DEPARTMENT OF ECOLOGY
State of Washington

Cleanup Action Plan

Pasco Landfill NPL Site

Kahlotus Road & Highway 12, Pasco

Facility Site ID 575, Cleanup Site ID 1910

August 2019

This document is available on the Washington State Department of Ecology's website at https://fortress.wa.gov/ecy/gsp/CleanupSiteDocuments.aspx?csid=1910.

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Acronyms and Abbreviations

AOC – area of contamination

bgs – below ground surface

CAP – cleanup action plan

CD – consent decree

CFR – Code of Federal Regulations

CUL – cleanup level

DCA – disproportionate cost analysis

Ecology – Washington State Department of Ecology

EDR – engineering design report

EPA – U.S. Environmental Protection Agency

EPI – Environmental Partners, Inc.

FFS – focused feasibility study

FS – feasibility study

GCCS – gas collection and control system

GPA – groundwater protection area

IHS – indicator hazardous substance

LNAPL – light, non-aqueous phase liquid

MSW – municipal solid waste

MTCA – Model Toxics Control Act

NAPL – non-aqueous phase liquid

NPL – National Priorities List

O&M – operations and maintenance

PAH – polycyclic aromatic hydrocarbon

PCB – polychlorinated biphenyl

PLP – potentially liable person

PQL – practical quantitation limit

PSC – Philip Services Corporation

RA/CLA – risk assessment/cleanup level analysis

RAO – remedial action objective

RCRA – Resource Conservation and Recovery Act

RCW – Revised Code of Washington

RI – remedial investigation

RME – reasonable maximum exposure

RTF – restoration time frame

RTO – regenerative thermal oxidation

Site – Pasco Sanitary Landfill NPL Site

SOW – scope of work

SVE – soil vapor extraction

SVOC – semi-volatile organic compound

TCE – trichloroethylene

TEE – terrestrial ecological evaluation

UIC – Underground Injection Control

VOC – volatile organic compound

WAC – Washington Administrative Code

WDOH – Washington State Department of Health

1 Introduction

This report presents the Washington State Department of Ecology's (Ecology) proposed cleanup action for the Pasco Sanitary Landfill NPL Site (Site) located at Kahlotus Road and Highway 12 in Pasco, Franklin County, Washington. The general location of the Site is shown in Figure 1 (page 73).

This Cleanup Action Plan (CAP) is a required part of the cleanup process under Chapter 173-340 of the Washington Administrative Code (WAC), Model Toxics Control Act (MTCA) cleanup regulations, Chapter 70.105D Revised Code of Washington (RCW), implemented by Ecology.

The cleanup action decision is based on the Remedial Investigation/Feasibility Study (RI/FS) and other relevant documents in the administrative record. Ecology has named the following as potentially liable persons (PLPs):

- 3M
- Akzo Nobel Canada, Inc.
- Basin Disposal
- Bayer Crop Science
- Blount, Inc.
- The Boeing Company
- Burlington Environmental, Inc./Chemical Processors, Inc.
- BNSF Railway Company
- Carr Aviation
- Collier Carbon and Chemical Company/Union Oil of California
- Crown Cork and Seal Company/Crown Beverage Packaging, LLC
- Daimler Trucks North America, LLC/Freightliner Corporation
- Leonard and Glenda Dietrich
- John and Marjorie Dietrich
- E.I. du Pont de Nemours & Co., Inc.
- Franklin County
- Georgia Pacific LLC
- B.F. Goodrich Corp./Kalama Chemical, Inc.
- Harbor Oil, Inc.
- ICI Canada, Inc.
- Intalco Aluminum
- James River II, Inc./Fort James Corporation
- Morton International, Inc.
- The O'Brien Corporation
- PACCAR
- PCC Structurals
- Pharmacia Corp.
- Pasco Sanitary Landfill, Inc.
- Piute Energy and Transportation
- PPG Industries, Inc.
- Puget Sound Naval Shipyards
- Resource Recovery, Inc.
- Sandvik Specialty Metals LLC
- Simpson Timber Company
- UARCO Incorporated/Standard Register Company
- U.S. Air Force
- U.S. Department of Agriculture
- U.S. Department of the Interior
- Weyerhaeuser NR Company
- Wood Treatment Chemicals Company
- Zep, Inc.

The PLPs have completed investigation activities under several different agreed orders and enforcement orders since the landfill was designated as a MTCA cleanup site in the early 1990s.

