 7.1.A and 7.1.D), whereas nickel (Figure 7.1.B) exceeded the Proposed RI CUL at only one location (MW-14) and mercury did not exceed the Proposed RI CUL (Figure 7.1.C).

In the saturated zone, metals concentrations in two samples exceeded Proposed RI CULs:

- At SB-27, chromium (69.2 mg/kg, EF = 1.0), copper (38.2 mg/kg, EF = 1.1), and TBT (0.01 mg/kg, EF = 2.6) were detected at 8 to 9 feet bgs, located at the top of the Alluvial Unit below the Fill Unit (the Tidal Flat Unit was not observed at this location).
- At MW-11D, copper (53.5 mg/kg, EF = 1.5) was detected at 10 to 11 feet bgs (see Figure 7.1.E), located at the bottom of the Fill Unit above the Tidal Flat Unit.

The vertical extent of metals contamination in soil in the Central Area, based on the available data, is limited to the upper 11 feet, and less than 3 feet at most locations tested.

All locations in the Central Area where at least one metal COPC was detected at a concentration exceeding Proposed RI CULs in one or more samples also included a sample with a Key Metal COPC exceedance, except for one location (see Figure 7.1.M):

- SB-34: a sample contained zinc (106 mg/kg, EF = 1.1), at 0 to 1 foot bgs.

Groundwater. A total of 31 groundwater samples (23 Fill Unit, 8 Alluvial Unit) collected from 15 wells (9 Fill Unit, 6 Alluvial Unit) in the Central Area were analyzed for metals. Arsenic, chromium, copper, and nickel exceeded Proposed RI CULs in at least one sample. Maximum detected concentrations and the frequency of metals exceeding Proposed RI CULs in groundwater are summarized below.

Analyte	Proposed RI CUL (ug/L)	Frequency of Exceedance	Maximum Detected Concentration			
			Conc. (ug/L)	EF	Location	Date
Fill Groundwater Unit						
Arsenic, Total	8	16%	16.7	2.1	MW-11	10/27/22
Arsenic, Dissolved	8	27%	22.4	2.8	MW-10	10/27/22
Chromium, Total	27	18%	5760	210	MW-10	03/22/23
Chromium, Dissolved	27	5%	28.6	1.1	MW-10	10/31/22
Copper, Total	3.1	77%	18.8	6.1	MW-10	03/22/23
Copper, Dissolved	3.1	68%	35.5	11	MW-10	10/27/22
Nickel, Dissolved	8.2	32%	206	25	MW-10	10/27/22
Nickel, Total	8.2	32%	207	25	MW-10	10/27/22
Alluvial Groundwater Unit						
Chromium, Total	27	11%	27.3	1.0	MW-01	03/12/08
Chromium, Dissolved	27	--	1.61	0.1	MW-01	10/09/07
Copper, Total	3.1	56%	6.63	2.1	MW-01	03/12/08
Copper, Dissolved	3.1	50%	5.91	1.9	MW-19D	10/27/22

Concentrations of metals exceeding Proposed RI CULs in the Fill Unit were as follows:

- **Arsenic.** Arsenic was detected in the Fill Unit above the Proposed RI CUL of 8 ug/L in two samples (MW-07 [15.6 ug/L, EF = 2.0] and MW-11 [17.6 ug/L, EF = 2.1]) in October 2022. Arsenic was not detected in samples from these wells in March 2023.

- **Chromium.** Chromium was detected above the Proposed RI CUL of 27 ug/L in samples from two Fill Unit wells (MW-10 and MW-11) in October 2022 and March 2023. Chromium concentrations in samples from these wells were highly variable, ranging from non-detect (0.2 U) to 5,760 ug/L (EF = 213) at MW-10 and from 0.596 ug/L to 88 ug/L (EFs = 0.2 to 3.3) at MW-11 over three events.

- **Copper.** Copper exceeded the Proposed RI CUL of 3.1 ug/L in at least one sample from most Fill Unit wells, as shown on Figure 7.1.N. The maximum concentration of copper detected in the Fill Unit was 35.5 ug/L (EF = 11.5) in the October 2022 sample from at MW-10.

- **Nickel.** Nickel exceeded the Proposed RI CUL of 8.2 ug/L in samples from four wells in the Fill Unit (MW-08, MW-09, MW-10, and MW-11) as shown on Figure 7.1.O. Nickel concentrations at these wells were highly variable, ranging from 4.67 to 131 ug/L (EFs = 0.57 to 16) at MW-07, 0.272 to 23.9 ug/L (EFs = 0.3 to 2.9) at MW-08, 9.25 to 207 ug/L (EFs = 1.1 to 25) at MW-10 and from 0.53 ug/L to 12.4 ug/L (EFs = 0.6 to 1.5) at MW-11 over three events. The maximum concentration (207 ug/L [EF = 25] at MW-10) was detected in October 2022.

In the Alluvial Unit, copper was the only metal detected in groundwater samples during the RI field investigation[69] above Proposed RI CULs in the Central Area, but no exceedance was more than two times the Proposed RI CUL:

- MW-11D: 3.32 ug/L (EF = 1.1) in October 2022
- MW-09D: 4.89 ug/L (EF = 1.6) in October 2022
- MW-08D: 3.32 ug/L (EF = 1.1) in October 2022

The metals exceedances reported for samples from shoreline groundwater wells in the Central Area may have been biased high due to analytical interferences created by elevated salinity (see specific conductivities reported in Table 6.7). To evaluate the effect of salinity, analysis for metals in groundwater from shoreline wells exhibiting high salinity (as indicated by specific conductivity greater than 1,000 uS/cm: MW-07, MW-08, MW-09, MW-09D, MW-10, and MW-11) was conducted in March 2023 with and without a reductive precipitation preparation method that reduces salinity interferences. This method resulted in overall lower concentrations compared to analysis without reductive precipitation, as follows:

- Arsenic: Concentrations in samples from MW-07, MW-08, MW-09, MW-09D, MW-10, and MW-11 were non-detect (0.5 U) with reductive precipitation and a maximum of 13.2 ug/L without.

- Chromium:

[69] Chromium was detected above the Proposed RI CUL at well MW-01 in 2007; however, due to the age of that data, it is not considered representative of current conditions.

  - Sample concentrations were generally lower with reductive precipitation vs. standard preparation:
    - MW-07: 0.31 vs. 1.69 ug/L
    - MW-08: 1.13 vs. 1.9 ug/L
    - MW-09: 0.39 vs. 1.6 ug/L
    - MW-10: 0.87 vs 5,760 ug/L[70] (low tide) and 0.2 U vs 1 ug/L (high tide)
  - The chromium concentration in the sample from MW-11 was slightly higher (94.6 vs. 88 ug/L) with reductive precipitation.
  - Chromium concentrations in the sample from MW-09D were non-detect by both methods.

- Copper:
  - Sample concentrations were lower with reductive precipitation vs. standard preparation:
    - MW-07: 2.11 vs. 4.22 ug/L
    - MW-08: 1.14 vs 7.45 ug/L
    - MW-09: 1.26 vs. 2.41 ug/L
    - MW-09D: 1.94 vs. 2.24 ug/L
    - MW-10: 0.1 U vs. 2.42 ug/L
    - MW-11: 3.62 vs. 5.36 ug/L

- Nickel:
  - Sample concentrations were generally lower with reductive precipitation vs. standard preparation:
    - MW-07: 2.5 vs. 5.29 ug/L
    - MW-08: 6.88 vs. 10.7 ug/L
    - MW-09: 2.49 vs 2.85 ug/L
    - MW-09D: 1.19 vs. 1.31 ug/L
    - MW-10: 11.9 vs. 38.2 ug/L (low tide)
  - The nickel concentration in the sample from MW-11 was slightly higher (8.58 vs 7.97 ug/L) with reductive precipitation.

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[70] The low-tide chromium concentration at MW-10 may also have been impacted by turbidity, based on total and dissolved concentrations, as discussed below.

- The nickel concentration in the sample from MW-10 (high tide) was the same by both methods.

Groundwater in the vicinity of all shoreline wells in the Central Area is impacted by elevated salinity. Therefore, it is unknown whether the metals exceedances along the shoreline in October 2022, without reductive precipitation analysis, represent actual exceedances. Nevertheless, although analysis for copper and arsenic without reductive precipitation may have biased data high, exceedances of chromium, copper, and nickel in samples from MW-11 and exceedances of nickel in samples from MW-10 were still detected with reductive precipitation.

Some of the total metals results may also have been affected by turbidity. Several samples exhibited significantly higher total metals compared to dissolved metals concentrations, in particular the March 22, 2023, sample from MW-10 that had a turbidity of 66.7 NTU and chromium concentrations of 5,760 ug/L (total) vs. 15.7 ug/L (dissolved); copper concentrations of 18.8 ug/L (total) vs.4.36 ug/L (dissolved); and nickel concentrations of 38.2 ug/L (total) vs. 11.9 ug/L (dissolved). For high-turbidity samples, dissolved metals concentrations are more representative of mobile metals (i.e., potentially transported in groundwater).

Metals concentrations exhibited significant variability between sampling events in samples from shoreline wells in the Central Area, where groundwater is tidally affected. Dilution from surface water is expected to be greater during higher tide conditions when salinity (as represented in Table 6.7 by specific conductance) is higher. In general, sampling events at shoreline wells targeted low, outgoing tide conditions to represent ‘worst-case’ groundwater discharge conditions. At one well, MW-10, samples were collected at lower-low tide on March 22, 2023, and at high tide on March 24, 2023, to evaluate tidal-stage effects on metals concentrations. Metals concentrations during the high-tide event were generally lower with no exceedances; however, the low-tide sample was likely affected by turbidity as discussed above, and both samples were potentially affected by salinity. Dissolved metals concentrations using reductive precipitation during the two tidal stage samples were slightly lower in the high-tide sample for chromium (0.2 U vs. 0.87 ug/L) and copper (0.1 U vs 0.99 ug/L), and slightly higher for nickel (10.1 vs 9.3 ug/L) and zinc (0.7 vs 0.5 U ug/L).

For the March 2023 low-tide sample from MW-10, the comparison of the total (unfiltered sample) result to the two dissolved (filtered sample) results indicate that the anomalously high total chromium concentration detected was biased high due to suspended solids in the sample, likely because of entraining solids from the well bottom while pumping from the well’s declining saturated thickness as the tide fell. The low tide and high tide samples both represent transitional zone groundwater that will discharge to the LDW. The low-tide sample represents the later stage of groundwater discharge when the discharging groundwater has lower salinity. The high-tide sample represents groundwater about to start discharging, and it has higher salinity. Both samples represent groundwater quality that exists for a short period of time within the tidal cycle, yet the groundwater screening levels are based on long-term (chronic) exposure. Comparing low-tide sample results as if they persist long-term (which is the basis for SLs) is therefore considered a conservative approach to assess compliance for transitional zone groundwater.

7.1.3 Metals in the Northwest Area

Soil. A total of 14 soil samples (9 vadose zone, 5 saturated zone) collected from 6 locations in the Northwest Area were analyzed for metals (non-organic). Copper and zinc exceeded Proposed RI CULs in soil in one sample each, as summarized below.

Analyte	Proposed RI CUL (mg/kg)	Frequency of Exceedance	Maximum Detected Concentration				
			Conc. (mg/kg)	EF	Location	Depth (ft bgs)	Geologic Unit
Vadose Zone Soil							
Copper	36	11%	37.4	1.0	SB-31	0 - 1	Fill
Zinc	100	11%	117	1.2	SB-31	3 - 5	Fill

No other metals concentrations were detected above Proposed RI CULs in vadose soil in the Northwest Area, no metals concentrations were detected above Proposed RI CULs in saturated zone soil, and no Non-Key COPCs exceeded the Proposed RI CULs at locations where Key COPCs did not also exceed the Proposed RI CULs. The maximum vertical extent of metals exceedances in soil in the Northwest Area, based on the available data, is approximately 5 feet.

Groundwater. Five groundwater samples (3 Fill Unit, 2 Alluvial Unit) collected from four wells in the Northwest Area were analyzed for metals. Maximum detected concentrations and the frequency of metals exceeding Proposed RI CULs in groundwater are summarized below.

Analyte	Proposed RI CUL (ug/L)	Frequency of Exceedance	Maximum Detected Concentration			
			Conc. (ug/L)	EF	Location	Date
Fill Groundwater Unit						
Copper, Total	3.1	100%	5.45	1.8	MW-13	10/26/22
Copper, Dissolved	3.1	67%	4.62	1.5	MW-13	10/26/22
Alluvial Groundwater Unit						
Arsenic, Total	8	50%	8.33	1.0	MW-13D	10/26/22
Arsenic, Dissolved	8	50%	8.52	1.1	MW-13D	10/26/22

Arsenic and copper exceeded Proposed RI CULs as follows:

- Arsenic was detected in the Alluvial Unit in the October 2022 sample from MW-13D. Arsenic was not detected above the Proposed RI CUL in any Fill Unit groundwater samples.
- Copper was detected in the Fill Unit in the October 2022 samples from MW-13 and MW-22. Copper was not detected above the Proposed RI CUL in any Alluvial Unit groundwater samples.

No other metals were detected in Northwest Area groundwater above Proposed RI CULs. The arsenic exceedance at MW-13D was the only location where a Non-Key Metal COPC exceeded the Proposed RI CUL, but a Key Metal COPC did not, in Fill or Alluvial Unit groundwater (Figure 7.1.V).

7.1.4 Metals in Adjacent Sediments

Arsenic, mercury, and TBT are the only metals in sediment adjacent to the SPM Property exceeding Selected Sediment SLs (see Appendix H). Therefore, this section discusses the occurrence of arsenic, mercury, and TBT in the adjacent sediments.

Arsenic. The full sediment dataset[71] includes 54 sediment samples (36 surface and 18 subsurface) collected from 48 locations and analyzed for arsenic. There were 19 samples removed from the full sediment dataset based on their age, sediment removal, or being superseded by newer data. The refined dataset includes 35 sediment samples (23 surface and 12 subsurface) analyzed for arsenic.

The comparison of the refined sediment dataset to Selected Sediment SLs is provided in Table H.7. The spatial distribution of arsenic in surface and subsurface samples is provided on Figure H.1. Arsenic occurrences in sediments in the refined dataset adjacent to the SPM Property are summarized as follows:

- **Surface Sediment.** Arsenic exceeded the screening level in 16 of 23 samples. The maximum detected concentration was 20 mg/kg (EF = 2.9).
- **Subsurface Sediment.** Arsenic exceeded the screening level in 10 of 12 samples. The maximum detected concentration was 11 mg/kg (EF = 1.6).

Arsenic exceedances in sediment were located throughout the Marina Basin as well as the 100-foot buffer outside the Marina Basin (Figure H.1). Exceedances of the SCUM natural background level of 11 mg/kg were delineated within the Marina Basin. All detected arsenic concentrations are below the LDW RAL of 57 mg/kg.

Mercury. The full sediment dataset includes 55 sediment samples (33 surface and 22 subsurface) collected from 44 locations and analyzed for mercury. There were 20 samples removed from the full sediment dataset based on their age, sediment removal, or being superseded by newer data. The refined sediment dataset includes 35 sediment samples (19 surface and 16 subsurface) analyzed for mercury.

The comparison of the refined sediment dataset to Selected Sediment SLs is provided in Table H.7. The spatial distribution of mercury in surface and subsurface samples is provided on Figure H.2. Mercury occurrences in sediments adjacent to the SPM Property are summarized as follows:

- **Surface Sediment.** Mercury slightly exceeded the Selected Sediment SL in 1 of 19 samples, outside of the Marina Basin near the navigation channel of the LDW. The maximum detected concentration was 0.42 mg/kg (EF = 1.02).
- **Subsurface Sediment.** Mercury did not exceed the Selected Sediment SL in any of the samples.

No mercury exceedances in sediment were detected within the Marina Basin, as shown on Figure H.2.

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[71] Refer to Section 6.1 for additional details on the development of the full sediment dataset and the refined sediment dataset.

TBT. The full sediment dataset includes 7 sediment samples (5 surface and 2 subsurface) collected from 6 locations and analyzed for TBT. All seven samples were removed from the full sediment dataset based on their age or sediment removal. Because of the lack of TBT data in the refined dataset, the distribution of TBT data in the full dataset is discussed below.

The comparison of the full sediment dataset to Selected Sediment SLs is provided in Table H.6. The spatial distribution of TBT in surface and subsurface samples is provided on Figure H.3. TBT occurrences in sediments adjacent to the SPM Property are summarized as follows:

- **Surface Sediment.** TBT exceeded the Selected Sediment SL in three of five samples, including within and outside of the Marina Basin. The maximum detected concentration (0.019 mg/kg, EF = 9) was located at the edge of the Marina Basin near the navigation channel of the LDW.
- **Subsurface Sediment.** TBT exceeded the Selected Sediment SL in one sample, T117-SC-COMP2 (61-122 cm depth), at a concentration of 0.12 mg/kg (EF = 57). TBT was not detected at the shallower, colocated composite sample T117-SC-COMP3 (0-61 cm depth).

All TBT concentrations were below the dry-weight adjusted RBTC (0.14 mg/kg) for the East Waterway Superfund Site.

7.1.5 Summary of Metals Occurrences

Metal COPCs for the Site include arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, selenium, TBT, and zinc. One or more of these metals exceed Proposed RI CULs in shallow soils across the Site, with the highest concentrations detected in the South Area. All detected metal concentrations in samples from the other Site Areas were less than 10 times the Proposed RI CULs, except for TBT in soil at five locations in the Central Area. Most exceedances of metals in soil outside the South Area were detected in the vadose zone in the Central Area. Metal exceedances in soil deeper than 6 feet are generally limited to the Pond Area. Copper exhibits the most widespread exceedances; exceedances of other metals, particularly outside the South Area, are more localized.

Arsenic, chromium, copper, nickel, and zinc were the only metals detected above Proposed RI CULs in groundwater. Metal exceedances in groundwater were generally limited to samples from Fill Unit wells near the shoreline and in the Pond Area, except for copper, which was more widely distributed. Metal concentrations in samples from wells along the shoreline exhibited significant variability between sampling events and may have been biased high due to turbidity and/or salinity interferences.

The extent of Site COPC metals in soil and groundwater exceeding Proposed RI CULs is generally limited to the SPM Property and has been sufficiently delineated for the purposes of the RI. The RI data bound the extent of metals exceeding Proposed RI CULs to the north and northwest, except for copper in Fill Unit groundwater. However, the magnitudes of copper exceedances are very low (maximum EF < 2), and Fill Unit groundwater appears to not extend to the north or west of the SPM Property based on observations at wells MW-18/18D, MW-20, and MW-21. At these locations, groundwater was not observed in the Fill Unit either due to the lack of the Tidal Flat Unit (at MW-18/18D and MW-20, where the Alluvial Unit was observed as an unconfined aquifer) or due to the Fill Unit being presumably drained by the adjacent bioswale (at MW-21). Therefore, the extents of metals exceeding the Proposed RI CULs in Fill Unit groundwater are bound to the north and west by the physical lack of saturation in these directions.

Metal exceedances in soil along the western and southern property boundaries are bounded because contaminated soil on the adjacent property and ROW were removed under separate cleanup actions (including the independent SPU interim actions and T-117 EAA Adjacent Streets and Yards Removal Area, Section 2.4.2). The maximum vertical extent of metals exceedances at the Site has been bounded and is approximately 15 feet.

Arsenic, mercury, and TBT were the only metals identified in sediments adjacent to the SPM Property above Selected Sediment SLs. Mercury exceedances in sediment were limited to one sample (EF = 1.02) outside of the Marina Basin near the navigation channel of the LDW, and all arsenic exceedances were below the LDW RALs. Arsenic and mercury exceedances in sediment were delineated and are being addressed under the LDW ROD (EPA, 2014). TBT exceeded the Selected Sediment SL (0.0021 mg/kg), which is based on the PQL assuming it is bioaccumulative, but does not exceed the East Waterway Superfund Site RBTC (0.14 mg/kg). The Source Control Evaluation Memorandum and its Addendum (Aspect, 2022c and 2024b) did not identify a concern for recontamination of sediments from metals at the Site under existing conditions. Potential transport pathways between the upland and adjacent sediments are further discussed in Section 8.

7.2 Polychlorinated Biphenyls

PCB occurrences at the Site have been quantified by Aroclor analysis and congener analysis,[72] and Site COPCs include total PCB Aroclors and total PCB congeners. Total Aroclor and total congener concentrations in samples analyzed by both methods are generally similar; the Aroclor dataset is much more extensive (233 soil samples for total PCB Aroclors vs 63 soil samples for total PCB congeners) and nearly all samples analyzed for PCB congeners were also analyzed for PCB Aroclors[73] (except for one soil sample collected from SB-42). All figures showing the occurrence of PCBs in soil and groundwater referenced in this section display Aroclor data, and the discussion of PCB occurrences in soil and groundwater refers to total PCB Aroclors, unless otherwise noted. The distribution of total PCB Aroclors in soil is shown on Figures 7.2.A (vadose zone) and 7.2.B (saturated zone). Figure 7.2.C depicts the vertical distribution of total PCB

[72] In accordance with the RI Work Plan, the extent of contamination was generally characterized using PCB Aroclor analysis. However, a subset of samples was also analyzed for PCB congeners for the purposes of quantifying PCB concentrations in areas where concentrations were below Aroclor method reporting limits, correlation of total PCB concentrations via congener and Aroclor analysis, and for potential source evaluation. Source evaluation via forensic analysis of PCB data was not conducted for this RI Report.

[73] Four groundwater samples for congener analysis were collected 2 months after samples were collected for Aroclor analysis, as the Aroclor data was used to select wells for congener analysis.

Aroclor concentrations in soil in the Pond Area. The distribution of PCB Aroclors in groundwater is shown on Figures 7.2.D (Fill Unit) and 7.2.E (Alluvial Unit).

Table J.2 contains summary statistics for PCB COPCs by Site Area and media. Occurrences of PCBs by Site Area are described below.

7.2.1 PCBs in the South Area

Soil. A total of 127 soil samples (58 vadose zone, 69 saturated zone) collected from 49 locations in the South Area were analyzed for PCB Aroclors. The highest concentrations of total PCB Aroclors were detected in the Pond Area. Maximum detected concentrations and the frequency of total PCB Aroclors exceeding Proposed RI CULs in soil are summarized below.

Analyte	Proposed RI CUL (mg/kg)	Frequency of Exceedance	Maximum Detected Concentration				
			Conc. (mg/kg)	EF	Location	Depth (ft bgs)	Geologic Unit
Vadose Soil							
Total PCB Aroclors	0.036	86%	50	1,400	SB-42	0 - 1	Fill
Saturated Soil							
Total PCB Aroclors	0.036	43%	131	3,600	B-02	6.5 - 7	Fill

Total PCB Aroclor concentrations exceeded the Proposed RI CUL of 0.036 mg/kg in vadose zone soil (based on protection of surface water, adjusted to PQL) throughout the South Area. Total PCB Aroclor exceedances in saturated zone soil were generally limited to the Pond Area, with one exception: a concentration of 0.043 mg/kg (EF = 1.2) was detected in a sample collected from SB-36 at a depth of 10.5 to 11.5 feet bgs, approximately 90 feet west of the Pond Area. Total PCB Aroclor concentrations at or above the TSCA threshold of 50 mg/kg in the South Area were limited to the Pond Area. Total PCB Aroclors were also detected in an LNAPL sample collected from well MW-04 in the Pond Area, at a concentration of 318 mg/kg (estimated value; lab report provided in Appendix G.2.A). See Section 7.4.1 for additional discussion of LNAPL.

The highest concentrations in the Pond Area are present in the vadose zone soils (0 to 6 feet bgs), and concentrations greater than 1 mg/kg are generally restricted to the Fill Unit or the Tidal Flat Unit (Figure 7.2.D). However, exceptions to that generality include samples within the top of the Alluvium Unit at MW-05D (up to 14 feet bgs) and MW-04/MW-04D (up to 17 feet bgs), at the east and south edges, respectively, of the pond footprint. No total PCB Aroclor exceedances were detected in soil greater than 22.5 feet bgs, although cross-contamination is suspected at the 22.5-foot depth sample, and the next deepest detected exceedance was at 17 feet bgs.[74]

[74] Total PCB Aroclors were detected above the Proposed RI CUL in one soil sample at 20 to 22.5 feet bgs, at MW-05. Cross contamination is suspected in this sample, based on the vertical distribution of other COPCs at this boring, the fact that this boring included drilling through heavy sheen and LNAPL, and because PCBs were not detected in samples collected between 18 to 19 feet bgs and 21.5 to 22.5 feet bgs at adjacent boring MW-05D. The variability between MW-05 and MW-05D is unlikely due to soil heterogeneity because the Alluvial Unit in this depth range is relatively homogeneous and beyond the vertical extent of the Pond Fill material.

