*Draft Final Report*

# Northwest Pipe Company Remedial Investigation and Source Control Evaluation

Prepared for

**Northwest Pipe Company**
**ECSI #138**
**Portland, Oregon**

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# Executive Summary

This report presents the results of the remedial investigation, risk assessment, remedial action, and source control evaluation for the Northwest Pipe Company site (the Site) in Portland, Oregon. The 29.15-acre Site is on a portion of a World War II-era shipyard where Northwest Pipe Company manufactures steel water transmission pipe for municipal, hydroelectric, and industrial uses.

Northwest Pipe Company has conducted investigations and focused remedial action to address instances of contaminated soil since it began the process of acquiring the Portland facility in the late 1980s. In 2000, the Oregon Department of Environmental Quality (DEQ) requested that Northwest Pipe Company prepare an expanded preliminary assessment as part of the Department's efforts to identify potential sources of contamination to the Willamette River in conjunction with the Portland Harbor Superfund process (which is being conducted in parallel by the United States Environmental Protection Agency [EPA] and a group of potentially responsible parties [referred to as the Lower Willamette Group]). 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 remedial investigation (RI) and source control evaluation (SCE) conducted under the 2004 agreement, as well as describing an Interim Remedial Measure (IRM) that was completed, with DEQ approval, in 2012.

## Pre-2007 Site Work

The site characterization and remediation work conducted by Northwest Pipe Company began in the late 1980s and continued up to late 2006 (a time when staffing and site priorities at DEQ caused a protracted lack of the Department's attention, continual changes in Department staff and project requirements, and a significant delay in progress at the Site). The work focused primarily on 14 areas of potential interest that had been identified during the Phase I and II Environmental Site Assessments for Northwest Pipe Company, completed in the late 1980s as part of property acquisition. This pre-2007 investigation work found low levels of polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and petroleum hydrocarbons in soil consistent with a 70-year history of industrial operations, starting as a large shipyard that produced more than 300 ships over an approximate 4-year period in World War II and continuing as a less-intensive manufacturing facility fabricating steel pipes.

An area of volatile organic compounds (VOCs) in groundwater in the Southeast Area of the facility, characterized by the localized presence of tetrachloroethene (PCE) and its breakdown products, was identified in the shallow (less than 30-foot-deep) water table aquifer. A draft RI/SCE Report presenting the results of site characterization and risk assessment work, as well as summarizing targeted soil removal actions and the results of natural attenuation modeling of the VOCs in the Southeast Area, was submitted to DEQ for review in December 2005. Shortly after the 2005 report was submitted, DEQ entered a period where it dedicated essentially no resources to the Northwest Pipe Site, which lasted until 2008.

## Post-2007 Work

Until the time DEQ re-engaged with the Northwest Pipe Company project, the Company continued to conduct an investigation of the Site, including an effort in fall 2007 to characterize groundwater quality across the Site to supplement prior investigation results, which had been focused on the Southeast Area of the Site and the area where a former underground fuel storage tank had been removed in the early 1990s in the northeast part of the Site. While low concentrations of hydrocarbons and chlorinated solvents were detected at scattered locations of the Site, consistent with the Site's history and historical long-term industrial use, concentrations were low and below levels of potential concern (considering the reasonably likely current and future beneficial use of groundwater, which is discharge to the Willamette River).

 

# Final Remedial Investigation Work

Active DEQ oversight resumed in spring 2008. Based on DEQ's review comments on the 2005 draft RI/SCE report and the new project manager's comments arising from his need to familiarize himself with the Site, work plans for additional Site characterization were continually developed and redeveloped interactively with DEQ and implemented during the period from 2008 to 2013. The work focused on the areas described below:

- **Surface Soil Sampling** – This work involved sampling soil exposed at the ground surface at 11 points around the Site to further document soil quality for PAHs and PCBs and to supplement the existing data set by additionally analyzing soil for selected inorganic constituents, pesticides, and phthalates. The results of surface soil analysis indicated that Site soil contains detectable concentrations of naturally occurring inorganic constituents; in certain samples, PCB Aroclor 1254 and (less commonly) Aroclor 1260 were detected in soil. Certain PAHs and petroleum hydrocarbons also were detected in soil, confirming previous results. Low concentrations (below occupational worker screening levels) of one pesticide (alpha BHC) and three phthalates were reported in some surface soil samples.

  A conservative risk screening, approved by DEQ, which relied on maximum detected concentrations rather than statistically averaged data, drew three conclusions:

  - Constituent concentrations for PAHs and PCBs in a subset of the sampled locations exceeded risk-based concentrations (RBCs) for occupational and construction worker exposure, if the soil were to become accessible to direct contact; however, direct contact was concluded to be unlikely at most of the areas.
  - Constituent concentrations in surface and subsurface soil are below levels of concern for potential volatilization to outdoor or indoor air.
  - Constituent concentrations in surface and subsurface soil are below levels of potential concern for potential future excavation workers.

  A hot spot evaluation consistent with Oregon Administrative Rules (OAR) 340-122-115(32)(b) determined that two hot spots were present at the Site, attributable to concentrations of benzo(a)pyrene: one in an area of formerly unpaved soil north of the lining and coating building in the northeastern edge of the Site; and the other on the southern Site boundary, containing less than one cubic yard of offsite soil that had sloughed onto the Site from the elevated rail spur and road shoulder along North Terminal Road, south of the Site boundary.

- **Roof Runoff Sampling** – Stormwater runoff samples from building roofs at the Site were collected and analyzed for inorganic constituents, PAHs, PCBs, VOCs, phthalates, and suspended solids to investigate the degree to which roof runoff may be contributing constituents, if any, to Site stormwater runoff. The laboratory results indicated that, with the exception of arsenic and zinc, all constituents analyzed in the roof runoff samples were not detected and/or were below very conservative *Joint Source Control Strategy Guidance* screening level values. It was noted that arsenic is naturally occurring in area soil and that its presence in some (3 of 6) roof runoff samples above laboratory reporting limits could be attributable to fugitive dust from area activities that had settled on the roof. The zinc detected in roof runoff is attributable to the presence of zinc-galvanized steel in downspout piping and facility roofing materials. Northwest Pipe Company's 2008 implementation of a source control measure, involving cleaning and coating the roof of the main plant building (which covers approximately 6 acres), led to a 98 percent decrease in zinc concentrations in runoff from this structure.

- **Expanded Risk Assessment for Chlorinated Solvents in Groundwater** – This work was conducted at DEQ's request to incorporate offsite data into the 2005 RI/SCE risk assessment and to update the assessment using current toxicological information and more recent groundwater data, where available. Considering the most recent data available for onsite and offsite groundwater, including the locations nearest to potential exposure points in surface water (specifically the Schnitzer International Terminals slip and the Port of Portland Terminal 4 Slip 1), the results of the risk screening for groundwater concluded the following:

- Constituent concentrations in groundwater do not pose a current or future risk to occupational workers at the Northwest Pipe Company facility from VOCs volatilizing to indoor or outdoor air.
- Constituent concentrations in groundwater are so low that the risk, if any, to recreational users of the Port of Portland Slip 1 at Terminal Four, the International Terminals Slip, and the Willamette River west of the Site, including water from the slips potentially reaching the Willamette River, are within the acceptable range.
- Constituent concentrations in groundwater are so low as to pose no unacceptable risk to aquatic resources, birds, and mammals using the Willamette River.

- **Stormwater System Investigation** – At DEQ's request, stormwater conveyance line cleaning procedures were evaluated, and sections of the facility's stormwater system were investigated with a video camera to document drainage line conditions. To facilitate Site drainage and stormwater system maintenance, catch basins and manholes/cleanout access points were installed.

## Interim Remedial Measure and Stormwater Treatment

Based on the results of surface soil sampling, Northwest Pipe Company proposed to DEQ that an interim remedial measure (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 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 subsequently was accepted by DEQ after a public comment period. DEQ elected to conduct a public comment because the Department anticipated the IRM would constitute a major part of the Site's final remedy.

Remedial activities began in July 2011 after obtaining DEQ approval of the remedial action work plan, and continued as resources became available and when conditions were appropriate for paving. The work was concluded in June 2012 after a total of four acres were paved and 1,050 tons of hot spot soil were removed and disposed at the Hillsboro Landfill. Confirmation samples collected in accordance with the DEQ-approved plan documented that hot spot-level concentrations of benzo(a)pyrene had been removed, indicating that the remedial objective of removing hot spot-level soil prior to paving was met.

In conjunction with the IRM and to comply with City of Portland's opinion concerning its stormwater treatment requirements, two state-of-the-art above-ground 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 Schnitzer International Terminals Slip. Various other stormwater improvements, such as covering waste receptacles and installing an isolated drainage system and oil-water separator next to the above-ground fueling system, were also implemented.

## 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 below grade. Excavation continued in a small area at this location until groundwater was encountered at a depth of about 8 feet. The location of the stained soil reportedly coincided with the location of a demister used as part of the former coal tar enamel operation.

At the request of DEQ, a stained soil investigation work plan was prepared for 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.

The results of the soil sampling indicated that inorganic constituents were below background values calculated by DEQ. Concentrations of PAHs, PCBs, and petroleum hydrocarbons were either below reporting limits or below potentially relevant RBCs. The only exception was the PAH naphthalene in one sample, which exceeded the RBC for leaching to groundwater.

The results of the two groundwater sampling events were screened against RBCs based on occupational exposure for the volatilization pathway (outdoor air), vapor intrusion (indoor air), and potential exposure by excavation workers. None of the concentrations exceeded potentially relevant screening levels except for three PAHs (benzo(a)pyrene, dibenzo(a,h)anthracene, and benzo(a)anthracene) in the May 2013 samples from MW-7, located in the center of the stained soil area at the location of the former demister. At DEQ's request, results also were screened against levels protective of water quality in the Willamette River, located approximately 2,000 feet west of the stained soil area. Some inorganic constituents and some PAHs exceeded these conservative screening values. The potential for migration towards the Willamette River was evaluated using the natural attenuation evaluation tool Bioscreen. Based on the evaluation and sensitivity analysis designed to intentionally exaggerate the potential for migration, the highest concentration and most mobile PAHs detected in groundwater were estimated to rapidly drop below a concentration of 0.001 mg/L along the flow path approximately 2,000 feet from the Willamette River. Consequently, concentrations of constituents detected in groundwater within the stained soil area would not pose a threat to the Willamette River.

## Source Control Evaluation

Based on the Site's inland location away from the Willamette River, and based on attenuation processes in groundwater and risk assessment work presented in this report, stormwater is the only complete pathway to the Willamette River for the Site. Site stormwater discharges via a communal outfall to a privately owned slip (the Schnitzer International Terminals Slip). The outfall, referred to as Outfall 18/WR-123, discharges stormwater to the eastern end of the slip approximately one-third mile from the Willamette River main stem. In addition to stormwater originating on the Northwest Pipe Company Site, this outfall discharges stormwater from approximately 100 additional acres of industrial land in the Outfall 18/WR-123 drainage basin. Stormwater discharges from the Site are permitted under its general 1200-Z Industrial Stormwater Discharge Permit (effective July 1, 2012), and, as a result of best management practices and site improvements—including installation of state-of-the-art stormwater treatment systems on Site stormwater discharge lines—the Site continues to maintain material compliance with its increasingly stringent stormwater discharge benchmarks.

Stormwater was characterized as part of the Site's Remedial Investigation and Source Control Evaluation. Sampling results in 2007 indicated that stormwater leaving the Site contained low to below-detection limit concentrations of phthalate esters, PCBs, PAHs, and inorganic constituents. Where concentrations of certain constituents were detected, they were within the range of concentrations determined by DEQ to be typical of area industrial sites (with the possible exception of arsenic, which is naturally occurring and naturally elevated above risk-based concentrations in area soil). Considering the comprehensive nature of site improvements made at the Northwest Pipe Company Site over the past decade and the continual and substantial improvement in stormwater quality observed due to source control actions, the Site has controlled sources to stormwater and does not pose a risk of contaminating sediment in the Schnitzer IT Slip or in the main stem of the Willamette River itself.

## Recommendation

With the completion of the IRM, the installation of storm water treatment, and the implementation of a broad range of best management practices, Northwest Pipe Company successfully identified legacy contaminants at its Site, addressed them where necessary, and conducts ongoing Site operations in a manner designed to manage hazardous substances to avoid releases to the environment. Consequently, Northwest Pipe Company has addressed potential risks, managed potential sources, and has completed its obligations under both the Oregon Hazardous Substance Remedial Action Rules (OAR 340 Division 122) and its *Voluntary Agreement for Remedial Investigation and Source Control Measures* with DEQ. Northwest Pipe Company requests that DEQ issue a determination of No Further Action for Source Control at the Site.

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# Acronyms and Abbreviations

| | |
|---|---|
| ˚F | degrees Fahrenheit |
| µg/L | micrograms per liter |
| amsl | above mean sea level |
| AOPC | area of potential concern |
| AWWA | American Water Works Association |
| BES | Bureau of Environmental Services |
| bgs | below ground surface |
| CEM | conceptual exposure model |
| COI | constituent of interest |
| COPC | constituent of potential concern |
| CPEC | constituent of potential ecological concern |
| CRD | Columbia River Datum |
| CSM | conceptual site model |
| DEQ | Oregon Department of Environmental Quality |
| ELCR | excess lifetime cancer risk |
| EPA | United States Environmental Protection Agency |
| EPC | exposure point concentration |
| EPH | extractable petroleum hydrocarbons |
| ft/ft | foot per foot |
| GPS | global positioning system |
| HI | hazard index |
| HQ | hazard quotient |
| HST | hydrodynamic and sediment transport |
| IDZ | isolated drainage zone |
| IT Slip | Schnitzer International Terminals Slip off the Willamette River |
| JSCS | Joint Source Control Strategy |
| Koc | organic carbon partition coefficient |
| LWG | Lower Willamette Group |
| mg/kg | milligram per kilogram |
| mg/L | milligram per liter |
| mL/g | milliliter per gram |
| mV | millivolt |
| NOAA | National Oceanic and Atmospheric Administration |

| | |
|---|---|
| NPDES | National Pollutant Discharge Elimination System |
| NRCS | Natural Resource Conservation Service |
| NTU | nephelometric turbidity unit |
| OAR | Oregon Administrative Rule |
| ORP | oxidation-reduction potential |
| OSC | Oregon Shipbuilding Corporation |
| OWRD | Oregon Water Resources Department |
| PA | preliminary assessment |
| PAH | polynuclear aromatic hydrocarbon |
| PCB | polychlorinated biphenyl |
| PCE | tetrachloroethene |
| PEC | probable effect concentration |
| Site | Northwest Pipe Company facility located at 12005 North Burgard Road in Portland, Oregon |
| PVC | polyvinyl chloride |
| QA | quality assurance |
| QC | quality control |
| RBC | risk-based concentration |
| RI | remedial investigation |
| RI-SCE | Remedial Investigation – Source Control Evaluation |
| RSE | risk screening evaluation |
| RSL | regional screening level |
| SAP | sampling and analysis plan |
| SLV | screening level value |
| SQV | sediment quality value |
| TCE | trichloroethene |
| TOC | total organic carbon |
| TPH | total petroleum hydrocarbons |
| TSS | total suspended solids |
| USACE | United States Army Corps of Engineers |
| USDA | United States Department of Agriculture |
| USGS | United States Geological Survey |
| VOC | volatile organic compound |
| VPH | volatile petroleum hydrocarbons |
| WR- | Willamette River outfall number assigned by the Lower Willamette Group |
| XPA | expanded preliminary assessment |

SECTION 1

# Introduction

This Remedial Investigation – Source Control Evaluation (RI/SCE) Report was prepared on behalf of the Northwest Pipe Company for the facility located at 12005 North Burgard Road in Portland, Oregon (Site).

## 1.1 Purpose

This document revises and updates the December 2005 draft RI/SCE report prepared for Oregon Department of Environmental Quality (DEQ) review. It presents the results of additional site characterization activities requested by DEQ and evaluates the source control measures implemented at the Site. This document provides the following information:

- Identifies and characterizes potential hazardous substance source areas
- Presents information relevant to potentially affected media at the Site
- Evaluates constituent migration pathways
- Identifies nature, extent, and distribution of hazardous substances
- Presents a conceptual site model (CSM)
- Identifies a current and reasonably anticipated future beneficial land and water use
- Presents human health and ecological risk for the Site
- Presents source control measures and indications of their effectiveness

Because this document describes results from the late 1980s to the present, data generated both by CH2M HILL as well as other, prior consultants are summarized in the report tables. Laboratory reports, however, are provided only for data generated by CH2M HILL (Appendix A).

## 1.2 Objective

This RI/SCE Report presents the results of sampling and interim remedial activities for the Site and demonstrates that there is no excess risk to reasonably likely potential human or ecological receptors. It documents that no ongoing sources of constituents of concern exist at the Site that have the potential to reach the Willamette River at unacceptable levels. Lastly, it concludes that potential sources of contamination are controlled, that no additional work under the Oregon Hazardous Substance Remedial Action rules is needed, and that the Site warrants a "No Further Action" Source Control determination by DEQ.

## 1.3 Regulatory Framework

This RI/SCE was conducted as requested by DEQ and agreed upon in the *Voluntary Agreement for Remedial Investigation and Source Control Measures* (DEQ 2004).

## 1.4 Report Organization

This RI/SCE Report is organized in the following sections:

- Section 1, Introduction
- Section 2, Site Background
- Section 3, Environmental Setting
- Section 4, Beneficial Land and Water use
- Section 5, Site Characterization and Interim Remedial Actions
- Section 6, Human Health and Ecological Risk Evaluation
- Section 7, Source Control Pathways and Constituents
- Section 8, Source Control Data Collection and Evaluation
- Section 9, Conclusions
- Section 10, References

SECTION 2

# Site Background

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

## 2.1 Site Description

The Site is located in the area generally referred to as the Burgard Industrial Park in the northern part of Portland, Oregon. The term “Burgard Industrial Park” is used colloquially to refer to a collection of industrial parcels, including the Northwest Pipe Site, most of which share a common street address and which are located east and south the Schnitzer International Terminals Slip (IT Slip). The Site measures approximately 1,013 feet long and 777 feet wide. The facility is approximately 1,500 feet from the eastern bank of the Willamette River, borders no surface water body, and is situated between and east of two manmade slips: the Port of Portland Terminal 4 Slip and the IT Slip owned in part by Schnitzer Investment Corp. and in part by Schnitzer Steel Industries. Some properties in this area, including the Site, share the street address 12005 North Burgard Road. Figure 2-1 presents the Site location.

The Northwest Pipe Site encompasses 29.15 acres of flat terrain and includes property owned by Northwest Pipe (25.94 acres split into a 25.27-acre manufacturing area and a 0.67-acre office area) as well as a small (3.21-acre) parcel owned by Felton Properties, Inc. of Portland, Oregon, that constitutes the southern edge of the Site between the main production building and North Terminal Road along the Site’s south boundary (Site). For the purposes of this report, the term “Site” refers to the 29.15 acres of land described above. 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 processes as ship breaking, metal sorting, vehicle shredding, shipping, sand blasting, metal fabrication, and manufacturing.

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 covered predominantly with concrete and with some areas covered with asphalt. A facility map is shown on Figure 2-2.

Northwest Pipe manufactures steel pipe at the Site that is used for a variety of municipal, industrial, and utility applications, primarily potable water transmission. The facility produces pipe in diameters ranging from 17 to 144 inches.

## 2.2 Site History

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

### 2.2.1 Ownership

The Site comprises two parcels of land identified by Multnomah County as Township 2 North, Range 1 West, Section 35 D, Tax lot numbers 700 and 900. The total area of land used for manufacturing owned by Northwest Pipe is 25.94 acres. The size of each tax lot is as follows:

- Lot 700 – 25.27 acres
- Lot 900 – 0.67 acre

Available data indicate 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, the property owners during this 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).

Before the beginning of direct United States involvement in World War II in December 1941, the Oregon Shipbuilding Corporation leased and then purchased several parcels in the area now known as the Burgard Industrial Park. Other property owners in the area included the United States and the City of Portland. Under contract to the Federal government, Oregon Shipbuilding Corporation constructed and operated a shipyard that produced more than 300 Liberty ships, Victory ships, and troop transports as part of the war effort. Although it was substantially destroyed by fire and rebuilt prior to Northwest Pipe's ownership, the large production buildings used by Northwest Pipe containing Bays 1 through 6 and Bay 9 were used as the Oregon Shipbuilding Corporation's Assembly Building.

Property ownership began to change after the war ended, as the former shipyard was sold to various owners. In 1949, Terminal Flour Mills Company bought a portion of the properties that now make up the Site. In 1950, the Surplus Properties Corporation, a corporation involved in consolidating and disbursing excess Federal government properties no longer needed for government purposes, purchased properties in the area, including a portion of what is now the Site. In 1950, Kerr Gifford & Co. began to store grain in the bays; in 1954, Cargill, Inc. acquired Kerr Gifford. According a State Fire Marshal report, grain was stored in the Bays when they burned in the 1961 fire at the facility (Gault and Pickett 1961).

Beall Pipe and Tank Company purchased properties in the area in 1950 and began manufacturing steel products soon thereafter. Other transactions of record concerning all or portions of the Northwest Pipe property include Reconstruction Finance Corporation (1951), Lawrence Warehouse Company (1952), Dulien Steel Products, Inc. (1961), Oregon State Board of Higher Education (1962), Broadway Holding Company (1968), Schnitzer Investment Corporation (1977), and Multnomah Land and Equipment (1982). Northwest Pipe and Casing Company (now Northwest Pipe Company) leased the two parcels from Multnomah Land and Equipment in 1982, and purchased the parcels in 1997.

Easements and rights-of-way that have been granted over the years include the following:

- Northwest Oil (1938)
- Northwest Terminal Company (1950)
- Oregon Washington Railway and Navigation Company, now Union Pacific Railroad (date not noted)
- Portland General Electric (date not noted)
- California Container Corporation (1950)

### 2.2.2 Operations

Property currently owned by Northwest Pipe Company has been used for industrial activities since its development in the early 1940s. The Site originally was used to manufacture components for Liberty Ships, Victory Ships, and troop transports used in World War II. Sections of the ships were constructed in the large building that occupied the footprint of Bays 1 through 6 and Bays 9, along with adjacent areas no longer under roof. These 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 consisted of cutting/drilling sheet steel, forming sheet steel, welding, and riveting (Oregon Shipbuilding Corporation, 1945).

Following the war, the Terminal Flour Mills Company used the Site as a grain warehouse. Activities on other parts of the Site during this time are not known.

In 1950, Beall Pipe and Tank Company used a portion of the Site to manufacture steel pipe and tanker trucks as well as to clean and repair used tanker trucks. Other than the grain storage activity noted in Section 2.2.1 up to the 1961 fire, activities on other parts of the Site during this time are not known, with land ownership changing hands repeatedly.

## 2.2.3 Regulatory History

### 2.2.3.1 Permits

Northwest Pipe Company currently operates under stormwater, air, and hazardous waste generator permits. Because of the nature of the Site's operations (for example, hazardous waste is stored for less than 90 days inside and under roof), only the stormwater permit is relevant to the source control evaluation.

The Site's stormwater discharge is authorized by DEQ under a general National Pollutant Discharge Elimination System (NPDES) 1200-Z permit (File 6739) issued August 30, 2012. The Site has operated under a 1200-Z permit since 1997.

From 1993 through 1996 before the issuance of the 1200-Z permits, the Site discharged stormwater through a 1200-H permit (Permit 10043). Historically, the facility also discharged non-contact cooling water through a GEN01 100-J NPDES permit issued by DEQ (Permit 10044) from 1981 through 2001. Production changes occurred that eliminated the cooling water in 2001. In the summer of 2011, the Site operated under a 1200-C permit (Permit 27413) during construction activities for the interim remedial measure (capping with pavement the remaining areas of exposed soil on the Site) from July 2011 through December 2012.