The purpose of the CAP is to identify the proposed and selected cleanup action for the Site and to provide an explanatory document for public review that:

- Describes the history of Site operations, ownership, and activities
- Summarizes nature and extent of contamination
- Summarizes the cleanup action alternatives considered in the remedy selection process
- Identifies Site-specific cleanup levels (CULs) and points of compliance for each hazardous substance and medium of concern for the proposed cleanup action
- Identifies applicable state and federal laws for the proposed cleanup action
- Describes the selected cleanup action(s) for the Site and the rationale for selecting this/these alternative(s)
- Identifies residual contamination remaining on the Site after cleanup and restrictions on future uses and activities to ensure continued protection of human health and the environment
- Discusses any required compliance monitoring and institutional controls

1.1 Declaration

Ecology has selected this remedy because it will be protective of human health and the environment. Furthermore, the selected remedy is consistent with the State of Washington's preference for permanent solutions, as stated in RCW 70.105D.030(1)(b). However, we will consider all public input before making the CAP final.

1.2 Applicability

This CAP is applicable only to the Pasco Landfill NPL Site. The remedial actions to be taken at this site were developed to meet the threshold and other requirements of WAC 173-340-360. They were developed as a part of an overall remediation process under Ecology oversight using MTCA authority, and should not be considered as setting precedents for other sites.

The PLP primarily responsible for Zone B cleanup work (Bayer CropScience, Inc.) petitioned Ecology in late 2018 to remove Zone B from the Pasco Landfill NPL Site. This petition sought to establish Zone B as a new, separate MTCA cleanup site. The basis for this petition was that contaminants from the Zone B portion of the Site do not appear to overlap or intermix with contamination from the other landfill disposal areas. Ecology approved this request in July 2019. Separate cleanup documents and a separate legal agreement will be prepared for Zone B that will be presented to the public for review. In response to this change, Zone B PLPs will become solely responsible for maintaining the Zone B cover and institutional controls, and will conduct its own independent groundwater monitoring. It will no longer participate in cleanup activities involving the rest of the Site.

1.3 Administrative record

The documents used to make the decisions discussed in this CAP are on file in the administrative record for the Site. Major documents are listed in the References section. The entire administrative record for the Site is available for public review by appointment at Ecology's Eastern Regional Office, located at 4601 N. Monroe Street, Spokane, Washington, 99205-1295.

1.4 Cleanup process

Cleanup conducted under the MTCA process requires the PLPs or Ecology to prepare specific documents. These procedural tasks and resulting documents, along with the MTCA section requiring their completion, are listed below with a brief description of each task.

- RI/FS (WAC 173-340-350) — documents the investigations and evaluations conducted at the Site from the discovery phase to the RI/FS document. The RI collects and presents information on the nature and extent of contamination and the risks posed by the contamination. The FS presents and evaluates Site cleanup alternatives and may propose a preferred cleanup alternative. The documents are usually prepared by the PLPs, accepted by Ecology, and undergo public comment.
- CAP (WAC 173-340-380) — sets cleanup standards for the Site, and selects the cleanup actions intended to achieve the cleanup standards. Ecology issues the document, and it undergoes public comment.
- Engineering Design Report (EDR), Construction Plans and Specifications (WAC 173-340-400) — outlines details of the selected cleanup action, including any engineered systems and design components from the CAP. These may include construction plans and specifications with technical drawings. The PLPs usually prepare the document, and Ecology approves it. Public comment is optional.
- Operation and Maintenance Plan(s) (WAC 173-340-400) — summarizes the requirements for inspection and maintenance of remediation operations. They include any actions required to operate and maintain equipment, structures, or other remedial systems. The PLPs usually prepare the document, and Ecology approves it.
- Cleanup Action Report (WAC 173-340-400) — provides details on the cleanup activities along with documentation of adherence to or variance from the CAP following implementation of the cleanup action. The PLPs usually prepare the document, and Ecology approves it.
- Compliance Monitoring Plan (WAC 173-340-410) — details the monitoring activities required to ensure the cleanup action is performing as intended. The PLPs usually prepare the document, and Ecology approves it.
- Public Participation Plan (WAC 173-340-600) — summarizes the methods that will be implemented to encourage coordinated and effective public involvement. Ecology prepares this document.

2 Site Background

This section summarizes the Site's history, investigations of contamination issues, and physical characteristics.

