Cleanup Action Plan
Cadet Manufacturing Company and
Swan Manufacturing Company Portions,
Vancouver Port of NuStar Cadet Swan Site

September 2023

Prepared by
Washington State Department of Ecology

Cleanup Action Plan
Cadet Manufacturing Company and
Swan Manufacturing Company Portions,
Vancouver Port of NuStar Cadet Swan Site

Prepared by

Washington State Department of Ecology
12121 NE 99th St., Suite 2100
Vancouver, WA 98682-2346

September 2023

CITATION

Washington State Department of Ecology, 2022. Cleanup Action Plan Cadet Manufacturing Company and Swan Manufacturing Company Portions, Vancouver Port of NuStar Cadet Swan Site. Prepared by the Washington State Department of Ecology, Vancouver, Washington. September 2023

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

LIST OF TABLES

LIST OF FIGURES

APPENDICES

ACRONYMS AND ABBREVIATIONS

AMEC	AMEC Earth and Environmental, Inc.
AO	Agreed Orders
ARAR	Applicable or relevant and appropriate requirements
COC	Contaminant of concern
ELCR	Excess Lifetime Cancer Risk
EPA	U.S. Environmental Protection Agency
FS	Feasibility study
GPTIA	Groundwater pump and treat interim action
HI	Non-cancer Hazard Index
MCL	Maximum contaminant level
MNA	Monitored natural attenuation
MTCA	Model Toxics Control Act
NPDES	National Pollutant Discharge Elimination System
PCE	Tetrachloroethylene
POC	Point of compliance
RI	Remedial investigations
SMC	Swan Manufacturing Company
TCE	Trichloroethylene
VOC	Volatile organic compound

EXECUTIVE SUMMARY

This document presents the Cleanup Action Plan (dCAP) for the Cadet Manufacturing Company (Cadet) and former Swan Manufacturing Company (SMC) portions of a larger cleanup site referred to in the Washington State Department of Ecology (Ecology) database as the “Vancouver Port of NuStar Cadet Swan” site (the Site). The Site is located in Vancouver, Washington. This dCAP has been prepared in accordance with the Model Toxics Control Act (MTCA) as defined in Washington Administrative Code (WAC) 173-340 and pursuant to requirements established in Agreed Order (AO) DE 18152. AO DE 18152 requires the Port to prepare a feasibility study (FS) and dCAP regarding certain hazardous substances on and in the vicinity of the Cadet and SMC portions of the Site. Remedial action alternatives evaluated in the FS were for (1) the SMC source area and (2) the dispersed residual groundwater concentrations at the Site. As described in the FS, the source area at the Cadet facility has met all regulatory requirements for cleanup, and no further remedial actions are proposed.

The selected cleanup action for the SMC source area includes a combination of institutional controls, engineering controls (future) and monitored natural attenuation (MNA). The cleanup action was selected for the following reasons:

- The cleanup action meets the following threshold requirements: protecting human health and the environment, complying with cleanup standards and all relevant and appropriate requirements (ARARs), and providing for compliance monitoring.
- The cleanup action meets the requirement for a permanent solution with respect to eliminating the exposure pathway. Institutional controls can remain in place through the Sitewide cleanup action restoration timeframe, as needed.
- The cleanup action addresses the source area risk by using institutional controls to eliminate or manage potential exposure pathways.

The selected cleanup action for the dispersed residual groundwater concentrations is MNA. This cleanup action alternative was developed to support shutdown of the existing pump and treatment system to achieve remedial action objectives. The cleanup action was selected for the following reasons:

- A number of interim actions have been conducted at the Site, including the operation of a groundwater pump and treatment system, which has significantly reduced the overall distribution of dissolved-phase contaminants throughout the Site.
- The cleanup action meets the following threshold requirements: protecting human health and the environment, complying with cleanup standards and ARARs, and providing for compliance monitoring.
- There is evidence that natural attenuation is occurring and will continue to occur at a reasonable rate at the site. Therefore, MNA meets the requirement for a permanent solution.
- Groundwater modeling indicates the intermediate zone of the Unconsolidated Sedimentary Aquifer will achieve cleanup levels at all points of compliance (POCs) within 10 years and the deep zone generally within 20 years.
- Groundwater modeling shows that at current conditions, public drinking water receptors will not be impacted above the maximum contaminant levels (MCLs).

Ecology has made a preliminary determination that a cleanup conducted in conformance with this dCAP will comply with the requirements for selection of a remedy under WAC 173-340-360.

1. INTRODUCTION

This document presents the Cleanup Action Plan (dCAP) for the Cadet Manufacturing Company (Cadet) and former Swan Manufacturing Company (SMC) portions of a larger cleanup site referred to in the Washington State Department of Ecology (Ecology) database as the "Vancouver Port of NuStar Cadet Swan" site (the Site). The Site is located in Vancouver, Washington. The areas associated with the various responsible parties of the Site, including the Cadet and SMC portions, are shown in Figure 1-2. Figure 1-3 shows the area encompassed by the extent of the Cadet and SMC portion of the Site as defined in the October 8, 2020, Agreed Order (AO) DE 18152 between Ecology and the Port and is the subject of this dCAP.

This dCAP has been prepared in accordance with the Model Toxics Control Act (MTCA) as defined in Washington Administrative Code (WAC) 173-340 and pursuant to requirements established in AO DE 18152. AO DE 18152 requires the Port to prepare a feasibility study (FS) and dCAP regarding certain hazardous substances on and in the vicinity of the Cadet and SMC portions of the Site (Figure 1-3). An FS was prepared for the Cadet and former SMC sites (Parametrix 2022) and has been approved for public review by Ecology.

A CAP is required as part of the site cleanup process under Chapter 173-340 WAC, MTCA Cleanup Regulations. The purpose of the CAP is to identify the proposed cleanup action for the Site and to provide an explanatory document for public review. This dCAP has been prepared in accordance with Ecology's 2016 Cleanup Action Plan Checklist guidance (Ecology 2016). More specifically, this plan:

- Describes the site.
- Summarizes current site conditions.
- Summarizes the cleanup alternatives considered in the remedy selection process.
- Describes the selected cleanup action of the site and the rationale for selecting this alternative.
- Identifies site-specific cleanup levels and points of compliance (POCs) for each hazardous substance and medium of concern for the projected cleanup action.
- Identifies applicable state and federal laws for the projected cleanup action.
- Identifies residual contamination remaining on the site after cleanup and restrictions on future uses and activities at the site to ensure continued protection of human health and the environment.
- Discusses compliance monitoring requirements.
- Presents the schedule for implementing the CAP.

Ecology has made a preliminary determination that a cleanup conducted in conformance with this dCAP will comply with the requirements for selection of a remedy under WAC 173-340-360.

1.1 Previous Studies

Numerous investigations, interim remedial actions, and other site-related activities have been conducted at the Site since 1998. A summary of the investigations and interim remedial actions for both the Cadet and SMC portions of the Site is included in the FS (Parametrix 2021). A general summary of previous investigations completed is provided below.

1.1.1 Cadet

Since 1998, several investigations and/or phases of investigation have been conducted at or in the vicinity of the Cadet site to delineate the nature and extent of subsurface trichlorethylene (TCE), tetrachloroethylene (PCE), and other related volatile organic compounds (VOCs). Most of the investigations were completed by AMEC, an environmental consulting firm hired by Cadet. Investigations conducted after 2006 were completed by the Port. Specific remedial investigation (RI) activities included:

- Source area investigation and soil interim action
- Installation and sampling of groundwater monitoring wells
- Depth-specific groundwater sampling during drilling of monitoring wells
- Geologic and hydrogeologic evaluation
- Stable isotope analysis and evaluation of groundwater samples
- Groundwater elevation measurements
- Installation of soil gas wells and soil gas monitoring
- Monitoring of indoor air and ambient air

In addition, the following interim actions were implemented to address the VOC contamination in the vicinity of the Cadet site:

- Air sparging/soil vapor extraction: 2002–12
- Recirculating groundwater remediation wells: 2004–12
- Residential soil vapor vacuum systems: 2003–13
- Groundwater pump and treat system: 2009–present

These investigations and interim actions are documented in various reports and technical memos. A detailed summary of the investigation activities is included in the Cadet RI report (Parametrix 2010). In addition, an updated summary of the investigations and interim actions is included in the FS (Parametrix 2021).

1.1.2 SMC

Since 1998, numerous investigations have been conducted at or in the vicinity of the SMC site to delineate the nature and extent of TCE and other VOCs. Specific RI activities included:

- Source area investigation
- Installation and sampling of groundwater monitoring wells
- Depth-specific groundwater sampling during drilling of monitoring wells
- Geologic and hydrogeologic evaluation
- Development of a regional groundwater hydrogeologic model
- Stable isotope analysis and evaluation of groundwater samples
- Groundwater elevation measurements
- Installation of soil gas wells and soil gas monitoring
- Monitoring of indoor air and ambient air

In addition, the following interim actions were implemented to address the VOC contamination in the vicinity of the SMC site:

- Source area excavation – 13,800 cubic yards: 1998
- Source area chemical oxidant injections (7 Events): 2002–04
- Groundwater pump and treat system: 2009–present

These investigations and interim actions are documented in various reports and technical memos. A detailed summary of the investigation activities is included in the SMC RI report (Parametrix 2009). In addition, an updated summary of the investigations and interim actions is included in the FS (Parametrix 2021).

1.2 Regulatory Framework

This dCAP has been conducted in accordance with MTCA as defined in WAC 173-340 and pursuant to requirements established in the October 8, 2020, AO DE 18152 between Ecology and the Port. AO DE 18152 requires the Port to prepare an FS and dCAP regarding certain hazardous substances on and in the vicinity of the Cadet and SMC portions of the Site. This generally includes the area north of NW Harborside Drive (Figure 1-3).

All investigations and activities for both the Cadet and SMC sites have been conducted under the supervision of and in cooperation with Ecology and in accordance with MTCA regulations.

This page intentionally left blank.

2. SITE DESCRIPTION

As defined in the AO (DE 18152), the Site is generally located in the southern half of Section 21 and northern half of Section 28 in Township 1 North, Range 1 East, Willamette Meridian in Vancouver, Washington (Figure 1-1). For administrative convenience, the Site is identified by four portions: (1) the SMC portion between 2001 and 2501 West Fourth Plain Boulevard; (2) the Cadet portion at 2500 West Fourth Plain Boulevard; (3) the NuStar portion at 2565 NW Harborside Drive; and (4) the Kinder Morgan Bulk Terminals, LLC (KMBT) Operating Area portion at 2701 NW Harborside Drive. The four portions are shown on Figure 1-2.

Releases to groundwater of halogenated volatile organic compounds (HVOCs), including TCE and PCE and other related compounds, occurred at the Swan, Cadet and NuStar portions of the Site. HVOCs have come to be located beneath the KMBT Operating Area. Each portion of the Site contains HVOCs in groundwater.

On May 20, 2019, the Port, NuStar, and KMBT entered into Agreed Order No. DE 15806. This required the parties to complete a Supplemental Remedial Investigation (RI) regarding the release or potential release of contaminants associated with materials handled by NuStar (fertilizer products) and by KMBT (copper ore) at a portion of the Site, prepare a Supplemental RI Report, and prepare a draft FS for the Site.

Before 2019, the HVOC groundwater plumes from Swan, Cadet and NuStar source areas were commingled and therefore considered a single Site. Following interim actions taken at the Site, 2019 HVOC groundwater data indicates there is now a clear separation of remaining groundwater contamination in the Swan and Cadet areas from contamination in the NuStar source area. Ecology determined that a preliminary draft FS and CAP can be drafted for the Swan and Cadet portions of the Site separate from those same documents required for the NuStar and Kinder Morgan portion of the Site.

This dCAP only addresses the SMC and Cadet portions of the Site as shown on Figure 1-3. As described in the FS, the source area at the Cadet facility has met all regulatory requirements for cleanup, and no further remedial actions are proposed. Remedial action alternatives evaluated in the FS were for the SMC source area and the dispersed residual groundwater concentrations at the Site. Therefore, the remainder of this dCAP focuses on the remedial actions selected for the SMC facility source area and the dispersed residual groundwater concentrations.

2.1 Site Geology/Hydrogeology

The regional geologic framework and associated groundwater system are based on the geologic setting described and the nomenclature used in the U.S. Geological Survey (USGS) water resources investigation report, *A Description of Hydrogeological Units in the Portland Basin, Oregon and Washington* (Swanson et al. 1993).

There are three regional geologic units (Quaternary alluvium, catastrophic flood deposits, Troutdale formation) in the project area. Regionally, groundwater in the Quaternary alluvium and catastrophic flood deposits is associated with the Unconsolidated Sedimentary Aquifer (USA), while groundwater in the upper section of the Troutdale formation is associated with the Troutdale gravel aquifer (TGA).

Consistent with the USGS Portland Basin nomenclature, there are two regional hydrogeologic units at the Site: the USA and the underlying TGA. The USA occurs in the Quaternary alluvium and catastrophic flood deposits while the TGA occurs in the Pleistocene-aged Troutdale formation.

Three groundwater zones have been established for the USA based on observed geologic and hydrogeologic conditions. Groundwater zones were delineated during the SMC and Cadet remedial investigation efforts to evaluate and describe groundwater quality and groundwater flow trends. The groundwater zones for the USA are as follows:

- Shallow USA groundwater zone – This zone extends from the ground surface to -10 feet mean sea level (msl), which is approximately 40 feet bgs. The shallow groundwater zone of the USA primarily corresponds to the alluvial deposits.
- Intermediate USA groundwater zone – This zone extends from the bottom of the shallow zone (-10 feet msl to -25 msl, depending upon location within the Site) to -100 feet msl (approximately 130 feet bgs). The intermediate groundwater zone of the USA primarily corresponds with the catastrophic flood sand and gravel deposits. This zone can also include a portion of the channel fill deposits and reworked Troutdale formation material.
- Deep USA groundwater zone – This zone extends below -100 feet msl (approximately 130 feet bgs). The deep groundwater zone of the USA primarily corresponds with the channel fill deposits and reworked Troutdale formation material. The deep zone generally corresponds to those portions of the aquifer that are less influenced by groundwater pumping.

Detailed analysis and information regarding the site geology and hydrogeology has been produced in various forms throughout the project effort and is available in the RI reports for both the SMC and Cadet sites (Parametrix 2009; 2010), as well as the FS for the SMC/Cadet site (Parametrix 2022) that precedes this current dCAP.

2.2 Site History

The SMC site is adjacent to and west of the intersection of Fourth Plain Boulevard and Mill Plain Boulevard in Vancouver, Washington (Figure 1-2). The building formerly occupied by SMC was located between 2001 and 2501 West Fourth Plain Boulevard and was demolished in 1986. The northern portion of the site is currently occupied by a pump building associated with the groundwater pump and treatment interim action (GPTIA) system (see Section 2.1.1 below). The remainder of the property is vacant or used periodically for storage (it has been used to store rebar products).

