

**Remedial Investigation in Support of  
Site-wide No Further Action Determination,  
Revised**

**Northwest Pipe Company  
12005 North Burgard Road  
Portland, Oregon 97203  
ECSI No. 138**

~~February 2020~~December 2021

Prepared by

**JACOBS®**





## Executive Summary

This Remedial Investigation (RI) Report was prepared by Jacobs on behalf of Northwest Pipe Company for the facility located at 12005 North Burgard Road in Portland, Oregon (the Site). Northwest Pipe Company has conducted investigations and focused remedial actions to address environmental conditions at the Site since it began operations at the Portland facility in the early 1980s. The purpose of this RI Report is to analyze and present existing site information sufficiently to support decision making with respect to the Oregon Department of Environmental Quality's (DEQ's) Hazardous Substance Remedial Action rules. This characterization includes determining the nature, extent, and distribution of constituents in Site media; determining the fate and transport of constituents; identifying migration pathways and receptors; and evaluating potential risk to human health and the environment.

This RI Report is presented in conjunction with a companion report, *Source Control Evaluation in Support of No Further Action Source Control Decision* (Companion SCE Report). Surface soil, subsurface soil, and groundwater are characterized in both reports. Stormwater and offsite sediment are characterized in the Companion SCE Report. Remaining media, specifically air and surface water, are not applicable to the analysis presented in these reports and are not discussed. Air emissions from industrial processes at the Site are regulated with a Title V permit, and air emissions from soil or groundwater are not applicable because the Site is paved. The Site does not border surface water.

This report presents the fourth version of the RI, first submitted in 2005, conducted under the 2004 Voluntary Agreement for Remedial Investigation and Source Control Evaluation (DEQ agreement LQDVC-NWR-04-01). Protracted regulatory review periods, changes in regulatory team members, changes in regulator's findings regarding the Site, and updates to guidance documents and data screening values have led to the last three versions of the RI submitted in 2014, 2015, and, now this version.

Despite the updates to the document and the additional investigations triggered by these factors, the conclusions of the RI remain the same. This RI Report demonstrates by multiple lines of evidence that there is no excess risk to reasonably likely potential human or ecological receptors at the Site. This report documents the following: (1) no ongoing sources of [constituents-contaminants](#) of potential concern exist at the Site that have the potential to reach the Willamette River at concentrations above target risk levels identified by DEQ; (2) potential sources of contamination are controlled; (3) no additional work under the Oregon Hazardous Substance Remedial Action rules is required; and (4) the Site warrants a No Further Action determination by DEQ.



## Contents

<b>Executive Summary</b> .....	<b>1</b>
<b>Acronyms and Abbreviations</b> .....	<b>v</b>
<b>1. Introduction</b> .....	<b>1-1</b>
1.1 Purpose and Objectives.....	1-1
1.2 RI Report Organization.....	1-1
<b>2. Site Background</b> .....	<b>2-1</b>
2.1 Site Location and Description.....	2-1
2.2 Site History and Facility Operations.....	2-1
2.2.1 Ownership.....	2-1
2.2.2 Historical Operations.....	2-2
2.2.3 Current Operations.....	2-2
<b>3. Environmental Setting</b> .....	<b>3-1</b>
3.1 Geology.....	3-1
3.2 Hydrogeology.....	3-1
3.2.1 Groundwater Recharge and Discharge.....	3-2
3.3 Surface Water.....	3-2
3.4 Aquatic and Terrestrial Habitat.....	3-2
3.5 Climatology.....	3-3
<b>4. Summary of Available Data</b> .....	<b>4-1</b>
4.1 Historical Environmental Investigations and Remedial Activities (1988 to 1999).....	4-1
4.2 Environmental Investigations (2000 to 2004).....	4-2
4.3 2005 Remedial Investigation/Source Control Evaluation Site Investigation.....	4-3
4.4 Follow-up Investigations (2006 to 2015).....	4-4
4.5 Southeast Area Groundwater Investigation (2016 to Present).....	4-5
<b>5. Remedial Investigation Results for Soil</b> .....	<b>5-1</b>
5.1 Nature and Extent of Constituents in Soil.....	5-1
5.1.1 Site Surface Soil Sampling Results.....	5-1
5.1.2 Site Subsurface Soil Sampling Results.....	5-4
5.1.3 Interim Remediation Measures.....	5-5
5.1.4 Stained Soil Investigation.....	5-6
5.1.5 Summary of Nature and Extent of Constituents in Soil.....	5-7
5.2 Fate and Transport for Constituents in Soil.....	5-8
<b>6. Remedial Investigation Results for Groundwater</b> .....	<b>6-1</b>
6.1 Nature and Extent of Constituents in Groundwater.....	6-1
6.1.1 Site Groundwater Characterization.....	6-2
6.1.2 Stained Soil Groundwater Investigation.....	6-3
6.1.3 Southeast Area Shallow Groundwater.....	6-3
6.1.4 Summary of Nature and Extent of Constituents in Groundwater.....	6-5
6.2 Fate and Transport for Constituents in Groundwater.....	6-6
6.2.1 Stained Soil Investigation Area.....	6-6
6.2.2 Southeast Area.....	6-7
<b>7. Conceptual Site Exposure Model</b> .....	<b>7-1</b>
7.1 Locality of Facility.....	7-1
7.2 Beneficial Land and Water Use.....	7-1

7.2.1	Current and Reasonably Likely Future Land Use .....	7-1
7.2.2	Current and Reasonably Likely Future Water Use .....	7-2
7.3	Human and Ecological Exposure Model .....	7-3
7.3.1	Constituent Sources and Release Mechanisms .....	7-3
7.3.2	Potentially Complete Human Exposure Pathways and Receptors .....	7-4
7.3.3	Potentially Complete Ecological Exposure Pathways and Receptors .....	7-5
<b>8.</b>	<b>Human Health Risk Screening Evaluation .....</b>	<b>8-1</b>
8.1	Data Evaluation .....	8-1
8.1.1	Data Representativeness Discussion .....	8-1
8.2	Human Health Risk Screening Methodology .....	8-2
8.2.1	Exposure Point Concentrations .....	8-3
8.2.2	Human Health Screening Methodology .....	8-3
8.3	Human Health Risk Screening Results .....	8-4
8.3.1	Occupational Worker Scenario .....	8-4
8.3.2	Construction and Excavation Worker Scenario .....	8-5
8.4	Uncertainty Evaluation .....	8-6
8.4.1	Sampling, Analysis, and Data Evaluation .....	8-6
8.4.2	Fate and Transport .....	8-6
8.4.3	Exposure .....	8-6
8.4.4	Toxicological Data and Risk Characterization .....	8-7
8.5	Risk Screening Conclusions .....	8-7
<b>9.</b>	<b>Conclusions and Recommendation .....</b>	<b>9-1</b>
9.1	Soil .....	9-1
9.2	Groundwater .....	9-1
9.3	Recommendation .....	9-2
<b>10.</b>	<b>References .....</b>	<b>10-1</b>

#### Appendixes

A	Boring and Well Logs
B	Historical Data
C	Laboratory Analytical Reports
D	Data Validation Reports
E	Contaminated Media Management Plan (Updated)
F	Groundwater Elevation Contour Maps
G	<a href="#">Risk Evaluation Calculations ProUCL Outputs</a>

#### Tables

1-1	Location of Information from Section VI(B) of DEQ (2002) in Northwest Pipe RI
2-1	Significant Property Owners and Operations Summary
4-1	Summary of Investigation and Remediation Activities Associated with Dames & Moore Areas of Concern
5-1	<a href="#">Rev. 1</a> , Surface Soil Sample Summary
5-2	<a href="#">Rev. 1</a> , Subsurface Soil Sample Summary
6-1	Analytical Groundwater Sampling Results
6-2	Well Construction Details
6-3	Analytical Groundwater Sampling Results for Port of Portland Wells
6-4	Stained Soil Investigation Area Groundwater Elevation Summary
6-5	Southeast Area Groundwater Elevation Measurements
6-6	Hydraulic Conductivity Estimates from 2005 Compared to 2016

- 6-7 Analytical Parameters and Weighting for Preliminary Screening for Anaerobic Biodegradation Processes
- 7-1 Water Wells Within a One-Mile Radius of Property Boundary
- 8-1 Soil Samples Used in the Human Health Risk Screening Evaluation
- 8-2 [Rev. 1](#), Surface Soil Summary Statistics (0 to 3 feet bgs)
- 8-3 [Rev. 1](#), Subsurface Soil Summary Statistics (0 to 10 feet bgs)
- 8-4 Human Health Risk Screening for Onsite Groundwater from 2001 to 2015
- 8-5 Human Health Risk Screening for Onsite Groundwater from 2016 to 2019
- 8-6 [Rev. 1](#), Human Health Risk Screening for Offsite Port of Portland Wells for 2004 to 2005
- 8-7 Human Health Risk Screening for Offsite Port of Portland Wells for 2016 to 2019
- 8-8 [Rev. 1](#), Human Health Risk Estimates for Exposure to Surface Soil (0 to 3 feet bgs)
- 8-9 [Rev. 1](#), Human Health Risk Estimates for Exposure to Subsurface Soil (0 to 10 feet bgs)
- 8-10 [Risk Estimates for Exposure to Chromium in Soil](#)

## Figures

- 2-1 Vicinity Map
- 2-2 Facility Map
- 2-3 Industrial Activities
- 2-4 Stormwater System
- 3-1 [Rev. 1](#), Selected Hydrologic Features from 1897 Map Digitized onto Current Aerial
- 4-1 Approximate Locations of Areas of Concern Identified in Dames & Moore (1989)
- 5-1 Surface Soil Sample Locations
- 5-2 Subsurface Soil Sample Locations
- 5-3 Total PAHs in Surface Soil
- 5-4 Total PCBs in Surface Soil
- 5-5 Interim Remedial Measures Hot Spot Excavation and Pavement Capping Areas
- 5-6 Stained Soil Investigation Soil Sample Locations
- 6-1 Groundwater Sample Locations
- 6-2 VOCs in Groundwater 2001 through 2004
- 6-3 Southeast Area Cross Section
- 6-4a Southeast Area VOC Concentrations August 2003 through October 2019
- 6-4b Southeast Area VOC Concentrations August 2003 through October 2019
- 6-5 Stained Soil Investigation Area Groundwater Flow Directions
- 6-6 Groundwater Elevation Contour Map Southeast Area, October 7, 2019
- 6-7a VOC Trend Plots in the Southeast Area (2003 – 2019)
- 6-7b VOC Trend Plots in the Southeast Area (2003 – 2019)
- 6-8 Molar Concentration Plots for Selected Wells (2003 – 2019)
- 6-9 Average Molar VOC Concentrations for Selected Wells (2016 – 2019)
- 7-1 Locality of Facility for Soil and Groundwater
- 7-2 Water Wells Within a One-Mile Radius of Property Boundary
- 7-3 Conceptual Site Model for Human Health and Ecological Exposure Pathways



## Acronyms and Abbreviations

°F	degree(s) Fahrenheit
µg/kg	microgram(s) per kilogram
µg/L	microgram(s) per liter
µmol/L	micromole(s) per liter
AST	aboveground storage tank
bgs	below ground surface
Burgard Equities	12005 Burgard Equities LLC
CEM	conceptual site exposure model
<a href="#">CH2M</a>	<a href="#">CH2M HILL Engineers, Inc.</a>
CMMP	contaminated media management plan
COI	<a href="#">constituent contaminant</a> of interest
COPC	<a href="#">constituent contaminant</a> of potential concern
DCE	dichloroethene
DEQ	Oregon Department of Environmental Quality
DO	dissolved oxygen
ELCR	excess lifetime cancer risk
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
<a href="#">Fe2+</a>	<a href="#">ferric iron</a>
<a href="#">Fe3+</a>	<a href="#">ferrous iron</a>
ft/ft	feet per foot
<a href="#">GP</a>	<a href="#">geoprobe</a>
<a href="#">GW</a>	<a href="#">groundwater</a>
<a href="#">HSCS</a>	<a href="#">hot spot confirmation sample</a>
HI	hazard index
HQ	hazard quotient
IRM	interim remedial measure
IT <a href="#">Slip</a>	International Terminals <a href="#">Slip</a>
JSCS	Joint Source Control Strategy
kg	kilogram(s)
LOF	locality of facility
mg/kg	milligram(s) per kilogram
mg/L	milligram(s) per liter
MNA	monitored natural attenuation
<a href="#">MW</a>	<a href="#">monitoring well</a>
NFA	No Further Action

OAR	Oregon Administrative Rule
ORP	oxidation-reduction potential
OSC	Oregon Shipbuilding Corporation
OWRD	Oregon Water Resources Department
PAH	<a href="#">polynuclear polycyclic</a> aromatic hydrocarbons
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
RBC	risk-based concentration
<a href="#">RI</a>	<a href="#">remedial investigation</a>
RSE	risk screening evaluation
SCE	source control evaluation
<a href="#">Terminal 4</a>	<a href="#">Port of Portland Terminal 4</a>
<a href="#">SS</a>	<a href="#">surface soil</a>
TCE	trichloroethene
TOC	total organic carbon
<a href="#">TP</a>	<a href="#">test pit</a>
TPH	total petroleum hydrocarbons
UCL	upper confidence limit
USGS	U.S. Geological Survey
UST	underground storage tank
VOC	volatile organic compound
XPA	expanded preliminary assessment

## 1. Introduction

This Remedial Investigation (RI) Report was prepared on behalf of Northwest Pipe Company for the facility located at 12005 North Burgard Road in Portland, Oregon (the Site). This RI Report supports a Site-wide No Further Action (NFA) determination for the Site, under the DEQ Hazardous Substance Remedial Action Rules.

### 1.1 Purpose and Objectives

Northwest Pipe Company has conducted investigations and focused remedial actions to address environmental conditions at the Site since it began operations at the Portland facility in the early 1980s. In 2000, the Oregon Department of Environmental Quality (DEQ) requested that Northwest Pipe Company prepare an expanded preliminary assessment (XPA) as part of DEQ's efforts to identify potential sources of contamination to the Willamette River in conjunction with the Portland Harbor Superfund process. In 2004, Northwest Pipe Company and DEQ executed a Voluntary Agreement for Remedial Investigation and Source Control Evaluation (DEQ agreement LQDVC-NWR-04-01). This report presents the results of the RI conducted under the 2004 agreement and describes the DEQ-approved Interim Remedial Measure (IRM) for soil that was completed in 2012.

The purpose of this RI Report is to analyze and present existing site information sufficient to support decision making with respect to DEQ's Hazardous Substance Remedial Action rules. This characterization includes determining the nature, extent, and distribution of constituents in Site media; determining the fate and transport of constituents; identifying migration pathways and receptors; and evaluating potential risk to human health and the environment. This RI Report is presented in conjunction with a Companion report, *Source Control Evaluation in Support of Monitored Natural Attenuation Source Control Decision* (herein referred to as the Companion SCE Report). Surface soil, subsurface soil, and groundwater are characterized in both reports. Stormwater and sediment are characterized in the Companion SCE Report. Remaining media, specifically air and surface water, are not applicable to this analysis and are not discussed in these reports.

Air emissions from industrial processes at the Site are regulated with a Title V permit, and air emissions from soil or groundwater are not applicable because the Site is paved. The Site does not border surface water. The information in this RI Report is intended to provide DEQ with the basis to make an NFA determination for the Site.

### 1.2 RI Report Organization

This document generally follows the outline in Table 3-13 of the *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA, 1988) and addresses the items listed in Section VI(B) of DEQ's *Recommended Format, Remedial Investigation/Feasibility Study Scope of Work (Long Version)* (DEQ, 2002a). In addition, this document includes human health and ecological risk assessment reporting elements from Section VI(C) of DEQ (2002a). A cross-reference table (Table 1-1) presents where each topic from Section VI(B) and (C) of DEQ (2002a) is found in this report.

This document is organized into the following sections:

- **Section 1, Introduction:** The introduction presents the purpose, objectives, and an overview of the governing regulatory framework.
- **Section 2, [Site Background](#):** This section details the Site location, ownership, activities, and operations. The stormwater system, regulatory permits, determinations, and previous investigations are also described in this section.
- **Section 3, Environmental Setting:** This section contains information about the climate, topography, soil, geology, surface water hydrology, hydrogeology, and critical habitats within and near the Site.

- **Section 4, Summary of Available Data:** This section presents more than two decades of investigation and focused remedial actions performed by Northwest Pipe Company under DEQ oversight. This section describes each of the investigations contributing data to this report.
- **Section 5, Remedial Investigation Results for Soil:** This section includes an evaluation of the nature and extent of constituents detected in surface and subsurface soil. The fate and transport of identified constituents also are described.
- **Section 6, Remedial Investigation Results for Groundwater:** This section includes an evaluation of the nature and extent of constituents detected in groundwater. The fate and transport of identified constituents also are described.
- **Section 7, Conceptual Site Exposure Model:** This section describes the locality of facility (LOF), beneficial land and water uses, and human and ecological exposure models. This information establishes the framework for completing the human health risk screening evaluation (RSE) described in Section 8.
- **Section 8, Human Health Risk Screening Evaluation:** This section presents and explains the conservative risk screening performed for the Site, including an evaluation of baseline risk from receptor exposure to surface soil, assuming the existing pavement cap were absent. Potential receptor exposure to constituents in groundwater also is evaluated in the context of DEQ acceptable risk levels.
- **Section 9, Conclusions and Recommendations:** This section summarizes the conclusions of the RI and recommends an NFA determination for the Site.
- **Section 10, References:** This section contains a list of documents used in preparing this RI.

Tables and figures are located at the end of this document, following Section 10. Appendixes follow the tables and figures and are provided electronically.

## 2. Site Background

This section summarizes the background information pertinent to the characterization of the Site.

### 2.1 Site Location and Description

The Site is located in the area generally referred to as the Burgard Industrial Park, in the northern part of Portland (Figure 2-1). The term "Burgard Industrial Park" refers to a collection of industrial parcels located east and south of the Schnitzer International Terminals (IT) Slip (~~IT Slip~~) and includes the Northwest Pipe Site. The Burgard Industrial Park is composed of 7 parcels that share the 12005 North Burgard Road street address. The Northwest Pipe Site measures approximately 1,013 feet long and 777 feet wide and is located approximately 1,500 feet from the eastern bank of the Willamette River. The Site borders no surface water body and is situated between and east of two manmade slips: the Port of Portland Terminal 4 Slip 1 and the IT Slip, which is privately owned by Schnitzer Investment Corp (now known as MMGL Corp.) and Schnitzer Steel Industries.

Encompassing 29.15 acres of flat terrain, the Site includes property owned by Northwest Pipe (25.96 acres split into a 25.29-acre manufacturing area and a 0.67-acre office area) and property owned by 12005 Burgard Equities LLC (Burgard Equities) (3.19 acres), which Burgard Equities leases to Northwest Pipe. The 3.19-acre property is managed by Burgard Equities' agent, Felton Properties, Inc., of Portland, Oregon, and is located at the southern border of the Northwest Pipe property. For purposes of discussing ownership and operations presented in Section 2.2, the 25.29-acre manufacturing area is identified as Parcel A, the 3.19-acre parcel leased by Northwest Pipe is identified as Parcel B, and the 0.67-acre office area is identified as Parcel C. Parcel C is an office area that houses an administrative building used for offices and meeting rooms. Parcel C has no history of industrial use; therefore, this report reflects investigations conducted for Parcels A and B.

The remainder of the Burgard Industrial Park surrounds the Site. Land use surrounding the Site is zoned by the City of Portland Bureau of Planning as "IHi," an abbreviation for heavy industrial/river industrial (City of Portland, 2014) and includes such current or historical processes as ship breaking, metal sorting, vehicle shredding, shipping, sand blasting, metal fabrication, and manufacturing.

Commented [A1]: Response to DEQ comment 2

The Site includes an administrative office, the main production buildings (Bays 1 through 6 in the large building and Bay 9 in a smaller building), the pipe coating and lining operations, a general storage area for supplies, a cement mortar coating operation, and the Flammable Materials Storage Building. The ground surface of the Site is covered either by buildings or asphalt pavement. The interior floors of buildings are predominantly concrete, with some areas of asphalt. A facility map is shown on Figure 2-2.

### 2.2 Site History and Facility Operations

This section summarizes the known history of ownership and use of the Site.

#### 2.2.1 Ownership

Northwest Pipe owns two parcels (Parcels A and C) and Burgard Equities owns one parcel and leases it to Northwest Pipe (Parcel B). The three parcels constitute 29.15 acres. Table 2-1 presents a summary of ownership and operations organized by Parcels A, B, and C as defined in Section 2.1 and shown on an inset map in Table 2-1.