A total of 22 soil samples (14 vadose zone, 8 saturated zone) collected in the South Area were also analyzed for PCB congeners. Total PCB Aroclor and congener concentrations from the same sample or colocated samples were similar (generally within a factor of 2). Total PCB congener concentrations exceeded the Proposed RI CUL of 0.00018 mg/kg throughout the South Area, including at the western edge of the Property at MW-18D, where total PCB Aroclors were not detected, but total PCB congeners were detected at a concentration of 0.000728 mg/kg (below the total PCB Aroclor reporting limit). All individual PCB congeners were detected in at least one sample in the South Area, except for PCB-080, PCB-127, PCB-159, and PCB-192 (see Tables I.6.B.2 and I.6.C.2).

Groundwater. A total of 17 groundwater samples (9 Fill Unit, 8 Alluvial Unit) collected from 11 wells (4 Fill Unit, 7 Alluvial Unit) in the South Area were analyzed for PCB Aroclors. Maximum detected concentrations and the frequency of total PCB Aroclors exceeding Proposed RI CULs in groundwater are summarized below.

Analyte	Proposed RI CUL (ug/L)	Frequency of Exceedance	Maximum Detected Concentration			
			Conc. (ug/L)	EF	Location	Date
Fill Groundwater Unit						
Total PCB Aroclors	0.0035	78%	17	4,900	MW-05	10/26/22
Alluvial Groundwater Unit						
Total PCB Aroclors	0.0035	25%	0.17	49	MW-16D	10/26/22

Total PCB Aroclor concentrations exceeding the Proposed RI CUL of 0.0035 ug/L in the Fill Unit and Alluvial Unit groundwater are summarized as follows:

- In the Fill Unit, total PCB Aroclor concentrations exceeded the Proposed RI CUL in at least one sample from each of the four Fill Unit wells. All total PCB Aroclor exceedances in the South Area were at locations in the Pond Area. Saturated conditions in the Fill Unit were not observed at MW-18 along the western boundary of the SPM Property (see Section 5.1.2.9).

  At the shoreline well MW-06, total PCB Aroclors were only detected in one of the three samples, and the concentration was an estimated value (J-flagged) and not replicated in two subsequent sampling events. The initial sampling event may have been subject to installation bias[75] and not representative of groundwater conditions, as is suspected at other site wells discussed in Section 7.2.2, or the results could reflect variability from tidal cycles: specific conductivity at MW-06, during the sampling event in which PCBs were detected, was lower than during the other event, indicating that there may have been less dilution from surface water mixing during that event.

- In the Alluvial Unit, total PCB Aroclors were only detected in samples from MW-16D, located on the western (upgradient) side of the Pond Area.

[75] Installation bias refers to the tendency of a groundwater sample collected from a newly installed monitoring well to exhibit higher concentrations than in later monitoring events, possibly due to carry-down during drilling and/or aquifer disturbance from well installation or development.

PCB congeners were analyzed for groundwater samples from two South Area wells, MW-04 and MW-05, both in the Fill Unit, in May 2021. Total PCB congener concentrations were similar to total PCB Aroclor concentrations measured at the same wells 2 months prior:

- MW-04: 0.103 ug/L and 0.153 ug/L for total PCB Aroclors and congeners, respectively
- MW-05: 0.679 ug/L and 0.304 ug/L for total PCB Aroclors and congeners, respectively

Most individual congeners were detected in samples from at least one of these wells, except for PCB-002, PCB-011, PCB-014, PCB-036, PCB-062, PCB-065, PCB-073, PCB-078, PCB-080, PCB-083, PCB-103, PCB-104, PCB-113, PCB-127, PCB-142, PCB-145, PCB-150, PCB-151, PCB-159, PCB-169, PCB-184, PCB-186, PCB-188, PCB-192, PCB-204, and PCB-205 (Table I.6.A.2).

7.2.2 PCBs in the Central Area

Soil. A total of 87 soil samples (61 vadose zone, 26 saturated zone) collected from 55 locations in the Central Area were analyzed for total PCB Aroclors. Maximum detected concentrations and the frequency of total PCB Aroclors exceeding Proposed RI CULs in soil are summarized below.

Analyte	Proposed RI CUL (mg/kg)	Frequency of Exceedance	Maximum Detected Concentration				
			Conc. (mg/kg)	EF	Location	Depth (ft bgs)	Geologic Unit
Vadose Soil							
Total PCB Aroclors	0.036	57%	66	1,800	SS-38	0 - 1	Fill
Saturated Soil							
Total PCB Aroclors	0.036	4%	0.046	1.3	SB-10	14 - 15	Tidal Flat

The highest concentration of total PCB Aroclors, at SS-38, was detected in an area adjacent to Dallas Avenue South in surface soil from 0 to 1 foot bgs at a concentration exceeding the TSCA threshold of 50 mg/kg.

Total PCB Aroclor concentrations exceeded the Proposed RI CUL in vadose zone soil across much of the Central Area (Figure 7.2.A). Other than the area adjacent to Dallas Avenue South noted above, which includes shallow soil samples SS-38, SS-21, and SS-33, concentrations generally did not exceed the direct contact screening level (1 mg/kg), with one exception: a sample concentration of 1.32 mg/kg was detected at SB-40 (0 to 1 foot bgs), located near the southwest corner of the former boat manufacturing building. Total PCB Aroclor exceedances in the vadose zone were generally less than 2 feet in depth, with two exceptions: a concentration of 0.0542 mg/kg (EF = 1.5) was detected from the 3- to 5-foot bgs sample at MW-12 and a concentration of 0.0422 mg/kg (EF = 1.2) was detected from the 3- to 5-foot bgs sample at MW-07.

In the saturated zone (greater than 6 feet bgs), total PCB Aroclors were only detected above the Proposed RI CUL in the 14 feet bgs sample from SB-10, at a concentration of 0.046 mg/kg (EF = 1.3). No other saturated zone sample exceeded the Proposed RI CUL for PCB Aroclors (Figure 7.2.B). In the area exhibiting the highest surface soil concentrations adjacent to Dallas Avenue South, the vertical extent of total PCB Aroclor exceedances near soil sample SS-38 is limited to depths above 12 feet based on the 12-13 feet bgs sample at MW-17, and the vertical extent of total PCB Aroclor exceedances near soil samples SS-21 and SS-33 are limited to depths above 10 feet based on the 10 feet bgs sample at SB-09.

A total of 36 soil samples (34 vadose zone, 2 saturated zone) collected in the Central Area were analyzed for PCB congeners. Total PCB Aroclor and congener concentrations from the same sample or colocated samples were similar (generally within a factor of 3). Total PCB congener concentrations exceeded the Proposed RI CUL of 0.00018 mg/kg in vadose zone soil throughout the Central Area but did not exceed the Proposed RI CUL in saturated soil in the two samples collected (MW-11D at a depth of 11 to 12 feet bgs, and MW-19D at a depth of 10 to 11 feet bgs). Most individual PCB congeners were detected in at least one soil sample in the Central Area, except for PCB-014, PCB-030, PCB-036, PCB-062, PCB-065, PCB-080, PCB-104, PCB-127, PCB-159, and PCB-192 (see Tables I.6.B.2 and I.6.C.2).

Groundwater. A total of 25 groundwater samples (19 Fill Unit, 6 Alluvial Unit) collected from 15 wells in the Central Area were analyzed for total PCB Aroclors. Maximum detected concentrations and the frequency of total PCB Aroclors exceeding Proposed RI CULs in groundwater are summarized below.

Analyte	Proposed RI CUL (ug/L)	Frequency of Exceedance	Maximum Detected Concentration			
			Conc. (ug/L)	EF	Location	Date
Fill Groundwater Unit						
Total PCB Aroclors	0.0035	16%	0.010	2.9	MW-07	03/29/21

Total PCB Aroclor concentrations exceeding the Proposed RI CUL of 0.0035 ug/L in the Fill Unit and Alluvial Unit groundwater are summarized as follows:

- In the Fill Unit, total PCB Aroclors were detected above the Proposed RI CUL in samples from three wells: MW-11 (maximum concentration of 0.006 ug/L [EF = 1.7]), MW-15 (maximum concentration of 0.007 ug/L [EF = 2.0]) and MW-07 (maximum concentration of 0.01 ug/L [EF = 2.9]). However, both these exceedances were only detected in the first sampling round after well installation, and PCBs were not detected at any of these wells in two subsequent sampling events, one of which was conducted in the wet season like the original sampling event. Sample turbidity was also higher during the first sampling event, particularly at MW-07 (143 in first event vs. up to 6.4 NTU in the subsequent two events). Therefore, the exceedances detected in the first sampling event may be a result of installation and/or turbidity bias and may not be representative of groundwater conditions.

- In the Alluvial Unit, total PCB Aroclors were not detected in any groundwater samples.

PCB congeners were analyzed for and detected above the Proposed RI CUL in samples from two Central Area wells, MW-08 (0.00288 ug/L) and MW-15 (0.00119 ug/L), both in the Fill Unit, in May 2021. Total PCB Aroclor concentrations measured at the same wells 2 months prior were not detected at a reporting limit of 0.01 ug/L. Fewer individual congeners were detected at Central Area wells than in South Area wells, which had higher total PCB congener concentrations (refer to Table I.6.A.2 for individual congener data).

7.2.3 PCBs in the Northwest Area

Soil. A total of 16 soil samples (9 vadose zone, 7 saturated zone) collected from 6 locations in the Northwest Area were analyzed for PCB Aroclors. None of the samples exceeded the Proposed RI CUL of 0.036 mg/kg for total PCB Aroclors. The maximum detected concentration of total PCB Aroclors in the Northwest Area was 0.0291 mg/kg in the 0- to 1-foot bgs sample from SB-31.

A total of two soil samples (one vadose zone, one saturated zone) collected in the Northwest Area were analyzed for PCB congeners. Total PCB Aroclor and congener concentrations from the vadose sample (SB-31 at a depth of 0 to 1 foot bgs) were similar (0.0291 and 0.0226 mg/kg, respectively). No PCB Aroclors were detected in the saturated zone sample (MW-22 at a depth of 17.5 to 18.5 feet bgs), and total detected PCB congener concentrations were 0.00000803 mg/kg, below the Proposed RI CUL of 0.00018 mg/kg.

Groundwater. Five groundwater samples (3 Fill Unit, 2 Alluvial Unit) collected from four wells (2 Fill Unit, 2 Alluvial Unit) in the Northwest Area were analyzed for PCBs. PCBs were not detected in any of these five groundwater samples.

7.2.4 PCBs in Adjacent Sediments

The full sediment dataset includes 220 sediment samples (104 surface and 116 subsurface) collected from 159 locations and analyzed for PCB Aroclors. Thirty-nine of those subsurface samples were also analyzed for PCB congeners. There were 61 samples removed from the dataset based on their age, sediment removal, or being superseded by newer data. The refined sediment dataset includes 157 sediment samples (57 surface and 100 subsurface) analyzed for PCB Aroclors, with 39 of the subsurface samples also analyzed for PCB congeners. The frequency of exceedance and maximum concentration were higher for total PCB Aroclors than for total PCB congeners; for simplicity, the discussion below only discusses total PCB Aroclor results.

The comparison of the refined dataset to Selected Sediment SLs is provided in Table H.7 and summarized as follows:

- **Surface Sediment.** Total PCB Aroclors were detected above the Selected Sediment SL (0.002 mg/kg) in 52 of 57 samples. The maximum detected concentration was 0.38 mg/kg (EF = 190). The spatial distribution of PCBs in surface sediments compared to the Selected Sediment SL is shown on Figure H.4.A.

- **Subsurface Sediment.** Total PCB Aroclors exceeded the Selected Sediment SL (0.5 mg/kg) in 3 of 100 samples. The maximum detected concentration was 0.826

mg/kg (EF = 1.7). The spatial distribution of PCBs in subsurface sediments compared to the Selected Sediment SLs is shown on Figure H.4.B.

Distribution of PCB concentrations exceeding the Selected Sediment SL in surface sediment extends throughout and outside of the Marina Basin (Figure H.4.A). However, PCB concentrations in background (upstream) sediment in the LDW also exceed the Selected Sediment SL (see Section 6.1.8). The extent of PCB concentrations in surface sediment exceeding the LDW RALs is displayed on Figure H.4.A.

PCB concentrations exceeding the LDW RAL is limited to a small area in the southwestern portion of the Marina Basin. This area is being addressed as part of the LDW Superfund Site (Upper Reach Sediment Management Area 13; Appendix A.12) and will be remediated as part of the in-water remedial action (Windward and Anchor QEA, 2024). One sample located outside the Marina Basin (SG-07-R2) exceeded the screening level (EF = 2.9); this sample was a compliance sample for the T-117 EAA Sediment Removal (Section 2.4.2.2), located south of the Marina Basin, which was deemed acceptable to leave in place by EPA (AECOM, 2016).

Subsurface sediment PCB exceedances of the Selected Sediment SL are limited in extent and are delineated based on surrounding samples (see Figure H.4.B). The exceedances occurred in samples collected at depths ranging from 150 to 500 cm, well below both the 45 cm point of compliance depth for clamming and the deepest point of compliance listed in the LDW ROD of 60 cm for potential scour areas.

7.2.5 Summary of PCB Occurrences

Total PCB Aroclors exceed the Proposed RI CUL in shallow soils across the Site, with the highest concentrations in the south and southwestern portions of the Site, in the South Area and adjacent to Dallas Avenue South in the Central Area. Total PCB congeners concentrations are similarly distributed, but also exceed the Proposed RI CUL at some locations where PCB Aroclors were not detected due to the lower method reporting limit for congeners. Total PCB Aroclor exceedances in saturated soil are generally limited to the South Area in the Pond Area, as are total PCB Aroclor exceedances in groundwater. Total PCB Aroclor concentrations exceeding the TSCA threshold of 50 mg/kg were detected in soil in the Pond Area and in a portion of the Central Area adjacent to Dallas Avenue South.

Total PCB Aroclors generally do not exceed the Proposed RI CUL in groundwater along the shoreline; the three exceedances (in samples from MW-11, MW-07 and MW-06, maximum EF = 5.7) during the March 2021 sampling event are considered likely biased high and were not replicated in subsequent monitoring events.

The extent of PCBs in soil and groundwater at the Site has been sufficiently delineated for the purposes of the RI. The RI data bound the extent of PCBs exceeding Proposed RI CULs to the north and northwest. Exceedances in soil along the western and southern property boundaries are bounded because contaminated soil on the adjacent property and ROW were removed under a separate cleanup action (independent SPU interim actions and T-117 Adjacent Streets and Yards Removal Area, Section 2.4.2). The maximum vertical extent of PCBs has been bounded and is approximately 17 feet in the Pond Area.

PCB exceedances in sediment have been delineated and are being addressed under the LDW ROD. The Source Control Evaluation Memorandum and its Addendum (Aspect, 2022c and 2024b) did not identify a concern for PCB recontamination of sediments from the Site under existing conditions. Potential transport pathways between the upland and sediments are further discussed in Section 8.

7.3 Dioxins/Furans

Site COPCs for dioxins/furans include total dioxin/furan TEQ and 2,3,7,8-TCDD. Total dioxin/furan TEQ was identified in Section 6.2.7 as a Key Site COPC, as it was the most widespread dioxins/furans COPC exceeding Proposed RI CULs. Fewer samples were analyzed for dioxins/furans than other Site COPCs because the exceedances of dioxins/furans are assumed to be limited to a subset of samples impacted by other Site COPCs and are less mobile than co-occurring Site COPCs, which is supported by the collected data.[76]

The distribution of dioxins/furans in soil samples is shown on Figures 7.3.A (vadose zone) and 7.3.B (saturated zone). The distribution of total dioxin/furan TEQ in groundwater in the Fill Unit is shown on Figure 7.3.C; no samples of groundwater from the Alluvial Unit were analyzed for dioxins/furans.

Table J.3 contains summary statistics for dioxins/furans COPCs by Site Area and media. Occurrences of dioxins/furans by Site Area are described below.

7.3.1 Dioxins/Furans in the South Area

Soil. A total of 11 soil samples (9 vadose zone, 2 saturated zone) collected from 10 locations in the South Area were analyzed for dioxins/furans. The frequency of exceedance and maximum detected concentrations of dioxins/furans are summarized below.

Analyte	Proposed RI CUL (mg/kg)	Frequency of Exceedance	Maximum Detected Concentration				
			Conc. (mg/kg)	EF	Location	Depth (ft bgs)	Geologic Unit
Vadose Zone Soil							
Total Dioxin/Furan TEQ	5.7E-06	100%	6.37E-03	1,118	MW-16	1.5 - 2	Fill
2,3,7,8-TCDD	5.2E-06	56%	4.38E-05	8.4	MW-16	1.5 - 2	Fill
Saturated Zone Soil							
Total Dioxin/Furan TEQ	5.7E-06	100%	4.01E-03	704	SB-42	6 - 8	Fill
2,3,7,8-TCDD	5.2E-06	100%	1.50E-04	29	SB-42	6 - 8	Fill

Total dioxin/furan TEQ concentrations exceeded the Proposed RI CUL of $5.7x10^{-6}$ mg/kg (based on protection of sediment via erosion, adjusted to PQL) in vadose zone soil throughout the South Area. Dioxins/furans exceeded the Proposed RI CUL in the two

[76] All samples containing dioxins/furans exceedances also contained other COPC exceedances, except for one sample (MW-13D, 0 to 1 foot bgs) that was only analyzed for pesticides; adjacent boring MW-13 contained other COPC exceedances in the same depth interval. Four soil samples contained dioxins/furans concentrations below the Proposed RI CUL but contained other COPC exceedances. No dioxins/furans exceedances were detected in groundwater.

saturated zone samples analyzed, both of which were collected in the Pond Area. The maximum depth of dioxins/furans exceedances was 8 feet based on the 8-foot samples from MW-04 and SB-42; no samples were analyzed for dioxins/furans below 8 feet bgs in the South Area.

All samples exceeding the Proposed RI CUL for 2,3,7,8-TCDD also exceeded for total dioxin/furan TEQ.

Groundwater. Three groundwater samples (all in the Fill Unit) collected from three wells in the South Area were analyzed for dioxins/furans. Dioxins/furans did not exceed the Proposed RI CUL of 5.7x10^{-5} ug/L (based on protection of surface water and sediment, adjusted to PQL) in any of the three groundwater samples. The maximum detected groundwater concentration of total dioxin/furan TEQ was 2.88 x10^{-5} ug/L, which was an estimated value (J-flagged).

7.3.2 Dioxins/Furans in the Central Area

Soil. Nine soil samples (all in the vadose zone) collected from eight locations in the Central Area were analyzed for dioxins/furans. The maximum detected concentration of total dioxin/furan TEQ is summarized below.

Analyte	Proposed RI CUL (mg/kg)	Frequency of Exceedance	Maximum Detected Concentration				
			Conc. (mg/kg)	EF	Location	Depth (ft bgs)	Geologic Unit
Vadose Zone Soil							
Total Dioxin/Furan TEQ	5.7E-06	44%	3.64E-05	6.4	SB-40	0 - 1	Fill

The distribution of total dioxin/furan TEQ in vadose zone soil is shown on Figure 7.3.A. Dioxins/furans concentrations exceeded the Proposed RI CUL in vadose zone soil sporadically within the Central Area. None of the concentrations exceeded the urban background concentration for total dioxin/furan TEQ (4.6 x10^{-5} mg/kg). The maximum depth of dioxin/furan TEQ exceedances was in the 0- to 1-foot bgs samples from SB-32, SB-40, and SB-41; no samples were analyzed for dioxins/furans below 1 foot bgs in the Central Area.

No samples in the Central Area exceeded the Proposed RI CUL for 2,3,7,8-TCDD.

Groundwater. Four groundwater samples (all in the Fill Unit) collected from four wells in the Central Area were analyzed for dioxins/furans. The distribution of total dioxin/furan TEQ in groundwater in the Fill Unit is shown on Figure 7.3.C. Total dioxin/furan TEQ did not exceed the Proposed RI CUL in any groundwater samples, with a detected maximum concentration of 1.56x10^{-6} ug/L, which was an estimated concentration (J-flagged).

7.3.3 Dioxins/Furans in the Northwest Area

Soil. Three soil samples (all in the vadose zone) collected from three locations in the Northwest Area were analyzed for dioxins/furans. Total dioxin/furan TEQ exceeded the Proposed RI CUL of 5.7x10^{-6} mg/kg in vadose zone soil in one sample from MW-13 (Figure 7.3.A), at a concentration of 1.3x10^{-5} mg/kg (EF = 2.5) at 0 to 1 foot bgs. The concentration was an estimated value (J-flagged).

No samples in the Northwest Area exceeded the Proposed RI CUL for 2,3,7,8-TCDD.

Groundwater. No groundwater samples in the Northwest Area were analyzed for dioxins/furans.

7.3.4 Dioxins/Furans in Adjacent Sediments

Dioxins/furans did not exceed the Initial Sediment SLs in surface sediment adjacent to the Site in the refined dataset; therefore, this section discusses subsurface sediment occurrences only.

The full sediment dataset includes 16 subsurface sediment samples collected from 4 locations, analyzed for dioxins/furans, none of which were removed from the dataset based on their age, sediment removal, or being superseded by newer data. Therefore, the refined dataset also includes these 16 subsurface sediment samples. Sediment data are provided in Table H.3.B.

Three of the 16 samples exceed the Selected Sediment SL, which is based on the human direct contact pathway. The spatial distribution of total dioxin/furan TEQ in sediment is shown on Figure H.5. All the samples exceeding the SL were outside the Marina Basin and were collected at depths greater than 60 cm, which is the LDW ROD's maximum point of compliance depth. Furthermore, as documented in the LDW RI and FS and discussed in the Source Control Review Memorandum (Aspect, 2022c), sediments adjacent to the SPM Property are in a depositional stretch of the LDW, and sediment quality is expected to improve over time due to deposition of clean sediments from further upstream.

7.3.5 Summary of Dioxins/Furans Occurrences

Total dioxin/furan TEQ concentrations exceed the Proposed RI CUL in shallow soil across much of the South Area, where the highest concentrations were also detected, particularly in the Pond Area. Total dioxin/furan TEQ exceedances are more limited within the remainder of the Site, and no samples in the Central Area or Northwest Area exceeded the urban background concentration (1.9×10^{-5} mg/kg), based on citywide data (see Section 6.2.9). Total dioxin/furan TEQ exceedances were colocated with exceedances of other Site COPCs in soil.[77] Total dioxin/furan TEQ concentrations were not detected above the Proposed RI CUL in groundwater.

The extent of dioxins/furans in soil and groundwater at the Site has been sufficiently delineated for the purposes of the RI. The RI data bound the extent of dioxins/furans in soil exceeding Proposed RI CULs to the north and northwest. Exceedances in soil along the southwestern and southern property boundaries are bounded because contaminated soil on the adjacent property and ROW were removed under separate action (T-117 Early Action). The vertical extent of total dioxin/furan TEQ concentrations exceeding Proposed RI CULs is at least 8 feet in the Pond Area. However, the vertical extent of dioxins/furans in soil in the South Area is assumed to be less than the maximum vertical extent of other

[77] Selection of samples for dioxin/furan analysis included targeting locations with high and low concentrations of PCBs; therefore, the correlation of dioxin/furan TEQ exceedances with exceedances of other Site COPCs is not necessarily due to sampling bias.

colocated COPCs (17 feet bgs), such as PCBs and SVOCs (Section 7.6, below), due to the lower mobility of dioxins/furans.

Total dioxin/furan TEQ exceedances in sediment have been delineated and are being addressed under the LDW ROD; no samples in the Marina Basin exceed LDW CULs. The Source Control Evaluation Memorandum and its Addendum (Aspect, 2022c and 2024b) did not identify a concern for recontamination of sediments from dioxins/furans at the Site under existing conditions. Potential transport pathways between the upland and sediments are further discussed in Section 8.

7.4 Total Petroleum Hydrocarbons

Site COPCs for TPH include TPH-G, TPH-D, TPH-O, and TPH-D+O. TPH-D+O was identified in Section 6.2.7 as a Key Site COPC, as it was the most widespread TPH fraction exceeding Proposed RI CULs in soil and groundwater. The distribution of TPH-D+O in soil is shown on Figures 7.4.A (vadose zone) and 7.4.B (saturated zone). Figure 7.4.C depicts the vertical distribution of TPH-D+O concentrations in the Pond Area. Locations where Non-Key TPH COPC concentrations exceeded Proposed RI CULs in vadose and saturated soil, but TPH-D+O did not, are shown on Figure 7.4.D.

The spatial distribution of TPH-D+O in groundwater is shown on Figures 7.4.E (Fill Unit) and 7.4.F (Alluvial Unit). There were no locations where Non-Key TPH COPC concentrations exceeded Proposed RI CULs in Fill or Alluvial Unit groundwater, but TPH-D+O did not, as shown on Figure 7.4.G.

Table J.4 contains summary statistics for TPH COPCs by Site Area and media. Occurrences of TPH by Site Area are described below. Because TPH data are not available for adjacent sediments, no discussion of sediments is included in this TPH section.

7.4.1 TPH in the South Area

Soil. A total of 92 soil samples (43 vadose zone, 49 saturated zone) collected from 44 locations in the South Area were analyzed for TPH. As observed for other Key Site COPCs, the highest concentrations of TPH were detected in the Pond Area. Maximum detected concentrations and the frequency of TPH exceeding Proposed RI CULs in soil are summarized below.