TCE was first discovered by the City of Vancouver in 1997 as part of the Mill Plain Boulevard Extension Project. The project involved the extension and rerouting of Mill Plain Boulevard, a major arterial road in Vancouver, Washington. In 1998, the Port initiated an RI at the SMC site to address TCE and other related VOCs in soil and groundwater in the project area. Between 1998 and 2009, numerous investigations were completed for soil, groundwater, soil gas, and air sampling throughout the project area and were documented in the SMC RI report (Parametrix 2009).

Interim actions were also completed throughout the RI process. From 1998 to 1999, the Port completed an interim action for soil that included the excavation and treatment of approximately 13,800 cubic yards of VOC-contaminated soil from the SMC source area. From 2002 to 2004, the Port completed an interim action for groundwater that included injecting Fenton’s Reagent and potassium permanganate to treat VOCs in groundwater in the SMC source area.

In June 2009, the Port completed construction and startup of the groundwater pump and treat system (referred to as the GPTIA) at the SMC site as an interim action to provide hydraulic containment and treatment of contaminants in the aquifer. The GPTIA is the primary remedial action completed at the Site and has significantly reduced groundwater concentrations throughout the project area. The performance of the GPTIA is the basis for the evaluation of alternatives in the FS. A summary of the GPTIA is provided below.

2.2.1 Groundwater Pump and Treat System

The GPTIA was constructed by the Port from 2008 to 2009, with startup in June 2009. The objectives of the GPTIA were to provide hydraulic containment of the dissolved-phase plume and to remove VOCs in groundwater. Specifically, a groundwater extraction well is used to remove TCE-impacted water from the aquifer, and a forced pipeline transports the water to the treatment system. Air strippers remove the TCE and other VOCs from the water and transfer them to an air stream for discharge to the atmosphere under a Southwest Clean Air Agency permit. The clean treated water is then discharged to the Columbia River via an existing stormwater outfall under a National Pollutant Discharge Elimination System (NPDES) Permit.

The groundwater extraction well (labeled EW-1) is located on the SMC site. EW-1 was drilled in this location for two reasons: (1) this location included the highest concentrations of VOCs associated with the SMC site; and (2) groundwater modeling indicated pumping at this location would capture the dissolved-phase plume in the overall project area.

Well construction consists of a 26-inch-diameter casing with a grout seal to approximately 40 feet below ground surface (bgs), a 22-inch-diameter screen from 40 to 104 feet bgs, and a 22-inch-diameter casing from 104 to 120 feet bgs as a pump chamber sump. Flow rates from the well are variable and controlled by a programmable logic controller located at the treatment plant. The average flow rate from 2009 through 2019 was approximately 2,500 gallons per minute (gpm). Starting in 2020, the flow rate decreased to approximately 1,000 to 1,200 gpm primarily due to fouling of the well screen and other factors including a significant reduction in the overall plume distribution and no longer needing a higher flow rate for hydraulic containment.

The treatment system includes two air strippers that operate in parallel to treat the maximum flow and TCE concentration. The off -gases from each air stripper are discharged to the atmosphere via a 2-foot-diameter stack. The treatment system design was based on removing TCE from a maximum concentration of 200 micrograms per liter (µg/L) down to the analytical reporting limit of 0.5 µg/L. The highest TCE concentration observed in the influent since startup was 52 µg/L in 2009. The treatment system continues to remove VOCs to below the analytical reporting limit of 0.5 µg/L.

The treated water is conveyed by gravity through the discharge line. The discharge line connects to the City-owned portion of a 36-inch stormwater line that runs beneath the Port/BNSF railroad tracks for approximately 333 linear feet. The flow then travels by gravity through the existing 36-inch storm line that runs beneath the rail spur and the Port Terminal 2 area. The 36-inch storm line discharges through an existing bank outfall beneath the Terminal 2 dock on the south side of the Port near Building 500. The effluent is monitored per requirements of the NPDES permit issued by Ecology.

The effectiveness of the GPTIA has been significant with respect to the total mass of VOCs removed from the groundwater. Since startup in June 2009, the GPTIA has extracted and treated a total of 14.47 billion gallons of groundwater and removed approximately 1,312 pounds of VOCs (as of December 2021). As expected, there has been a steady decrease in the annual pounds of VOCs removed, beginning with 263 pounds during the last 6 months of 2009 to the 16 pounds removed during 2021.

The overall extent and concentrations of contamination in all groundwater zones (shallow, intermediate, and deep) have been reduced significantly by the interim actions completed in the Cadet and SMC areas of the Site, as described in Section 2.3.1 below.

2.3 Human Health and Environmental Concerns

The following section provides a summary of the current contamination at the Site and potential receptors from the current contamination.

2.3.1 Current Environmental Conditions

As described in the FS, the remaining areas of the Site that were evaluated for remedial actions include (1) the SMC source area and (2) the dispersed residual groundwater concentrations. The current conditions of these areas are summarized below.

2.3.1.1 SMC Source Area

The current extent of residual contamination in the SMC source area is shown on Figure 2-1. The remaining contamination within the source area appears to be primarily bound within the fine-grained sand layer, which is located between approximately 12 and 25 feet bgs. The tighter-grained material has slowed the cleanup of the shallow source area relative to the layers immediately below the fine-grained sand layer.

TCE is used to evaluate the extent of VOC contamination as TCE concentrations are typically an order of magnitude higher than PCE and 1,2-DCE concentrations. Since operation of the GPTIA began in June 2009, the source area extent and concentrations have decreased significantly. In general, the source area groundwater is represented by shallow monitoring wells IMW-05, MW-05, VMW-08, VMW-09, VMW-10, and VMW-11. Based on the data collected from these wells, as well as the project area monitoring well network, the source area is currently confined to an area encompassing approximately 70 feet by 100 feet. This extent is estimated using areas where current TCE concentrations exceed 25 µg/L (see Figure 2-2). In general, the current source area extent is located beneath a gravel lot where the well house sits and east of the well house and extends east to Mill Plain Boulevard. It is generally confined to the SMC property, with some extension beneath the Mill Plain Boulevard right of way (see Figure 2-2).

For reference, the shallow groundwater plumes over time are shown in Figure 2-3. Historically, the highest concentrations of TCE in the source area have been detected in monitoring well MW-5 and have decreased significantly from a high of 21,000 µg/L (December 2009) to 216 µg/L (August 2020) during operation of the GPTIA.

2.3.1.2 Dispersed Residual Groundwater Concentrations

As described above, the GPTIA was installed by the Port at the SMC site in 2009 to extract and treat dissolved-phase groundwater contaminants in the project area. Operation of this system, in addition to the five other interim actions completed on and in the vicinity of the SMC and Cadet sites, has significantly reduced the overall distribution of dissolved-phase contaminants throughout the Site.

The intermediate and deep Unconsolidated Sedimentary Aquifer (USA) zones were the focus of the evaluation of remedial alternatives for the residual groundwater concentrations. Figure 2-4 shows the current distribution of TCE in the intermediate USA zone in the project area. Figure 2-5 shows the intermediate dissolved-phase contamination in 2009, 2013, and 2020. As shown, limited areas of residual concentrations remain in the intermediate USA zone above MTCA cleanup levels, primarily near MW-05i, MW-23i, MW-15i and MW-37i.

Figure 2-6 shows the current distribution of TCE in the deep USA zone in the project area. Figure 2-7 shows the deep dissolved-phase contamination in 2009, 2013, and 2020. As shown, the residual concentrations in the deep USA zone are relatively low and continue to decrease slowly in response to the overall contaminant removal.

2.3.2 Risk Evaluation and Current Receptors

A risk assessment was completed in accordance with MTCA guidance as part the SMC RI in 2008. Potential risks to human health from exposure to contaminants in groundwater, soil, indoor air, and outdoor air were examined. The various interim actions have significantly decreased the potential risk in all media, and in some cases eliminated risk based on MTCA levels. Figure 2-8 shows the current conceptual site model with potential complete exposure pathways. A summary of the exposure pathways and updated risk evaluation by medium is included below.

2.3.2.1 Groundwater

The potential risk associated with groundwater was evaluated for project area workers, an excavation worker, and nearby residents. While previous remedial actions have significantly reduced groundwater concentrations, current concentrations in the source area are still at a level that suggests potential elevated risks to human health for source area receptors only (all other receptors are below risk levels). Drinking water for the area is currently supplied by the City of Vancouver; in areas located within the urban growth boundary and where the public agency is able to provide a safe and reliable service, connection to the public water source is required as a condition of the building permit. Therefore, there is little potential that a drinking water well would be approved and installed near the SMC site. Thus, the presence of a reliable public drinking water source indicates that there is no current or future unacceptable risk associated with drinking water from the shallow zone. However, there remains a potential complete exposure pathway (future) for intermediate zone groundwater based on its designation as a drinking water source.

2.3.2.2 Soil

The potential risk associated with soil was evaluated for a source area worker and excavation worker. Based on the human health risk assessment, the current risk associated with contaminants of concern (COCs) in soil in the source area is within the acceptable risk range. Further remediation of soil is not warranted based on the potential receptor scenarios evaluated.

2.3.2.3 Indoor Air

The potential risk associated with indoor air was evaluated for the source area workers and neighborhood residents. Measured concentrations of VOCs at limited residences previously indicated elevated cancer risks (i.e., above $1x10^{-6}$) from chronic exposure to indoor air. However, since completion of the indoor air risk assessment in 2008, the U.S. Environmental Protection Agency (EPA) has changed the toxicity factor that must be used to calculate risk for TCE and PCE. Because of the EPA change (and subsequently Ecology-adopted values), the potential risk is substantially lower than originally calculated. Further evaluation conducted subsequent to the RI indicated that no potential risk is present to current residents due to a significant decrease in underlying groundwater concentrations. The indoor air issue has been completely addressed, and Ecology has indicated that no further investigation or remedial actions are required (Ecology 2013).

2.3.2.4 Outdoor Air

The risk from outdoor air was evaluated for a source area worker and a resident (child and adult). Based on the human health risk assessment, the current risk associated with COCs in outdoor air is negligible.

2.3.2.5 Current and Reasonably Likely Future Exposure Pathways

In summary, the following potential complete exposure pathways are addressed by the cleanup action presented in this dCAP.

- SMC source area – Excavation worker direct contact with shallow soil and/or groundwater.
- Dispersed residual concentrations – Occupational worker exposure to drinking water via future potential wells (no current wells) in the project area.

2.4 Cleanup Standards

The following identifies the contaminants of concern at the Site and the associated cleanup levels.

2.4.1 Contaminants of Concern

As specified in WAC 173-340-703, indicator hazardous substances may be selected for the purpose of defining cleanup requirements. COCs representing potential unacceptable baseline risks were selected as indicator hazardous substances for the specific source areas and the dispersed groundwater plume. As described in the respective RI reports and associated risk assessments, the majority of the potential risk within the Site can be attributed to PCE, TCE, and cis-1,2-DCE. The selection of a cleanup standard for human receptors considered the applicable risk pathways (e.g., potable use of groundwater) and specific contaminants that remedial actions need to address.

Currently, only PCE, TCE and cis-1,2-DCE have had recent concentrations exceeding cleanup levels in one or more wells across the site. Therefore, these compounds are considered the constituents of concern (COCs) at the site.

2.4.2 Cleanup Levels

The cleanup levels for the indicator hazardous substances (PCE, TCE, and cis-1,2-DCE) are consistent with established MTCA procedures. MTCA specifies three methods (Methods A, B, and C) that can be used to develop cleanup standards for contaminated media. Method A, B, and C cleanup standards for impacted groundwater are addressed in WAC 173-340-720.

Method A cleanup levels can only be used at simple sites with few hazardous substances and routine cleanups (WAC 173-340-704). Due to the complexity of this project, Method A cleanup levels are not applicable.

Method B can be used to establish cleanup levels at any site (WAC 173-340-705). Method B cleanup levels must be at least as strict as concentrations developed under state or federal law and are calculated using risk equations specified in WAC 173-340-720(4).

Method C cleanup levels are protective of human health and the environment, but are generally less restrictive than those developed using Methods A and B. Method C can be used to develop cleanup levels when the cleanup levels comply with applicable state and federal laws, all practicable treatment methods have been used, institutional controls are implemented, and Methods A and B result in cleanup levels that are below technically achievable concentrations or pose a greater overall threat to human health or the environment (WAC 173-340-706). Method C cleanup levels are calculated using a risk assessment to define acceptable cleanup levels (WAC 173-340-720(5)).

In general, Method B cleanup levels were used for this project. The development of cleanup levels and POCs is addressed in Section 4.3. The established cleanup levels are included in Table 4-1.

This page intentionally left blank.

3. CLEANUP ACTION ALTERNATIVES AND ANALYSIS

A feasibility study was completed and includes an evaluation of cleanup action alternatives for both the SMC source area and the dispersed residual groundwater concentrations (Parametrix 2022). The following provides a summary of the cleanup action alternatives and selection of the preferred remedy(s).

3.1 Cleanup Action Alternatives

The cleanup action alternatives development process included: (1) identifying general response actions and corresponding technologies, (2) screening technologies to eliminate those that are clearly not feasible, and (3) assembling remaining technologies into a list of cleanup action alternatives. Technology screening included all available technologies for each of the cleanup action areas. These include the following general cleanup action categories:

- Institutional controls
- Engineering controls
- Containment
- Removal/discharge
- Ex situ biological or physical/chemical treatment (used for treatment of extracted groundwater)
- In situ biological treatment or physical/chemical treatment

Numerous technologies are included within each category as presented in the FS. For the technologies identified, three criteria (effectiveness, implementability, and cost) were used to provide an initial screen. The identified technologies were further screened to select those that are suitable for the site conditions and COCs, as well as to determine whether the action uses permanent solutions to the maximum extent practicable.

The technologies that pass this screening were assembled into cleanup action alternatives that were evaluated for use at the site. Cleanup action alternatives were developed based on the nature and extent of contamination, potential future use of the site, technological feasibility, and engineering/logistical considerations. The following sections provide the cleanup action alternatives compiled for each area of interest.

3.1.1 SMC Source Area

After consideration of the nature and extent of contamination in the SMC source area, potential future use of the site, technological feasibility, and engineering/logistical considerations, the remedial alternative technologies were reduced to the following four alternatives for evaluation in the FS:

Alternative A – Institutional Controls and Monitored Natural Attenuation (MNA)

Alternative B – Remedial Excavation/Soil Mixing of Source Area

Alternative C – Air Sparging and Soil Vapor Extraction

Alternative D – In Situ Substrate Injection (Chemical Oxidation)

Further evaluation of the remedial alternatives for the SMC source area is summarized in Sections 3.2 and 3.3.