2.1 General Site setting and history

The Pasco Landfill is about 1.5 miles northeast of the City of Pasco, north of the intersection of Kahlotus Road with U.S. Highway 12. The landfill property covers nearly 200 acres and is surrounded by agriculture and commercial businesses. The Basin Disposal transfer station on Dietrich Road is at the southern end of the landfill. The landfill no longer accepts waste and is closed to the public. Gates, fencing, and signs restrict access to this active cleanup site.

Residential and commercial areas are located to the south and southwest of the Site, the closest of which lies approximately 0.5 miles from the landfill boundary. The Columbia River is located approximately 2.5 miles south of the Site. The Site includes zoned areas that lie within the City of Pasco and zoned areas lying within unincorporated Franklin County. The City of Pasco parcels west and south are zoned light industrial. The Franklin County parcels east and north are zoned agricultural production. Additional details on specific zoning and land use is provided in Section 4.2.

Waste disposal and closure activities were conducted at the landfill under permits issued by the Benton-Franklin Health District, the Franklin County Planning Department, and/or Ecology. Municipal solid waste (MSW) was landfilled from 1958 through 1993. MSW was placed in the Burn Trenches from 1958 to 1965, the MSW Landfill from 1958 to 1993, the Balefill Area and Inert Waste Disposal Area from 1976 to 1993, and other contiguous MSW disposal areas. In 1969, the landfill was designated as a disposal site for pesticides and their containers by the Washington State Department of Agriculture. During the 1970s, the municipal landfill operations also included the disposal of various bulk liquids, septic tank wastes, sewage sludges, and animal fat emulsions. These wastes were disposed in lagoons or spread over the ground from 1976 to 1992. Waste material and soil from these operational areas were later disposed at the MSW Landfill and/or used as daily cover to minimize surface exposure of the wastes.

Industrial wastes were disposed at the Site from 1972 through 1975. The industrial wastes were received in bulk (tanker trucks) and in 55-gallon drums or other containers. Industrial waste was segregated into five primary zones at the facility designated as zones A, B, C, D, and E (referred to as the Industrial Waste Area). Figure 2 (page 74) shows the location of waste disposal areas and zones across the Site. A broad and diverse inventory of industrial wastes was received including both organic and inorganic hazardous wastes. Drummed industrial wastes were disposed in two zones, one of which was designated and managed for herbicide-manufacturing wastes. Industrial waste that was delivered in bulk liquid form was placed into large, unlined evaporation lagoons. One of the industrial waste areas was designated for chlor-alkali wastes, a paper manufacturing sludge. During the period when industrial wastes were being actively disposed at the site, community concerns caused Franklin County to prohibit further industrial waste disposal activities, at large, at the landfill. Interim closure of the industrial waste areas began in 1975, and was completed in 1980.

All landfilling activities at the site ended in 2001. Further description of the operational history is presented in Section 2.3 and in the *Final Draft Phase I Remedial Investigation, Pasco Landfill* (Phase I RI Report; Burlington Environmental 1994) and *Final Phase II Remedial Investigation Report, Pasco Landfill* (Phase II RI Report, Philip Services Corporation [PSC] 1998a).

2.2 Waste disposal areas and zones

Resource Recovery Corporation formed in 1972 to direct and manage the overall waste disposal operations at the Pasco Landfill, including the disposal of hazardous industrial wastes. The Site received a variety of different waste types during its period of active operations. This included household and commercial garbage, construction debris, and industrial waste. The industrial waste disposal activities at the Site pre-dated the Resource Conservation and Recovery Act (RCRA) regulations that passed in 1976. Industrial wastes disposed at the landfill included liquids, sludges, and solids that contained chemical constituents known at the time of disposal to be hazardous, toxic, and/or carcinogenic. These industrial wastes were managed in the designated Industrial Waste Area that separated them from adjoining MSW disposal areas. Ecology issued Industrial Waste Discharge Permit (No. 5301) to Resource Recovery Corporation in March 1973, authorizing industrial waste disposal in accordance with the stipulated conditions and requirements of the permit.