Aerial photography shows that the Site was undeveloped before World War II. Based on a review of the title chain for the two parcels now owned by Northwest Pipe (Parcels A and C, Table 2-1), the property owners during the pre-World War II era included the City of Portland and the William Gatton Estate Company, a corporation that managed the former William Gatton donation land claim (circa 1926 to 1941). As part of the lead up to World War II, the Oregon Shipbuilding Corporation (OSC) (one of three Kaiser shipyards in the Portland-Vancouver area) leased, and then purchased, several parcels in the

area, now known as the Burgard Industrial Park, from 1941 through 1949. Other property owners in the area included the United States government and the City of Portland (Table 2-1).

Beall Pipe and Tank Company (which operated as a division or subsidiary of L.B. Foster Company), purchased the two properties (Parcels A and C, Table 2-1) in 1950 and began manufacturing steel products soon thereafter. Multnomah Land and Equipment acquired the properties in 1982, when Northwest Pipe and Casing Company (now Northwest Pipe Company) leased the properties and began operations. Northwest Pipe purchased the two parcels in 1997.

The historical ownership of the third parcel (Parcel B, Table 2-1) is less certain. Review of the available ownership records shows it was owned by the City of Portland and the William Gatton Estate Company in the pre-World War II era (1926 through 1941), and that OSC leased and then purchased this property during the World War II era. From 1972 through 2006, Schnitzer owned the property, and from 2006 until the present, the parcel has been owned by Burgard Equities.

### 2.2.2 Historical Operations

Property currently owned and leased by Northwest Pipe Company has been used for industrial activities since its development by the OSC (one of the Kaiser shipyards) in 1941. Under contract to the federal government and at its direction, OSC constructed and operated a shipyard on the Site that produced more than 450 Liberty ships, Victory ships, and troop transports as part of the war effort. Sections of the ships were constructed in a large building composed of 11 manufacturing bays, some of which were subsequently damaged by fire and removed. Remaining portions of the footprint of this once-larger building are occupied by the present-day Bays 1 through 6 and Bay 9. The fabricated ship components then were moved to the shipways located to the west along the Willamette River and assembled to create ships. The known activities that occurred on the property now owned by Northwest Pipe Company consisted of cutting/drilling sheet steel, forming sheet steel, welding, and riveting (OSC, 1945). Following the war, a portion of the Site was used as a grain warehouse. Activities on other parts of the Site during this time are not known. The warehouse was substantially destroyed by fire in 1961 and rebuilt prior to Northwest Pipe Company's ownership. From 1950 through 1982, Beall Pipe and Tank Company used the Site to manufacture steel pipe and tanker trucks as well as to clean and repair used tanker trucks.

### 2.2.3 Current Operations

Northwest Pipe Company began operations at the Site in 1982 under a lease and purchased the Site in 1997. Northwest Pipe Company manufactures steel pipe at the Site that is used for a variety of municipal, industrial, and utility applications, primarily potable water transmission. Steel pipe is manufactured using the submerged arc welding process. The Site is a "job shop" in which operations are run based on the orders placed by customers. The Site runs operations as needed to fill specific orders. Not all equipment or operations discussed in this document run continuously.

Northwest Pipe Company operates three spiral weld mills to produce welded steel pipe ranging in size from 17-inch outside diameter through 144-inch outside diameter. The submerged arc welding process produces little to no welding fumes, and welding is predominantly conducted indoors. If requested by the customer, the Northwest Pipe can produce pipe with coatings and linings (specifically, cement mortar, polyethylene tape, polyurethane, and specialty paints).

Figure 2-3 presents the specific locations of industrial activities throughout the Site. Pipe is welded and cut in Bays 1 through 5. The X-ray area, quality control laboratory, and shipping and receiving area are adjacent to Bay 1. Pipe fittings such as elbows, tees, manifolds, reducers, and manholes are fabricated in Bay 3. Abrasive blasting prior to taping or coating occurs in the Lining and Coating Building, western end of Bay 6, and within the Sand Blast Room in Bay 9. The Maintenance Shop is adjacent to Bay 6. Pipe fittings that require a cement lining are treated in the mortar spraying area just northwest of Bay 9. A hydro-test facility is located at the western end of Bay 9. Dumpsters that contain scrap materials and refuse are stored under cover in the Bay 9 Annex.

Cement mortar lining and coating occur at the Cement Plant near the northwestern corner of the Site. The cement curing bays are located north of the Cement Plant at the northern edge of the property. Paint and other coatings are applied in the Lining and Coating Building, which is on the western edge of the

Site and in Bay 6. Paint is stored in a contained area under cover in the Flammable Materials Storage Building near the eastern property line. Gasoline and diesel fuel are stored in two aboveground storage tanks (ASTs) with secondary containment.

A building containing offices, restrooms, and a meeting room is east of Bay 3. The remainder of the Site is used for storing finished pipe and for shipping access by rail and truck. Northwest Pipe Company decommissioned the underground storage tanks (USTs) found onsite in the late 1980s, receiving an NFA letter upon completion of the work (DEQ, 1990). The Company also has conducted extensive site investigations and cleanups with DEQ oversight and has worked to improve the existing facilities at the property throughout its tenure at the Site.

Northwest Pipe Company's stormwater system consists of roof downspouts and catch basins that drain into a network of stormwater conveyance lines, which in turn flow to the north/northeast to two state-of-the-art stormwater treatment systems, where stormwater is treated before leaving the Site via two discharge lines along the northern Site boundary (Figure 2-4). These two lines discharge into a single communal stormwater line that subsequently discharges into the IT Slip through a single outfall, commonly referred to as Outfall 18 (also known as Lower Willamette Group Outfall WR-123), located more than 0.33 mile (approximately 1,960 feet) from the mouth of the slip. The Site is covered with either pavement or structures, so the Site consists of impervious surfaces. Figure 2-4 depicts the Site drainage and includes directional stormwater runoff patterns of the Site, the location of the stormwater treatment systems, and the three isolated drainage zones, and shows the approximate locations of local drainage divides.



### 3. Environmental Setting

Sections 3.1 through 3.5 describe the environmental setting of the Site, including the geology, hydrogeology, surface water, aquatic and terrestrial habitat, and climatology.

#### 3.1 Geology

The Site occupies the location of former marshland and alluvial floodplain of the Willamette River. Dredged material was used to fill and level the area in early 1941 (OSC, 1945). The Linnton U.S. Geological Survey (USGS) 7.5-minute topographic map indicates that the topography of the Site is relatively flat (USGS, 1961). Surface elevations range from 30 to 35 feet above mean sea level with elevations in the northern part of the Site slightly lower than in the southern part.

The subsurface geology of northwestern Portland is characterized by Tertiary and Quaternary sedimentary and volcanic deposits. The Site lies within a north-northwest-trending structural depression that contains late Tertiary and Quaternary sediment deposits of fluvial (river) and lacustrine (lake) origin.

Most native surface soil at the Site has been covered by fill or modified by re-grading and construction. As shown in an 1897 USGS map of the area (USGS, 1897), the Site was a marsh and alluvial floodplain of the Willamette River before its development in 1941 (Figure 3-1). The historical location of Gatton Creek was offsite to the east of the Site and flowed south to the area now occupied by Terminal 4 Slip 1. As part of the OSC's shipyard development, the marsh was filled with dredge material to raise the elevation of the area to facilitate industrial development. According to Natural Resources Conservation Service maps, two different types of original native soil are located within the Site, which are described as follows (USDA, 2009):

- Sauvie-Rafton-Urban land complex, 0 to 3 percent slopes. The Sauvie soil, protected phase, is silty, poorly drained, and occurs in floodplains. This soil is subject to flooding. The top of the saturated zone in the shallow fill aquifer is located in Sauvie soil during spring and early summer. The Rafton soil, protected phase, is silty, very poorly drained, and occurs on floodplains. This soil is subject to flooding. The top of the saturated zone in the shallow fill aquifer is located in Rafton soil during winter, spring, and summer.
- Pilchuck-Urban land complex, 0 to 3 percent slopes. The Pilchuck soil, protected phase, is sandy, somewhat excessively drained, and occurs on floodplains. This soil is subject to flooding and erosion.

Based on inference from boring logs across the Site, the Site is underlain by a shallow silty sand dredged material fill interval placed during original site development in the early 1940s. This fill is underlain by native silt historically deposited in side channels of the Willamette River and interpreted by CH2M HILL [Engineers, Inc. \(CH2M\)](#) (2005a) to be the former surface of the floodplain that existed prior to filling and site development. The thickness of the native silt may exceed 100 feet based on Oregon Water Resources Department (OWRD) logs of water wells (see Section 7.2.2).

#### 3.2 Hydrogeology

The Site is located on flat floodplain deposits and fill material east of the Willamette River. Fill and fluvial/lacustrine deposits extend from the ground surface to at least 258 feet below ground surface (bgs) and are composed of interbedded silt, sand, and gravel layers, consisting of several distinct zones:

- A shallow zone of fine sand and silty sand fill material (0 to 28 feet bgs), saturated in its lower half under unconfined conditions, and underlain by a low-permeability confining layer.
- An upper confining layer of low-permeability silt with sparsely interbedded sand from approximately 28 feet to 161 feet bgs. The top of this confining layer represents the historical ground surface prior to site filling and development. Principal sandy horizons within the upper confining layer are from 98 to 118 feet bgs and from 129 to 133 feet bgs.

- A deep confined, water-bearing zone of sand and gravel from 161 feet to 221 feet bgs, in which the Site's production well is screened.
- A deep confining layer from 221 to at least 258 feet bgs (maximum depth of the Site's production well).

The depth to groundwater varies seasonally between approximately 6 and 14 feet bgs and is encountered in the shallow fill water-bearing zone. The depth to groundwater is shallower in the central part of the Site. A groundwater divide occurs between the IT Slip located north-northwest of the Site and the Terminal 4 Slip 1 located southwest of the Site, with groundwater occurring deeper on the northern and southern edges of the Site. The groundwater flow direction in the southeastern portion of the Site is consistently south-southwest.

A municipal gravity sanitary sewer line crosses the northern portion of the Site and is situated approximately 20 feet bgs, below the shallow groundwater. This line is sloped to drain east, away from the Willamette River, toward a lift station that pumps sewage to the Columbia Boulevard Wastewater Treatment Plant. The underground utility lines that have been exposed to date are situated in the fine sand and silty sand fill material that occurs from below site pavement to a depth of 28 feet bgs. No crushed gravel or other pipe bedding material has been encountered around the underground utilities. Consequently, coarse bedding material that could provide a preferential pathway for flow is absent at the Site.

The silt horizon that underlies the shallow sand interval is a confining layer that separates the shallow water-bearing zone from the deep, confined aquifer. Water in the deep confined aquifer is under pressure, so when the aquifer was penetrated by the Site's deep production well in 1973, the static water level in the well rose from a depth of approximately 200 feet bgs (the depth to the top of the aquifer) to a depth of 16 feet, as documented in the OWRD water well report MULT 001824 (included in Appendix A).

### 3.2.1 Groundwater Recharge and Discharge

The source of recharge for the shallow aquifer in the Site vicinity is infiltrated precipitation. The completion of capping at the Site as part of the IRM (described in Section 5.1.3) substantially reduced the potential for onsite recharge; consequently, essentially all groundwater migrating across the Site in the shallow aquifer originates from offsite recharge.

The regional discharge point for groundwater in the area is the Willamette River. Because both the shallow and deep groundwater discharge to the river, the vertical hydraulic gradient for groundwater is generally upward toward the river. However, shallow groundwater flow in the fill aquifer is horizontal because the fill aquifer lies (depending on location and depth) above or adjacent to the river. After migrating offsite to the south and west, shallow groundwater in the fill aquifer continues to flow toward either the Willamette River or associated slips. Groundwater ultimately discharges either as subaqueous seepage or as seepage on the river bank above the river level, where it would be partially or (depending on season) completely lost to evaporation and/or plant transpiration processes prior to reaching the river.

## 3.3 Surface Water

The Site lies within the drainage basin designated as the Lower Willamette Basin at an elevation of approximately 30 to 35 feet (USGS, 1961). Precipitation occurs mainly as rain, with an annual average of approximately 36 inches per year (NOAA, 2019). The Willamette River, located approximately 1,500 feet directly west of the Site, drains the Willamette Valley before discharging into the Columbia River, approximately 4 miles north-northeast of the Site. The entire Site is within the 100-year floodplain of the Willamette River. The stormwater from the Site is collected in a stormwater conveyance system that is part of a communal system that discharges solely into the IT Slip located north-northwest of the Site (Section 2.1). The Site does not discharge stormwater directly to the main stem of the Willamette River.

## 3.4 Aquatic and Terrestrial Habitat

The Site is paved and is developed for industrial purposes. It does not support or provide habitat for state or federally listed threatened or endangered species.

### 3.5 Climatology

The climate in Portland is defined as moderate and is influenced by the Pacific Ocean and Coast Range located 65 and 30 miles west of the Site, respectively, and the Cascade Mountain Range located 30 miles east of the Site. Summers tend to be warm and dry, and winters are mild and rainy. The average daily temperature is 60 to 70 degrees Fahrenheit (°F) in the summer and 40 to 50°F in the winter (NOAA, 2019).

The average annual precipitation is approximately 36 inches per year, with roughly 88 percent of the annual rainfall occurring from October through May (NOAA, 2019). Accounting for evapotranspiration, the average net precipitation is 13.81 inches per year. Regional airflow is typically to the northwest in the spring and summer months and to the east to east-southeast in the fall and winter months (WeatherFlow, 2019).



## 4. Summary of Available Data

Northwest Pipe Company has completed extensive characterization of the Site as part of its efforts to appropriately manage the facility and in response to DEQ oversight. This section presents the main investigations completed at the Site with the presentation of information organized by chronological phase. In 1989, a Phase I and Phase II Environmental Site Assessment was conducted for Northwest Pipe Company (Dames & Moore, 1989). This work was conducted to identify environmental concerns associated with the property prior to the planned property acquisition, which occurred in 1997, and was done under a voluntary agreement with DEQ (DEQ, 1988). Section 4.1 describes the data associated with these historical investigations and actions. In 1991, DEQ issued a site assessment and strategy recommending that the Department "not proceed with any further assessment, listing, or other action for the site at the present time" (DEQ, 1991). This decision resulted in the nearly decade-long gap in investigations through 1999.

Following its purchase of the property and the proposed listing of Portland Harbor on the National Priorities List as a federal Superfund Site, Northwest Pipe Company completed an XPA under a second voluntary Cleanup Letter Agreement with DEQ, dated July 14, 2000 (DEQ, 2000). As site investigation work progressed, and subsequent to submitting the XPA report and XPA Addendum (CH2M HILL, 2000, 2001a), a voluntary Agreement for Remedial Investigation and Source Control was signed between Northwest Pipe and DEQ, effective December 30, 2004 (DEQ, 2004). Section 4.2 describes the data associated with investigations performed between 2000 and 2004.

Based on the voluntary agreement, an investigation (described in Section 4.3) was conducted in 2005 to collect information identified by DEQ as necessary to supplement the existing site characterization information. A Draft RI/Source Control Evaluation (SCE) Report was submitted in December 2005 to DEQ (CH2M HILL, 2005a). The Joint Source Control Strategy (JSCS) guidance was finalized in December 2005 (DEQ and EPA, 2005) after the 2005 Draft RI/SCE Report was submitted to DEQ.

While waiting for DEQ decisions and comments, Northwest Pipe Company continued collecting and analyzing additional soil, catch basin solids, groundwater, and stormwater samples to provide current, additional information on Site conditions. In 2008, DEQ requested a work plan to address DEQ's review comments of the 2005 Draft RI/SCE Report and a re-evaluation of site data, leading to additional work, described in Section 4.4.

The time associated with regulatory review, changes in regulatory team members, changes in regulator's findings regarding the Site, and updates to guidance documents and data screening values resulted in the next versions of the RI/SCE being submitted in January 2014 and March 2015. Following the receipt of the March 2015 RI/SCE, the U.S. Environmental Protection Agency (EPA) required additional investigation into the volatile organic compounds (VOCs) in Area 1 (hereinafter referred to as the Southeast Area). A work plan was prepared and submitted to DEQ and EPA in August 2016 to fulfill the agency request that groundwater quality information be updated to supplement the existing data set and inform the source control decision for groundwater at the Site (CH2M, 2016). Groundwater investigations related to this work are described in Section 4.5.

### 4.1 Historical Environmental Investigations and Remedial Activities (1988 to 1999)

This section summarizes the key historical site investigation and remediation efforts undertaken between 1988 and 1999. Fourteen investigation areas, or areas of concern, were identified based on the 1989 Dames & Moore Phase I Assessment (Figure 4-1). A summary of the sampling data and remedial actions associated with the reports listed below is provided in Table 4-1, organized by area of concern. Sample locations and data are provided in Appendix B. Specific sample locations and analytical data for samples collected in this period are contained in the reports listed below:

- **1989 Dames & Moore Phase I and Phase II Property Transfer Assessment.** In 1988, Northwest Pipe Company (then Northwest Pipe and Casing) requested DEQ oversight of a Preliminary

Assessment and Site Investigation that were being conducted at the Site. Northwest Pipe signed a DEQ Letter Agreement with the Environmental Cleanup Division's Site Response Section (predecessor to DEQ's current Voluntary Cleanup Program) on December 27, 1988, to provide DEQ oversight and assistance for the project. Dames & Moore completed a *Phase I and Phase II Property Transfer Assessment* in 1988 and 1989 as part of a business financing transaction and Northwest Pipe Company's consideration of a potential future purchase of the property (Dames & Moore; 1989). In its Phase II report, Dames & Moore identified 14 numbered areas of concern (Figure 4-1), 11 of which were originally identified by Dames & Moore during Phase I, and 3 of which were added by DEQ after the Phase I assessment. Dames & Moore concluded that sampling and possibly remediation were warranted at 11 of the 14 identified areas described in Table 4-1.

- **May 1989 Crosby & Overton Remedial Activities Report.** In May 1989, Crosby & Overton began remediation at a UST excavation in Area 8a (Crosby & Overton; 1989a). Approximately 300 cubic yards of soil were removed from the excavation and disposed of at the St. Johns Landfill. Twelve soil samples and two groundwater samples (one from the excavation and one from a monitoring well installed within the backfilled excavation) were collected.
- **August 1989 Crosby & Overton Corrective Action Report.** In August 1989, Crosby & Overton described progress made from additional work at the Site, including soil removed from Areas 1 and 12 and additional sampling of Areas 1, 2, 3, 5, 6, 9, 12, and 14 (Crosby & Overton; 1989b).
- **1990 OMNI Environmental Groundwater Monitoring Well Report.** In March 1990, five monitoring wells were installed by OMNI Environmental (locations included in Appendix B). The wells were installed to monitor groundwater conditions in the vicinity of Areas 4 and 8a, the aboveground diesel and former underground gasoline storage tanks.

Following Northwest Pipe's submission of these reports, DEQ issued a letter of NFA for the removal of the 2,000-gallon AST (Area 4), 1,000-gallon UST (Area 8a), and associated removal and disposal of 300 cubic yards of contaminated soil (DEQ; 1990). DEQ issued the following site assessment and strategy recommendation in 1991, which summarized the environmental investigations and remedial actions performed to date:

- **1991 DEQ Site Strategy Recommendation.** The assessment noted that "soil contamination at the site has been significantly reduced and that the potential for direct contact with any residual contamination in excavated areas, and potential releases to the air (i.e., contaminated dust) have been reduced by the addition of clean backfill and in some areas by paving. Only a few small areas of exposed contamination remain" (DEQ; 1991).

The assessment recommended that the Department "not proceed with any further assessment, listing, or other action for the site at the present time" (DEQ, 1991). This decision resulted in the nearly decade-long gap in investigations; however, two reports were produced during this time which reaffirmed or repeated earlier investigation data (Hart Crowser; 1994; Clayton; 1994):

- **1994 Hart Crowser Preliminary Site Assessment.** This report reaffirmed earlier investigations. No additional sampling was conducted.
- **1994 Clayton Environmental Consultants Phase I Environmental Assessment.** This report reaffirmed earlier investigations. No additional sampling was conducted.

Northwest Pipe Company purchased the Site in 1997.

## 4.2 Environmental Investigations (2000 to 2004)

In 2000, DEQ requested that Northwest Pipe Company prepare an XPA as part of the Department's efforts to identify potential sources of contamination to the Willamette River. The investigative work by DEQ was being done in conjunction with the Portland Harbor Superfund process (which was being conducted in parallel by the EPA and a group of potentially responsible parties, referred to as the Lower Willamette Group). The XPA summarized the work described in Section 4.1 and became the basis for follow-on investigations described below:

- **2000 URS Letter Report.** URS, the successor firm to Dames & Moore, produced a report in August 2000 that provided an overview of environmental work conducted at the Site during and subsequent

to the 1988 and 1989 Dames & Moore site assessment work (URS, 2000). The report provided some of the basis for, and was appended to, the 2000 XPA.