Analyte	Proposed RI CUL (mg/kg)	Frequency of Exceedance	Maximum Detected Concentration				
			Conc. (mg/kg)	EF	Location	Depth (ft bgs)	Geologic Unit
Vadose Zone Soil							
TPH-G	30	5%	570	19	SB-42	3.5 - 4.5	Fill
TPH-D	2,000	14%	12,000	6.0	SB-16	3.5 - 4	Fill
TPH-O	2,000	35%	34,000	17	SB-18	5	Fill
TPH-D+O	2,000	40%	40,300	20	SB-18	5	Fill
Saturated Zone Soil							
TPH-G	30	12%	650	22	MW-04	7 - 8	Fill
TPH-D	2,000	10%	9,550	4.8	MW-05	6 - 7	Fill
TPH-O	2,000	22%	49,000	25	MW-04D	14 - 15	Tidal Flat
TPH-D+O	2,000	27%	57,700	29	MW-04D	14 - 15	Tidal Flat

In vadose zone soil, TPH-D+O concentrations exceeding the Proposed RI CUL of 2,000 mg/kg (based on protection of groundwater) were generally in the Pond Area and limited west of the Pond Area (at HA-02, HA-03, and SB-38). Exceedances in saturated zone soil were limited to the Pond Area.

The highest detected concentrations (e.g., exceeding 10,000 mg/kg) occur throughout the saturated portion of the Fill Unit in the Pond Area and extend vertically to depths of 15 feet bgs in the sample from MW-04, located on the south edge of the Pond Area (Figure 7.4.C). Concentrations rapidly decline below 15 feet bgs, with the maximum vertical extent for TPH-D+O exceeding the Proposed RI CUL detected in the sample collected from 16 to 17 feet bgs, at MW-04D.

TPH-G exceedances in the South Area were detected within a subset of samples exhibiting TPH-D+O exceedances. Based on the relative concentrations, it is probable that TPH-G concentrations represent overlap from the diesel range, rather than an indication that a gasoline-range petroleum product is present. No TPH-G exceedances were detected at locations without TPH-D+O exceedances in the South Area.

The TPH concentrations and distribution are consistent with field observations at explorations within the Pond Area, which included heavy sheen (see Section 5.1.1.2). In addition, a thin accumulation of free product was measured in the two Fill Unit wells, MW-04 (maximum thickness 0.05 feet) and MW-05 (maximum thickness 0.08 feet) installed in the Pond Area (Table C.2). Generally, a greater measurable thickness of LNAPL was present in both wells during gauging events in the dry season (October) than during the wet season (March and May). The free product was observed to be highly viscous, which is consistent with the heavier petroleum fraction (primarily motor oil-range) detected in soil. An LNAPL sample collected from MW-04 was analyzed for TPH and contained 270,000 mg/kg TPH-D and 880,000 mg/kg TPH-O (lab report included in Appendix G.2.A).[78]

Groundwater. A total of 15 groundwater samples (7 Fill Unit, 8 Alluvial Unit) collected from 11 wells in the South Area were analyzed for TPH. Maximum detected concentrations and the frequency of TPH exceeding Proposed RI CULs in groundwater are summarized below.

[78] The LNAPL sample was also analyzed for PCB Aroclors, PAHs, and SVOCs; data are discussed in Sections 7.2.1, 7.5.1 and 7.6.1, respectively.

Analyte	Proposed RI CUL (ug/L)	Frequency of Exceedance	Maximum Detected Concentration			
			Conc. (ug/L)	EF	Location	Date
Fill Groundwater Unit						
TPH-D	500	57%	4,430	8.9	MW-05	03/31/21
TPH-O	500	57%	1,400	2.8	MW-04	10/26/22
TPH-D+O	500	57%	5,350	11	MW-05	03/31/21
Alluvial Groundwater Unit						
TPH-D	500	13%	770	1.5	MW-05D	10/26/22
TPH-O	500	13%	860	1.7	MW-05D	10/26/22
TPH-D+O	500	13%	1,630	3.3	MW-05D	10/26/22

Concentrations of TPH-D+O exceeding the Proposed RI CUL of 500 ug/L (based on surface water protection) in the Fill Unit and Alluvial Unit groundwater are summarized as follows:

- In the Fill Unit, TPH-D+O concentrations consistently exceeded the Proposed RI CUL in samples from two Fill Unit wells: MW-04 (maximum concentration of 2,020 ug/L, EF = 4.0) and MW-05 (maximum concentration of 5,350 ug/L, EF = 11).
- In the Alluvial Unit, one TPH-D+O exceedance was detected in a sample from MW-05D.

All TPH-D+O exceedances were located within the Pond Area. TPH-D+O did not exceed the Proposed RI CUL at the shoreline wells within the South Area. No TPH-G exceedances were detected in groundwater.

7.4.2 TPH in the Central Area

Soil. A total of 54 soil samples (31 vadose zone, 23 saturated zone) collected from 27 locations in the Central Area were analyzed for TPH. There were limited TPH detections in shallow soils across the Central Area at generally low concentrations, and TPH-D+O was not detected above the Proposed RI CUL (Figure 7.4.A). Maximum detected concentrations and the frequency of TPH exceeding Proposed RI CULs in soil in the Central Area are summarized below.

Analyte	Proposed RI CUL (mg/kg)	Frequency of Exceedance	Maximum Detected Concentration				
			Conc. (mg/kg)	EF	Location	Depth (ft bgs)	Geologic Unit
Vadose Zone Soil							
TPH-G	30	14%	78	2.6	SB-27	0 - 1	Fill

TPH-D+O did not exceed the Proposed RI CUL in either the vadose or saturated zone soil in the Central Area, which is consistent with the absence of TPH exceedances in groundwater discussed below.

TPH-G exceedances of the Proposed RI CUL were limited to vadose zone, Fill Unit soil in the Central Area at the following locations and depths:

- MW-11: 0 to 1 foot bgs, 31.9 mg/kg, EF = 1.06
- SB-27: 0 to 1 foot bgs, 77.7 mg/kg, EF = 2.6
- SB-32: 4 to 5 feet bgs, 49.8 mg/kg, EF = 1.7
- SB-33: 0 to 1 foot bgs, 48.6 mg/kg, EF = 1.6

All of these soil samples except the 4- to 5-foot sample at SB-32 contained exceedances of Key Site COPCs discussed in other sections.

Groundwater. A total of 21 groundwater samples (15 Fill Unit, 6 Alluvial Unit) collected from 15 wells in the Central Area were analyzed for TPH. No exceedances were detected in any of these samples.

7.4.3 TPH in the Northwest Area

Soil. A total of 21 soil samples (12 vadose zone, 9 saturated zone) collected from 7 locations in the Northwest Area were analyzed for TPH. TPH-D+O was not detected above the Proposed RI CUL in any samples in the Northwest Area. No TPH-G exceedances were detected in the vadose zone. TPH-G was detected in the saturated zone above the Proposed RI CUL of 30 mg/kg (based on protection of surface water) in samples from two locations (Figure 7.4.D):

- MW-13: 71.9 mg/kg (EF = 2.4) at 18 to 19.5 feet bgs (Tidal Flat Unit)
- SB-31: 5,440 mg/kg (EF = 180) at 13 to 14.5 feet bgs (Tidal Flat Unit), and 81.6 mg/kg (EF = 2.7), 19 to 20 feet bgs (Alluvial Unit)

Groundwater. Eight groundwater samples (4 Fill Unit, 4 Alluvial Unit) collected from four wells in the Northwest Area were analyzed for TPH. TPH-D+O was detected above the Proposed RI CUL in one sample in the Alluvial Unit (MW-13D: 760 ug/L, EF = 1.5) in October 2022, but was not detected at the same well in March 2023.

TPH-G exceedances were detected at MW-13 and MW-20; however, the laboratory noted that these exceedances were due to analytical interferences from the presence of PCE, based on chromatogram review (Appendix G.4.A), and the results were rejected by the data validator. See Section 7.8.3 for a review of PCE data in the Northwest Area. This is based on case narrative and analyst notes by the reporting laboratory for the 2021 detection at MW-13 and for the 2022 and 2023 detections at MW-20 and MW-13:

- 2021 (MW-13) - “The response noted in the gasoline chromatogram may be attributed to the response for tetrachloroethylene measured in the volatile analysis, as chromatograms appear identical” and “GRO is mostly due to a large hit of tetrachloroethylene.”
- 2022 and 2023 (MW-20 and MW-13) - “Review of the sample chromatograms did not show the presence of a low boiling product, such as gasoline…the NWTPH-Gx concentrations were biased by the presence of a discrete compound…review of the 8260 data and peak retention time shows the compound as tetrachloroethene.”

Although there is some uncertainty in the presence of TPH-G in groundwater at these wells since the data were rejected, it appears highly likely that that TPH-G is either not present or present at low concentrations below the Proposed RI CUL, based on analyst notes and the review performed by the data validator.

Soil Gas. Two soil gas samples were collected in the Northwest Area from beneath the portion of the existing building that includes an office and a customer waiting area. TPH (as air-phase hydrocarbons and benzene, toluene, ethylbenzene, and xylene) was not detected in either sample. Additional discussion of the VI pathway is discussed in the South Park Marina – Tire Factory Vapor Intrusion Assessment Results Memorandum (Aspect, 2023c) provided in Appendix K.

7.4.4 Summary of TPH Occurrences

TPH exceedances at the Site are primarily TPH-D+O in the South Area, low-level TPH-G exceedances (EFs < 3) in vadose zone soil in the Central Area, and TPH-G in saturated zone soil in a limited portion of the Northwest Area. The highest concentrations of TPH in soil are found in the Pond Area where residual product is present in the upper portion of the saturated zone in the Fill Unit. Groundwater TPH-D+O exceedances are generally limited to the Pond Area, and do not exceed the Proposed RI CUL at the shoreline or point of discharge to the LDW. All TPH-G exceedances in groundwater were attributed to PCE by the laboratories based on review of the chromatograms (Appendix G.4).

A VI assessment within the Tire Factory building in the Northwest Area verified there is currently not a VI concern for TPH under existing Site conditions (Appendix K). TPH concentrations in soil and groundwater in the South Area represent a potential VI concern; however, no enclosed, occupied structures are currently present in that area. Further assessment of the VI pathway for TPH may be needed if there is a change in Site usage.

The extent of TPH in soil and groundwater at the Site has been sufficiently delineated for the purposes of the RI. The RI data bound the extent of TPH exceeding Proposed RI CULs to the north and northwest. Exceedances in soil along the southwestern and southern property boundaries are bounded because contaminated soil on the adjacent property and ROW were removed under the independent SPU interim actions and the T-117 Adjacent Streets and Yard Removal (Section 2.4.2). The maximum vertical extent of soil TPH exceedances has been bounded and is approximately 20 feet (TPH-G) in the Northwest Area, 5 feet (TPH-G) in the Central Area, and 17 feet (TPH-D+O) in the South Area.

7.5 Polycyclic Aromatic Hydrocarbons

Site COPCs for PAHs include the following: 1-methylnaphthalene, 2-methylnaphthalene, benzo[g,h,i] perylene, fluoranthene, pyrene, benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, chrysene, dibenzo[a,h]anthracene, indeno[1,2,3-cd]pyrene, total benzofluoranthenes, total HPAHs, and total cPAH TEQ. Total cPAH TEQ was identified as a Key Site COPC in Section 6.2.7 as the most widespread PAH exceeding Proposed RI CULs in soil and groundwater, and with the highest magnitude of exceedances, and it also includes the cumulative effects of individual carcinogenic PAHs. The distribution of total cPAH TEQ in soil is shown on Figure 7.5.A (vadose zone) and Figure 7.5.B (saturated zone). The vertical distribution of total cPAH TEQ in soil in the Pond Area is shown on Figure 7.5.C. SB-15 was the only location where Non-Key PAH COPCs exceeded the Proposed RI CULs but Key PAH COPCs did not, as shown on Figure 7.5.D.

The distribution of total cPAH TEQ in groundwater is shown on Figures 7.5.E (Fill Unit) and 7.5.F (Alluvial Unit). There are no locations where Non-Key PAH COPC concentrations exceeded Proposed RI CULs in groundwater but total cPAH TEQ did not, as shown on Figure 7.5.G.

Table J.5 contains summary statistics for PAH COPCs by Site Area and media. Occurrences of PAHs by Site Area are described below.

7.5.1 PAHs in the South Area

Soil. A total of 102 soil samples (42 vadose zone, 60 saturated zone) collected from 37 locations in the South Area were analyzed for PAHs. The highest concentrations of PAHs were detected in the Pond Area. Maximum detected concentrations for each PAH exceeding Proposed RI CULs in soil and the frequency of exceedance are summarized below.

Analyte	Proposed RI CUL (mg/kg)	Frequency of Exceedance	Maximum Detected Concentration				
			Conc. (mg/kg)	EF	Location	Depth (ft bgs)	Geologic Unit
Vadose Zone Soil							
2-Methylnaphthalene	0.67	10%	3.00	4.5	SB-16	3.5 - 4	Fill
Benz(a)anthracene	0.73	2%	0.75	1.03	SB-43	2.5 -3.5	Fill
Benzo(a)pyrene	0.00050	62%	0.86	1,700	SB-43	2.5 - 3.5	Fill
Total Benzofluoranthenes	1.1	2%	1.43	1.3	SB-43	2.5 - 3.5	Fill
Total HPAHs	1.1	23%	7.92	7.2	SB-43	2.5 - 3.5	Fill
Total cPAH TEQ	0.00076	74%	1.15	1500	SB-43	2.5 - 3.5	Fill
Saturated Zone Soil							
2-Methylnaphthalene	0.67	3%	4.50	6.7	SB-14	7.5 - 8	Fill
Benzo(a)pyrene	0.00050	43%	0.17	340	SB-22	10	--
Total HPAHs	1.1	7%	5.9	5.4	SB-14	7.5 - 8	Fill
Total cPAH TEQ	0.00076	47%	0.76	990	SB-14	7.5 - 8	Fill

Concentrations exceeding the Proposed RI CUL for total cPAH TEQ of 0.00076 mg/kg (surface water protection, adjusted to PQL) were detected throughout the South Area in the vadose and saturated zones; however, as described below, groundwater exceedances of total cPAH TEQ and 1-methylnaphthalene are limited to the Pond Area and do not extend to MW-06, and no other PAHs were detected in groundwater above Proposed RI CULs. Therefore, the groundwater-to-surface water and groundwater-to-sediment pathways for PAHs are not complete. The next lowest soil screening level for total cPAH TEQ is 0.19 mg/kg, based on direct contact; exceedances of the direct contact screening level are limited to soil in the Pond Area and one sample west of the Pond Area, at a depth of 0 to 1 foot bgs at SB-38 (0.298 mg/kg). Only five samples in the South Area, all within the Pond Area, exceeded the urban background concentration for total cPAH TEQ of 0.34 mg/kg (see Section 6.2.8).

PAHs were also detected in an LNAPL sample collected from well MW-04 in the Pond Area, including total cPAH TEQ at a concentration of 12.3 mg/kg (lab report provided in Appendix G.2.A). See Section 7.4.1 for additional discussion of LNAPL.

In the Pond Area, total cPAH TEQ concentrations greater than urban background (0.34 mg/kg) or the direct contact SL (0.19 mg/kg) are restricted to the Fill Unit, at depths of 10 feet bgs or less (Figure 7.5.C). Concentrations of total cPAH TEQ exceeding the Proposed RI CUL were detected to a maximum depth of 16 feet bgs, at MW-05.[79]

All samples in the South Area with a PAH exceedance other than total cPAH TEQ were located in the Pond Area. All samples containing a Non-Key PAH COPC exceedance also had a total cPAH TEQ exceedance, except SB-15, located in the Pond Area (Figure 7.5.D) where concentrations of 2-methylnaphthalene and total HPAHs exceeded the Proposed RI CULs (EFs = 1.6 and 4.3, respectively).

Groundwater. A total of 15 groundwater samples (7 Fill Unit, 8 Alluvial Unit) collected from 11 wells in the South Area were analyzed for PAHs. Maximum detected concentrations and the frequency of COPC PAHs exceeding Proposed RI CULs in groundwater are summarized below.

Analyte	Proposed RI CUL (ug/L)	Frequency of Exceedance	Maximum Detected Concentration			
			Conc. (ug/L)	EF	Location	Date
Fill Groundwater Unit						
1-Methylnaphthalene	0.17	29%	2.63	15	MW-05	03/31/21
Benz(a)anthracene	0.01	29%	0.052	5.2	MW-05	10/26/22
Benzo(a)pyrene	0.01	29%	0.046	4.6	MW-05	10/26/22
Benzo(b)fluoranthene	0.01	29%	0.056	5.6	MW-05	10/26/22
Chrysene	0.016	29%	0.092	5.8	MW-05	10/26/22
Total cPAH TEQ	0.015	29%	0.0615	4.1	MW-05	10/26/22

Only 1-methylnaphthalene, total cPAH TEQ and four individual cPAHs (benzo[a]pyrene, chrysene, benz[a]anthracene, and benzo[b]fluoranthene)[80] were detected in groundwater above Proposed RI CULs. The only well where 1-methylnaphthalene was detected above Proposed RI CULs was MW-05, in the Fill Unit. The spatial distribution of total cPAH TEQ samples are shown on Figures 7.5.E (Fill Unit) and 7.5.F (Alluvial Unit). Occurrences of total cPAH TEQ in the Fill Unit and Alluvial Unit groundwater are summarized as follows:

[79] A sample collected from 26.5 to 28 feet bgs at MW-05 also exceeded the Proposed RI CUL for cPAHs; however, as discussed in Section 7.1.1, that sample is suspected to have been compromised by cross-contamination, and the exceedance was not replicated at the same depth interval at MW-05D.

[80] Individual cPAHs are included in total cPAH TEQ and are not discussed individually. All samples with an individual cPAH exceedance also contained a total cPAH TEQ exceedance.

- In the Fill Unit, total cPAH TEQ exceeded the Proposed RI CUL of 0.015 ug/L (protection of surface water, adjusted to PQL) in samples from two wells: MW-05 and MW-04. These wells are located within the Pond Area.
- In the Alluvial Unit, total cPAH TEQ was not detected in samples from any wells in the South Area.

7.5.2 PAHs in the Central Area

Soil. A total of 53 soil samples (33 vadose zone, 20 saturated zone) collected from 25 locations in the Central Area were analyzed for PAHs. The highest concentrations of PAHs were detected in the 0-to 1-foot bgs sample at MW-17, located adjacent to Dallas Avenue South. This area of Dallas Avenue South was remediated, as described in Section 2.4.2 and shown in Appendix A.21; data collected from that work, including PAH data, is provided in Appendix A.19. Maximum detected concentrations for each PAH exceeding Proposed RI CULs in soil and the frequency of exceedance are summarized below.

Analyte	Proposed RI CUL (mg/kg)	Frequency of Exceedance	Maximum Detected Concentration				
			Conc. (mg/kg)	EF	Location	Depth (ft bgs)	Geologic Unit
Vadose Zone Soil							
Benzo(g,h,i)perylene	0.67	3%	8.5	13	MW-17	0 - 1	Fill
Fluoranthene	1.7	3%	4.3	2.5	MW-17	0 - 1	Fill
Pyrene	2.6	3%	5.5	2.1	MW-17	0 - 1	Fill
Benz(a)anthracene	0.73	3%	8.7	12	MW-17	0 - 1	Fill
Benzo(a)pyrene	0.0005	82%	22	44,000	MW-17	0 - 1	Fill
Chrysene	1.4	3%	11	7.9	MW-17	0 - 1	Fill
Dibenzo(a,h)anthracene	0.23	3%	2.2	9.6	MW-17	0 - 1	Fill
Indeno(1,2,3-cd)pyrene	0.60	3%	11	18	MW-17	0 - 1	Fill
Total Benzofluoranthenes	1.1	3%	28	25	MW-17	0 - 1	Fill
Total HPAHs	1.1	3%	111	101	MW-17	0 - 1	Fill
Total cPAH TEQ	0.00076	82%	28.1	37,000	MW-17	0 - 1	Fill
Saturated Zone Soil							
Benzo(a)pyrene	0.00050	20%	0.010	21	SB-27	8 - 9	Alluvial
Total cPAH TEQ	0.00076	25%	0.016	21	SB-27	8 - 9	Alluvial

Concentrations of total cPAH TEQ exceeding the Proposed RI CUL were detected in soil throughout the Central Area in the vadose and saturated zones (Figures 7.5.A and 7.5.B); however, as described below, no groundwater exceedances of total cPAH TEQ were detected in the Central Area, including at wells along the shoreline. Therefore, the soil-to-groundwater-to-surface water pathway for PAHs in the Central Area is not complete under current conditions.[81] The next lowest screening level for total cPAH TEQ is 0.19 mg/kg, based on direct contact; the only exceedance of the direct contact screening level was in the sample collected from 0 to 1 foot bgs at MW-17. This was also the only

[81] As noted in Section 6.2.4, the highest concentrations of several PAHs in the Central Area were in vadose zone soil in a paved location; therefore, the groundwater-to-surface is still considered potentially complete in the future.

sample that exceeded the urban background concentration for total cPAH TEQ of 0.34 mg/kg.

The only PAH exceedances other than benzo[a]pyrene or total cPAH TEQ were detected in the MW-17 sample described above.

Groundwater. A total of 21 groundwater samples (16 Fill Unit, 5 Alluvial Unit) collected from 15 wells (9 Fill Unit, 6 Alluvial Unit) in the Central Area were analyzed for PAHs. No PAHs were detected in groundwater above Proposed RI CULs in any samples from this area.

7.5.3 PAHs in the Northwest Area

Soil. A total of 20 soil samples (9 vadose zone, 11 saturated zone) collected from 7 locations in the Northwest Area were analyzed for PAHs. Only concentrations of benzo[a]pyrene, total HPAHs, and the total cPAH TEQ exceeded Proposed RI CULs in soil. Maximum detected concentrations for these PAHs in soil and the frequency of exceedance are summarized below.

Analyte	Proposed RI CUL (mg/kg)	Frequency of Exceedance	Maximum Detected Concentration				
			Conc. (mg/kg)	EF	Location	Depth (ft bgs)	Geologic Unit
Vadose Zone Soil							
Benzo(a)pyrene	0.00050	100%	0.22	440	MW-20	0.5 - 1.5	Fill
Total HPAHs	1.1	11%	1.49	1.4	MW-20	0.5 - 1.5	Fill
Total cPAH TEQ	0.00076	100%	0.28	370	MW-20	0.5 - 1.5	Fill
Saturated Zone Soil							
Benzo(a)pyrene	0.00050	36%	0.021	42	MW-22	13 - 13.75	Tidal Flat
Total cPAH TEQ	0.00076	45%	0.028	36	MW-22	13 - 13.75	Tidal Flat

The highest concentrations were detected in the 0- to 1-foot bgs sample from MW-20, located in the Dallas Avenue South ROW to the west of the SPM Property. The sample from MW-20 was above the South Park urban background concentration (0.18 mg/kg), but below the citywide urban background concentration (0.34 mg/kg) for total cPAH TEQ and consistent with the ubiquitous distribution of cPAHs in urban soils (Section 6.2.8). It is also possible that cPAH concentrations in shallow soil at MW-20 are influenced by the historical roadbed that existed in this area of Dallas Avenue South. The asphalt was approximately 1.5 feet thick at MW-20 (Appendix B.2), and the sample was collected from the interval directly underneath the asphalt. This portion of Dallas Avenue South was repaved but not excavated as part of the T-117 Adjacent Streets and Yards Removal Area, and the thickness of the asphalt observed at MW-20 suggests that the new asphalt was placed directly or nearly directly on top of the historical asphalt road during repaving of Dallas Avenue South. The maximum detected concentration of total cPAH TEQ on the SPM Property in the Northwest Area was 0.107 mg/kg (EF = 140) in the 3- to 5-foot bgs sample from SB-30.

Concentrations that exceeded the Proposed RI CUL of 0.00076 mg/kg were detected throughout the Northwest Area in the vadose and saturated zones (Figures 7.5.A and 7.5.B); however, as described below, no groundwater exceedances of total cPAH TEQ were detected in the Northwest Area. Therefore, the groundwater-to-surface water pathway for PAHs in the Northwest Area is not complete. The next lowest screening level for total cPAH TEQ is 0.19 mg/kg, based on direct contact; the only sample that exceeded the direct contact screening level was the 0.5- to 1.5-foot interval at MW-20, located west of the SPM Property. No samples collected on the SPM Property had concentrations that exceeded the direct contact screening level, or the urban background concentration of 0.34 mg/kg.

Groundwater. Five groundwater samples (3 Fill Unit, 2 Alluvial Unit) collected from four wells (2 Fill Unit, 2 Alluvial Unit) in the Northwest Area were analyzed for PAHs. No PAHs were detected in groundwater above Proposed RI CULs in any samples from the Northwest Area.

7.5.4 PAHs in Adjacent Sediments

A total of 58 sediment samples (35 surface and 23 subsurface) collected from 49 locations in sediments adjacent to the SPM Property were analyzed for PAHs; no exceedances of Selected Sediment SLs were detected.