The disposal areas and corresponding waste materials at the Site are as follows:

- MSW Landfill Area: contains household and commercial garbage
- Balefill/Inert Waste Area: contains household waste, tires, and construction debris. Garbage placed into the Balefill Area typically was compacted into bales, stacked, and buried.
- Industrial Waste Area:
    - Zone A: contains an estimated 35,000 55-gallon drums. The drums originally contained solvent and paint sludges, cleaners, and a broad variety of other hazardous industrial waste.
    - Zone B: contained nearly 5,000 drums of herbicide-manufacturing waste that were excavated and disposed offsite in 2002. Residual soil contamination attributable to drum leakage still is present.
    - Zones C/D: contains residues from disposing approximately 3-million gallons of plywood resin waste, wood treatment and preservative waste, lime sludge, cutting oils, paint and paint solvent waste, and other bulk liquid waste. These zones were combined in 2002.
    - Zone E: contains approximately 11,000 tons of chlor-alkali waste, a mercury-enriched barium sludge from paper manufacturing.

A separate lined solid waste landfill area (New Waste, Inc.) was constructed north of the MSW Landfill in 1993 and closed in 2001. Though located within the Pasco Sanitary Landfill Inc. property boundary, the New Waste Landfill is not considered to contribute to environmental impacts, and is not part of the Site cleanup.

The Focused Feasibility Study (FFS) Report (Figure 2.3-2) provides a timeline of Pasco Landfill operations, including various cleanup milestones and related activities through 2017.

2.3 EPA National Priorities Listing and contaminant concerns

The site was investigated in 1984 as part of the United States Environmental Protection Agency's (EPA's) nationwide dioxin investigation because of the herbicide wastes buried in Zone B. EPA conducted follow-up investigations in 1985 and identified several volatile organic compounds (VOCs) in groundwater beneath the site. In June 1988, EPA added the Pasco Landfill to the National Priorities List (NPL) of Superfund Sites in 1990. A 1991 agreement between Ecology and EPA assigned the Pasco Landfill site as a state-led cleanup site. Ecology initially identified 29 PLPs for the Site and entered into Agreed Order No. DE92TC-E105 for an RI at the Site.

Phase I RI activities commenced in 1992 to assess the nature and extent of contamination at the site. Additional Phase II RI work performed in 1995 addressed various data gaps identified during Phase I. The RI confirmed the presence of extensive soil and groundwater contamination from past waste disposal activities, including groundwater contamination that had traveled to areas lying outside the footprint of the landfill property. The City of Pasco passed an ordinance in 2001 creating a groundwater protection area (GPA) to address portions of East Pasco where landfill-sourced contaminants had contaminated groundwater. The GPA remains in place. Groundwater contamination currently includes non-aqueous-phase liquid (NAPL) on groundwater beneath Zone A.

2.4 Investigations

The Site has a long and complex history of environmental investigations, beginning in the 1980s. The FFS report (Figure 2.3-2) provides a timeline of key RI/FS, interim action, and associated investigation intervals and reporting milestones. Selected investigation activities considered most relevant to CAP development are summarized below.

2.4.1 Remedial investigation, risk assessment, cleanup level development, and interim actions

Phase I and Phase II RIs were conducted in the early- to mid-1990s to evaluate the nature and extent of contamination at the Site. These RI activities provided the original technical framework for establishing a conceptual site model that could be used to describe the overall types, location, and distribution of site contaminants. A risk assessment and CUL analysis was subsequently performed along with an ecological assessment report. These documents provided the first analysis of potential risks posed by Site contamination. This included selecting indicator hazardous substances, an exposure assessment, a toxicity assessment, identifying physical hazards at the Site, developing CULs, and comparing maximum observed contaminant concentrations to CULs. Additional discussion of RI data (and other post-RI data) used to perform the CULs analysis in the CAP is in Section 3.

During the remedial investigation, several interim remedial measures were implemented to reduce the risks to human health and the environment from Site conditions, including:

- Providing bottled water to all off-property households whose water supply wells may have been impacted by contaminants from the Pasco Landfill
- Providing City of Pasco municipal water to all households whose wells were adversely impacted by landfill-related contaminants
- Installing and operating a soil vapor extraction (SVE) system to remove and treat contaminants in soils at the Site to help minimize impacts to local groundwater
- Installing and operating an in-well air stripping system (NoVOCs™) to remove and treat VOCs that continued to reach groundwater

2.4.2 Feasibility study

The FS conducted in the late 1990s assessed and ranked cleanup options designed to reduce risk at each contaminant source area at the Site. The FS Report (PSC 1999) concluded that six areas at the Site (Zone A, Zone B, Zones C/D, Zone E, and the MSW Landfill) required cleanup. The PLPs' preferred options included long-term monitoring and implementing remedial measures at the MSW Landfill Area and all the Industrial Waste Area zones. These proposed remedial measures were directed at source control and groundwater remediation. Ecology approved the PLPs' preferred remedy as an interim action – not a final remedy. Final CAP preparation was deferred, pending the outcome from a 5-year performance-monitoring period during which the effectiveness of the interim action would be assessed.