In response to the proposed listing of the Portland Harbor as a Superfund site (the listing eventually occurred in December 2000), DEQ requested that industrial facilities located on the Willamette River and in the vicinity of the Portland Harbor National Priorities List site conduct either preliminary assessments or XPAs to evaluate the possible presence of ongoing potential sources of contamination to the Willamette River.

- **2000 Expanded Preliminary Assessment and 2001 Expanded Preliminary Assessment Addendum.** An XPA Report (CH2M [HILL](#), 2000) and XPA Addendum (CH2M [HILL](#), 2001a) were prepared describing the history, operations, and known environmental conditions of the Site in response to DEQ's request associated with Portland Harbor.
- **2001 Site Investigation.** Based on its review of the XPA and XPA Addendum, DEQ requested additional soil and groundwater characterization (DEQ, 2001). A work plan for conducting soil and groundwater sampling was developed in mid-2001, and the sampling was conducted on September 7 and 10, 2001. The results of this investigation were presented in Technical Memorandum No. 1: Site Investigation Report (CH2M [HILL](#), 2001b).
- **2002 Southeast Area Soil and Groundwater Investigation.** In 2002, DEQ directed Northwest Pipe Company to further investigate groundwater and soil in the Southeast Area of the Northwest Pipe Company facility (DEQ, 2002b). In response to this request, a work plan was prepared, and 3 soil samples and 13 groundwater samples were collected using direct-push sampling technology, using a Geoprobe, on August 29 and 30, 2002 (CH2M-[HILL](#), 2002). The sampling conducted for this work was intended to more fully characterize the nature and extent of VOCs that had been detected in shallow groundwater in the area in September 2001 (CH2M [HILL](#), 2001b).
- **2003 Southeast Area Groundwater Investigation.** In 2002, DEQ requested that Northwest Pipe Company install monitoring wells to investigate groundwater conditions in the Southeast Area of Northwest Pipe Company's facility (DEQ, 2003a). The work was conducted to further investigate the presence of VOCs in groundwater that had been reported via previous Geoprobe sampling conducted in 2002 (CH2M-[HILL](#), 2002), and to document the groundwater flow direction in the area. Three monitoring wells were installed in the Southeast Area. Samples collected from the monitoring wells were analyzed for VOCs and specific field parameters.
- **2003 Stormwater System Sampling.** The data were collected in support of the SCE and are further described in the Companion SCE Report.
- **2004 Southeast Area Supplemental Site Investigation.** In 2004, DEQ directed Northwest Pipe Company to conduct a supplemental site investigation in the Southeast Area of the Site (CH2M [HILL](#), 2004a). Ten shallow Geoprobos and one deep Geoprobe were advanced and 12 groundwater samples collected to investigate both the lateral and vertical extent of VOCs in groundwater. Two additional monitoring wells were installed in the Southeast Area to monitor groundwater and provide additional detail in understanding the hydraulic gradient of groundwater in the area. Results of this investigation were reported to DEQ in the *Southeast Area Supplemental Site Investigation Report, Northwest Pipe, Portland, Oregon*, submitted on October 19, 2004 (CH2M [HILL](#), 2004b).

Results of these investigations are presented in Sections 5 and 6.

### 4.3 2005 Remedial Investigation/Source Control Evaluation Site Investigation

A Voluntary Agreement for Remedial Investigation and Source Control Evaluation was made between Northwest Pipe and DEQ in December 2004. The purpose of the 2005 RI/SCE work was to collect information identified by DEQ as necessary to supplement the existing site characterization information, as described in the *Remedial Investigation/Source Control Evaluation Work Plan, Northwest Pipe Company Site* (CH2M [HILL](#), 2005b). This investigation included expanded stormwater sampling, groundwater sampling of existing monitoring wells, and surface soil sampling, as follows:

- **Stormwater.** Stormwater sampling was conducted in July 2005 to further characterize stormwater discharge from the Site. The data were collected in support of the SCE and are further described in the Companion SCE Report.
- **Groundwater.** Two additional groundwater monitoring events were conducted at the Southeast Area groundwater monitoring wells. Groundwater samples were collected under spring wet conditions (June 2005) and during summer dry conditions (September 2005). Similar to previous monitoring events, groundwater samples were analyzed for VOCs. For the purpose of further evaluating natural attenuation processes likely occurring in the Southeast Area, groundwater samples also were analyzed for natural attenuation indicator parameters, specifically dissolved oxygen (DO), nitrate, ferrous iron, manganese, sulfate, methane, carbon dioxide, alkalinity, oxidation-reduction potential (ORP), chloride, and total organic carbon (TOC).
- **Surface Soil.** To investigate whether polychlorinated biphenyls (PCBs) were present in surface soil at concentrations above DEQ's published generic PCB industrial risk-based concentrations (RBCs) (DEQ, 1997), four randomly located surface soil samples were collected from Area 11 and analyzed for PCBs. Surface samples were collected to a depth of 0.5 foot below the bottom of compacted gravel paving the ground surface. Samples were collected in accordance with the field procedures described in the Sampling and Analysis Plan (CH2M [HILL](#), 2005b).

Following the submittal of the 2005 RI/SCE, the Portland Harbor JSCS guidance was finalized in December 2005 (DEQ [and EPA](#), 2005). Northwest Pipe Company continued to collect additional soil, catch basin solids, groundwater, and stormwater samples to provide current, additional information on site conditions. DEQ's 2008 review and comments on the 2005 RI/SCE included the request to update the report to reflect the final JSCS guidance as well as integrate the ongoing sampling, which occurred in the interim between the initial report submittal and DEQ review. Results of these investigations are presented in Sections 5 and 6.

#### 4.4 Follow-up Investigations (2006 to 2015)

After submitting the 2005 Draft RI/SCE document, the Site entered a period with little DEQ involvement because of staff changes at the Department and management decisions to focus the Department's efforts on higher priority sites. Northwest Pipe Company continued to characterize the Site during this period with the following studies:

- **2006 Surface Soil and Catch Basin Solids Sampling.** As part of the Site's SCE, 19 surface soil samples and five catch basin solids samples were collected in October 2006 after the Draft RI/SCE report was submitted the previous December. Each of the samples was analyzed for zinc, and a subset of these were analyzed for [polynuclear polycyclic](#) aromatic hydrocarbons (PAHs) and PCBs. Catch basin solids samples are described in detail in the Companion SCE Report.
- **2007 Comprehensive Soil and Groundwater Sampling.** In September 2007, a comprehensive soil and groundwater sampling effort was conducted to supplement the existing site characterization information for the Northwest Pipe Site. To further document groundwater conditions, 14 shallow groundwater samples (13 to 14 feet bgs) were collected from approximately 5 feet below the top of the saturated zone in the shallow fill aquifer using temporary stainless steel well points placed using direct-push technology. In addition to the temporary well points, the monitoring wells in the Southeast Area were also resampled. The direct-push groundwater samples were analyzed for total petroleum hydrocarbons (TPH) in the diesel and gasoline range, dissolved zinc, and VOCs. The groundwater samples collected from the six monitoring wells were analyzed for the same constituents and also for PAHs. Twenty-one surface soil samples (0 to 6 inches deep) were collected across the Site from unpaved areas. All soil samples were analyzed for diesel-range TPH, a subset of 14 samples was analyzed for PAHs, and nine samples were analyzed for PCBs.

In 2008, DEQ assigned a new project manager to the Site, and a work plan was requested to address DEQ's review comments of the 2005 Draft RI/SCE Report. In response, a Supplemental RI Work Plan was prepared (CH2M [HILL](#), 2009) that described supplemental investigations for surface soil, groundwater, and stormwater. After further discussion of the scope and objectives of the supplemental Site characterization work, and DEQ's review of draft versions of work plan sections, the final work plan

was approved by DEQ on October 6, 2009. The work plan was divided into individual elements (numbered work plans) as listed below:

- **Work Plan 1: Surface Soil Sampling.** Following the procedures presented in Work Plan 1 (surface soil sampling), a soil sampling effort was completed in response to DEQ's request to further characterize the nature and extent of potential [constituents contaminants](#) of interest (COIs) and other constituents identified by DEQ that may be found in surface soil (surface to 6 inches bgs) at the Site.
- **Work Plan 2: Roof Runoff Sampling.** The data were collected in support of the SCE and are further described in the Companion SCE Report.
- **Work Plan 3: Expanded Risk Screening Evaluation.** The results of the expanded RSE for groundwater is included in Section 8.
- **Work Plan 4: Stormwater System Investigation.** CH2M [HILL](#) reviewed available information on the stormwater system, current stormwater cleanup procedures, and best management practices used by Northwest Pipe Company to maintain stormwater permit compliance at the Site (CH2M [HILL](#), 2009). As requested by DEQ in response to the stormwater system evaluation, a video inspection was conducted of lengths of the stormwater system identified by DEQ to document existing conditions (CH2M [HILL](#), 2011a). The data were collected in support of the SCE and are further described in the Companion SCE Report.
- **Work Plan 5: Final Stormwater Source Control Evaluation.** The data were collected in support of the SCE and are further described in the Companion SCE Report.

Investigations and remedial actions based on the results of the work plans included the following:

- **Interim Remedial Measure.** Based on the results of surface soil sampling, Northwest Pipe Company proposed to DEQ that an IRM be implemented at the Site to address potential risks posed by constituents identified in Site soil and to serve as a source control measure in the unlikely event that Site soil were to be eroded and transported offsite via stormwater. The IRM proposal was formalized in a Risk Evaluation/Feasibility Study Memorandum. The memorandum recommended a hot spot removal and soil capping alternative that was accepted by DEQ after a public comment period. DEQ elected to conduct a public comment period because the Department anticipated that the IRM would constitute a major part of the Site's final remedy.
- **Stormwater Treatment.** In conjunction with the IRM and to address the City of Portland's Storm Water Management Manual, two state-of-the-art aboveground stormwater treatment systems were installed (one on each stormwater line leaving the Site) prior to their connection to the single communal line that subsequently discharges through a communal outfall in the IT Slip. Various other stormwater improvements, such as covering waste receptacles and installing an isolated drainage system and oil-water separator next to the aboveground fueling system, were also implemented. These site improvements are further described in the Companion SCE Report.
- **Stained Soil Investigation.** During hot spot removal in the area north of the Lining and Coating Building, workers encountered a previously unidentified area of stained soil in the shallow subsurface at a depth of approximately 1 foot bgs. At the request of DEQ, a stained soil investigation work plan was prepared by Northwest Pipe Company. DEQ approved the work, which involved subsurface soil sampling; installing, developing, and sampling three monitoring wells; and data evaluation, including natural attenuation modeling/sensitivity analysis for conservatively selected PAHs in groundwater.

Following the completion of these activities, the RI/SCE Report was updated in January 2014 (CH2M [HILL](#), 2014), comments were received from DEQ and addressed in the reissued version of the report in March 2015 (CH2M [HILL](#), 2015). Results of these investigations are presented in Sections 5 and 6.

#### 4.5 Southeast Area Groundwater Investigation (2016 to Present)

The groundwater pathway in this area was the subject of investigation in the early 2000s after VOCs were detected in the area. Work leading up to the 2005 RI showed VOCs in the Southeast Area did not pose a

risk to the Willamette River. The Southeast Area shallow groundwater was thoroughly investigated to document the nature of constituents, their horizontal and vertical extent, results of fate and transport modeling, and the results of a human health and ecological risk assessment (CH2M-HILL, 2005a, 2012c). The conclusion of this work was that the limited presence of VOCs in groundwater at the Site did not pose an unacceptable risk to human health or the environment (Oregon Administrative Rule [OAR] 340-122-0115). DEQ agreed with the conclusion that no unacceptable risk exists from Site groundwater (DEQ, 2013a). DEQ also concluded that "VOC concentrations in groundwater at the site are not significant or connected to the river" (DEQ, 2016). However, following the receipt of the March 2015 RI/SCE, EPA required additional investigation into the VOCs in the Southeast Area. A work plan was prepared and submitted to DEQ and EPA in August 2016 to fulfill the agency request that groundwater quality information be updated to supplement the existing data set and inform the source control decision for groundwater at the Site (CH2M, 2016).

Notwithstanding the conclusions previously reached by DEQ, investigation work in this area restarted in 2016 and data collected since that time has been consistent with conclusions from previous work. As part of the update, the following investigations were performed:

- **Supplemental Groundwater Data Report for the Southeast Area.** The scope of work for this data collection effort consisted of a monitoring well survey, well redevelopment, aquifer testing, and groundwater sampling in the Southeast Area and at selected Port wells offsite and downgradient from the Northwest Pipe Site. Samples were analyzed for selected VOCs and natural attenuation parameters. An update to the BIOCHLOR model evaluation of the fate and transport of VOCs from the Southeast Area was also prepared (CH2M, 2017).
- **Ongoing Groundwater Sampling.** Groundwater sampling in the Southeast Area using the same network and program as established in CH2M (2016) is continuing with the intent of informing a monitored natural attenuation (MNA) source control decision for the Site. Groundwater data collected through October 2019 are included in this report. Northwest Pipe intends to continue to collect monitoring data on a semiannual basis until the MNA Work Plan is approved by DEQ and EPA. The continued collection of data is intended to avoid gaps in the data set that could complicate later data analysis and to provide support for the MNA remedy.

Results of this investigation are presented in Section 6.

## 5. Remedial Investigation Results for Soil

This section presents the characterization of COIs detected in soil at the Site.

### 5.1 Nature and Extent of Constituents in Soil

Soil investigations were conducted from 2001 through 2012. These investigations included general site surface and subsurface soil characterization, and targeted investigation during remedial efforts, as requested by DEQ. Results are summarized in Sections 5.1.1 through 5.1.4.

From 2005 through 2009, general site surface and subsurface soil was sampled. Results of surface and subsurface soil sampling are presented in Sections 5.1.1 and 5.1.2, respectively. These efforts were later used to guide IRMs, including soil removal and paving. Confirmation soil sampling, conducted in 2011 following soil removals, is described in Section 5.1.3.

During the IRM hot spot removal in the area north of the Lining and Coating Building in 2011, a previously unknown area of stained soil was observed in the shallow subsurface at a depth of approximately 1 foot bgs. Excavation was continued at this location until groundwater was encountered at a depth of about 8 feet. An investigation was performed in 2012 to assess the nature and extent of the stained soil. The results of the soil sampling associated with this investigation are included in Section 5.1.4.

For purposes of characterizing Site soil, data are grouped as surface (from ground surface to less than 1 foot bgs) or subsurface (greater than or equal to 1 foot bgs) soils. Surface and subsurface soil sample results are screened against DEQ RBCs (May 2018 revision) in Tables 5-1 and 5-2, respectively, for the following scenarios:

- Soil ingestion, dermal contact, and inhalation – occupational, construction worker, and excavation worker scenarios
- Volatilization to outdoor air – occupational scenario
- Vapor intrusion into buildings – occupational scenario
- Leaching to groundwater – occupational scenario

If the constituent concentrations were found to exceed any of the selected RBCs, an exceedance factor was calculated and is reported beside the constituent concentrations in Tables 5-1 and 5-2 in italics. DEQ requested that an evaluation of the magnitude of exceedances be included in the evaluation of the data ([that is, i.e.,](#) less than 10, 10, 100, or 1,000 times screening value) (DEQ, 2017). Based on this direction, exceedance factors less than 10 are shown as “<10” in the tables and discussed in the corresponding text in this report. Sampling locations for surface and subsurface soil samples are shown on Figures 5-1 and 5-2, respectively. Laboratory analytical reports are included in Appendix C, and data validation reports are included in Appendix D.

#### 5.1.1 Site Surface Soil Sampling Results

Site surface soil sampling was conducted in 2001, 2005, 2006, 2007, and 2009 to characterize areas of unpaved soil at the Site (Figure 5-1). In 2001, two surface soil samples ([surface soil](#) [SS\\_1](#) and [SS\\_2](#)) were collected in the transformer storage area north of Bay 6. Samples were collected from soil below compacted gravel at depths of approximately 0.5- to 0.75-foot bgs and submitted for TPH and PCB analysis. One additional surface soil sample was collected from soil boring [geoprobe](#) ([GP](#))-5 at a depth of 6 inches bgs and analyzed for VOCs and TPH.

In 2005, four surface soil samples were collected ([SS\\_101](#), [SS\\_102](#), [SS\\_103](#), and [SS\\_104](#)) below compacted gravel (0.5 foot bgs) at the Transformer Substation Area to the north of Bay 9 and analyzed for PCB Aroclors.

In 2006, 19 surface soil samples (SS-1 through SS-19) were collected from unpaved areas across the Site. All samples were analyzed for zinc, and a subset of samples was analyzed for PAHs, PCBs, and diesel-range TPH. In 2007, 21 surface soil samples (SS-301 through SS-321) were collected from 0 to 6 inches bgs from unpaved areas across the Site. All soil samples were analyzed for diesel-range TPH, and a subset of 14 samples was analyzed for PAHs and PCBs.

The most recent collection event for surface soil occurred in 2009 and included 11 samples (SS-401 through SS-411) collected from 0 to 6 inches bgs from various points located across the Site. Samples were analyzed for inorganic constituents (arsenic, selenium, and specific metals) and organic constituents (phthalates, PCBs, pesticides, and TOC). A subset of samples was analyzed for PAHs. Data associated with these three sampling events, presented in Table 5-1, were screened against Oregon DEQ RBCs for soil ingestion, dermal contact, and inhalation for occupational, construction worker, and excavation worker scenarios as well as regional background metals concentrations for soil in the Portland Basin (DEQ, 2013b). Sample locations are shown on Figure 5-1, laboratory analytical reports are included in Appendix C, and data validation reports are included in Appendix D. A discussion of the data is presented in Sections 5.1.1.1 through 5.1.1.7.

#### **5.1.1.1 Total Petroleum Hydrocarbons**

TPH was analyzed in 2001, 2006, and 2007. No concentrations exceeded DEQ RBCs.

#### **5.1.1.2 Inorganic Constituents**

Inorganic constituents were evaluated in 2006 (zinc) and 2009 (aluminum, antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc). All constituents were detected in at least one sample, which was expected because these constituents occur naturally in the minerals that constitute rock and soil. Arsenic, which is not a constituent related to Northwest Pipe Company activities, was the only constituent that exceeded its RBC. Nine of the 11 sample values were above the occupational worker RBC, and one of those was above the construction worker RBC (sample location SS-410). Of the 11 samples, only two measured concentrations of arsenic above the regional background for soil in the Portland Basin of 8.8 milligrams per kilogram (mg/kg) (DEQ, 2013b). All but one of the exceedances of the occupational RBC were less than 10 times the RBC. The concentration at SS-410 exceeded the occupational RBC by a factor of 17 but was less than 10 times the construction worker RBC.

OAR 340-122-115(32)(b) defines a highly concentrated hot spot for carcinogens as having a concentration greater than 100 times the acceptable risk level for individual carcinogens, as defined by DEQ, or for non-carcinogens, having a concentration 10 times the DEQ RBC. The results of the inorganic constituent analysis for surface soil identified no highly concentrated hot spots for inorganic constituents. Previously unpaved soil at the Site was capped with pavement from 2011 to 2012 as part of the IRM, so the potential exposure pathways contemplated in the comparison described above are incomplete.

#### **5.1.1.3 Organochlorine Pesticides**

Surface soil samples were analyzed for organochlorine pesticides in 2009. One constituent, alpha-hexachlorocyclohexane, was identified in one sample (SS-409) at a concentration above the method detection limit but below the laboratory reporting limit. The laboratory estimated its concentration at 6.78 micrograms per kilogram ( $\mu\text{g}/\text{kg}$ ). Concentrations at these low levels may be attributable to air deposition of fugitive dust, such as dust from traffic on the access road just south of the Site, or from the 2008 demolition and removal of several large grain silos on Port of Portland property across from the Northwest Pipe access road. Pesticide use in conjunction with grain storage is well known and contaminated dust could have easily been mobilized during demolition activities of the neighboring grain silos (OSHA, 2015). The concentration found at this location was well below the DEQ RBC for the occupational worker exposure scenario (360  $\mu\text{g}/\text{kg}$ ) and construction worker exposure scenario (3,000  $\mu\text{g}/\text{kg}$ ).