3.1.2 Dispersed Residual Groundwater Concentrations

Additional site-specific conditions that served as criteria to determine the cleanup action alternatives for the dispersed residual groundwater concentrations are provided below:

- The contaminated media include the shallow, intermediate, and deep groundwater zones of the aquifer, which is designated as a sole source aquifer.
- Contamination consists of dissolved-phase VOCs (primarily TCE and PCE).
- The site supports light and heavy industrial usage with heavy traffic. Some residential areas are located near the dispersed residual groundwater contamination.
- Known public drinking water wells are in the project vicinity (CPU, Port, and COV).
- Industrial use of groundwater in the project vicinity includes uses by Port tenants and COV at a wastewater treatment facility at an off-site property.
- The existing pump and treat system at the SMC source area (used as an interim action) was designed to extract and treat groundwater at the Site. Dispersed residual groundwater contamination as a result of operation of the interim action since 2009 is limited to localized areas and approaches MTCA Method B cleanup levels.
- Interim actions have been conducted in the Cadet and SMC source areas to reduce source area concentrations. The remedial action for the dispersed residual groundwater contamination will supplement and support any selected additional source area remedial action.

Using these considerations, the availability and success of the pump and treat system focused the technological evaluation on the feasibility of alternatives that support site closure. This was generally limited to continued operation of the pump and treat system and/or MNA. After consideration of the above site-specific conditions, the remedial alternatives for the dispersed residual groundwater concentrations were reduced to the following two for evaluation in the FS:

Alternative A – MNA

Alternative B – Continued Pump and Treat

Alternative A involves termination of the use of the existing pump and treat system and then allowing MNA to address the low concentrations of dispersed residual groundwater contamination in the project area. Alternative B assumes that the current pump and treat system will continue operation to contain and treat dispersed residual groundwater concentrations. Further evaluation of the remedial alternatives for the dispersed residual groundwater concentrations is summarized in Sections 3.2 and 3.3.

3.2 Initial Screening of Alternatives

The compiled cleanup action alternatives were evaluated based on the requirements of WAC 173-340-360. The following summarizes these requirements.

- Threshold requirements (WAC 173-340-360(2)(a)):
  - Protect human health and the environment.
  - Comply with cleanup standards.
  - Comply with ARARs.
  - Provide for compliance monitoring.
- The selected cleanup action shall:
  - Use permanent solutions to the maximum extent practicable.
  - Provide for a reasonable restoration timeframe.
  - Consider public concerns.
  - Prevent or minimize present and future releases and migration of hazardous substances in the environment.
  - Not rely primarily on dilution and dispersion unless the incremental costs of any active remedial measures over the costs of dilution and dispersion grossly exceed the incremental degree of benefits of active remedial measures over the benefits of dilution and dispersion.
- For groundwater cleanup actions:
  - If practicable, a permanent cleanup action shall be used to achieve the cleanup levels for groundwater at the standard POC.
  - Where a permanent cleanup action is not practicable, the following measures shall be taken:
    - Conduct treatment or removal of the source.
    - To the maximum extent practicable, implement groundwater containment including barriers or hydraulic control through groundwater pumping, or both, to avoid lateral and vertical expansion of the groundwater volume affected by the hazardous substance.
    - Institutional controls shall be used if concentrations above Method A or B cleanup levels remain at the Site.

The FS included a detailed evaluation of each of the alternatives individually for both the SMC source area and the dispersed residual groundwater concentrations. A disproportionate cost analysis was also completed as specified in WAC 173-340-360(3)(e) and (f) and detailed below.

3.3 Detailed Evaluation of Alternatives

As presented in the FS, each alternative was evaluated individually against the threshold requirements. The disproportionate cost analysis was used to assess the alternatives on a comparative basis. Costs are determined to be disproportionate to benefits if the incremental cost of a more expensive alternative over that of a lower-cost alternative exceeds the incremental degree of benefits achieved by the more expensive alternative. As specified in WAC 173-340-360(3)(e) and (f), the disproportionate cost analysis includes evaluation criteria that are a mix of qualitative and quantitative factors. These include:

- Protectiveness
- Permanence
- Long-Term Effectiveness
- Short-Term Risks
- Implementability
- Consideration of Public Concerns

For this project, a seventh criteria (Reduce Disparate Impacts), was added to the disproportionate cost analysis as a result of the Port's inclusion of environmental justice considerations.

- Reduce Disparate Impacts – The relative ability for the remedial alternative to reduce potential disproportionate impacts or outcomes (health, community quality, etc.) during both implementation of the remedy and continued operation on the highly impacted community. Ecology defines a highly impacted community as likely to bear a disproportionate burden of public health risks from environmental pollution, such as minority, low-income, tribal, or indigenous populations.

The following provides a summary of the disproportionate cost analysis for each cleanup action area. Tables 3-1 and 3-2 provide a summary of the comparison and relative ranking of alternatives.

3.3.1 SMC Source Area Alternatives

A comparative analysis of the alternatives was completed using the above criteria. The comparative analysis allowed for each alternative to be compared relative to others with respect to the primary evaluation criteria. Each alternative was scored relative to the other alternatives. A scale of 0 (least beneficial) to 10 (most beneficial) was used for each criterion. Table 3-1 presents an overall comparative summary of the four alternatives. Important differences and similarities among the alternatives are discussed below for each of the criteria.

Protectiveness

Alternative A (Institutional Controls) meets the RAOs and, thus, meets the protectiveness criterion. Alternative B (Remedial Excavation) appears to achieve protectiveness in the timeliest manner due to direct removal of the source area. Alternatives C (AS/SVE) and D (Substrate Injection) are similar in terms of protectiveness due to similar target areas and technologies.

Permanence

Alternative A (Institutional Controls) is permanent and effective against eliminating exposure and addresses the potential unacceptable risks posed by the site; however, it does not treat the contaminants and relies on institutional controls and MNA. Alternative B (Remedial Excavation) is generally permanent as it includes direct removal of contaminants; however, the contaminants are transferred to a landfill. Alternatives C (AS/SVE) and D (Substrate Injection) generally have similar permanence as they are both treating/destroying contaminants.

Long-Term Effectiveness

Alternative A (Institutional Controls) achieves long-term effectiveness to eliminate exposure but does not actively treat contaminants. Alternatives B through D are similar, relying on remedial efforts to provide continued protection. Alternative B (Remedial Excavation), however, provides a greater level of long-term effectiveness due to the complete removal of impacted soil for off-site disposal. Alternatives C (AS/SVE) and D (Substrate Injection) are scored slightly lower due to some uncertainty regarding the remedial actions.

Short-Term Risks

The implementation risk for Alternative A (Institutional Controls) is moderate due to the potentially long timeframe to achieve cleanup levels. Alternative B (Remedial Excavation) has relatively high short-term risk related to the significant construction project that must occur to implement the action. In addition, shoring and dewatering issues contribute to a high short-term risk. Alternatives C (AS/SVE) and D (Substrate Injection) have similar short-term risks due to the complexity of the source area geology. Alternative C was scored lower than Alternative D due to the infrastructure involved for the AS/SVE system.

Implementability

Alternative A (Institutional Controls) is the easiest to implement as it requires no action other than restrictive covenants (and sitewide compliance monitoring for MNA). Alternative B (Remedial Excavation) would be difficult to implement due to the significant dewatering and shoring involved, as well as available space for stockpiling and disruption of the site. Alternative C (AS/SVE) is implementable but has significant issues associated with the geology and target area; precise placement of the AS wells may not be feasible. There are similar concerns with the implementability for Alternative D (Substrate Injection) relating to the target area.

Consideration of Public Concerns

The proposed actions would be submitted for public comment through the Ecology process and any potential concerns raised would be addressed prior to design and implementation. There may be public concerns associated with Alternative A as it requires no further action or cleanup. Some concerns associated with Alternative B may be realized due to disruption of the site and surrounding area for a large construction/excavation project. It is anticipated that potential concerns of the public would be similar among the remaining alternatives.

Reduce Disparate Impacts

Alternative A does little to reduce the already very low potential impacts on the nearby FVN community but does provide restriction of the SMC site from future groundwater use and provides isolation of subsurface contaminants from site workers with protection measures. All of the active alternatives (B, C and D) provide some level of contaminant removal that conceptually could reduce potential impacts to the community, although these current impacts are already very low or negligible. Alternatively, implementation of a large-scale remediation project at the SMC site has potential to impact the FVN community through increased vehicle traffic, noise, emissions such as dust (for Alternative B) and contaminants through remedial equipment emissions (for Alternative C), or remobilization (Alternative D).

3.3.1.1 Scoring and Ranking of Alternatives

The scoring for each alternative, shown in Table 3-1, was conducted using a relative basis from 0 to 10 for each of the criteria (prior to evaluation of costs). The total score for each alternative is as follows:

Alternative A – 54

Alternative B – 43

Alternative C – 49

Alternative D – 41

After consideration of the individual screening and comparative analysis, the highest scored remedial alternative was Alternative A –Institutional Controls, Engineering Controls (Future) and MNA. Alternative A was shown to be effective, reliable, implementable, and has moderate implementation risk. Alternative A also achieves all of the RAOs established for the SMC source area.

3.3.2 Dispersed Residual Groundwater Concentrations Alternatives

The following provides a summary of the remedial action alternative for the dispersed residual groundwater concentrations.

3.3.2.1 Alternative A – Monitored Natural Attenuation

This alternative primarily consists of MNA and was developed to support shutdown of the existing pump and treatment system to achieve RAOs. Natural attenuation processes include a variety of physical, chemical, and biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in groundwater. Periodic monitoring is necessary to demonstrate that contaminant concentrations continue to decrease at a rate sufficient to ensure that they do not become a threat to human health or the environment.

According to MTCA as described under WAC 173-340-370(7), MNA as a remediation alternative is most appropriate for sites with the following characteristics:

- Source control has been conducted to the maximum extent practicable.
- Leaving contaminants on the site during the restoration timeframe does not pose an unacceptable threat to human health or the environment.
- There is evidence that natural biodegradation or chemical degradation is occurring and will continue to occur at a reasonable rate at the site.
- Appropriate monitoring is conducted to ensure that contaminant concentrations continue to decrease, the natural attenuation processes continue to occur, and human health and the environment are protected.

For the dispersed residual groundwater contamination associated with the SMC and Cadet sites, MNA technology would be applicable because:

- Various source control activities (e.g., interim actions at Cadet and SMC) have been completed that have reduced concentrations significantly in the source areas and throughout the groundwater aquifer. Only a small area of impacted saturated soil in the source area (primarily the fine-grained sand layer) remains.
- Residual groundwater contamination does not pose a threat because potential receptors do not have direct contact with the contaminants remaining at the site and the contamination does not pose a risk to human health or the environment because there is no complete exposure pathway. Potential future exposure pathways via drinking water from regional supply wells can be demonstrated to not be impacted by current contaminants. An MNA sampling program can be employed to ensure that assumptions for exposure are continually validated.
- There is evidence that natural attenuation is currently occurring and has significantly decreased contaminant concentrations. As an example, concentrations of contaminants located beyond the capture zone of the GPTIA have continued to decrease. Groundwater concentrations of all contaminants at the Site have been declining, are now only found in localized areas, and are expected to achieve cleanup levels in the intermediate zone of the Unconsolidated Sedimentary Aquifer within 10 years and in the deep zone generally within 20 years.
- Groundwater monitoring is required for the Site and has been conducted for the source areas and the dispersed groundwater plume. As part of the implementation of the FS remedy, an MNA sampling program will be developed and implemented. This will include establishing points of compliance (POCs) and sampling methodology and criteria.
- Land use restrictions will be in place to protect potential exposure through direct contact or ingestion of groundwater that exceeds cleanup levels (source area).
- The availability of the current groundwater pump and treat system for the SMC source area provides a contingency element if MNA is not proceeding as expected or an additional remedial action is required to supplement MNA. This contingency will be included in the development of the MNA implementation plan in the corrective action plan, including criteria for permanently shutting down and dismantling the GPTIA system.

3.3.2.2 Alternative B – Continued Pump and Treat

This alternative primarily consists of continued operation of the pump and treatment system and was developed as an alternative to shutting down the system and to MNA. The pump and treatment system in this alternative is assumed to be operated at the current reduced rate of approximately 1,200 gpm and operated until MTCA Method B cleanup levels are achieved at all POCs in the intermediate USA zone.

Since the source controls are the same as those described for Alternative A, this alternative is primarily an evaluation of whether additional benefits are gained by continued operation of the pump and treatment system to achieve cleanup levels in the intermediate zone versus implementation of MNA (i.e., active versus passive remedial action). The pump and treatment system will be operated until cleanup levels are obtained at all POCs throughout the intermediate USA zone. Based on the past and current groundwater contaminant trends in the intermediate zone wells, as well as the significant reduction of the groundwater plume areal footprint since operation of the GPTIA began in 2009, it is expected that cleanup levels would be achieved in less than 10 years.

The groundwater model simulations described for Alternative A were also used to evaluate the effectiveness of the pump and treat system. Key findings associated with continued pump and treatment are summarized below:

- Groundwater modeling indicates that the low concentrations of dispersed groundwater contamination in the intermediate zone will not impact regional pumping wells in the vicinity (CPU, COV, Port, etc.) above the MTCA Method B cleanup levels in the absence of EW-1 operation (i.e., turning the system off). Thus, any active alternative, such as pump and treat, is considered additionally conservative.
- Groundwater modeling shows that the SMC source area will not impact the intermediate zone above the MTCA Method B cleanup level. This can be achieved whether the pump and treatment system is on or off. Thus, the active alternative is considered additionally conservative.
- When compared to Alternative A, the timeframe to achieve cleanup levels through GPTIA pumping at the current rate is likely to be similar. The GPTIA has effectively eliminated the dispersed groundwater plume, and only localized areas of residual contamination remain. It is not apparent that operation of the system would reduce those disparate areas in a significantly shorter time period.
- It is apparent that the efficiency of the pump and treatment system, relative to the amount of groundwater pumped and VOCs recovered, has been decreasing at a steady rate and appears to be nearing its feasible limit. The cost for operation and maintenance of the system, including electrical costs, is significant relative to the benefit the GPTIA currently provides. The assumed additional 5 years of pumping does not appear to have substantial benefit.

3.3.2.3 Disproportionate Cost Analysis

A disproportionate cost analysis was completed to further evaluate the alternatives. Table 3-2 presents an overall comparative summary of the two alternatives. Important differences and similarities among the alternatives are discussed below for each of the criteria.

Protectiveness

Current receptors (drinking water wells) are protected with Alternatives A (MNA) and B (Continued Pump and Treat). Alternative B is thought to provide a slightly greater level of protectiveness by incorporating a longer pump and treat timeframe into the remedy, thus potentially reducing the timeframe to achieve the MTCA cleanup levels.

Permanence

Alternatives A (MNA) and B (Pump and Treat) generally have similar permanence as they are both reducing residual concentrations to MTCA levels and protecting drinking water receptors. However, Alternative A relies on MNA to ultimately reach cleanup levels. Alternative B is thought to provide a slightly greater level of permanence by incorporating a longer pump and treat timeframe into the remedy, thus potentially reducing the timeframe to achieve the MTCA cleanup levels.