7.5.5 Summary of PAH Occurrences

Total cPAH TEQ and benzo[a]pyrene exceeded the Proposed RI CUL in soils across the Site, with the highest concentrations detected in the Pond Area and in one shallow soil sample from MW-17, adjacent to Dallas Avenue South in the Central Area. Total cPAH TEQ concentrations in shallow soil in the Northwest Area exceeded the Proposed RI CUL but were below the citywide urban background concentration, and the highest concentration was detected in the Dallas Avenue South ROW and is likely not related to the Site. Exceedances of other PAHs in soil were limited to the Pond Area and in the MW-17 sample. However, the Proposed RI CUL for total cPAH TEQ is based on protection of surface water, which is currently incomplete based on the groundwater data.[82] Concentrations of total cPAH TEQ exceeding the direct contact screening level on the SPM Property are limited to the Pond Area and the sample at MW-17.

Total cPAH TEQ, and individual cPAHs that are included in total cPAH TEQ, were the only PAHs detected above Proposed RI CULs in groundwater. Total cPAH TEQ exceedances in groundwater were limited to Fill Unit wells in the Pond Area. No PAH exceedances were detected in groundwater along the shoreline.

The extent of PAHs in soil and groundwater has been sufficiently delineated for the purposes of the RI. PAH concentrations in soil at the SPM Property boundary generally do not exceed direct contact or urban background concentrations. The one exceedance in soil along the western boundary at MW-17 is bounded because contaminated soil in the adjacent ROW was removed under the T-117 Adjacent Streets and Yards Removal Area (Section 2.4.2.3). Other exceedances of PAHs in soil at the SPM Property boundaries are not considered a data gap because (1) the concentrations only exceed the protection of surface water screening level, and the surface water pathway is incomplete; and (2) concentrations are below urban background.

[82] Transport of groundwater from the Pond Area to the LDW is partly controlled by the sheet pile wall; therefore, the soil to groundwater to surface water pathway for cPAHs in the Pond Area is potentially complete in the future if the sheet pile wall were removed.

7.6 Semivolatile Organic Compounds

Site COPCs for SVOCs include the following: 2,4-dimethylphenol, 2,4-dinitrophenol, 2-methylphenol, benzyl alcohol, benzyl butyl phthalate, BEHP, diethyl phthalate, dimethyl phthalate, di-n-butyl phthalate, hexachlorobenzene, n-nitrodiphenylamine, and pentachlorophenol. BEHP was identified in Section 6.2.7 as a Key Site COPC, as it was the most widespread SVOC exceeding Proposed RI CULs in soil and the only SVOC exceeding the Proposed RI CUL in groundwater. The distribution of BEHP in soil is shown on Figure 7.6.A (vadose zone) and Figure 7.6.B (saturated zone). The vertical distribution of BEHP in soil in the Pond Area is shown on Figure 7.6.C. Locations where Non-Key SVOC COPC concentrations exceeded Proposed RI CULs in soil, but BEHP did not, are shown on Figure 7.6.D. The distribution of BEHP in groundwater is shown on Figures 7.6.E (Fill Unit) and 7.6.F (Alluvial Unit). There were no locations where Non-Key SVOC COPC concentrations exceeded Proposed RI CULs in groundwater, but BEHP did not, as shown on Figure 7.6.G.

Table J.6 contains summary statistics for SVOC COPCs by Site Area and media. Occurrences of SVOCs by Site Area are described below.

7.6.1 SVOCs in the South Area

Soil. A total of 87 soil samples (38 vadose zone, 49 saturated zone) collected from 37 locations in the South Area were analyzed for SVOCs. The highest concentrations of SVOCs were generally detected in the Pond Area.[83] Maximum detected concentrations for each SVOC exceeding Proposed RI CULs in soil and the frequency of exceedance are summarized below.

Analyte	Proposed RI CUL (mg/kg)	Frequency of Exceedance	Maximum Detected Concentration				
			Conc. (mg/kg)	EF	Location	Depth (ft bgs)	Geologic Unit
Vadose Zone Soil							
2-Methylphenol	0.063	3%	0.0902	1.4	MW-04	0 - 1	Fill
Benzyl alcohol	0.057	8%	0.71	12	21F-SS-01	0 - 0.07	Fill
Benzyl butyl phthalate	0.063	8%	2.2	35	SB-11	2.5 - 2.75	Fill
BEHP	0.04	32%	7	175	SB-16	3.5 - 4	Fill
Di-n-butyl phthalate	0.025	21%	3.6	144	MW-16	1.5 - 2	Fill
Dimethyl phthalate	0.071	18%	2.3	32	21F-SS-01	0 - 0.07	Fill
N-Nitrosodiphenylamine	0.028	3%	0.0506	1.8	SB-26	0 - 1	Fill
Pentachlorophenol	0.36	26%	14	39	MW-16	1.5 - 2	Fill
Saturated Zone Soil							
2,4-Dimethylphenol	0.029	2%	0.0376	1.3	MW-04	7 - 8	Fill
2,4-Dinitrophenol	0.075	3%	2.3	31	SB-21	9 - 9	--
Benzyl butyl phthalate	0.063	2%	0.093	1.5	MW-05D	13 - 14	Tidal Flat
BEHP	0.04	20%	2	50	SB-14	7.5 - 8	Fill
Hexachlorobenzene	0.022	2%	0.0469	2.1	MW-05	6 - 7	Fill
N-Nitrosodiphenylamine	0.028	2%	0.0995	3.5	MW-05	6 - 7	Fill

[83] SVOCs were not detected in a number of samples collected from the pond footprint prior to the RI, but detection limits were elevated relative to RI samples.

SVOC concentrations, including BEHP (Figure 7.6.A) were generally highest in vadose zone soil (except within the Pond Area), with fewer and lower magnitude of exceedances, in the saturated zone (Figure 7.6.B). In the saturated zone, all exceedances were in the Pond Area.

The highest concentrations (0.94 to 2 mg/kg) of BEHP in the Pond Area are present in the saturated portion of the Fill Unit (Figure 7.6.C). Beneath the Tidal Flat Unit, concentrations ranging from 0.16 to 0.62 mg/kg occur near the top of the Alluvium Unit. The maximum depth of SVOC exceedances was at MW-05, with a BEHP exceedance detected at a depth of 20 to 22.5 feet (0.0438 mg/kg, estimated concentration); however, cross-contamination of that sample is suspected (see Section 7.2.1), and the exceedance was not replicated at the same depth at adjacent boring MW-05D. The next deepest BEHP exceedance was detected at MW-04D at a depth of 16 to 17 feet (0.098 mg/kg, estimated concentration). Outside the Pond Area, the vertical extent of SVOC contamination in soil is limited to 3 feet bgs.

SVOCs were not detected in an LNAPL sample collected from well MW-04 in the Pond Area, (lab report provided in Appendix G.2.A). See Section 7.4.1 for additional discussion of LNAPL.

All samples with at least one SVOC COPC that exceeded Proposed RI CULs were collected from explorations that included samples with a Key Site SVOC COPC (BEHP) exceedance, with the following exceptions (see Figure 7.6.D):

- Within the Pond Area at the following locations:
  - SB-11: benzyl butyl phthalate (EF = 35) and pentachlorophenol (EF = 6.4) in a sample from 2.5 to 2.75 feet bgs
  - SB-12: dimethyl phthalate (EF = 3.2) and pentachlorophenol (EF = 7.8) in a sample from 1.5 to 2 feet bgs
  - SB-21: 2,4-dinitrophenol (EF = 31) in a sample from 9 feet bgs
  - SB-26: di-n-butyl phthalate (EF = 4.5), n-nitrosodiphenylamine (EF = 1.8), and pentachlorophenol (EF = 1.2) in a sample from 0 to 1 foot bgs
  - SB-42: dimethyl phthalate (EF = 11) and pentachlorophenol (EF = 1.1) in a sample from 0 to 1 foot bgs
  - MW-16: pentachlorophenol (EF = 8.1) in a sample from 0 to 1 foot bgs and di-n-butyl phthalate (EF = 140) and pentachlorophenol (EF = 39) in a sample from 1.5 to 2 feet bgs
- Outside the Pond Area at SB-36, which is adjacent to explorations with BEHP exceedances (HA-02, SB-39, and SB-37), pentachlorophenol exceeded the Proposed RI CUL (EF = 1.6) in the sample from 0 to 1 foot bgs. Concentrations of pentachlorophenol at SB-36 were below the Proposed RI CUL in the vadose soil sample from 2 to 3 feet bgs.

All of these locations contain at least one exceedance of a Key Site COPC discussed in other sections.

Groundwater. A total of 15 groundwater samples (7 Fill Unit, 8 Alluvial Unit) collected from 11 wells in the South Area (4 Fill Unit, 7 Alluvial Unit) were analyzed for SVOCs. Only BEHP was detected in groundwater above Proposed RI CULs, as shown on Figure 7.6.G.

Occurrences of BEHP in the Fill Unit and Alluvial Unit groundwater are summarized as follows:

- In the Fill Unit, BEHP exceeded the Proposed RI CUL of 0.2 ug/L (based on protection of surface water, adjusted to the PQL) in samples from two wells in the Pond Area: MW-04 and MW-05, both with a maximum concentration of 0.6 ug/L (EF = 3.0).
- In the Alluvial Unit, BEHP exceeded the Proposed RI CUL in a sample from one well, MW-18D, at a concentration of 2.6 ug/L (EF = 13). This well is located on the upgradient (western) edge of the SPM Property, and BEHP was not detected in soil at that location. BEHP is a ubiquitous urban contaminant, and the concentration detected at MW-18D may represent a contribution from urban background.

In general, exceedances of SVOCs are less extensive in groundwater than in soil in the South Area. No SVOCs other than BEHP exceeded Proposed RI CULs in groundwater in the South Area, and exceedances of BEHP in groundwater in the South Area were limited to the Pond Area and western (upgradient) edge of the SPM Property.

7.6.2 SVOCs in the Central Area

Soil. A total of 43 soil samples (25 vadose zone, 18 saturated zone) collected from 25 locations in the Central Area were analyzed for SVOCs.

Maximum detected concentrations for each SVOC exceeding Proposed RI CULs in soil and the frequency of exceedance are summarized below.

Analyte	Proposed RI CUL (mg/kg)	Frequency of Exceedance	Maximum Detected Concentration				
			Conc. (mg/kg)	EF	Location	Depth (ft bgs)	Geologic Unit
Vadose Zone Soil							
Benzyl alcohol	0.057	4%	0.138	2.4	MW-14	0 - 1	Fill
Benzyl butyl phthalate	0.063	4%	0.122	1.9	SB-27	0 - 1	Fill
BEHP	0.040	32%	0.981	25	SB-27	0 - 1	Fill
Di-n-butyl phthalate	0.025	12%	0.268	11	SB-27	0 - 1	Fill
Diethyl phthalate	0.20	8%	0.982	4.9	MW-11	0 - 1	Fill
Dimethyl phthalate	0.071	16%	0.271	3.8	MW-14	0 - 1	Fill

BEHP exceedances were detected in samples across the Central Area, primarily in shallow soil in unpaved areas or near the former boat manufacturing building. All soil SVOC concentrations above Proposed RI CULs in the Central Area were in vadose zone soil, in samples collected from 0 to 1 foot bgs; no exceedances were detected in the saturated zone.

All sample locations in the Central Area with at least one SVOC COPC that exceeded the Proposed RI CULs included a Key Site SVOC COPC (BEHP) exceedance except for one sample at MW-15 from 0 to 1 foot bgs, where di-n-butyl phthalate was detected at a concentration of 0.223 mg/kg (EF = 8.9) as shown on Figure 7.6.D.

Groundwater. A total of 19 groundwater samples (14 Fill Unit, 5 Alluvial Unit) collected from 15 wells in the Central Area (9 Fill Unit, 6 Alluvial Unit) were analyzed for SVOCs. The only SVOC to exceed Proposed RI CULs was BEHP. Concentrations exceeding the Proposed RI CUL in Fill Unit and Alluvial Unit groundwater are summarized as follows:

- In the Fill Unit, BEHP exceeded the Proposed RI CUL of 0.2 ug/L in a sample collected from well MW-19, at a concentration of 1.6 ug/L (EF = 8).
- In the Alluvial Unit, BEHP was not detected in any groundwater samples above the Proposed RI CUL.

7.6.3 SVOCs in the Northwest Area

Soil. Soil samples from the Northwest Area were not analyzed for SVOCs.

Groundwater. Four groundwater samples (2 Fill Unit, 2 Alluvial Unit) collected from four wells in the Northwest Area were analyzed for SVOCs. No exceedances of SVOCs, including BEHP, were detected in any groundwater samples in the Northwest Area.

7.6.4 SVOCs in Adjacent Sediments

Benzyl alcohol, phenol, and 4-methylphenol are the only SVOCs exceeding Selected Sediment SLs (Table H.6). 4-methylphenol and phenol did not exceed Proposed RI CULs in soil or groundwater and were not identified as Site COPCs. Therefore, this section focuses on the occurrence of benzyl alcohol in adjacent sediments, which only exceeded the Proposed RI CUL in vadose zone soil.

The full sediment dataset includes 47 sediment samples (31 surface and 16 subsurface) collected from 41 locations analyzed for benzyl alcohol. There were 18 samples removed from the dataset based on their age, sediment removal, or being superseded by newer data. The refined sediment dataset includes 29 sediment samples (19 surface and 10 subsurface) analyzed for benzyl alcohol.

The comparison of the refined dataset to selected sediment screening levels is provided in Table H.7. The spatial distribution of benzyl alcohol in surface and subsurface samples is provided on Figure H.6.

Benzyl alcohol occurrences in sediments adjacent to the SPM Property are summarized as follows:

- **Surface Sediment.** Benzyl alcohol exceeded the screening level in 4 of 19 samples. The maximum detected concentration was 0.28 mg/kg (EF = 4.9).

- **Subsurface Sediment.** Benzyl alcohol exceeded the screening level in 7 of 10 samples. The maximum detected concentration was 0.22 mg/kg (EF = 3.9).

Benzyl alcohol exceedances above the Selected Sediment SL in sediment were delineated and are being addressed under the LDW ROD. Benzyl alcohol exceedances were flagged as estimated concentrations in the surface sediment samples, and benzyl alcohol is known to be a ubiquitous and naturally occurring compound. In a 2016 assessment of benzyl alcohol in marine sediments, USACE concluded that “Multiple lines of evidence suggest the occurrence of benzyl alcohol is not a significant cause of concern to the DMMP agencies” (USACE, 2016). In the Final Remedial Design Report for the LDW Upper Reach (Windward and Anchor QEA, 2024), benzyl alcohol is not identified as requiring cleanup in the adjacent sediments. The Source Control Evaluation Memorandum and its Addendum (Aspect, 2022c and 2024b) did not identify a concern for recontamination of sediments from SVOCs at the Site under existing conditions.

7.6.5 Summary of SVOC Occurrences

SVOCs exceeding Proposed RI CULs in shallow soils are limited across the Site, with the highest concentrations detected in the South Area. SVOC exceedances in soil deeper than 3 feet bgs are generally limited to the Pond Area.

BEHP was the only SVOC detected above Proposed RI CULs in groundwater. BEHP exceedances in groundwater were limited to samples from Fill Unit wells in the Pond Area, samples from one Fill Unit well in the center of the Central Area, and a sample from one Alluvial Unit well on the upgradient edge of the Site. BEHP was not detected in groundwater at concentrations exceeding the Proposed RI CULs along the shoreline, or in any Alluvial Unit wells other than the upgradient well.

The extent of SVOCs in soil and groundwater at the Site has been sufficiently delineated for the purposes of the RI. The RI data bound the extent of SVOCs that exceed Proposed RI CULs to the north and west. Exceedances in soil along the southern property boundary are bounded because contaminated soil on the adjacent property was removed under the T-117 EAA Upland Removal and in Dallas Avenue South and its ROWs under the SPU independent action. The maximum vertical extent of SVOC exceedances in soil has been bounded and is approximately 17 feet bgs.

Benzyl alcohol was the only SVOC that is a Site COPC identified in sediments adjacent to the SPM Property above sediment screening levels; benzyl alcohol exceedances in sediment were delineated and are being addressed under the LDW ROD. The Source Control Evaluation Memorandum and its Addendum (Aspect, 2022c and 2024b) did not identify a concern for recontamination of sediments from SVOCs at the Site. Potential transport pathways between the upland and sediments are further discussed in Section 8.

7.7 Pesticides

Site COPCs include the following pesticides: 4,4’-DDE, 4,4’-DDT, aldrin, alpha-BHC, cis-chlordane, dieldrin, endrin aldehyde, heptachlor, and trans-chlordane. Aldrin, dieldrin, and 4,4’-DDE were identified in Section 6.2.7 as Key Site COPCs, as they were the pesticides most frequently detected at concentrations above Proposed RI CULs in soil and groundwater.

The distribution of pesticides in soil is shown on Figure 7.7.A (aldrin, vadose zone), Figure 7.7.B (dieldrin, vadose zone), Figure 7.7.C (4,4'-DDE, vadose zone), Figure 7.7.D (aldrin, saturated zone), Figure 7.7.E (dieldrin, saturated zone), and Figure 7.7.F (4,4'-DDE, saturated zone). The vertical distribution of aldrin, dieldrin, and 4,4'-DDE in soil in the Pond Area is shown on Figure 7.7.G, Figure 7.7.H, and Figure 7.7.I, respectively. Locations where Non-Key Pesticide COPC concentrations exceeded Proposed RI CULs in soil, but Key Pesticide COPCs did not, are shown on Figure 7.7.J.

The distribution of pesticides in groundwater is shown on Figures 7.7.K (aldrin, Fill Unit), 7.7.L (dieldrin, Fill Unit), 7.7.M (4,4'-DDE, Fill Unit), 7.7.N (aldrin, Alluvial Unit), 7.7.O (dieldrin, Alluvial Unit), and 7.7.P (4,4'-DDE, Alluvial Unit). Locations where Non-Key Pesticide COPC concentrations exceeded Proposed RI CULs in groundwater, but Key Pesticide COPCs did not, are shown on Figure 7.7.Q.

Table J.7 contains summary statistics for pesticide COPCs by Site Area and media. Occurrences of pesticides by Site Area are described below.

7.7.1 Pesticides in the South Area

Soil. A total of 88 soil samples (36 vadose zone, 52 saturated zone) collected from 36 locations in the South Area were analyzed for pesticides. The highest concentrations of pesticides were detected in the Pond Area.

Maximum detected concentrations and frequency of exceedance for each pesticide exceeding Proposed RI CULs in soil are summarized below.

Analyte	Proposed RI CUL (mg/kg)	Frequency of Exceedance	Maximum Detected Concentration				
			Conc. (mg/kg)	EF	Location	Depth (ft bgs)	Geologic Unit
Vadose Zone Soil							
4,4'-DDE	0.0010	25%	0.75	750	MW-16	0 - 1	Fill
4,4'-DDT	0.0010	25%	4.0	4,000	SB-16	3.5 - 4	Fill
Aldrin	0.0017	22%	3.5	2,100	SB-11	2.5 - 2.75	Fill
Dieldrin	0.0010	22%	0.92	920	SB-14	3 - 3.5	Fill
Saturated Zone Soil							
4,4'-DDE	0.0010	27%	0.39	390	SB-14	7.5 - 8	Fill
4,4'-DDT	0.0010	12%	1.6	1,600	SB-13	7 - 7.5	Tidal Flat
Aldrin	0.0017	37%	20.3	12,000	MW-05	6 - 7	Fill
Alpha-BHC	0.00050	5%	0.014	28	MW-04	13.5 - 14.5	Alluvial
cis-Chlordane	0.00050	2%	0.047	94	SB-21	9	--
Delta-BHC	0.0048	5%	0.056	12	SB-22	10	--
Dieldrin	0.0010	27%	3.1	3,100	MW-05	6 - 7	Fill
Endrin Aldehyde	0.011	5%	0.16	15	MW-05	6 - 7	Fill
Heptachlor	0.00050	6%	0.017	34	SB-22	10	--
trans-Chlordane	0.0017	2%	0.18	110	SB-21	9	--

In the vadose zone, exceedances of Key Pesticide COPCs aldrin and dieldrin in soil were generally in samples collected within the Pond Area, except for samples from SB-36, located farther west of the pond (Figures 7.7.A and 7.7.B). Exceedances of Key Pesticide

COPC 4,4’-DDE were also generally in samples collected within the Pond Area, except for samples from SB-08 and SB-38, west of the pond (Figure 7.7.C).

In the saturated zone, all aldrin and dieldrin exceedances in soil were in samples collected within the Pond Area except for a sample at SB-07, located north of the Pond Area (Figures 7.7.D and 7.7.E). Exceedances of 4,4’-DDE in soil were also generally in samples collected within the Pond Area, except for samples from SB-35 and SB-36, west of the pond (Figure 7.7.F). All pesticide concentrations detected in soil in the saturated zone had EFs < 10.

Aldrin, dieldrin, and 4,4’-DDE concentrations within the Pond Area exceeding Proposed RI CULs occur throughout the Fill Unit, the Tidal Flat Unit, and the upper portion of the Alluvial Unit (Figures 7.7.G, 7.7.H, and 7.7.I). The maximum vertical extent of pesticide concentrations above Proposed RI CULs was 17 feet, in the sample from MW-04D.[84]

Samples with at least one pesticide COPC that exceeded Proposed RI CULs were collected at locations that included exceedances of a Key Pesticide COPC (aldrin, dieldrin, and 4,4’-DDE), with the following exceptions (Figure 7.7.J):

- 21F-SS-01 and 21F-SS-2, which were surface soil samples collected after the 2021 fire (0 to 0.07 feet bgs) and are located in the area affected by the 2021 fire. These samples contained concentrations of 4,4’-DDT of 0.014 mg/kg (EF = 14) and 0.0091 mg/kg (EF = 9.1), respectively.
- SB-02, north of the Pond Area, a sample contained a concentration of 4,4’-DDT of 0.0018 mg/kg (EF = 1.8) at 9 to 11 feet bgs.
- SB-05, northwest of the Pond Area, a sample contained a concentration of heptachlor of 0.00056 mg/kg (EF = 1.1) at 8 to 9 feet bgs.
- SB-12, in the Pond Area, a sample contained a concentration of 4,4’-DDT of 0.6 mg/kg (EF = 600) at 1.5 to 2 feet bgs.
- MW-18D, located along the western (upgradient) SPM Property boundary, a sample contained a concentration of alpha-BHC of 0.0073 mg/kg (EF = 15) at 24 to 24.5 feet bgs.

Except for MW-18D, these samples also exceeded the Proposed RI CUL for at least one Key Site COPCs discussed in other sections. At MW-18D, pesticides, including alpha-BHC, were not detected in any other soil interval and were also not detected in groundwater (the Proposed RI CUL for alpha-BHC is based on a leaching-to-groundwater pathway).

Groundwater. A total of 17 groundwater samples (8 Fill Unit, 9 Alluvial Unit) collected from 11 wells (4 Fill Unit, 7 Alluvial Unit) in the South Area were analyzed for pesticides. 4,4’-DDE, 4,4’-DDT, aldrin, alpha-BHC, and dieldrin were detected in groundwater at concentrations above Proposed RI CULs in at least one sample.

[84] Aldrin exceedances were detected in two deeper samples at MW-05; however, cross-contamination from carry-down during drilling in these samples was suspected, and aldrin was not detected in follow-up sampling at similar intervals at MW-05D, located adjacent to MW-05.

Maximum detected concentrations and the frequency of pesticides exceeding Proposed RI CULs in groundwater are summarized below.

Analyte	Proposed RI CUL (ug/L)	Frequency of Exceedance	Maximum Detected Concentration			
			Conc. (ug/L)	EF	Location	Date
Fill Groundwater Unit						
4,4'-DDE	0.0013	13%	0.014	11	MW-04	10/27/22
Aldrin	0.00063	38%	0.78	1,200	MW-04	10/27/22
Alpha-BHC	0.00063	13%	0.0031	4.9	MW-06	03/29/22
Dieldrin	0.0013	88%	0.071	55	MW-06	10/26/22
Alluvial Groundwater Unit						
4,4'-DDT	0.0013	22%	0.0022	1.7	MW-02	10/09/07
Aldrin	0.00063	44%	0.019	30	MW-04D	10/26/22
Dieldrin	0.0013	78%	0.11	85	MW-04D	10/26/22

All groundwater sample locations in the South Area except MW-18D (located along the upgradient edge of the SPM Property) had at least one sample with a pesticide exceedance. Pesticide concentrations above Proposed RI CULs in Fill Unit and Alluvial Unit groundwater samples from the South Area are summarized as follows:

- In the Fill Unit:
  - 4,4-DDE concentrations exceeded in one sample from MW-04.
  - Aldrin concentrations exceeded in samples from two wells, MW-04 and MW-05.
  - Dieldrin concentrations exceeded in samples from four wells, MW-04, MW-05, MW-06, and MW-16.
- In the Alluvial Unit:
  - 4,4'-DDT concentrations exceeded in samples from two wells, MW-02 and MW-03.[85]
  - Aldrin concentrations exceeded in samples from two wells, MW-04D and MW-5D.
  - Dieldrin concentrations exceeded in samples from six wells, MW-02, MW-03, MW-04D, MW-05D, MW-06D, and MW-16D.