#### 5.1.1.4 Polynuclear Polycyclic Aromatic Hydrocarbons

PAHs were analyzed in samples collected in 2006, 2007, and 2009. Figure 5-3 presents the calculated total PAH concentration for each sample location where PAHs were analyzed. Total PAH concentrations were calculated by adding the detected values for each PAH compound and zero for each nondetected compound. Of the PAHs detected at the facility, four were found to exceed RBCs: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene. Exceedance factors for the occupational worker scenario RBCs for benzo(a)pyrene were less than 10 for all but three sample locations (SS-18, SS-321, and SS-411). Samples from these three locations exceeded the construction worker scenario RBC, but none by more than a factor of 10. Samples SS-18 and SS-321 were collected from north of the Lining and Coating Building. Sample SS-411 was collected at the southern edge of the Site from soil that had eroded and sloughed onto pavement from the elevated land along the southern boundary of the Site. This elevated land includes a rail line and an access road to Northwest Pipe and the neighboring scrap recycler, where scrap metal delivery trucks and bins associated with the Schnitzer Steel Industries scrap yard operation are routinely staged or parked.

A risk screening and hot spot evaluation was conducted in 2010 to evaluate PAH concentrations in surface soil (CH2M HILL, 2010). At the time, the benzo(a)pyrene hot spot screening level was 27,000 µg/kg for an occupational worker. The three elevated sample locations (SS-18, SS-321, and SS-411) exceeded this criterion and were subject to remedial action (discussed in Section 5.1.3). Since the time of the 2010 evaluation, the hot spot screening levels changed to 210,000 µg/kg for an occupational worker and 740,000 µg/kg for a construction worker (DEQ, 2018b). All of the concentrations measured in surface soil fall below these updated screening levels.

#### 5.1.1.5 Polychlorinated Biphenyls

PCBs were analyzed in samples collected in 2001, 2005, 2006, 2007, and 2009. Figure 5-4 presents the calculated total PCB concentration for each sample location. Only PCB Aroclors-1254 and -1260 were detected at the Site. The concentration of Aroclor-1254 was found to range from its highest at SS-13 (11,000 µg/kg) to below laboratory reporting limits at SS-01. Of the 31 surface soil sample locations, 16 locations had total PCB concentrations exceeding the occupational worker scenario RBC of 590 µg/kg. All but five of the locations with exceedances were less than 10 times the RBC (SS-2, SS-13, SS-306, SS-307, and SS-409). These five locations also exceeded the construction worker scenario RBC of 4,900 µg/kg but all at less than 10 times the screening value. Figure 5-4 presents the sample locations, the corresponding calculated total PCB concentration for each point, and the locations with samples exceeding RBCs.

A comparison of the data to the May 2018 DEQ hot spot criterion (5,900 µg/kg for the occupational scenario) yields the same five sample locations where the total PCB concentrations exceed the revised hot spot value (shown on Figure 5-4 as exceeding the May 2018 construction worker scenario RBC):

- SS-2 in the central part of the Site near the transformer storage area (6,200 µg/kg total PCBs)
- SS-13 in the north-central part of the Site between Bay 9 and the Cement Plant (12,500 µg/kg total PCBs)
- SS-306 and SS-307 in the northeastern area of the Site in an area currently used for pipe storage (8,930 and 8,248 µg/kg total PCBs, respectively)
- SS-409 in the southwestern part of the Site near the Paper Shed (8,740 µg/kg total PCBs)

Of these locations, four have been graded and capped, eliminating the potential for exposure. The fifth location (SS-2) is within a fenced limited-access area with a roof. Curbing was installed around the area in 2009, and the ground surface is composed of compacted gravel. A Contaminated Media Management Plan (CMMP) is in place for the Site. Consequently, these hot spots have been addressed via engineering controls.

#### 5.1.1.6 Phthalate Esters

Only bis(2-ethylhexyl) phthalate, butyl benzyl phthalate, and di-n-butyl phthalate were detected in the 2009 soil samples. All of the detected phthalate concentrations were below RBCs for the occupational scenario. Even though the method blanks associated with these samples did not contain phthalate esters above laboratory reporting limits, EPA recognizes phthalate esters and bis(2-ethylhexyl) phthalate (the most widely reported phthalate in these samples) as common laboratory contaminants (EPA, 2008). The detection of low concentrations of selected phthalate esters was likely associated with laboratory contamination.

#### 5.1.1.7 Volatile Organic Compounds

One sample, the surface soil sample from the Geoprobe sampling location in the Flammable Materials Storage Shed (GP-5), was analyzed for VOCs. No VOCs were detected.

### 5.1.2 Site Subsurface Soil Sampling Results

Site subsurface soil sampling was performed in 2001, 2002, 2007, and 2008. Data collection performed in 2011 and 2012 was conducted during IRMs and is discussed in Section 5.1.3. Boring and test pit locations are shown on Figure 5-2, analytical results are presented in Table 5-2, and boring logs are included in Appendix A.

Four subsurface soil samples were collected from three borings drilled in 2001. Two of these borings (GP-1 and GP-2) were drilled in the Southeast Area to determine whether the former waste oil tank had led to the presence of hydrocarbons or VOCs in soil or groundwater (Figure 5-2). Geoprobe locations GP-1 and GP-2 were advanced to a depth of 18 feet. The soil sample from the 6-foot depth from GP-1 and a soil sample from the 18-foot depth from GP-2 were selected for analysis. Both samples were analyzed for VOCs, TPH, and PAHs. One soil boring (GP-5) was drilled near the Flammable Materials Storage Building and two subsurface samples were collected from 3 and 6 feet bgs, respectively, and analyzed for VOCs and TPH.

Additional subsurface samples were collected from the Southeast Area in 2002. Of the 12 Geoprobes used to collect groundwater samples ([groundwater \[GW\]-01](#) through [GW-12](#)), two were also used to collect subsurface soil samples. Subsurface soil samples were collected from 9 feet bgs at [GW-03](#), and from 2.5 and 13.5 feet bgs at [GW-05](#) (Figure 5-2). Samples were analyzed for VOCs only.

The samples collected in 2007 and 2008 were intended to supplement site characterization information. In 2007, CH2M [HILL](#) collected 14 subsurface soil samples (GP-201 through GP-214) from 8 to 10 feet bgs across the Site. Each sample was collected just above the top of the saturated zone in the shallow fill aquifer. All 2007 soil samples were analyzed for TPH, and a subset of samples was analyzed for PAHs, VOCs, PCBs, and zinc. In January 2008, soil samples were collected from three test pits ([test pit \[TP\]-101](#), [TP-102](#), and [TP-103](#)) from a depth of 1 foot and 3 feet bgs. Samples were analyzed for total zinc, PAHs, and PCBs. Locations of test pits are shown on Figure 5-2. A discussion of the data is presented in Sections 5.1.2.1 through 5.1.2.7.

#### 5.1.2.1 Total Petroleum Hydrocarbons

TPH was evaluated in 2001 and 2007 samples. While there were detections of diesel-range and gas-range TPH, all concentrations were below DEQ RBCs.

#### 5.1.2.2 Inorganic Constituents

Inorganic constituents were evaluated in 2007 and 2008 (zinc). RBCs have not been established for zinc.

#### 5.1.2.3 Organochlorine Pesticides

Given the limited mobility of organochlorine pesticides, they are most likely to be found in surface soil. Subsurface soil was not analyzed for phthalate esters.

#### 5.1.2.4 Polynuclear Polycyclic Aromatic Hydrocarbons

PAHs were evaluated in 2001, 2007, and 2008. All reported concentrations were below RBCs.

#### 5.1.2.5 Polychlorinated Biphenyls

PCBs were analyzed in 2007 and 2008 in a total of 12 samples. Three of the 12 samples analyzed for PCBs had one detected Aroclor: Aroclor-1254 in GP-213 at a concentration of 186 µg/kg, Aroclor-1254 at 1 foot bgs in TP-101 at a concentration of 2,940 µg/kg, and Aroclor-1260 at 1 foot bgs in TP-102 at a concentration of 119 µg/kg. Of these, one constituent in one location exceeded DEQ RBCs; Aroclor-1254 exceeded the occupational worker scenario by less than a factor of 10 at a depth of 1 foot bgs in TP-101. This location was collocated with the surface sample SS-18, and soil in this location was later removed in the soil excavation work described in Section 5.1.3. The remaining concentrations were below DEQ RBCs (May 2018 revision).

#### 5.1.2.6 Phthalate Esters

Given the limited mobility of phthalate esters, they are most likely to be found in surface soil. Subsurface soil was not analyzed for phthalate esters.

#### 5.1.2.7 Volatile Organic Compounds

VOCs were analyzed in 2001, 2002, and 2007 in a total of 11 samples. In the Southeast Area, VOCs (tetrachloroethene [PCE], trichloroethene [TCE], and cis-1,2-dichloroethene [[cis-1,2-DCE](#)]) were detected in soil sample location GP-2, GW-03, and GW-05. Concentrations were highest in GP-2; however, because this sample subsequently was determined to be from below the top of the saturated zone (the depth to groundwater in the area stabilized at 15.5 feet, and the sample was from the 18-foot depth), and because the relative magnitudes of the three compounds closely mimic concentrations detected in groundwater at GP-2, the reported soil concentrations are believed to have been caused by the presence of groundwater containing these VOCs.

PCE, TCE, and cis-1,2-DCE were detected at location GP-203 with maximum concentrations in replicate samples of 65.5 µg/kg, 0.87 µg/kg, and 4.2 J µg/kg, respectively. Chlorobenzene was detected in GP-207 at 0.31 J µg/kg, and PCE was detected in GP-212 at 1.0 J µg/kg. Methylene chloride was detected in sample GP-5 from the Flammable Materials Storage Shed at 3 and 6 feet bgs at concentrations of 1.2 and 1.3 µg/kg, respectively. All of the detected VOCs are below DEQ RBCs (May 2018 revision).

#### 5.1.3 Interim Remediation Measures

In 2010, Northwest Pipe Company proposed to DEQ that an IRM be implemented at the Site to address potential risks posed by PAHs identified in Site soil and to prevent offsite transport via stormwater. Based on the results of surface soil sampling, two soil hot spots for benzo(a)pyrene concentrations in surface soil and other areas exceeding RBCs were identified (Section 5.1.1.4). In addition, DEQ RBCs were exceeded for benzo(a)pyrene in six other sample locations, generally in the northern portion of the Site. None of these areas would be considered hot spots under current DEQ hot spot guidance and regulations.

In this current and final version of the RI, DEQ has required Northwest Pipe to screen the 2010 PCB sample results against updated 2018 RBCs. While the IRM resolved any potential problems and this screening includes RBCs developed 8 years after the IRM was approved, five locations would have exceeded PCB hot spot concentrations using 2018 RBCs. As described in Section 5.1.1.5, these locations were already addressed via engineering controls, including grading and pavement capping, limited access, and implementation of a CMMP.

The IRM proposal was formalized in a Risk Evaluation/Feasibility Study Memorandum (CH2M-~~HILL~~, 2010) evaluating four remedial alternatives, consistent with OAR 340-122-0085. The memorandum recommended Alternative 4 (hot spot removal and soil capping). After a public comment period, this

alternative was accepted by DEQ as an interim remedy that DEQ anticipated would constitute a major part of the Site's final remedy (DEQ, 2010a).

On behalf of Northwest Pipe Company, CH2M HILL prepared a Remedial Action Work Plan in 2011 (CH2M HILL, 2011b). The work plan, which described hot spot removal, confirmation sampling, the grading plan, erosion and sediment control plan, and pavement design, was implemented in stages as equipment and personnel were available and as weather conditions permitted paving activities. The IRM also included the development of a sitewide CMMP. A current version of the CMMP, which is updated as needed to reflect site practices, is attached as Appendix E. The CMMP provides guidance to facility staff on how to manage potentially affected media to which receptors may be briefly exposed during short-term subsurface construction activities at the Site (CH2M HILL, 2011b). Remedial activities were performed between July 2011 and December 2012. Four acres were paved, and 1,050 tons of soil were removed and disposed of at the Hillsboro Landfill. The paving project effectively capped surface soil and prevented erosion of surface soil by stormwater. In addition, concrete eco-blocks (2 feet square in cross section and 6 feet long) were placed in the area of soil sloughing from the off-site roadway to minimize future sloughing onto the Site. Figure 5-5 indicates the areas of hot spot removal and pavement cap areas.

Ten confirmation samples were collected in September 2011 at the hot spot removal location. Four samples ([hot spot confirmation sample \[HSCS\]-1](#), HSCS-2, HSCS-3, and HSCS-4) were from an area of newly identified stained soil, which was discovered during excavation activities. The excavation in this area was advanced to a depth of 8 feet bgs, where the top of the saturated zone in the shallow fill aquifer was encountered. This area became the subject of a follow-up investigation described in Section 5.1.4. The remaining six samples (HSCS-5 through HSCS-10) documented that soil containing hot spot-level concentrations of benzo(a)pyrene had been removed (Table 5-2). Soil removal area and confirmation sample locations are presented on Figure 5-5. All confirmation samples outside of the Stained Soil Investigation Area were below hot spot values for benzo(a)pyrene and for other PAHs, indicating that the remedial objective of removing hot spot-level soil prior to paving was met. Section 5.1.4 describes actions continued in the Stained Soil Investigation Area separate from the hot spot removal action.

#### 5.1.4 Stained Soil Investigation

During hot spot removal in the area north of the Lining and Coating Building, workers encountered a previously unknown area of stained soil in the shallow subsurface at a depth of approximately 1 foot bgs. Excavation continued at this location until groundwater was encountered at a depth of about 8 feet. Four samples were collected from the sidewalls of the deeper excavation, at approximately 5.5 feet bgs. Analytical results confirmed elevated concentrations of PAHs and Aroclor-1254 (samples HSCS-1, HSCS-2, HSCS-3, and HSCS-4 in Table 5-2 and on Figure 5-5).

Soil and groundwater samples were collected in accordance with the *Stained Soil Investigation Work Plan* (CH2M HILL, 2012a) to investigate the nature and extent of the stained soil. Soil samples were collected at depths of 7 to 14 feet at the top of the saturated zone in the shallow fill aquifer from five locations using Geoprobe direct-push sampling equipment (GP-301, GP-302, GP-303, GP-304, and GP-305), for a total of five discrete samples (Figure 5-6). Geoprobe locations GP-303, GP-304, and GP-305 were analyzed for PAHs, PCBs, and TPH. TOC was analyzed in three samples from the saturated zone at each monitoring well location (GP-302, GP-306, and GP-307) to provide insight into the influence of fractional organic carbon on transport of organic constituents in the subsurface. Table 5-2 provides a summary of the laboratory results for the soil samples with comparison to 2018 DEQ RBCs.

Potential COIs were diesel-range TPH, PAHs, and PCBs. The first two borings were advanced in the most heavily affected soil intervals identified using field observation within the initial two borings advanced near previous sample locations HSCS-1 and HSCS-4 (GP-301 and GP-302). Analysis for these two samples included PAHs, PCBs, TPH, and TPH fraction. Total metals and arsenic were also included in the analysis for the soil sample from GP-302, at DEQ request. Samples from Geoprobe locations GP-303, GP-304, and GP-305 were analyzed for PAHs, PCBs, and TPH. TOC was analyzed in three samples from the saturated zone at each monitoring well location (GP-302, GP-306, and GP-307) to provide insight into the influence of fractional organic carbon on transport of organic constituents in the subsurface. Table 5-2 provides a summary of the laboratory results for the soil samples with comparison to 2018 DEQ RBCs.

When compared to 2018 direct exposure RBCs (soil ingestion, dermal contact, and inhalation), only five COIs in one soil boring (GP-302) exceeded the occupational worker scenario RBC, all by an exceedance

factor of less than 10 (Table 5-2). Arsenic was the only inorganic constituent with an exceedance of an RBC, and the concentration (2.52 mg/kg) was well below the regional background for soil in the Portland Basin of 8.8 mg/kg (DEQ, 2013b). PAHs with exceedances were benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene. None of the concentrations exceeded the RBCs for construction worker or excavation worker direct contact, for occupational volatilization to outdoor or indoor air, or leaching to groundwater. Diesel-range TPH exceeded the direct contact occupational scenario but no other screened RBCs.

Naphthalene exceeded the RBC for leaching to groundwater in one of the five samples at GP\_302 (Table 5-2). The potential for groundwater transport of naphthalene is evaluated in the discussion of groundwater in the Stained Soil Investigation Area in Section 6.1.2.

The extractable petroleum hydrocarbon and volatile petroleum hydrocarbon results were evaluated using DEQ's risk-based decision-making spreadsheet (DEQ, 2003b) for calculating site-specific RBCs for the particular mix of hydrocarbons observed in the Stained Soil Investigation Area. Sample results for the most concentrated sample (GP\_302) were entered into the spreadsheet, which returned a value of ">MAX" for the leaching to groundwater pathway. This correlates to a concentration of more than 1,000,000 mg/kg. This means that, even if those constituents were present as pure-phase substances (that is, 1 million parts per million), they would not pose a threat to groundwater quality because of the combination of their limited intrinsic toxicological risk and their low propensity for leaching. Consequently, any concentration of these constituents that might be present in site soil would not pose a threat to groundwater quality, including the range of concentrations detected in Northwest Pipe soil samples, all of which are orders of magnitude below this level.

Based on this evaluation, the reported concentrations of PAHs in soil do not pose an excess risk to potential receptors, and no further sampling or analysis associated with the stained soil remediation area is indicated.

#### 5.1.5 Summary of Nature and Extent of Constituents in Soil

COIs were identified through comparison of surface and subsurface soil sample results to DEQ RBCs (May 2018 revision) for the following scenarios:

- Soil ingestion, dermal contact, and inhalation – occupational, construction worker, and excavation worker scenarios
- Volatilization to outdoor air – occupational scenario
- Vapor intrusion into buildings – occupational scenario
- Leaching to groundwater – occupational scenario

A constituent was identified as a COI if one or more sample results exceeded one of these screening values. The following constituents were identified as COIs for surface soil:

- PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene)
- PCBs (Aroclor-1254, Aroclor-1260, total PCBs)

The distribution of these COIs in surface soil at the Site is shown on Figures 5-3 and 5-4.

COIs in subsurface soil include the following:

- Arsenic
- PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, naphthalene)
- Diesel-range TPH

Arsenic is an intrinsic component of minerals that compose soil in Oregon and consequently occurs naturally in soil in Oregon. The arsenic value that exceeded the arsenic RBC is below the Oregon background level of 8.8 mg/kg for arsenic in soil (DEQ, 2013b).

## 5.2 Fate and Transport for Constituents in Soil

This section describes the fate and transport evaluation for soil. In the context of this discussion, the “fate and transport” refers to how constituents move through or are transformed in environmental media, and thereby how they may come into contact with plants, animals, or humans.

In 2011 and 2012, Northwest Pipe Company paved approximately 4 acres of previously unpaved soil, eliminating potential receptor exposure to impacted soils (Figure 5-5). In addition, areas where the existing pavement was failing were repaired and repaved. Accordingly, surface soil at the Site has been capped with pavement, eliminating the direct exposure pathway. As part of this focused paving work, the Company re-graded areas around the Site to facilitate stormwater flow, discharge, and collection of stormwater entering the stormwater system.

## 6. Remedial Investigation Results for Groundwater

This section presents the characterization of COIs detected in groundwater at the Site.

### 6.1 Nature and Extent of Constituents in Groundwater

Groundwater sampling at the Site generally was performed to characterize selected areas of concern identified in the XPA and XPA Addendum (CH2M [HILL](#), 2000, 2001a), to supplement existing site characterization data, to investigate the Stained Soil Area, and to characterize groundwater conditions in the Southeast Area.

In September 2001 and September 2007, groundwater samples were collected from across the Site to supplement the existing site data. Seven shallow groundwater samples were collected in 2001 and 14 samples were collected in 2007 from approximately 5 feet below the top of the saturated zone in the shallow fill aquifer using temporary stainless steel well points placed using direct-push technology. A sample from the Site's onsite production well was also collected and analyzed. Results of the groundwater characterization are discussed in Section 6.1.1.

During hot spot removal in the area north of the Lining and Coating Building as part of the IRM, a previously unknown area of stained soil was observed in the shallow subsurface at a depth of approximately 1 foot bgs. An investigation was completed in 2012 to assess the nature and extent of the stained soil and groundwater. Three groundwater monitoring wells were installed in the area, and data evaluation included natural attenuation modeling for selected PAHs in groundwater. Results of this investigation are discussed in Section 6.1.2.