Long-Term Effectiveness

Alternatives A (MNA) and B (Pump and Treat) are similar with respect to long-term effectiveness. Each relies on remedial efforts to provide continued protection from the source areas and ultimately achieve cleanup levels in the residual groundwater plume. Alternative B, however, provides a slightly greater level of long-term effectiveness due to the removal of impacted groundwater through treatment, while Alternative A relies on the monitoring of natural processes. The effectiveness of both alternatives would be evaluated based on similar monitoring programs. Alternative B would likely require significantly more maintenance than Alternative A.

Short-Term Risks

There is little risk associated with Alternative A (MNA) as no construction or implementation is required and the ongoing measures of effectiveness (i.e., groundwater monitoring) are well established in the project area. There is also little risk associated with Alternative B (Pump and Treat) as the infrastructure has already been constructed and the operational process has already been implemented.

Implementability

Both alternatives are considered implementable and technically feasible. MNA (Alternative A) is very implementable and has been ongoing at the site for several years. Alternative B is also very implementable as the current pump and treat system at SMC would be used; it is operational and has no significant concerns. Since Alternative B uses infrastructure and mechanical equipment, with the potential for malfunction and maintenance, this technology is less implementable than Alternative A.

Consideration of Public Concerns

The proposed actions would be submitted for public comment and concerns raised would be addressed prior to design and implementation. It is anticipated that potential concerns of the public could be addressed as appropriate. It is not expected that any public concerns that would prevent the implementation of the alternatives would be received or could not otherwise be rectified. Alternatives A and B are generally scored the same. However, the consideration of greenhouse gasses (GHGs) in operation of the pump and treatment system for Alternative B, as well as off-gassing of VOCs emitted through the treatment system stack to the atmosphere, Alternative B was scored slightly less than Alternative A which have no such direct emissions nor electricity usage.

Reduce Disparate Impacts

The Fruit Valley Neighborhood (FVN) is considered a highly impacted community that may have disproportionate impacts due to several outlying factors, including demographics and environmental conditions. However, little or no impact from the current groundwater cleanup efforts or associated residual conditions were identified. In addition, public engagement did not identify specific impacts or concerns that would affect the selection of the remedial alternative for the dispersed residual groundwater contamination. Thus, the two alternatives developed are not significantly different in terms of reducing disparate impacts to the FVN community. However, the following factors were considered in the scoring of this criteria.

Alternative A has some potential to reduce impacts to the community through reduction of GHG-equivalent emissions by eliminating large electricity usage. Shut down of the pump and treatment system will also include a potential benefit to the community due to the elimination of VOCs emitted through the air stripper from the treatment process potentially upwind of the FVN. However, this benefit may be small as all past and current emissions from the treatment system has met the Southwest Clean Air Agency (SWCAA) permit requirements. Alternative B includes continued operation of the GPTIA for 5 years, which includes additional VOC emissions from the air stripper stack that could have some impact on the nearby community. Although it appears to be low or negligible, Alternative B may have some added benefit by reducing the groundwater concentrations near the FVN in a more-timely fashion. However, Alternative A was scored higher than Alternative B primarily due to the VOCs emissions and reduction of GHGs.

3.3.2.4 Scoring and Ranking of Alternatives

The scoring for each alternative, shown in Table 3-2, was conducted using a relative basis from 0 to 10 for each of the criteria. Prior to evaluation of the disproportionate costs, the score for each alternative is as follows:

Alternative A – 59

Alternative B – 56

An evaluation of Alternative A (MNA) versus Alternative B (Pump and Treat) suggests that no significantly greater benefit is achieved through implementation of Alternative B. The timeframe for achieving cleanup of the dispersed residual groundwater contamination is similar, but it is suspected that a slight increase is gained by active operation of the pump and treat system as described for Alternative B. However, the reduction of risk and protection of human health and the environment is not any greater than with Alternative A. In addition, both alternatives are considered protective, permanent, and implementable, and have little short-term risks or public concern issues. The cost to implement Alternative B over Alternative A is significantly higher, but it does not achieve a higher incremental degree of benefit.

Thus, after consideration of the individual screening and comparative analysis and the disproportionate cost analysis, the highest scored remedial alternative was Alternative A, MNA. Alternative A was shown to be effective, reliable, implementable, and has little implementation risk.

4. DESCRIPTION OF SELECTED REMEDY

The following provides a summary of the selected remedial alternative including design elements of the cleanup action, cleanup standards and POCs, restoration timeframes, compliance monitoring, and schedule for implementation.

4.1 Site Description

The Cadet and SMC sites are part of a larger cleanup site referred to as the "Vancouver Port of NuStar Cadet Swan" Site. The areas associated with the various responsible parties of the Site are shown in Figure 1-2. Figure 1-3 shows the area encompassed by the extent of the Cadet and SMC portion of the Site as defined in the October 8, 2020, AO DE 18152 between Ecology and the Port. The area shown on Figure 1-3 is the only area addressed by this dCAP.

4.2 Description of the Cleanup Action

Remedial alternatives were evaluated separately in the FS for (1) the SMC source area, and (2) the dispersed residual groundwater concentrations. The selected cleanup action components for each of the two areas are described below.

4.2.1 SMC Source Area

The selected cleanup action for the SMC source area includes a combination of institutional controls, engineering controls (future building construction), and MNA. As described in the FS, the cleanup action was selected for the following reasons.

- The cleanup action meets the following threshold requirements: protecting human health and the environment, complying with cleanup standards and ARARs, and providing for compliance monitoring.
- The cleanup action meets the requirement for a permanent solution with respect to eliminating the exposure pathway. Institutional controls can remain in place through the Sitewide cleanup action restoration timeframe, as needed.
- The cleanup action addresses the source area risk by isolation.

The components of the cleanup action are described below.

4.2.1.1 Institutional Controls

In general, institutional controls include the following:

- Implementation of groundwater use restrictions (restrictive covenant, contaminated media management plan, or equivalent) for the SMC property to prevent groundwater from being used and/or to prevent any other potential exposure to hazardous substances at SMC.
- Annual reporting of monitoring results to support institutional control requirements.

Institutional controls would be placed on the Swan portion of the Site in the form of a restrictive covenant to prevent potential exposure. Potential site worker exposure to groundwater via drinking water will be managed by implementing a restrictive covenant for drinking water wells on the SMC site. Since operation of the GPTIA began in 2009, the footprint of the shallow groundwater zone contamination exceeding MTCA cleanup levels has been significantly reduced. As shown on Figure 2-2, the current impacted groundwater zone is located in the northeast corner of the SMC property and encompasses an area of approximately 70 by 100 feet. The area of groundwater with concentrations exceeding the MTCA cleanup level extends slightly off the SMC property beneath W. Mill Plain Boulevard. Placing a restrictive covenant for drinking water on the SMC site will eliminate that potential pathway. In addition, drinking water wells could not be placed within the Mill Plain Boulevard right of way. A restrictive covenant would not be placed on any of the adjacent private property. However, all drinking water within the area is supplied by the City of Vancouver from production wells located outside the project area, and the potential for drinking water wells to be placed within the Fruit Valley Neighborhood (FVN) or other areas near the site *and* targeting shallow groundwater is extremely low or negligible. Any domestic wells in the FVN would not likely come to be affected by contamination at the SMC property. Based on these considerations, the placement of a restrictive covenant on the Port-owned SMC property will effectively eliminate the drinking water exposure route as a complete pathway.

As shown on Figure 2-1, residual soil and groundwater contamination is present in the source area at concentrations that are significantly reduced, but still above MTCA cleanup levels. There is no current exposure route to site workers. However, in the event of construction or utility work with deep excavations (greater than 15 feet bgs) there is some potential for construction worker exposure to subsurface contaminated media. This potentially complete exposure pathway will be managed through the preparation of pre-construction documents and health and safety plans. A contaminated media management plan will be prepared for the site to guide future construction activities, if any. The plan would include health and safety protocols and measures and requirements for soil, vapors and/or groundwater encountered during construction. The requirement for health and safety measures during construction will effectively limit and/or manage the construction worker exposure route as a complete pathway.

4.2.1.2 Engineering Controls (Future)

Based on the current presence of VOCs (TCE and PCE) in shallow groundwater at concentrations above MTCA cleanup levels in the source area, vapor intrusion to indoor air of an overlying building is a potential future complete exposure pathway (no current occupied building exists). A restrictive covenant for future use of the site will be established. The site is currently zoned and used for industrial purposes. This land use will be maintained; no residential development will be allowed.

Future development of the site could include office space or other occupied building use. Potential site worker exposure to indoor air via vapor intrusion will be managed by completion of a vapor intrusion assessment at that time and evaluating if implementation of mitigation (i.e., engineering controls) is deemed necessary for occupied buildings on the property. If the vapor intrusion assessment indicates that engineering controls are needed, alternatives will be examined, including potential use of a vapor barrier, passive venting systems beneath the building foundation, or building heating, ventilation, and cooling controls such as maintaining internal positive pressure or other similar technologies. Building design and use can also be considered to avoid vapor intrusion (e.g., location of parking structures versus occupied area). The requirement for a vapor intrusion assessment on a future building will be included as part of the restrictive covenant. Based on these considerations, the placement of a restrictive covenant on the Port-owned SMC property and future design considerations and evaluation requirements will effectively limit the vapor intrusion exposure route as a complete pathway.

4.2.1.3 MNA (In Coordination with Sitewide Selected Remedy)

MNA uses natural processes to reduce COC levels to acceptable concentrations. These processes include natural biodegradation, dispersion, dilution, sorption, volatilization, and chemical and biological stabilization, transformation, or destruction of hazardous substances. Monitoring is conducted to verify that these processes are actively reducing hazardous substance concentrations.

This alternative uses the Sitewide MNA approach to reduce the dispersed residual groundwater concentrations associated with the SMC and Cadet sites. Focused monitoring of the SMC source area will be incorporated into the overall Site compliance monitoring plan (see Section 4.6) to ensure that the compliance objectives are being met and contingency measures can be employed, as needed.

4.2.2 Dispersed Residual Groundwater Concentrations

The selected cleanup action for the dispersed residual groundwater concentrations is MNA. This cleanup action alternative was developed to support shutdown of the existing GPTIA to achieve remedial action objectives. The cleanup action was selected for the following reasons:

- The operation of the GPTIA has significantly reduced the overall distribution of dissolved-phase contaminants throughout the Site.
- The cleanup action meets the following threshold requirements: protecting human health and the environment, complying with cleanup standards and ARARs, and providing for compliance monitoring.
- There is evidence that natural attenuation is occurring and will continue to occur at a reasonable rate at the Site. Therefore, MNA meets the requirement for a permanent solution.
- Groundwater modeling indicates the intermediate zone of the Unconsolidated Sedimentary Aquifer will achieve cleanup levels at all POCs within 10 years and in the deep zone generally within 20 years.
- Groundwater modeling shows that at current conditions, public drinking water receptors will not be impacted above the MCLs.

For the dispersed residual groundwater concentrations associated with the SMC and Cadet sites, MNA technology is applicable because:

- Various source control activities (e.g., interim actions at Cadet and SMC) have been completed that have reduced concentrations significantly in the source areas and throughout the groundwater aquifer. Only a small area of impacted saturated soil in the source area (primarily the fine-grained sand layer) remains (shown on Figure 2-1).
- Residual groundwater contamination does not pose a threat because potential receptors do not have direct contact with the contaminants remaining at the Site, and the contamination does not pose a risk to human health or the environment because there is no complete exposure

pathway. Potential future exposure pathways via drinking water from regional supply wells was demonstrated to not be impacted by current contaminant concentrations. A groundwater sampling program will be employed to ensure that assumptions for exposure are continually validated.

- There is evidence that natural attenuation is currently occurring and has significantly decreased contaminant concentrations. As an example, concentrations of contaminants located beyond the capture zone of the GPTIA have continued to decrease. Groundwater concentrations of all contaminants at the Site have been declining, are now only found in localized areas, and are expected to achieve cleanup levels in the intermediate zone of the Unconsolidated Sedimentary Aquifer within 10 years and in the deep zone generally within 20 years.
- Groundwater monitoring is required for the Site and has been conducted for the source areas and the dispersed groundwater plume. As part of the implementation of the cleanup action, a groundwater monitoring and compliance plan will be developed and implemented.
- Land use restrictions will be in place to protect potential exposure through direct contact, vapors or ingestion of groundwater that exceeds cleanup levels (SMC source area).
- The availability of the current GPTIA provides a contingency element if MNA is not proceeding as expected or an additional remedial action is required to supplement MNA. This will be included in the development of a MNA contingency plan as required prior to implementation of the cleanup action, including criteria for permanently shutting down and dismantling the GPTIA system.

4.3 Cleanup Standards and Point of Compliance

Cleanup standards and POC for each of the impacted media are discussed. As previously discussed, indicator hazardous substances were derived based on more than 20 years of monitoring at the Site and include PCE, TCE, and cis-1,2-DCE. Cleanup levels for the Site are shown in Table 4-1. POCs for each medium are provided below.

4.3.1 Soil

Soil cleanup standards were developed in accordance with WAC 173-340-745. The land use for the SMC source area meets the criteria to be categorized as an industrial property and soil contamination does not extend beyond the property boundary. However, soil cleanup standards do need to protect the leaching to groundwater pathway. Therefore, soil cleanup standards were developed in accordance with MTCA Method B. Table 4-1 includes the soil cleanup levels developed for the SMC source area.

Per WAC 173-340-745(7) and -740(6)(b), the standard POC for soil cleanup levels protective of the groundwater pathway is throughout the Site. However, if COCs in groundwater meet groundwater cleanup levels, it is assumed that soil is also compliant.

4.3.2 Groundwater

Under MTCA, the establishment of groundwater cleanup levels depends upon the classification of groundwater as either potable (a current or potential source of drinking water) or non-potable (WAC 173-340-700). Groundwater cleanup levels must be established based on the highest beneficial use of groundwater, assumed to be drinking water unless it can otherwise be demonstrated (WAC 173 340-720(1)(a)). Groundwater in the project area is classified as a drinking water resource and will likely continue to be classified as a drinking water resource in the future. Groundwater at the Site is therefore considered potable and includes all groundwater within the USA zone (i.e., shallow, intermediate, and deep zones). Groundwater has also been designated as a sole source aquifer by EPA.

Based on the cleanup standard evaluation, MTCA Method B cleanup levels are used for the Site and are included on Table 4-1. PCE and TCE, which are the primary contaminants in groundwater at the Site and have been the driver of past interim action efforts, have cleanup levels of 5 ug/L and 4 ug/L, respectively.