### 2.2.3.2 Oregon Cleanup Program Regulatory History

Northwest Pipe Company first entered into a letter agreement for voluntary action at the Site with DEQ in 1988 to oversee site assessment work being conducted by Dames & Moore related to Northwest Pipe's planned acquisition of the property, which subsequently occurred in 1997. In 2000, Northwest Pipe completed an Expanded Preliminary Assessment (XPA) under a second voluntary cleanup letter agreement with DEQ dated July 14, 2000. As site investigation work progressed subsequent to submitting the XPA report (CH2M HILL 2000), a Voluntary Agreement for Remedial Investigation and Source Control was signed between Northwest Pipe and DEQ effective December 30, 2004.

Since 2000, Northwest Pipe Company has worked with four DEQ project managers: Alicia Voss (2000 to 2005), Rod Struck (2005), Mike Romero (2005 to 2006), and Jim Orr (2008 to present). The Site characterization and remediation work conducted by Northwest Pipe Company up to late 2006 (a time when staffing and site priorities at DEQ caused a protracted lapse in the Department's attention, continual changes in Department staff and project requirements, and a significant delay in progress at the Site) focused, with DEQ's concurrence, primarily on 14 areas of potential interest that had been identified during the 1989 Phase I and II Environmental Site Assessment work for Northwest Pipe Company (Dames & Moore 1989).

When the Site transitioned to its third DEQ project manager, Mr. Mike Romero, the Department's December 8, 2005, Transition Memorandum identified the following three items as "future work":

1) "Review Remedial Investigation/Source Control Report (Due December 30, 2005)"
2) "Resolve DEQ comments on Remedial Investigation/Source Control Report;"
3) "Prepare a Source Control Decision and NFA (no-further-action) determination"

By that time, both Mr. Struck and his predecessor Ms. Voss had expressed to Northwest Pipe Company that an NFA determination should be or would be issued once any final comments on the Remedial Investigation/Source Control Report were addressed. [1] In March 2006, in a teleconference between Mr. Ken Shump of CH2M HILL and Mr. Mike Romero, Mr. Romero said that he was still waiting for some review comments on the 2005 RI/SCE report, and that he expected to complete the source control evaluation "in a month or so," which, after review internally, would go to United States Environmental Protection Agency (EPA) for a 30-day review period. Mr. Romero said he knew the Site was "near the end" and opined that it should be "easy" to finish the Site because it "was almost as if it was set up already." Instead of proceeding

[1] In a conference call between Ms. Claudia Powers of Ater Wynne LLP, attorney for Northwest Pipe Company, and Mr. Keith Johnson of DEQ on April 27, 2006, concerning DEQ's lack of progress on the Site, Mr. Johnson stated that Mr. Romero "really wanted to get this site done" and had no reason to believe that Rod's [Mr. Rod Struck's] opinion should be changed.

down this path, DEQ entered a phase with no clear evidence of work or progress on the Site, after which it assigned a fourth new project manager for the Site in 2008, Mr. Jim Orr, who has taken a radically different approach than his predecessors (see Section 5.4 for further information on additional work requested by DEQ after it re-engaged on the project in 2008).

#### 2.2.3.3 Regulatory Determinations

Key environmental regulatory determinations that have been made during Northwest Pipe Company's presence at the Site related to source control are as follows:

- Determination of No Further Action from DEQ regarding decommissioning of above and below ground fuel storage tanks in 1990
- DEQ approved the Surface Soil Risk Screening and Focused Feasibility Study for Interim Action (DEQ, 2010a; CH2M HILL 2010) and issued notice to proceed for a soil capping and removal action (DEQ, 2010b)

## 2.3 Current Operations

Northwest Pipe Company has owned its Site since 1997; however, the company began operations at the Site in 1982 under a lease from Multnomah Land and Equipment Company. Northwest Pipe Company manufactures potable water transmission pipe that is used in water utility, hydroelectric construction, agricultural, mining, and industrial applications.

The Site is a "job shop" in which operations are run based on the orders placed by clients. The Site runs operations as needed to fill specific orders. Not all equipment or operations discussed in this document are run continuously.

Northwest Pipe Company manufactures water transmission pipe at the Site, which is used in water utility, hydroelectric construction, agricultural, and mining applications. Steel pipe is manufactured using the submerged arc welding process. This welding process produces little to no welding fumes, and welding is predominantly done indoors.

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. If requested by the customer, the Site 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 located adjacent to Bay 1. Pipe fittings such as elbows, tees, manifolds, reducers, and manholes are fabricated in Bay 3. The maintenance area is located in the alley between Bay 6 and Bay 9. Sand blasting prior to taping or coating occurs in the south end of the lining and coating facility, west end of Bay 6, and in Bay 9, within the Sand Blast Rooms. 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 in east 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 occurs at the Cement Plant in the northeastern corner of the Site. Northwest Pipe added the Cement Curing Bays at the northern edge of the property. Paint and other coatings are applied in the Lining and Coating Facility, which is located in a building 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 with secondary containment. An office building containing offices, restrooms, and a meeting room is east of the building containing Bays 1 through 6. The remainder of the Site is used for storing finished pipe for shipping access by rail and truck. Northwest Pipe Company has decommissioned the underground storage tanks found onsite, has conducted extensive site investigations and cleanup, and has continually improved the existing facilities at the property during its tenure at the Site.

# 2.4 Stormwater Conveyance System

Historical maps, figures, and City of Portland plumbing records were reviewed to identify the location of historical as well as current catch basins and drain lines. As requested by DEQ, Northwest Pipe Company also conducted video logging of the selected sections of the stormwater system (CH2M HILL, 2010a). This information was compared to observations in the field, drain line video logging results, and plant personnel site knowledge to identify storm drain lines that are known to be abandoned and lines that continue to function as of the writing of this document. Figure 2-4 displays the current understanding of the Site's operating stormwater conveyance system.

## 2.4.1 Stormwater System and Receiving Water

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 before leaving the Site via two discharge points along the northern Site boundary. 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 by Lower Willamette Group [LWG] Outfall designation WR-123) located over 1/3 mile (approximately 1,960 feet) from the mouth of the slip[2]. In addition to Outfall 18/WR-123, Bridgewater Group mapped approximately 15 former and current stormwater outfalls leading to the IT Slip from other neighboring facilities (Bridgewater Group, 2000). This is discussed further in Section 7.0 of this document.

The slip is on the eastern bank of the Willamette River approximately 4 miles upstream of the confluence of the Willamette and Columbia rivers. This slip was constructed by the Oregon Shipbuilding Corporation in 1941 and used during World War II to finish construction of Liberty Ships, Victory Ships, and troop transports that were manufactured in the adjacent (off the present-day Northwest Pipe Company Site) shipways. The activities that were carried out in the slip during WW II included machinery work, system testing, welding, electrical work, finish coats of paint, and other final touches before commissioning the ships for duty. Based on historical aerial photographs taken after the war, the slip was used to store log rafts waiting transport to local sawmills. Sometime between 1966 and 1968, old ships were docked in the slip as well as the log rafts. Sometime in the early 1970s, log rafts were no longer stored in the slip. The old ships that were in the slip were cut up in the slip for recycling as scrap metal. A 1998 aerial photograph shows a barge partially dragged out of the water with bulldozers at the head of the slip being dismantled in the general vicinity of Outfall 18. This practice of dismantling ships has been observed in the slip as recently as July 2008.

The stormwater system on the Northwest Pipe Company Site has been verified in the field, and licensed professional surveyors have surveyed the location of each catch basin. The Site's catch basins consist of a combination of flow-through basins and "Lynch" style basins. The flow-through basins have a pipe that conveys water into the basin and a second pipe slightly above the bottom of the catch basin to allow

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[2] Historical WWII-era maps depict a connection between what is now the southwest corner of the present-day Northwest Pipe Company Site and an old Willamette River outfall, referred to as Schnitzer Steel Outfall 1 or LWG WR-108. Because stormwater had not been observed discharging from this outfall for an extended period prior to 2002, the stormwater line leading to the outfall was investigated by Schnitzer Steel Industries, Inc. as requested by DEQ (Bridgewater Group, 2002). The line was determined to have been subject to differential settlement after its installation in the early 1940s, which caused a reversed gradient (away from the river) and promoted sedimentation within the line. This situation rendered Outfall 1/WR-108 inactive. The portion of the present-day Northwest Pipe Company Site historically mapped as connected to this line experienced chronic flooding dating at least to the 1960s, based on interviews with former plant manager Harold Parrett, who also understood that there was no viable connection between the Site and the stormwater line leading to Outfall 1/WR-108. Consequently, in 2002, Northwest Pipe Company changed its stormwater line configuration to alleviate this chronic flooding caused by the lack of effective stormwater drainage, which interfered with safe vehicular traffic and steel pipe movement. This change involved installing a stormwater pump station to move stormwater from the southwest part of the Site to the north, where it eventually would discharge from the Site via an existing Northwest Pipe Company stormwater line to the large communal stormwater line that discharges to the IT Slip. This change alleviated the flooding to permit safe vehicle passage and permanently removed the non-functional connection to the inactive, plugged stormwater line leading to Outfall 1/WR-108. CH2M HILL identified no records or other evidence indicating that Outfall 1/WR-108 functioned as an active outfall during Northwest Pipe Company's presence at the Site since 1982.

suspended solids to settle out of the stormwater. The Lynch style basins have a settling sump in which stormwater collects until it reaches the invert elevation of the discharge pipe, which allows the stormwater to exit the catch basin via a discharge pipe and flow into one of the main stormwater conveyance lines. The Lynch style catch basins are generally in the northeastern portion of the Site where the stormwater conveyance line is more than 3 or 4 feet below ground surface. All catch basins have a replaceable fabric filter and oil absorbent sock installed to further reduce sediment loading of the stormwater. Plant personnel regularly inspect and maintain the filters and socks to confirm they remain functional and effective for their intended purpose.

The underground storm drain pipe lines throughout the Site are predominately corrugated galvanized steel, which connect to some shorter lengths of larger concrete pipes just before merging with the communal system offsite. Northwest Pipe Company has installed some shorter lengths of polyvinyl chloride (PVC) drain lines during maintenance and upgrading activities.

Figure 2-4 depicts the Site drainage. The entire Site is paved, so the Site consists of impervious surfaces. This map includes directional stormwater runoff patterns of the Site, identifies the three isolated drainage areas, and shows the approximate locations of local drainage divides.

### 2.4.2 Stormwater Treatment System

In January 2012, Northwest Pipe Company installed a stormwater treatment system upgradient of both sample point 3 and sample point 4, on the two lines conveying stormwater offsite. The two systems, marketed as the Aquip system by StormwateRX, LLC of Portland, Oregon, include a diversion structure that captures stormwater in the first portion of a settling basin. Water in this basin is pumped into holding tanks; from the holding tanks, the water is pumped into the filtration system where it percolates through a sand medium to remove particulate matter. The water is gravity fed through the filter medium and into the second portion of the diversion structure for each system where it discharges into the existing stormwater line upgradient of sample points 3 and 4. The system is constructed with two pumps in the diversion structure. This allows for redundancy; if one pump fails, the system will still operate at capacity. During a heavy rain event, both pumps turn on to pump water to the retention tank. As the rain event subsides, water in the tank continues to be processed through the filter.

### 2.4.3 Isolated Drainage Zones

The Site is divided into two drainage basins with point source discharges and three isolated drainage zones (IDZs) segregated from stormwater discharge. The southern portion of the mortar lining plant is IDZ I. The rebound storage area is IDZ II. The refueling area is IDZ III. These IDZs are described in more detail below.

#### 2.4.3.1 Isolated Drainage Zone I

IDZ I covers the southern end of the mortar plant consisting of the mortar application area (Figure 2-4). Stormwater in IDZ I drains through a water recycling system designed to capture and recycle stormwater falling within the mortar plant area and wash water used in the mortar lining process. This system consists of a series of settling basins that is used to capture solids and reduce the turbidity of water captured in this area. These basins discharge into a series of tanks that hold the captured water until the water is needed for production.

This system was put in place to reduce the potential for discharge of stormwater that has come into contact with cement mortar operations.

#### 2.4.3.2 Isolated Drainage Zone II

Cement mortar rebound material is contained inside a walled, covered cell until it is removed offsite for disposal, an area identified as IDZ II. Stormwater that falls in IDZ II is captured in the rebound storage area (Figure 2-4). This area was re-graded to reduce the potential for rebound material to enter the stormwater system. Rainwater that accumulates in front of and behind the rebound storage structure is diverted into the lined rebound storage area. This water is placed in a watertight open-topped tote container and evaporated, with evaporation residue removed from the Site by an outside vendor for offsite disposal as needed. Stormwater that falls on the roof of this structure is diverted away from the rebound storage area and flows into the facility's stormwater system.

#### 2.4.3.3 Isolated Drainage Zone III

Stormwater that falls in the refueling area, referred to as IDZ III, is captured and flows through an oil/water separator before being discharged to the sanitary sewer.

### 2.4.4 Offsite Run-on

Surface runoff from offsite areas that flows into Northwest Pipe Company's stormwater system and deposits eroded offsite material on the Northwest Pipe Company property has been observed along the southern and southeastern fence line. The majority of this surface flow originates from North Terminal Road, which provides access to the neighboring metal recycling facility (Figure 2-5). Scrap metal haulers delivering material to this neighboring facility use this roadway. Along the sides of this roadway, uncovered dumpsters and trailers are routinely parked containing a variety of scrap metals (Figure 2-5). Other onsite surface flow originates from a historical railroad line that is elevated relative to the rest of the Site. This railroad line runs along the boundary of the Site, but is only above the facility's ground level on the southern side.

#### 2.4.4.1 Railroad Grade Flooding

Northwest Pipe Company experienced unusual flooding along the railroad spur just east of the Site between 2009 and 2011 (Figure 2-5). This flooding occurred throughout the winter and spring of these years and ended in 2011. After observing conditions in the area, Northwest Pipe Company staff determined that the flooding occurred because of changes to drainage patterns at the Northwest Container Corporation, and due to construction activity on North Burgard Road by the City of Portland's Department of Transportation (and BES) to the east and upgradient of the Site. The area of flooding previously drained onto the Site by sheet flow and would discharge into the Site's stormwater catch basins. The City of Portland has since completed construction activities, which eliminated the majority of the flooding conditions. The Site's border with this area has also been re-graded and paved to prevent most of this run-on under typical rainfall conditions except for some run-on that still occurs on occasion through the main gate area of the Site. Northwest Pipe Company may elect to further raise the grade at the main gate area to more effectively exclude run-in in this area.

SECTION 3

# Environmental Setting

## 3.1 Climate

The climate in Portland, Oregon, 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 (National Oceanic and Atmospheric Administration [NOAA], 2009).

The average annual precipitation is approximately 37 inches per year, with roughly 88 percent of the annual rainfall occurring from October through May. Including 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 southeast in the fall and winter months (NOAA, 2009).

## 3.2 Topography

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 (Oregon Shipbuilding Corporation [OSC], 1945). The Linnton U.S. Geological Survey (USGS) 7.5-minute topographic map indicates the topography of the Site is relatively flat (USGS, 1961). Surface elevations range from 30 to 35 feet above mean sea level (amsl) with elevations in the northern part of the Site slightly lower than in the southern part.

## 3.3 Soil and Geology

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. The Site was a marsh and flood plain before its development in 1941. As part of the Oregon Shipbuilding Corporation shipyard development, the marsh was filled with dredge material to raise the elevation of the area to facilitate industrial development. According to Natural Resource Conservation Service (NRCS) maps, two different types of original native soil are located within the Site. Soil types are described as follows (U.S. Department of Agriculture [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. A water table is present 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. A water table is present 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, underlain by native silt historically deposited in side channels of the Willamette River. The thickness of the native silt may exceed 100 feet based on logs of water wells (CH2M HILL, 2005b).

## 3.4 Surface Water Hydrology

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

36.30 inches per year (NOAA, 2009). 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 facility is within the 100-year floodplain of the Willamette River. Most of 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 2.4). The Site does not discharge stormwater directly to the main stem of the Willamette River.

## 3.5 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 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 onsite production well).

The depth to groundwater in the shallow fill water-bearing zone varies seasonally between approximately 6 and 14 feet bgs. The groundwater flow direction in this zone, in the southeast portion of the Site, is consistently south-southwest. A more detailed description of Site hydrogeology is provided in the Hydrogeologic Conceptual Model (Section 6.2.3).

## 3.6 Critical Habitats

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

SECTION 4

# Beneficial Land and Water use

This section presents information on beneficial land and water use from Oregon Water Resources Department (OWRD) well log database as well as findings first presented in the Site2005 draft RI/SCE Report (CH2M HILL, 2005b).

## 4.1 Current and Reasonably Likely Future Land Use

The Site is in an industrial area of North Portland. For more than 70 years, land use in the vicinity of the Site has primarily consisted of industrial operations (Section 2.2). The Northwest Pipe Company property is zoned for industrial use by the City of Portland. Land use is expected to remain the same into the foreseeable future because of a recognized shortage of industrial land in the Portland area. Land surrounding the facility is zoned for industrial use and uses include such processes as ship breaking, metal sorting, vehicle shredding, and shipping; sand blasting; metal fabrication; manufacturing; and marine-related commercial activity. Burgard Industrial Park surrounds the Site. The Northwest Pipe Company property is small (28 acres) relative to adjacent operations, which include Schnitzer Investment Corp. (approximately 200 acres) and the Port of Portland Terminal 4 (260 acres), which surround and are adjacent to the Site, respectively.

## 4.2 Current and Reasonably Likely Future Water Use

The facility's production well, installed in the deep aquifer and screened from 195 to 220 feet bgs, historically was used for industrial cooling purposes; however, currently the production well is used intermittently for make-up water in the hydrostatic testing operations or for applying shotcrete to steel pipe. The facility is not located adjacent to surface water.

The beneficial water use evaluation presented in the following subsections is based on the data reviewed in the OWRD online well log database as well as information gathered by CH2M HILL and Hart Crowser (CH2M HILL, 2005b; 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 that are within about 0.75 mile of the Site in October 2013.

### 4.2.1 Past Beneficial Water Use

The area has been primarily under industrial land use for the past 70 years, with most of the early water use provided by water wells. The 19 water well records found for the vicinity of the Site indicate that about 80 percent of the wells were installed before 1980. The Port of Portland property survey in the Site vicinity (Hart Crowser, 1999) indicated that the majority of the 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.

## 4.3 Current Beneficial Water Use

A total of 19 water wells, all installed in the deep aquifer, were identified within the vicinity of the Site (Table 4-1). The two industrial wells located adjacent to the Site at Schnitzer Investment Corporation reportedly are used only to supply fire hydrants and in the summer for cooling purposes and dust suppression (Figure 4-1). Northwest Pipe Company's industrial production well (identified with Beall Pipe and Tank as owner on the well log and in Table 4-1) is used intermittently for make-up water in the hydrostatic testing operations and for applying shotcrete to steel pipe. 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 4-1). 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 4-1) were installed during the 1940s for industrial use during the ship building efforts; their current status could not be determined. The four wells located at the Toyota Vehicle Processing are used for road sweeping and car washing. The one well located at the Rivergate Scrap Metals is used for equipment cooling, dust suppression, and supplying fire hydrants. The two remaining wells (the Port of Portland well and the Oregon Hydrocarbon, Inc. well) are used for irrigation according to OWRD well records.

The City of Portland public water system, which originates at Bull Run Reservoir and is supplemented by the Columbia South Shore well field in Northeast Portland, currently is the principal source of water for drinking water and other uses in the Site area.

Current beneficial uses of groundwater near the Site include recharge to surface water (Willamette River) from the shallow unconfined groundwater, and landscape irrigation and industrial use of deeper groundwater.

### 4.3.1 Future Use

Anticipated future uses of groundwater and surface water 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 supply system. Deep groundwater may continue to be used for industrial, fire suppression, or landscape irrigation purposes at properties with wells.

### 4.3.2 Summary of Beneficial Water Use

In summary, there are two current and reasonably likely future beneficial uses of the groundwater at the Site:

- Recharge to surface water (Willamette River)—shallow unconfined groundwater and deep groundwater
- Back up for industrial uses such as non-contact cooling water, landscape irrigation, and fire suppression—deeper groundwater (depth to aquifer is approximately 100 to 200 feet depending on location)

SECTION 5

# Site Characterization

Northwest Pipe Company has completed extensive characterization of the Site in response to its efforts to appropriately manage the facility and in response to DEQ direction.

## 5.1 Previous (Pre-2007) Environmental Site Work

This section lists and briefly summarizes the key site investigation and remediation efforts undertaken during Northwest Pipe Company's tenure at the Site. Results from these efforts are summarized in Section 5.2.

### 5.1.1 1989 Dames & Moore Phase I and Phase II Property Transfer Assessment

On December 22, 1988, Northwest Pipe Company (then Northwest Pipe and Casing) requested DEQ oversight of a Preliminary Assessment and Site Investigation of its plant 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 & More identified 14 areas of concern (Figure 5.1), eleven of which were originally identified by Dames & Moore, and three 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, as listed in Table 5-1.

A summary of sampling conducted by Dames & Moore and others is provided in Section 5.2.

### 5.1.2 May 1989 Crosby & Overton Remedial Activities Report

In May 1989, Crosby & Overton began remediation at an underground storage tank (UST) excavation in Area 8a (Crosby & Overton, 1989a). Approximately 300 cubic yards of soil were removed from the excavation and disposed at the St. John's 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.

A summary of sampling conducted by Crosby & Overton is discussed by area and media in Section 5.2.

### 5.1.3 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). A summary of sampling conducted by Crosby & Overton is discussed by area and media in Section 5.2.

### 5.1.4 1990 OMNI Environmental Groundwater Monitoring Well Report

In March 1990, five monitoring wells were installed by OMNI Environmental. 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. A summary of sampling conducted by OMNI Environmental is discussed by area and media in Section 5.2.

### 5.1.5 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 Expanded Preliminary Assessment, described in Section 5.1.6 (CH2M HILL, 2000).

### 5.1.6 2000 Expanded Preliminary Assessment and Preliminary Assessment Addendum

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 NPL site conduct either preliminary assessments (PAs) or expanded PAs (XPAs) to evaluate the possible presence of ongoing potential sources of contamination to the Willamette River. An XPA Report (CH2M HILL, 2000) and PA Addendum (CH2M HILL, 2001a) were prepared describing the history, operations, and known environmental conditions of the Site.

### 5.1.7 2001 Site Investigation

Based on its review of the XPA and PA Addendum, DEQ determined that six of the 14 areas evaluated in the XPA report required no further investigation. Additional soil and groundwater samples were requested for the remaining eight areas: Areas 1, 2, 3, 5, 7, 9, 12, and 14 (DEQ, 2001). A work plan for conducting soil and groundwater sampling was developed through a series of correspondence between DEQ and CH2M HILL 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, Northwest Pipe Company (CH2M HILL, 2001b). Findings of this investigation concluded that, with the exception of volatile organic compounds (VOCs) identified in groundwater of the Southeast Area (Area 1), no further investigation of the other areas was warranted. Results of this investigation are described in detail by area and media in Section 5.2.

Building on the results of the Site investigation and further discussion and correspondence between DEQ and Northwest Pipe, additional sampling work was requested by DEQ for the Southeast Area of the Site where concentrations of VOCs were detected in groundwater. DEQ also requested that additional sampling be conducted of the facility's stormwater system.