The Southeast Area has been the focus of investigation for VOCs in groundwater since the removal of an AST and contaminated soil in 1989 (DEQ; 1990). The VOCs of concern in this area are PCE, TCE, cis-1,2-DCE, and vinyl chloride. Natural attenuation in the form of reductive dechlorination is influencing the presence and concentration of VOCs in groundwater. PCE is a definitive parent compound, while TCE may be a parent compound or a breakdown (or daughter) product of PCE. The reductive dechlorination sequence progresses by reducing PCE to TCE, TCE to DCE, DCE to vinyl chloride, and vinyl chloride to ethene. Reductive dechlorination is an important biologically mediated fate process for natural attenuation of VOCs, where chlorine atoms are removed sequentially from the VOC molecule by subsurface bacteria and replaced with hydrogen ions. The removal of the chlorine atoms occurs as anaerobic microorganisms obtain energy by transferring electrons from electron donors (such as naturally occurring organic matter) to electron acceptors, such as DO, nitrate, ferrous iron (Fe<sup>3+</sup>), sulfate, carbon dioxide, and chlorinated aliphatic hydrocarbons such as PCE, TCE, DCE, and vinyl chloride.

Samples in the Southeast Area were collected from 2001 through 2005 to support the XPA and 2005 Draft RI/SCE (CH2M [HILL](#), 2005a). Northwest Pipe Company collected additional groundwater samples in 2007 to supplement the site characterization. These results were integrated into the 2014 January RI/SCE and the updated and reissued RI/SCE Report in March 2015 (CH2M [HILL](#), 2015). Following the receipt of the March 2015 RI/SCE, EPA required additional investigation into the VOCs in the Southeast Area. Groundwater sampling restarted in 2016 and continues through the present. Six wells are installed in the Southeast Area and Geoprobe sampling has been performed on several occasions. Routine groundwater monitoring is continuing in the Southeast Area on a semiannual basis because the expected Source Control Decision is MNA. An MNA [Work Plan](#) is being developed and is expected to follow the submission of this document. The Southeast Area is discussed separately in Section 6.1.3.

Groundwater data are presented in Table 6-1 with screening against DEQ RBCs (May 2018 revision) for the following scenarios:

- Ingestion and inhalation from tap water – occupational scenario
- Volatilization to outdoor air – occupational scenario
- Vapor intrusion into buildings – occupational scenario
- Groundwater in an excavation – construction and excavation worker scenario

Shallow groundwater is not and has never been used for any purpose at the Site. The most likely beneficial use of shallow groundwater from the Site would be potential recharge to surface water. The Site is located approximately 1,500 feet from the eastern bank of the Willamette River. However, the DEQ RBC screening values, based on drinking water standards, were used at DEQ's direction. Sampling locations are shown on Figure 6-1, laboratory analytical reports are included in Appendix C, and data validation reports are included in Appendix D.

### 6.1.1 Site Groundwater Characterization

Following the DEQ NFA letter for the removal of the AST, UST, and contaminated soil (DEQ, 1990), and the DEQ site assessment and strategy recommendation in 1991, DEQ requested additional groundwater investigation for select areas around the Site (DEQ, 2001). Seven groundwater samples (16 to 20 feet bgs) were collected from approximately 5 feet below the top of the saturated zone from temporary stainless steel well points placed using direct-push technology. All samples were analyzed for VOCs, and data are tabulated in Table 6-1. Sample locations (GP-1 through GP-7) are shown on Figure 6-1. Locations GP-1 and GP-2 were sampled in the Southeast Area (further described in Section 6.1.3). Also in September 2001, the deep onsite production well was sampled for VOCs (sample PW1W shown on Figure 6-1 and data included Table 6-1).

In 2007, CH2M HILL collected 14 shallow groundwater samples (13 to 14 feet bgs) across the Site to supplement existing sampling information. Each sample was collected approximately 5 feet below the top of the saturated zone from temporary stainless steel well points placed using direct-push technology. In addition to the temporary well points (GP-201 through GP-214), CH2M HILL resampled the six monitoring wells that had previously been installed in the Southeast Area of the Site (discussed in Section 6.1.3). The direct-push groundwater samples were analyzed for diesel-range TPH, gasoline-range TPH, dissolved zinc, and VOCs. Temporary well point samples were not analyzed for PAHs because unavoidable turbidity in direct-push samples would have yielded biased, nonrepresentative results for hydrophobic PAHs (as compared to the more soluble and less hydrophobic VOCs, which are not substantially biased by turbidity). Sample locations are depicted on Figure 6-1. Table 6-1 presents the groundwater analytical results, boring logs are included in Appendix A, laboratory analytical reports are included in Appendix C, and data validation reports are included in Appendix D. A discussion of the data is presented in Sections 6.1.1.1 through 6.1.1.3.

#### 6.1.1.1 Total Petroleum Hydrocarbons

The 14 groundwater samples collected in 2007 were analyzed for TPH. Diesel-range and gasoline-range TPH were detected in 9 of the 14 shallow groundwater samples. In three of the nine samples (GP-203, GP-207, and GP-212), diesel concentrations were above DEQ's 2018 RBCs for diesel. In two of the nine samples (GP-203 and GP-212), gasoline concentrations exceeded the DEQ RBC for gasoline. None of the exceedances were greater than a factor of 10.

#### 6.1.1.2 Inorganic Constituents

Dissolved zinc was analyzed for the samples collected in 2007. Six of the 14 samples were nondetect. There is no established RBC for zinc.

#### 6.1.1.3 Volatile Organic Compounds

Samples collected in 2001 and 2007 were analyzed for VOCs. Nine of the 19 shallow groundwater samples (excluding GP-1 and GP-2 from the Southeast Area, discussed in Section 6.1.3) exceeded RBCs for the occupational scenario for inhalation from tap water for at least one VOC. The most common exceedance of DEQ's 2018 RBCs was vinyl chloride, present in well locations GP-4, GP-6, GP-204, GP-206, GP-209, GP-210, and GP-212. Other exceedances included naphthalene in locations GP-207 and GP-212, and 1,4-dichlorobenzene in location GP-209. Two exceedances were greater than a factor of 10: vinyl chloride in GP-4 at a factor of 15 and naphthalene in GP-207 at a factor of 17. None of the other exceedances were greater than a factor of 10.

In September 2001, the deep onsite production well was sampled for VOCs (sample PW1W shown on Figure 6-1 and data included Table 6-1). Data showed low concentrations of VOCs, specifically PCE and its breakdown product cis-1,2-DCE. The high proportion of a breakdown product (74 percent of the total moles of VOCs present) suggests that the source of VOCs in the deep, confined aquifer at the Site is located a considerable distance from the well itself. These reported concentrations of VOCs in Northwest Pipe Company's deep production well are consistent with concentrations found in other deep, confined aquifer wells in North Portland, such as at the St. Johns Landfill, and appear to be part of a regional VOC plume (CH2M-HILL, 2012b).

To determine whether deep groundwater VOC concentrations detected in the production well were the result of site operations in the production well vicinity, a shallow groundwater sample was collected adjacent to a decommissioned subsurface drain line located near the production well in 2004 (CH2M HILL, 2004b). The sample was collected with a Geoprobe (GP-101 shown on Figure 6-1) and analyzed for VOCs (Table 6-1). Vinyl chloride and 1,1-dichloroethane were detected at estimated concentrations below laboratory reporting limits. No other VOCs were detected. No further sampling was requested by DEQ based on these results.

### 6.1.2 Stained Soil Groundwater Investigation

Three monitoring wells were installed in the Stained Soil Investigation Area just north of the Lining and Coating Building in June 2012 (monitoring well [MW]-7, MW-8, and MW-9 shown on Figure 6-1). Well construction details are included in Table 6-1, and boring logs are included in Appendix A. The first well (MW-7) was installed in the footprint of the stained soil excavation after it was backfilled. The second and third wells (MW-8 and MW-9, respectively) were installed approximately 10 feet beyond the most distant stained soil sample locations.

Two rounds of groundwater samples were collected from these wells: the initial samples in June 2012 and the second set of samples in May 2013. Sample collection followed the procedures identified in the DEQ-approved Work Plan (CH2M-HILL, 2012a) and follow-up email communications between DEQ and the project team. The samples were submitted to the laboratory and analyzed for total and dissolved metals, PAHs, PCBs, diesel-range TPH, and oil-range TPH (Table 6-1). DEQ did not request PCB analysis in the second set of groundwater samples from the Stained Soil Investigation Area because no PCBs were detected in the first set of samples.

Laboratory results for groundwater samples for the two sampling rounds are presented in Table 6-1. MW-7 had the highest concentration of PAHs and petroleum hydrocarbons, with MW-8 and MW-9 reflecting low concentrations at the upper end to values less than the laboratory reporting limit at the lower end. PCBs were not detected in the initial groundwater samples in June 2012, and no further sample analysis for PCBs was determined to be necessary by DEQ. Inorganic constituent concentrations were generally low or below laboratory reporting limits, except for manganese and arsenic. Elevated manganese and arsenic concentrations may be the result of geochemically reducing conditions, which can cause naturally occurring concentrations in the basalt-derived soil and sediments of the area to enter solution. Constituents with exceedances of 2018 RBCs included arsenic, PAHs (benzo(a)anthracene, benzo(a)pyrene, dibenzo(a,h)anthracene, naphthalene), and diesel- and oil-range hydrocarbons in selected wells (Table 6-1). Of the RBC screening scenarios considered, only the occupational scenario for inhalation of tap water resulted in exceedances, and all were less than 10 times the applicable screening values. Only MW-7 showed exceedances of PAH screening values. Arsenic and TPH showed exceedances of RBCs for the occupational scenario for inhalation of tap water scenario in all wells.

### 6.1.3 Southeast Area Shallow Groundwater

VOCs are the principal COIs in the Southeast Area, primarily PCE and its breakdown products TCE, cis-1,2-DCE, and vinyl chloride. While TCE is a breakdown product of PCE, historically it was also used as a commercially available solvent, and its presence may be attributable, in part, to the historical use of products containing TCE. Elevated VOC concentrations were determined during Geoprobe sampling in the early 2000s to be limited to the shallow unconfined aquifer. The groundwater flow direction in the

Southeast Area generally is toward Terminal 4 Slip 1 on the Port of Portland property to the south of the Site. Additional hydrogeologic characterization of the Southeast Area is provided in Section 6.2.2.

In 2001, 2002, and 2004, groundwater samples in the Southeast Area were collected using direct-push sampling technology. In 2003 and 2004, six monitoring wells were installed in the shallow aquifer and comprise the groundwater monitoring network in the Southeast Area, with sampling from 2003 to present (Figure 6-1). A compilation of VOC concentrations from the Southeast Area, including Geoprobes and initial monitoring well results for 2001 through 2005, is presented on Figure 6-2. Results of all sampling are included in Table 6-1. These early sampling investigations are described below:

- In 2001, two probes were advanced in the vicinity of a former AST in the Southeast Area. PCE was detected at a maximum concentration of 9,800 micrograms per liter ( $\mu\text{g/L}$ ) in sampling location GP-1. Sample location GP-2, which was located approximately 40 feet west of GP-1, had 4,300  $\mu\text{g/L}$  of PCE. Based on these investigation results, additional groundwater investigations were performed in the Southeast Area.
- In 2002, 12 Geoprobes (GW-01 through GW-12) were advanced in the Southeast Area. The highest concentrations of VOCs were found near the eastern property boundary of the Southeast Area. These results suggest that at least some of the observed VOCs in the Southeast Area may have migrated onto the Site from the eastern-northeastern offsite area. Maximum concentrations of PCE observed in 2002 were less than those observed in 2001 at locations GP-1 and GP-2, reflecting spatial and/or temporal variations in concentrations. As shown in Table 6-1, degradation products of PCE also were detected in groundwater in this area. Specifically, TCE and cis-1,2-DCE were found at the highest concentrations and in the greatest number of sample locations.
- In 2003, six groundwater monitoring wells (MW-01 through MW-06) were installed in the Southeast Area to further evaluate the presence of VOCs and to assess the subsurface profile, local hydrology, and the hydraulic gradient beneath the Site. The locations of the monitoring wells are shown on Figure 6-1. Monitoring well construction information for the Southeast Area wells is summarized in Table 6-2, and well logs are included in Appendix A. Constituents detected at concentrations above the laboratory reporting limits in monitoring well samples are PCE and its breakdown products TCE, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, and vinyl chloride (Table 6-1). Other VOCs (1,1-dichloroethane, toluene, benzene, and chloromethane) were detected below the laboratory reporting limit at estimated concentrations during the 2004 monitoring event, but none of these constituents were detected during any of the 2005 monitoring events. Chloroform and acetone, which are common laboratory contaminants, were detected in samples collected from MW-06 during the January 2005 monitoring event.
- In 2004, 11 Geoprobe (GP-101 through GP-111) sampling points were advanced and samples were collected to further investigate both the lateral and vertical extent of VOCs in the Southeast Area. Nine of these Geoprobe sample locations were situated along the eastern-northeastern and southern edges of the Southeast Area to investigate the concentrations of VOCs on the upgradient (east) and downgradient (south) edges of the Southeast Area (Figure 6-1). VOCs were detected along the northeastern edge of the Southeast Area. Concentrations in this area were above laboratory reporting limits for PCE and its breakdown products TCE, cis-1,2-DCE, and vinyl chloride. Geoprobes GP-102, GP-103, and GP-104 were located downgradient from older Geoprobe sample locations GP-1 and GP-2, along the southern edge of the Southeast Area. Analytical results in GP-102, GP-103, and GP-104 indicated PCE concentrations more than one to two orders of magnitude lower (ranging from 59  $\mu\text{g/L}$  at GP-102 to 260  $\mu\text{g/L}$  at GP-104) than those observed at GP-1. These results indicate that concentrations of VOCs decrease rapidly as groundwater migrates southward toward the Site boundary.
- Also in 2004, the deep Geoprobe (GP-112 on Figure 6-1) was advanced to a depth of 120 feet bgs near the location of previous sample GP-1. The location coincides with the highest observed concentration of VOCs. GP-112 was advanced to investigate the vertical extent of VOCs in the subsurface. The subsurface profile encountered during probing was predominantly silt below a depth of 28 feet bgs. Two thin, slightly sandier water-bearing intervals were encountered at depths of 65 and 98 feet, from which groundwater samples were collected and subsequently analyzed for VOCs (Figure 6-3). VOCs were not detected in either of these two deep samples (Table 6-1). The upward gradient characteristic of the groundwater regime, the presence of the thick, low-permeability

silt zone below 28 feet, and the absence of VOCs in the two samples collected at 62 and 96 feet confirm that the VOCs are limited to the shallow fill aquifer in the Southeast Area.

The spatial distribution of VOCs in groundwater in the Southeast Area from 2001 through 2005 (Figure 6-2) indicate that the highest concentrations of PCE occurred near MW-06 and MW-01, with lower concentrations upgradient (MW-05) and downgradient (MW-03 and MW-04) from these wells. MW-02, located west of GP-1 and GP-2, defines the approximate westward extent of VOCs in groundwater. In September 2005, the PCE concentrations observed in the upgradient well MW-05 (Figure 6-2) were higher than previously observed but were still well below concentrations observed further downgradient (sample locations MW-06 and GP-1).

The Southeast Area groundwater wells were resampled as part of the sitewide groundwater characterization performed in 2007. The wells were also sampled during the supplemental groundwater investigation performed from 2016 through 2017 (CH2M, 2017). Sampling is currently ongoing on a semiannual basis in the Southeast Area, and an MNA [work plan](#) is under development to support the Site's source control decision (Table 6-1). Since 2016, the groundwater investigation has included sampling of selected Port of Portland wells to characterize the downgradient fate of the VOC plume (T4S1MW-03S, T4S1MW-09, T4S1MW-23, and T4S1MW-24) as provided by the approved Work Plan (CH2M, 2016) and under an agreement with the Port of Portland, owner of the wells. To aid in analysis, Port data prior to 2016 were obtained from Ash Creek Associates, Inc. (2007). Groundwater in this offsite area contains VOCs from past practices, possibly as fumigants in the large grain storage operation that formerly existed on the Port's property. Port groundwater data from 2004 through 2019 are presented in Table 6-3. Locations of Port of Portland monitoring wells and groundwater elevation contour maps corresponding to the sampling data are provided in Appendix F. Monitoring well data for both the Northwest Pipe Site and Port site from 2003 through 2019 are shown on Figures 6-4a and 6-4b, respectively.

The wells with the highest VOC concentrations have consistently been wells MW-05 and MW-06. MW-01, MW-03, and MW-04 have consistently moderate concentrations, and MW-02 and the Port property wells have concentrations near or below the laboratory reporting limits for VOCs. Although the recent data shown on Figure 6-4a and 6-4b exhibit temporal variability in concentrations, the maximum value of the most highly concentrated VOC identified in data from 2016 through 2019 (PCE in MW-05) is less than half the maximum value previously detected in groundwater at the Site (PCE in GP-1).

Based on the stability in the relative distribution of VOCs within the plume, and the consistently low to nondetectable results for VOCs in Port wells, with concentrations lower than reported previously, the plume extent is stable and possibly shrinking, because concentrations in wells most downgradient of the plume are lower now than they were in the past, with some variation in concentration, up or down, within the interior of the plume. These characteristics are consistent with a stable or decreasing plume that is effectively controlled by natural attenuation processes.

#### 6.1.4 Summary of Nature and Extent of Constituents in Groundwater

COIs were identified through comparison of groundwater data to DEQ RBCs (May 2018 revision) for the following scenarios:

- Ingestion and inhalation from tap water – occupational scenario
- Volatilization to outdoor air – occupational scenario
- Vapor intrusion into buildings – occupational scenario
- Groundwater in an excavation – construction and excavation worker scenario

A constituent was identified as a COI if one or more sample results exceeded one of these screening values. The following constituents were identified as COIs:

- Arsenic
- PAHs (benzo(a)anthracene, benzo(a)pyrene, dibenzo(a,h)anthracene, and naphthalene)
- TPH (gasoline-, diesel-, and motor oil-range)
- VOCs (1,4-dichlorobenzene, chloroform, cis-1,2-DCE, PCE, TCE, vinyl chloride, and naphthalene)

Elevated arsenic concentrations may be the result of geochemically reducing conditions, which can cause naturally occurring arsenic in the basalt-derived soil and sediments of the area to enter solution. Elevated PAHs were measured in one well (MW-7) in the Stained Soil Investigation Area. TPH exceedances of RBCs were also generally limited to the Stained Soil Investigation Area, in addition to three other sample locations (GP-203, GP-207, and GP-212). The concentration of 1,4-dichlorobenzene exceeded the RBC for the occupational scenario for ingestion and inhalation from tap water for one sample from GP-209, at 2.4 times the RBC. Concentrations of chloroform exceeding the RBCs occurred sporadically in the Southeast Area, with the greatest exceedance of 2.7 times the RBC for the occupational scenario for ingestion and inhalation from tap water at GW-12. Two samples exceeded the RBC for the occupational scenario for ingestion and inhalation from tap water for naphthalene, as follows: one sample from Geoprobe location GP-207 at 17 times the RBC, and another sample from GP-212 at 1.1 times the RBC. Concentrations of PCE, TCE, cis-1,2-DCE, and vinyl chloride measured in locations in the Southeast Area had the greatest exceedances of the DEQ RBCs. The RBCs for the construction and excavation worker scenario for groundwater in an excavation were exceeded in several samples for PCE and TCE, all at less than 10 times the RBC, prior to 2007. All other exceedances for these constituents are for the occupational scenario for ingestion and inhalation from tap water.

Outside of the Stained Soil Investigation Area and the Southeast Area, these results indicate that shallow groundwater contains low concentrations of various hydrocarbons, and, in some wells, VOCs consistent with a nearly 80-year history of industrial activity.

## 6.2 Fate and Transport for Constituents in Groundwater

This section describes the fate and transport evaluation for groundwater. In the context of this discussion, the “fate and transport” refers to how constituents move through or are transformed in environmental media, and thereby how they may come into contact with plants, animals, and humans.

Groundwater investigations were conducted at the two areas with the greatest concentration of COIs: the Stained Soil Investigation Area and the Southeast Area. The investigations included hydrogeologic characterizations and natural attenuation evaluations to determine whether detected constituents would be likely to migrate to a discharge point and pose excess risk to potential receptors.

### 6.2.1 Stained Soil Investigation Area

Groundwater elevations were measured in Site monitoring wells in June 2012 and May 2013 (Table 6-4). Figure 6-5 depicts the resulting potentiometric surface of the shallow aquifer for both events. Water levels in May 2013 were approximately 0.9 foot lower than observed in June 2012. The hydraulic gradient for the two sample events was similar, directed west-northwest, with a consistent magnitude of approximately 0.0013 foot per foot (ft/ft). Based on the June 2012 hydraulic gradient, the discharge point for groundwater to surface water was approximately 2,000 feet from the investigation area to the main stem of the Willamette River along the flow path.

Field parameters indicate near-neutral groundwater pH, low specific conductance typical for shallow groundwater in the area, and geochemically reducing conditions. The uniformly negative ORP values and the low DO content indicate the presence of geochemically reducing conditions. Reducing conditions have been documented in both the Stained Soil Investigation Area and the Southeast Area of the Site. The reduced conditions may be attributed to decomposing natural organic matter incorporated into the dredged material used as fill material at the Site.