As part of the development of the groundwater cleanup levels presented in Table 4-1, an evaluation was completed to ensure that the cleanup levels meet MTCA requirements for sites with multiple carcinogenic compounds. MTCA guidance indicates that the cumulative risk associated with all site contaminants must not exceed an excess lifetime cancer risk (ELCR) of 1 in 100000 or $1x10^{-5}$. The evaluation of the cleanup levels is included in Appendix A. As noted, the cumulative ELCR does not exceed the MTCA guidance of 1×10^{-5} for multiple cancer-causing compounds. In addition, the non-cancer hazard index (HI) segregated by toxic endpoints does not exceed the MTCA HI threshold of 1. Therefore, the existing cleanup levels for TCE, PCE, and c-DCE in Table 4-1 do not need to be modified for this specific site and are protective of human health and the environment.

Per WAC 173-340-720(8)(b), the standard POC is throughout the Site and throughout the saturated zone. This POC will correspond to the drinking water pathway cleanup level. For the purpose of this project, the saturated zone is defined as all groundwater beneath the Site within the USA zone (i.e., shallow, intermediate, and deep zones). No alternative POCs are proposed. However, a detailed discussion of the POC and monitoring will be included in the groundwater compliance monitoring plan as required for implementation of the cleanup action.

4.3.3 Air

Air cleanup standards were developed in accordance with WAC 173-340-750. An extensive indoor air evaluation was previously conducted on behalf of the Port for the residences in the Fruit Valley Neighborhood. Residential indoor air issues in the project area have been completely addressed, and Ecology has determined that no further investigation or remedial actions are required. Therefore, air cleanup levels were developed for current or future industrial buildings only. Table 4-1 includes the applicable indoor air cleanup levels developed for the Site.

The standard POC for indoor air cleanup levels is throughout the sites, specifically in the interior of the buildings or future buildings, if any.

4.4 ARARs

WAC-173-340-710 requires that cleanup actions comply with applicable state and federal laws, which are defined as “legally applicable requirements and those requirements that the department determines…are relevant and appropriate requirements” (i.e., ARARs). A cleanup action performed under MTCA authority (e.g., an AO) is exempt from the procedural requirements of certain state and local environmental laws; although the cleanup action must still comply with the substantive requirements of applicable federal, state, and local laws.

"Legally applicable" requirements include cleanup standards or environmental protection requirements under state or federal laws that specifically address a hazardous substance or cleanup action for a site. "Relevant and appropriate" requirements include cleanup standards or environmental requirements (e.g., cleanup standards, standards of control, environmental criteria, environmental limits) under state and federal law that, while not legally applicable to the cleanup action, address problems or situations that are considered sufficiently similar to those encountered at the site.

A list of federal, state, and local laws that were considered during development of cleanup standards and the selection and implementation of cleanup actions is presented in Table 4-2.

4.5 Restoration Timeframe

The selected remedy contains two components, one for the SMC source area and one for the dispersed residual groundwater concentrations. The restoration timeframes for each of the cleanup actions are described below.

4.5.1 SMC Source Area

The selected cleanup action for the SMC source area includes a combination of institutional controls, engineering controls (future) and MNA. This cleanup action will eliminate potential complete exposure pathways and is protective of human health and the environment. The cleanup action will result in concentrations of COCs remaining in place for a period of time. Based on trend analysis, it is expected that source area reduction to MTCA cleanup levels could take more than 20 years at present rates of decrease. However, the area currently exceeding MTCA cleanup levels is an approximately 70- by 100-foot area. As shown in Figure 2-3, the area of impact for shallow groundwater at the SMC source area has been reduced by more than 99 percent since 2009. The cleanup action eliminates potential complete exposure pathways until MTCA cleanup levels are achieved through implementation of institutional controls.

4.5.2 Dispersed Residual Groundwater Concentrations

The cleanup action for the dispersed residual groundwater concentrations is MNA. The current GPTIA system will be shut down as part of implementation of the CAP. Groundwater modeling indicates the intermediate zone of the Unconsolidated Sedimentary Aquifer will achieve cleanup levels at all POCs within 10 years and the deep zone generally within 20 years. Groundwater will be monitored in accordance with the groundwater monitoring compliance plan to ensure cleanup objectives are met.

4.6 Compliance Monitoring

Compliance groundwater monitoring is a primary aspect of the selected remedy and will comply with WAC 173-340-410. In the context of this cleanup project, the compliance monitoring is considered protection monitoring under WAC 173-340-410(c). Since the cleanup action for the dispersed residual concentrations is MNA and includes shutting down the GPTIA system, a component of protection monitoring will be the implementation of a contingency plan if MNA is not occurring as expected. A summary of the groundwater compliance monitoring plan components, as well as other documents required as part of the CAP implementation, are included below.

4.6.1 Groundwater Compliance Monitoring

A groundwater compliance monitoring plan will be developed as part of the requirement for implementation of the cleanup action, specifically to ensure MNA is progressing as expected. The monitoring plan will include a discussion of the monitoring well network, POCs, groundwater sampling methods and procedures, schedule and frequency of monitoring, and reporting requirements. The plan will be prepared by the Port and submitted to Ecology for review and approval.

4.6.2 Operation Plan

An operation plan will be completed as part of the requirement for implementation of the cleanup action. The operation plan will include procedures for shutdown of the GPTIA system, maintenance during the shutdown period, startup of the GPTIA (as required by the contingency plan), and for permanent decommissioning of the GPTIA system. The operation plan will be prepared by the Port and submitted to Ecology for review and approval.

4.6.3 Cleanup Action Contingency Plan

A contingency plan will be developed as part of the requirement for implementation of the cleanup action. The intent of the contingency plan is to develop methods and procedures for further assessment or actions if the cleanup action is not performing as expected. The contingency plan will include the development of criteria that would trigger additional actions, such as an increase in concentrations or trends in specific wells or areas. The contingency plan will include a decision matrix based on the established criteria that will indicate if actions such as additional sampling or frequency of monitoring, further investigation, or potentially restarting of the GPTIA system are warranted. The contingency plan will include methods and protocols for trend analysis of groundwater concentrations that will be used as part of the decision matrix. The contingency plan will be prepared by the Port and submitted to Ecology for review and approval.

4.7 Schedule for Implementation

Implementation of the CAP is expected to occur within 6 months from the date of the final agreed order (AO). The CAP will be subject to a 30-day public comment period. CAP-required documents, such as the groundwater compliance monitoring plan, operation plan, cleanup action contingency plan, and restrictive covenant for the SMC property will be completed within 120 days from the end of the public comment period. Upon resolution of any public comments and final approval of the CAP and CAP-required documents, the GPTIA will be shut down and the CAP implemented.

4.8 Institutional/Engineering Controls

As part of selection of the remedy for the SMC source area, institutional controls and potential engineering controls will be implemented.

Institutional controls include placing a restrictive covenant on the former SMC property to ensure that no drinking water wells can be installed. If needed, the restrictive covenant will require maintaining the current use of the property (non-residential). It is expected that the restrictive covenant will also include notice requirements for site workers (construction workers) to ensure that during excavation, workers are notified of potential contamination in the soil and groundwater at the property. An SMC-specific contaminated media management plan will be referenced as part of the restrictive covenant.

Engineering controls will only be implemented as needed in the case that the property is developed with an occupied (non-residential) building. An assessment of potential vapor intrusion will be conducted prior to construction of a building. Engineering controls, if any, will be based on the results of the vapor intrusion assessment, which may include on-site borings to collect soil gas samples or other means to assess potential vapor intrusion. Engineering controls will be based on the assessment results and the type of building that is proposed for the property. Engineering controls can be completed in a variety of manners including heating, ventilation, and cooling modifications; subsurface vapor barriers; passive collection systems; or other similar technologies. No engineering control requirements are being implemented at this time; implementation will be based on the vapor intrusion assessment.

4.9 Public Participation

Documents related to the selection of the cleanup action and implementation of the cleanup action will be available for public review and comment. Documents that will be made available for the duration of the public comment period include the RI reports, FS, this dCAP, and the draft AO.

All Ecology guidelines and requirements for implementing a public comment period will be followed. It is expected that the public comment period will be 30 days.

5. REFERENCES

Ecology. 2009. Letter: Ecology Approval of the 2009 Final Remedial Investigation Report Former Building 2220 Site. Craig Rankine, Washington State Department of Ecology to Patty Boyden, Port of Vancouver, Vancouver, Washington. May 8, 2009.

Ecology 2016. Cleanup Action Plan Checklist. Washington Department of Ecology, Toxics Cleanup Program. Publication No. 16-09-008, May 2016.

Parametrix. 2009. Final RI Report, Former Building 2220 Site (Swan Manufacturing Company Site). Prepared for the Port of Vancouver, Vancouver, Washington. May 2009.

Parametrix. 2010. Final Remedial Investigation Report, Cadet Manufacturing Company Site. Prepared for Port of Vancouver. May 2010.

Parametrix. 2021. Draft Feasibility Study, Cadet Manufacturing Company and Swan Manufacturing Company Portions, Vancouver Port of NuStar Swan Cadet Site. October 2021.

This page intentionally left blank.

Tables

Table 3-1
Comparative Analysis of Remedial Alternatives for the SMC Source Area

Alternative		Protectiveness	Permanence	Long-term Effectiveness	Implementability	Short-Term Risk	Reduce Disparate Impacts	Public Concerns	Sum	Cost Effectiveness*
		Selection Criteria**								
Alternative A:	Institutional Controls, Engineering Controls, and MNA	Protects all exposure scenarios via institutional or engineering controls. Does not attain cleanup standards or RAOs quickly. Source area has been been reduced to SMC only, which can be controlled.	Controls future land use and restricts groundwater use; prevents all exposure pathways. Easy to maintain controls.	Effective at eliminating exposure and institional controls can remain in-place indefinantly; does not achieve cleanup levels qucikly.	Can be implemented in short order. Restrictive covenant can be recorded on Port-owned property. Engineering controls (future) are well known and easy to implement during new building construction.	Must meet Agency acceptance; does not remove contaminants, only isolates them from exposure.	Provides isolation of contaminants from the community. Long-term timeframe for cleanup is higher than for active alternatives.	The neighborhood has witnessed several interim actions since discovery, and there has been some concern regarding the contamination. Alternative does not remove contaminants, which could be public perception issue.		$120,000
	Score	7	9	7	10	8	7	6	54	5
Alternative B:	Remedial Excavation of Source Area	Meets effectiveness criteria by preventing potential exposure to contaminants. Direct removal at one time. Places soil in a permitted landfill.	High reliability due to excavation and off-site disposal of the impacted soil. Soil is placed at a permitted landfill.	Effectively removes the impacted soil and disposes off-site. However, this is direct removal at one time, with no long-term monitoring.	Excavation is a common method and disposal options exist. However, groundwater will be encountered. Dewatering and shoring will be required, and extracted water needs to be treated before discharging. Site access is limited. Clean overburden needs to be stockpiled, and space is limited.	High incremental implementation risk. There is increased risk to excavation workers to implement this alternative. There is potential that de-watering can not occur. The exact volume to excavate is not known. Potential impacts from soil contaminants to the surrounding community and environment can be minimized through implementation of BMPs specified in a CMMP. Confirmation sampling will need to be conducted to confirm that remedial excation achives site RAOs.	Provides removal of source area contaminants and places them off-site in landfill; thus, reducing future potential impacts from these contaminants. However, implementation of large-scale excavation could impact nearby community through vehicle traffic, dust emmissions, potential spills, and noise.	This alternative addresses public concern by actively removing the source and disposing the contamination off-site. May be some concern of a large-scale excavation project near the FVN.		$900,000
	Score	8	8	8	3	4	5	7	43	1
Alternative C:	Air Sparging and Soil Vapor Extraction	This is a very effective technique for removing volatile organic compounds from groundwater. However, soil at the site has very low permeability, and the radius of influence (ROI) for each well would be small.	AS/SVE systems have proven reliable in extracting volatile organic compounds from groundwater. The Port would have to maintain the AS/SVE system until the site can be closed, and Ecology determines an NFA. This technique includes some risk of rebound.	Proven to be a very effective technique. However, long-term maintenance is necessary, and there is some risk of rebound after the system is shut off.	Requires design, engineering, and more consultation with regulatory agencies. Easy to implement on currently mostly vacant site. However, the source area is a thin layer, with low permeability, and groundwater will be encountered. Exact placement of wells is necessary for success. Requires long-term system operation and maintenance.	Minimum risk to construction workers. Potential impacts from soil contaminants to the surrounding community and environment can be minimized through implementation of BMPs specified in a CMMP.There is a risk of placing the AS wells in the wrong location due to several factors: depth and elevation of the fine grain sand layer (source area) is not precisely known; the source area layer is thin; and, this layer has low permeability, making the radius of influence small.	Provides removal of source area contaminants through in-situ remediation; thus, reducing future potential impacts from these contaminants. However, implementation of AS/SVE could impact nearby community through on-site equipment, short-term vehicle traffic and construction, emmissions of contaminants through SVE exhaust.	This technique addresses public concern. It is an effective remedial action that the public has witnessed at the Cadet site.		$280,000
		8	7	8	6	5	7	8	49	3
Alternative D:	In-Situ Substrate Injection	Meets effectiveness criteria by reducing contaminants in place. However this alternative needs to be designed with site conditions in mind, to maintain its effectiveness.	Capable of achieving high treatment efficiencies (>90%) for VOC compounds such as TCE. Other organics are amenable to partial degradation as an aid to subsequent bioremediation. This technique includes some risk of rebound. May be difficult to implement effectively within the thin fine-grained sand layer.	This techinque requires design and engineering specific to the site conditions. If the agent can be injected into the fine-grain sand layer, and dispersed horizontally, this alternative can be effective long term. However, there are some risks.	Requires design, engineering, and more consultation with regulatory agencies. Easy to implement on currently mostly vacant site, however the key to successful implementation will be to inject the agent into the fine-grain sand layer, and to get it dispersed horizontally. Requires subsequent injections.	Minimal risk to construction workers. Potential impacts from soil contaminants to the surrounding community and environment can be minimized through implementation of BMPs specified in a CMMP. There is a risk of placing the injection wells in the wrong location due to several factors: depth and elevation of the fine grain sand layer (source area) is not precisely known; the source area layer is thin; and, this layer has low permeability, making the radius of influence small.	Provides removal of source area contaminants through in-situ remediation; thus, reducing future potential impacts from these contaminants. However, implementation of injection could impact nearby community through on-site equipment, short-term vehicle traffic and construction, use of chemcial compounds and potential aboveground storage and spills, and contaminant off-gassing.	This technique addresses public concern by actively treating the contamination, over the long-term.		$400,000
		6	6	6	3	5	7	8	41	2

Criteria

Protectiveness
The overall protectiveness of human health and the environment, including the degree to which existing risks are reduced, time required to reduce risk at the facility and attain cleanup standards, on-site and off-site risks resulting from implementing the alternative, and improvement of the overall environmental quality.