7.7.2 Pesticides in the Central Area

Soil. A total of 38 soil samples (23 vadose zone, 15 saturated zone) collected from 21 locations in the Central Area were analyzed for pesticides. Maximum detected

[85] MW-02 and MW-03 were decommissioned in 2008; groundwater data from these locations may not be representative of current conditions.

concentrations and the frequency of exceedance for each SVOC exceeding Proposed RI CULs in soil are summarized below.

Analyte	Proposed RI CUL (mg/kg)	Frequency of Exceedance	Maximum Detected Concentration				
			Conc. (mg/kg)	EF	Location	Depth (ft bgs)	Geologic Unit
Vadose Zone Soil							
4,4'-DDE	0.0010	9%	0.0092	9.2	HA-03	0 - 1	Fill
4,4'-DDT	0.0010	17%	0.017	17	HA-03	0 - 1	Fill
Alpha-BHC	0.0005	9%	0.032	64	HA-03	0 - 1	Fill
cis-Chlordane	0.0005	9%	0.016	32	HA-06	0 - 1	Fill
Dieldrin	0.0010	9%	0.0094	9.4	SB-40	0 - 1	Fill
trans-Chlordane	0.0017	9%	0.014	8.2	HA-06	0 - 1	Fill
Saturated Zone Soil							
4,4'-DDT	0.0010	7%	0.0036	3.6	SB-10	14 - 15	Tidal Flat

In the vadose zone, the maximum depth with an exceedance in soil above the Proposed RI CULs was in the sample collected from HA-03, at 2 to 3 feet bgs; all other exceedances were from samples collected from 0 to 1 foot bgs.

In the saturated zone, only one soil sample, from SB-10, in the Central Area exhibited a pesticide exceedance: 4,4'-DDT was detected at a concentration of 0.0036 mg/kg (EF = 3.6) at 14 feet bgs. 4,4'-DDT was not detected in the groundwater sample from MW-15, installed adjacent to SB-10 (the Proposed RI CUL for 4,4'-DDT is based on a leaching-to-groundwater pathway).

Samples in the Central Area with at least one pesticide COPC that exceeded Proposed RI CULs were collected at locations that included exceedances of a Key Pesticide COPC (aldrin, dieldrin, and 4,4'-DDE), except for SB-10 noted above and the following location (Figure 7.7.J):

- HA-07, where a sample contained a concentration of 4,4'-DDT at 0.0045 mg/kg (EF = 4.5) at 0 to 1 foot bgs.

Groundwater. A total of 20 groundwater samples (14 Fill Unit, 6 Alluvial Unit) collected from 15 wells in the Central Area (9 Fill Unit, 6 Alluvial Unit) were analyzed for pesticides. Maximum detected concentrations and the frequency of pesticides exceeding Proposed RI CULs in groundwater are summarized below.

Analyte	Proposed RI CUL (ug/L)	Frequency of Exceedance	Maximum Detected Concentration			
			Conc. (ug/L)	EF	Location	Date
Fill Groundwater Unit						
Aldrin	0.00063	15%	0.0032	5.1	MW-11	03/30/21
Alpha-BHC	0.00063	23%	0.0038	6.0	MW-15	03/30/21

No pesticides were detected in the Alluvial Unit. Pesticide concentrations exceeding Proposed RI CULs in Fill Unit groundwater samples from the Central Area are summarized as follows:

- Aldrin concentrations exceeded in samples from two wells in March 2021; MW-08 (0.0027 ug/L, EF = 4.3) and MW-11 (0.0032 ug/L, EF = 5.1), but was not detected at these wells in October 2022.
- Alpha-BHC concentrations exceeded in samples from three wells in March 2021; MW-08 (0.0027 ug/L, EF = 4.3), MW-11 (0.0033 ug/L, EF = 5.2), and MW-15 (0.0038 ug/L, EF = 6.0), but was not detected at these wells in October 2022.

It is possible that these exceedances, which were only detected in the initial sampling event following installation of the wells, were affected by installation bias, as is similarly suspected for the PCB results (see Section 7.2.1) and may not be representative of groundwater quality; pesticides were not detected in soil at these locations. For the purposes of the RI, the exceedances were retained for assessment of potential exposure pathways in Section 8. At shoreline wells MW-08 and MW-11, the variability of the results could also reflect variability from tidal cycles; however, well MW-15 is not tidally influenced.

7.7.3 Pesticides in the Northwest Area

Soil. Two soil samples (all in the vadose zone) collected from one location (MW-13D) in the Northwest Area were analyzed for pesticides. Pesticides were not detected in those samples.

Groundwater. Four groundwater samples (2 Fill Unit, 2 Alluvial Unit) collected from four wells (2 Fill Unit, 2 Alluvial Unit) in the Northwest Area have been analyzed for pesticides. No pesticides were detected in any of these samples.

7.7.4 Pesticides in Adjacent Sediments

Three pesticides were detected at concentrations above Selected Sediment SLs in sediment samples collected adjacent to the SPM Property: aldrin in surface sediment and aldrin, 4,4'-DDT, and trans-chlordane in subsurface sediment. Occurrences of these pesticides in sediment are discussed below.

Aldrin. The full sediment dataset includes five surface and 13 subsurface sediment samples collected from 12 locations analyzed for aldrin. All five surface sediment samples and six subsurface samples for aldrin were removed from the dataset based on their age, sediment removal, or being superseded by newer data. The refined sediment dataset includes seven subsurface samples analyzed for aldrin. Because of the limited aldrin data in the refined dataset, the distribution of data in the full dataset is also discussed below.

- **Surface Sediment.** Aldrin concentrations exceeded the Selected Sediment SL in one of five samples in the full dataset (maximum concentration of 0.046 mg/kg; EF = 4.8). There were no surface sediment samples analyzed for aldrin in the refined dataset. The sediment represented by the sample that exceeded the Selected Sediment SL was removed by dredging during the T-117 Early Action.

- **Subsurface Sediment.** Aldrin concentrations exceeded the Selected Sediment SL in 2 of 13 samples in the full dataset (maximum concentration of 0.0033 mg/kg; EF = 33). Aldrin was not detected in the seven samples in the refined dataset.

The distribution of aldrin concentrations in sediments compared to Selected Sediment SLs is shown on Figure H.8. The only sample located within the Marina Basin that exceeded the Selected Sediment SL was located in the Marina Corner and was removed by dredging during the T-117 Early Action.

4,4’-DDT. The full sediment dataset includes 5 surface and 11 subsurface samples collected from 10 locations analyzed for 4,4’-DDT. All five surface and five subsurface samples for 4,4’-DDT were removed from the refined dataset based on their age, sediment removal, or being superseded by newer data. The refined sediment dataset includes seven subsurface samples analyzed for 4,4’-DDT. Because of the limited 4,4’-DDT data in the refined dataset, the distribution of data in the full dataset is discussed below.

- **Surface Sediment.** 4,4’-DDT concentrations did not exceed the Selected Sediment SL in any of five samples in the dataset (no detections).
- **Subsurface Sediment**. 4,4’-DDT concentrations exceeded the Selected Sediment SL in two of 11 samples in the dataset, and in two of the seven samples in the refined dataset (maximum concentration of 0.02 mg/kg; EF = 200). Concentrations of 4,4’-DDT were not detected in the other samples analyzed. The samples that exceeded the Selected Sediment SL were collected in 2012 and located outside the Marina Basin at depths greater than 200 cm and were qualified as estimated values (J).

The distribution of 4,4’-DDT concentrations in sediments compared to Selected Sediment SLs is shown on Figure H.7. Due to the limited data, all surface and subsurface sediment data in the full dataset are included. The only exceedances are located outside the Marina Basin at depths of 200 to 270 cm, well below the deepest point of compliance in the LDW ROD (60 cm). Furthermore, these samples are over 10 years old, and as documented in the LDW RI/FS (Windward, 2010) and discussed in the Source Control Review Memorandum (Aspect, 2022c), sediments adjacent to the SPM Property are in a depositional stretch of the LDW; therefore, sediment quality is expected to improve over time due to deposition of clean sediments from further upstream.

Trans-Chlordane. The full sediment dataset includes one surface and nine subsurface samples collected from five locations analyzed for trans-chlordane. The surface and two subsurface samples for trans-chlordane were removed from the refined dataset based on their age, sediment removal, or being superseded by newer data. The refined sediment dataset includes seven subsurface samples analyzed for trans-chlordane. Because of the limited trans-chlordane data in the refined dataset, the distribution of data in the full dataset is discussed below:

- **Surface Sediment.** Trans-chlordane was not detected in the one surface sediment sample.

- **Subsurface Sediment**. Trans-chlordane concentrations exceeded the Selected Sediment SL in two of 11 samples in the full dataset (maximum concentration of 0.0025 mg/kg; EF = 25), and in none of the seven samples in the refined dataset.

The only exceedances are located outside the Marina Basin at depths of 200 to 270 cm, well below the deepest point of compliance in the LDW ROD (60 cm). Furthermore, these samples are over 10 years old, and as documented in the LDW RI/FS and discussed in the Source Control Review Memorandum (Aspect, 2022c), sediments adjacent to the SPM Property are in a depositional stretch of the LDW; therefore, sediment quality is expected to improve over time due to deposition of clean sediments from further upstream.

7.7.5 Summary of Pesticide Occurrences

Concentrations of pesticides that exceeded the Proposed RI CULs in soil are primarily located in the South Area. Concentrations of pesticides that exceeded the Proposed RI CUL in vadose soil are located throughout the South Area; concentrations that exceeded in saturated soil are generally limited to the Pond Area. Concentrations of pesticides exceeding Proposed RI CULs were also detected in the Central Area, generally in the upper 3 feet of soil.

Similar to soil, groundwater concentrations that exceeded the Proposed RI CULs for pesticides in the Fill Unit were identified throughout the South Area, while groundwater exceedances for pesticides in the Alluvial Unit were primarily in the Pond Area. Pesticides (EF < 7) were also detected in Fill Unit groundwater in the Central Area during the initial RI sampling event, but not in subsequent groundwater monitoring.

The extent of pesticides in soil and groundwater has been sufficiently delineated for the purposes of the RI. The RI data bound the extent of pesticide concentrations that exceed Proposed RI CULs to the north and west. Exceedances in soil samples along the southern SPM Property boundary are bounded because contaminated soil on the adjacent property and right-of-way were removed under the T-117 Early Action. The maximum vertical extent of pesticides at the Site has been bounded at approximately 17 feet, in the Pond Area.

Aldrin, 4,4'-DDT, and trans-chlordane were the only pesticides detected in sediment samples adjacent to the SPM Property above Selected Sediment SLs. Trans-chlordane and aldrin in subsurface sediment were not detected above Selected Sediment SL in the refined dataset; the only detections of these compounds above Selected Sediment SLs in the full dataset were in two samples collected in 1991 from outside the Marina Basin that were excluded from the refined dataset. The only sample that exceeded the Selected Sediment SL for aldrin in surface sediment was removed during the T-117 Early Action; the exceedances for 4,4'-DDT were all located at depths below potentially applicable points of compliance and at locations outside the Marina Basin.

7.8 Volatile Organic Compounds

Site COPCs include the following VOCs: 1,2,3-trichloropropane, 1,2-dichlorobenzene, benzene, methylene chloride, PCE, TCE, vinyl chloride, and total xylenes. PCE was identified in Section 6.2.7 as a Key Site COPC, as it was the most frequently detected exceeding Proposed RI CULs in soil and groundwater and had the highest magnitude of exceedance.

The distribution of PCE in soil is shown on Figure 7.8.A (vadose zone) and Figure 7.8.B (saturated zone). Locations where Non-Key VOC COPC concentrations exceeded Proposed RI CULs in soil, but PCE did not, are shown on Figure 7.8.C. The distribution of PCE in groundwater is shown on Figures 7.8.D (Fill Unit) and 7.8.E (Alluvial Unit). Locations where Non-Key VOC COPC concentrations exceeded Proposed RI CULs in groundwater, but PCE did not, are shown on Figure 7.8.F. PCE concentrations in soil gas and indoor air are shown on Figure 7.8.G.

Table J.8 contains summary statistics for VOC COPCs by Site Area and media. Occurrences of VOCs by Site Area are described below.

7.8.1 VOCs in the South Area

Soil. A total of 79 soil samples (35 vadose zone, 44 saturated zone) collected from 30 locations in the South Area were analyzed for VOCs. The highest concentrations of VOCs were detected in samples from the Pond Area.

Maximum detected concentrations and frequency of exceedance for each VOC exceeding Proposed RI CULs in soil are summarized below.

Analyte	Proposed RI CUL (mg/kg)	Frequency of Exceedance	Maximum Detected Concentration				
			Conc. (mg/kg)	EF	Location	Depth (ft bgs)	Geologic Unit
Vadose Zone Soil							
1,2-Dichlorobenzene	0.050	8%	0.31	6.2	SB-16	3.5 - 4	Fill
Benzene	0.0088	11%	0.078	8.9	SB-16	3.5 - 4	Fill
PCE	0.029	23%	2.7	93	SB-43	2.5 - 3.5	Fill
Total Xylenes	1.4	9%	68	49	SB-16	3.5 - 4	Fill
TCE	0.0044	14%	0.17	39	SB-11	2.5 - 2.75	Fill
Vinyl Chloride	0.0011	14%	0.87	791	SB-16	3.5 - 4	Fill
Saturated Zone Soil							
1,2-Dichlorobenzene	0.050	5%	0.11	2.2	SB-22	10	--
Benzene	0.0010	9%	0.016	16	SB-42	10 - 11	Tidal Flat
PCE	0.0016	25%	0.011	6.9	SB-35	11 - 12	Fill
Total Xylenes	1.4	2%	4.16	3.0	SB-42	10 - 11	Tidal Flat
TCE	0.0010	2%	0.0062	6.2	SB-42	10 - 11	Tidal Flat

The Key VOC COPC, PCE, exceeded Proposed RI Cleanup Levels in soil samples throughout the South Area in vadose soil (Figure 7.8.A) and saturated soil (Figure 7.8.B). Most PCE concentrations were less than 10 times the Proposed RI CUL. The maximum vertical extent of detected PCE exceedances was 12.5 feet at SB-26, located in the Pond Area.

All samples in the South Area with at least one VOC COPC exceeding Proposed RI CULs were collected at a location that included a PCE exceedance, with the following exceptions (Figure 7.8.C):

- Pond Area:

  - MW-04: benzene - 0.00356 mg/kg (EF = 3.6) at 10.5 to 11.5 feet bgs
  - MW-05D: benzene - 0.0076 mg/kg (EF = 7.6), at 10 to 11 feet bgs
  - SB-12: vinyl chloride - 0.0014 mg/kg (EF = 1.3) at 1.5 feet bgs
  - SB-15: vinyl chloride - 0.0027 mg/kg (EF = 2.5) at 3.5 feet bgs
  - SB-22: 1,2-dichlorobenzene - 0.11 mg/kg (EF = 2) at 10 feet bgs

- SB-38: TCE - 0.0048 mg/kg (EF = 1.1) at 0 to 1 foot bgs. PCE was detected in the same sample at a concentration below the Proposed RI CUL.

These locations had samples that contained an exceedance of at least one other Key COPC discussed in other sections.

Groundwater. A total of 17 groundwater samples (8 Fill Unit, 9 Alluvial Unit) collected from 11 wells in the South Area (4 Fill Unit, 7 Alluvial Unit) were analyzed for VOCs. PCE and vinyl chloride were detected at concentrations above the Proposed RI CULs in at least one sample. Maximum detected concentrations and the frequency of VOCs exceeding Proposed RI CULs in groundwater are summarized below.

Analyte	Proposed RI CUL (ug/L)	Frequency of Exceedance	Maximum Detected Concentration			
			Conc. (ug/L)	EF	Location	Date
Fill Groundwater Unit						
PCE	2.9	14%	2.99	1.0	MW-06	03/29/21
Vinyl Chloride	0.18	29%	0.35	1.9	MW-05	03/31/21

No exceedances were detected in groundwater in the Alluvial Unit. Occurrences in the Fill Unit groundwater are summarized as follows:

- PCE concentrations exceeded the Proposed RI CUL in the March 2021 sample from shoreline well MW-06. PCE was not detected in samples from this well in a subsequent monitoring event in October 2022.
- Vinyl chloride concentrations exceeded the Proposed RI CUL in two samples from MW-05 in March 2021 and October 2022.

The exceedance of vinyl chloride at MW-05 was the only location where a Non-Key COPC was detected above the Proposed RI CUL and PCE was not (Figure 7.8.F).

7.8.2 VOCs in the Central Area

Soil. A total of 49 soil samples (32 vadose zone, 19 saturated zone) collected from 21 locations in the Central Area were analyzed for VOCs.

Maximum detected concentrations and frequency of exceedance for each VOC exceeding Proposed RI CULs in soil are summarized below.

Analyte	Proposed RI CUL (mg/kg)	Frequency of Exceedance	Maximum Detected Concentration				
			Conc. (mg/kg)	EF	Location	Depth (ft bgs)	Geologic Unit
Vadose Zone Soil							
1,2,3-Trichloropropane	0.050	3%	0.15	3.0	MW-17	0 - 1	Fill
Saturated Zone Soil							
PCE	0.0016	26%	0.31	194	MW-09D	24 - 25	Alluvial
TCE	0.0010	26%	0.026	26	MW-09D	24 - 25	Alluvial

PCE concentrations did not exceed Proposed RI CULs in vadose zone soil in the Central Area (Figure 7.8.A). The only concentrations of PCE in saturated zone soil that exceeded the Proposed RI CULs were at MW-09 and MW-09D, along the shoreline (Figure 7.8.B). The maximum depth of detected PCE exceedance was 25 feet bgs at MW-09D (0.31 mg/kg); no deeper samples were analyzed for PCE at this location.

All samples in the Central Area with at least one VOC COPC exceeding Proposed RI CULs were at locations that included a PCE exceedance, except in the 0- to 1-foot bgs sample at MW-17, which had the 1,2-3-trichloropropane exceedance noted above (Figure 7.8.C). This location had samples that contained exceedances of at least one Key Site COPC discussed in other sections.

Groundwater. A total of 30 groundwater samples (22 Fill Unit, 8 Alluvial Unit) collected from 15 wells (9 Fill Unit, 6 Alluvial Unit) in the Central Area were analyzed for VOCs. PCE, TCE, and vinyl chloride concentrations were detected in groundwater above Proposed RI CULs in at least one sample. Maximum detected concentrations and the frequency of VOCs exceeding Proposed RI CULs in groundwater are summarized below.

Analyte	Proposed RI CUL (ug/L)	Frequency of Exceedance	Maximum Detected Concentration			
			Conc. (ug/L)	EF	Location	Date
Fill Groundwater Unit						
PCE	2.9	14%	28.1	9.7	MW-09	03/29/21
TCE	0.70	14%	15.2	22	MW-09	03/29/21
Alluvial Groundwater Unit						
PCE	2.9	44%	420	140	MW-09D	10/24/22
TCE	0.70	44%	120	170	MW-09D	10/24/22
Vinyl Chloride	0.18	22%	0.95	5.3	MW-19D	03/23/23

VOC exceedances of the Proposed RI CULs in Fill Unit and Alluvial Unit groundwater are summarized as follows:

- Fill Unit:
  - PCE concentrations exceeded the Proposed RI CUL in three samples from MW-09, in March 2021, October 2022, and March 2023.
  - TCE concentrations exceeded the Proposed RI CUL in three samples from MW-09 in March 2021, October 2022, and March 2023.

- Alluvial Unit:
  - PCE concentrations exceeded the Proposed RI CUL in four samples from MW-09D and MW-19D, in October 2022 and March 2023. The maximum concentration of PCE detected was 420 ug/L (EF = 140) at MW-09D and 140 ug/L (EF = 48) at MW-19D.
  - TCE concentrations exceeded the Proposed RI CUL in four samples from MW-09D and MW-19D in October 2022 and March 2023. The maximum concentration of TCE detected was 120 ug/L (EF = 170) at MW-09D and 11 ug/L (EF = 16) at MW-19D.
  - Vinyl chloride concentrations exceeded the Proposed RI CUL in two samples from MW-19D in October 2022 and March 2023. The maximum concentration of vinyl chloride detected was 0.95 ug/L (EF = 5.3).

All samples in the Central Area with a Non-Key COPC exceedance also had an exceedance for PCE (Figure 7.8.F).

7.8.3 VOCs in the Northwest Area

Soil. A total of 29 soil samples (10 vadose zone, 19 saturated zone) collected from 7 locations in the Northwest Area were analyzed for VOCs. Maximum detected concentrations and frequency of exceedance for each VOC exceeding Proposed RI CULs in soil are summarized below.

Analyte	Proposed RI CUL (mg/kg)	Frequency of Exceedance	Maximum Detected Concentration				
			Conc. (mg/kg)	EF	Location	Depth (ft bgs)	Geologic Unit
Vadose Zone Soil							
PCE	0.029	90%	1.9	66	MW-20	0.5 - 1.5	Fill
TCE	0.0044	10%	0.00471	1.1	MW-13	0 - 1	Fill
Saturated Zone Soil							
Benzene	0.0010	21%	0.01	10	MW-13D	35.5 - 36.5	Till
Methylene Chloride	2.6	5%	10.7	4.1	SB-31	13 - 14.5	Tidal Flat
PCE	0.0016	68%	18.7	11,688	SB-31	13 - 14.5	Tidal Flat
TCE	0.0010	53%	0.672	672	SB-31	19 - 20	Alluvial
Vinyl Chloride	0.0010	21%	0.0029	2.9	MW-22	13 - 13.75	Tidal Flat

The highest PCE concentrations in samples from the Northwest Area were detected along the western (upgradient) edge of the SPM Property and at MW-20 located west of the SPM Property, downgradient of the former dry cleaner. The highest concentrations in soil on the SPM Property were detected in the saturated zone. The maximum depth of PCE concentrations exceeding Proposed RI CULs was 20 feet bgs at SB-31; the maximum depth of TCE and vinyl chloride concentrations exceeding Proposed RI CULs in soil were 24 feet and 36.5 feet bgs, respectively, both at MW-13D.

All samples with at least one VOC COPC exceedance were collected at a location that included one or more samples with a PCE exceedance, except at MW-13D, which included exceedances of benzene (up to EF = 10), TCE (EF = 1.1), and vinyl chloride (up to EF = 1.6), as shown on Figure 7.8.C.

Groundwater. Eight groundwater samples (5 Fill Unit, 3 Alluvial Unit) collected from four wells (2 Fill Unit, 2 Alluvial Unit) in the Northwest Area were analyzed for VOCs. PCE, TCE, and vinyl chloride concentrations were detected in groundwater samples above Proposed RI CULs in at least one sample. Maximum detected concentrations and the frequency of VOCs exceeding Proposed RI CULs in groundwater are summarized below.

Analyte	Proposed RI CUL (ug/L)	Frequency of Exceedance	Maximum Detected Concentration			
			Conc. (ug/L)	EF	Location	Date
Fill Groundwater Unit						
PCE	2.9	100%	4640	1,600	MW-13	03/31/21
TCE	0.70	100%	280	400	MW-13	10/26/22
Vinyl Chloride	0.18	50%	1.2	6.7	MW-13	10/26/22
Alluvial Groundwater Unit						
PCE	2.9	100%	3300	1,100	MW-20	10/31/22
TCE	0.70	100%	42	60	MW-13D	10/26/22
Vinyl Chloride	0.18	50%	12	67	MW-13D	03/24/23

The spatial distribution of PCE in groundwater is shown on Figures 7.8.D (Fill Unit) and 7.8.E (Alluvial Unit). Occurrences in Fill Unit and Alluvial Unit groundwater are summarized as follows:

- Fill Unit:
  - PCE concentrations exceeded the Proposed RI CUL in five samples from MW-13 and MW-22.
  - TCE concentrations exceeded the Proposed RI CUL in five samples from MW-13 and MW-22.
  - Vinyl chloride concentrations exceeded the Proposed RI CUL in two samples from MW-13.
- Alluvial Unit:
  - PCE concentrations exceeded the Proposed RI CUL in four samples from MW-13D and MW-20.
  - TCE concentrations exceeded the Proposed RI CUL in four samples from the MW-13D and MW-20.
  - Vinyl chloride concentrations exceeded the Proposed RI CUL in two samples from MW-13D.

Soil Gas and Indoor Air. An assessment of the VI pathway was performed in the Tire Factory building due to the VOC detections in shallow groundwater and soil near the building, which is downgradient of the former dry cleaner. Six sub-slab soil gas samples were collected from four locations beneath the building, and four indoor air samples were collected from four locations inside the building, as shown on Figure 7.8.G. Sub-slab soil gas concentrations of PCE exceeded VI screening levels (based on commercial exposure) in four of the six samples, with a maximum concentration of 43,000 micrograms per cubic meter (ug/m^3) (EF = 29). PCE concentrations exceeded the Proposed RI CUL for indoor air for unrestricted land use in three of the four indoor air samples, with a maximum concentration of 4,700 ug/m^3 (EF = 490).