2.4.3 Interim remedial measures

Interim remedial measures were conducted in 2001/2002. RCRA C-compliant cover systems were installed at Zone A, Zones C/D, and Zone E. An enhanced cover system compliant with WAC 173-351 landfill closure requirements was installed at the MSW Landfill along with a landfill gas collection system and flare to treat gas from the MSW Landfill and contaminant vapors conveyed approximately 0.5 miles from the Zone A SVE system. Additional Zone A interim remedial measures included SVE system improvements, and expanding the NoVOCs™ groundwater treatment system. The groundwater-monitoring network was also expanded.

2.4.4 Zone B drum removal

An interim action drum removal in 2002 removed all drums at Zone B containing herbicide-manufacturing wastes and other related contaminants. The work generally consisted of the excavation, removal, and offsite incineration and disposal of approximately 5,500 cubic yards of drummed waste and impacted soil. Following the drum removal, Zone B was capped with a 12-mil plastic cover. As noted in Section 1.2, Ecology will develop a separate CAP for Zone B.

2.4.5 Interim action performance monitoring

The PLPs prepared an Interim Action Performance Monitoring Report in 2007 to document the performance and effectiveness of the interim action cleanup activities implemented in 2001. Ecology reviewed the report and identified a number of concerns about the performance and effectiveness of certain components of the interim remedial measures. These concerns prevented Ecology from accepting and approving the interim remedial measures as final cleanup remedies that would achieve all remedial action objectives (RAOs), including completing Site cleanup within a reasonable restoration timeframe. As a result, Ecology deferred the final CAP and required the PLPs to do further additional interim action work. The additional interim action work was necessary to assess critical data gaps and uncertainties over site conditions, and to better inform the development of an acceptable final site remedy.

2.4.6 Zone A additional interim actions

Beginning in 2008, two phases of interim actions addressed critical data gaps and uncertainties over fundamental conceptual site model elements associated with Zone A. Phase I focused on the existing groundwater monitoring program and the operational performance of the SVE and NoVOCs™ systems. Phase II evaluated and characterized conditions under Zone A and expanded the groundwater-monitoring network. These activities helped refine the overall conceptual site model for Zone A and provided further information about the apparent effectiveness of Zone A SVE operations for protecting groundwater.

2.4.7 MSW flare operations and testing

A stack test was performed in 2010 to assess the effectiveness of the MSW Landfill flare at treating vapors, gases, and condensate from the MSW Landfill and Zone A SVE operations. The MSW flare was shown to treat vapors and gases satisfactorily, but its performance was adversely affected during liquid condensate treatment. Flare treatment of condensate ended in August 2011. In response to findings from the MSW Flare Stack Test, the flare was modified to accommodate continued Zone A SVE treatment in light of decreasing methane generation and collection rates at the MSW Landfill. Contaminated vapors from the Zone A SVE system were treated at the flare until October 2015. MSW Landfill gas continues to be treated at the flare.

2.4.8 Zone A SVE system modifications

In 2011, the Zone A SVE system was upgraded to include six new wells near the central interior of Zone A. The original SVE system included wells positioned around the exterior of the Zone A waste disposal area. The screened interval of these exterior SVE wells typically was positioned within deeper portions of the unsaturated zone. The new wells were installed in two clusters, with each cluster containing a shallow, intermediate, and deep SVE well. The blower units also were upgraded to support these modified SVE system operations. The previous exterior SVE wells were deactivated. The reconfigured SVE system resulted in an increase in the VOC mass removal rates compared to the original exterior SVE well network. Subsurface temperatures observed in the interior SVE wells prompted subsequent constraints on both air flow rates and wellhead temperatures. A series of below-ground moisture separators also were installed during this SVE system upgrade to capture and remove SVE vapor condensate that was generated in the SVE conveyance piping. SVE condensate is managed as investigation-derived waste involving offsite treatment.