### 5.1.8 2002 Southeast Area (Area 1) Investigation

In 2001, DEQ directed Northwest Pipe Company to further investigate groundwater and soil in the Southeast Area of the Northwest Pipe Company facility (DEQ, 2002). In response to this request, a work plan was prepared, and samples collected using direct-push sampling technology 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).

### 5.1.9 2003 Southeast Area (Area 1) Groundwater Investigation

In 2002, DEQ also requested that Northwest Pipe Company install monitoring wells to investigate groundwater conditions in the Southeast Area (Area 1) of Northwest Pipe Company's facility (DEQ, 2003a). The objectives of this work were 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. As part of the same field effort, four of a group of six unused monitoring wells in the northern part of the Site, installed in association with the 1990 OMNI Environmental ground water investigation, were located and abandoned in accordance with Oregon Water Resources Department (OWRD) requirements. Although the remaining two monitoring wells could not be found, the general area of all the OMNI wells has been paved.

The results of the 2003 sampling work indicated that a southern hydraulic gradient existed in the Southeast Area, and that VOCs, including tetrachloroethene (PCE) and its degradation products were located near the property boundary at the southeast corner of the Site. The hydraulic gradient was observed to be consistent in direction during the period July through December 2003. The area upgradient of the identified plume is occupied by the eastern portion of the Burgard Industrial Park, which according to Multnomah County tax records consists of tax lots owned by Schnitzer Steel Industries, Inc. and Thomas Dunkin II, chairman of industrial contractor Dunkin & Bush, Inc.

### 5.1.10 2003 Stormwater System Sampling

As requested by DEQ (2002b), Northwest Pipe Company collected stormwater samples from five points on and around the Site. The results of the sample analysis generally were below DEQ's Level II Screening Assessment Level Values (SLVs) for ecological receptors (DEQ, 2001). For those SLVs that were exceeded, the constituents involved tend to be tightly bound to the solid phase. Consequently, ongoing efforts to reduce the load of suspended solids in stormwater being undertaken by Northwest Pipe Company were appropriate for reducing the concentrations of constituents in stormwater leaving the Site.

This expanded sampling showed that low concentrations of some polynuclear aromatic hydrocarbons (PAHs), some polychlorinated biphenyls (PCBs), and some metals were detected in Site stormwater. Using DEQ's Level II SLVs for aquatic receptors as a general screening tool, the samples generally were found to be below relevant SLVs, and no PCBs exceeded relevant SLVs. For those instances where SLVs other than PCBs were exceeded, the data suggest that background metals concentrations or suspended solids played a major role in the exceedance, highlighting the importance of continuing to maintain effective BMPs to reduce the potential for suspended solids to enter stormwater.

### 5.1.11 2004 Southeast Area (Area 1) Supplemental Site Investigation

In 2004, DEQ directed Northwest Pipe Company to conduct a supplemental site investigation in the Southeast Area (Area 1) of the Site. In response to this direction, Northwest Pipe Company and DEQ met on April 16, 2004, to discuss the scope of the investigation. This discussion led to a work plan that was submitted on May 25, 2004 (CH2M HILL, 2004a). 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).

Ten shallow Geoprobes 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.

### 5.1.12 2005 RI/SCE Site Investigation

After the effective date of the Voluntary Agreement for Remedial Investigation and Source Control Evaluation in December 2004, a 2005 investigation was conducted in support of the 2005 RI/SCE report for the Northwest Pipe facility. As indicated in the previous sections, a significant amount of site characterization and focused remediation work had been conducted by Northwest Pipe Company since 1988. The purpose of the 2005 RI/SCE work was to collect information identified by DEQ as necessary to fill data gaps, as described in the *Remedial Investigation / Source Control Evaluation Work Plan, Northwest Pipe Company Site* (CH2M HILL, 2005a).

This investigation program included the following:

- Expanded stormwater sampling
- Groundwater sampling of existing monitoring wells
- Surface soil sampling

#### 5.1.12.1 Stormwater Sampling

An additional stormwater sampling event was conducted in July 2005 to further characterize stormwater discharge from the Site and to provide sufficient information necessary to complete a source control evaluation for stormwater. The July 2005 monitoring event was conducted in accordance with the *Revised Stormwater Characterization Plan* (CH2M HILL, 2003a) using sampling and analysis procedures described in the *Remedial Investigation / Source Control Evaluation Work Plan, Northwest Pipe Company Site*

(CH2M HILL, 2005a). Stormwater leaving the Site is conveyed to the IT Slip north of the Northwest Pipe Company facility and discharges through a single communal outfall (Outfall 18/WR-123) to the IT Slip.

Stormwater samples were collected from three sampling locations in and around the Site (Figure 5-2). The samples were collected during a precipitation event with a total rainfall of approximately 0.2 inch, following a period of more than 10 days of dry weather. Stormwater samples were collected from the most downstream access points in each of the two stormwater drain lines before they leave the Site (sampling points then-referred to as CB-3 and CB-4). A sample was also collected from the existing 42-inch stormwater line draining the Ryerson property (CB-5) upstream from the point into which the two Northwest Pipe Company stormwater conveyance lines discharge.

The stormwater samples were analyzed for constituents potentially related to Site activities, specifically PAHs by EPA Method 8270 SIM, PCBs by EPA Method 8082, and both dissolved and total metals (lead, copper, zinc, manganese, chromium, nickel, molybdenum, and aluminum), pH, oil and grease, and total suspended solids (TSS). Samples were collected in accordance with the field procedures described in the sampling and analysis plan (SAP) appended to the RI/SCE work plan (CH2M HILL, 2005a).

#### 5.1.12.2 Southeast Area Groundwater Sampling

Two additional groundwater monitoring events were conducted at the Southeast Area groundwater monitoring wells (see Figure 5-3). Groundwater samples were collected under spring wet conditions (June 2005) and during summer dry conditions (September 2005). Prior to collecting groundwater samples, water levels were measured at all monitoring wells. Similar to previous monitoring events, groundwater samples were analyzed for VOCs by EPA Method 8260. 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). Samples were collected in accordance with the field procedures described in the SAP (CH2M HILL, 2005a).

#### 5.1.12.3 Surface Soil Sampling (Area 11)

To investigate whether PCBs were present in surface soil above generic PCB industrial RBCs, four randomly located surface soil samples were collected from Area 11 and analyzed for PCBs by EPA Method 8082. 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 SAP (CH2M HILL, 2005a). The locations of the surface soil samples are shown in Figure 5-4.

### 5.1.13 2006 Surface Soil and Catch Basin Solid Source Control Sampling

As part of the Site's ongoing source control evaluation, 12 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 PAH by EPA method 8270 SIM and for PCB Aroclors by EPA method 8082. The sample locations are presented in Figure 5-5.

## 5.2 Pre-2007 Site Characterization Results

This section presents the characterization of hazardous substances detected at the Site up to 2006. This characterization summary addresses each medium of concern by "Areas of Concern" previously identified in the 1989 Phase I and Phase II Property Transfer Assessment (Dames & Moore, 1989).

### 5.2.1 Dames & Moore Area 1 - Aboveground Waste Oil Tank and 10 55-gallon Drums of Petroleum

#### 5.2.1.1 Soil Results

In 1989, petroleum hydrocarbons were detected in two soil samples collected at 1.6 and 1.7 feet bgs during Dames & Moore's Phase I and Phase II Property Transfer Assessment (Dames & Moore, 1989). In addition, the VOCs PCE and 1,1,1-trichloroethane (1,1,1-TCA) were detected in one surface soil sample. In 1990, Crosby & Overton excavated to 9 feet bgs and removed approximately 170 cubic yards of soil (Crosby & Overton, 1989b). Twenty cubic yards were transported and disposed at an offsite landfill. The remaining 150 cubic yards were placed in an onsite lined and bermed treatment area. In 1991, the material was transported from the Site to an offsite landfill.

Following excavation, confirmation sampling was performed, and low levels of residual PCE met then-applicable cleanup targets (0.17 milligrams per kilogram [mg/ kg] in the east excavation wall sample and 0.16 mg/kg in a composite sample from the excavation bottom).

In 2001, additional soil sampling was conducted by CH2M HILL in the Southeast Area (Area 1) to respond to DEQ's request to determine if the former waste oil tank had led to the presence of hydrocarbons or VOCs in soil or groundwater. Direct-push Geoprobes were advanced at two locations in the Southeast Area (Area 1) close to the site of a former tank, based on mapping (Dames & Moore, 1989). These two locations are labeled GP-1 and GP-2 in Figure 5-6.

Geoprobes GP-1 and GP-2 were advanced to a total depth of 18 feet. Using a photoionization detector (PID) to screen for the presence of ionizable VOCs, soil was screened at 3- to 4-foot intervals for the presence of VOCs and to identify specific depths to collect soil samples for laboratory analysis. No field evidence of contamination (staining or detectable VOC vapors) was observed at GP-1. The soil sample from the 6-foot depth was selected for laboratory analysis for VOCs, total petroleum hydrocarbons (TPH), and PAHs.

At GP-2, the PID readings indicated the presence of VOCs near groundwater at the 18-foot depth, so a soil sample from this depth was selected for analysis for VOCs, TPH, and PAHs. VOCs, TPH, and PAHs were not detected above reporting limits in the soil sample collected from GP-1. TPH and PAHs were not detected above the reporting limits in the soil sample collected from GP-2. Consistent with PID detections, VOCS were detected at soil sample GP-2 (PCE at 0.726 mg/kg, trichloroethene [TCE] at 0.0252 mg/kg, and cis-1,2-dichloroethene [c-1,2-DCE] at 0.0211 mg/ kg). Because this sample subsequently was determined to be from below the water table (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.

Additional soil screening was conducted during subsequent groundwater investigations within the Southeast Area (Area 1) in 2002, 2003, and 2004. Locations of borings and Geoprobes associated with these investigations are shown in Figure 5-3. With the exception of soil screening conducted in the immediate vicinity of the highest groundwater concentrations, soil in the Southeast Area (Area 1) did not contain VOCs. No further soil investigation was proposed in the Southeast Area (Area 1).

#### 5.2.1.2 Groundwater Results

**Geoprobe Results**

Based on investigation results submitted in the XPA Report and the PA Addendum (CH2M HILL, 2000; 2001a), DEQ requested that additional investigation be conducted in the Southeast Area (Area 1). These investigations have included Geoprobe soil and groundwater investigations in 2001, 2002, and 2004, and installing and sampling six groundwater monitoring wells in the Southeast Area of the Northwest Pipe Company facility. The Geoprobe boring and monitoring well locations are shown in Figure 5-3.

Tables 5-2 summarizes the analytical results for constituents detected in Southeast Area groundwater during the 2001, 2002, and 2004 Geoprobe and monitoring well investigations.

In 2001, two borings were advanced in the vicinity of a former AST, based on the mapping of two Geoprobes (Dames & Moore, 1989). PCE was detected at a maximum concentration of 9.8 mg/L in sampling location GP-1. Sample GP-2, which was located approximately 40 feet west of GP-1, had 4.33 mg/L of PCE. Based on these investigation results, additional groundwater investigations were recommended for the Southeast Area (Area 1).

In 2002, 12 Geoprobes (GW-1 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, suggesting that at least some of the observed VOCs in the Southeast Area have migrated onto the Site from the east/northeast offsite area. Maximum concentrations of PCE observed in 2002 were less than those observed in 2001 at GP-1 and GP-2, reflecting spatial and/or temporal variation in concentrations. As shown in Table 5-2, degradation products of PCE also were detected in groundwater in this area. Specifically, TCE and c-1,2-DCE were found at the highest concentrations and in the greatest number of sample locations.

In 2004, 11 shallow Geoprobes (GP-101 through GP-111) and one deep Geoprobe (GP-112) were advanced and 12 groundwater samples collected to further investigate both the lateral and vertical extent of VOCs in the Southeast Area. Nine of the 2004 Geoprobe sample locations were situated along the east-northeast and south edges of the Southeast Area to investigate the concentrations of VOCs on the upgradient (east) and downgradient (south) edges of the Southeast Area. VOCs that were detected along the upgradient edge of the Southeast Area at concentrations above reporting limits were PCE and its breakdown products TCE, c-1,2-DCE, and vinyl chloride. Geoprobes GP-102, CP-103, and GP-104 (located downgradient of older Geoprobe samples GP-1 and GP-2 along the south edge of the Southeast Area) had PCE concentrations more than one to two orders of magnitude lower (ranging from 0.059 mg/L at GP-102 to 0.260 mg/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.

The deep Geoprobe was advanced to a depth of 120 feet bgs near the location of previous sample GP-1 (the location with the highest observed concentration of VOCs) 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; however, two thin, slightly sandier, water-bearing intervals were encountered at depths of 65 feet and 98 feet, from which groundwater samples were collected and subsequently analyzed for VOCs. VOCs were not detected in either of these two deep samples (Table 5-2). Based on the presence of the thick, low-permeability silt zone below a depth of 28 feet, and because of the absence of VOCs in the two samples collected at 62 and 96 feet, the VOCs detected in shallow groundwater in the Southeast Area were confirmed to be limited to the shallow water-bearing zone beneath the Southeast Area of the facility.

**Monitoring Well Groundwater Quality Results**

Six groundwater monitoring wells (MW-1 through MW-6) were installed in the Southeast Area to further evaluate the presence of chlorinated organic solvents and to assess the local hydrogeology beneath the Site (including the subsurface profile and the hydraulic gradient beneath the Site). The locations of the monitoring wells are shown in Figure 5-3. Monitoring well construction information for the Southeast Area wells is summarized in Table 5-3.

Field parameters (pH, specific conductance, temperature, dissolved oxygen [DO], and oxidation-reduction potential [ORP]) measured prior to groundwater sample collection are summarized in Table 5-4. The specific conductance, temperature, and pH are similar to typical shallow groundwater conditions encountered in western Oregon. The uniformly negative ORP values and the very low DO content, which indicate the presence of geochemically reducing conditions, are consistent with the presence of chlorinated solvent breakdown products, which are formed under reducing conditions. Natural attenuation parameters are presented in Table 5-5.

The analytical results for constituents detected in groundwater at the monitoring wells are summarized in Table 5-2. Constituents detected above the reporting limits in monitoring well samples are PCE and its breakdown products: TCE, c-1,2-DCE, trans-1,2-dichloroethene (t-1,2-DCE), 1,1 dichloroethene (1,1-DCE), and vinyl chloride. Other VOCs (1,1-dichloroethane [1,1 -DCA], toluene, benzene, and chloromethane) were detected below the reporting limit at estimated concentrations during the 2004 monitoring event, although these VOCs were not detected during any of the 2005 monitoring events. Chloroform and acetone, which are common laboratory contaminants, were detected in samples collected from MW-6 during the January 2005 monitoring event.

The distribution of VOCs in groundwater in the Southeast Area using PCE as an indicator is shown in Figure 5-7. This figure includes the Geoprobe borings in the Southeast Area and monitoring well data for the September 2005 groundwater monitoring event. The monitoring well data show a spatial distribution of VOCS similar to that indicated by the Geoprobe data. The highest concentrations of PCE have been detected near MW-6 and MW-1, with lower concentrations detected both upgradient (MW-5) and downgradient (MW-3 and MW-4) of these wells. MW-2, located west of GP-1 and GP-2, defines the approximate westward extent of VOCs in groundwater.

**Groundwater Levels and Hydraulic Gradient**

Water levels measured during the June 2005 and September 2005 monitoring events are summarized in Table 5-6. Consistent with previous events, the groundwater flow direction during both the June 2005 and September 2005 monitoring events was slightly west of due south, at a hydraulic gradient of 0.00072 foot per foot (ft/ft) and 0.00085 ft/ft, respectively.

**Natural Attenuation Evaluation**

Reductive dechlorination is an important fate process for natural attenuation of chlorinated solvents, including PCE, TCE, t-1,2-DCE, and vinyl chloride. In reductive dechlorination, chlorine atoms are successively removed from the chlorinated hydrocarbon and are replaced by hydrogen atoms. 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, ferric iron (Fe2+), sulfate, carbon dioxide, and chlorinated aliphatic hydrocarbons such as PCE, TCE, DCE, and vinyl chloride.

After DO is consumed, the anaerobic microorganisms preferentially use additional electron acceptors in the following order of preference: nitrate, Fe2+, sulfate, and, finally, carbon dioxide. Reductive dechlorination is most effective in the range corresponding to sulfate reduction and methanogenesis (which occurs through the reduction of carbon dioxide). Groundwater chemistry indicative of 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 (mV) and preferable below -100 mV
- Low concentrations of nitrate, typically less than 1 mg/L
- The presence of ferric iron (Fe2+), which results from the reduction of ferrous iron ($Fe_3$), at concentrations greater than 1 mg/L

Table 5-4 presents field parameters measured during collection of groundwater samples. DO and ORP levels measured at site monitoring wells (typically below 0.20 mg/ L and -100 mV, respectively) demonstrate that reducing conditions are present throughout the Southeast Area. Additionally, the pH (which ranged from 6.1 to 7.1) is within the range amenable to microorganism survival, and the alkalinity (which ranged from 120 to 192 mg/L) is sufficient for buffering the pH against acids produced during biodegradation.

Table 5-5 presents other natural attenuation parameters analyzed during the RI/SCE: nitrate, iron, manganese, sulfate, carbon dioxide, methane, chloride, and TOC. Combining these data with the field parameter data described above and the record of chlorinated solvent data from monitoring well samples (Table 5-2), it is possible to evaluate whether site conditions are consistent with reductive dechlorination of chlorinated solvents. EPA developed a screening worksheet for evaluating the potential for reductive dechlorination based on geochemical conditions (EPA, 1998). Table 5-7 contains the worksheet, along with scores assigned to the Northwest Pipe Company facility based on available monitoring well data. The total score of 24 for the facility falls within the "strong evidence" category identified by EPA for chlorinated solvent 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 chlorinated solvents.

Additional evidence that demonstrates that reductive dechlorination is occurring is found in the presence of PCE and TCE daughter products, such as trans-1,2-DCE, cis-1,2-DCE, 1,1-DCE, and vinyl chloride in the shallow groundwater. The presence of cis-1,2-DCE as a more common breakdown product (compared to trans-1,2-DCE and 1,1-DCE) has been shown to be indicative of reductive dechlorination through biodegradation (EPA, 1998). Moreover, the elevated chloride concentrations in MW-6 compared to cross-gradient background conditions in MW·2 are consistent with chloride production from reductive dechlorination.

### 5.2.2 Dames & Moore Area 2 - Pipe Lining and Coating Building (Northwest Corner - Dark-stained Soil)

#### 5.2.2.1 Soil Results

In 1989, six soil samples were collected by Dames & Moore from Area 2 (Dames & Moore, 1989). Low levels of noncarcinogenic polynuclear aromatic hydrocarbons (NPAHs) and PCE, and low to moderate levels of TPH and carcinogenic PAHs (CPAHs) were detected in samples collected from the surface to 2 feet bgs. The deepest sample collected was from 7.8 feet below the surface. Crosby & Overton resampled Area 2 in June 1989. Neither TPH nor VOCs were detected. Crosby & Overton removed a total of 40 cubic yards from Area 2 and Area 3, and placed the soil in an onsite bermed area for treatment. The soil subsequently was disposed offsite in October 1991.

After the Crosby & Overton soil removal excavation was completed in Area 2, three confirmation samples were collected at the 4-foot depth within the excavation: one from the south wall, one from the east wall, and one from the west wall. No PAHs were detected at a detection limit of 0.1 mg/ kg. Similarly, no TPH was detected (at a detection limit of 1 mg/kg), and no VOCs were detected with detection limits ranging from 0.005 to 0.010 mg/kg.

In 2001, a Geoprobe (GP-7 shown in Figure 5-6) was advanced in Area 2 for the purpose of collecting a groundwater sample. Soil samples retrieved during Geoprobe advancement indicated no elevated PID readings (indicating the absence of field indications of VOCs in soil). Based on these previous investigations, DEQ and Northwest Pipe Company agreed that no further soil investigation was warranted in Area 2.

#### 5.2.2.2 Groundwater Results

The GP-7 sampling location is shown in Figure 5-6. A groundwater sample was collected and analyzed for VOCS after purging 2 gallons of water from GP-7. PCE was the only VOC detected at this location at a concentration of 0.0033 mg/L. Based on these previous investigations, DEQ and Northwest Pipe Company agreed that no further groundwater investigation was warranted in Area 2.

### 5.2.3 Dames & Moore Area 3 - Pipe Lining and Coating Building (Southeast Corner - Dark-stained Soil and Concrete)

#### 5.2.3.1 Soil Results

In 1989, three soil samples were collected from Area 3 (Dames & Moore, 1989). A few PAHs and VOCs were detected in the samples, which ranged in depth from 0.25 to 8 feet bgs. PCE concentrations in the 0.25-foot and 0.5-foot depths were 12 and 20 mg/kg, respectively.

Crosby & Overton resampled Area 3 prior to beginning a remedial excavation. In these samples, 0.8 mg/kg 1,1,1-TCA and 0.2 mg/kg PCE were detected. Crosby & Overton removed a total of 40 cubic yards from Area 2 and Area 3, and placed the soil in an onsite lined, bermed area. The soil subsequently was disposed offsite in 1991. Four confirmation samples collected in the excavation at Area 3 from a depth of 1 foot indicated that detectable concentrations of VOCs and TPH remained in the soil. VOC analysis in the four samples detected only PCE and 1,1,1 -TCA. Concentrations of PCE ranged from 0.34 mg/kg to 12.1 mg/kg, and 1,1,1-TCA concentrations ranged from below detection limits (less than 0.005 mg/kg) up to 0.49 mg/kg. The TPH concentrations in the confirmation samples ranged from 8 to 330 mg/kg. Based on these findings, DEQ and Northwest Pipe Company agreed that no additional soil investigation was warranted in Area 3.

#### 5.2.3.2 Groundwater Results

In 2001, a Geoprobe was advanced in Area 3 in response to DEQ's request to determine if the past use of coating and lining products in this area had led to the presence of VOCs in groundwater. The Geoprobe was advanced to a total depth of 16 feet. This sampling location is identified as GP-4 in Figure 5-6.

The subsurface profile in Area 3 is consistent with that described previously in the Southeast Area of the Site. The depth to groundwater in Area 3 was 12 feet bgs. PCE and its biodegradation products were detected in the groundwater sample collected from GP-4 at the following concentrations:

- PCE = 0.0046 mg/L
- TCE = 0.0111 mg/L
- cis-1,2-DCE = 0.056 mg/L
- Vinyl chloride = 0.0074 mg/L

In addition, 1-1,-DCA was detected at a concentration of 0.0017 mg/L. These concentrations are below preliminary screening values for groundwater (Level II SLVs and Recommended Water Quality Criteria) except for PCE, which slightly exceeded the recommended water quality criterion for human health (consumption of aquatic organisms). Given the tendency of PCE to biodegrade under the reducing conditions present at the Site, the minor degree of the screening value exceedance, and the long distance to surface water (at least 1,700 feet), it is highly unlikely that concentrations of PCE above the screening criteria could reach potential surface water receptors from Area 3. Based on this evaluation, DEQ and Northwest Pipe Company agreed that no additional ground water investigation was warranted in Area 3.

### 5.2.4 Dames & Moore Area 4 - 2,000-gallion Diesel Underground Storage Tank and Pumps (Dark-stained Soil)

#### 5.2.4.1 Soil Results

A UST was removed from Areas 4 and 8a in 1989 by Pegasus Waste Management. Crosby & Overton then completed a soil removal effort totaling 300 cubic yards to address hydrocarbons detected in the UST excavation (Crosby & Overton, 1989a). Approximately one year following this removal action, OMNI Environmental installed five monitoring wells in addition to the single well previously installed by Crosby & Overton (OMNI Environmental 1990). Hydrocarbons were not observed during monitoring well installation, and VOCs were not detected in the field with a PID during field screening of soil sampled during drilling. Therefore, DEQ and Northwest Pipe Company agreed that no further soil investigation was warranted in Area 4.