The highest sub-slab soil gas concentrations were below the western edge of the Tire Factory building, closest to the former dry cleaner, while the highest indoor air concentration was in the eastern portion of the building where sub-slab soil gas concentrations were below the screening level (commercial exposure). A subsequent facility investigation discovered significant sources of PCE (PCE-containing brake cleaner and a PCE solvent in a reusable spray can) and concluded that exceedances in indoor air were due to the presence and use of PCE solvent in tenant operations. Additional VI assessments may be needed if tenant operations change. Additional discussion of the VI pathway is discussed in the South Park Marina – Tire Factory Vapor Intrusion Assessment Results Memorandum (Aspect, 2023c) provided in Appendix K.

7.8.4 VOCs in Adjacent Sediments

Two sediment samples (both surface) collected from two locations in sediments adjacent to the SPM Property were analyzed for VOCs; no exceedances of Selected Sediment SLs were detected.

7.8.5 Summary of VOC Occurrences

VOCs with concentrations exceeding Proposed RI Cleanup Levels at the Site are primarily PCE, TCE, and vinyl chloride. The exceedances are generally located in the South Area, the Northwest Area, and in groundwater in a portion of the Central Area generally downgradient of the Northwest Area. VOC concentrations in the South Area are relatively low; most soil VOC concentrations have EFs less than 10, and only PCE and vinyl chloride concentrations were detected above Proposed RI CULs in groundwater (maximum EF of 1.9). The maximum vertical extent of VOCs exceeding Proposed RI CULs in the South Area is approximately 12.5 feet.

Higher concentrations of PCE (with EFs up to 12,000 in soil and 1,600 in groundwater), and associated compounds TCE and vinyl chloride,[86] were detected in soil and groundwater samples in the Northwest Area, including at MW-20, which is located west (upgradient) of the SPM Property and the Northwest Area. MW-20 is located downgradient of a former dry-cleaning operation (Section 2.4.3). The highest concentrations of PCE in soil on the SPM Property were detected in the saturated zone, downgradient of the former dry cleaner. The groundwater plume of PCE, TCE, and vinyl chloride extends downgradient to the shoreline at wells MW-09 and MW-09D, with the highest concentrations detected in the Alluvial Unit. Based on the vertical and lateral

[86] PCE and TCE are both used commercially as solvents, for example in dry-cleaning or degreasing. TCE can also be produced as a breakdown product of PCE in the environment. Vinyl chloride is a breakdown product of PCE and TCE; vinyl chloride is typically not used commercially except in chemical manufacturing.

distribution of PCE in soil and groundwater, the former dry cleaner located west of Dallas Avenue South is the suspected source of PCE and associated compounds in the Northwest Area and Central Area. The extent of PCE has not been bounded in soil or groundwater west of Dallas Avenue South in the vicinity of the former dry cleaner; this is not considered a data gap for the purposes of this RI. The vertical extent of the suspected upgradient dry-cleaner PCE plume has not been determined.

A VI assessment in the Tire Factory building did not identify a VI concern, under existing Site conditions, due to use of solvents by the current tenant; VI from the suspected dry cleaner plume in the Northwest Area is a potential concern if tenant operations change. VOC concentrations in Fill Unit groundwater in the Central Area and South Area are below VI SLs for commercial use,[87] and VOC concentrations in vadose zone soil in the Central Area are below Proposed RI CULs. VOC concentrations in vadose zone soil in the South Area may represent a potential VI concern; however, no enclosed, occupied structures are present in that area. Further assessment of the VI pathway for VOCs may be needed if Site conditions change.

[87] One vinyl chloride detection in Fill Unit groundwater (0.35 ug/L, at MW-05) exceeded the vapor intrusion screening level for residential use (0.33 ug/L).

8 Conceptual Site Model

This section describes the CSM, including Site physical setting, potential contaminant sources, pathways by which contaminants are transported between environmental media and from the SPM Property, the resulting contaminant distribution by media, and human and ecological receptors for an unrestricted Site use. The following terminology is used for describing the CSM:

- Exposure pathway: In accordance with WAC-173-340-200, "…an exposure pathway describes the mechanism by which an individual or population is exposed or has the potential to be exposed to hazardous substances at or originating from a site. Each exposure pathway includes an actual or potential source or release from a source, an exposure point, and an exposure route. If the exposure point differs from the source of the hazardous substance, the exposure pathway also includes a transport/exposure medium."
- Incomplete pathway: At least one element of the exposure pathway (i.e., source, transport pathway, exposure point/medium, exposure route, or receptor) does not exist.
- Potentially complete pathway: All elements of the exposure pathway may be present, but uncertainty exists:
    - Potentially complete pathway of concern: All components of an exposure pathway may be present, and resulting risk may be above acceptable levels.
    - Potentially complete pathway not of concern: All components of an exposure pathway may be present, but based on the available data, the resulting risk is below acceptable levels.

Section 8.1 summarizes the Site physical setting that is detailed in Sections 2 and 3. Section 8.2 describes the potential exposure pathways for the Site. A flowchart representation of Site exposure pathways is provided on Figure 8.1.

Sections 8.3, 8.4, and 8.5 describe elements of the CSM specific to the distinct sources, types, transport, and distribution of COPCs across the three defined Site Areas. Figures 8.2 and 8.3 are schematic representations of the CSM's physical features and pathways for contaminant transport and human/ecological exposure in the South Area and Northwest/Central Areas, respectively.

Table 8.1 summarizes Site COPCs in each media and the potential applicability of screening levels, based on the exposure pathway analysis, in each area. The sediment, surface water, and indoor air pathways presented in Table 8.1 are a combination of exposure pathway for the environmental media plus the transport pathway by which contaminants migrated to that media from other media, consistent with the basis for development of the Proposed RI Cleanup Levels. For the headers in Table 8.1, the exposure media is the first term (soil, sediment, surface water [abbreviated SW], and indoor air [abbreviated IA]).

8.1 Site Physical Setting

The Site is located along the west side of the LDW between River Miles 3.3 and 3.5, and is bordered on the north by Thistle Avenue, on the east by the LDW, on the south by Duwamish River People's Park (formerly T-117), and on the west by Dallas Avenue South. The 3.7-acre SPM Property is relatively flat, sloping from an elevation of approximately 20 feet along Dallas Avenue South on the west to elevations of 14 to 15 feet along the shoreline on the east. Approximately 2.6 acres of the SPM Property is impervious (pavement or building roofs), and 1.1 acres is covered with a combination of soil, grass, and/or gravel. The SPM Property's LDW shoreline is armored with an ecology block retaining wall and riprap along its base. The top of the block wall is above the ground surface inland of it, and thus it currently prevents direct overland flow of stormwater into the LDW.

Stormwater at the SPM Property is managed under SPM's NPDES Boatyard General Permit WAG030045. Currently, approximately 99 percent of the SPM Property falls within four[88] stormwater areas defined in Section 2.3.2.2: the Northern, Central, and Southern Catchment Areas; and the Shoreline Area (a narrow area of gravel along the block wall). Current operations in the Central and Southern Catchment Areas and the Shoreline Area are primarily boat maintenance and storage, with a small portion of auto repair in the northwest corner; the primary operation in the Northern Catchment Area is auto repair. Currently, stormwater drainage to the LDW occurs as follows (see Figure 2.4): from the northern catchment via a King County storm drain to Outfall OF-2215; from the central catchment to the SPM Outfall; and from the southern catchment via the StormwateRx™ system and then Unnamed Outfall UOF-1. Stormwater infiltrates the ground within the eastern gravel area (Figure 2.4). Since 2023, SPM has been designing and permitting improvements to the stormwater system within the central catchment area. The infrastructure improvements will include replacement of selected catch basins and conveyance piping, replacement of the SPM Outfall in the same location, and installation of a second above-ground filtration system plumbed between the new capture/conveyance system and the new SPM Outfall. Discussions about project permitting and design are ongoing.

The interpreted geologic units underlying the Site include, from surface down: Fill Unit, Tidal Flat Unit, Alluvial Unit, and Glacial Till Unit.

- The Fill Unit is comprised of variable percentages of sand, silt, and anthropogenic debris, with an average thickness of approximately 10 feet. Within the South Area, the material historically used to fill the Former A&B Barrel Pond extends to a depth of approximately 10 feet (Figure 3.3) and is distinct from the rest of the Fill Unit, containing a high percentage of anthropogenic debris and abundant chemical sheens and odors.

- The Tidal Flat Unit is present beneath the Fill Unit across most of the SPM Property, excluding its westernmost portion and a small area along the eastern shoreline (Figure 3.2). Where present, the Tidal Flat Unit ranges in thickness

[88] Three smaller drainage areas comprise the remaining 1 percent of the SPM Property as described in Section 2.3.2.2.

from approximately 0.5 to 10.5 feet and generally consists of organic-rich silt and silty sand, commonly with a sulfur-like odor.

- The Alluvial Unit is present beneath the entire SPM Property, including areas where the Tidal Flat Unit is absent. The Alluvial Unit is comprised of poorly graded sand with trace to little silt. The thickness of the Alluvium Unit was documented at up to 17 feet where fully penetrated in the southeast, southwest, and northwest corners of the SPM Property.
- The Glacial Till Unit is present beneath the Alluvial Unit. The upper surface of the Glacial Till Unit was observed to dip northward from depths of 20 to 24 feet bgs near the SPM Property's southern boundary to about 35 feet bgs in its northwest corner. Where observed, the Glacial Till Unit is a dense/stiff (glacially overridden), unsorted mixture of predominantly silt with sand and trace gravel.

Across most of the Site, the Fill Unit and Alluvial Unit are distinct water-bearing zones, vertically separated by the Tidal Flat Unit that functions as an aquitard that restricts but does not prevent vertical flow of groundwater. The relatively large vertical (downward) gradients from the Fill Unit to the Alluvial Unit measured during Site tidal studies confirm that the intervening Tidal Flat Unit, where present, functions as an aquitard. The Glacial Till Unit is saturated but because it has much lower permeability than the Fill Unit or Alluvial Unit, it is considered an aquitard that restricts downward movement of groundwater.

Where saturated, the Fill Unit occurs under unconfined (water-table) conditions, with a water table depth ranging from approximately 6 to 14 feet bgs (elevations approximately 4 to 9 feet). Water levels in the Fill Unit near the shoreline are influenced by tidal fluctuations in the adjacent LDW; the magnitude of tidal response diminishes to negligible within roughly 150 feet of the shoreline. The Fill Unit along the shoreline nearly or completely drains (becomes unsaturated) during lower-low tidal stages. As such, the saturated thickness of the Fill Unit along the shoreline ranges from 0 to approximately 4 to 5 feet depending on location, season, and tidal stage.

Where the Tidal Flat Unit is present, the Alluvial Unit occurs under confined conditions with observed saturated thickness ranging from 5 feet in the Pond Area to greater than 20 feet on the north end of the SPM Property (where the bottom of the Alluvial Unit was not confirmed but is expected to be 60 feet bgs or greater based on nearby geotechnical borings for the South Park Bridge). Because of the confined conditions, the LDW's tidal (pressure) fluctuations are transmitted much more efficiently in the Alluvial Unit than in the Fill Unit, with small tidal responses observed in Alluvial Unit wells near the west side of the SPM Property. While Alluvial Unit water levels fluctuate in response to tides across the SPM Property, mixing of Alluvial Unit groundwater with LDW surface water (Alluvial Unit transitional zone) appears limited to within approximately 100 feet of the shoreline based on specific conductivity data collected during the tidal studies.

Where the Tidal Flat Unit is absent in the westernmost portion of the Site, a single water-bearing unit occurs under water table conditions. In that area, a thin zone of saturation may occur within the base of the fill, but the majority of the saturated thickness occurs within the alluvium (e.g., Figures 3.4 and 3.5).

The Site tidal studies confirm that Site groundwater in the Fill Unit and Alluvial Unit discharges to the LDW during lower tidal stages. During higher tidal stages, the groundwater flow direction along the shoreline in both Units reverses from outgoing to incoming, but the condition is temporary. Based on a comparison of the elevation of surface water in the LDW to the elevation of groundwater in shoreline monitoring wells over a 6-day period during the Phase 2 tidal study, the hydraulic gradient is reversed for the following periods in each Unit:

- Fill Unit: The hydraulic gradient is incoming approximately 26 to 29 percent of each day at the southern end of the shoreline at MW-06 and MW-07, compared to 42 to 43 percent of each day at central and northern portions of the shoreline at MW-09, MW-10, and MW-11. The hydraulic gradient was calculated as incoming approximately 48 percent of each day at MW-08, but these results are not comparable because MW-08 is screened at a different elevation than the other shoreline wells (Figure 3.4) and the Tidal Flat Unit is absent in this portion of the shoreline (Figure 3.2).
- Alluvial Unit: The hydraulic gradient is incoming approximately 50.3 to 49.8 percent of each day at shoreline monitoring wells MW-06D, MW-08D, and MW-09D. The data from MW-11D was not suitable for this analysis, since the datalogger intermittently malfunctioned. It is important to note that while the hydraulic gradient spends about an equal amount of time between incoming and outgoing, the magnitude of the gradient is much greater during the outgoing portion of each day, resulting in overall discharge to the LDW.

As demonstrated by the tidal studies, the tidally averaged hydraulic gradient in both the Fill Unit and Alluvial Unit results in overall discharge to the LDW. The L-shaped sheet pile wall installed in the Site's southeast corner in 2015 does not prevent all flow of groundwater through it. However, the wall restricts flow enough to result in higher groundwater elevations behind the wall, reduce intermixing between groundwater and LDW surface water (as evidenced by specific conductivities), and locally alter the flow of groundwater in both the Fill and Alluvial Units prior to discharge to the LDW.

Groundwater discharge to the LDW in both the Fill Unit and Alluvial Unit is controlled by a combination of hydraulic conductivity, hydraulic gradient, and cross-sectional area to flow. The horizontal hydraulic gradient in the Fill Unit (0.007 to 0.014 foot/foot) is slightly larger than the Alluvial Unit (0.003 to 0.010 foot/foot). However, the cross-sectional area to flow in the Alluvial Unit is much larger than in the Fill Unit, and the hydraulic conductivity of the Alluvial Unit is likely higher than the Fill Unit. Thus, groundwater discharge to the LDW from the Alluvial Unit is expected to be significantly greater than discharge from the Fill Unit.

8.2 Potential Exposure Pathways for Site

As described above, exposure pathways include a source, exposure point/medium, transport pathway (if the exposure point is different than the source), exposure route, and receptor. The pathways by which the potential human and ecological receptors may be exposed to Site COPCs are listed below. Each of these receptor/exposure pathway combinations, illustrated schematically on Figures 8.2 and 8.3, are hypothetical, based on

MTCA exposure assumptions implicit in the SLs and Proposed RI CULs applied in this RI; the exposure pathways consider current and potential future non-industrial uses of the Site. Section 8.3 describes and evaluates exposure pathways specific to different areas of the Site.

8.2.1 Potential Sources

Potential sources of COPCs at the Site include historical and current operations at the Site and surrounding properties that involved storage, use, or management of chemical products, by-products, or wastes that may have been released to the environment. Specific potential sources by Site area are described in Sections 8.4.1, 8.5.1, and 8.6.1.

8.2.2 Exposure Points

An exposure point is the physical location where a receptor could be exposed to a contaminant, and includes environmental media (soil, groundwater, sediment, indoor air) and organisms.

8.2.3 Transport Pathways

Transport pathways are mechanisms by which contaminants move from one environmental medium to a different exposure point. Potential transport pathways at the Site include

- volatilization of contaminants from vadose soil or shallow groundwater to soil gas;
- sorption of contaminants in soil gas to soil;
- movement of contaminants in soil gas to indoor air via advection or diffusion;
- leaching of contaminants from soil to groundwater;
- movement of contaminants in groundwater to surface water via advection, dispersion, or diffusion;
- sorption of contaminants in groundwater to soil or sediment;
- erosion of contaminated soils to sediment; and
- bioaccumulation of contaminants through the food chain via sorption into tissues.

8.2.4 Potential Human and Ecological Receptors

The Site's current non-industrial land use is described in Section 2.3. Based on the Site's current and potential future land uses, potential human receptors of Site COPCs are as follows:

- Residents, recreational users, and commercial workers
- Humans who consume marine organisms from the LDW

Potential ecological receptors of Site COPCs are as follows:

- Terrestrial ecological receptors (wildlife)

- Benthic organisms (e.g., shellfish) in LDW sediment
- Aquatic organisms (e.g., fish) in LDW surface water
- Higher trophic level ecological receptors (e.g., river otters, seals, birds) that consume marine organisms

8.2.5 Potential Exposure Routes

Potential exposure routes are listed below by media.

8.2.5.1 Soil

- Human direct contact[89] with soil containing Site COPCs
- Terrestrial ecological receptor direct contact with soil containing Site COPCs

8.2.5.2 Indoor Air

- Human inhalation of air containing vapor-phase Site COPCs within occupied structures (indoor air)

8.2.5.3 LDW Sediment

The following are potential exposure routes for LDW sediment identified in the LDW ROD (EPA, 2014):

- Benthic organism direct contact with LDW sediment containing Site COPCs
- Higher trophic level ecological receptors consumption of benthic organisms, fish, and/or LDW sediment containing Site COPCs
- Human consumption of fish and shellfish exposed to LDW sediment containing Site COPCs
- Human incidental ingestion and dermal contact with LDW sediment containing Site COPCs

8.2.5.4 LDW Surface Water

The following are potential exposure routes for LDW surface water identified in the LDW ROD (EPA, 2014):

- Benthic organism and fish direct contact with LDW surface water containing Site COPCs
- Higher trophic level ecological receptor consumption of benthic organisms, fish, and/or LDW surface water containing Site COPCs
- Human consumption of fish and shellfish exposed to LDW surface water containing Site COPCs

[89] Incidental ingestion of soil, assuming a residential child for conservatism.

8.3 Evaluation of Exposure Pathways by Site Area

Table 8.1 presents, for each Site Area, the COPCs[90] by media, their corresponding Proposed RI CULs and the basis of the Proposed RI CUL and evaluates the concentrations and spatial occurrence of COPCs relative to pathway-specific screening levels to determine which COPCs in each area are potentially of concern under current or potential future use. This table does not present a comprehensive evaluation of all exposure pathways; in some cases, the pathway evaluated is a transport pathway that is a component of multiple potential exposure pathways but does not (for example) distinguish between different receptors. The purpose of this evaluation is to identify exposure pathways or specific elements of exposure pathways (e.g., transport pathways) that may be complete and of potential concern, and which pathway-specific screening levels may be applicable to different areas of the Site, to support development of cleanup levels and remedial alternatives in a future FS.

To be conservative, a pathway or pathway component was retained as potentially complete if there was any exceedance of a potentially applicable screening level, unless empirically demonstrated to be incomplete. Data that were suspected to exhibit high bias as discussed in Section 7 were included, and no statistical analysis was performed to evaluate compliance.[91]

Pathway or pathway components that may be affected by Site conditions that are subject to change (e.g., pavement over contaminated soils, the sheet pile wall reducing groundwater discharge, or the absence of residences above groundwater contaminated with VOCs) were identified as potentially complete in the future in areas where the potentially applicable SLs were exceeded.

Table 8.1 summarizes whether potential exposure pathways or pathway components for COPC occurrences in the South Area, Central Area, and Northwest Area are (1) incomplete, (2) potentially complete but not of concern, (3) potentially complete and of concern, or (4) if incomplete or not of concern if it may be potentially complete and potentially of concern under future conditions.

Pathways and pathway components were evaluated as described below.

8.3.1 Human Direct Contact with Soil

COPC concentrations detected in soil, at the standard point of compliance (0 to 15 feet bgs), are compared to direct contact soil screening levels (SL-1 in the PCUL Workbook), or the Proposed RI CUL (if adjusted to PQL or natural background and SL-1 is lower). The following rules apply for each COPC:

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[90] All Site COPCs are presented for the media in which they are identified as COPCs (see Table 6.6), except individual cPAHs, total PCB congeners and TEQ, 2,3,7,8-TCDD, and TPH-D and TPH-O. These COPCs are considered to be adequately evaluated by the associated Key COPCs of total cPAH TEQ, total PCB Aroclors, total dioxin/furan TEQ, and TPH-D+O, respectively.

[91] Statistical analysis was used in Section 6 for determining COPCs but was not used in this section for determining pathways of concern.

- If the COPC is not detected in the upper 15 feet of soil, the direct contact pathway is considered incomplete.
- If a COPC is detected but there is no SL-1 screening level, or if the maximum concentration detected in soil does not exceed SL-1 (or the Proposed RI CUL, if higher), the direct contact pathway is considered potentially complete but not of concern.
- If the maximum concentration detected in soil exceeds SL-1, then the direct contact pathway is considered potentially complete and of concern.

8.3.2 Terrestrial Ecological Exposure via Direct Contact with Soil

COPC concentrations detected in soil at the standard point of compliance (0 to 15 feet bgs) are compared to TEE soil screening levels (SL-9 in the PCUL Workbook, updated with Site-specific TEE values [Section 6.2.2.2]), or the Proposed RI CUL (if adjusted to PQL or natural background and SL-9 is lower). The following rules apply for each COPC:

- If the COPC is not detected in the upper 15 feet of soil, the TEE pathway is considered incomplete.
- If there is no SL-9 screening level, or if the maximum concentration in soil does not exceed SL-9 (or the Proposed RI CUL, if higher), the TEE pathway is considered potentially complete but not of concern.
- If the maximum concentration in soil exceeds SL-9 (or the Proposed RI CUL, if higher), then the TEE pathway is considered potentially complete and of concern.

8.3.3 Transport to Sediment via Erosion

COPC concentrations detected in soil, at the standard point of compliance (0 to 15 feet bgs), are compared to protection of sediment screening levels based on erosion (SL-8 in the PCUL Workbook), or the Proposed RI CUL (if adjusted to PQL or natural background and SL-8 is lower). The following rules apply for each COPC:

- If a COPC is not detected in soil or in sediment, exposure pathways that include the erosion-to-sediment transport pathway are considered incomplete.
- If there is no SL-8 screening level, or if the maximum concentration in soil does not exceed SL-8 (or the Proposed RI CUL, if higher), exposure pathways that include the erosion-to-sediment transport pathway are considered potentially complete and not of concern.
- If the maximum concentration in soil exceeds SL-8 (or the Proposed RI CUL, if higher), but the maximum concentration of that COPC in sediment in the Marina Basin is below Selected Sediment SLs, exposure pathways that include the

erosion-to-sediment transport pathway are considered potentially complete and not of concern, but potentially of concern in the future.[92]

- If concentrations in soil exceed SL-8 (or the proposed RI CUL, if higher), and the maximum concentration of that COPC in sediment in the Marina Basin is above Selected Sediment SLs, exposure pathways that include the erosion-to-sediment transport pathway are considered potentially complete and of concern.

8.3.4 Transport to Sediment via Groundwater

Maximum COPC concentrations detected in groundwater at shoreline wells[93] and non-shoreline Pond Area wells[94] are compared to the groundwater protection of sediment screening level (GW-3), or the Proposed RI CUL (if adjusted to PQL or natural background and GW-3 is lower); maximum COPC concentrations in sediment in the Marina Basin are compared to Selected Sediment SLs. The following rules apply for each COPC:

- If a COPC is not detected in groundwater at shoreline wells or is not detected in sediment, then exposure pathways that include the groundwater-to-sediment transport pathway are considered incomplete.
- If a COPC is detected in groundwater at shoreline wells and is detected in sediment, but the maximum concentration in groundwater at shoreline wells does not exceed GW-3 (or the next Proposed RI CUL, if higher), or the maximum COPC concentration detected in sediment is below the Selected Sediment SL, exposure pathways that include the groundwater-to-sediment transport pathway are considered potentially complete but not of concern.
- If the maximum COPC concentration in groundwater at shoreline wells exceeds GW-3 (or the Proposed RI CUL, if higher), and the maximum concentration of that COPC in sediment in the Marina Basin is above Selected Sediment SLs, exposure pathways that include the groundwater-to-sediment transport pathway are considered potentially complete and potentially of concern.
- If exposure pathways that include the groundwater-to-sediment pathway are currently incomplete or potentially complete but not of concern, but the maximum COPC concentration detected in non-shoreline Pond Area wells exceeds GW-3 (or the Proposed RI CUL, if higher), those exposure pathways may be potentially complete and potentially of concern under future conditions.

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[92] Engineering controls are currently in place that mitigate erosion of soil to sediment, but there is no guarantee those controls will continue into the future.

[93] Shoreline wells include MW-06, MW-06D, MW-07, MW-08, MW-09, MW-09D, MW-10, MW-11, and MW-11D.