2.4.9 Treatment of Zone A SVE vapors/gases – 2015 to present

Treatment of vapors and gases from the Zone A SVE system shifted from the MSW flare to a thermal oxidation treatment unit installed in 2015. Performance testing of the original regenerative thermal oxidation (RTO) unit in January 2016 indicated insufficient treatment of Zone A SVE system vapors and gases. Specifically, emission limits in Ecology Air Quality Program Approval Order No. 14AQ-E571 were not being met. The PLPs subsequently installed a new RTO unit to replace the original, underperforming unit. The Air Quality Program issued a new Approval Order (16AQ-E031) in May 2017 to support installing and operating the new RTO unit. The new RTO began operating on July 14, 2017. Performance testing in 2017 and 2018 confirmed compliance with emission limits in the Approval Order. The existing RTO unit continues to treat Zone A SVE vapors and gases during the current phase of interim action cleanup.

2.4.10 Zone B interim action cover installation

An interim action RCRA C-compliant cover system was installed in 2013 to address residual contamination that still was present in Zone B following the 2002 drum removal. Several phases of soil investigation were conducted prior to developing the cover system design to determine the extent of residual surficial contamination around the perimeter of Zone B. Contaminated soil from around the Zone B perimeter were excavated and consolidated beneath the new cover system. The interim action activities resulted in the landfill property boundary being modified and existing monitoring wells located near Zone B being replaced. As noted in Section 1.2, a separate CAP is being developed for Zone B.

2.4.11 Balefill Area fire investigation

A landfill fire was identified in November 2013 within the Balefill Area near the northeast corner of Zone A. Multiple investigations occurred to assess the vertical and lateral extent of the combustion zone. The PLPs tried various approaches to suppress and extinguish the fire. The PLPs developed a comprehensive extinguishment plan in 2015 with the following objectives:

- Extinguish the subsurface area of smoldering combustion and quench an area with temperatures greater than 170 degrees Fahrenheit on the western margin of the Balefill Area near the northeast margin of Zone A
- Protect wastes and interim remedial actions in Zone A from other areas of potentially combustible wastes located north and east of Zone A.

The combustion area was later extinguished using an Ecology-approved deep trenching and waste quenching approach coupled with a cement/bentonite-slurry containment wall. The work also included installing a deep soil-cement-bentonite wall along the northern and northeastern portions of Zone A to help physically cutoff Zone A wastes from adjacent MSW wastes (Balefill Area and Inert Waste Area). Subsurface temperature and soil gas monitoring provided additional information on subsurface conditions within both Zone A and the adjacent MSW areas. A report describing the outcome from the fire extinguishment work was submitted to Ecology in April 2016.

2.4.12 Focused Feasibility Study

The FFS was initiated in October 2012 to develop options for final Site cleanup in accordance with MTCA and the requirements of Agreed Order No. DE 9240. The FFS process, including developing cleanup options for each waste area at the Site, incorporated PLP experience gained during the prior interim remedial measures performance-monitoring period, and subsequent information obtained during the additional interim actions. Ecology received two separate FFS documents (Anchor QEA 2017, Aspect 2017) from two PLP subgroups in August 2017. Ecology shared the FFS documents with the public for their review and input in September/October 2018, and published responses to comments in November 2018. Selective information and results from the FFS are discussed in this CAP and have been used to guide Ecology’s final cleanup remedy for this Site.

2.4.13 Zone A combustion evaluation

A field investigation of combustion concerns associated with Zone A began in early 2017. The investigation was prompted by several lines of evidence, including data collected and observations made during 2012 through 2016. These data and observations caused Ecology to require a targeted investigation of Zone A subsurface conditions, including potential combustion conditions. Ecology believed investigation activities and associated technical evidence demonstrated the strong likelihood that combustion had, was, and/or likely would occur beneath Zone A. Ecology disagreed with the PLPs’ April 2017 draft summary report (GSI Environmental et al. 2017), and its conclusions about whether subsurface combustion was occurring or likely would occur in the future. The findings from the Zone A Combustion Evaluation further highlighted concerns held by Ecology and certain PLPs about the use of an SVE-centered remedial alternative to achieve the cleanup objectives for this part of the Site.

2.5 Physical characteristics

2.5.1 Topography and climate

The Site occupies an approximate 200-acre area in an area of gently rolling hills and flat terrain. Prior to landfill operations, aerial photos show the property was open, unimproved grassland characterized by both stabilized and active sand dunes. Elevations at the site range from approximately 370 to 480 feet above mean sea level. Highest elevations occur at the northeast corner of the site.