#### 5.2.4.2 Groundwater Results

In 1989, one monitoring well was installed in the backfill by Crosby & Overton; in 1990, five monitoring wells were installed around the former UST (including Areas 9 and 10) by OMNI Environmental. In the initial 1989 Crosby & Overton sampling, 0.6 mg/L of benzene was detected in groundwater at MW-0, located in the tank excavation. OMNI Environmental resampled MW-0 and MW-1 through MW-5 in 1990 for benzene, toluene, ethylbenzene, and xylenes, with the following hydrocarbon detections in MW-0:

- Benzene = 0.004 mg/L
- Ethylbenzene = 0.003 mg/L
- Xylenes = 0.018 mg/L

No hydrocarbon detections were observed above a detection limit of 0.001 mg/L in the other monitoring wells sampled by OMNI Environmental. The greater than 99 percent decrease in benzene concentrations from 1989 to 1990 in MW-0 and the absence of hydrocarbons in wells located around the former tank excavations are consistent with the expected conditions following remediation of a minor UST release.

DEQ reviewed the information developed during remediation of Area 4 and determined that the most recent groundwater sampling showed a dramatic reduction in groundwater concentrations (DEQ, 1990). The remaining soil contains small amounts of benzene, toluene, ethylbenzene, and xylenes in relation to TPH; consequently, the potential for additional groundwater impacts is minimal.

Based on these conclusions, DEQ determined that No Further Action was required to address the release of hydrocarbons that had been remediated in Area 4 (DEQ, 1990 and 1991).

After documenting that concentrations of petroleum-related constituents were below cleanup targets, and after receiving a No Further Action determination from DEQ dated April 16, 1990, confirming the Department's concurrence, the wells were no longer needed for their original purpose. As part of ongoing activities associated with Site maintenance, the unneeded wells were scheduled for abandonment in 2001. This abandonment was postponed at the request of DEQ until the initial Site investigation work in 2001 was completed. Northwest Pipe Company proceeded with abandoning the monitoring wells in conjunction with monitoring well installation work in the Southeast Area of the Site conducted in July 2003. As noted earlier in this report, of the six monitoring wells (MW-0 through MW-5), four were found (MW-0, MW-1, MW-2, and MW-4). Wells MW-3 and MW-5 could not be found after repeated attempts to locate them, including the use of shovels and metal detectors. The identified wells were abandoned by an Oregon-licensed well constructor in accordance with OWRD Regulations. The abandonment reports are attached to *Technical Memorandum 4 - Southeast Area Groundwater Investigation* (CH2M HILL, 2003b).

Based on the results of past monitoring, no further groundwater investigation was warranted in Area 4.

### 5.2.5 Dames & Moore Area 5 – Transformer Storage

#### 5.2.5.1 Soil Results

In 1989, Dames & Moore collected a soil sample in the area most likely to have been affected by possible leaks from the transformers (Dames & Moore, 1989). PCBs were not detected in these samples at a detection limit of 10 mg/kg. Samples were collected by Crosby & Overton in 1989 at depths of 1 to 10 feet bgs (Crosby & Overton, 1989b). These sample results indicated that TPH was present at shallow depths, with concentrations decreasing significantly at depths of 1, 5, and 10 feet in the Maintenance Shop, from 11,000 mg/kg, less than 5 mg/kg, and less than 5 mg/kg, respectively. The TPH concentrations at depths of 1 and 4 feet were 7,300 mg/kg and 200 mg/kg, respectively, in the soil in front of the transformers. On the east side of the transformers, TPH concentrations were low at the 1-foot depth (91 mg/kg) and decreased to less than 5 mg/kg at depths of 4 and 8 feet. Soil sampling at Area 5 showed that PCBs were not present above 10 mg/ kg and that TPH in soil was limited to surficial depths only.

In 2001, additional soil samples were collected from surface soil, as requested by DEQ to determine if PCBs or TPH were present. Two surface soil 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. Diesel and heavy-range TPH and PCBs were detected in the soil samples. The reported PCB concentration and none of the TPH concentrations (detected either in 2001 or previously) exceeded preliminary screening values for occupational workers. Based on these findings, DEQ and Northwest Pipe Company agreed that no further soil investigation was necessary in Area 5.

#### 5.2.5.2 Groundwater Results

Previous sampling has demonstrated that affected soil was limited to shallow depths, above groundwater elevations observed throughout the facility. Furthermore, given the strong affinity for PCBs and heavy-range TPH to adhere to soil, the likelihood for groundwater to be affected is minimal. Consequently, no groundwater investigation was requested by DEQ in Area 5.

## 5.2.6 Dames & Moore Area 6 - 16 55-gallon Drums of Solvent (No Containment)

### 5.2.6.1 Soil Results

Two soil samples were collected (at the ground surface and at 0.5 foot bgs) in 1989 (Dames & Moore, 1989). Samples were analyzed for VOCs with no detections. Two pairs of samples were collected by Crosby & Overton in 1989 at depths of 1 and 2 feet bgs and were tested for TPH. Sample results detected TPH in surface soil samples with substantially lower concentrations with increasing depth (1-foot depth: 2,900 mg/kg TPH versus 2-foot depth: 10 mg/kg TPH). These sample results show that TPH was present near the surface, but that concentrations decreased substantially over a depth interval of 1 foot.

Given that no VOCs were detected and TPH concentrations were below risk-based screening values, DEQ and Northwest Pipe Company agreed that no further soil investigation was warranted in Area 6.

### 5.2.6.2 Groundwater Results

Based on the decreasing concentration of TPH detected in shallow soil with depth, no groundwater investigation was requested by DEQ in Area 6.

## 5.2.7 Dames & Moore Area 7 - Production Well

### 5.2.7.1 Soil Results

Investigation of soil related to the industrial well is not applicable.

### 5.2.7.2 Groundwater Results

This deep aquifer water supply well was used exclusively for industrial purposes. In 1989, three water samples were collected from the supply well and analyzed for VOCs, TPH, PCBs, and PAHs (Dames & Moore, 1989). The analysis detected low levels of TPH (0.17 to 18 mg/L), PCE (not detected at 0.0005 mg/L in two samples and detected at 0.0005 mg/L in one), and the NPAH fluoranthene (detected in one sample at 0.000026 mg/L). PCBs were not detected at detection limits ranging from 0.00015 mg/L to 0.001 mg/ L.

The TPH and fluoranthene could be related to past use of an oil-lubricated vertical turbine pump in this well. This kind of pump was almost universally installed in deep industrial production wells until electric submersible pumps became more widely available and began to replace, in some cases, vertical turbine pumps. Over years of use, oil-lubricated vertical turbine pumps will commonly leave a layer of oil floating on the water surface in the well. Consequently, it is not surprising to find low concentrations of hydrocarbons in older production wells. The low concentration of PCE detected in one of the three samples from the well may be related to a regionally dispersed deep chlorinated solvent plume in North Portland that was identified at St. John's Landfill and at the Portland Stockyards site in North Portland (Golder, 1991).

In September 2001, at the request of DEQ, the deep onsite production well was sampled for VOCs. Consistent with previous data, the deep, confined aquifer contained 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 chlorinated solvent 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). In 2004, Northwest Pipe Company advanced a Geoprobe direct-push sampler to investigate deep groundwater conditions in the Southeast Area of the Site. The probe encountered a thick (approximately 95-foot-thick) low-permeability silt layer separating shallow groundwater at the Site from the deeper interval tapped by the onsite production well. This finding, coupled with the documented absence of VOCs at two depths (65 and 98 feet) where slightly sandier conditions permitted groundwater sample collection, confirmed that the shallow VOCs in the Southeast Area are unrelated to the regional presence of low-level VOCs in deep groundwater documented at many locations in North Portland.

In 2004, DEQ requested that Northwest Pipe Company collect a shallow groundwater sample adjacent to a decommissioned subsurface drain line located near the production well (CH2M HILL, 2004b). The sample, which was collected with a Geoprobe (GP-101 shown in Figure 5-3) and analyzed for VOCs, did not contain VOCs above reporting limits. Vinyl chloride and 1,1-DCA were detected at estimated concentrations below reporting limits. No further sampling was requested by DEQ based on these results.

### 5.2.8 Dames & Moore Area 8a - 1,000-gallon Gasoline Underground Storage Tank

The removal and sampling associated with this UST is described the Area 4 discussion in Section 5.2.4. These areas received a No Further Action determination from DEQ in April 1990, based on the results of remedial activities and post-remediation sampling that have been completed.

### 5.2.9 Dames & Moore Area 8b - Bay 9 Asphalt Dipper Tank

A soil sample was collected next to the old asphalt dipper tank by Dames & Moore (Dames & Moore, 1989). The sample was analyzed for TPH, which was non-detect with a detection limit of 1 mg/kg. Therefore, no additional soil sampling was requested by DEQ in Area 8b.

### 5.2.10 Dames & Moore Area 9 - Railroad Spur (Stained Soil)

#### 5.2.10.1 Soil Results

The removal and sampling associated with this feature is provided in the Area 4 discussion in Section 5.2.4. These areas received a No Further Action determination from DEQ in April 1990, based on the results of remedial and sampling activities that have been completed.

#### 5.2.10.2 Groundwater Results

In 2001, DEQ requested that a groundwater sample be obtained from Area 9 to assess whether an apparent historical release from a rail car, noted in 1989, had led to the presence of VOCs in groundwater. A single Geoprobe was advanced to a depth of 20 feet bgs. A groundwater sample was collected and analyzed for VOCs. PCE and vinyl chloride were detected at 0.0033 and 0.0015 mg/L, respectively. DEQ and Northwest Pipe Company agreed that no additional groundwater investigation was necessary in Area 9. Detected constituents in groundwater are discussed further in the Risk Assessment presented in Section 6.0.

### 5.2.11 Dames & Moore Area 10 - Dust Suppressant Use and Storage

The removal and sampling associated with this feature is provided in the Area 4 discussion in Section 5.2.4. These areas received a No Further Action determination from DEQ in April 1990, based on the results of remedial activities that have been completed.

### 5.2.12 Dames & Moore Area 11 - Transformer Area (Stained Soil)

#### 5.2.12.1 Soil Results

Dames & Moore collected a surface sample of stained soil from Area 11 and analyzed it for PCBs (Dames & Moore, 1989). One PCB (Aroclor 1254) was detected at a concentration of 31.3 mg/kg. Other Aroclors were not detected above the reporting limit of 10 mg/kg. The concentration of Aroclor 1254 and the detection limits for the other Aroclors exceeded what was at that time DEQ's generic PCB industrial risk-based concentration (RBC) of 7.5 mg/ kg. Additional soil samples were collected in Area 11 to more completely characterize the previously detected occurrence of PCBs in soil. The results of this sampling are discussed in Section 5.3.2 and evaluated in the Risk Assessment in Section 6.0.

#### 5.2.12.2 Groundwater Results

Because of the low mobility of PCBs and the low concentrations involved at Area 11, it is highly unlikely PCBs would have migrated downward to groundwater. Consequently, no groundwater sampling was requested by DEQ in Area 11.

## 5.2.13 Dames & Moore Area 12 - Flammable Materials Storage Area

### 5.2.13.1 Soil Results

Dames & Moore collected one soil sample from Area 12 at a depth of 1 foot for VOC analysis (Dames & Moore, 1989). No VOCs were detected. Crosby & Overton sampled the area again at depths of 1 and 2 feet and analyzed the samples for TPH and VOCs. Crosby & Overton's analysis detected TPH at concentrations ranging from 180 to 750 mg/ kg. No VOC constituents were detected at detection limits ranging from 0.1 mg/kg to 0.2 mg/kg, with the exception of a single detection of PCE at a concentration of 0.3 mg/kg at a depth of 1 foot.

After removing approximately 15 cubic yards of soil to an onsite lined and bermed treatment area (which was subsequently disposed offsite in 1991), Area 12 was resampled. Post-excavation data were lower than were measured prior to excavation, with PCE concentrations below the detection limit (0.005 mg/kg) except in one sample, which had a very low concentration of 0.011 mg/ kg. TPH concentrations in the two confirmation samples were 610 mg/kg and 670 mg/kg.

In 2001, soil samples were collected as requested by DEQ in the area of the flammable materials storage building. Three soil samples were collected from soil boring GP-5 at depths of 0.5, 3, and 6 feet bgs and analyzed for VOCs and TPH. PCE was detected at 3 and 6 feet bgs at concentrations of 0.0012 and 0.0013 mg/kg, respectively. TPH was not detected. The soil concentrations in Area 12 for PCE and TPH are below then-current screening criteria. Based on these results, DEQ requested no further soil characterization in Area 12.

### 5.2.13.2 Groundwater Results

In 2001, a groundwater sample was collected as requested by DEQ to determine whether past practices had led to the presence of VOCs in groundwater at Area 12. A Geoprobe (GP-5) was advanced to a depth of 16 feet bgs. Except for PCE and c-1,2-DCE, no VOCs were detected. The reported concentrations of PCE (0.0028 mg/L) and c-1,2-DCE (0.0013 mg/L) are below screening levels. Detected constituents in groundwater are discussed further in the Risk Assessment presented in Section 6.0. Based on these results, DEQ requested no further groundwater characterization in Are 12.

## 5.2.14 Dames & Moore Area 13 - Lay Down Area South of Main Building

### 5.2.14.1 Soil Results

In 1989, two samples were collected in shallow soil (zero to 3 inches) (Dames & Moore, 1989). These samples had TPH detections of 1,200 mg/kg and 2,800 mg/kg. As the only suspected sources of hydrocarbons in this area are asphalt and incidental drips of grease and oil from motor vehicles, URS (2000) suspected that particles of asphalt account for the observed TPH detections. The pavement in this area is routinely maintained by Northwest Pipe Company to reduce the potential for incidental drops of vehicular grease and oil to pass through pavement and enter the soil. Based on this information, DEQ requested no further soil characterization in Area 13.

### 5.2.14.2 Groundwater Results

The relatively low concentrations and shallow depth of soil affected by TPH at Area 13 indicate the absence of a substantial amount of hydrocarbons in soil sufficient to cause hydrocarbons to migrate to groundwater. Consequently, no groundwater investigation was requested by DEQ in Area 13.

## 5.2.15 Dames & Moore Area 14 - Onsite Sumps Associated with a Wash Pad and Stormwater System

In 1995 and 1996, the steam cleaning wash pad was decommissioned and shallow, stained soil in this area was incorporated as aggregate into the concrete cap constructed in this area. A new steam-cleaning process was installed on a sloped concrete pad that leads to a blind (no outlet) sump. The sump is periodically cleaned out by a subcontractor and any recovered residue is sent off site for recycling.

A feature incorrectly identified as a "plugged storm drain" in Area 14 (Dames & Moore, 1989) actually is a large sump with a water outlet evidently connected to the Site's stormwater system located well above the sump bottom. Two samples (and two duplicates) of settled solids contained in the sump were collected (Dames & Moore, 1989). One pair of samples was analyzed for VOCS, and the other pair was analyzed for PAHs and TPH. The only VOC detected in the samples was PCE at a concentration of 0.055 mg/kg to 0.73 mg/kg. TPH was detected at 2,500 mg/kg and 3,300 mg/kg. The maximum concentration of certain CPAHs (benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene), which ranged up to 16.8 mg/kg, exceeded then-existent EPA preliminary remediation goals (PRGs) for industrial soil. NPAHs were detected at relatively low concentrations well below screening concentrations.

Crosby & Overton removed two drums of settled solids from the sump (Dames & Moore, 1989). Because of the size of the sump, the solids level was well below the water outlet. The removed material was tested for disposal characterization purposes and found to have no detectable Extraction Procedure toxicity for metals, a lower concentration of TPH (740 mg/kg) than originally reported by Dames & Moore, no detectable VOCs, and a detectable concentration (4.5 mg/kg) of PCBs. After characterization, the material was disposed offsite.

Because Area 14 is a sump that has been cleaned out, no further characterization of soil, groundwater, or air at Area 14 was requested by DEQ.

## 5.3 RI/SCE Site Investigation Results and Source Control Soil Sampling

Groundwater results associated with the RI/SCE were described in the Dames & Moore Area 1 discussion presented in Section 5.3.1. This section summarizes the results of soil and stormwater samples collected at DEQ request during the 2005 RI/SCE and in a sampling event completed in 2006 after the draft RI/SCE report was submitted.

### 5.3.1 2005 RI/SCE Stormwater Sampling Results

Table 5-8 summarizes the analytical results for constituents detected during the July 2005 stormwater sampling event. During the sampling event, samples were collected from three different catch basins on and near the Northwest Pipe Company facility. The samples were analyzed for PCBs; total and dissolved metals; PAHs; oil and grease; and TSS. PCB Aroclor 1254 was detected in only one of the stormwater samples during the 2005 RI/SCE sampling. No other Aroclors were detected.

Metals detected during the 2005 RI/SCE sampling were aluminum, chromium, copper, manganese, and zinc, which were each detected in both the total and dissolved samples. Lead was detected in the unfiltered, "total metals" sample, but was not detected in the filtered, dissolved metals sample. Molybdenum and nickel were not detected during the sampling event.

PAHs detected above the reporting limits in stormwater samples during the 2005 RI/SCE sampling are naphthalene, acenaphthylene, anenaphthene, fluorene, phenanthrene, anthracene, f1uoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)f1uoranthene, benzo(k)f1uoranthene, indeno (1,2,3·cd) pyrene, dibenzo (a,h) anthracene, and benzo(g,h,i)perylene.

Oil and grease were detected in the stormwater samples at concentrations below NPDES benchmark levels. TSS was below the NPDES benchmark level for the samples collected on the Northwest Pipe Company Site; however, the offsite stormwater sample collected in the communal stormwater line upstream of where the Northwest Pipe Company discharge joins the communal outfall exceeded the NPDES benchmark for TSS.

In summary, the offsite concentrations of metals, oil & grease, suspended solids, and PAHs in the communal stormwater line upstream of Northwest Pipe Company Site's discharge were substantially higher than those detected in stormwater samples from the Site's Stormwater.

### 5.3.2 2005 RI/SCE Soil Sampling Results

Table 5-9 summarizes the analytical results for PCBs detected during the 2005 soil sampling effort. Four soil samples were collected from soil below compacted gravel at the substation area and analyzed for PCB Aroclors. Aroclors detected above the reporting limit during the 2005 sampling are Aroclor-1254 and Aroclor-1260, with only Aroclor 1254 at a single sample location (SS103) above the JSCS SLVs for Aroclors. Aroclors-1016, -1221, -1232, -1242, and -1248 were not detected above the reporting limit during the 2005 sampling effort. Because the soil in this area is covered with compacted gravel and located on level ground approximately 220 feet from the nearest stormwater catch basin, the potential for erosion and offsite transport is negligible.

### 5.3.3 2006 Surface Soil Source Control Sample Results

The results of the 2006 surface soil sampling are summarized in Table 5-10. Of the 19 samples analyzed for zinc, only two were found to have concentrations that exceeded JSCS SLV (459 mg/kg). Six of the seven samples analyzed for PCBs and PAHs were found to have concentrations that exceeded their respective JSCS SLVs. Of the PCBs, only two Aroclors were detected above the reporting limit: Aroclor 1254 and Aroclor 1260. Aroclors 1016, 1221, 1232, 1242, and 1248 were not detected above the reporting limit. The detected PAHs generally were above JSCS SLVs for PAHs, and the soil in the areas sampled in 2006 subsequently was capped with asphalt pavement during the 2012 interim remedial measure implementation.

### 5.3.4 2006 Catch Basin Solids Sampling

Settled solids that had accumulated in selected catch basins at the Site were sampled in October 2006. Figure 5-8 shows the locations of the sampled catch basins, and analytical results are summarized in Table 5-11. Even though DEQ requested these data for determining the potential release of constituents of concern to the Willamette River, the solids sampled in this activity were captured in the stormwater system and are not representative of the composition of any suspended solids that may have been discharged from the Site via the stormwater system. In contrast, the sample results for LWG's in-line sediment trap collected in July 2007 and again in January 2008 from Outfall 18/WR123 may represent constituents of concern being discharged through Outfall 18/WR123; however, Outfall 18/WR123 is a communal outfall and the Northwest Pipe Company Site constitutes about 27 percent of its drainage area.

#### 5.3.4.1 Catch Basin Solids Inorganic Constituent Results

The Site's catch basin solids were analyzed for zinc. Of the five catch basins sampled, four exceeded the JSCS SLV for zinc. Of these, only one exceeded the DEQ comparison value for other industrial sites in the Portland Harbor (DEQ 2010c).

#### 5.3.4.2 Catch Basin Solids Polynuclear Aromatic Hydrocarbon Results

Each of the five sampled catch basins was found to contain solids with detectable levels of PAHs. Benzo(b)fluoranthene, benzo(k)fluoranthene, and dibenz(a,h)anthracene were detected below their JSCS SLVs. The remaining PAHs were found in concentrations that exceeded their JSCS SLVs in a least one of the sampled solids. Because of these results, the Site's stormwater source control samples were analyzed for PAHs.

#### 5.3.4.3 Catch Basin Solids Polychlorinated Biphenyl Results

The catch basin solids samples were found to contain detectable levels of two PCB Aroclors (Aroclor 1254 and Aroclor 1260). Of these two, only Aroclor 1254 was found to exceed the JSCS SLV in four of the five samples. Each of the five catch basin solids samples exceeded the JSCS SLV for total PCBs. Because of these results, the Site's stormwater source control samples were analyzed for PCBs.

## 5.4 Post-2007 Work

As described in Section 2.2.3.2, after submitting the 2005 Draft RI/SCE document, the Site entered a period with little DEQ involvement due to staff changes at the Department and DEQ management decisions to focus the Department's efforts on other sites. Northwest Pipe Company continued to characterize the Site during this period with a groundwater sampling effort in 2007.

### 5.4.1 2007 Groundwater Sampling

Up to 2007, groundwater characterization at the Site had been focused on the vicinity of the former UST (Section 5.2.4.2) and the Southeast Area (Section 5.2.1.2). To further document groundwater conditions in other parts of the Site, CH2M HILL collected 14 shallow groundwater samples (13 to 14 feet bgs) across the Site in 2007. Each sample was collected approximately 5 feet below the water table from temporary stainless steel well points placed using direct-push technology. In addition to the temporary well points, CH2M HILL resampled the six monitoring wells that had previously been installed in the Southeast Area of the Site. The direct-push groundwater samples were analyzed for TPH in the diesel and gasoline range, dissolved (that is, field-filtered) zinc, and VOCs. The groundwater samples collected from the six monitoring wells were analyzed for the same constituents and also for PAHs. Temporary well point samples were not analyzed for PAHs, because unavoidable turbidity in direct-push samples would have yielded biased, non-representative 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 5-9.

Table 5-12 presents a summary of the groundwater analytical results. Although drinking water is not a reasonably likely beneficial use of the shallow aquifer at the Site (see Section 4), concentrations are screened for convenience against such levels consistent with the JSCS (DEQ 2007a). The zinc concentrations measured in the temporary well points were below the screening levels. TPH diesel and gasoline were detected in nine of the 14 shallow groundwater samples. In three of the nine samples (GP203, GP207, and GP212), diesel and gasoline concentrations were above DEQ's risk-based screening levels for TPH (0.35 milligrams per liter [mg/L] for diesel and 0.4 mg/L for gasoline).