A natural attenuation evaluation was completed using the EPA's screening tool BIOSCREEN (EPA, 1997a). The potential for PAHs, to migrate a substantial distance in the subsurface (CH2M HILL, 2013) was investigated. The evaluation was conducted because PAHs have the following characteristics: (1) exhibit notably low solubility, (2) tend to adsorb to organic carbon in the subsurface, (3) are known to attenuate under both aerobic and anaerobic conditions, and (4) do not tend to form extensive plumes in groundwater except in unusual circumstances (such as manufactured gas plants or creosote wood treating operations) where large quantities of nonaqueous phase liquids are present in the subsurface. The results of the BIOSCREEN evaluation showed a predicted migration distance of 100 feet before

extinction of PAHs below a concentration of 0.001 milligram per liter (mg/L) under conservative assumptions; this distance is more than 1,900 feet from the Willamette River (CH2M HILL, 2013).

Based on this evaluation, the reported concentrations of PAHs in soil and groundwater do not pose an excess risk to potential receptors, including to the Willamette River, and no further groundwater sampling or analysis associated with the stained soil remediation area is indicated. The sampling results and analysis confirm that the pocket of contamination identified in the Stained Soil Investigation Area is contained.

## 6.2.2 Southeast Area

Elevated VOC concentrations identified in the Southeast Area are limited to the shallow unconfined aquifer, based on previous Geoprobe sampling in the area. The shallow aquifer is located within hydraulic fill (dredged river sediment) placed in the late 1930s and early 1940s over the mudflats that formerly existed in the Site vicinity. The hydraulic fill is characterized by fine sand and silty sand extending from the ground surface to approximately 28 feet bgs, saturated in its lower half under unconfined conditions, and underlain by a thick, low-permeability confining layer. The confining layer consists of low-permeability silt with interbedded sand from approximately 28 to 161 feet bgs (Figure 6-3). The top of this confining layer represents the historical ground surface prior to site filling and development.

### 6.2.2.1 Groundwater Flow Characteristics of the Southeast Area

A hydrologic characterization of the shallow aquifer in the Southeast Area was performed in 2016 and 2017 and is described in greater detail in the Supplemental Groundwater Data Report (CH2M, 2017). Data collection has continued through 2019, resulting in seven measurement events of both water levels and groundwater concentrations from 2016 through 2019. Key attributes of the hydrologic characterization (evaluated using data from the seven events) are summarized as follows:

- Groundwater flow directions in the Southeast Area are toward Terminal 4 Slip 1 on the Port of Portland property, located to the south of the Site. For this reason, monitoring includes several wells on the southwest, downgradient Port of Portland property. These wells are included in the hydrologic characterization.
- The historical off-site location of Gatton Creek (Figure 3-1) is offsite to the east, which prevents it from acting as a preferential flow path for the Southeast Area plume because it is located cross-gradient from the flow path.
- Consistent with historical measurements, the measured depth to groundwater ranged from 6.66 to 13.89 feet bgs on the Northwest Pipe Site. Depth to groundwater was from 5.65 to 19.99 feet bgs on the Port site (Table 6-5).
- Groundwater elevation contour maps were prepared for seven measurement events. The most recent map from October 2019 is presented on Figure 6-6, and all other available contour maps are included in Appendix F.<sup>1</sup> Groundwater flow direction is consistently south-southwest toward Slip 1 on the Port site, downgradient from the Southeast Area. On the Northwest Pipe Site, the hydraulic gradient is smaller in magnitude and more variable than it is further south, but flow is predominantly southerly. The observed variability in hydraulic gradient based on quarterly water level measurements appears to be caused by short-term aquifer response to changes in river stage and precipitation events. Variations in hydraulic gradient documented by a small fraction of water level measurement data sets are short in duration and do not change the conceptual site model that the net groundwater flow on an annual basis is south-southwest toward Slip 1.
- As is typical for local and regional groundwater discharge areas, the hydraulic gradient increases approaching Terminal 4 Slip 1, increasing from an average of 0.005 ft/ft at the southern boundary of the Northwest Pipe Site through the middle of the Port site, then transitioning to an average of 0.01 ft/ft near the slip. Although brief apparent gradient reversals appear to occur on the Northwest

<sup>1</sup> Selected maps (April 2017 and July 2017) from the 2016 – 2017 *Supplemental Groundwater Sampling and Data Evaluation* have been revised because of a conversion error from measured depth to groundwater to groundwater elevation.

Pipe Site, actual groundwater movement against the predominant flow direction is negligible given the combination of low hydraulic gradient, low hydraulic conductivity, short duration, and the overall flow regime of flow toward the river as the regional groundwater discharge point. The strongest gradient across the Southeast Area (0.0013 ft/ft) was measured during a period of south to southwest flow from MW-05 to MW-06 to MW-03 in July 2017.

- Hydraulic conductivity in wells in and downgradient from the Southeast Area was investigated in 2016 (Table 6-6). The typical hydraulic conductivity for the shallow aquifer along the flow path ranges from approximately 2 to 25 feet per day. The hydraulic conductivity of MW-05 was calculated to be higher (134 feet per day) than the typical range noted above, indicating that this well is screened in a zone of higher hydraulic conductivity. This zone of higher hydraulic conductivity is unlikely to have a substantial impact on groundwater flow rate because downgradient flow is limited by the bounding aquifer zones of lower hydraulic conductivity, including in the downgradient direction (CH2M, 2017).

#### 6.2.2.2 Evaluation of Spatial Trends in VOC Concentrations

MW-01, MW-02, and MW-04 have the lowest VOC concentrations along the perimeter of the plume in the Southeast Area (Figures 6-7a and 6-7b). Concentrations in MW-02 are low and remain the lowest in the Southeast Area. Concentrations in MW-01 have decreased since the last measurement events in 2003 to 2007. Concentrations in MW-04 are generally stable to decreasing, with the exception of cis-1,2-DCE, which is higher than measured in 2007, but about half of the peak concentration measured in 2004. Concentrations in MW-05, which has been confirmed to be along the upgradient edge of the Northwest Pipe Site, reflect possible onsite migration of an upgradient, offsite VOC plume.

The concentration trends in the plume interior of the Southeast Area are more complex than the consistently decreasing concentrations at the plume margins on the Port property (Figures 6-7a and 6-7b). The concentration trend plots are presented at differing concentration scales to magnify the trends observed. The variability of concentrations within the plume interior probably represents higher- and lower-concentration zones within the plume flowing past individual monitoring wells. This condition is illustrated by concentrations at MW-03, MW-04, MW-05, and MW-06.

#### 6.2.2.3 Evaluation of Natural Attenuation

To remove the effect of different molecular weights for different constituents, the VOC concentrations were converted from [µg/L micrograms per liter](#) to micromoles per liter (µmol/L, based on molarity) by dividing concentration data for different VOCs by molecular weight using data from the three wells along the assumed centerline, or highest concentration zone, of the plume (MW-05, MW-06, and MW-03) (Figure 6-8). The resulting plots allow for the direct comparison of the magnitude of different VOCs in each subsequent well, allowing a clearer interpretation of VOC trends. The three plots have different axes to allow for the detail of the concentration trends to be observed. PCE is a definitive parent compound, while TCE may be a parent compound or a breakdown or daughter product of PCE. The variability of the trends in these three wells is most likely the result of the following factors:

- Degradation of parent compounds to daughter products (leading to rising concentrations of degradation products in certain wells)
- Continued onsite migration of an upgradient, offsite PCE plume (reflected in rising PCE concentrations in the most upgradient well at the Site, MW-05)

Additional evidence of degradation beyond the Southeast Area is observed when average molar concentrations for principal VOCs are compared between wells in the Southeast Area and wells on Port property. Average molar concentrations are presented for the three highest-concentration wells in the Southeast Area (MW-05, MW-06, and MW-03), along with Port wells [T4S1MW-22 \(cross-gradient from the plume but higher concentrations than T4S1MW-23\)](#), T4S1MW-03S, and T4S1MW-09, which are closest to Slip 1 (Figure 6-9). Molar concentrations of PCE are reduced from an average of 18.5 µmol/L at MW-05 to 3.5 µmol/L at MW-03. Degradation product cis-1,2-DCE peaks in concentration at MW-06 and is further degraded by the time groundwater reaches MW-03. Downgradient on the Port site, all average VOC molar concentrations are less than 0.05 µmol/L, confirming VOC concentrations are substantially reduced on the Northwest Pipe Site, and further reduced to very low levels before reaching T4S1MW-03S and T4S1MW-09. This pattern is consistent with a degrading plume of VOCs because as

groundwater migrates from upgradient to downgradient, the molar concentration of VOCs decreases because of natural attenuation processes.

The presence of PCE and TCE daughter products (cis-1,2-DCE and vinyl chloride) in the shallow groundwater indicates that natural attenuation from reductive dechlorination is occurring (EPA, 1998). In addition, the elevated chloride concentrations in the source area (in well MW-06) and the geochemically reducing conditions (Table 6-1) are consistent with conditions indicating active reductive dechlorination processes.

To supplement the evidence of reductive dechlorination, natural attenuation parameters were also analyzed for Southeast Area shallow groundwater, and a natural attenuation evaluation was performed. Reductive dechlorination is most effective in the range corresponding to sulfate reduction and methanogenesis (which occurs through the reduction of carbon dioxide). Groundwater chemistry that indicates sulfate-reducing or methanogenic conditions includes the following:

- Low DO concentrations, typically less than 0.5 mg/L
- Low ORP, typically less than 50 millivolts and preferably below -100 millivolts
- Low concentrations of nitrate, typically less than 1 mg/L
- The presence of ferric iron (Fe<sup>2+</sup>), which results from the reduction of Fe<sup>3+</sup>, at concentrations greater than 1 mg/L

These conditions are found in the Southeast Area.

Natural attenuation parameters were measured in 2005 and from 2016 through 2019 to evaluate the potential for reductive dechlorination based on geochemical conditions at the Site (Table 6-1). DO and ORP levels measured at site monitoring wells typically meet the criteria for sulfate-reducing or methanogenic conditions listed above. Additionally, pH measurements are within the range amenable to microorganism survival, and the alkalinity (measured in 2005) is sufficient for buffering the pH against acids produced during biodegradation.

The natural attenuation data also were evaluated with EPA's screening worksheet for the potential for reductive dechlorination based on geochemical conditions (EPA, 1998). The evaluation was performed using data from MW-02 for background conditions for both data sets. For data representing the higher-concentration zone of VOCs, wells MW-01, MW-04, and MW-06 were selected for 2005, and wells MW-05 and MW-06 were selected for 2016 through 2019. The potential for reductive dechlorination on the Port site also was evaluated for 2016 through 2019 using wells T4S1MW-03S, T4S1MW-09, T4S1MW-23, and T4S1MW-24, although the evaluation is intended for use with data from the most elevated zone (EPA, 1998).

Table 6-7 contains the worksheet along with scores assigned to the Northwest Pipe Company facility for 2005 and 2016 through 2019 and to the Port of Portland wells for 2016 through 2019 based on available monitoring well data. The total scores of 23 for 2005 data and 23<sup>2</sup> for 2016 through 2019 for Northwest Pipe Company data both fall within the "strong evidence" category identified by EPA for VOC degradation via reductive dechlorination (EPA, 1998), indicating that geochemical conditions at the Site are conducive to reductive dechlorination and consistent with the observed limited migration of VOCs.

The score for the Port of Portland wells is 8 for data collected from 2016 through 2019 falling within the "limited evidence" category identified by EPA for VOC degradation via reductive dechlorination (EPA, 1998). However, it is important to note that these wells are located far downgradient from the Southeast Area where VOC concentrations already have undergone significant reductive dechlorination. These results are meaningful because they indicate that the interval of the aquifer between MW-06 and MW-03 is important to removing a substantial fraction of the VOCs from groundwater. Furthermore, the much slower rate of biodegradation that evidently is happening downgradient from MW-03 is still important in further

<sup>2</sup> Ferrous iron concentrations for the data period of 2016 through 2019 were used from sampling events conducted in December 2018 and May 2019.

reducing concentrations to acceptable levels, owing to the greater distance (and timeframe) over which this slower degradation rate has the opportunity to operate.

#### 6.2.2.4 Conclusion

Consistent with the data collected from groundwater monitoring in the Southeast Area over the past 20 years at this Site, an MNA [Work Plan](#) is being developed and will [closely](#) follow the submission of this document. Considering the observed groundwater concentrations both on the Northwest Pipe Site and on the Port of Portland site near Terminal 4 Slip 1, VOCs in the Southeast Area shallow groundwater are contained by ongoing MNA processes. [As discussed in the \*Passive Soil Gas Investigation Results and Proposed Well Locations Memorandum\* \(Jacobs 2021\), VOC concentrations in soil gas were below detection limits across all but the northernmost portion of the Port of Portland property, indicating minimal downgradient migration has occurred, which supports the use of MNA as a remedy.](#)

Commented [A2]: Added in response to DEQ comment 4

## 7. Conceptual Site Exposure Model

This section describes the potential exposure pathways within the LOF (described in Section 7.1) for COIs believed to be possibly associated with the Site. The conceptual site exposure model (CEM) is formulated according to applicable guidance, with the use of professional judgment and site-specific information on land use, water use, ecological habitat, contaminant sources, release mechanisms, routes of migration, potential exposure points, potential routes of exposure, and potential receptor groups associated with the Site.

### 7.1 Locality of Facility

OAR 340-122-080(3) requires a facility characterization to identify current and reasonably likely future beneficial land and water uses in the LOF. The LOF is defined by OAR 340-122-115(34) as any point where a human or an ecological receptor contacts, or is reasonably likely to come into contact with, facility-related COIs.

The boundaries of the LOF are determined using the following considerations:

- The chemical and physical characteristics of the COIs
- Physical, meteorological, hydrogeological, and biological human activities, and ecological characteristics that determine the migration of the COIs through environmental media or accumulation through food webs
- The time required for COI migration to occur based on the above factors

Based on these considerations, it is reasonable to identify separate LOFs for soil and groundwater at the Site based on the significant differences among the media, which include the following factors:

- Beneficial uses
- Possible receptors
- Contaminant migration pathways

Using these criteria, the LOF for soil at the Northwest Pipe Site encompasses potentially affected surface and subsurface soil on and beneath the Site (Figure 7-1). The LOF for groundwater encompasses potentially affected groundwater beneath the Site in the fill or shallow aquifer, and groundwater downgradient from the Site in the shallow aquifer extending southwest onto the Port of Portland property. The shallow groundwater is presumed to discharge to the Willamette River (Figure 7-1). While some migration of VOCs is likely based on the current site CEM, data collected to date indicate that VOCs attenuate to concentrations below any level of concern before reaching the river.

### 7.2 Beneficial Land and Water Use

This section presents information on beneficial land and water use from the OWRD well log database and findings first presented in the 2005 Draft RI/SCE Report (CH2M [HILL](#), 2005a).

#### 7.2.1 Current and Reasonably Likely Future Land Use

The Site is in an industrial area of North Portland. Burgard Industrial Park surrounds the Site. The Northwest Pipe Company property is small (25.96 acres) relative to adjacent operations, which include Schnitzer Investment Corp. (approximately 200 acres) and the Port of Portland Terminal 4 (260 acres). Both the Site and the surrounding land is zoned Heavy Industrial by the City of Portland. For nearly 80 years, land use in the vicinity of the Site has consisted of industrial operations (Section 2.2). Land use is expected to remain the same into the foreseeable future because of a recognized shortage of industrial land in the Portland area. Uses of the land surrounding the facility include processes such as

ship breaking, metal sorting, vehicle shredding, shipping, sand blasting, metal fabrication, manufacturing, and marine-related commercial activity.

### 7.2.2 Current and Reasonably Likely Future Water Use

The beneficial water use evaluation is based on data reviewed in the OWRD online well log database and information gathered by CH2M HILL and Hart Crowser (CH2M HILL, 2005a; Hart Crowser, 1999). That work included contacting nearby property owners and conducting a field review of nearby areas. The OWRD database was reviewed for wells within about 0.75 mile of the Site in November 2019.

According to OWRD well records, 19 production water wells, all installed in the deep aquifer, are located in the vicinity of the Site (Table 7-1 and Figure 7-2). The two industrial wells adjacent to the Site at Schnitzer Investment Corp. are reportedly used only to supply fire hydrants, and in the summer for cooling purposes and dust suppression. Four wells are located at Northwest Container (three identified as Union Carbide and the fourth as Portland Container on the well logs and in Table 7-1). Water from one well is used part of the year for washing storage containers and dust suppression; the other three wells are inactive. Five wells that were identified in the survey (the "Shenker" wells in Table 7-1) were installed during the 1940s for shipyard use; their current status could not be determined. Four wells located at the Toyota Vehicle Processing facility are used for road sweeping and car washing. One well located at the Rivergate Scrap Metals facility is used for equipment cooling, dust suppression, and supplying fire hydrants. The Port of Portland well and the Oregon Hydrocarbon, Inc. well are used for irrigation.

Northwest Pipe Company's industrial production well (identified with Beall Pipe and Tank as owner on the well log and in Table 7-1) is installed in the deep aquifer and screened from 195 to 220 feet bgs. The well was used historically for industrial cooling purposes. Since 2014, the production well has not been in use. However, should Northwest Pipe opt to use the production well in the future, it would only be used intermittently for makeup water in the hydrostatic testing operations.

Most of the early water use in the area was provided by deep aquifer water wells. About 80 percent of the wells were installed before 1980. The Port of Portland property survey in the Site vicinity (Hart Crowser, 1999) indicates that most properties were supplied with water by wells prior to the expansion of the City of Portland's public water system into this part of North Portland. The City of Portland public water system, which originates at Bull Run Reservoir and is supplemented by the Columbia South Shore well field in northeastern Portland, is currently the principal source of drinking water and other uses in the Site area.

Current and future beneficial uses of groundwater in the LOF include recharge to surface water (Willamette River) from the shallow unconfined aquifer. Shallow groundwater is not and has never been used for any purpose at the Site. The most likely beneficial use of shallow groundwater from the Site would be potential recharge to surface water. The Site is located approximately 1,500 feet from the eastern bank of the Willamette River. Although the deep confined aquifer is outside the LOF, deep groundwater also discharges to the Willamette River and supports landscape irrigation and industrial use in the region outside the LOF. All area properties within the LOF are connected to the City of Portland public water system. Deep groundwater in the region outside the LOF (with a depth to aquifer of approximately 100 to 200 feet depending on location) may continue to be used for industrial, fire suppression, or landscape irrigation purposes at properties with wells.

Three beneficial uses of the groundwater have been identified for the Site:

- Recharge to surface water (Willamette River) for shallow groundwater
- Recharge to surface water (Willamette River) for deep, confined groundwater
- Landscape irrigation and industrial use of deep, confined groundwater

Anticipated future uses of groundwater near the Site are the same as current uses. All area properties within the subject area are connected to the City of Portland public water system (CH2M HILL, 2005a; Hart Crowser, 1999).

## 7.3 Human and Ecological Exposure Model

The CEM was developed using regulatory guidance supplemented by information on constituent sources, release mechanisms, routes of migration, potential exposure points, potential routes of exposure, and potential receptor groups associated with the Site to identify potentially complete human and ecological exposure pathways. Figure 7-3 is a comprehensive human health and ecological CEM schematic for the Site, including information relevant to soil and groundwater. Exposure pathways (highlighted in orange on Figure 7-3) are evaluated in Section 8. Surface water exposure pathways (highlighted in blue on Figure 7-3) are evaluated as part of the SCE and are presented in the Companion SCE Report.

### 7.3.1 Constituent Sources and Release Mechanisms

The Site has a nearly 80-year history of heavy industrial use beginning as part of a World War II shipyard and transitioning into a steel water transmission pipe manufacturing facility. The potential contaminant sources at the Site include the following:

- High intensity ship manufacturing during WWII, prior to the modern era of waste management regulation or use of best practices for waste materials management and stormwater quality protection
- Historical use of the Site for grain storage
- Environmental effects (such as formation of combustion byproducts, including PAHs) from the 1961 fire at the Site
- Historical use of the Site for new tanker truck manufacturing and used tanker truck cleaning prior to the modern era of waste management regulation or environmental permitting that emerged in the 1980s
- Historical use of the Site for materials and used oil storage, a practice that has evolved over time from being virtually unregulated, except for fire protection purposes, to being highly regulated under, for example, the Resource Conservation and Recovery Act and municipal stormwater regulations
- Historical heavy manufacturing operations, which, as noted above, have become more highly regulated over time in response to modern waste management regulations and permitting requirements, thereby reducing over time the potential for causing environmental contamination
- Shipbreaking and metal scrapping activities on adjacent properties, which could lead to contaminant loading onto the Site from deposition of fugitive dust emissions, and off the site both from stormwater discharge to the IT Slip as well as over-water industrial activities in the slip

While the Site currently is used for heavy industry and stores certain materials under roof (such as used oil and flammable materials), current regulations, materials handling and storage, and industrial processes reduce and minimize the potential for environmental contamination. The greatest potential contributors to Site contamination are legacy Site uses such as the shipyard activities in the 1940s.