Permanence
The degree to which the alternative permanently reduces the toxicity, mobility or volume of hazardous substances, including the adequacy of the alternative in destroying the hazardous substances, the reduction or elimination of hazardous substance releases and sources of releases, the degree of irreversibility of waste treatment process, and the characteristics and quantity of treatment residuals generated.

Cost
The cost to implement the alternative, including the cost of construction, the net present value of any long-term costs, and agency oversight costs that are cost recoverable. Long-term costs include operation and maintenance costs, monitoring costs, equipment replacement costs, and the cost of maintaining institutional controls. Cost estimates for treatment technologies shall describe pretreatment, analytical, labor, and waste management costs. The design life of the cleanup action shall be estimated and the cost of replacement or repair of major elements shall be included in the cost estimate.

Long-Term Effectiveness
This includes the degree of certainty that the alternative will be successful, the reliability of the alternative during the period of time hazardous substances are expected to remain on-site at concentrations that exceed cleanup levels, the magnitude of residual risk with the alternative in place, and the effectiveness of controls required to manage treatment residues or remaining wastes. The following types of cleanup action components may be used as a guide, in descending order, when assessing the relative degree of long-term effectiveness: Reuse or recycling; destruction or detoxification; immobilization or solidification; on-site or offsite disposal in and engineered, lined and monitored facility; on-site isolation or containment with attendant engineering controls; and institutional controls and monitoring.

Short-term Risks
The risk to human health and the environment associated with the alternative during construction and implementation, and the effectiveness of measures that will be taken to manage such risks.

Implementability
Ability to be implemented including consideration of whether the alternative is technically possible, availability of necessary offsite facilities, services and materials, administrative and regulatory requirements, scheduling, size, complexity, monitoring requirements, access for construction operations and monitoring, and integration with existing facility operations and other current of potential remedial actions.

Consideration of Public Concerns
Whether the community has concerns regarding the alternative and, if so, the extent to which the alternative addresses those concerns. This process includes concerns from individuals, community groups, local governments, tribes, federal and state agencies, or any other organization that may have an interest in or knowledge of the site.

Reduce Disparate Impacts
The relative ability for the remedial alternative to reduce potential disproportionate impacts or outcomes (health, community quality, etc.) during both implementation of the remedy and continued operation on the highly impacted community. Ecology defines a highly impacted community as likely to bear a disproportionate burden of public health risks from environmental pollution, such as minority, low-income, tribal or indigenous populations.

Criteria Scoring

1 - Does not satisfy the criterion
3 - Marginally satisfies the criterion
5 - Partially satisfies the criterion
7 - Mostly satisfies the criterion
10 - Completely satisfies the criterion

* Costs excludes those items common to the alternatives, including long-term monitoring.

Table 3-2
Comparative Analysis of Remedial Alternatives for the Dispersed Residual Groundwater Contamination

Alternative		Selection Criteria**							Sum	Cost Effectiveness
		Protectiveness	Permanence	Long-term Effectiveness	Implementability	Short-Term Risk	Public Concerns	Reduce Disparate Impacts		
Alternative A:	MNA	Meets protectiveness criteria by isolating source area contaminants. Current receptors (drinking water wells) are protected through MNA monitoring to cleanup levels at all POCs. Modeling indicates contaminants do not reach regional source wells at unacceptable levels.	High reliability due to source area control. MNA monitoring program implemented on a site-wide basis to ensure permanance. P&T can remain as backup contingency under this alternative.	Effectively isolates the most impacted groundwater (source area). MNA monitoring program implemented on a site-wide basis to ensure long-term effectiveness remains intact. P&T can remain as backup contingency under this alternative.	Existing source area remedial actions are implementable. MNA can be easily implemented and incorporated into the sampling program. P&T maintained as contingency.	Moderate risk due to some uncertainty of source area contaminants migrating to intermediate zone. Robust sampling required to confirm that remedial actions achieve RAOs and MNA is implemented.	Little percieved public concerns. This alternative addresses public concern by removing any potential risk in the source area and implmentating a long-term MNA plan.	Shut-down of the P&T has shown to reduce GHG emmissions by 0.1 tons per year.		$1M - $1.5M
	Score	**8**	**8**	**8**	**10**	**7**	**9**	**9**	**59**	**5**
Alternative B:	Continued Pump and Treat	Meets protectiveness criteria by isolating source area contaminants, with some containment due to P&T system operation. Current receptors (drinking water wells) are protected through continued operation of the P&T to achieve cleanup levels.	High reliability due to source area control. P&T will be operational until cleanup levels met and includes containment of all contaminants. After 5-year operation, MNA implemented to ensure permanance.	P&T proven to be a very effective technique. System will continue to be operational until cleanup levels met. Long-term maintanence is necessary.	Existing source area remedial actions are implementable. P&T currently exists and is operational. P&T has some potential maintenance issues and costs associated with continued operation.	Moderate risk due to uncertainty of source area contamination; P&T has little impact on source area contaminants but does capture migrating contaminants to the intermediate zone. P&T is currently operational, so little risk of typical construction issues. Robust sampling required to confirm that remedial actions achieve RAOs.	Little percieved public concern. Public has been receptive of P&T and its operating success. Discharge of VOCs through the P&T system stack may be of some public concern. Climate change analysis indicated GHG emmissions related to high electricity for operation of the system may have some public concern.	Emissions from the pump and treat system will be continued and has some potential to impact the nearby community.		$2M-$2.5M
	Score	**9**	**8**	**8**	**8**	**9**	**8**	**6**	**56**	**3**

Criteria

Protectiveness
The overall protectiveness of human health and the environment, including the degree to which existing risks are reduced, time required to reduce risk at the facility and attain cleanup standards, on-site and off-site risks resulting from implementing the alternative, and improvement of the overall environmental quality.

Permanence
The degree to which the alternative permanently reduces the toxicity, mobility or volume of hazardous substances, including the adequacy of the alternative in destroying the hazardous substances, the reduction or elimination of hazardous substance releases and sources of releases, the degree of irreversibility of waste treatment process, and the characteristics and quantity of treatment residuals generated.

Cost
The cost to implement the alternative, including the cost of construction, the net present value of any long-term costs, and agency oversight costs that are cost recoverable. Long-term costs include operation and maintenance costs, monitoring costs, equipment replacement costs, and the cost of maintaining institutional controls. Cost estimates for treatment technologies shall describe pretreatment, analytical, labor, and waste management costs. The design life of the cleanup action shall be estimated and the cost of replacement or repair of major elements shall be included in the cost estimate.

Long-Term Effectiveness
This includes the degree of certainty that the alternative will be successful, the reliability of the alternative during the period of time hazardous substances are expected to remain on-site at concentrations that exceed cleanup levels, the magnitude of residual risk with the alternative in place, and the effectiveness of controls required to manage treatment residues or remaining wastes. The following types of cleanup action components may be used as a guide, in descending order, when assessing the relative degree of long-term effectiveness: Reuse or recycling; destruction or detoxification; immobilization or solidification; on-site or offsite disposal in and engineered, lined and monitored facility; on-site isolation or containment with attendant engineering controls; and institutional controls and monitoring.

Short-term Risks
The risk to human health and the environment associated with the alternative during construction and implementation, and the effectiveness of measures that will be taken to manage such risks.

Implementability
Ability to be implemented including consideration of whether the alternative is technically possible, availability of necessary offsite facilities, services and materials, administrative and regulatory requirements, scheduling, size, complexity, monitoring requirements, access for construction operations and monitoring, and integration with existing facility operations and other current of potential remedial actions.

Consideration of Public Concerns
Whether the community has concerns regarding the alternative and, if so, the extent to which the alternative addresses those concerns. This process includes concerns from individuals, community groups, local governments, tribes, federal and state agencies, or any other organization that may have an interest in or knowledge of the site.

Reduce Disparate Impacts
The relative ability for the remedial alternative to reduce potential disproportionate impacts or outcomes (health, community quality, etc.) during both implementation of the remedy and continued operation on the highly impacted community. Ecology defines a highly impacted community as likely to bear a disproportionate burden of public health risks from environmental pollution, such as minority, low-income, tribal or indigenous populations.

Criteria Scoring

1 - Does not satisfy the criterion
3 - Marginally satisfies the criterion
5 - Partially satisfies the criterion
7 - Mostly satisfies the criterion
10 - Completely satisfies the criterion

Table 4-1
Selected Cleanup Levels for COCs
SMC and Cadet Sites

Cleanup Level Based on Media				
Site	COC	Groundwater (µg/L)[1]	Soil (mg/kg)[2]	Air (µg/m^3)[3]
Cadet/SMC	PCE	5	0.05	9.6
	TCE	4	0.025	0.33
	c-DCE	16	0.079	NA

Notes

1. Cleanup levels for TCE and cDCE from MTCA Method B published values (Ecology's CLARC database). Method B cleanup level for PCE exceeds the state of Washington MCL; therefore, the MCL is used.
2. Cleanup levels from MTCA Method B published values (Ecology's CLARC database). Leaching to groundwater pathway.
3. Cleanup levels from MTCA Method B published values (Ecology's CLARC database).

NA indicates CLARC value is not available and/or applicable.

µg/L = micrograms per liter

mg/kg = milligrams per kilogram

µg/m^3 = micrograms per cubic meter

Table 4-2
Summary of Applicable or Relevant Federal and State Laws

Applicable Law	Reference Location	Corresponding Applicable Cleanup Levels (Y/N)
Federal		
The Clean Water Act (CWA)	33 U.S.C §1251 et seq.	Y
Safe Drinking Water Act (SDWA)	42 U.S.C §300f et seq.	N
National Toxics Rule	57 FR 60848; 40 CFR Part 131	Y
Resource Conservation and Recovery Act (RCRA)	42 U.S.C. §6901 et seq.	N
Federal Clean Air Act	42 U.S.C. §7401 et seq.	N
Endangered Species Act of 1973	16 U.S.C. §1531-1544, 87 Stat. 884	N
United States Fish and Wildlife Service (USFWS) Mitigation Policy	46 FR 7644	N
Sole Source Aquifer [Section 1424(3) of SDWA]	42 U.S.C §300f et seq., Public Law 93-523	N
The Fish and Wildlife Coordination Act of 1934	16 U.S.C. 661-667e	N
State		
State Environmental Policy Act (SEPA)	Chapter 43.21C RCW; WAC 197-11	N
Washington Water Pollution Control Act	Chapter 90.48 of RCW; WAC 173-201A	Y
Washington Hydraulic Code	Chapter 77.55 RCW; WAC 220-110	N
Washington State Clean Air Act	Chapter 70.94 RCW	N
Washington Solid Waste Management – Reduction and Recycling Act	Chapter 70.95 RCW; WAC 173-350	N
Washington Hazardous Waste Management Act	Chapter 70.105 RCW; WAC 173-303	N
Underground Injection Control (UIC) Program	Chapter 173-218 WAC	N
Compensatory Mitigation Policy for Aquatic Resources and Aquatic Resources Mitigation Act.	Chapters 75.46 and 90.74 RCW	N
Water Resources Act	Chapter 90.54 RCW	N
State Aquatic Lands Management Laws	Chapters 79.90 through 79.96 RCW; WAC 332-30	N
Healthy Environment for All (HEAL) Act	E2SSB 5141	N
Growth Mangement Act	Chapters 36.70A, 36.70.A.150, and 36.70.A.200 RCW	N

Abbreviations:
1. U.S.C = United States Code.
2. FR = Federal Register.
3. RCW = Revised Code of Washington.
4. WAC = Washington Administrative Code.

Figures

Parametrix

Source: © Mapbox, © OpenStreetMap, Port of Vancouver

0 250 500 1,000 Feet

Figure 1-1
Project Area

Cleanup Action Plan SMC and Cadet Sites
Vancouver, Washington

Parametrix

Source: © Mapbox, © OpenStreetMap, Port of Vancouver

0 250 500 1,000 Feet

Site - Historical Maximum Extent of HVOC Contamination
SMC Site
Cadet Facility
Kinder Morgan Facility
NuStar Facility

Figure 1-2
Site Location Map

Cleanup Action Plan SMC and Cadet Sites
Vancouver, Washington

Parametrix

Source: © Mapbox, © OpenStreetMap, Port of Vancouver

0 250 500 1,000 Feet

- Site - Historical Maximum Extent of HVOC Contamination
- Area of Site Included in Agreed Order 18152
- SMC Site
- Cadet Facility
- Kinder Morgan Facility
- NuStar Facility

Figure 1-3
Swan and Cadet Site Portion

Cleanup Action Plan SMC and Cadet Sites
Vancouver, Washington

Parametrix Date: 1/25/2022 Path: \\parametrix.com\pmx\Port\Projects\Clients\1940-Port of Vancouver\275-1940-006-POV TCE\99Svcs\GIS\POV\MXD_PDF\2022\Fig_2-1_ResidualSourceArea.mxd

Extent of Former Excavation
Potential Extent of Residual Source Area
Elevated Source Area*
Extraction Well
Shallow Source Area Monitoring Well
SMC Site Property Boundary

*Based on historical soil conc. exceeding 10,000 µg/kg and groundwater exceeding 10,000 µg/L.