The Site is in an arid region of the Columbia Plateau that is surrounded on the west, north, and northeast by mountain ranges. The Pasco Tri-Cities Airport climate station (National Weather

Service station ID KPSC) has been used for local, continuous weather data and is located approximately 2.5 miles from the Site. Mean annual precipitation in the Pasco Basin ranges from approximately 4 to 13 inches, with mean precipitation of approximately 7.5 inches. Snowfall averages about 14 inches annually. Monthly precipitation ranges from 0.24 inches in August to 1.42 inches in December. Average winds range from 5 miles per hour to 8 miles per hour. Maximum winds range from 11 to 16 miles per hour. Gusts of over 25 miles per hour have been observed with large storm events. Potential evapotranspiration ranges from 0.55 inches in December to 7.75 inches in July.

2.5.2 Regional hydrogeology

The Site is located within the Pasco Basin geologic province on the Columbia River Plateau. The Site is underlain by a thick sequence of basalts that are covered by a relatively thin sequence of semi-consolidated and unconsolidated sediments. From oldest (bottom) to youngest (top), the primary stratigraphic units beneath the Site include:

- Surficial sand and silt; imported fill material (0–10 feet thick)
- Touchet Beds — interbedded fine sand and silt (15–30 feet thick)
- Upper Pasco Gravels — fine to coarse sand with occasional gravel (15–40 feet thick)
- Lower Pasco Gravels — sand and gravel, gravel increases with depth (10–35 feet thick)
- Columbia River Basalt — Yakima basalt subgroup (>4,000 feet)

The Touchet Beds and Upper Pasco Gravels are the hydrostratigraphic units of primary interest at the Site. The physical and chemical characteristics of these units influence the fate and transport of site contaminants both within the unsaturated (vadose) zone and within the regional groundwater system. Remedial actions in this CAP focus largely on the distribution and concentration of various Site contaminants within these two units.

Groundwater typically is first encountered in an alluvial aquifer system that has developed within the Pasco Gravels. This uppermost regional aquifer system extends well outside the boundaries of the landfill property to the west and north. The Columbia River, located approximately 2.5 miles south of the landfill property, serves as the primary discharge zone for groundwater that flows generally southward from the landfill property. The Snake River, located approximately 2.5 miles southeast of the landfill property, forms a separate hydrologic boundary for the regional alluvial groundwater system.

The depth to groundwater beneath the landfill property varies primarily due to topography and the overall southwesterly groundwater gradient. The water table typically is encountered at depths ranging from approximately 30 feet below ground surface (bgs) to 70 feet bgs. The shallowest depth to groundwater is observed on the north end of the MSW Landfill, at a depth of less than 20 feet bgs. The water table fluctuates seasonally approximately 2–3 feet.

The horizontal hydraulic gradient beneath the site varies from about 0.003 to 0.004 ft./ft., and becomes flatter in areas closer to the Columbia River. Vertical hydraulic gradients tend to be of small magnitude and vary seasonally. The RI report presented a horizontal hydraulic conductivity of approximately 1,200 feet/day for the unconfined alluvial aquifer based on the results of a single pumping test. Within the landfill property, groundwater flow rates (seepage velocity) are estimated to range from 5 to 15 feet/day. Beneath the Site, groundwater flows generally to the southwest; the flow becomes more southerly in areas south of the Site. Groundwater flow rates in off-property areas to the south are expected to be lower due to the flatter horizontal hydraulic gradient in areas closer to the river.

3 Remedial Investigation, Interim Actions, and Supplemental Data Collection

An RI was performed in two phases to assess the nature and extent of contamination. Soil and groundwater were investigated to determine whether they were impacted by Site contaminants. Additional information regarding Site activities, sampling, analyses, and methodology is contained in the Phase I and Phase II RI reports (Burlington Environmental Inc. 1994, PSC 1998). Additional site characterization, including collecting soil, soil vapor, and groundwater samples, was conducted after the RI was completed. Environmental data from these sampling activities were generated in conjunction with a number of interim action activities performed between 2008 and 2018. The summary below provides a generalized overview of contamination findings from this approximate 25-year period of site characterization and investigation. Section 2.5 from the FFS Report provides key findings from the various data collection and investigation activities conducted during this time.