The zinc, TPH and, PAH concentrations found in the monitoring wells were below screening levels, with the exception of TPH-gasoline measured at 0.436 mg/L in MW-6, located in the Southeast Area. The groundwater samples (with the exception of GP211, located just east of Bay 5), exceeded screening levels for at least one VOC. The most common exceedance was PCE, which exceeded screening levels in 10 of the 14 temporary well points and the monitoring wells; however, reported PCE concentrations outside the Southeast Area are at or below 0.001 mg/L and are below the drinking water maximum contaminant level (MCL) for PCE. Similarly, vinyl chloride, which was the next most common VOC to exceed the screening levels (in nine of the 14 temporary well points) was at concentrations less than the MCL outside the Southeast Area, except for sample location GP-212 (located south of the lining and coating building), which had a vinyl chloride concentration of 0.0034 mg/L, less than twice the MCL.

These results indicate that, outside of the Southeast Area of the Site, where VOC concentrations had been previously documented, shallow groundwater at the Site locally contains low concentrations of various hydrocarbons and, in some wells, VOCs, consistent with a more than 70-year history of industrial activity.

Shallow groundwater is not and has never been used for any purpose at the Site. The most likely interpretation of beneficial use of shallow groundwater from the Site is potential recharge to surface water. The closest surface water is approximately 1,500 feet from the Site along potential flow paths to the south and west. However, Both the JSCS and DEQ RBC screening values, based on drinking water standards, are used in this evaluation because of the anticipated agency request to do so pursuant to the JSCS. Constituents in groundwater exceeding screening level values based on drinking water standards include diesel, gasoline, and chlorinated solvents (PCE and associated daughter products).

### 5.4.2 DEQ Re-engagement and Work Plan Development

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, 2009a) 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 after Department review of draft versions of work plan sections, the final work plan was approved via email from Jim Orr of 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
- Work Plan 2: Roof Runoff Sampling
- Work Plan 3: Expanded Risk Assessment
- Work Plan 4: Stormwater System Investigation
- Work Plan 5: Final Stormwater Source Control Evaluation

The results of these investigations, assessment, and data evaluations are presented below.

### 5.4.3 Surface Soil Sampling and Analysis (Work Plan #1)

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 chemicals of interest (COIs) and other constituents identified by DEQ that may be found in surface soil (surface to 6 inches bgs) at the Site.

#### 5.4.3.1 Soil Sampling

Surface soil samples were collected on October 19, 2009, in accordance with the DEQ-approved Work Plan. For each surface soil sample collected, the sample location was determined with a handheld sub-meter global positioning system (GPS) device. The field GPS data subsequently were downloaded and processed for differential correction to address atmospheric interference to attain sub-meter accuracy. The recorded sample locations are shown on Figure 5-10.

As directed by DEQ, surface soil samples were analyzed for inorganic constituents (aluminum, antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc) and organic constituents (phthalates, PCBs, pesticides, and total organic carbon). In addition, DEQ requested that selected samples also be analyzed for PAHs. The surface soil in the location of these samples has been paved, or the soil removed as part of the October 2009 Interim Remedial Measure/Source Control action (see Section 5.4.3).

**Analytical Results**

The final laboratory data report (Appendix A) was reviewed and evaluated by a CH2M HILL chemist to determine if project quality assurance (QA) and quality controls (QC) were implemented in the field as well as in the laboratory. All data were found to meet the project QA/QC standards established for this work with the addition of a few data qualifying flags. A more detailed discussion is presented in the data quality evaluation report presented in Appendix B.

Sampling results were compared to the initial upland source control SLVs for soil listed in Table 3-1 of the JSCS guidance document (DEQ, 2007a) and DEQ RBCs for soil ingestion, dermal contact, and inhalation for the occupational receptor scenario (DEQ, 2009b). The lower of the RBCs for the construction worker or occupational worker exposure scenario was used for comparison consistent with DEQ human health and ecological risk assessment guidance documents for using conservative, generic RBCs as an initial screen.

For those constituents where DEQ has not published a screening level, EPA RSLs are referenced (EPA, 2009). Some SLVs are set at a value DEQ considers to represent background concentrations. Because of natural variability in soil composition, the concentration of any element will vary naturally with location either above or below the background value. A guideline of two times the background value is used as a general indication of elevated concentrations of inorganic constituents, an approach suggested by EPA (EPA, 1998) for identifying naturally occurring constituent concentrations that are elevated relative to background. A summary of the laboratory data as compared to these screening levels is presented in Table 5-13.

This section discusses the findings of the October 2009 surface soil sampling.

***Inorganic Constituents***

The 2009 surface soil sampling event found concentrations of aluminum, antimony, mercury, and silver to be below screening levels; whereas, concentrations of arsenic, cadmium, chromium, copper, lead, nickel, selenium, and zinc exceeded screening levels in some samples. The JSCS SLVs for arsenic, cadmium, lead, and selenium are set at regional background concentrations (DEQ, 2007a), values that subsequently were revised by DEQ (2013a). The samples with constituent concentrations above screening levels were as follows:

- Arsenic (10 of 11 values above the occupational worker RBC, and 2 of 11 above regional background)
- Cadmium (all samples below construction worker RBC, and 10 of 11 above regional background)
- Chromium – (all samples below occupational/construction worker RBCs [for hexavalent chromium; no total chromium RBC exists], 7 of 11 samples above the JSCS SLV, and 6 of 11 greater than regional background)
- Copper – (all samples below the construction worker RBC, 3 of 11 above the JSCS SLV, and 9 of 11 samples above regional background)
- Lead – (all samples below construction worker RBC, 7 of 11 samples above JSCS SLV, and 2 of 11 above regional background)
- Nickel – (all samples below construction worker RBC, 4 of 11 above the JSCS SLV, and 3 of 11 above regional background)
- Selenium (all samples below EPA RSL [no DEQ RBC exists], one sample above the JSCS SLV, and 2 of 11 samples above regional background)
- Zinc (all samples below the EPA RSL [no DEQ RBC exists], 3 of 11 samples above the JSCS SLC, and 2 of 11 samples above regional background)

Oregon Administrative Rule (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, or – for non-carcinogens – having a concentration 10 times the acceptable risk-based concentration. The results of the inorganic constituent analysis for surface soil identified no highly concentrated hot spots for inorganic constituents. Previously exposed soil at the Site was capped with pavement in 2011-2012 as part of the interim remedial measure, so the potential exposure pathways contemplated in the comparison described above no longer is complete.

#### *Organochlorine Pesticides*

This analysis of surface soil samples documented that organochlorine pesticides are not present at the Site above reporting limits. Alpha-BHC was identified above the method detection limit but below the reporting limit at one sample location (SS409) in the extreme southwestern corner of the Site near the Dry Materials Storage building. The laboratory estimated its concentration as 0.00678 mg/kg. Concentrations at this level could be attributable to air deposition of fugitive dust, such as dust from traffic on North Terminal Road just south of the Site, or from the 2008 demolition of several large grain silos formerly located across North Terminal Road from this location on Port of Portland property. There is no screening level value for alpha-BHC indicated in the JSCS. The concentration found at this location is well below the DEQ RBC for the occupational worker exposure scenario (0.34 mg/kg) and below the RBC for construction worker exposure (2.6 mg/kg).

#### *Polynuclear Aromatic Hydrocarbons*

Data from the 2009 soil sampling indicate that PAHs are present in surface soil at concentrations that vary with location. Figure 5-11 presents the most recent sample locations and the corresponding calculated total PAH concentration for each sample location. Total PAH concentrations were calculated by adding the detected values for each PAH compound and zero for each non-detected compound. Concentrations of PAHs across the Site vary with location, with the highest concentrations observed in a small area of now-paved soil north of the Lining and Coating building on the plant's northeast side, and in a small patch of offsite soil that had sloughed onto pavement from the offsite elevated rail spur.

As with many sites containing PAHs, the compound benzo(a)pyrene often determines the need for remedial action. Benzo(a)pyrene's hot spot screening level is 27 mg/kg for an occupational worker and 210 mg/kg for a construction worker. None of the benzo(a)pyrene concentrations exceeded the construction worker hot spot screening level. One sample location from the most recent data set (SS411 - located on leased property, on the southern end of the Site next to an offsite rail line) and one sample from the 2007 data set (SS321 – located on a narrow strip of soil at the northern end of the lining and coating building) had concentrations of benzo(a)pyrene that exceeded the occupational worker hot spot screening level: SS411 at 29.75 mg/kg and SS321 at 38.2 mg/kg. Sample SS321, which is bounded by pavement and other samples that showed substantially lower PAH concentrations, was collected from north of the lining and coating area. This was the location of a demister used as part of the former coal tar enamel operations. The Site has not used coal tar enamel to coat pipes since 2008. Sample SS411 was collected at the southern edge of the Site from soil that had eroded and sloughed onto pavement on the property leased by Northwest Pipe Company from the elevated land that runs along the southern boundary of this leased land. This elevated land includes a rail line and North Terminal Road, where scrap metal delivery trucks and bins associated with the IT Slip scrap yard operation are routinely parked. In summary, the location of SS321 has been paved and the location of SS411, directly related to off-site conditions, is addressed by BMPs.

***Polychlorinated Biphenyls***

Sample data from 2009 indicate PCBs are present in some surface soil at varying concentrations depending on location. Only PCB Aroclors 1254 and 1260 have been detected at the Site, with Aroclor 1260 detected only in approximately half of the historical surface soil samples and in none of the most recent (October 2009) samples. The concentration of Aroclor 1254 was found to range from its highest at SS13 (11 mg/kg) to its lowest at SS408 (0.025 mg/kg). Figure 5-12 presents the sample locations and the corresponding calculated total PCB concentration for each point. None of the PCB Aroclor concentrations constitute a highly concentrated hot spot for industrial worker exposure, because none exceeded a value of 74 mg/kg, which is 100 times the industrial worker RSL for Aroclors 1254 and 1260, based on cancer risk (EPA, 2010). As noted above, soil at the Site has been capped with pavement, so no complete exposure pathway exists for the detected PCB Aroclors.

***Phthalate Esters***

Only bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, and di-n-butyl phthalate were detected in the 2009 soil samples. Concentrations in some samples exceeded screening levels; however, none of the detected phthalate concentrations exceeded highly concentrated hot spot levels. Even though the method blanks associated with these samples did not contain phthalate esters above reporting limits, EPA recognizes phthalate esters and in particular 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 in soil at the Site may be influenced by this effect.

**Surface Soil Summary**

Constituents detected during the 2009 soil sampling effort showed concentrations of PAHs and PCBs similar to those that had been reported previously. The analysis of other constituents requested by DEQ (inorganic constituents, pesticides, and phthalates) did not identify significant new findings. The reported concentrations are below industrial worker hot spot levels except for a single constituent (benzo(a)pyrene) at two locations: one sample in a narrow strip of now-paved soil north of the Lining and Coating building; and the other sample in soil that had sloughed onto pavement from raised ground offsite along a railroad spur and North Terminal Road, which border the Site to the south. The detection at low concentrations of bis(2-ethylhexyl)phthalate as well as – in certain samples – two other phthalates, may have some relation to laboratory bias, because phthalates are unrelated to Site activities but are common laboratory contaminants.

### 5.4.4 Interim Remediation/Source Control Measure

Based on the results of surface soil sampling, Northwest Pipe Company proposed to DEQ that an interim remedial measure (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 Site soil were to be eroded and transported offsite via stormwater. CH2M HILL completed a hydraulic analysis of the facility's stormwater conveyance system to confirm that increased runoff caused by paving the remaining unpaved portions of the Site would not cause temporary flooding during the design storm events (24-hour, 2-, 10-, and 25-year storms). Results of the modeling, completed with XP-SWMM storm water modeling code, were used to develop and evaluate a grading plan to promote effective runoff management.

The interim remedial action proposal was formalized in a risk evaluation/feasibility study memorandum (CH2M HILL, 2010a) evaluating four remedial alternatives consistent with Oregon Administrative Rule (OAR) 340-122-0085. The memorandum recommended Alternative 4 (hot spot removal and soil capping). This alternative subsequently was accepted by DEQ (DEQ, 2010a) after a public comment period as an interim remedy that DEQ anticipated would constitute a major part of the Site's final remedy.

On behalf of Northwest Pipe Company, CH2M HILL prepared a remedial action work plan (CH2M HILL, 2011a). The work plan, which described hot spot removal, confirmation sampling, the grading plan, and erosion and sediment control plan, and pavement design, was implemented in stages as equipment and personnel were available and weather conditions were consistent for paving activities. Remedial activities began in July 2011 after submitting a revised work plan in response to DEQ comments. The work was concluded in December 2012 after a total of 4 acres were paved and 1,050 tons of soil were removed and disposed at the Hillsboro Landfill. In addition to this work, Northwest Pipe Company installed storm drain line improvements completing paving (capping) of the entire facility.

Six confirmation samples were collected in September 2011 documenting that soil containing hot spot-level concentrations of benzo(a)pyrene had been removed (Table 5-14). All confirmation samples were below hot spot values for benzo(a)pyrene as well as for other PAHs, indicating that the remedial objective of removing hot spot-level soil prior to paving was met.

In conjunction with cap construction and to comply with City of Portland requirements for stormwater treatment, Northwest Pipe Company installed two state-of-the-art industrial stormwater treatment systems, one on each stormwater line carrying water to the Outfall 18/WR-123 communal outfall, as well as various other stormwater improvements, such as covering waste receptacles and installing an isolated drainage system and oil-water separator next to the above-ground fueling system. Section 2.4.2 provides additional information on the stormwater treatment systems.

### 5.4.5 Stained Soil Investigation

During hot spot removal in the area north of the Lining and Coating Building, workers encountered an unexpected area of stained soil in the shallow subsurface at a depth of approximately 1 foot below grade. Excavation continued at this location until groundwater was encountered at a depth of about 8 feet. The location of the stained soil evidently coincided with the location of a demister used as part of the former coal tar enamel operation.

After discussion with DEQ and after preparing a *Stained Soil Investigation Work Plan* (CH2M HILL, 2012a) soil and groundwater samples were collected for analysis to investigate the nature and extent of the stained soil. This section presents a summary of the sampling activities in and around the stained soil area north of the Lining and Coating Building.

#### 5.4.5.1 Subsurface Soil Sampling

**Soil Sampling and Analysis**

One soil sample was collected from a depth coincident with the water table from five locations using Geoprobe direct-push sampling equipment (GP301, GP302, GP303, GP304, and GP305) for a total of five discrete samples (Figure 5-13). Soil samples were collected for laboratory analysis from the portion of the core that straddled the water table observed at the time of sampling, as this depth was expected to contain the highest concentration of constituents because of the light, nonaqueous nature of residues associated with the coal tar demister that formerly operated in the area. The soil samples were submitted to the laboratory for the following analyses:

- TPH in the diesel and heavy oil fractions
- Extractable and volatile petroleum hydrocarbons (EPH/VPH, former demister location only)
- PAHs
- PCBs
- Inorganic constituents (arsenic, cadmium, chromium, copper, lead, nickel, manganese, mercury, and zinc)
- Total organic carbon (TOC)

**Soil Results**

Table 5-15 provides a summary of the laboratory results for the soil samples with comparison to background values (for inorganic constituents) and potentially relevant DEQ RBCs.

The concentrations for inorganic constituents were below published DEQ background values (DEQ, 2013a) for the Portland Basin. Consequently, metals and inorganic constituent concentrations show no evidence of having been affected by the operation of the former coal tar demister.

The other tested constituents (PAHs, PCBs, and petroleum hydrocarbons) were detected in one or more of the soil samples tested, with concentrations highest at the reported location of the former demister (GP302). Except for hydrocarbons at GP302, concentrations generally are low or below reporting limits.

The samples collected for this effort are deep (ranging in depth from 7 to 14 feet) and located within a large industrial area. Consequently, the only potentially relevant RBCs are based on occupational exposure for leaching to groundwater, volatilization to outdoor air pathway, and volatilization to indoor air. By contrast, direct exposure RBCs (DEQ, 2003) or screening levels based on potential erosion and transport to surface water (DEQ, 2005) are not reasonably plausible exposure pathways.

As noted in Table 5-15, naphthalene in one sample at GP302 exceeded the RBC for leaching to groundwater, whereas the other four samples tested were well below the naphthalene leaching RBC. The potential for groundwater transport of naphthalene is evaluated in Section 5.3.2. None of the constituents exceeded the screening level for volatilization to outdoor air or indoor air.

The EPH and VPH results were evaluated using DEQ's risk-based decision-making spreadsheet (DEQ, 2003) for calculating site-specific RBCs for the particular mix of hydrocarbons observed in the stained soil 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 100,000 mg/kg (DEQ, 2003). Concentrations observed at the Site are orders of magnitude below this level, indicating EPH and VPH are well below levels of potential concern for the leaching to groundwater pathway.

#### 5.4.5.2 Stained Soil Groundwater Investigation

Three monitoring wells were installed in the Stained Soil Area just north of the Lining and Coating Building in June 2012. The first well was installed in the backfilled area that was excavated during removal of the stained soil. The second and third wells were installed approximately 10 feet beyond the location of the most distant stained soil investigation subsurface soil sample locations (Figure 5-14). The wells were installed such that the screened interval straddled the water table observed at the time of well installation;

however, subsequent water level measurements made during sampling events indicated that the static water level in the wells generally is above the top of the screened interval in each well. Samples were collected using low-flow sampling techniques and submitted to the laboratory for analysis (lead, manganese, mercury, nickel, arsenic, cadmium, chromium, copper and zinc; PAHs; TPH diesel and oil range hydrocarbons; PCBs; and total suspended solids [TSS]). Table 5-16 summarizes the analytical results.

Two rounds of groundwater samples have been 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 key difference between the two sample events is that the second set of samples were collected with a sampling pump (peristaltic pump) while the water level in the well was artificially drawn down to below the top of the well screen by pumping from a lower, stainless steel submersible pump as requested by DEQ. The samples were submitted to the laboratory and analyzed for inorganics (lead, manganese, mercury, nickel, arsenic, cadmium, chromium, copper and zinc), PAHs, PCBs, and TPH diesel and oil range hydrocarbons (Table 5-16). DEQ did not request PCB analysis in the second set of groundwater samples from the Stained Soil Area.

#### 5.4.5.3 Field Observations and Hydraulic Gradient in Stained Soil Area

Table 5-17 summarizes groundwater elevations measured in site monitoring wells during the two sampling events, and Figures 5-14 and 5-15 depict the resulting potentiometric surface of the shallow fill aquifer. 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 ft/ft.

Table 5-18 provides a summary of the field parameters observed at the end of purging just before samples were collected. These measurements indicate near-neutral groundwater pH, low specific conductance typical for shallow groundwater in the area, and geochemically reducing conditions, with ORP ranging from -31 mV to -134 mV, similar to that observed in the Southeast Area of the Site. Because reducing conditions have been documented in both the stained soil area and the Southeast Area of the Site, they reasonably may be attributed to the oxygen demand exerted by microbes decomposing natural organic matter incorporated into the dredged material used to fill the Site and, inadvertently create the shallow aquifer, as part of original Site development. Turbidity levels measured during the May 2013 sampling event using the modified sampling method were lower than in the May 2012 samples for MW-7 and MW-8. Turbidity measurements in MW-9, while still low at less than 5 nephelometric turbidity units (NTUs), increased slightly from 2.8 to 3.0 NTUs.

#### 5.4.5.4 Analytical Results

Table 5-16 presents the laboratory results for groundwater samples for the two sampling rounds.

MW-7, which was installed near the former demister location, had the highest concentration of PAHs and petroleum hydrocarbons, with MW-8 and MW-9 reflecting low to below reporting limit concentrations. PCBs were not detected in the initial groundwater samples in June 2012, and no further sample analysis for PCBs was requested by DEQ. Inorganic constituent concentrations were generally low or below reporting limits, except for manganese and arsenic. Both of these constituents are sensitive to ORP, with their solubility increasing as ORP becomes increasingly negative. The range of manganese concentrations is similar to that observed in the Southeast Area of the Site during past sampling (CH2M HILL, 2005a), suggesting that the naturally reducing conditions found in the shallow fill aquifer may be causing naturally occurring arsenic and manganese in the aquifer matrix to enter solution.

Because of the lack of reasonably likely drinking water exposure for the shallow aquifer, screening against tap water RBCs is inappropriate. Moreover, the location of the study area is approximately 2,000 feet from the projected point of discharge to the Willamette River (based on the June 2012 hydraulic gradient), and the natural attenuation evaluation presented in Section 5.4.5.5 indicates that screening values anticipating aquatic exposure or ingestion also are inappropriate for comparison. Consequently, Table 5-16 screens the groundwater results against RBCs based on occupational exposure for the volatilization pathway (outdoor air), vapor intrusion (indoor air), and potential exposure by excavation workers. As noted in Table 5-16, none of the concentrations exceeded potentially relevant screening levels except for three PAHs (benzo(a)pyrene, dibenzo(a,h)anthracene, and benzo(a)anthracene) in the May 2013 samples from MW-7, located in the center of the stained soil area at the location of the former demister.

Because of the low constituent mobility and long distance to surface water – and considering the natural attenuation evaluation described in Section 5.4.5.5, the concentrations reported in Stained Soil Area monitoring wells would not reasonably be expected to pose a risk to receptors in the river.

#### 5.4.5.5 Natural Attenuation Evaluation

CH2M HILL completed a natural attenuation evaluation to investigate the potential for the concentrations of PAHs reported in groundwater near the former coal tar demister to migrate a substantial distance in the subsurface. The evaluation was conducted because PAHs have notably low solubility, tend to adsorb to organic carbon in the subsurface, are known to attenuate under both aerobic and anaerobic conditions, and consequently 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 screening tool BIOSCREEN, version 1.4 (EPA, 1997) was used to evaluate the potential mobility of acenaphthene, the PAH detected at the highest concentration in groundwater, as well as naphthalene, the PAH with the lowest organic carbon partition coefficient, the lowest retardation factor, and consequently the greatest potential for migration. Table 5-19 lists the basis for input parameters used in the analysis. The output of both the base case and sensitivity runs are provided in Appendix C and are discussed below.

**Base Case Evaluation**

The base case evaluation for both constituents indicates that natural attenuation via anaerobic degradation would be an important fate process for naphthalene and acenaphthene. Neither constituent was predicted to migrate above a concentration of 0.001 mg/L more than 30 feet under steady state conditions, far short of the 2,000-foot flow path distance to the Willamette River. Despite the relatively slow anaerobic degradation rates (compared to faster aerobic rates), the relatively high organic carbon partition coefficients (Koc) associated with PAHs slow the migration of PAHs substantially, allowing even slow anaerobic degradation rates to become significant. This is consistent with the decision to focus the screening level comparisons discussed in previous sections of this report on volatilization and excavation worker pathways and to discount any comparison to surface water values.

**Sensitivity Evaluation**

Three variables were adjusted to evaluate their potential to affect the conclusion reached under base case conditions. The following adjustments were made and evaluated using BIOSCREEN:

- The anaerobic degradation half-life was raised by a factor of 10, simulating conditions under which degradation occurs at one-tenth the rate reported in the literature.
- The Koc was adjusted from the geometric mean to a value equal to the lowest value for each constituent cited by EPA (EPA, 1996).
- The concentration in the source area was raised by a factor of 10, to provide a more potent source term and evaluate if higher concentrations substantially affect predicted outcomes.

The results of these sensitivity runs are as follows:

- **Adjusted half-life**: Using the midpoint of the distance range in which the constituent dropped below 0.001 mg/L, raising the degradation half-life by a factor of 10 increased the migration distance by a factor of approximately 3 for acenaphthene and 3.6 for naphthalene; however, the maximum predicted migration distance under this scenario remained less than 100 feet.