The primary COIs identified at the Site related to surface soil are PAHs and PCBs. There is no complete pathway of transport for soil at the Site to reach the Willamette River because the Site is capped with pavement, and all stormwater is collected and treated before discharging offsite. However, although not anticipated, hypothetical future receptor exposure to COIs could occur if there is a disruption of the cap or excavation. Subsurface soil exposure by workers in excavations is expected to be limited to a depth of 10 feet given the shallow occurrence of site groundwater at 6 to 14 feet bgs.

The primary COIs identified at the Site related to groundwater are VOCs, with relatively low concentrations of petroleum hydrocarbons, PAHs, and arsenic. The primary mechanisms transporting the COIs from the source areas, via groundwater, to potential receptors include the following:

- Shallow groundwater advection towards offsite surface water
- Volatilization of VOCs emanating from shallow groundwater to indoor and outdoor air

### 7.3.2 Potentially Complete Human Exposure Pathways and Receptors

Based on the current understanding of land and water beneficial use conditions in the LOF, the most plausible receptor exposure to COIs in groundwater and soil are described in Sections 7.3.2.1 and 7.3.2.2. Onsite potential exposures are evaluated in Section 8, while offsite surface water potential receptor exposures are evaluated as part of the Companion SCE Report.

#### 7.3.2.1 Onsite Occupational Worker Exposure Scenario

The RSE included in Section 8 was prepared under the assumption that the following hypothetical baseline conditions existed:

- Soil is uncapped, even though it has been capped since 2012 and will continue to be capped.
- Current and future occupational workers have the potential to be exposed to hypothetically uncapped soil through incidental ingestion, dermal contact, and inhalation of particulates and volatiles.
- Current and future occupational workers have the possibility of being exposed to groundwater through inhalation of volatile COIs emanating from shallow groundwater to indoor air and outdoor air within the area of elevated VOCs in groundwater in the Southeast Area of the Site.
- RBCs for occupational workers are based on the assumption that an 80-kilogram (kg) adult would contact COIs in surface soil for 250 days each year over a duration of 25 years.
- Environmental fate and transport of COIs is simplified to assume that no chemical loss, natural attenuation, biodegradation, or transformation is occurring. This assumption is inconsistent with site data showing biodegradation via reductive dechlorination and the presence of degradation daughter products (Section 6.2) but is recommended in the DEQ risk assessment guidance.

Prior to construction of the pavement cap, soil at the Site had long been covered by several inches of compacted gravel to promote safe movement of prefabricated ship hull sections, shipbuilding materials, equipment, and steel pipe under wet conditions that are typical for a substantial portion of the year. The compacted gravel also limited direct contact with soil by occupational workers. Under current conditions, the two discrete hot spot areas previously identified have been remediated, and paving has been placed over the soil surface; thus, under current land use, no direct contact exposures are anticipated. As required by DEQ, the RSE for soil in Section 8 has been calculated under baseline conditions for the hypothetical and highly conservative situation that soil is accessible (~~i.e. that is~~, hypothetically uncapped) for direct exposure.

#### 7.3.2.2 Onsite Construction and Excavation Worker Exposure Scenario

The RSE included in Section 8 was prepared under the assumption that the following hypothetical baseline conditions exist:

- Soil is uncapped, even though it has been capped since 2012 and will continue to be capped.
- Future construction and excavation workers have the possibility of being exposed to unpaved soil through incidental ingestion, dermal contact, and inhalation of particulates.
- Subsurface soil exposure is expected to be limited to a depth of 10 feet given the shallow occurrence of site groundwater at 6 to 14 feet bgs.
- RBCs for the construction worker scenario are based on the assumption that an 80-kg adult would contact subsurface soil for 250 days per year over a duration of 1 year. RBCs for the excavation worker scenario are based on the assumption that an 80-kg adult would contact subsurface soil for 9 days per year over a duration of 1 year.

- Environmental fate and transport of COIs is simplified to assume that no chemical loss, natural attenuation, biodegradation, or transformation occurred. This assumption is inconsistent with site data showing biodegradation via reductive dechlorination and the presence of degradation daughter products (Section 6.2) but is recommended in the DEQ risk assessment guidance.

Because of the depth to shallow groundwater at the Site, there is the potential for construction and excavation workers to be directly exposed to groundwater that conceivably could accumulate in a deep excavation. This unlikely scenario assumes that the construction activity would take place within the area of elevated VOCs in groundwater in the Southeast Area of the Site.

### 7.3.3 Potentially Complete Ecological Exposure Pathways and Receptors

The Site and surrounding properties have been used for heavy industrial activities since 1940. The Site is covered with structures or pavement. The Site is located approximately 1,500 feet from the eastern bank of the Willamette River, and the Site neither abuts nor discharges surface water directly to the main channel of the Willamette River. A groundwater divide occurs in the central part of the Site causing groundwater to migrate offsite to the northwest or southwest, depending on location. After migrating offsite to the northwest or southwest, groundwater continues to flow toward either the Willamette River or associated slips located north (IT Slip) and south (Terminal 4 Slip 1) of the Site, ultimately discharging either as subaqueous seepage or as seepage on the river bank above the river level, where it would be partially or (depending on season) completely lost to evaporation and/or plant transpiration processes prior to reaching the river.

The Site discharges stormwater through a communal discharge pipe to the IT Slip. Both slips are active industrial slips that are regularly disturbed by vessel traffic and periodically dredged. The IT Slip is used for salvaging raw materials from ships and barges as well as loading ships and barges with scrap metal for reprocessing. Accordingly, ecological habitat is neither fostered nor encouraged; however, some hardier opportunistic plant and animal species that have adapted to the disrupted nature of industrial areas may be sparsely present. Some semi-resident piscivorous fish, such as smallmouth bass, are affiliated with certain in-water structures and, therefore, may be found in the slips. Also, anadromous fish may use the slips as temporary refuge and resting areas away from the main channel of the river.

The Site provides poor quality terrestrial habitat that is incapable of supporting wildlife, and no wildlife corridors border the Site. Current exposure pathways to COIs in soil for ecological receptors is incomplete. Potential future conditions are expected to be similar to current conditions because the Site will continue to be used for industrial activities for the foreseeable future. Terrestrial ecological exposure pathways to onsite soil are incomplete and are not evaluated in the risk evaluation (Section 8) for the following reasons:

- The site is capped with pavement or structures and consequently lacks suitable vegetative habitat and food resources.
- The property is bounded by heavy industry, is surrounded by chain-link fencing, and does not contain migratory corridors that would encourage access by mammals or birds.

Potential pathways of site-related COIs to the Willamette River could include surface runoff and groundwater discharge. Surface runoff from the Site is collected and treated (Section 2.2.3). Ecological exposure pathways to site-related COIs in surface runoff are incomplete. Potential exposures in offsite surface water are evaluated as part of the SCE and presented in the Companion SCE Report.



## 8. Human Health Risk Screening Evaluation

This section presents the methodology and results of the human health and ecological RSE for sitewide soil and groundwater. The Site location is shown on Figure 2-1. This section serves as an addendum to risk evaluations conducted as part of the 2005 Draft RI/SCE Report (CH2M-HILL, 2005a) and 2015 Final RI/SCE Report (CH2M-HILL, 2015). The RSE was performed in accordance with OAR 340-122-080(5), which allows for pre-baseline screening of COIs. Ecological habitat at the Site was determined to be of poor quality and not capable of supporting wildlife. Therefore, exposure pathways for wildlife are considered incomplete, and this RSE focuses on human health exposure pathways. Risks associated with potential receptor exposures in offsite surface water are evaluated in the Companion SCE Report.

### 8.1 Data Evaluation

For the purposes of this RSE, the following soil and groundwater analytical data were used in the risk calculations:

- A total of 80 groundwater samples collected from 9 onsite monitoring wells between 2002 and 2019, 45 groundwater samples collected from 44 temporary well points advanced with direct-push technology from 2001 to 2007, 108 groundwater samples collected from 22 offsite monitoring wells between 2004 and 2019, and 1 groundwater sample collected from the onsite production well in 2001.
- A total of 95 soil samples collected from 2001 through 2012 were aggregated. These soil data were partitioned into 68 surface (0 to 3 feet bgs) and 95 subsurface soil (0 to 10 feet bgs) groupings. A list of the soil samples used in each grouping is provided in Table 8-1. Surface and subsurface soil groupings differ from those used in Section 5 because of the different purpose for which the data are being used. The groupings used for this RSE are consistent with DEQ Human Health Risk Assessment Guidance (DEQ, 2010b) and are designed to consider circumstances where subsurface soil is brought to the surface in the future.
- Some of the Site soil was excavated as part of hot spot removal, regrading, and paving/capping work. Sample results associated with soil that has been removed from the Site (SS-18, SS-321, SS-319, and SS-411) were removed from the data set used in this evaluation because those results no longer represent soil conditions at the Site. However, sample locations that were capped were included in the data set to provide a conservative baseline RSE that represents conditions as if the cap were not present, consistent with DEQ Human Health Risk Assessment Guidance (DEQ, 2010b).

Soil and groundwater sample locations are presented on Figures 5-1 and 5-2 for surface and subsurface soil, respectively, and Figure 6-1 for groundwater. Analytical data used in the RSE were collected and summarized as part of the following investigations:

- *Supplemental Site Characterization Results* (CH2M-HILL, 2008)
- *Remedial Investigation/Source Control Evaluation Report* (CH2M-HILL, 2005a)
- *Remedial Investigation Report Terminal 4 Slip 1 Upland Facility* (Ash Creek Associates, Inc., 2007)
- *Surface Soil Risk Screening and Focused Feasibility Study for Interim Action* (CH2M-HILL, 2010)
- *Stained Soil Investigation: Updated Report and Evaluation* (CH2M-HILL, 2013)
- *Supplemental Southeast Area Groundwater Investigation* (CH2M, 2017)
- Continued groundwater sampling in the Southeast Area in 2018 and 2019

#### 8.1.1 Data Representativeness Discussion

Site data were evaluated to determine whether they represent current and future exposures possible for the Site. The criteria for data representativeness are defined as follows:

- **Chemical representativeness**—Identifies whether analyses were conducted for constituents expected to be present, based on an understanding of historical processes or practices and potential releases at the Site.

- **Exposure representativeness**—Identifies whether data were collected where receptor exposure is most feasible.
- **Spatial representativeness**—Identifies whether samples were collected with a sufficient density and areal coverage, so the detected constituent concentrations represent a geographically integrated exposure for the receptors of concern.
- **Temporal representativeness**—Identifies whether samples were collected within a timeframe such that detected constituent concentrations indicate current site conditions.

Considering the criteria presented above, the following conclusions for soil and groundwater data are as follows:

- Soil data collected during investigations from 2001 through 2012 represent baseline conditions (as if the Site were not capped) at the Site. Older data in this timeframe are expected to overestimate exposure because processes acting on soil, such as photolysis, biodegradation, weathering, and leaching, would tend to reduce constituent concentrations in soil over time.
- Groundwater data collected from 2016 through 2019 from six onsite monitoring wells (MW-01, MW-02, MW-03, MW-04, MW-05, and MW-06) and four offsite monitoring wells are the most temporally representative of the current conditions at the Site. The 2016 through 2019 data include an approved focused analyte list that consists of the primary VOCs related to the Site.
- Groundwater data from 2001 to 2015 are chemically representative and provide important information relative to concentration trends but are less representative of current conditions compared to more recent samples for the reasons stated above.
- Considering hydraulic gradients documented at the Site, groundwater quality data from the southern part of the Site represent groundwater concentrations potentially moving offsite toward Terminal 4 Slip 1 (to the southwest). Groundwater quality data in the northern part of the Site represent groundwater concentrations potentially moving toward either the Willamette River (to the west) or the IT Slip (to the north-northwest). Concentrations in groundwater collected from offsite wells installed for the Port of Portland as part of Terminal 4 site investigations represent groundwater concentrations potentially moving toward Terminal 4 Slip 1 surface water potential exposure points. Onsite data collected from Geoprobe sample points located on the northern end of the property are conservatively assumed to represent concentrations potentially moving toward the IT Slip surface water potential exposure points.

Overall, the data set described above provides a conservative estimate of risk.

## 8.2 Human Health Risk Screening Methodology

This section provides the results of the risk screening human health and ecological risk evaluations. Pathways associated with offsite migration of site-related constituents toward the Willamette River are generally addressed in the Companion SCE Report. The objectives of the RSEs at the Site are to meet the objectives of OAR 340-122-080(5), identify the potential for human health and ecological exposures to site-related chemicals, and identify the likelihood of adverse impacts on potential receptors.

As described by EPA (1997b), this RSE is conducted using a phased (tiered) approach. The results of a given tier are used to determine which of the following recommendations can be made:

- No further investigations at the Site
- Continuation of the risk screening process at the next level
- Undertake a remedial action

All COIs detected in soil and groundwater were evaluated to determine whether risks above DEQ acceptable risk targets could occur for occupational workers, construction workers, and excavation workers. All COIs detected in soil and groundwater were evaluated to determine whether unacceptable risks could occur under baseline conditions. Baseline conditions were evaluated for soil samples now located under the engineered cap. In accordance with OAR 340-122-0115, acceptable risk is defined as follows:

- A noncancer hazard quotient (HQ) for a COI of less than 1, or a noncancer hazard index (HI) less than 1 for similarly acting toxicants.
- Excess lifetime cancer risk (ELCR) for individual carcinogens less than 1 in 1,000,000, and ELCR for multiple carcinogens exceeding 1 in 100,000.

Calculations supporting the RSE are provided in Attachment G.

### 8.2.1 Exposure Point Concentrations

Exposure point concentrations (EPCs) are estimated from measured concentrations, and pathway-specific intakes (doses) are estimated for use in the subsequent risk calculations. The following paragraphs describe the method of selecting the EPCs for soil and groundwater:

- **Soil:** For this baseline evaluation, the entire site was treated as a single exposure area in evaluating soil exposure. In simple terms, this means that a site worker has an equal potential to be exposed to soil at any site location, hypothetically assuming the existing site cap would no longer be present. Sample data associated with previously excavated soil sample locations were removed from the data set used in the evaluation. EPCs for aggregate risk estimation were calculated for each COI using the EPA statistical program ProUCL, Version 5.1 (EPA, 2016). This procedure identifies the statistical distribution type (that is, normal, lognormal, or nonparametric) and 95 percent upper confidence limit (UCL) for each constituent within the defined exposure area. DEQ recommends using and computes the corresponding 90 percent upper confidence limit (UCL) for the identified distribution type. If ProUCL recommends a 97.5 or 99 percent UCL, then DEQ recommends using the 95 percent UCL for the identified distribution type. If the calculated 90 percent recommended UCL exceeded the maximum detected concentration of a constituent, the maximum detected concentration was used in the screening in place of the 90 percent recommended UCL. Individual sample data for COIs in surface and subsurface soil are provided in Tables 5-1 and 5-2, respectively. Summary statistics for surface and subsurface soil are provided in Tables 8-2 and 8-3. ProUCL outputs are provided in Appendix G.
- **Groundwater:** For evaluation of vapor intrusion of VOCs from groundwater and exposure to groundwater in an excavation, EPCs were identified on a location-specific basis, rather than aggregating data spatially. EPCs were identified this way because potential exposure to indoor air vapors originating from shallow groundwater can be localized and depend on the placement of an onsite future building. The maximum detected concentrations from monitoring well and Geoprobe locations were used as a conservative (high) estimate of EPCs for each of the data groupings described in Section 8.1. The individual sample data for COIs in groundwater at the Site are provided in Tables 6-1 (onsite data) and 6-3 (offsite data).

### 8.2.2 Human Health Screening Methodology

The human health RSE used to identify potential risks for soil and groundwater constituents/contaminants of potential concern (COPCs) at the Site was performed in accordance with current DEQ guidance (DEQ, 2010b). The following conservative screening benchmarks were used to determine the potential for risk from COIs:

- For the screening-level risk evaluation for future onsite occupational workers at the Site, data from soil are directly compared with DEQ occupational worker direct contact RBCs (DEQ, 2018a).
- For the screening-level risk evaluation for future construction and excavation workers at the Site, data from soil are directly compared with the lower of the DEQ construction and excavation worker direct contact RBCs (DEQ, 2018a).
- For the evaluation of effects on future onsite occupational workers at the Site, data from groundwater are directly compared with DEQ vapor intrusion screening RBCs and outdoor (ambient) air screening RBCs for groundwater (DEQ, 2018a).
- For the evaluation of effects on future excavation workers at the Site, data from groundwater are directly compared with DEQ excavation RBCs for groundwater (DEQ, 2018a).

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- RBCs for occupational workers are based on the assumption that an 80-kg adult would contact surface soil for 250 days each year over a duration of 25 years. RBCs for the construction worker scenario are based on the assumption that an 80-kg adult would contact subsurface soil for 250 days per year over a duration of 1 year. RBCs for the excavation worker scenario are based on the assumption that an 80-kg adult would contact subsurface soil for 9 days per year over a duration of 1 year.

In accordance with DEQ guidance, EPA Regional Screening Levels (EPA, 2019), if available, are used for those COIs that do not have a DEQ RBC. RBCs for each exposure scenario are provided in Tables 8-4 through 8-9. Although this RSE uses RBCs or similar benchmarks to screen for potential risk, these numbers are intentionally conservative and may not predict actual health outcomes. Any interpretation of the RBC comparisons provided should include consideration of the nature and weight of evidence supporting these estimates, as well as the magnitude of uncertainty surrounding them.

This RSE considers the potential for risk posed by receptor exposure to individual COIs and multiple COIs simultaneously within a given environmental medium. The screening methodology used is as follows:

- **Step 1** – COIs are divided into two groups: carcinogens and noncarcinogens, although some COIs are evaluated as both.
- **Step 2** – Screening for identification of COPCs is done using the following equation:

$$R_i = C_i / RBC_i$$

Where:

- $R_i$  is the risk posed by the “i” individual constituent;  $C_i$  is the EPC for “i” in a given medium.
- $RBC_i$  is the RBC for the “i” individual constituent based on an ELCR of  $1 \times 10^{-6}$  for carcinogens or based on a HQ of 1 for noncarcinogens.
- For carcinogens, any individual constituent with  $R_i > 1$  requires further evaluation. DEQ does not require a cumulative risk screen for carcinogens that are below RBCs (DEQ, 2010b).
- For noncarcinogens, any individual constituent with  $R_i > 0.1$  requires further evaluation if the sum of  $R_i$ s for multiple constituents also exceeds 1.
- Maximum detected concentrations are used for EPCs for this screening step, to be conservative.
- **Step 3** – For constituents identified as COPCs in the steps described above, cumulative cancer risk estimates and HIs are calculated. These estimates are calculated using a 90<sup>th</sup> percentile recommended UCL of the mean for surface and subsurface soil, and the maximum detected concentration by groundwater location for groundwater (e.g., for example, by well), to be conservative.

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### 8.3 Human Health Risk Screening Results

The results of the RSE are provided in Sections 8.3.1 and 8.3.2.

#### 8.3.1 Occupational Worker Scenario

This section presents the risk screening results for an occupational worker hypothetically exposed to COIs detected in Site soil and groundwater.

##### 8.3.1.1 Soil

For this scenario, the entire site was treated as one exposure area. In the initial screening to identify COPCs (Steps 1 through 3 in Section 8.2.2), the maximum concentrations for each COPC in surface soil (0 to 3 feet bgs) were compared with occupational direct contact RBCs as shown in Table 8-8. The resulting COIs that exceeded either the occupational RBC (for carcinogenic COIs) or one-tenth the occupational RBC (for noncarcinogenic COIs) were identified as COPCs for the purposes of evaluation. The resulting COIs identified as COPCs were PAHs (benzo(a)anthracene, benzo(a)pyrene,

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benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene); arsenic; and two PCB Aroclors (Aroclor-1254 and Aroclor-1260).