[94] Non-shoreline Pond Area wells include MW-04D, MW-05 and MW-05D. Groundwater at the Site is generally considered to be representative of current and potential future conditions. However, engineering controls are present in the Pond Area (GAC mat and sheet pile wall); future conditions consider the potential for these controls to be removed

8.3.5 Transport to Surface Water via Groundwater

Maximum COPC concentrations detected in groundwater at shoreline wells and non-shoreline Pond Area wells are compared to the groundwater protection of surface water screening level (GW-2) or the Proposed RI CUL (if adjusted to PQL or natural background and GW-2 is lower). The following rules apply for each COPC:

- If a COPC is not detected in groundwater at shoreline wells, exposure pathways that include the groundwater-to-surface water transport pathway are considered incomplete.
- If a COPC is detected in groundwater at shoreline wells, but the maximum concentration does not exceed GW-2 (or the Proposed RI CUL, if higher), exposure pathways that include the groundwater-to-surface water transport pathway are considered potentially complete but not of concern.
- If the maximum COPC concentration in groundwater at shoreline wells exceeds GW-2 (or the Proposed RI CUL, if higher), exposure pathways that include the groundwater-to-surface water pathway are considered potentially complete and potentially of concern.
- If exposure pathways that include the groundwater-to-surface water pathway are incomplete or complete but not of concern, but the maximum COPC concentration detected in groundwater at a non-shoreline Pond Area well exceeds GW-2 (or the Proposed RI CUL, if higher), those exposure pathways may be potentially complete and potentially of concern under future conditions.

8.3.6 Indoor air via VI

For VOCs, COPC concentrations detected in vadose zone soil above the water table (0 to 6 feet bgs) are compared to Proposed RI CULs, COPC concentrations in groundwater are compared to the protection of indoor air screening level (GW-4), and COPC concentrations in soil gas are compared to VI SLs for soil gas (unrestricted and commercial). The following rules apply for each COPC:

- If a COPC is not a volatile chemical, then the VI pathway is not evaluated.
- If a volatile COPC is not detected in vadose soil or Fill Unit groundwater, then the VI pathway is considered incomplete.
- If a volatile COPC is detected in soil gas but does not exceed the unrestricted land use VI SL, the VI pathway is considered potentially complete but not of concern.
- If a volatile COPC is detected in soil gas above the unrestricted land use VI SL but not in indoor air above the indoor air SL based on the current area use, the VI pathway is considered potentially complete but not of concern, but potentially of concern in the future.
- If there is no soil gas data in an area, and if a volatile COPC is detected in vadose zone soil above the Proposed RI CUL or is detected in Fill Unit groundwater above the unrestricted land use VI screening level (GW-4), then the VI pathway is considered potentially complete.

- If there is no currently occupied structure in the area, then the VI pathway is considered currently incomplete, but potentially complete in the future.

The following sections describe the contaminant conditions within each Site Area, including potential contaminant sources, contaminant distributions, pathways by which contaminants are transported, and an evaluation of potential exposures for human and ecological receptors.

8.4 South Area Contaminant Conditions

The South Area in the southern portion of the SPM Property (Figure 7.0) includes the area where the A&B Barrel Co. historically conducted barrel reconditioning and cleaning (approximately 1950 to 1960) and which, since then, has been used for boat maintenance and other marina activities for more than 60 years.

8.4.1 Potential Contaminant Sources

Potential contaminant sources associated with historical and current operations in the South Area include the former A&B Barrel Co., particularly the discharge of chemically diverse wastes into the facility's disposal pond (Former A&B Barrel Pond); boat maintenance activities including sanding, finishing, and chemical use; and other operations and activities involving chemical storage or use such as woodworking. Sections 2.2.1 and 2.3.1.1 include a detailed listing of historical and current activities representing potential contaminant sources within this Site Area.

Potential historical contaminant source(s) on neighboring properties include the T-117 site upland to the immediate south and the adjacent streets and yards to the immediate west of this Site Area.

8.4.2 Contaminant Distribution

8.4.2.1 Pond Area

The Pond Area, within the South Area, is the most contaminated area of the Site. Relative to other portions of the Site, the Pond Area contains the widest range of COPCs, generally the highest COPC concentrations (including floating free product), and the deepest vertical distribution of COPC exceedances.[95] It is also located adjacent to the LDW shoreline. The available data indicates the bottom of the Former A&B Barrel Pond was excavated during its original construction to just above the top of the Tidal Flat Unit; there is no evidence[96] the Tidal Flat Unit was breached or is otherwise absent beneath the Former A&B Barrel Pond. Select samples of saturated Fill Unit soil within the Former A&B Barrel Pond footprint contain PCB concentrations exceeding the 50 mg/kg TSCA disposal threshold. COPCs have migrated downward through the Tidal Flat Unit into the Alluvial Unit within the Former A&B Barrel Pond footprint, but the vast majority of COPC mass in Pond Area soil remains within the Fill Unit. Progressively lower COPC

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[95] In discussing contaminant distribution by Area, "exceedance" means a detected concentration greater than a Proposed RI CUL protective of all exposure pathways, including exposure pathways that include cross-media transport. The contaminant transport discussion for each Area considers pathway-specific screening levels less stringent than the Proposed RI CUL.

[96] Based on boring logs in the Pond Area and hydrogeologic observations.

concentrations extend into the Tidal Flat Unit and then into the Alluvial Unit.[97] Soil PCB exceedances extend as deep as 17 feet bgs, in the Alluvial Unit, at the MW-04D location along the south edge of the Former A&B Barrel Pond footprint. The downward migration of COPCs from the Fill Unit to the Alluvial Unit is limited in part by the higher TOC of the intervening Tidal Flat Unit, which sorbs hydrophobic organic compounds.

Multiple COPCs (nickel, zinc, total PCBs, TPH-D+O, BEHP, total cPAH TEQ, pesticides, and vinyl chloride) exceed Proposed RI CULs in Fill Unit groundwater in the Pond Area. One detection of vinyl chloride also marginally exceeded the vapor-intrusion SL for unrestricted land use, a value less-stringent than the Proposed RI CUL that addresses all groundwater-related exposure pathways. Fill Unit groundwater COPC concentrations generally attenuate between the Former A&B Barrel Pond footprint and downgradient shoreline well MW-06, but exceedances for select metals and pesticides persist at MW-06. Of those COPCs, only the pesticide dieldrin exceeded the Proposed RI CUL in groundwater samples from MW-06 during each of the three sampling events in Phases 1, 2, and 3 of the RI (Table 6.7). Groundwater COPC concentrations also attenuate during downward migration from the Fill Unit into the Alluvial Unit adjacent to the Former A&B Barrel Pond footprint; relatively low-magnitude exceedances for nickel, TPH-D+O, and select pesticides were detected there. PCBs were not detected in the groundwater sample from well MW-04D, despite the PCB soil exceedance within the depth interval of the well screen. At the downgradient Alluvial Unit shoreline well MW-06D, only low-level exceedances for copper and the dieldrin were detected.

8.4.2.2 West of Pond Area

In the portion of the South Area west of the Pond Area, exceedances of Proposed RI CULs for multiple metals, PCBs, and total cPAH TEQ are broadly distributed within vadose zone soils, with highest concentrations generally but not exclusively occurring in the upper 2 feet. All but one sample had total cPAH TEQ concentrations less than the 0.34 mg/kg Seattle urban background concentration. Exceedances for TPH-D+O, select SVOCs (including BEHP), select pesticides, and PCE were also detected in vadose zone soils across limited areas of the South Area. Low-level exceedances of PCE in vadose and saturated zone soils were detected in several borings located in and around the footprint of the former A&B Barrel Co. building, which has since had former and current boat maintenance activities and other tenants such as the woodworking shop that was destroyed in the 2021 fire. Relative to vadose zone soil, saturated soil in the South Area west of the Pond Area had less frequent and lower magnitude exceedances for most COPCs.

Fill Unit groundwater at the western (upgradient) edge of the Pond Area (MW-16) contained exceedances of Proposed RI CULs for copper, total PCBs, and dieldrin; PCE was also detected at a concentration slightly below the Proposed RI CUL. Exceedances for these same COPCs plus nickel were detected in Alluvial Unit groundwater at that same location (well MW-16D). The PCB concentration detected in a sample from MW-16D was the maximum detected in Alluvial Unit groundwater within the entire South Area. Groundwater at the upgradient edge of the South Area, along Dallas Avenue,

[97] For some COPCs (e.g., 4,4'-DDE and PCE), the lateral extent of exceedances in the South Area is greater in the saturated zone than in the vadose zone, but this is largely due to the lower screening levels in saturated zone soil.

contained a low-level copper exceedance and the highest concentration of BEHP detected on Site, indicating off-Site contributions for these COPCs.

Nickel was detected above the Proposed RI CUL in groundwater samples from shoreline well MW-06 (maximum EF = 19). It is uncertain why higher Fill Unit groundwater nickel concentrations were detected at MW-06 than at inland wells in this Area, particularly given there are very few soil nickel exceedances detected in the South Area; however, it may be due to release of naturally occurring, nickel-containing sulfide minerals within highly mixed transitional-zone groundwater (see Section 7.1.1).

8.4.3 Contaminant Transport Pathways

The potentially complete contaminant transport pathways applicable for the South Area, assuming MTCA standard points of compliance for soil and groundwater, are as follows:

- Migration of dissolved-phase contaminants in groundwater that discharges to LDW surface water
- Leaching of contaminants from soil to groundwater that discharges to LDW surface water
- Migration of dissolved-phase contaminants in groundwater that discharges to LDW sediment
- Leaching of contaminants from soil to groundwater that discharges to LDW sediment
- Erosion of contaminated soils to LDW sediment via the storm drain system or overland flow[98]
- Vapor-phase transport of volatile contaminants from vadose zone soil or shallow groundwater to soil gas

In the following section (8.4.4), leaching and groundwater migration pathways for the South Area are evaluated based on soil, groundwater, and sediment data; the vapor-phase transport pathway is evaluated based on soil, groundwater, and soil gas data; and the erosion pathway is evaluated based on soil and sediment data.

In conjunction with the RI, a source control evaluation was performed for the Site that included collection and evaluation of stormwater and catch basin solids data, which also inform the potential for transport via the erosion pathway, but are also affected by contributions from other potential sources. These data are tabulated in Appendix I.3.D (catch basin solids) and I.3.E (stormwater). The vast majority of stormwater in the South Area either infiltrates or is captured within the Southern Catchment Area (see Figure 2.4).[99]

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[98] The overland flow pathway is currently controlled by the ecology block wall along the Site shoreline (refer to Aspect, 2022b and 2024b); however, for purposes of this RI, that feature is assumed to be not permanent and thus the pathway remains a potential for future land uses.

[99] A very small portion of the South Area along Dallas Avenue South may be part of the 17th Avenue South Storm Drain Area.

The South Area includes stormwater vault/sample location SWRX-PRE and associated stormwater sample locations SWRX-MID, and SWRX-POST (which represent samples collected downstream of the vault within [-MID] and after [-POST] the StormwateRx™ treatment system). The vault captures runoff from both the South Area and the southern portion of the Central Area. Potential contributions to contaminants in stormwater and catch basin solids at this location include ongoing operations within these areas (primarily boat storage and maintenance), roof runoff, dust deposition, and track-on from vehicles entering these Areas, as well as potential erosion from exposed soils.

8.4.4 Exposure Pathway Evaluation

As described in Section 8.3, Table 8.1 presents an evaluation of Site data relative to screening levels that are based on specific potential exposure and transport pathways. The evaluation of potential exposure to Site COPCs in the South Area is discussed below by the environmental media.

8.4.4.1 Potential Exposure to Soil

Concentrations of multiple COPCs exceed SLs based on human direct contact and terrestrial ecological exposure in the upper 15 feet of soil (the standard point of compliance for both); therefore, these exposure pathways are considered potentially complete. Although these soil exposure pathways are potentially complete, they do not currently represent a concern to human or ecological receptors within the South Area because there are no child residents,[100] limited, if any, vegetation or animals are present,[101] and pavement and gravel surfacing cover much of the Area's soil.[102]

Site COPCs with potentially complete exposure pathways based on direct contact or terrestrial ecological exposure to soil include the following:

- Human Direct Contact: arsenic, cadmium, lead, zinc, total PCBs, total dioxin/furan TEQ (including 2,3,7,8-TCDD), total cPAH TEQ (including benzo(a)pyrene), pentachlorophenol, 4,4'-DDT, aldrin, dieldrin, and vinyl chloride

- Terrestrial Ecological Exposure: cadmium, chromium, copper, lead, mercury, zinc, total PCBs, total HPAHs, 2,4-dintrophenol, BEHP, di-n-butyl phthalate, pentachlorophenol, 4,4'-DDT, aldrin, dieldrin, endrin aldehyde, TPH-D+O, total xylenes, PCE, and vinyl chloride

8.4.4.2 Potential Exposure to Indoor Air

There are no occupied structures in the South Area, and there are no plans to build additional structures. Therefore, VI exposure pathways, including inhalation of indoor air, are currently incomplete.

Under potential future use, humans may be exposed to COPCs in indoor air through vapor-phase transport of volatile contaminants from vadose zone soil or shallow

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[100] Receptor assumed for human direct contact SLs.
[101] Receptors assumed for terrestrial ecological SLs.
[102] Surface soil sampling depth intervals in the RI indicate the depth of soil starting at the base of the surface cover (asphalt, concrete, or gravel). Therefore, a sample depth of 0 to 1 foot does not necessarily represent exposed soil.

groundwater to soil gas and then to indoor air (VI). The standard point of compliance for soil for the VI pathway is in soil above the water table, and the standard point of compliance for groundwater for the VI pathway is at the water table.

Mercury is a volatile contaminant in its elemental form. Although it was not observed in its elemental form during the RI at the Site, for conservativism, it has been retained as a COPC that may be potentially complete for the VI pathway in the future.

Vinyl chloride was detected in one sample of groundwater from Pond Area Fill Unit well above the VI SL for indoor air under unrestricted land use. No other VOCs were detected in Fill Unit groundwater above VI SLs. PCE and TCE were detected in vadose zone soil above Proposed RI CULs at concentrations that have the potential to volatilize to soil gas and result in concentrations greater than VI SLs. As stated above, the VI pathway is currently incomplete because there are no occupied structures in or adjacent to the Pond Area. However, the pathway is potentially complete in the future if structures were to be built and occupied in this area. In that case, additional investigation including soil gas sampling may be warranted to assess the VI pathway for mercury, PCE, TCE, and vinyl chloride if future structures are built and occupied in or adjacent to the Pond Area.

8.4.4.3 Potential Exposure to Sediment

Site COPCs can be transported to LDW sediments via groundwater migration and sorption onto sediment, leaching from soil to groundwater and sorption onto sediment, and direct erosion of soil to sediment via overland flow (if the block wall were removed from the bank) or transport via the stormwater system.

The following Site COPCs were detected in Marina Basin surface sediment adjacent to the South Area above Selected Sediment SLs in the refined sediment dataset: arsenic, total PCBs, and benzyl alcohol.[103] In addition, TBT was detected above the Selected Sediment SL in the full sediment dataset; no TBT samples were in the refined dataset. Of these COPCs, only PCBs were detected in groundwater at concentrations above protection of sediment SLs in samples from shoreline wells MW-06 or MW-06D. As such, the groundwater-to-sediment pathway and the soil-to-groundwater-to-sediment pathway are not currently complete for the South Area for all COPCs except PCBs. However, current conditions are affected by engineering controls (the sheet pile wall and GAC mat). Based on maximum detections in groundwater upgradient of the sheet pile wall at MW-04, MW-05, and MW-05D, the groundwater-to-sediment pathway (including the soil-to-groundwater-to-sediment pathway) would be potentially complete and of concern for zinc, total PCBs, total cPAH TEQ, aldrin, and dieldrin if conditions change in the future (e.g., sheet pile wall/GAC mat removed).

Site COPCs detected in Marina Basin sediment above the Selected Sediment SLs were also detected in soil in the South Area above protection of sediment SLs based on direct erosion. However, this transport pathway is currently controlled by pavement/gravel cover over much of the area, a stormwater treatment system, and a block wall that prevents direct runoff to the LDW. Based on the available catch basin solids and

[103] As discussed in Section 7.6.4, benzyl alcohol has not been identified as requiring cleanup in sediments and was not identified as a potential concern for recontamination of sediments from the Site in the Source Control Evaluation Memorandum or its Addendum (Aspect, 2022c and 2024b).

stormwater data (Tables I.3.D and I.3.E), the Site source control evaluation determined that erosion and discharge via the SPM Property stormwater system would not recontaminate sediments to levels above the LDW ROD RALs under current Site conditions (Aspect, 2022c and 2024b). For the purposes of this RI, the soil-to-sediment transport pathway based on direct erosion is considered potentially complete for total PCBs, TBT, and arsenic, because these chemicals were detected in South Area soil above the protection of sediment SL and were detected in sediment above Selected Sediment SLs. This transport pathway is not complete now based on sediment data but potentially complete for metals (cadmium, chromium, copper, lead, mercury, zinc), 2-methylnaphthalene, total cPAH TEQ, total dioxin/furan TEQ, SVOCs (2,4-dimethylphenol, 2-methylphenol, benzyl butyl phthalate, BEHP, dimethyl phthalate, di-n-butyl phthalate, hexachlorobenzene, N-nitrosodiphenylamine, pentachlorophenol), pesticides (4,4'-DDT, aldrin, dieldrin, cis- and trans-chlordane, heptachlor), and the VOC 1,2-dichlorobenzene if conditions change in the future (e.g., stormwater system or block wall removed).

8.4.4.4 Potential Exposure to Surface Water

Site COPCs can be transported to surface water via groundwater migration and by leaching from soil to groundwater and then groundwater migration and discharge to the LDW. Shoreline wells MW-04D, MW-06, and MW-06D are most representative of groundwater quality approaching the point of discharge to the LDW. Under current Site conditions, data from these wells indicate these transport pathways are potentially complete and of concern in the South Area for the following COPCs: metals (arsenic, chromium, copper, nickel), total PCBs, pesticides (aldrin, alpha-BHC, dieldrin), and VOCs (PCE). However, the use of groundwater data from upland shoreline wells to evaluate these pathways is considered conservative. Of these COPCs, only copper and dieldrin exceedances were reproducible in repeated groundwater sampling events. Furthermore, tidal fluctuations induce twice-daily reversals in nearshore groundwater flow directions. This increases groundwater flow path length and hydrodynamic dispersion and circulates geochemically distinct surface water[104] into the subsurface, creating a physically and chemically dynamic nearshore transitional zone. Attenuation of groundwater COPC concentrations is observed in the relatively short distance between the Former A&B Barrel Pond footprint and shoreline wells MW-06 and MW-06D; additional attenuation and dilution will occur between the shoreline wells and the point of discharge to bioactive-zone sediment and then surface water in the LDW.

As stated above, current conditions are affected by engineering controls (the sheet pile wall and GAC mat). Conservatively, based on maximum detections in groundwater upgradient of the sheet pile wall (wells MW-04and MW-05/MW-05D), this groundwater-to-surface water pathway is not currently complete but potentially complete and of

[104] Geochemically distinct from upland groundwater due to its higher concentrations of dissolved oxygen, select cations (e.g., sodium, magnesium, calcium, potassium), and select anions (e.g., sulfate, chloride).

concern in the future for the following COPCs in the South Area: metals (zinc), total cPAH TEQ,[105] BEHP, pesticides (4,4'-DDE), and VOCs (vinyl chloride).

8.5 Central Area Contaminant Conditions

The Central Area encompasses the majority of the SPM Property (Figure 7.0) and includes the historical boat manufacturing area, the historical mobile home park, the historical and current boat maintenance and storage areas, the current boat wash area, the Legacy Master Marine facility, and areas adjacent to the Dallas Avenue South ROW.

8.5.1 Potential Contaminant Sources

Potential contaminant sources associated with historical and current operations in the Central Area include boat manufacturing; boat maintenance[106] activities including sanding, finishing, and chemical use; operations in the SPM Main Shop and Office including chemical storage; and Legacy Master Marine operations including chemical storage and use. Sections 2.4.1, 2.4.2, and 2.4.3 include a detailed listing of historical and current activities representing potential contaminant sources within this Site Area.

Potential historical contaminant source(s) on neighboring properties include the T-117 Adjacent Streets and Yards EAA to the west, and historical dry-cleaning operations (with chlorinated solvent contamination) located upgradient (west) at 8500 14th Avenue South and identified as a MTCA site (see Section 2.4.3).

8.5.2 Contaminant Distribution

8.5.2.1 Soil

Concentrations above Proposed RI CULs for several metals (copper and TBT, most commonly), total PCBs, and total cPAH TEQ[107] are sporadically distributed in shallow soils (primarily less than 2 feet) across the Central Area. The highest TBT concentrations (greater than 0.039 mg/kg, EF > 10) were located in shallow soil adjacent to the former Boat Manufacturing building (SB-27) and in unpaved areas where boat storage and maintenance has been conducted (HA-03, HA-07, MW-11, and SB-32). The highest copper concentrations (greater than 180 mg/kg, EF > 5) were also located in unpaved areas used for boat storage and maintenance (MW-14 and HA-03). The highest PCB concentrations in soil in the Central Area, including one shallow sample (SS-38) that exceeded the 50 mg/kg TSCA disposal threshold, are present on the west edge of the Central Area along Dallas Avenue South. This area also exhibited elevated PAH concentrations, with up to 28.1 mg/kg total cPAH TEQ in shallow soil at MW-17. In shallow soil adjacent to this area that was removed during the T-117 Adjacent Streets and

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[105] For the purposes of this pathway analysis, individual cPAHs that have potentially complete pathways are not identified; all pathways that are potentially complete now or in the future for an individual cPAH are also for Total cPAH TEQ.

[106] Many boat paints contain anti-fouling agents that include copper and zinc, and to a lesser extent or historically, other heavy metals that have been identified as Site COPCs such as mercury, nickel, chromium, and TBT.

[107] No total cPAH TEQ concentrations exceeded the urban soil background concentration presented in Section 6.2.8.

Yards Removal, PCB concentrations ranged up to 18 mg/kg total PCB Aroclors[108] (see Appendix A.19). PCB concentrations in soil across the rest of the Central Area are less than 1 mg/kg in all but one sample location (1.32 mg/kg [EF = 37] at SB-40 on south edge of former boat manufacturing building). Concentrations above the Proposed RI CULs for other COPCs (TPH, total dioxin/furan TEQ,[109] select SVOCs including BEHP, select pesticides, and PCE) were detected sporadically in vadose zone soils across the Central Area.

Concentrations of COPCs that exceeded the Proposed RI CULs in saturated zone soil were detected at lower frequency and magnitude than in vadose zone soil; one or more COPCs exceeded Proposed RI CULs in only one Alluvial Unit sample (SB-27-8-9), one Tidal Flat Unit sample (SB-10-14), and two Fill Unit samples (MW-17-12-13 and SB-04-8), including in and around the area of the highest COPC concentrations near Dallas Avenue South. This indicates limited vertical migration of COPCs.

8.5.2.2 Groundwater

At most Fill Unit wells inland from the shoreline, concentrations in groundwater samples that exceeded the Proposed RI CULs are limited to copper (EFs up to approximately 3); one sample from MW-15 also exceeded the Proposed RI CUL for alpha-BHC (EF = 6). In addition, concentrations of total PCBs and the pesticide alpha-BHC above Proposed RI CULs were detected in the first sample collected from shoreline well MW-11 (these exceedances were not replicated in two subsequent samples). A concentration of BEHP above the Proposed RI CUL was detected in the first sample collected from MW-19; additional samples collected from this monitoring well were not analyzed for SVOCs. The sample results for these hydrophobic compounds may be a result of installation and/or turbidity bias in samples collected soon after well installation and development.

At Fill Unit shoreline wells, several metals (arsenic, chromium, copper, nickel) and pesticides (aldrin and alpha-BHC) were detected above their respective Proposed RI CULs. Metals concentrations in the samples were variable across sampling events, and some appear biased-high by sample salinity[110] and/or turbidity. As observed for inland wells, the pesticide exceedances were detected in the first sampling event but not detected in the subsequent event.

Concentrations of TCE and PCE above Proposed RI CULs were detected in groundwater samples from Alluvial Unit well MW-19D (in the north-central portion of the Area), and paired Fill/Alluvial Unit wells MW-09/MW-09D (along the shoreline). Concentrations of vinyl chloride above its Proposed RI CUL were also detected in samples collected from MW-19D. Concentrations of PCE, TCE, and vinyl chloride from these three monitoring wells also exceeded SLs for the VI pathway (25, 1.4, and 3.3 ug/L, respectively). Concentrations of VOCs in these wells are assumed to be associated with the plume emanating from the upgradient Dallas Ave S PCE Site (former dry cleaner), not the Site.

[108] No cPAH data was collected in Dallas Avenue South in this area at a depth less than 4 feet bgs.
[109] No dioxins/furans concentrations exceeded the urban soil background concentration presented in Section 6.2.8.
[110] Which can create analytical interferences for trace metals analyses.

Apart from those VOCs, the only additional COPC exceedances in Alluvial Unit groundwater in the Central Area were low-level copper in samples from each of the five Alluvial Unit wells (EF < 2).