- **Adjusted Koc**: Reducing the Koc value to the lowest value cited by EPA (EPA, 1996) for each constituent had no calculated effect on acenaphthene migration, but increased the distance naphthalene is predicted to migrate until dropping below 0.001 mg/L by a factor of 1.4, yet still well short of the Willamette River.
- **Adjusted concentration**: Raising the initial concentration by a factor of 10 had no calculated effect on the migration distance for either acenaphthene or naphthalene. A second run was completed for the adjusted concentration for acenaphthene, because the May 2013 acenaphthene concentration was slightly higher than that observed in June 2012. The adjusted higher concentration (10 x 2 mg/L = 20 mg/L) led to a consistent result: acenaphthene was calculated to degrade rapidly below 0.001 mg/L, within 20 feet of the source area.

The results of the BIOSCREEN evaluation showed relatively little sensitivity to the adjustments used in the sensitivity analysis. Even raising the most sensitive variable evaluated (degradation half-life) by an order of magnitude yielded a predicted migration distance before extinction below 0.001 mg/L more than 1,900 feet short of reaching the Willamette River. 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.

#### 5.4.5.6 Stained Soil Investigation Conclusions

The two rounds of groundwater samples indicate low concentrations of certain metals and PAHs in the stained soil area groundwater. Because of the low mobility of metals and PAHs and the propensity for PAHs to biodegrade in the subsurface, the concentrations observed in site groundwater would not pose a risk to the Willamette River. Based on these results and evaluation findings, no further groundwater sampling or analysis associated with the stained soil remediation area is indicated.

### 5.4.6 Roof Run-off Stormwater Sampling and Analysis (Work Plan #2)

Stormwater roof run-off samples were collected on November 7, 2009, in accordance with the DEQ-approved Work Plan. For each roof run-off sample collected, the sample location was noted in the field logbook. The recorded sample locations are shown on Figure 5-16. According to the City of Portland's Hydra rain gauge at the Port of Portland Terminal 4, 1.19 inches of precipitation fell on November 7, 2009, the majority of which occurred in the afternoon coincident with sampling activities (USGS, 2010).

The stormwater roof run-off samples were analyzed for total zinc concentrations, and at least one sample from each of the buildings was analyzed for total concentrations of other inorganic constituents (aluminum, antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc) and for organic constituents (phthalates, PCBs, PAH, and VOCs), as well as for TSS.

#### 5.4.6.1 Sampling Results

The final laboratory data report (Appendix A) was reviewed and evaluated by a project chemist to ensure project QA/QC were implemented in the field as well as in the laboratory. The data were found to meet the project QA/QC standards established for this work with the addition of a few data flags. A more detailed discussion is presented in Appendix B.

Sampling results were compared to the initial upland source control screening values for stormwater listed in Table 3-1 of the JSCS guidance document (DEQ, 2005, table updated July 16, 2007) (SLVs). A summary of the laboratory data as compared to these screening levels are presented in Table 5-20.

Historical stormwater roof run-off samples focused solely on total zinc concentrations due to past work to identify and control potential zinc in Site stormwater. Northwest Pipe Company has completed an extensive roof cleaning and coating program for the main production building (Bays 1 through 6) as a source control measure since many of these samples were collected. Consequently, these historical sample results do not represent current conditions. These data are included in the report (Table 5-21) to provide context and to illustrate the effectiveness of the roof coating program.

Six of the 11 roof run-off samples were analyzed for the following inorganic constituents in the November 2009 sampling effort: aluminum, antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc. The only inorganic constituents that exceeded the JSCS SLVs in roof run-off are arsenic and zinc, although an exceedance of an SLV in roof run-off does not necessarily indicate stormwater discharge from the Site will exceed the SLV (because of unavoidable mixing and dilution with run-off from other areas of the Site before discharge).

**Arsenic**

Arsenic was detected below the laboratory's reporting limit in three of the six samples analyzed for the full suite of inorganic constituents. The other three samples analyzed for arsenic did not have arsenic concentrations above the method detection limit. Of the three samples that contained arsenic above the detection limit, one sample was a field duplicate sample for a parent sample that contained no detectable arsenic. Arsenic is a naturally occurring element in area soil – DEQ assumes the Portland Basin has a background concentration of 8.8 mg/kg – so these low concentrations of arsenic may be attributable to soil dust captured in the sample rather than originating from the roofs themselves.

**Zinc**

Zinc has been found in varying concentrations in historical stormwater samples. The source of this zinc was identified as the protective galvanized coating of steel structures, including some building roofs, which cover a significant portion of the Site. During the summer of 2009, Northwest Pipe Company cleaned and coated the roof of the main plant building, covering approximately 292,320 square feet (6.7 acres) of galvanized roofing, as part of its source control efforts. This source control action reduced zinc concentrations in roof run-off from the main plant building by 98 percent, with pre-coating concentrations averaging 2.56 mg/L and the concentrations observed in 2009 samples averaging 0.063 mg/L (Tables 5-20 and 5-21).

Zinc values observed in the roof run-off from the 2009 sampling event for the main plant roof (Bays 1 through 6) are an order of magnitude below the NPDES permit 1200-Z benchmark but are slightly above the conservative JSCS screening level (0.036 mg/L). Zinc concentrations found in the roof run-off on other buildings range between 0.0171 and 0.98 mg/L. The wide variance of zinc concentrations in roof run-off can be attributed to the downspout piping, roofing material, and the age of these materials (because older galvanized coatings are more pitted from weathering and age, and this greater surface area exposes more zinc to precipitation and roof run-off). As shown on Figure 5-17, which shows zinc concentrations in Site run-off from April 2005 to February 2010, coating the acres of roof of the main plant building has helped the Site maintain compliance with its stormwater permit benchmark for zinc.

**Polynuclear Aromatic Hydrocarbons**

Two of the five roof run-off samples analyzed for PAHs (DS005 and DS012) were below detection limits for all PAHs. Two other samples (DS223 and DS221) were found to have low concentrations of phenanthrene. The reported concentrations of phenanthrene in these samples were below both the conservative screening level and the laboratory reporting level. The remaining sample point, DS120, was the only sample with PAH concentrations above the laboratory reporting level for fluorene and phenanthrene. Pyrene also was detected but was below laboratory reporting level. All detected concentrations in each of the roof run-off samples were below the JSCS SLVs for PAHs.

**Polychlorinated Biphenyls**

No PCBs were detected in the stormwater roof run-off samples.

**Phthalate Esters**

No phthalates were detected in the stormwater roof run-off samples.

**Volatile Organic Compounds**

No VOCs were detected in the stormwater roof runoff samples with the exception of 2-butanone (also known as methylethyl ketone) and acetone, which are common laboratory contaminants (EPA, 2008). Both of these constituents were detected in all samples analyzed for VOCs, except the trip blank, at low levels. All detected concentrations were below the JSCS SLVs.

#### 5.4.6.2 Roof Runoff Summary

With the exception of arsenic and zinc, all constituents analyzed in the roof run-off samples are below the conservative JSCS screening values. As discussed earlier, arsenic is a naturally occurring element found in soil throughout the Willamette Valley. The low sporadic concentrations observed in roof run-off samples are plausibly attributable to arsenic-containing soil dust that has settled on the Site roofs and is subsequently entrained by stormwater. The zinc detected in roof run-off is attributable to the downspout piping, facility roofing material, and the roofing material's age. Northwest Pipe Company's source control action, involving cleaning and coating the roof of the main plant building, resulted in a 98 percent decrease in zinc concentrations in roof run-off from the main plant building.

## 5.5 Expanded Risk Assessment for Groundwater Plume (Work Plan #3)

The results of the expanded risk assessment for groundwater are described in Section 6. The risk assessment, which evaluated potential human health and ecological receptors, identified no unacceptable risk due to the presence of Site-related constituents in groundwater.

## 5.6 Stormwater System Investigation (Work Plan # 4)

A work plan was developed by CH2M HILL and approved by DEQ to investigate the stormwater discharge system at the Site (CH2M HILL, 2009: Work Plan #4). CH2M HILL reviewed available information of the stormwater system, current stormwater cleanout procedures, and best management practices used by Northwest Pipe Company to maintain stormwater permit compliance at its Portland Plant. This review determined that the methods used by Northwest Pipe Company are effective and—particularly with the recent coating of the main building roof—are capable of enabling the Company to maintain compliance with its NPDES stormwater permit benchmarks (CH2M HILL, 2010a). Sampling of the small quantity of solids removed from the stormwater system as part of this investigation was determined to be non-effective, as the solids consisted of gravel with little to no fines. As requested by DEQ in response to the stormwater system evaluation, a video inspection was conducted of selected lengths of the stormwater system to document existing conditions (CH2M HILL, 2011b). The video inspection encountered four previously unknown features: two catch basins that were either covered by pavement or non-functional, as well as two tributary lengths of pipe that were not functioning. The investigation recommended the area around these features be excavated and the features closed off and properly abandoned. Northwest Pipe Company anticipates addressing these features as time and resources allow.

## 5.7 Final Source Control Evaluation (Work Plan #5)

The Source Control Evaluation is provided in Section 8.

SECTION 6

# Human Health and Ecological Risk Screening Evaluation for Groundwater in the Southeast Area (Work Plan #3)

This section presents the methodology and results of the human health and ecological risk screening evaluation (RSE) for groundwater in the Southeast Area and adjacent offsite area from the Site that was completed by CH2M HILL (2012c). The Site location is shown on Figure 2-1. This section serves as an addendum to the risk evaluation contained in the 2005 Draft RI/SCE Report (CH2M HILL, 2005b) and incorporates new groundwater data collected from both onsite and downgradient offsite sample locations, as agreed in Work Plan #3. This RSE was performed in accordance with OAR 340-122-080(5), which allows for pre-baseline screening of COIs. Where applicable, and to avoid presentation of extraneous information, Site details from previous evaluations are referenced.

## 6.1 Data Evaluation

For the purposes of this RSE, the analytical data for the Southeast Area and adjacent offsite area were partitioned into the following three data groups:

- Onsite 2007 groundwater data from Northwest Pipe Company (includes one sampling event from six onsite monitoring wells and 14 temporary well points advanced with direct-push technology)
- Onsite 2005 groundwater data from Northwest Pipe Company (includes three sampling events from six onsite monitoring wells and one 2001 sampling event from the deep production well)
- Offsite 2004-2005 groundwater data from the Port of Portland (includes semiannual sampling at 24 offsite monitoring wells)

Sample locations are presented on Figure 6-1. Analytical data used in the RSE were collected and summarized as part of the following investigations:

- *Supplemental Site Characterization Results, Northwest Pipe Company, Portland, Oregon* (CH2M HILL, 2008)
- *Remedial Investigation/Source Control Evaluation Report Northwest Pipe Company Portland, Oregon* (CH2M HILL, 2005b)
- *Remedial Investigation Report Terminal 4 Slip 1 Upland Facility, Port of Portland, Portland, Oregon 97209* (Ash Creek Associates, Inc., 2007)

### 6.1.1 Data Representativeness Discussion

Site data were evaluated to determine whether they represented 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 groundwater data in the Southeast Area of the Site are as follows:

- Groundwater data from six monitoring wells and 14 Geoprobe samples collected during September 2007 are considered the most temporally and chemically representative of the current conditions at the Site.
- Groundwater data from six monitoring wells collected during three sampling events in 2005 (January, June, and September) and groundwater data from the production well collected in 1998 sampling event are chemically representative and provide important information relative to temporal concentration trends.
- Because of the availability of more recent data that meet the representativeness criteria above, groundwater data collected onsite between 1988 and 2004 are not considered temporally representative of current site conditions. These data are therefore not included in the RSE with the exception of the 2001 production well sample. This is the most recent data point representative of the deeper aquifer.
- Considering hydraulic gradients documented at the Site, groundwater quality data from the southern part of the Site represent groundwater concentrations potentially moving offsite toward the Port of Portland Terminal 4 (T4) Slip 1 (to the southwest) and groundwater 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). Offsite wells installed for the Port of Portland as part of T4 site investigations represent groundwater concentrations potentially moving toward T4 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. Other onsite data are included in the RSE for observations of spatial patterns and attenuation.

## 6.2 Conceptual Exposure Model for Human Health and the Environment

The conceptual exposure model (CEM) was developed using regulatory guidance and professional judgment, 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 6-2 is a comprehensive human health and ecological CEM schematic for the Site, including information relevant to groundwater. The exposure routes considered in this groundwater RSE are those boldfaced on Figure 6-2.

### 6.2.1 Characterization of Current and Reasonably Anticipated Future Land Use

The Site is zoned Heavy Industrial (HI) as designated by the City of Portland. Land use is expected to remain the same into the reasonable future because of a recognized shortage of industrial land in the Portland area. Land surrounding the Site is also zoned HI. The Northwest Pipe Company-owned and leased property used for manufacturing purposes is a small part (28.48 acres) of a much larger industrial area, large parts of which are composed of the North Burgard Industrial Park (approximately 200 acres) and the Port of Portland's Terminal 4 (260 acres), which are surrounding and adjacent to the Northwest Pipe Company Site, respectively.

### 6.2.2 Current and Future Beneficial Groundwater Use

One previous and two current beneficial uses of the groundwater have been identified for the Site (see Section 4 for additional information):

- Recharge to surface water (Willamette River) for shallow groundwater(the risk screening is based on groundwater samples collected from this unit)
- Recharge to surface water for deep, confined groundwater (Willamette River)
- Industrial use for 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 municipal water supply system.

### 6.2.3 Summary of Site Hydrogeologic Conditions

This hydrogeologic conceptual site model (CSM) has been developed to assist in evaluating potential exposure pathways for constituents in groundwater at the Site. It is developed from the data and information presented in this report, particularly from the results of groundwater investigations conducted over more than a decade. It focuses primarily on the shallow aquifer at the site, which is the zone of interest with respect to site monitoring wells and associated data.

### 6.2.4 Groundwater Occurrence

Based on geologic logs for direct-push borings, monitoring wells, and the site production well (Appendix D), the site is underlain by two principal horizons in the upper 100 feet: a shallow silty sand interval from the surface to approximately 26 feet bgs, composed of fine to medium-grained sand with intervals of silty sand (interpreted to be hydraulic fill generated from dredging activities prior to Northwest Pipe Company's presence at the site) underlain by a thick deposit of fine-grained silt with infrequent sandier silt intervals (interpreted to be native alluvium deposited in a low-energy environment), from approximately 26 feet to at least 120 feet bgs. Below these shallow horizons is a deep, confined, coarse sand and gravel aquifer penetrated by the onsite production well at a depth of 198 to 203 feet below ground surface.

### 6.2.5 Groundwater Levels

The shallow sand interval is the uppermost water-bearing zone at the Site, with a depth to groundwater of 8 to 14 feet bgs, depending on Willamette River stage and ground surface elevation (while generally flat, the southern part of the Site is topographically higher than the northern part). The underlying silt horizon is a confining layer that separates the shallow water-bearing zone from the deep, confined aquifer. The depth to water in the deep production well noted on the well construction log available through OWRD was 16 feet, similar to, but possibly slightly less than, that of the shallow aquifer. Figure 6-3 presents a cross-section depicting the subsurface profile in the Southeast Area of the Site to a depth of 120 feet (the depth of deep GP-112), including the concentrations of PCE detected in samples from the area. Groundwater levels have been measured on eight occasions in the Southeast Area since July 2003. As shown in Figure 6-4, the relative water levels in Site monitoring wells have remained consistent for each set of measurements.

### 6.2.6 Hydraulic Conductivity

Table 6-1 presents the estimates of transmissivity and hydraulic conductivity for the shallow aquifer calculated using ASTM Method D 5472-93. Details regarding these calculations are provided in Appendix A of the RI/SCE Work Plan (CH2M HILL, 2005). Hydraulic conductivity estimates varied from 2.6 feet/day (ft/d) to 28 ft/d, with higher conductivity values estimated for MW-1 and MW-6 (28 and 19 ft/d, respectively), and lower conductivity values estimated for downgradient wells (MW-3 and MW-4, 3.1 and 5.6 ft/d, respectively). A hydraulic conductivity of 2.6 ft/d was estimated from data measured at MW-2. Although the hydraulic conductivity at MW-5 could not be quantitatively evaluated because drawdown was minimal at this well, the minimal drawdown indicates that the hydraulic conductivity near MW-5 is apparently greater than at the other monitoring wells.

Time-drawdown data collected during sampling in 2012 at newer wells MW-7, -8, and -9 indicate an average hydraulic conductivity in the stained soil area of about 28 ft/d; equivalent to that observed at MW-1 in the Southeast Area. Based on these results, the relative hydraulic conductivity of the shallow water-bearing zone decreases from an upgradient to downgradient direction in the Southeast Area of the Site and appears to remain at about 28 ft/d to the northwest towards the stained soil area. This apparent southward decrease in hydraulic conductivity is accompanied by a slight increase in hydraulic gradient, described below.

### 6.2.7 Hydraulic Gradient

Figure 6-5 presents the groundwater level contours based on water levels measured during the September 21, 2005, monitoring event. During each monitoring event, the groundwater flow direction in the Southeast Area has been slightly west of due south (similar to that shown in Figure 6-5). The hydraulic gradient across the Southeast Area has ranged from 0.00072 ft/ft to 0.0015 ft/ft with an average gradient of 0.0010 ft/ft. As noted above in Section 5.4.4.3, the hydraulic gradient in the stained soil area is similar to this average value, though oriented toward the west. Table 5-6 summarizes the hydraulic gradient estimated for several groundwater level monitoring events in the Southeast Area. Closer examination of the contour map indicates that the hydraulic gradient in the northern portion of the Southeast Area, near MW-5, is lower than the gradient in the southern portion of the Southeast Area, near MW-3, MW-4, and MW-6. This spatial variation in gradient correlates well with the apparent spatial variation in hydraulic conductivity described above.

### 6.2.8 Groundwater Flow Velocity

The groundwater flow velocity at the site can be estimated using a modified form of Darcy's Law:

$$v = K*i/n_e$$

where:

$v$ = groundwater seepage velocity in ft/d
$K$ = hydraulic conductivity (ft/d)
$i$ = hydraulic gradient (ft/ft)
$n_e$ = effective porosity (unitless)

Using an average hydraulic gradient across the Southeast Area of 0.001, an average hydraulic conductivity for MW-3 and MW4 of 4.4 ft/d, and an assumed effective porosity of 0.2, the average seepage velocity of groundwater migrating to the south is estimated to be 0.022 ft/d, or approximately 8 feet per year. Due to a slightly higher hydraulic conductivity and similar gradient magnitude, the groundwater seepage velocity to the west in the stained soil area is slightly greater, approximately 0.18 ft/d, or about 66 feet per year

### 6.2.9 Groundwater Recharge and Discharge

The source of recharge for the shallow aquifer in the Site vicinity ultimately is infiltrated precipitation. The completion of capping at the Site as part of the IRM substantially reduces the potential for onsite recharge; consequently, essentially all groundwater migrating across the Site in the shallow aquifer originates from offsite recharge. The similarity in groundwater levels between the shallow aquifer and the deep, confined aquifer, coupled with the very thick low-permeability silt confining layer separating the two aquifers, indicates that vertical migration either up or down in response to transient variations in river stage or recharge conditions likely would lead to negligible vertical flow. Therefore, groundwater flow in the shallow aquifer would be horizontal.

After migrating offsite to the south and west, it is anticipated that groundwater would continue to flow toward either the Willamette River or associated slips; ultimately discharging as 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.

Low concentrations of PCE and some low level detections of PCE biodegradation products have been found in certain Geoprobe sample locations at the Site. The highest concentrations of PCE and PCE biodegradation products are located in the Southeast Area of the Site, with the highest PCE concentration detected at upgradient well MW-05, followed by MW-06 located directly downgradient of MW-05. As noted in Section 5.2.1.2, this distribution of VOC concentrations suggests at least some of the PCE and degradation products originated upgradient and offsite of the Southeast Area.

### 6.2.10 Ecology

Vegetation at the Site is largely non-existent. Areas located outdoors are paved. The indoor facilities also are paved, including the floors of the large manufacturing buildings. Vegetation is limited to opportunistic weed and grass species growing in gravel areas near the fence lines (primarily at the northern boundary of the property). Arboreal vegetation does not exist on or near the property. Ecological exposure pathways to onsite soil is incomplete because: 1) the entire site is capped with pavement or structures and consequently lacks vegetative habitat; and 2) the property is bounded by heavy industry, is surrounded chain-link fencing, and does not contain migratory corridors that would encourage access by mammals or birds.

The Willamette River, located west of the Site, represents a potential point of exposure to wildlife if groundwater containing Site-related COIs would actually discharge to the river. The main channel of the Willamette River represents a significant wildlife habitat resource and supports a variety of aquatic and terrestrial species; however, the Site neither abuts nor discharges surface water to the main channel of the Willamette River.

### 6.2.11 Constituent Sources and Release Mechanisms for Groundwater

The potential COI sources at the Site include historical industrial activities described in Section 2. The potential COI sources at the Site include historical leaks and spills related to past shipyard activities; historical operation of a coal tar enamel demister; and historical used oil storage by prior and present owners and operators. The primary COIs identified at the Site related to groundwater are chlorinated solvents, with relatively low concentrations of petroleum hydrocarbons, PAHs, and zinc.

The primary mechanisms transporting the COIs from the source areas, via groundwater, to potential receptors include the following:

- Shallow groundwater discharge to offsite surface water
- Volatilization of COIs emanating from shallow groundwater to indoor and outdoor air

### 6.2.12 Potentially Complete Human Exposure Pathways and Receptors

Based on current understanding of land and water beneficial use conditions at or near the Site, the most plausible exposure settings considered for characterizing human health risks associated with groundwater exposure are described as follows.

#### 6.2.12.1 Onsite Occupational Worker Scenario

This screening evaluation assumes that current and future occupational workers have the potential to be exposed to groundwater or exposed to volatile COIs emanating from shallow groundwater to indoor air and outdoor air within the area of contaminated groundwater in the southeast area of the Site.

#### 6.2.12.2 Onsite Construction and Excavation Worker Scenario

Due to the depth to shallow groundwater at the Site (8 – 14 feet bgs), there is potential for construction and excavation workers to be exposed to groundwater that accumulates in a deep excavation. This assumes that the construction activity takes place within the area of contaminated groundwater in the southeast area of the Site.

#### 6.2.12.3 Offsite Recreational User Scenario

Future recreational users might hypothetically become exposed to COIs in surface water mixed with a small proportion of shallow groundwater after it discharges and mixes with water in slips next to the Willamette River or along the river shoreline itself. This presumes that:

- These constituents are capable of migrating to surface water without attenuating below concentrations of concern or levels of detection.
- The constituents will then bioaccumulate into fish despite low octanol-water partition coefficients, as explained in the Offsite Recreational User Scenario in Section 6.3.1.
- The fish are then consumed by humans in large quantities annually for 70 years.

The potential route of exposure to groundwater for the offsite recreational user scenario is ingestion of fish that may have accumulated COIs.