For these identified COPCs, the 90-percent recommended UCL was used as the EPC and compared to the occupational worker RBCs (Table 8-8). When the 90-percent UCL EPC is compared to the occupational worker RBCs, only the ELCRs for arsenic (EPC=11.6 mg/kg) and Aroclor-1254 were calculated to be greater than 1E-06, or the 1 in 1,000,000 chance of getting cancer, DEQ's level of acceptable risk. Arsenic levels were detected below DEQ's default soil background level in 9 of 10 sample locations which suggests arsenic levels at most of the exposure area are attributable to background. The arsenic EPC (12.1 mg/kg) only slightly exceeds DEQ's default arsenic background level (8.8 mg/kg), which shows that most (if not all) arsenic measured in surface soil is attributable to naturally occurring background levels. When the COPCs are collectively considered for cumulative risk, the ELCR is 1E-05, which does not exceed DEQ's cumulative risk threshold. Aroclor-1254 (with a noncancer ratio of 5.9) is the only individual COPC with an HQ exceeding 1. The cumulative HI for noncarcinogens is 6.07, with Aroclor-1254 contributing 91 percent. This indicates that the only risk to occupational workers exceeding DEQ thresholds in surface soil is contributed by Aroclor-1254. Under current conditions (that is, capped Site), there would be no direct exposures or unacceptable risk.

### 8.3.1.2 Groundwater

EPCs for groundwater data were the maximum detected concentrations from monitoring well and Geoprobe locations used as a conservative (high) estimate. These EPCs from individual groundwater samples collected from the production well, onsite and offsite monitoring wells, and Geoprobe samples were compared to DEQ groundwater vapor intrusion RBCs, groundwater outdoor air RBCs, and groundwater in an excavation RBCs. Groundwater risks were evaluated for four data groups: 2001 to 2015 Onsite (Table 8-4), 2016 to 2019 Onsite (Table 8-5), 2001 to 2015 Offsite (Table 8-6), and 2016 to 2019 Offsite (Table 8-7). None of the COI concentrations exceeded outdoor or indoor air occupational worker RBCs.

### 8.3.2 Construction and Excavation Worker Scenario

This section presents the risk screening results for a hypothetical future construction and excavation worker exposed to COIs detected in Site soil and groundwater.

#### 8.3.2.1 Soil

The entire Site was treated as one exposure area. In the initial screening to identify COPCs (Steps 1 through 3 in Section 8.2.2), the maximum concentrations for each COPC in subsurface soil (0 to 10 feet bgs) were compared with construction worker direct contact RBCs as shown in Table 8-9. The resulting COIs that exceeded either the construction worker RBC (for carcinogenic COIs) or one-tenth the construction worker RBC (for noncarcinogenic COIs) were identified as COPCs for the purposes of evaluation. The resulting COIs identified as COPCs were PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, fluoranthene, naphthalene, phenanthrene, and pyrene); arsenic; and Aroclor-1254.

For these identified COPCs, the 90-percent recommended UCL was used as the EPC and compared to the construction worker RBCs (Table 8-9). When the 90-percent EPC-UCL is compared to the construction worker RBCs, the ELCRs from all COPCs were less than 1E-06, or the 1 in 1,000,000 chance of getting cancer, DEQ's acceptable level of risk. When the COPCs are considered for their impact on cumulative risk, the calculated cumulative ELCR of 2E-06 also does not exceed DEQ's acceptable risk. In addition, the cumulative HI for noncarcinogens is 1 with no individual COPC's HI exceeding 1.

#### 8.3.2.2 Groundwater

EPCs for groundwater data were the maximum detected concentrations from each monitoring well and Geoprobe locations used as a conservative (high) estimate. These EPCs from individual groundwater samples collected from the production well, monitoring wells, and Geoprobe samples were compared to

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DEQ groundwater in excavation RBCs. Groundwater risks were evaluated for four data groups and the results are as follows:

- 2001 to 2015 Onsite Groundwater (Table 8-4) – PCE and TCE were identified as COPCs:
  - GP-1 – PCE HI of 2, TCE HI of 3, and cumulative HI of 5
  - GP-2 – individual HIs all below 1, with a cumulative HI of 1
  - GW\_03 – PCE HI of less than 1, TCE HI of 2, and cumulative HI of 3
  - GW\_05 – PCE HI of less than 1, TCE HI of 2, and cumulative HI of 2
  - MW-06 – PCE HI of less than 1, TCE HI of 4, and cumulative HI of 5
- 2016 to 2019 Onsite Groundwater (Table 8-5) –PCE, TCE, and cis-1,2-DCE were identified as COPCs:
  - MW-05 – individual HIs all below 1, with a cumulative HI of 1
- 2001 to 2015 Offsite Groundwater (Table 8-6) – TCE was identified as a COPC; however, no locations exceed an HI of 1.
- 2016 to 2019 Offsite Groundwater (Table 8-7) – No COPCs were identified.

## 8.4 Uncertainty Evaluation

Uncertainties in screening level risk evaluation methods may result in either understating or overstating the ecological risks. The latter is more likely because screening level risk evaluations are intended to be conservative. In general, risk estimates are subject to uncertainty from a variety of sources, including the following:

- Sampling, analysis, and data evaluation
- Fate and transport estimation
- Exposure estimation
- Toxicological data

### 8.4.1 Sampling, Analysis, and Data Evaluation

Uncertainty associated with sampling and analysis includes the inherent variability (standard error) in the analysis, representativeness of the samples, sampling errors, and heterogeneity of the sample matrix. The quality assurance/quality control program used in the investigation serves to reduce these errors, but it cannot eliminate all errors associated with sampling and analysis. The degree to which sample collection and analyses reflect actual Site concentrations partly determines the reliability of the risk estimates.

### 8.4.2 Fate and Transport

Simplified assumptions about environmental fate and transport of COIs are typically made in screening risk evaluations; specifically, that no chemical loss, natural attenuation, biodegradation, or transformation occurred. These assumptions are inconsistent with site data showing biodegradation via reductive dechlorination and presence of degradation daughter products (Section 6.2). In addition, maximum concentrations were used as estimates of groundwater EPCs, which diverge from current or reasonably expected future conditions, thus contributing to a general overestimation of risk.

### 8.4.3 Exposure

The estimation of exposure requires assumptions that describe potential exposure situations. There are uncertainties regarding the likelihood of exposure, the concentration of COIs at exposure points, and the duration and frequency of exposure. Exposure parameters selected to develop screening values are intended to be conservative and likely overstate the actual risks to humans. For example, RBCs for occupational workers are based on the assumption that an 80-kg adult would contact surface soil for 250 days each year over a duration of 25 years. Baseline exposures evaluated in this risk evaluation do not account for the pavement cap throughout the Site, thereby significantly overstating the exposures and risk under current conditions.

Inhalation of vapors by excavation workers in a trench is not part of the development of the default soil RBCs. Considering this, worker exposures may be underestimated if trenching activities occur.

#### 8.4.4 Toxicological Data and Risk Characterization

Uncertainties in toxicological data can also influence the reliability of risk management decisions. The usefulness of existing toxicity information in assessing human health and ecological impacts is constrained by several factors. Most toxicity information is generated by laboratory studies with selected test species. The screening values used for this RSE have varying levels of confidence that will affect the usefulness of the resulting risk estimates. The screening values are calculated to be protective of human health and the environment and, as such, are highly conservative.

Among the inorganic constituents detected, total chromium was detected at concentrations above its respective background level; however, the maximum detected total chromium concentration was below the RBC value for trivalent chromium. Chromium at the Site is expected to occur as elemental chromium or trivalent chromium based on the historical operations at the Site (~~that is, e.~~, as an alloying agent in various types of steel used over the Site's nearly 80-year history). In natural soil, chromium could exist as metallic elemental chromium, as a component in natural minerals (overwhelmingly as the trivalent form but in some soil types and climatic conditions, a small fraction may occur as the hexavalent form), ~~or as a mixture of these forms. As noted in the background data set from DEQ (2016), hexavalent chromium typically occurs as a small fraction in the mixture of total chromium. The use of hexavalent chromium toxicity factors alone to evaluate total chromium in soil would severely overestimate risk because, b~~Based on site history, little to no chromium would be expected to be in the hexavalent form, so trivalent chromium toxicity factors were used. This could result in an underestimation of risk if a portion of the total chromium at the site occurs as the hexavalent form. However, considering hexavalent chromium is an inhalation carcinogen, any risk is expected to be mitigated by engineering controls, specifically the existing pavement cap and CMMP.

~~In DEQ's background data set, total chromium was detected at 75.8 mg/kg and hexavalent chromium was detected at 0.63 mg/kg (DEQ, 2013b). This ratio of hexavalent to total chromium indicates hexavalent chromium is approximately 1 percent of the total chromium. As an uncertainty evaluation, risk was evaluated as if the chromium detected in Site soil were to contain similar proportions of trivalent to hexavalent chromium as reflected in DEQ's background data set. Table 8-10 contains the results of that evaluation, showing that the hypothetical risk from hexavalent chromium evaluated using 1 percent of the total chromium content indicated an estimated risk of 4 cancers in 1,000,000, which would be near, but slightly above, the acceptable risk level of 1 in 1,000,000 for an individual chemical. The identified hypothetical risk, based on the "1 percent" assumption, would be mitigated by a combination of engineering controls, specifically the existing pavement cap and CMMP.~~

#### 8.5 Risk Screening Conclusions

This section documents the updated human health RSE for soil and groundwater. The evaluation incorporates more recent groundwater data collected from both onsite and downgradient offsite sample locations that were available when the 2005 Draft RI/SCE Report and 2015 Final RI/SCE Report were prepared (CH2M ~~HILL~~, 2005a, 2015). Based on current understanding of beneficial use conditions at or near the Site, the most plausible human health exposure scenarios considered are the onsite occupational worker scenario and future construction/excavation worker scenarios. Ecological habitat at the Site was determined to be of poor quality and not capable of supporting wildlife. Therefore, exposure pathways for wildlife are considered incomplete.

Conclusions from the human health risk screening for soil are that, 1) although the maximum detected concentrations of several individual contaminants (PAHs, arsenic, and PCBs) exceed RBCs individually based on the DEQ target ELCR of 1E-06 and 2), overall aggregate risks do not exceed the DEQ target cumulative ELCR of 1E-05, even when hypothetically assuming the absence of the pavement cap. Aroclor-1254 was the only non-carcinogenic exceedance of the target HI of 1. However, the pavement cap has addressed this risk by eliminating direct exposure to soil and will be maintained as part of the institutional controls for future land use. Furthermore, the CMMP provides guidance to facility

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staff by describing how to manage potentially affected media to which receptors may be briefly exposed during short-term subsurface construction activities in the future (CH2M HILL, 2011b). Therefore, residual risk evaluated once the final remedy is considered shows that risk is acceptable.

Conclusions from the human health risk screening for groundwater are that maximum COI concentrations in groundwater do not pose an unacceptable risk to indoor or outdoor occupational workers. Historical PCE and TCE concentrations in certain groundwater monitoring wells and Geoprobe sampling locations exceeded the noncancer HI target of 1 for hypothetical future excavation workers. However, the most recent data generated since groundwater monitoring resumed in 2016 (and continues to the present) confirm that the risk posed by recent and current concentrations is below the DEQ HI target of 1. The more recent data are a better reflection of risk at the Site because they account for continued and active degradation of VOCs.

## 9. Conclusions and Recommendation

Northwest Pipe Company has completed a combination of independent and voluntary site investigations, as well as remediation activities at the Site over the past 30 years. This work has provided environmental data that defined the nature and extent of constituents at the Site and documented the effectiveness of the targeted remedial actions taken by the Company.

The Site, which has a nearly 80-year history of heavy industrial use, beginning as part of a World War II shipyard and transitioning into a water transmission steel pipe manufacturing facility, occupies approximately 29.15 acres (25.96 acres of which are owned and used for industrial processes by Northwest Pipe Company). The Site is located approximately 1,500 feet from the eastern bank of the Willamette River. Because of its location within the larger area that provides groundwater and stormwater discharge to the Portland Harbor Superfund site, Site investigation, remediation, and source control work conducted since 2000 has been predominantly done under DEQ review and approval.

This section provides a summary of the conclusions reached through site investigation and remediation work conducted at the Site, followed by a request for an NFA remedial decision from DEQ.

### 9.1 Soil

Soil at the Site has been investigated since the late 1980s. As stained or otherwise affected soil was identified, it was removed, as necessary, and properly disposed of at solid waste landfills or evaluated for risk to determine whether removal or another remedial action was appropriate. The Site has been paved and capped since it was originally developed for industrial purposes. The approximate 4 acres that were not paved prior to 2011 were found to contain concentrations of petroleum hydrocarbons, PAHs, and PCBs in soil ranging from below laboratory reporting limits to above potentially applicable RBCs for industrial worker exposure. In 2012, Northwest Pipe Company completed a focused soil hot spot removal and site capping IRM. The objectives of the IRM were to remove soil from small, isolated areas of the Site with PAH concentrations above hot spot levels under relevant Oregon Cleanup Rules, to pave the remaining unpaved areas to mitigate potential worker exposure, and to reduce the potential for erosion and offsite transport via stormwater.

Confirmation sampling was conducted after hot spot removal and completion of paving. Analytical results from confirmation samples indicate that the remedial objectives were met. This action eliminated the potential for Site runoff to include eroded soil and eliminated direct exposures to constituents in soil by humans and wildlife. A CMMP was prepared by CH2M ~~HILL~~ and approved by DEQ to provide guidance to facility staff describing how to manage potentially affected media to which receptors may be briefly exposed during short-term subsurface construction activities in the future (CH2M ~~HILL~~, 2011b).

### 9.2 Groundwater

Groundwater at the Site has been investigated since the late 1980s. It has been characterized using a combination of direct-push grab samples and monitoring well samples. Low concentrations of hydrocarbons and VOCs have been detected at scattered locations of the Site, consistent with long-term industrial use. Detected concentrations are generally low and below levels of potential concern, as screened against the reasonably likely current and future beneficial use of groundwater. Two areas of the Site were investigated in detail over the years of investigations: the Stained Soil Investigation Area, where PAHs were detected in groundwater at an area where deep stained soil had been identified, and the Southeast Area, where VOCs have been detected in groundwater at elevated concentrations compared to the rest of the Site.

Groundwater risk evaluation and fate and transport modeling determined that Site groundwater does not pose an excess risk to receptors given the current and reasonably likely future beneficial use of groundwater. The most recent data generated since groundwater monitoring resumed in 2016 (and through [2019](#)[2021](#)) confirms that the potential risk posed by recent and current concentrations is below

the DEQ HI target of 1. VOC concentrations in the Southeast Area of the Site are anticipated to continue to attenuate below levels of potential concern, due to ongoing process of reductive dechlorination, before reaching surface water. In addition, the RSE concluded that no excess risk exists for Site workers who may be exposed to vapors from VOCs in the Southeast Area of the Site. Considering the observed groundwater concentrations both on the Northwest Pipe Site and on the Port of Portland site near Terminal 4 Slip 1, VOCs in the Southeast Area shallow groundwater are contained by ongoing MNA processes. An MNA [Work plan](#) ~~is was being~~ developed and ~~will follow~~[has been the submission of submitted with](#) this document.

### **9.3 Recommendation**

Based on the findings of the RI and the results of capping and soil removal under the IRM, the Northwest Pipe Company Site does not pose an unacceptable risk to human or ecological receptors as defined by OAR 340-122-0115. As part of the IRM implementation, the Site operates under a DEQ-approved CMMP to ensure that future management of contaminated media from the Site, if any, will be conducted in accordance with local, state, and federal regulations.

Consequently, Northwest Pipe Company requests that DEQ issue a Sitewide NFA determination consistent with the requirements contained in the Oregon Hazardous Substance Remedial Action Rules and associated statutes.

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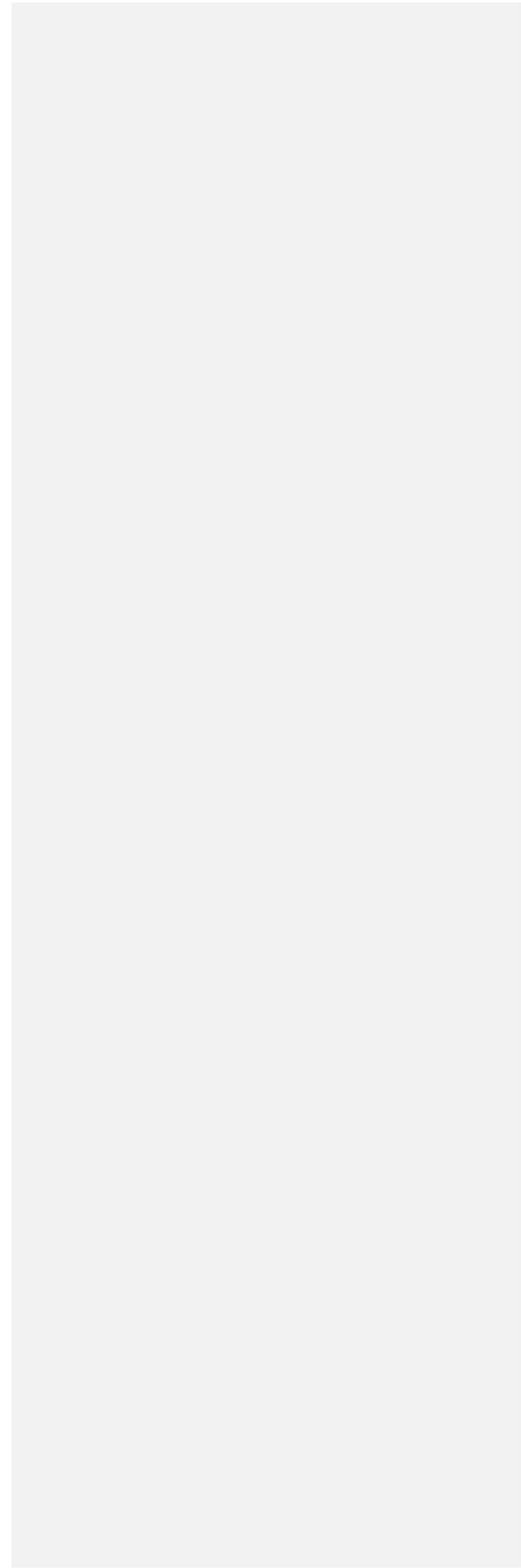
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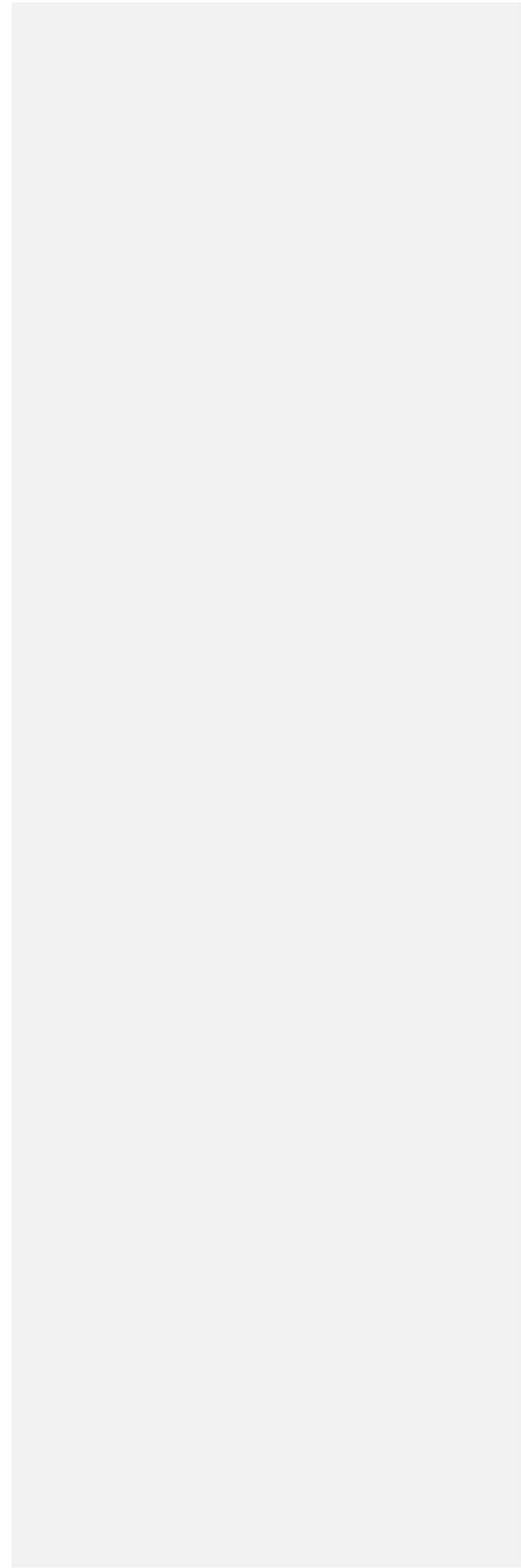


## **Tables**





## Figures





## **Appendixes**

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