0 25 50 100 Feet

Figure 2-1
Residual Source Area - SMC

Cleanup Action Plan SMC
and Cadet Sites
Vancouver, Washington

Parametrix

Date: 1/25/2022 Path: \\parametrix.com\pmx\Port\Projects\Clients\1940-Port of Vancouver\275-1940-006-POV TCE\99Svcs\GIS\POV\MXD_PDF\2022\Fig_2-2_FormerSMCSiteArea_TCE_Q1_2020.mxd

Source: Clark County

0 25 50 100 Feet

MW-10 — Well Location Name
23 — March 2020 Result (µg/L)
15 — January 2020 Result (µg/L)
19 — March 31, 2020 Result (µg/L)
27 — August 2020 Result (µg/L)

Indicates shallow zone result

ND = Non-Detect
NS = Not sampled
IA = Inactive Sampling Location

> 4 µg/L
> 25 µg/L
> 100 µg/L
> 500 µg/L

SMC Site Property Boundary

Ownership

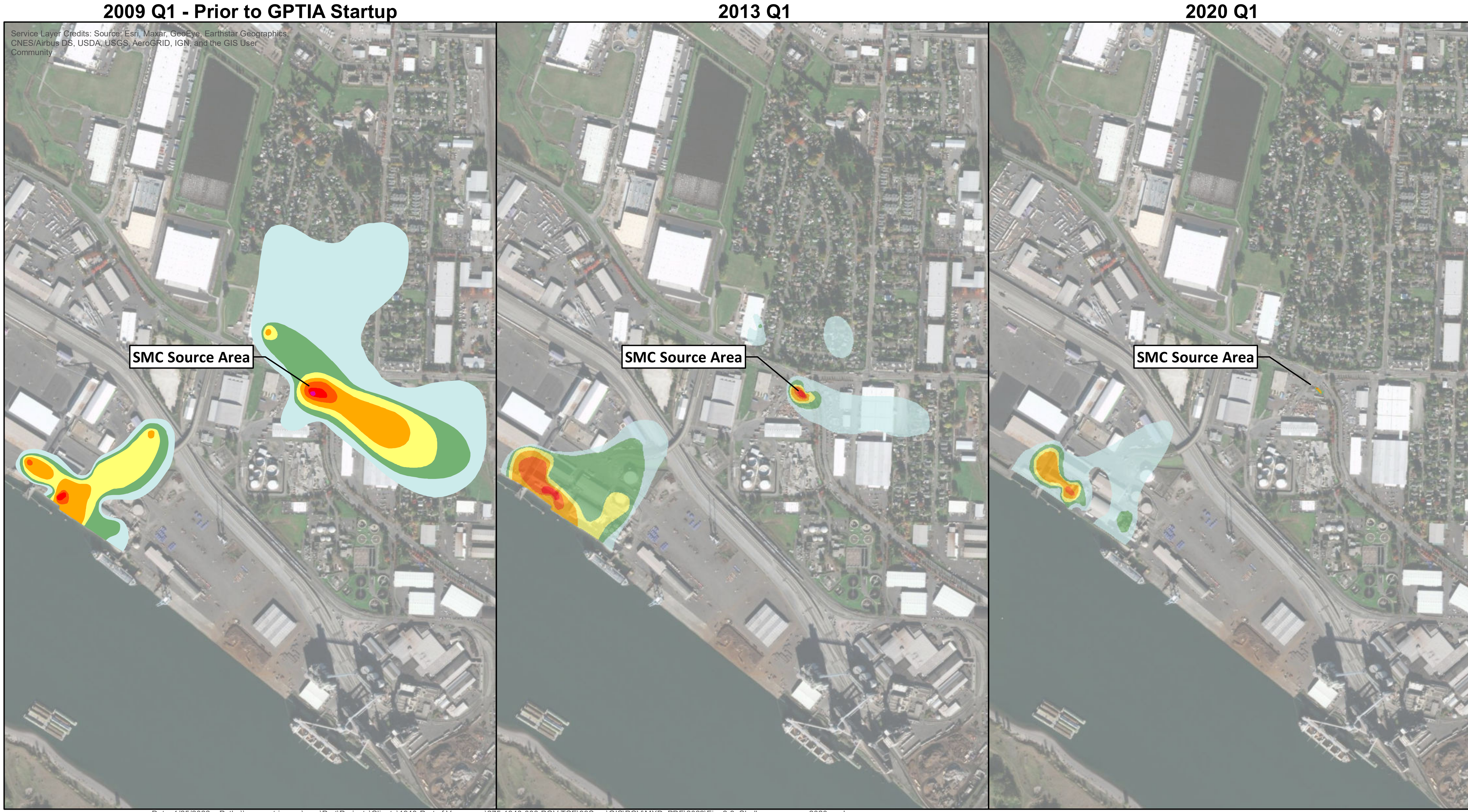
City of Vancouver ROW (No Fill)
Port of Vancouver
Private

Shallow USA Groundwater Monitoring Well
Intermediate USA Groundwater Monitoring Well
Deep USA Groundwater Monitoring Well
TGA Monitoring Well
GPTIA Extraction Well

Note: Isoconcentrations are based on shallow zone well results

Figure 2-2
Former SMC Site Area
TCE Concentrations in Groundwater
1st Quarter 2020

Draft Cleanup Action Plan
SMC and Cadet Sites
Vancouver, Washington



Date: 1/25/2022 Path: \\parametrix.com\pmx\Port\Projects\Clients\1940-Port of Vancouver\275-1940-006-POV TCE\99Svcs\GIS\POV\MXD_PDF\2022\Fig_2-3_Shallow_compare_2020.mxd

Parametrix

> 4 µg/L
> 25 µg/L
> 50 µg/L
> 100 µg/L
> 500 µg/L
> 1000 µg/L

0 500 1,000 2,000 Feet

Figure 2-3
TCE Isoconcentrations in Shallow USA Zone Groundwater 2009, 2013, and 2020

Cleanup Action Plan
SMC and Cadet Sites
Vancouver, Washington

Parametrix

MW-10 — Well Location Name
23 — September 2020 Sample Result (µg/L)
15 — Jan 2020 Sample Result (µg/L)
27 — August 2020 Sample Result (µg/L)
12 — December 1, 2020 Sample Result (µg/L)

> 4 µg/L
> 25 µg/L

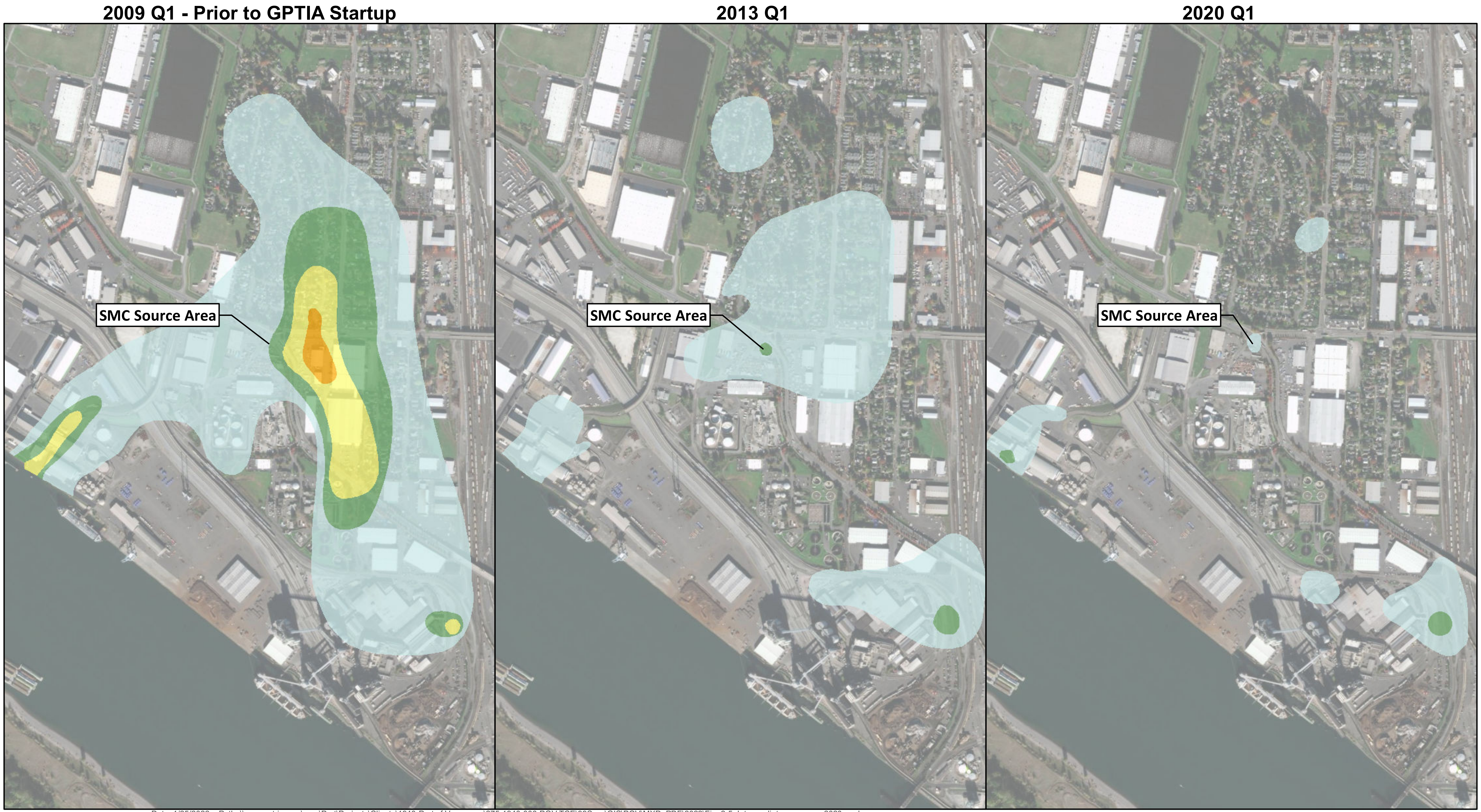
ND = Non-Detect
NS = Not sampled
IA = Inactive Sampling Location

Note: Wells shown in italics have been decommissioned.
*Isoconcentrations are based on March 2020 Results.

0 250 500 1,000 Feet

Figure 2-4
2020 TCE Isoconcentrations in Intermediate USA Zone Groundwater

Cleanup Action Plan
SMC and Cadet Sites
Vancouver, Washington



Date: 1/25/2022 Path: \\parametrix.com\pmx\Port\Projects\Clients\1940-Port of Vancouver\275-1940-006-POV TCE\99Svcs\GIS\POV\MXD_PDF\2022\Fig_2-5_Intermediate_compare_2020.mxd

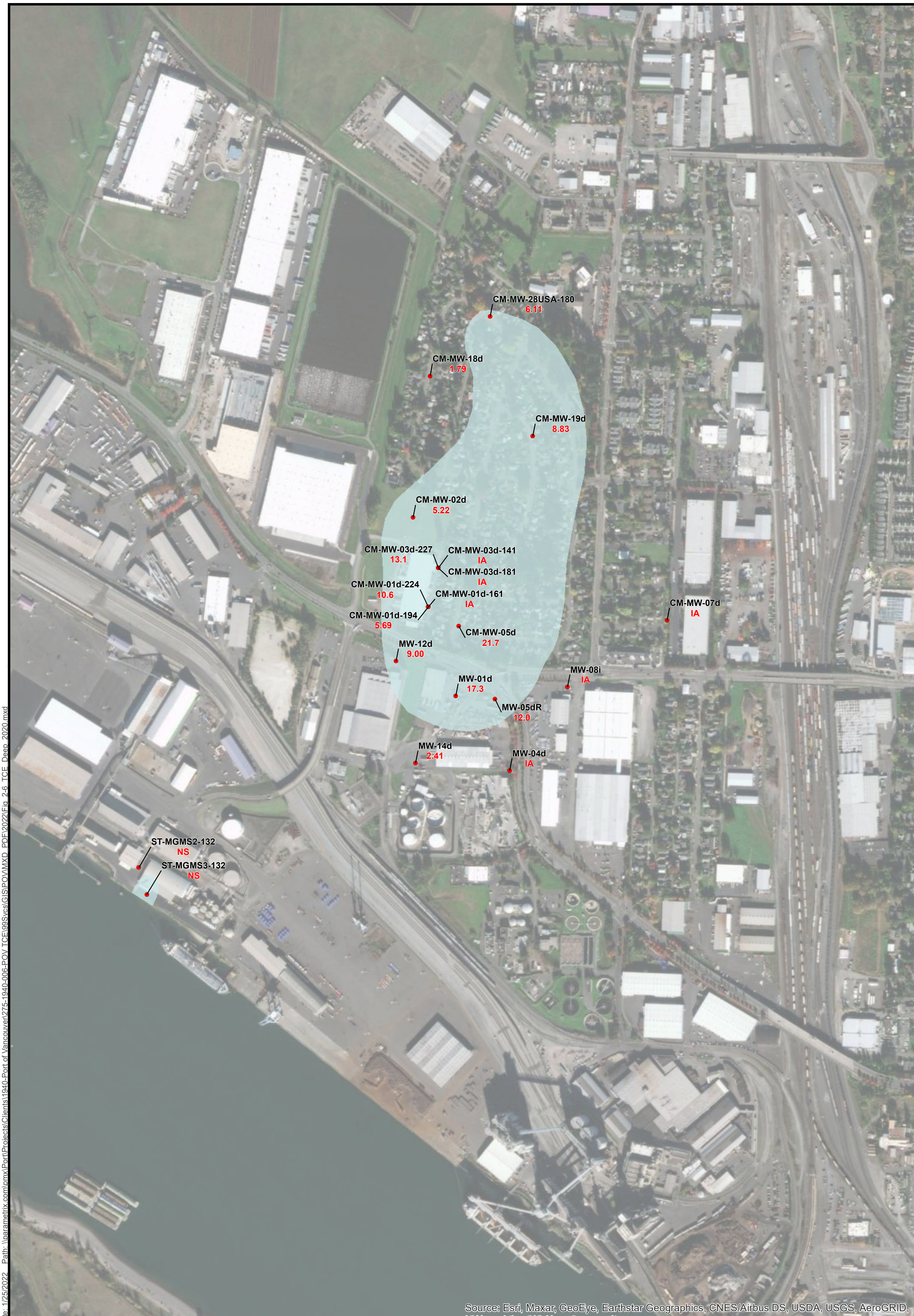
Parametrix

0 500 1,000 2,000 Feet

- > 4 µg/L
- > 25 µg/L
- > 50 µg/L
- > 100 µg/L

Figure 2-5
TCE Isoconcentrations in Intermediate USA Zone Groundwater 2009, 2013, and 2020

Cleanup Action Plan
SMC and Cadet Sites
Vancouver, Washington



Date: 1/25/2022 Path: \\parametrix.com\pmx\Port\Projects\Clients\1940-Port of Vancouver\275-1940-006-POV TCE\99Svcs\GIS\POV\MXD_PDF\2022\Fig_2-6_TCE_Deep_2020.mxd

Parametrix

MW-10 — Well Location Name
23 — March 2020 Sample Result (µg/L)