**Offsite Drinking Water Scenario**

Based on DEQ's request, groundwater quality results from the most downgradient monitoring wells offsite of the Southeast Area were compared to drinking water screening levels (specifically, MCLs). Potential receptor exposure, as suggested by this comparison, would require several impossible or highly unlikely occurrences, specifically the following:

- Groundwater use from a well
  - No attenuation of VOCs in groundwater as it migrates through the aquifer (despite having strong evidence for natural attenuation based on site geochemistry and presence of degradation products, see Section 5.2.1.2)
  - Installation of a shallow-aquifer drinking water well within the Port of Portland's Terminal 4 area (an area zoned and actively used for heavy industry and served by the City of Portland's municipal water system), despite the documented poor natural water quality in the shallow aquifer (elevated concentrations of naturally-occurring iron, manganese, and arsenic due to reducing geochemical conditions caused by microbial degradation of natural organic matter in the fill used to construct what is now the shallow aquifer) as well as documented poor well yield, despite the certain availability of municipal water supply
- River water use as drinking water
  - Construction of a drinking water intake downstream of combined sewers that discharge raw, untreated sewage into the river up to four times per year under typical circumstances, triggering warnings to not have contact with river water (City of Portland, 2013)
  - As discussed above, no attenuation of VOCs in groundwater as it migrates through the aquifer (despite having strong evidence for natural attenuation based on site geochemistry and presence of degradation products, see Section 5.2.1.2)
  - No mixing between groundwater and surface water as groundwater seepage discharges and migrates vertically and laterally through the river to an hypothetical surface water intake
  - No volatilization, photolysis, hydrolysis, or biodegradation of VOCs in surface water, processes that would act to reduce VOC concentrations in water

### 6.2.13 Potentially Complete Ecological Exposure Pathways and Receptors

Based on the Level I Scoping Assessment (CH2M HILL, 2005b) and the habitat identified within the vicinity of the Northwest Pipe Company property, the most plausible ecological exposure pathways at the Site include the following:

- Potential future exposure of offsite aquatic resources to Site-related COIs detected in shallow groundwater, in the event these chemicals migrate offsite and discharge to surface water
- Potential future exposure of birds or mammals that may ingest Site-related COIs detected in shallow groundwater, in the event these chemicals migrate offsite and discharge to surface water

## 6.3 Risk Screening Results

This section provides the results of the screening human health and ecological risk evaluations. 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 recommended by OAR 340-122-080(5) (DEQ, 2001), and EPA (EPA, 1997), this screening risk evaluation 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, or
- Continuation of the risk assessment process at the next level, or
- Undertake a remedial action

### 6.3.1 Human Health Risk Screening Methodology and Results

All COIs detected in groundwater were evaluated to determine whether unacceptable risks could be posed under an occupational worker scenario and offsite recreational users. In accordance with OAR Rule 340-122; unacceptable risk is defined as:

- A noncancer hazard quotient (HQ) for a COI in groundwater exceeding 1, or a noncancer hazard index (HI) exceeding 1 for similar-acting toxicants
- Excess lifetime cancer risk (ELCR) for individual carcinogens exceeding $1x10^{-6}$ or ELCR for multiple carcinogens exceeding $1x10^{-5}$

#### 6.3.1.1 Exposure Point Concentrations

Exposure point concentrations (EPCs) were identified on a well-specific basis. That is, 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 6.1. This is 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 individual sample data for COIs in groundwater at the Site are provided in Tables 6-2 through 6-4.

#### 6.3.1.2 Human Health Screening Methodology

The human health RSE used to identify groundwater constituents of potential concern (COPCs) at the Site was performed in accordance with current DEQ guidance (DEQ, 2010a). The EPC for each detected constituent was compared to its respective screening benchmark. The following conservative screening benchmarks were used to determine the potential for risk from COIs:

- For the evaluation of effects to 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, 2003).

- For the evaluation of potential for effects to offsite recreational users near the Site (that is, Willamette River), data from groundwater downgradient of potential source areas are directly compared with screening benchmarks provided in the Portland Harbor JSCS (DEQ/EPA, 2007) for human health, for the fish consumption exposure route. Some of the contaminants detected in these downgradient sample points are not attributable to the Site, such as carbon disulfide. Carbon disulfide has not been used at the Site, it has not been detected in the groundwater samples from the Site, nor is it a daughter product of the COIs identified for the Property. Carbon disulfide is attributable to the downgradient sites and is not part of this RSE.

For the first bullet, a summary of RBCs for each exposure scenario is provided in Tables 6-2 through 6-4. For potential offsite exposure points in surface water, a summary of groundwater data compared with JSCS screening benchmarks is provided in Table 6-5.

Although this RSE uses RBCs or similar benchmarks to screen for potential risk, it should be recognized that these numbers are intentionally conservative and may not predict actual health outcomes. Any interpretation of the RBC comparisons provided should consider 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 exposure to both individual COIs and multiple COIs simultaneously within a given medium. The screening methodology used is described below.

- ***Step 1*** - COIs are divided into two groups: carcinogens and noncarcinogens, although some may fall into 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, in mg/L

$RBC_i$ is the risk-based concentration for the “i” individual constituent based on an excess lifetime cancer risk of $1 \times 10^{-6}$ for carcinogens or based on a hazard quotient of 1 for noncarcinogens, in mg/L

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, 2010a).

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.

#### 6.3.1.3 Human Health Risk Screening Results

The results of the RSE are provided in the following subsections.

**Onsite Occupational Worker Scenario**

Data from individual groundwater samples collected from production well, monitoring well, and Geoprobe samples at the Site were compared to DEQ groundwater vapor intrusion RBCs and groundwater outdoor air RBCs. The results of this comparison are provided in Table 6-2 for samples collected in 2007 and Table 6-3 for samples collected in 2001 and 2005. None of the COI concentrations exceeded outdoor air RBCs. The following constituents detected in groundwater exceeded the screening RBCs for indoor air:

- TCE in MW-6 with maximum factors of exceedance of 13 and 3 in 2005 and 2007, respectively
- PCE in MW-6 with a maximum factor of exceedance of 2 in 2005; PCE concentrations in 2007 were below the RBC

These chemicals are considered COPCs and are discussed further below.

**TCE and PCE in Groundwater**

TCE and PCE concentrations exceeded the indoor air vapor intrusion RBCs at one well location in 2005 (MW-6). Both PCE and TCE decreased over the period 2005 to 2007 and PCE levels measured at MW-6 in 2007 were below the RBC. MW-6 is approximately 140 feet from Bay 1 (nearest operations building or office). DEQ guidance recommends evaluating indoor air exposures when volatile constituents in groundwater are located beneath or within 10 feet of a commercial/industrial building (DEQ, 2003). Furthermore, EPA guidance for evaluating the vapor intrusion pathway (EPA, 2002) indicates that only buildings near contamination should be considered for this pathway. EPA recommends that "an inhabited building generally be considered **"**near**"** subsurface constituents if it is located within approximately 100 feet laterally or vertically of known or interpolated soil gas or groundwater constituents." (EPA, 2002)

For groundwater samples collected within 100 feet of the shipping and receiving area and Bay 1 of the main plant building (MW-2 and MW-5), there was no exceedance of RBCs (Tables 6-2 and 6-3). As a result, and consistent with both DEQ and EPA guidance, current occupational worker risk of exposure to VOCs emanating from groundwater to indoor air is acceptable (DEQ, 2003; EPA, 2002). It should also be recognized that this comparison is highly conservative under current and reasonable anticipated future site use conditions, as the high ceilings and large volume of air in Bays 1 through 6, plus their anticipated substantial air exchange rate with outdoor air owing to large open doors inherent to the building design, would allow far more mixing and flushing of indoor air to outdoor air than anticipated when the indoor air RBCs were calculated.

In addition, the TCE and PCE concentrations decreased by over 4- and 2-fold, respectively, between 2005 and 2007. These results show that VOC concentrations are attenuating, suggesting that continuing sources are not present.

**Offsite Occupational Worker Scenario**

Data from individual groundwater samples collected from offsite monitoring wells located downgradient of the Site were compared to DEQ groundwater vapor intrusion RBCs and groundwater outdoor air RBCs. The results of this comparison are provided in Table 6-4 for samples collected in 2004 and 2005. None of the COI concentrations exceeded DEQs groundwater vapor intrusion or outdoor air RBCs.

**Offsite Recreational User Scenario**

Even though COIs from the Site have not been confirmed in surface water in either the Terminal 4 Slip 1 or the IT Slip, for purposes of this RSE, data from individual groundwater samples collected from monitoring wells (T4MW01, T4MW07, T4MW03s, T4MW08, T4MW09, and T4MW10) on Port of Portland property downgradient of the southern part of the Site and Geoprobes (GP201, GP202, and GP203) along the northern edge of the Site near the IT Slip are compared to surface water benchmarks (for fish consumption) provided in the JSCS (DEQ/EPA, 2007). Note that the long history of industrial use of the Terminal 4 area reasonably suggests that some of the constituents detected in Port of Portland monitoring wells may have originated at Terminal 4 itself rather than upgradient of Terminal 4.

The nearest exposure points to groundwater discharging from the Site are hypothetically the Terminal 4 Slip 1 and the IT Slip off the Willamette River, which are not intended to be used, nor are they much used, for fishing. The IT Slip is privately owned and tightly controlled consistent with Department of Homeland Security requirements. Public access to the slip from the shore is intentionally prevented by chain link fencing, a locked and chained gate, and signage warning against trespassing. The Port of Portland's Terminal 4 is similarly protected against public access.

As recommended in the JSCS, the screening benchmarks used are provided based on the hypothetical fish consumption rate of 17.5 grams per day; however, considering access restrictions, it is highly unlikely that individuals could consume their entire diet of fish from these limited access slips. Regardless, the result of the comparisons for this hypothetical exposure scenario is provided in Table 6-5. The following constituents detected in groundwater exceeded the JSCS screening benchmarks (factors of exceedance are provided in parentheses):

***<u>At the 17.5 grams per day Fish Consumption Rate</u>***

PCE at T4MW3 (4.2)
Vinyl chloride at T4MW3 (2.3)

PCE and vinyl chloride are therefore considered COPCs and are discussed further below.

***Evaluation of the Significance of the Groundwater Exceedance***

The recreational user scenario, which evaluates the potential risk to consumers of fish that have accumulated COIs hypothetically originating from groundwater migrating from the Site, is because of the following assumptions:

- All fish consumed by a recreational angler are caught in the Terminal 4 Slip 1 and the IT Slip off the Willamette River. (However unlikely, it is conservatively assumed that anglers would obtain all their fish from these slips.)
- The fish living in the slips spend their entire lives in a limited range. (It is conservatively assumed that fish become contaminated exclusively from groundwater discharge into a specific slip.)
- Groundwater concentrations from the sample locations do not attenuate during transport through the aquifer prior to reaching surface water. (Conversely, data at the Site show that concentrations have and do measurably attenuate within a few feet of the areas of highest concentration.)
- After discharging to the slip, concentrations of water in the slip are the same as groundwater concentrations from the sample locations throughout each consumable fish's lifetime. (In fact, volatile COIs hypothetically discharging to surface water would unavoidably and rapidly dissipate through photodegradation, volatilization, diffusion, and groundwater/surface water mixing.)

The maximum concentrations of PCE and vinyl chloride measured in groundwater samples collected nearest to the hypothetical exposure points were observed in samples collected at T4MW3s in August 2004 and January 2005. Concentrations measured in the most recent sampling event (May 2005) were all below the recreational user fish consumption (17.5 grams per day) screening benchmarks. The PCE and vinyl chloride concentrations measured in May 2005 at T4MW3s were 0.0019 and less than 0.0005 mg/L, respectively. These compounds are VOCs that are generally not persistent in surface water nor considered as bioaccumulative compounds. EPA considers organic compounds with log $K_{ow}$s greater than 4.0 milliliters per gram (mL/g, equivalent to 10,000 mL/g) to potentially have a high tendency to bioaccumulate (EPA, 2000) and all of these compounds are orders of magnitude below this threshold as shown below (EPA, 1996):

- PCE: log $K_{ow}$s = 2.67 mL/g, or equivalent to 468 mL/g
- VC: log $K_{ow}$s = 1.50 mL/g, or equivalent to 32 mL/g

Moreover, DEQ's *Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment* (DEQ, 2007) does not list any organic compounds with a log $K_{ow}$ less than 4.4 mL/g (equal to 25,000 mL/g) as potential bioaccumulative COIs. With consideration of the conservative assumptions listed above and the entire weight of evidence, it is highly improbable that the historical exceedance at one well location (T4MW3s) during one sampling event would result in in-stream concentrations high enough to pose an unacceptable risk to recreational anglers.

#### 6.3.1.4 Conclusions for the Human Health Risk Screening

This human health risk screening for the Site was conducted in accordance with DEQ guidance. Considering the screening results and uncertainties and assumptions (Section 6.4), the following conclusions can be made:

- COI concentrations in groundwater do not pose a current or future risk to occupational workers at the Site from VOCs emanating to indoor or ambient air.
- COI concentrations in groundwater are not high enough to pose an unacceptable risk to recreational users of the Willamette River through the only potentially complete pathway (fish consumption).

Although COI concentrations locally exceed drinking water MCLs in some wells for certain constituents, several lines of evidence, including the conclusions of the beneficial use evaluation, indicate such exposure is not reasonably likely

### 6.3.2 Ecological Risk Screening Methodology and Results

This section provides a general description of the ecological risk screening process for groundwater at the Site. The Level I Scoping Assessment (CH2M HILL, 2005b) indicated that the Northwest Pipe Company property and surrounding properties are heavily developed and highly ruderal (that is, where vegetation is present it consists primarily of plant species capable of living in cleared, disturbed land), minimizing the likelihood that wildlife will reside or forage onsite. However, aquatic habitat in Terminal 4 Slip 1 and the IT Slip, while degraded because of physical aspects of the slips, may be of sufficient quality to support wildlife populations. Therefore, assuming that onsite COIs at the Site could hypothetically reach either slip, an ecological risk screening is undertaken in this RSE for evaluating whether concentrations of COIs detected in shallow groundwater pose a potential for unacceptable risk to aquatic resources and avian/mammalian wildlife using the Terminal 4 Slip 1 and the IT Slip.

#### 6.3.2.1 Ecological Screening Methodology

Based on the findings of the Level I Scoping Assessment (CH2M HILL, 2005b) and a current understanding of habitats and receptors and the COIs, potential ecological exposure pathways were developed for the Site. These potential pathways are discussed above, and depicted in the CSM diagram provided on Figure 6-2.

#### 6.3.2.2 Assessment and Measurement Endpoints

The assessment endpoints identified for groundwater at the Site, and the corresponding measures of exposure and effect, are summarized in Table 6-6.

#### 6.3.2.3 Ecological Risk Screening Results/Discussion

The purpose of the ecological risk screening is to identify which COIs should be classified as constituents of potential ecological concern (CPECs). Similar to the human health screening, a phased screening approach was used. The following conservative screening benchmarks are used for the Phase 1 risk screening:

- For the evaluation of effects to wildlife in the vicinity of the Site (that is, Willamette River), data from groundwater downgradient of the Site and nearest to potential exposure points (that is, surface water) are directly compared with DEQ Level II screening assessment surface water SLVs for birds and mammals (DEQ, 2001).
- For the evaluation of hypothetical effects to aquatic organisms at the Terminal 4 Slip 1 and the IT Slip, data from groundwater downgradient of the Site and nearest to potential exposure points are directly compared with DEQ Level II surface water SLVs protective of aquatic organisms (DEQ, 2001).

**Exposure Point Concentrations**

EPCs are estimated chemical concentrations that a receptor may contact and are specific to each exposure medium. EPCs are represented by concentrations directly measured in site media. For this RSE, maximum chemical concentrations from individual sample points (that is, monitoring wells and Geoprobes) in shallow groundwater downgradient from the Site and nearest to potential exposure points (that is, surface water) are used as a conservative (high) estimate of the EPCs for these comparisons.

**Groundwater Screening Results**

Data from individual groundwater samples collected from monitoring wells (T4MW01, T4MW07, T4MW03s, T4MW08, T4MW09, and T4MW10) and Geoprobes (GP201, GP202, and GP203) at locations downgradient of the Site and nearest to potential exposure points are compared to surface water benchmarks (for protection of aquatic organisms, birds, and mammals) provided in the DEQ Level II SLVs (DEQ, 2001). The nearest exposure points, hypothetically, are Terminal 4 Slip 1 and the IT Slip off the Willamette River. The results of this comparison are provided in Table 6-5. No COI concentrations in the Geoprobe or T4 monitoring wells exceeded Level II SLVs for potential aquatic, bird, or mammalian receptors.

#### 6.3.2.4 Conclusions and Recommendations for the Ecological Risk Assessment

The screening-level ecological risk assessment for the Site was conducted in accordance with DEQ's Level I scoping assessment and Level II screening assessment ecological risk assessment approaches. Considering the Level II screening assessment results and uncertainties and assumptions (Section 6.4), the following conclusions can be made:

- COI concentrations in groundwater downgradient of the Site are low and do not pose an unacceptable risk to aquatic resources using the Willamette River.
- COI concentrations in groundwater are low and do not pose an unacceptable risk to birds and mammals using the Willamette River.

## 6.4 Uncertainty Evaluation

Uncertainties in screening level risk assessment methods may result in either understating or overstating the ecological risks. The latter is more likely because screening level risk assessments are intended to be highly 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

#### 6.4.1.1 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 QA/QC 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 real EPCs partly determines the reliability of the risk estimates.

#### 6.4.1.2 Fate and Transport

These screening risk evaluations make simplifying assumptions about environmental fate and transport of COIs; specifically, that no chemical loss or transformation occurred. This assumption is inconsistent with site data presented in the 2005 draft RI/SCE report (CH2M HILL, 2005b), showing biodegradation via reductive dechlorination and presence of degradation daughter products, as well as data presented in this RI/SCE report, which show ongoing reductions in constituent concentrations over time. It also is inconsistent with known physical/chemical processes that would attenuate the concentrations of VOCs in surface water, if they were capable of reaching the shoreline at concentrations of potential interest. In addition, maximum concentrations were used as estimates of EPCs. Because of this, the EPCs used for screening likely are biased high. For screening purposes, groundwater concentrations were assumed to not attenuate prior to migration towards the river, or after discharge into the water column.

#### 6.4.1.3 Exposure

The estimation of exposure requires many assumptions to 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. This RSE assumes that aquatic organisms are exposed continuously to the concentrations of chemicals detected in groundwater, which overestimates the concentration and duration of exposure for these organisms. Exposure parameters selected to develop screening values are intended to be conservative and likely overstate the actual risks to humans and wildlife at the Site. For example, and as noted previously, fish consumed by anglers would not be expected to be caught solely from the Willamette River slip downgradient of the Site. In addition, fish consumption screening levels used for risk estimation unreasonably assume that recreationally-consumed fish accumulate undiluted groundwater concentrations to steady-state tissue levels, followed by long-term consumption of these fish by the same individual over their lifetime.

Site-related VOC concentrations have not been shown to be present within the main channel of the Willamette River. Even if present, such concentrations would be undetectable and exposures from these routes would be insignificant considering the contrast in flux between shallow aquifer groundwater and the Willamette River. Incidental ingestion and dermal contact of recreational users with surface water was not quantitatively evaluated during this RSE because, for this site, these exposures are only considered potentially complete within the main channel of the Willamette River.

#### 6.4.1.4 Toxicological Data

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 assessment have varying levels of confidence that will affect the usefulness of the resulting risk estimates. Although the screening levels used in this RSE are considered protective of human health and the environment, they should not be construed as site cleanup values.

## 6.5 Risk Screening Conclusions

This section documents the updated human health and ecological RSE for groundwater at the Site, incorporating more recent groundwater data collected from both onsite and downgradient offsite sample locations than were available when the 2005 draft RI/SCE report was prepared (CH2M HILL, 2005b). 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 offsite recreational user scenario. The most plausible ecological exposure pathways downgradient of the Site are the hypothetical future exposure of offsite aquatic resources to Site-related COIs detected in shallow groundwater, and the hypothetical future exposure of birds and mammals that may ingest Site-related COIs detected in shallow groundwater, in the event these chemicals migrate offsite and discharge to surface water.

Conclusions from the human health risk screening are that COI concentrations in groundwater do not pose a current or future risk to occupational workers at the Site, from VOCs emanating to indoor or ambient air, and COI concentrations in groundwater are not high enough to pose an unacceptable risk to recreational users of the Willamette River, through a fish-consumption pathway.

Conclusions from the ecological RSE are that COI concentrations in downgradient groundwater are so low as to pose no unacceptable risk to aquatic resources, birds, or mammals using the Willamette River.

SECTION 7

# Source Control Pathways and Constituents

## 7.1 Source Control Pathway Evaluation

Consistent with previous determinations, in the most recent *Milestone Report for Upland Source Control* (DEQ, 2013b), DEQ determined the following pathways are "not applicable" for the Site, owing to the Site's inland location with no shoreline frontage as well as no wastewater discharges to the river or material air pollution discharges:

- Overland transport/sheet flow
- Bank erosion
- Overwater activities
- Other, which includes factors such as permitted wastewater discharges and air pollution

With respect to Pathway Priority Level, DEQ determined the priority of these pathways for the Site as "none." (DEQ, 2013b)

### 7.1.1 Groundwater Pathway

The groundwater pathway has been the subject of investigations over the past decade to document the nature and both the horizontal and vertical extent of constituents; fate and transport modeling; and a human health and ecological risk assessment discussed in previous sections of this document and previous reports to DEQ (CH2M HILL, 2005b, 2012a, and 2012b). The conclusion of this work has been that the identified, limited groundwater contamination at the Site does not pose an unacceptable risk to human health or the environment. DEQ has reviewed the results of the expanded Groundwater Risk Assessment (CH2M HILL, 2012 and presented in Section 6 of this document) and has agreed with the conclusion that no unacceptable risk exists from site groundwater (DEQ, 2013c). Accordingly, the pathway determination for groundwater is that the pathway is not complete.

### 7.1.2 Stormwater Pathway

Stormwater is the only pathway to be considered for source control purposes. While this pathway is complete, potential sources (that is, exposed soil, stored materials, and settled solids in the stormwater conveyance system) have been removed or controlled by a range of actions that have occurred over the past 15 years. Table 7-1 summarizes 21 separate actions that have been undertaken to control potential sources to stormwater, ranging from straightforward operational improvements such as covering waste bins to major actions, including installing a state-of-the-art stormwater treatment system.

## 7.2 Sediment Quality near Outfall 18/WR-123

The only potential discharge from the Site to the Willamette River is via a single communal outfall that discharges near the east end of the IT Slip, Outfall 18/WR-123, approximately 1,960 feet from the mouth of the slip where it connects with the Willamette River. The Site constitutes approximately 26 percent of the drainage area of the outfall, based on topography, stormwater system mapping, and interpretation of drainage basins for stormwater system elements (CH2M HILL, 2010b). The IT Slip is a closed end harbor basin about 2,200 feet long and 300 feet wide. It contains quiescent water and has limited water exchange with the Willamette River because of its shape, length, and orientation relative to river flow. The LWG completed hydrodynamic sediment transport modeling for Portland Harbor, which confirmed that the sediment in the IT Slip experiences the lowest modeled bed shear (potential sediment erosional forces) found anywhere in the harbor under both normal flow conditions as well as flood flow conditions (LWG, 2009). The slip is a depositional environment rather than an erosional environment. The length, configuration, orientation and hydrodynamic features of the IT Slip effectively isolate sediment in the eastern portion of the slip from the main stem of the Willamette River, a conclusion further substantiated by the constituent fingerprinting presented by CH2M HILL (2009b).