8.5.3 Contaminant Transport Pathways

The potentially complete contaminant transport pathways applicable for the Central Area, assuming MTCA standard points of compliance for soil and groundwater, are as follows:

- Migration of dissolved-phase contaminants in groundwater that discharges to LDW surface water
- Leaching of contaminants from soil to groundwater that discharges to LDW surface water
- Migration of dissolved-phase contaminants in groundwater that discharges to LDW sediment
- Leaching of contaminants from soil to groundwater that discharges to LDW sediment
- Erosion of contaminated soils to LDW sediment via the storm drain system or overland flow
- Vapor-phase transport of volatile contaminants from vadose zone soil or shallow groundwater to soil gas

In the following section, leaching and groundwater migration pathways for the Central Area are evaluated based on soil, groundwater, and sediment data; the vapor-phase transport pathway is evaluated based on soil, groundwater, and soil gas data; and the erosion pathway is evaluated based on soil and sediment data.

In conjunction with the RI, a source control evaluation was performed for the Site that included collection of stormwater and catch basin solids data, which also inform the potential for transport via the erosion pathway. These data are tabulated in Appendix I.3.D (catch basin solids) and I.3.E (stormwater). A portion of stormwater in the Central Area is captured within the Southern Catchment Area, as described in Section 8.4.3. The remainder of stormwater in the Central Area either infiltrates or is captured in the Central Catchment Area (see Figure 2.4), which also captures some roof runoff from buildings in the Northwest Area. The Central Area includes catch basin/stormwater sample locations CB-01, CB-02, CB-03, CB-04, CB-05, CB-06, CB-07, CB-08, and CB-09. Potential contributions to contaminants in stormwater and catch basin solids at these locations, in addition to erosion from exposed soils, include ongoing operations within these areas (primarily boat storage and maintenance), roof runoff, dust deposition, and track-on from vehicles entering the Central Area.

8.5.4 Exposure Pathway Evaluation

As described in Section 8.3, Table 8.1 presents an evaluation of Site data relative to screening levels based on specific potential exposure pathways and transport mechanisms. The evaluation for potential exposure to Site COPCs in the Central Area is discussed below by the environmental media.

8.5.4.1 Potential Exposure to Soil

Concentrations of multiple COPCs exceeded the SLs for the human direct contact and terrestrial ecological exposure pathways in the upper 15 feet of soil (the standard point of compliance); therefore, these pathways are considered potentially complete. The Central Area includes residences, but these soil exposure pathways are not of concern for human or ecological receptors because pavement and gravel surfacing cover much of the Central Area.

Site COPCs with potentially complete exposure pathways based on direct contact or terrestrial ecological exposure to soil include the following:

- Human Direct Contact: arsenic, lead, total PCBs, total dioxin/furan TEQ, total cPAH TEQ, and 1,2,3-trichloropropane
- Terrestrial Ecological Exposure: copper, lead, total PCBs, total HPAHs, BEHP, di-n-butyl phthalate, and PCE

8.5.4.2 Potential Exposure to Indoor Air

VOCs were not detected in Fill Unit groundwater above VI SLs, with one exception: concentrations of TCE (maximum of 15.2 ug/L) and PCE (maximum of 28.1 ug/L) in samples collected from Fill Unit groundwater well MW-09, which exceeded respective VI SLs for unrestricted land use (25 ug/L PCE and 1.4 ug/L TCE). One of the three samples collected (March 2021) also exceeded the VI SL for commercial workers[111] for TCE (11 ug/L).

The elevated groundwater chlorinated VOC concentrations in Fill Unit well MW-09 are likely due to upwelling groundwater behind the block wall during high tide from the Alluvial Unit (which exhibits higher PCE and TCE concentrations) at this location and, therefore, are assumed to be limited to near the shoreline. As shown on Figure C.7.B, this upwelling condition is temporary as the vertical hydraulic gradient between the Fill and Alluvial units is reversed during incoming tides. This interpretation is based on the following data:

- There are no VOCs detected in groundwater samples from Fill Unit well MW-19 located between MW-09 and Fill Unit well MW-13 to the southwest, closer to the inferred VOC source at the Dallas Avenue S PCE Site. Conversely, there are VOC exceedances detected in Alluvial Unit well MW-19D located next to MW-19. In other words, the VOC groundwater plume is present in the Alluvial Unit but not the Fill Unit at the MW-19/MW-19D location upgradient of the MW-09/MW-09D location.
- Higher groundwater elevations occur in the Alluvial Unit than in the Fill Unit at the MW-09/MW-09D paired well location at high tide, thus there is a temporary

[111] Assuming Legacy Master Marine or SPM facility workers.

upward gradient present there (compare low-tide groundwater elevation contour maps for Fill Unit and Alluvium Unit; Figures C.5.A and C.5.B, respectively).

- The rapid rate at which water levels in the shoreline Fill Unit wells drain to dry or near-dry conditions during falling tides suggests the presence of a permeable pathway for vertical groundwater flow in either direction depending on the tidal stage. While the ecology blocks comprising the wall each have a smooth surface, they were likely placed against an irregular bank surface, and therefore voids between the concrete and bank soils likely occur in places immediately behind the block wall.

No occupied structures exist in the area of MW-09,[112] so the VI pathway is not currently complete, but could be complete in the future for PCE, TCE, and 1,2,3-trichloropropane if occupied structures were constructed. Additional investigation including soil gas sampling may be warranted to assess the VI pathway for the Central Area if structures are built and occupied in the future.

8.5.4.3 Potential Exposure to Sediment

Of the Site COPCs that were detected in Marina Basin sediment adjacent to the Central Area above Selected Sediment SLs (arsenic, TBT, total PCBs, and benzyl alcohol), only concentrations of total PCBs exceeded sediment-protection SLs in shoreline wells in the Central Area, and only from the first sample of groundwater collected from MW-11. This exceedance was not reproduced in two subsequent sampling events from the well; however, because only two sampling events were conducted, to be conservative, the groundwater-to-sediment and the soil-to-groundwater-to-sediment pathways are considered potentially complete in the Central Area for PCBs.

Site COPCs that were detected in soil in the Central Area above protection of sediment SLs based on direct erosion included arsenic, TBT, total PCBs, total HPAHs, total cPAH TEQ, fluoranthene, pyrene, benzyl alcohol, benzyl butyl phthalate, dimethyl phthalate, diethyl phthalate, total dioxin/furan TEQ, 4,4’-DDT, cis- and trans-chlordane, and dieldrin. The soil-erosion-to sediment pathway is currently controlled by an engineering control (pavement/gravel cover over much of the area, and a block wall that prevents direct runoff to the LDW). Based on the available catch basin solids and stormwater data (Tables I.3.D and I.3.E), the Site source control evaluation determined that erosion and discharge via the SPM Property stormwater system would not recontaminate sediments to levels above the LDW ROD RALs under current Site conditions (Aspect, 2022c and 2024b). Of these COPCs, this pathway is considered potentially complete only for arsenic, TBT, total PCBs, and benzyl alcohol,[113] which exceed Selected Sediment SLs in surface sediment offshore of the Central Area. For the other COPCs listed above, this pathway is incomplete now but may be potentially complete in the future if conditions change.

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[112] The closest occupied structure is the east residential structure, approximately 100 feet west of MW-09.

[113] As discussed in Section 7.6.4, benzyl alcohol has not been identified as requiring cleanup in sediments and was not identified as a potential concern for recontamination of sediments from the Site in the Source Control Evaluation Memorandum or its Addendum (Aspect, 2022c and 2024b).

8.5.4.4 Potential Exposure to Surface Water

Based on the maximum concentrations detected in groundwater samples from shoreline wells, the groundwater-to-surface water and/or the soil-to-groundwater-to-surface water pathways are potentially complete for the following COPCs in the Central Area: metals (arsenic, chromium, copper, nickel), total PCBs, pesticides (aldrin, alpha-BHC), and VOCs (PCE and TCE). The detected groundwater metals concentrations may have been biased high due to salinity and/or turbidity interferences, and the pesticide exceedances were not reproducible in subsequent sampling events. Furthermore, the use of shoreline groundwater data to evaluate this pathway is considered conservative (as discussed in Section 8.4.4) due to concentration reductions, through attenuation and dilution, between the shoreline and the point of discharge to surface water.

8.6 Northwest Area Contaminant Conditions

The Northwest Area encompasses the northwest portion of the SPM Property that historically included a fueling station and radiator shop. It is currently occupied by the Tire Factory that operates as an auto-repair shop.

8.6.1 Potential Contaminant Sources

Potential contaminant sources associated with historical and current operations in the Northwest Area include the former gasoline service station and radiator shop operations with chemical storage and use, and automotive service station operations (currently the Tire Factory) with chemical storage and use. Section 2.4.2 includes a detailed listing of historical and current activities representing potential contaminant sources within this Site Area.

Contaminant source(s) on neighboring properties include the T-117 yards to the west and historical dry-cleaning operations (with chlorinated solvent contamination) within the upgradient Dallas Ave S PCE Site (former dry cleaner) to the west.

8.6.2 Contaminant Distribution

Concentrations of COPCs that exceeded Proposed RI CULs in the Northwest Area include metals (copper in groundwater and copper and zinc in vadose soil), TPH (TPH-G in saturated soil and TPH-D+O in groundwater), total dioxin/furan TEQ in vadose soil, total cPAH TEQ in vadose and saturated soil, benzene in saturated soil, and chlorinated VOCs (PCE, TCE, vinyl chloride in soil[114] and groundwater and methylene chloride[115] in saturated soil).

Based on the distribution of chlorinated VOCs, these COPCs appear to be associated with the upgradient Dallas Ave S PCE Site (former dry cleaner), not the Site, as described above for the Central Area.

Occurrences of metals and total dioxin/furan TEQ were isolated, with only one sample for each COPC exceeding Proposed RI CULs, and with a maximum exceedance factor of

[114] Vadose and saturated soil for PCE and TCE; saturated soil only for vinyl chloride.
[115] Methylene chloride is a common laboratory contaminant. It was detected in the laboratory blank during sampling in September 2022 but not in March 2021, so the methylene chloride concentrations detected in March 2021 samples were not rejected, and it has been retained as a COPC in the RI. However, whether these detections represent Site conditions is uncertain.

2.5. All detected total cPAH TEQ concentrations in Northwest Area soil were below the 0.34 mg/kg Seattle citywide urban background concentration.

The primary exceedance of COPCs other than chlorinated VOCs was a localized detection of TPH-G in saturated soil from one sample from boring SB-31 (5,540 mg/kg at 13- to 14.5-foot depth), near the suspected former location of the former service station USTs. That soil sample was located in the Tidal Flat Unit; a soil sample from the same boring in the Alluvial Unit (19 to 20 feet bgs) slightly exceeded the Proposed RI CUL for TPH-G (81.6 mg/kg [estimated value], EF = 2.7). Groundwater concentrations of TPH-G were below Proposed RI CULs at MW-13D, in the Alluvial Unit; TPH-G data for groundwater samples at MW-13 in the Fill Unit were rejected due to PCE interference (Appendix G.4.B). TPH-D+O slightly exceeded the Proposed RI CUL at MW-13D in one of two groundwater samples collected (760 ug/L, EF = 1.5). Although PCE interferences in groundwater create some uncertainty in whether TPH-G is present above Proposed RI CULs in groundwater, the cumulative soil and groundwater data indicate that TPH occurrences are limited to a small area around SB-31.

8.6.3 Contaminant Transport Pathways

The potentially complete contaminant transport pathways applicable for the Northwest Area, assuming MTCA standard points of compliance for soil and groundwater, are as follows:

- Migration of dissolved-phase contaminants in groundwater that discharges to LDW surface water
- Leaching of contaminants from soil to groundwater that discharges to LDW surface water
- Erosion of contaminated soils to LDW sediment via the storm drain system or overland flow
- Vapor-phase transport of volatile contaminants from vadose zone soil or shallow groundwater to soil gas

In the following section, leaching and groundwater migration pathways for the Northwest Area are evaluated based on soil, groundwater, and sediment data; the vapor-phase transport pathway is evaluated based on soil, groundwater, and soil gas data; and the erosion pathway is evaluated based on soil and sediment data.

The source control evaluation performed for the Site did not include any catch basin or stormwater samples in the Northwest Area. The majority of stormwater in the Northwest Area is captured within the Northern Catchment Area and discharges to outfall OF-2215 (see Figure 2.4), with a portion of roof runoff going to the Central Catchment Area and a small area along South Thistle Street and Dallas Avenue South going to the City Sewer System Area.

8.6.4 Exposure Pathway Evaluation

As described in Section 8.3, Table 8.1 presents an evaluation of Site data relative to screening levels based on specific potential exposure and transport pathways. The evaluation of potential exposure to Site COPCs in the Northwest Area is discussed below by the environmental media.

8.6.4.1 Potential Exposure to Soil

Concentrations of multiple COPCs in the Northwest Area exceeded pathway-specific SLs for the human direct contact and terrestrial ecological exposure pathways in the upper 15 feet of soil (the standard point of compliance); therefore, these pathways are considered potentially complete. As described for the South Area, these soil exposure pathways do not currently represent an imminent threat to human or ecological receptors because there are no child residents and limited if any vegetation or animals present, and pavement and gravel surfacing covers much of the Northwest Area.

Site COPCs with potentially complete exposure pathways based on direct contact or terrestrial ecological exposure to soil include the following:

- Human Direct Contact: total cPAH TEQ and TPH-G
- Terrestrial Ecological Exposure: TPH-G, methylene chloride, and PCE

Note that total cPAH TEQ exceeded the soil direct contact SL at MW-20 (0.28 mg/kg vs 0.19 mg/kg SL); however, MW-20 is located in Dallas Avenue South and not considered part of the Site. As noted in Section 7.5.3, the total cPAH TEQ exceedance is suspected to be caused by the historical roadbed that underlies the 1.5 feet of asphalt in this location, which is assumed to be a combination of both the asphalt from repaving as part of the T-117 Adjacent Streets and Yard Removal Area and the historical roadway. The total cPAH TEQ detection is also below a 0.34 mg/kg Seattle urban background concentration. The only other COPC exceeding Proposed RI CULs at this location is PCE, which is suspected to be sourced from the upgradient dry cleaner.

8.6.4.2 Potential Exposure to Indoor Air

Concentrations of PCE and TCE in Fill Unit groundwater in the Northwest Area exceeded VI SLs for residential (unrestricted land use) and commercial worker uses (respectively: 48 and 120 ug/L for PCE; 3.9 and 12 ug/L for TCE). Likewise, concentrations of PCE and TCE in soil gas samples collected beneath the Tire Factory floor slab exceeded VI SLs for residential and commercial worker uses (respectively: 610 and 1,500 ug/m^3 for PCE; 30 and 95 ug/m^3 for TCE). In addition, concentrations of PCE were detected above the commercial worker SL in indoor air samples collected within the Tire Factory; however, the VI assessment determined that the likely source of PCE in indoor air was on-Site use of PCE in facility operations, and not from VI (Aspect, 2023c; see Appendix K). Under current conditions, per Ecology guidance (Ecology, 2022), further VI assessment is not planned since potential background indoor air sources cannot be eliminated based on the use of the building. This pathway may be potentially complete in the future and may need to be reassessed if conditions or uses in this Area change.

8.6.4.3 Potential Exposure to Sediment

None of the Site COPCs that have been detected in Marina Basin sediment above Selected Sediment SLs (arsenic, total PCBs, total dioxin/furan TEQ, benzyl alcohol, 4,4'-DDT, and aldrin) exceed sediment-protection SLs in groundwater in the Northwest Area. Furthermore, this area is located more than 150 feet from the shoreline. As such, the groundwater-to-sediment and the soil-to-groundwater-to-sediment transport pathways are considered incomplete for the Northwest Area.

Concentrations of total cPAH TEQ and total dioxin/furan TEQ were detected in soil in the Northwest Area above protection of sediment SLs based on direct erosion, but were not detected in surface sediment above the Selected Sediment SLs in the refined sediment dataset. The erosion transport pathway is currently controlled by an engineering control (pavement/gravel cover over much of the area, and a block wall that prevents direct runoff to the LDW). This transport pathway is further mitigated by the distance of the Northwest Area from the LDW. This pathway is currently incomplete but may be potentially complete in the future if conditions change.

8.6.4.4 Potential Exposure to Surface Water

The Northwest Area is located more than 150 feet from the LDW, and therefore does not include any shoreline wells. Based on the maximum groundwater concentrations in samples collected from monitoring wells in the Northwest Area and in the Central Area downgradient of the Northwest Area (including MW-12, MW-19, and MW-19D), the groundwater-to-surface water and the soil-to-groundwater-to-surface water pathways are potentially complete for VOCs (PCE, TCE, and vinyl chloride). Concentrations of copper above the surface water-based SL were detected in samples from some monitoring wells; however, based on the magnitude of the maximum exceedance (EF = 1.8) and the distance to the LDW, the potential for copper to be transported from the Northwest Area to the LDW via groundwater flow is considered highly unlikely.

9 Conclusions

In compliance with the AO, an RI was conducted for the Site to determine the sources, nature, fate/transport, and extent of contamination sufficiently to select a cleanup action for the Site. This investigation was completed in accordance with the RIWP and RIWP Addendum (Aspect, 2021 and 2022b) and achieved its objectives.

Based on the collective data, Site COPCs that have been detected above Proposed RI CULs in one or more upland environmental media (soil, groundwater, soil gas, and indoor air) include metals, total PCBs, dioxins/furans, pesticides, PAHs, SVOCs, TPH, and VOCs. COPCs for each medium, their Proposed RI CULs, and potentially complete pathways for each COPC in each Site Area are summarized in Table 8.1. Site COPCs detected in sediments adjacent to the SPM Property above Selected Sediment SLs are being addressed under the LDW ROD, but include arsenic, mercury, total PCBs, dioxins/furans, and benzyl alcohol.

The extents of COPCs from the Site with concentrations above the Proposed RI CULs have been adequately characterized for the purposes of this RI. The extents have been vertically delineated in all areas on the SPM Property, and the lateral extents are well characterized by either work conducted as part of this RI or by work conducted for neighboring sites, as described below:

- To the south of the SPM Property: As part of Phase 1 of the T-117 EAA, vertical and lateral delineation of contaminants was completed along the southern SPM Property boundary to support remedial design. Subsequently, soil along the southern SPM Property boundary (and throughout the T-117 Upland Property) was excavated as part of the T-117 Upland Removal Area. Following excavation of soils (including localized over-excavation and resampling), concentrations of COCs for the T-117 EAA detected in soil samples complied with respective RvALs for the T117 remedial action.
- To the west of the SPM Property: As part of Phase 2 of the T-117 EAA, vertical and lateral delineation of contaminants was completed throughout Dallas Avenue South along the western SPM Property boundary to support remedial design. Soil in this area was excavated as part of both the independent SPU cleanup action and the T-117 Adjacent Streets and Yards Removal Area. Soil excavation occurred where total PCB concentrations exceeded a 1- mg/kg RvAL. For removal area decision units that had been characterized using multi-incremental sampling, an RvAL of 0.5 mg/kg total PCBs was used to define soils to be removed. The predefined lateral and vertical extents of excavation units were confirmed by survey with acceptance by USACE or EPA on-site representative. Site COPCs (cPAHs and PCE) that were detected above Proposed RI CULs at MW-20, which is located in Dallas Avenue South west of the Northwest Area and outside the area addressed by the T-117 Adjacent Streets and Yards Removal Area, are considered not related to the Site.[116]

[116] At MW-20, cPAHs in soil are believed to be from the asphalt roadbed, and PCE in soil and groundwater is believed to be from the upgradient dry cleaner.

- To the east of the SPM Property: As part of the LDW Superfund Site, sediment within the Marina Basin has been characterized to support remedial design. As described in the finalized remedial design, there is only one limited sediment remedial action area in the Marina Basin where contaminant concentrations exceed the LDW ROD RALs. The limited sediment remedial action area in the Marina Basin is identified as Remedial Action Area 13, and the selected remedy enhanced natural recovery, which includes the placement of a thin layer (nominally, 6 to 9 inches) of clean material.
- To the north of the SPM Property: Limited characterization was completed north of the SPM Property. Only a very limited number of Site COPCs were detected above the Proposed RI CULs near the northern SPM Property boundary, and these Site COPCs were detected at relatively low EFs:
  - To the north of the northwest corner of the SPM Property, only total cPAH TEQ concentrations in soil exceed the Proposed RI CUL in a vadose soil sample from MW-21 (EF = 21).
  - To the north of the northeast corner of the SPM Property, only copper, lead, total cPAHs TEQ, and total PCBs concentrations exceed the Proposed RI CUL in soil samples from MW-11D (EFs = 1.5, 2.6, 44, and 1.1, respectively).

  All total cPAH TEQ concentrations on the SPM Property near the northern boundary are below urban background concentrations. Furthermore, the potential extent of Site COPCs in shallow soil to the north is bounded by the construction of the bioswale adjacent to the South Park Bridge. Therefore, the northern extent of contamination is considered adequately characterized for the purposes of the RI.

A summary of areas and media of concern at the Site is shown on Figure 9.1. Areas of environmental media with relatively high exceedances of the Proposed RI CULs (e.g., EF > 100; also referred to as 'hot spots' on Figure 9.1) or representing a particular exposure pathway of concern, are summarized as follows:

- *Soil and groundwater in the Pond Area*. This area includes all Site COPCs in soil and/or groundwater. The vertical extent of Site COPCs with EF > 100 and/or for total cPAH TEQ at concentrations greater than both the direct contact screening level and urban background is approximately 18 feet.
- *Shallow soil in the South Area*. This is the area surrounding and west of the Pond Area and includes most COPCs in vadose zone soil. The vertical extent of Site COPCs with EF > 100 and/or for total cPAH TEQ at concentrations greater than the direct contact screening level but less than urban background, is approximately surface to 6 feet.[117]

[117] Total cPAH TEQ in soil included EF>100 into the saturated zone west of the Pond Area and adjacent to Dallas Avenue South; however, the Proposed RI CUL is based on leaching to groundwater,

- *Shallow soil in the westernmost portion of the Central Area*. This is an area adjacent to the area that was addressed by the T-117 Adjacent Streets and Yards Removal Area in Dallas Avenue South and includes PCBs and PAHs in surface soil within the Central Area. The vertical extent of PCBs with EF > 100 and/or for total cPAH TEQ at concentrations greater than both the direct contact screening level and urban background in this area is approximately 1.5 feet.
- *PCE groundwater plume in the Northwest and Central Areas*. This area includes PCE, and to a lesser extent TCE and vinyl chloride, in saturated soil and groundwater. The lateral extent has not been defined to the west, upgradient of the SPM Property, in the vicinity of the former dry cleaner. The vertical extent of the PCE plume in soil or groundwater has not been defined.
- *Potential PCE vapor intrusion area (Northwest Area)*. This area includes PCE (and to a lesser extent, TCE) in vadose zone soil, Fill Unit groundwater, and soil gas at concentrations above VI SLs. The lateral extent of this area has not been defined to the west, upgradient of the SPM Property, in the vicinity of the Dallas Ave S PCE Site (former dry cleaner). The eastern extent under the Tire Factory building was confirmed by sub-slab soil gas sampling.

In addition to the areas summarized above, lower-level exceedances (generally EFs < 100[118]) of Site COPCs have been detected across the SPM Property (e.g., adjacent to the above areas, in areas of boat and auto maintenance, and/or areas of repair and boat manufacturing, primarily in vadose zone soil and Fill Unit groundwater).

This RI evaluated potential exposure pathways, including human and terrestrial ecological direct contact with soil, and exposure pathway components (e.g., transport pathways), including VI into indoor air, leaching to groundwater, and migration of groundwater to surface water and sediment. Most exposure pathways are mitigated under current Site conditions (pavement/gravel cover, stormwater collection and treatment, shoreline block wall, and a sheet pile wall/GAC mat). At a few shoreline wells, sporadic and generally low-level exceedances of some metals (arsenic, chromium, copper, nickel), pesticides (alpha-BHC, aldrin, dieldrin), and VOCs (PCE, TCE) have been detected in groundwater above surface water-based SLs. However, shoreline groundwater data is a conservative measure of discharge to surface water due to tidal mixing; furthermore, almost all exceedances were in Fill Unit groundwater, which contributes a relatively small amount of groundwater discharge to the LDW compared to the Alluvial Unit. The source control review conducted under the AO (see Section 5.2.3) concluded that the Site does not present a risk of recontaminating Marina Basin sediments in the near-term, and therefore an interim action is not required at the Site to achieve source control sufficiency.

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and total cPAH TEQ was not detected in groundwater at these locations. The vertical extent of total cPAH TEQ exceeding the next highest SL (human direct contact, 0.19 mg/kg) is less than 2 feet in these areas. As described in prior sections, soil depths start at the base of the surface cover (asphalt, concrete, or gravel).

[118] In addition to total cPAH TEQ concentrations with EF > 100 discussed above, one sample outside the identified hot-spot areas contained TBT with EF > 100: SB-27 (EF = 287). This occurrence was not contiguous with any other samples with EF > 100 and was not defined as a hot-spot area.

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11 Limitations

Work for this project was performed for Seattle City Light, the Port of Seattle, and the South Park Marina Limited Partnership (PLP Client Group), 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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