ND = Non-Detect
NS = Not sampled
IA = Inactive Sampling Location

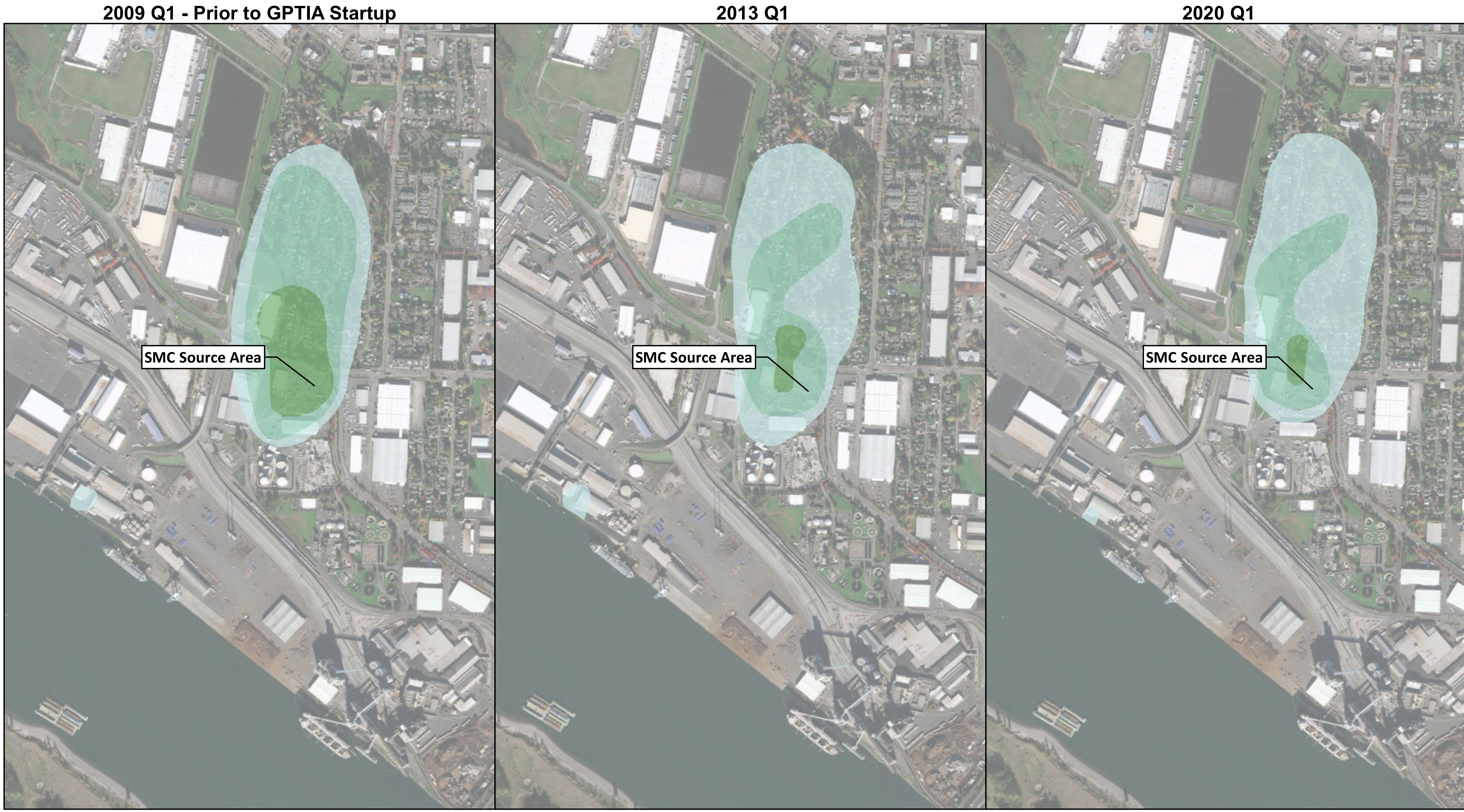
> 4 µg/L
> 25 µg/L

0 250 500 1,000 Feet

Note: Wells shown in italics have been decommissioned.

Figure 2-6
2020 TCE Isoconcentrations in Deep USA Zone Groundwater

DraftCleanup Action Plan
SMC and Cadet Sites
Vancouver, Washington



Date: 1/25/2022 Path: \\parametrix.com\pmx\Port\Projects\Clients\1940-Port of Vancouver\275-1940-006-POV TCE\99Svcs\GIS\POV\MXD_PDF\2022\Fig_2-7_Deep_compare_2020.mxd

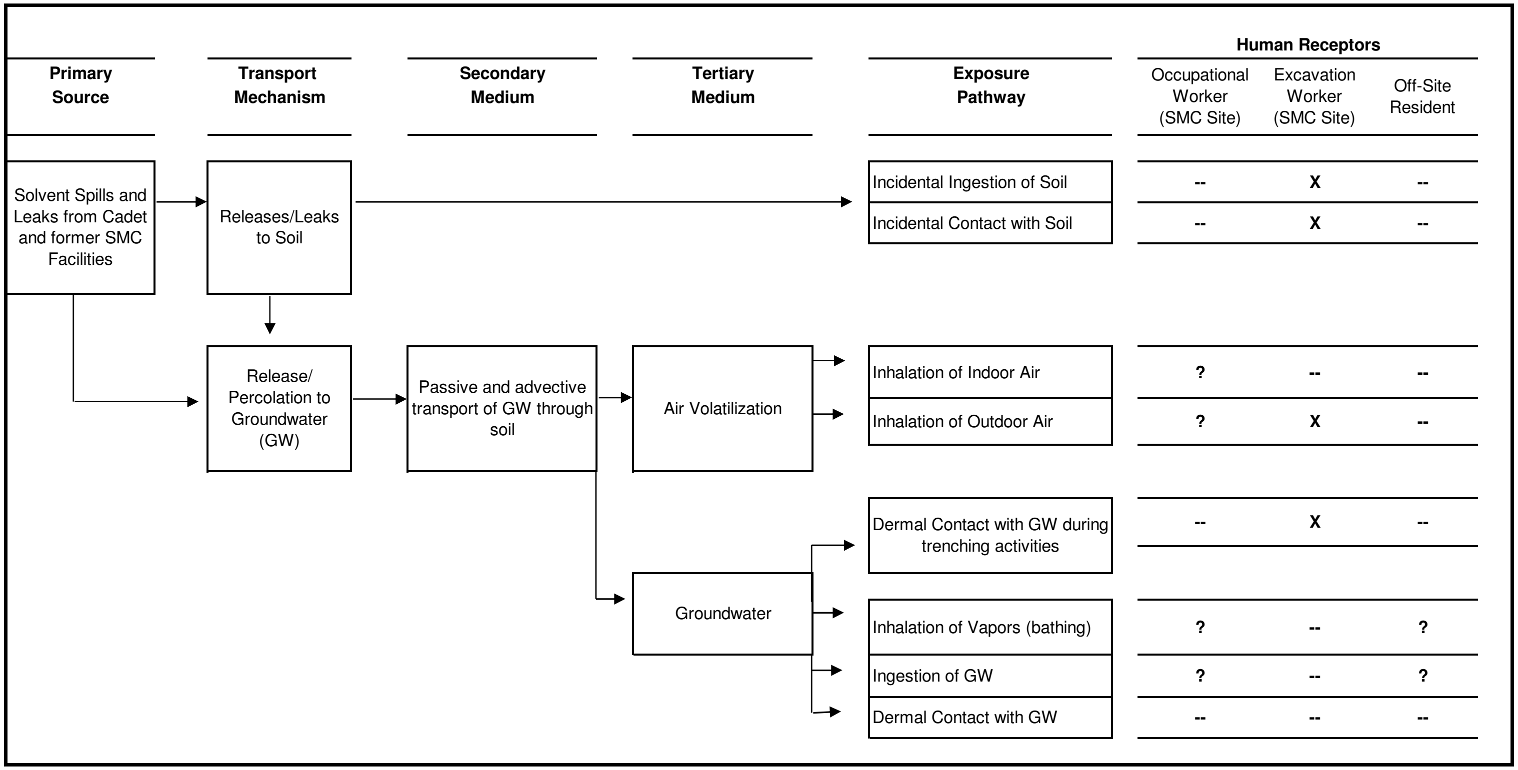
Parametrix

0 500 1,000 2,000 Feet

> 4 µg/L
>10 µg/L
> 25 µg/L

Figure 2-7
TCE Isoconcentrations in Deep USA Zone Groundwater 2009, 2013, and 2020

Cleanup Action Plan SMC and Cadet Sites Vancouver, Washington



"**X**" Potentially **c**omplete pathway evaluated in the risk assessment

"--" Incomplete pathway not evaluated in the risk assessment

"?" Potentially complete pathway only under specific and unlikely future scenario

Figure 2-8
Conceptual Site Model

Cleanup Action Plan
Cadet and SMC Sites
Vancouver, WA

Appendix A

Cumulative Risk and Hazard Index Evaluation of Port of Vancouver Cleanup Levels

Appendix A
Cumulative Risk and Hazard Index Evaluation
Port of Vancouver Cleanup Levels

The following presents backup calculations to support discussion of cumulative risks associated with cleanup levels and contaminants at the Port of Vancouver site. Per MTCA guidance, since multiple cancer-related contaminants are present at the site, the cumulative risk associated with the contaminants must not exceed an excess lifetime cancer risk (ELCR) of 1 in 100,000 or $\mathbf{1 \times 10^{-5}}$.

MTCA Method B cleanup levels used in CLARC data tables for carcinogens are calculated with a target ELCR of 1 in 1,000,000 or $\mathbf{1 \times 10^{-6}}$. However, the contaminants associated with the Port site (TCE and PCE) have modified cleanup levels related to the drinking water maximum contaminant level (MCL)[1]. Thus, the following provides a calculation of the ECLR for the modified cleanup levels to ensure that the cumulative ELCR is within the MTCA cancer risk standard of 1×10^{-5}.

<u>TCE Method B (cancer) Cleanup Level (CUL)</u>

As described in MTCA guidance and in the CLARC data tables, the modified MTCA equation 720-2 is used to calculate the CUL for a specific compound. For TCE, this is:

CUL = (ELCR x AT x UCF) / (Total CPFo x Total ELE adjustment factor x INH x Drinking Water fraction)

Where:

ELCR = Excess Lifetime Cancer Risk = 1×10^{-6}

AT = Averaging time (lifespan) = 75 years

UCF = unit conversion factor = 1,000 µg/mg

Total CPFo = Cancer potency factor = 0.046 $(mg/kg\text{-}day)^{-1}$

Total ELE = early-life exposure adjustment = 1.516 ltr-yr/kg-day

INH = inhalation factor = 2

Drinking Water Fraction = 1

CUL = (0.000001 x 75 yrs x 1,000 µg/mg) / (0.046 $(mg/kg\text{-}day)^{-1}$ x 1.516 lt-yr/kg-day x 2 x 1)

CUL = 0.54 µg/L for TCE

However, as noted in Table 4 of the *TCE: Deriving Cleanup Levels under the MTCA* paper (Ecology January 2020), the CUL for TCE was replaced with the MCL of 5 µg/L, but then adjusted downward to 4 µg/L to account for the Hazard Quotient exceeding 1. CLARC CUL for TCE = 4 µg/L.

---

[1] CULs based on applicable state or federal law are considered sufficiently protective if the cancer risk is less than or equal to 1×10^{-5} or a hazard index of 1 (WAC 173-340-720[7][b]). However, CULs (including those based on state or federal laws) must be adjusted downward to account for exposure to multiple hazardous substances such that the total site risk does not exceed 1×10^{-5} or a hazard index of 1 (WAC 173-340-720[7][a]).

Therefore, as shown below, the ELCR associated with a CUL of 4 µg/L can be solved by rearranging the equation above.

ELCR = (CUL x Total CPFo x Total ELE adjustment factor x INH x Drinking Water fraction) / (AT x UCF)

ELCR = (4 µg/L x 0.046 $(mg/kg\text{-}day)^{-1}$ x 1.516 lt-yr/kg-day x 2 x 1) / (75 yrs x 1,000 µg/mg)

ELCR for TCE CUL (4 µg/L) = 0.0000074 = 7.4 x 10^{-6}

PCE Method B (cancer) Cleanup Level (CUL)

For PCE, the same general process applies as described above except that PCE is not adjusted for mutagenic effects based on increased risk from early-life exposure. A PCE-specific CPFo was utilized per CLARC guidance and MTCA equation 720-2 is used to calculate the CUL. For PCE, this is:

CUL = (ELCR x ABW x AT x UCF) / (CPFo x DWIR x ED x INH x Drinking Water fraction)

Where:

ELCR = Excess Lifetime Cancer Risk = 1 x 10^{-6}

ABW = Average body weight = (70 kg)

AT = Averaging time (lifespan) = 75 years

UCF = unit conversion factor = 1,000 µg/mg

CPFo = Cancer potency factor = 0.0021 $(mg/kg\text{-}day)^{-1}$

DWIR = Drinking water ingestion rate = 2 ltr/day

ED = Exposure duration = 30 yrs

INH = inhalation factor = 2

Drinking Water Fraction = 1

The CLARC-calculated CUL is 21 µg/L. However, similar to the process describe above and described in the *PCE Toxicity Information & MTCA Cleanup Levels* (Ecology 2012), the MTCA guidance allowed Ecology to modify the CUL to the existing drinking water **MCL of 5 µg/L.** CLARC CUL for PCE = 5 µg/L.

Therefore, as shown below, the ELCR associated with a CUL of 5 µg/L can be solved by rearranging the equation above.

ELCR = (CUL x CPFo x DWIR x ED x INH x Drinking Water fraction) / (ABW x AT x UCF)

ELCR = (5 µg/L x 0.046 $(mg/kg\text{-}day)^{-1}$ x 2 ltr/day x 30 yrs x 2 x 1) / (70 kg x 75 yrs x 1,000 µg/mg)

ELCR for PCE CUL (5 µg/L) = 0.00000024 = 2.4 x 10^{-7}

c-DCE Method B Cleanup Level (CUL)

The third compound found at the Port site is cis-1,2-dichloroethylene (c-DCE). c-DCE does not have a cancer potency factor in CLARC. Thus, the Method B CUL for c-DCE is for non-cancer (16 µg/L). Based on this concentration and lack of cancer toxicity, it does not significantly impact the total ECLR.

NONCANCER HAZARD INDEX

The noncancer hazard index (HI) is an expression of additivity of noncarcinogenic health effects. CULs (including those based on state or federal laws) must be adjusted downward to account for exposure to multiple hazardous substances such that the noncancer hazard index does not exceed 1 (WAC 173-340-720[7][a]).

Application of the CULs identified for PCE and TCE (5 and 4 µg/L, respectively) and the CUL for c-DCE (16 µg/L) generates an HI of 2.1.

- PCE – 5 µg/L equals an HQ of 0.1
- TCE – 4 µg/L equals an HQ of 1.
- PCE – 16 µg/L equals an HQ of 1.
  HI = 2.1

The principle of additivity for noncancer health effects assumes that similar organ systems and health endpoints will be affected by the chemicals of concern. As such, and consistent with EPA superfund risk assessment guidance, MTCA allows noncancer HQs from multiple chemicals to be apportioned by similar type of toxic response when evaluating compliance with the noncancer target HI of 1. As shown below, the hazard quotients (HQs) for PCE, TCE, and c-DCE may be segregated by toxic endpoint to further evaluate noncancer hazards for compliance with an HI threshold of 1.

- Nervous, Ocular (PCE) – HI = 0.1
- Developmental, Immune (TCE) – HI = 1
- Urinary (c-DCE) – HI = 1

The HIs presented above do not exceed 1 based on the segregation by toxic endpoints and meet the MTCA HI threshold of 1.

CONCLUSION

The cumulative ELCR for TCE and PCE is simply additive for each compound:

7.4×10^{-6} (TCE ELCR) + 2.4×10^{-7} (PCE ELCR) = $\mathbf{7.64 \times 10^{-6}}$ cumulative ELCR

The cumulative ELCR does not exceed the MTCA guidance of 1×10^{-5} for multiple cancer-causing compounds. In addition, the noncancer HIs segregated by toxic endpoints do not exceed the MTCA HI threshold of 1. Therefore, the existing CULs for TCE, PCE, and c-DCE do not need to be modified from the CLARC values for this specific site and are protective of human health and the environment.

This page intentionally left blank.