The sediment quality in the IT Slip and around Outfall 18/WR-123 vicinity has been studied (LWG, 2009; CH2M HILL, 2009b). The results indicate that, while constituents such as PAHs and PCBs are detected generally at most sample locations throughout the slip and in the Willamette River, PAHs and PCBs that are consistent with the Site soil and catch basin solids are limited to a small area of approximately 1.2 acres in the immediate vicinity of Outfall 18/WR-123. By comparison, sediment further west within the slip and in the Willamette River outside the slip shows distinctly different signatures of PAHs and PCBs, consistent with the IT Slip serving as a sediment deposition area with negligible water exchange, and, in the eastern part of the slip, no demonstrated sediment exchange with the Willamette River. The following conclusions can be drawn from these findings: the affected sediment in the immediate vicinity of Outfall 18/WR-123

- Is in a stable, non-erosional area of the IT Slip
- Is small (occupying only about 1.2 acres)
- Extends toward the river only about 175 feet to the west from Outfall 18/WR-123
- At its closest, is approximately 1,785 feet (over one-third mile) away from the main stem of the Willamette River

## 7.3 Constituents of Interest for Source Control Evaluation

The COIs for this source control evaluation was based on the following information:

- Review of site history
- Results of extensive historical site characterization sampling
- Review of the JSCS guidance document (DEQ, 2005)
- Review of LWG's stormwater and sediment data collected from the outfall Schnitzer Investment Corp. refers to as Outfall 18 (LWG sample point WR123) (LWG, 2008)

Based on this evaluation and conversations with DEQ, the COI for this evaluation include metals/inorganics (aluminum, antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc), PAHs, PCB Aroclors, TSS, TOC, and VOCs. In addition, DEQ requested that phthalates and organochlorine pesticides also be analyzed in source control samples.

SECTION 8

# Final Source Control Sampling and Evaluation (Work Plan #5)

Potential sources of contamination to the Willamette River have been identified and evaluated in general accordance with DEQ guidance (DEQ, 2010c). As discussed in Section 7, stormwater is the only potentially complete pathway for constituents to reach the Willamette River from the Site. Over the years, Northwest Pipe Company has implemented a number of source control measures, and the Site will continue to evaluate their effectiveness through the sampling required by the Site's NPDES permit.

This section describes source control measures, discusses source control sampling for stormwater consistent with the DEQ-approved work plan, evaluates the results of the source control sampling work, and discusses other lines of evidence supporting the conclusion that Northwest Pipe Company has controlled potential sources at the Site. Table 8-1 provides a roadmap that shows where, in this RI/SCE report, the information described in Appendix C of the *Guidance for Evaluating the Stormwater Pathway at Upland Sites* (DEQ 2010c) may be found.

## 8.1 Source Control Measures

### 8.1.1 System Cleaning

The stormwater system is cleaned twice per year, once in the spring after the seasonally heavy rains have ended (typically in April or May), and once in the fall before the start of the rainy season (generally in September or October). The timing of these clean-out events varies based on the level of production at the plant, accessibility to the storm lines, availability of maintenance staff, and cash flow.

Since 2006, Northwest Pipe Company has retained a number of subcontractors to conduct the cleaning. Most recently, Bravo Environmental NW Inc. of Portland, Oregon, has conducted this work. The crew uses a process referred to as "jet rodding" to remove debris or solid deposits that may accumulate in the stormwater conveyance system and capture them in a vacuum truck operated by the subcontractor.

Once captured, the solids are allowed to settle out of the water. The water, consisting of 3,000 to 5,000 gallons per cleaning event, is discharged onsite to the sanitary sewer through a batch discharge permit obtained by Northwest Pipe Company. The solids, consisting of approximately 1 cubic yard per cleaning event, are processed offsite and disposed of by the subcontractor at the Wasco County landfill.

### 8.1.2 Maintenance

Catch basins at the Site have a replaceable fabric filter in place to retain soil that may be suspended in stormwater entering the stormwater system. Additionally, all catch basins have an oil-absorbent filter sock installed with the sediment filter fabric. The catch basin filters and filter socks are replaced approximately twice each year. In some instances, these may be changed more frequently if the monthly inspection indicates a need for replacement.

In addition to the catch basin filters, Northwest Pipe Company has retained Cowlitz Clean Sweep, Inc. of Portland, Oregon, to sweep the road surfaces throughout the Site on a weekly basis. This practice was implemented on a weekly basis in 2007 to reduce the dust and debris that could be captured in stormwater flowing across road surfaces.

### 8.1.3 Site Improvements

In July 2009, Northwest Pipe Company finished applying a protective coating on the roof of the main plant building to provide a barrier between incident precipitation and zinc-galvanized steel roof. This effort reduced zinc concentrations in run-off from the painted roof by 98 percent.

A re-grading project was completed in October 2009 to segregate and collect precipitation from the area surrounding the mortar lining and coating plant. Stormwater captured in this area is used in production activities and kept separate from the stormwater leaving the Site via permitted outfalls. As stated in the 2009 Paving Plan (CH2M HILL, 2009b), Northwest Pipe Company paved several small areas that previously were unpaved. As part of this focused paving work, the Company re-graded areas around the plant to facilitate stormwater flow, discharge, or collection. This work was conducted to reduce the amount of suspended solids entering the stormwater system and reduce the volume of stormwater on-flow from neighboring facilities. As part of this focused paving work, areas where the existing pavement was failing were repaired and repaved.

As discussed in Section 5.4.3, Northwest Pipe Company completed an IRM in 2012 to address potential risk to site workers posed by PAHs in surface soil and to reduce the potential for soil erosion and transport via stormwater. The IRM, which occurred between July 2011 and December 2012, consisted of hot spot removal, grading, storm drain line improvements, and paving of approximately 4 acres of previously-unpaved soil, completing paving (capping) of the entire facility. In conjunction with this effort, two state-of-the-art stormwater treatment systems were installed (one on each stormwater line leaving the site) as well as various other stormwater improvements, such as covering waste receptacles and installing an isolated drainage system and oil-water separator next to the above-ground fueling system.

Results of NPDES stormwater sampling indicate these improvements/source control measures are effective in reducing the concentrations of constituents of concern from entering the stormwater system and potentially discharging to the Willamette River.

## 8.2 Sampling and Analysis (Work Plan #5)

Sampling activities were conducted in accordance with the DEQ-approved Final Supplemental RI/SCE Work Plan (CH2M HILL, 2009a) and the updated Work Plan 5: Final Stormwater Source Control Evaluation, dated August 2012.

The Site has two NPDES sampling ports (Sample Port 3 and Sample Port 4), located downstream of the Site's stormwater treatment units. These two locations were sampled as specified in the DEQ-approved work plan. Efforts were made to capture stormwater samples that meet the criteria of a "significant storm event"; however, because of the storage and treatment elements of the Site's stormwater treatment system, the concept of capturing samples that meet DEQ's definition of a "first flush" were not relevant. Samples were collected in December 2012 and May 2013. Because of elevated reporting limits for inorganic constituents in the May 2013 samples, an additional set of stormwater samples was collected for inorganic constituent analysis in November 2013. Figure 8-1 shows the time of sample collection compared to the rainfall event noted for the City of Portland's HYDRA rain gauge located at 8900 North Sever Road, approximately 225 feet east of the eastern boundary of the Site. Samples were collected within 10 minutes of manually initiating discharge to the outfall by opening a valve in the treatment system.

Sampling was conducted by lowering laboratory-prepared sample containers into the stormwater that was discharging from Sample Points 3 and 4. Samples containing preservatives (such as for inorganics) were filled from a non-preserved sampling container to avoid over-filling or spilling the preservative. The samples were submitted to Applied Sciences Laboratory in Corvallis, Oregon, an environmental laboratory accredited by the Oregon Environmental Laboratory Accreditation Program, for analysis.

## 8.3 Data Summary and Evaluation

The results of the sampling are summarized in Table 8-2. As expected, because of the combination of remedial work (soil capping and hot spot removal), best management practices (covering waste material, sweeping, and maintaining the stormwater system) and stormwater treatment prior to discharge, constituent concentrations generally were below SLVs, with some exceptions as described below.

### 8.3.1 Inorganic Constituents

The May 2013 data set for inorganic constituents did not meet project quality control expectations due to elevated reporting limits. Consequently, the discussion below focuses on the December 2012 and November 2013 data, which achieved substantially lower reporting limits. In the following discussion, where SLVs were exceeded the text notes the degree of the exceedance, as it is CH2M HILL's understanding that DEQ has, for other sites, used an exceedance factor of 10 (one order of magnitude) as an informal assessment of significance. This approach is appropriate given that SLVs are, by design, low values obtained (in some cases) from the scientific literature, are not formal criteria, and the exceedance of SLVs is not necessarily an indication of excess risk. Of the 12 inorganic constituents analyzed in November 2013, eight were below JSCS SLVs. Four others exceeded their respective SLVs. These were:

- Arsenic – SLV exceeded in both sample point 4 (east side of the Site) and sample point 3 (west side of the Site) with estimated, "J-flagged" results. (J-flagged results indicate a constituent was positively identified in a sample but at a concentration below the recognized accuracy range of the analytical method and is considered an estimated value.) SLV exceeded by a maximum factor of 3 and 4 respectively
- Copper – SLV exceeded in sample point 3 by a factor of 1.8. The sample from sample point 4 was below the SLV
- Lead – SLV exceeded in sample point 3 by a factor of 2.7 and in sample point 4 by a factor of 1.7
- Zinc – SLV exceeded in sample point 3 by a factor of 1.2

Figure 8-2 contains plots developed by DEQ in 2009 of the concentrations of "typical" and "elevated" industrial stormwater concentrations for certain constituents identified by DEQ (DEQ, 2010c). Concentrations of inorganic constituents reported in stormwater discharging from the Northwest Pipe Company Site are well within the typical range noted by DEQ.

Each of the inorganic constituents for which conservative JSCS SLVs were exceeded were present at a concentration only slightly above the SLV, in each case less than an order of magnitude, and well within the levels indicated by DEQ as "normal" for industrial sites in the Portland Harbor. The concentrations of inorganic constituents discharging through the Site's stormwater system do not pose an unacceptable risk of inorganic constituents to potential receptors in the Willamette River.

### 8.3.2 Organic Constituents

#### 8.3.2.1 PCB Aroclors

No PCB Aroclors were detected in stormwater source control samples. Because of the non-detection of PCBs in the stormwater samples, stormwater discharging from the Site does not pose an unacceptable risk of PCBs to potential receptors in the Willamette River.

The JSCS SLVs for PCBs are so low that the concentrations found in rainwater can exceed the PCB SLV. While no rainwater sample was collected in this investigation, studies have identified PCB concentrations in rainwater well above this screening level. Background concentrations of PCBs have been detected in rainwater in the Portland Harbor and measured at various sites throughout the world in concentrations that range from 0.0293 microgram per liter (µg/L) to 0.00035 µg/L (Mandalakis and Stephanou, 2004; Offenberg, J. and J. Baker., 1997), indicating PCBs at these concentrations is a pervasive issue. In Switzerland, the mean PCB concentrations in rainwater sampled from more than 89 rain events remained practically constant at 0.035 µg/L for 12 years (Rossi et al., 2004). Although some of these sites are far away from Portland Harbor, such precipitation-transported PCBs have been found in very remote sites, such as ice in Antarctica (Fuoco et al., 1994). Screening levels set at as low a level as the JSCS SLVs raise a concern that atmospheric deposition of PCBs could be a significant factor in their occurrence in stormwater at a site (Totten et al., 2006).

#### 8.3.2.2 Volatile Organic Compounds

No VOCs were detected above reporting limits. Because of the non-detection of VOCs in the stormwater samples, stormwater discharging from the Site is not likely to pose an unacceptable risk of VOCs to potential receptors in the Willamette River.

#### 8.3.2.3 Organochlorine Pesticides

Of the 19 organochlorine pesticides analyzed, 16 were not detected above reporting limits and three were detected at estimated, “J-flagged” concentrations below reporting limits. The following two constituents exceeded their SLVs:

- Aldrin in one sample from sample point 4, 16.6 times higher than the SLV
- 4,4-DDT, in one sample from each of the two sample points, approximately 65 times the SLV

Pesticides are not manufactured, stored, or used on the Site. The sporadic nature of the detections, as well as the low concentrations detected, indicate that the Site is not a source of pesticides and does not pose an unacceptable risk to potential receptors in the Willamette River. As with PCBs noted above, the SLVs for organochlorine pesticides are so low that ambient concentrations related to anthropogenic background due to historical use (and pesticide manufacturing activity within the Portland Harbor at other sites) may be an important factor in their presence relative to SLVs.

#### 8.3.2.4 Phthalates

Phthalate esters were generally below reporting limits, except for bis(2-ethylehexyl)phthalate and di-n-octyl phthalate. Only di-n-octyl phthalate, at sample point 4, had a concentration that was close to, but slightly above, its SLV, exceeding it by less than a factor of two.

Because phthalates are not used nor are they a byproduct of activities at the Site, phthalates were not included in the suite of analysis for the catch basin solids samples. At DEQ’s request, Northwest Pipe Company included phthalates as an analytical constituent for SCE stormwater samples. The Site’s stormwater data indicates there was a low detection of only one phthalate during the sampling events at concentrations slightly above SLVs. Based on these results (few detections, barely above SLVs), it can be concluded that the Site is not contributing to releases of phthalates at unacceptable levels to the Willamette River via stormwater.

#### 8.3.2.5 PAHs

Low concentrations of PAHs were detected in the stormwater samples, generally at estimated concentrations below reporting limits, with the following PAHs exceeding SLVs:

- Benzo(a)anthracene in one sample from sample point 3
- Benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)perylene in both samples from sample point 3 and one from sample point 4
- Benzo(k)fluoranthene , chrysene, and dibenz(a,h)anthracene in one sample each from sample point 3 and 4

All of the noted PAHs were at concentrations less than an order of magnitude above their respective SLVs. Based on these results (few detections, barely above SLVs), it can be concluded that the Site is not an ongoing source of PAHs at unacceptable levels to the Willamette River via the stormwater system.

## 8.4 Other Lines of Evidence

### 8.4.1 Lower Willamette River Data

Outfall 18/ WR-123 discharges into the IT Slip, which is connected to the Willamette River in the eastern margin of the area identified by the LWG’s Draft Portland Harbor Feasibility Study as Area of Potential Concern (AOPC) 3 (LWG, 2012). While AOPC 3 is characterized by a number of constituents of concern, only a few inorganic constituents (arsenic, chromium, copper, and zinc), PAHs, pesticides, and dioxins were found at elevated levels around Outfall 18. Of these, as with much of the Harbor, risk to potential receptors is driven by PCBs and certain PAHs. As noted in Section 8.2, concentrations of PCBs and PAHs in Northwest Pipe Company stormwater discharge are very low to non-detectable. With the implementation of the new source control measures identified above in Sections 6.1 and 7.2, as well as the ongoing stormwater sampling required in the Site's NPDES permit 1200-Z, potential sources of PAHs and PCBs, as well as inorganic constituents, have been controlled and consequently should not affect stormwater quality leaving the Site at levels that would result in risk to the receptors in the Willamette River.

### 8.4.2 NPDES Stormwater Sampling

As required by the Site's NPDES permit 1200-Z, stormwater samples have been collected for over a decade. A summary of data developed under the current 1200-Z permit compared to permit benchmarks is presented in Table 8-3, and historical NPDES 1200-Z stormwater data are presented in Table 8-4. These data indicate infrequent exceedance of the permit benchmarks for zinc, pH, and TSS. Of these, only zinc is a constituent of concern for Outfall 18/WR-123. As indicated in the data presented in Table 8-4, the zinc concentrations have dropped below screening levels since the coating of the Site's roof in 2009. In addition, with the implementation of the stormwater treatment system, the Site's stormwater is well within the NPDES stormwater permit benchmarks.

### 8.4.3 Sediment Analysis near Outfall 18/WR-123

Sediment characterization in the IT Slip near the outfall serving the Site (Outfall 18/WR-123) shows that the closed, east end of the slip where the outfall is located is depositional with low potential for erosion even during flood events (which isolate the sediment around Outfall 18/WR-123 from the main stem of the Willamette River). Three factors are attributed to this isolation: the lack of erosion in the slip; the documented shoaling at the western mouth of the slip; and the distance of more than one-third mile from Outfall 18/WR-123 to the mouth of the slip.

Constituent fingerprinting (CH2M HILL, 2010b) demonstrates that sediment quality in the immediate vicinity of Outfall 18/WR-123 can be distinguished from sediment quality in other parts of the IT Slip as well as from the main stem of the Willamette River. These observations support the conclusion that historical stormwater discharges from Outfall 18/WR-123 affected sediment quality in only a small area around Outfall 18/WR-123. The data also indicate these effects have not extended to the main stem of the river itself.

### 8.4.4 Stormwater Sample Results Compared to Other Harbor Sites

Figure 8-2 contains plots developed by DEQ of the concentrations of "typical" and "elevated" industrial stormwater concentrations for certain constituents identified by DEQ in its guidance (DEQ, 2010c). Except for the single sample event in which arsenic was found in elevated concentrations, the remaining inorganic constituents are well within the typical range noted by DEQ.

The concentrations in stormwater leaving the Site of organic constituents of concern, for which DEQ provides a comparison chart (DEQ, 2010c), were found to be well below the "toe of the slope" indicating where typical concentrations transition to elevated concentrations. This indicates the stormwater discharging from the Site is at lower concentrations than what DEQ has document as discharging from the majority of other facilities in the Portland Harbor study area.

### 8.4.5 Effectiveness of Source Control Measures

Even though the Site has been in material compliance with its NPDES stormwater permit, Northwest Pipe Company has taken 21 source control actions over the past two decades to improve the quality of stormwater discharging from the site (Table 8-5). Table 8-6 compares the average concentration in stormwater samples collected during site investigation activities in 2007 (11 samples within the site interior) with the average results from the recent source control samples (four samples collected at the two discharges from the Site). As noted in Table 8-6, PAH concentrations have decreased an average of

65 percent, with decreases ranging from 50 to 98 percent for individual compounds. Only Aroclor 1254 was detected in the 2007 samples (three samples). No PCB Aroclors were detected in the recent Stormwater Source Control samples, with reporting limits less than previously detected. Lastly, zinc concentrations in the recent source control samples were 79 percent lower, on average, than in 2007, attributable at least in part to a 98 percent zinc concentration reduction in roof runoff accomplished by coating the roof of the main production building.

These results indicate the source control actions taken by Northwest Pipe Company have had a material and beneficial effect on improving stormwater quality at the Site.

SECTION 9

# Conclusions and Recommendation

Northwest Pipe Company has completed a combination of independent and voluntary site investigation and remediation/source control activities at its 28-acre Portland, Oregon, manufacturing facility over the past 25 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 action taken by the Company.

The site, which has a 70-plus-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, occupies approximately 28 acres and is located about one-third mile from the main stem of the Willamette River. Because of its location within the larger area identified as the Portland Harbor Superfund Site, Site investigation and remediation work conducted since 2000 has been predominately done under DEQ review and approval.

This section provides a brief summary of the conclusions reached through site investigation and remediation at the site, followed by a request for a no-further-action Source Control determination to be issued by DEQ consistent with the JSCS guidance and the objectives of the 2004 Voluntary Agreement between Northwest Pipe Company and DEQ.

## 9.1 Soil

Soil has been investigated in a number of sampling events since the late 1980s. As stained or otherwise affected soil was identified, it was either removed and properly disposed at area solid waste landfills, or evaluated for risk to determine if such removal or other remedial action was appropriate. In general, the majority of the soil at the Site has been paved and capped since the Site originally was developed for industrial purposes. Approximately 4 acres was not paved, and this unpaved soil has been found to contain, consistent with long-term industrial use, concentrations of petroleum hydrocarbons, PAHs, and PCBs ranging from below laboratory reporting limits to above potentially applicable risk-based screening levels for industrial worker exposure. In 2012, Northwest Pipe Company completed a focused soil hot spot removal and site capping interim remedial measure (IRM) to construct a pavement cap over the remaining unpaved soil at the Site. The objective of the IRM was to remove soil in small areas of the Site with PAH concentrations above hot spot levels under the Oregon Cleanup Rules, and to pave the Site to address potential worker exposure and to reduce the potential for erosion and offsite transport via stormwater. Confirmation sampling conducted after hot spot removal, the successful completion of paving, and stormwater sampling results indicate that the remedial objectives were met. This action has eliminated the potential for Site runoff to include eroded soil and made incomplete the potential pathway for worker exposure to soil. A contaminated media management plan was prepared by CH2M HILL and approved by DEQ to provide guidance to plant staff describing how to manage potentially affected media that may be briefly exposed during short-term subsurface construction activities in the future (CH2M HILL, 2011a).

## 9.2 Groundwater

Groundwater at the Site has been characterized using a combination of direct-push grab samples and monitoring well samples from wells installed in areas of particular interest. While low concentrations of hydrocarbons and chlorinated solvents have been detected at scattered locations of the Site, consistent with long-term industrial use, concentrations generally are low and below levels of potential concern, considering the reasonably likely current and future beneficial use of groundwater. Two areas of the Site were investigated repeatedly: the Southeast Area, where VOCs (chlorinated solvents) have been detected in groundwater at a concentration greater than 1 mg/L, and the stained soil area, where PAHs were detected in groundwater at an area where deep stained soil had been identified; evidently in association with a former coal tar enamel demister system.

A groundwater risk assessment and contaminant fate modeling effort determined that Site groundwater does not pose an excess risk to receptors, given current and reasonably likely future beneficial use of groundwater. Moreover, Site groundwater was determined to not pose a risk to potential human or ecological receptors in the Willamette River because concentrations – where present -- would attenuate below levels of potential concern before reaching surface water. In addition, the risk assessment concluded that no excess risk exists for Site workers who may be exposed to vapors from VOCs in the Southeast Area of the Site.

## 9.3 Stormwater

Of all media investigated, only stormwater was determined to have a potentially complete pathway to the Willamette River, as Site stormwater discharges via a single communal outfall to a privately owned slip (the Schnitzer International Terminals Slip). The outfall, referred to as Outfall 18/WR-123, discharges stormwater to the eastern end of the slip approximately one-third mile from the Willamette River main stem. In addition to stormwater originating on the Site, it carries stormwater from approximately 120 additional acres of industrial land in the Outfall 18/WR-123 drainage basin. Stormwater discharges from the Site are permitted under a general 1200-Z industrial stormwater permit and, as a result of best management practices and site improvements – including installation of state-of-the-art stormwater treatment systems on Site stormwater discharge lines – the Site maintains compliance with its stormwater discharge benchmarks.

Stormwater was characterized as part of the Site's Remedial Investigation and Source Control Evaluation. Sampling results indicate that stormwater contains low to below-detection limit concentrations of phthalate esters, PAHs, and inorganic constituents. PCBs and VOCs were not detected in stormwater. Where concentrations of certain constituents were detected above laboratory reporting limits, the reported concentrations were within the range of concentrations determined by DEQ to be typical of area industrial sites (with the possible exception of arsenic, which is naturally occurring and naturally elevated above risk-based concentrations in area soil). Considering the number of improvements made at the Site during its tenure and the improvement in stormwater quality observed due to source control actions (such as zinc, PAH, and PCB reductions), the Site has controlled potential sources to stormwater and does not pose a risk of re-contaminating sediment in either the Schnitzer IT Slip or the main stem of the Willamette River itself.

## 9.4 Recommendation

Based on the findings of the RI/SCE program 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. Moreover, on the basis of source control actions, best management practice implementation, and operation of stormwater treatment systems, the Site does not pose a recontamination risk to the Willamette River. As part of the IRM implementation, the Site already prepared a DEQ-approved Contaminated Media Management Plan to confirm that future management of contaminated media from the Site, if any, will be conducted in an environmentally responsible manner.

Consequently, Northwest Pipe Company requests that DEQ issue a No Further Action Source Control determination recognizing the Site's status as properly managed consistent with the requirements contained in the Oregon Hazardous Substance Remedial Action Rules and associated statute.

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# Tables

# Figures

# Appendix A
# Laboratory Data Reports

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# Appendix B
# Laboratory Data Validation Reports

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# Appendix C
# Bioscreen Tables and Figures

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# Appendix D
# Well and Boring Logs

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# Appendix E
# Select Port of Portland Terminal 4 Slip 1 Figures

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