3.1 Soil and soil gas

3.1.1 MSW Landfill

Section 2.5.1 of the FFS report (Aspect 2017) provides a summary of key remedial investigation findings for the MSW Landfill, Burn Trenches, Balefill Area, and Inert Waste Disposal Area, including evaluation of soil and soil gas. The 1993 Phase I RI report notes that the unlined MSW Landfill contains wastes that are subject to anaerobic bacterial degradation, resulting in the production of methane and carbon dioxide gas. The solid wastes disposed at the MSW Landfill also included materials that contained various organic compounds. As these organic compounds volatilize and diffuse from the solid waste, they can then migrate to soil and groundwater. RI and post-RI monitoring activities conducted near the MSW Landfill confirm that both aqueous- and gaseous- phase migration of contaminants to subsurface soils beneath the waste zone has occurred. This is evidenced by past and current evaluation of groundwater contamination near the MSW Landfill and the detection of chlorinated VOCs in soil gas collected from gas probes along the landfill area’s western and southern perimeter. The MSW Landfill gas collection and treatment system captures landfill gas from within the waste mass. The capture and treatment of landfill gas minimizes the potential for lateral and vertical gas migration and mitigates potential adverse impacts to air, soil, and groundwater. As discussed in Section 2.4.7, the MSW Landfill flare historically treated gases and vapors from the MSW Landfill and from Zone A.

3.1.2 Balefill and Inert Waste Area

Section 2.5.1 of the FFS report (Aspect 2017) provides a summary of key RI findings for the MSW Landfill, Burn Trenches, Balefill Area, and Inert Waste Disposal Area, including soil and soil gas evaluations. The Phase I RI assessed soil gas concentrations around the Balefill and Inert Waste Area. The RI data confirmed the presence of chlorinated VOCs in soil gas collected from a limited number of gas probes installed around this MSW disposal area. Methane concentrations were not measured. More recent monitoring of soil gases conducted since 2016 from selected gas probes installed within the Balefill Area and Inert Waste Area demonstrate low-level concentrations of landfill gas constituents consistent with the normal degradation of these wastes.

3.1.3 Burn Trench Areas

Section 2.5.1 of the FFS report (Aspect 2017) provides a summary of key RI findings for the MSW Landfill, Burn Trenches, Balefill Area, and Inert Waste Disposal Area, including soil and soil gas evaluations. The Phase I RI assessed soil gas concentrations around the Burn Trench Areas. Chlorinated VOCs were detected in a limited number of gas probes installed adjacent to the East-West (BT-1) and North-South (BT-2) Burn Trench Areas. The soil gas composition measured near BT-2 may reflect a combination of contaminant releases from both BT-2 and the nearby Zone A. Soil gas data from gas probes located close to BT-1 suggested the likelihood that VOCs were being released to subsurface soils from this older MSW disposal area. The potential for ongoing release of landfill gases from the Burn Trench Areas likely has declined significantly during the post-RI period based on the age of the MSW materials and degree of biodegradation that has occurred.

3.1.4 Zone A

Section 2.5.3 of the FFS report (Anchor QEA 2017) provides a summary of key remedial investigation findings for Zone A, including soil and soil gas evaluations. Additional soil characterization data for Zone A is presented in Appendix G of the FFS report. Extensive subsurface soil and soil gas investigation work occurred in the vicinity of Zone A during the RI. Soil samples were analyzed for VOCs, semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and Priority Pollutant metals. The RI confirmed the presence of extensive subsurface contamination involving a broad suite of chemical constituents distributed throughout the vicinity of Zone A. Additional post-RI investigation of Zone A up through 2018 has further refined lateral and vertical contamination distribution, spatial concentration variations, and the broad range of contaminant types that are present in this area. Sections 2.4.6 and 2.4.11 of this CAP describe two important Zone A post-RI investigations. These contemporary investigations have helped further refine the conceptual site model used to describe subsurface soil and soil gas contamination at Zone A.

3.1.5 Zones C/D

Section 2.5.5 of the FFS report (Anchor QEA 2017) provides a summary of key RI findings for Zones C/D, including soil and soil gas evaluations. Additional soil characterization data for

Zones C/D is presented in Appendix G of the FFS report. Soils samples were analyzed for VOCs, SVOCs, pesticides, PCBs (one location), and Priority Pollutant metals. Halogenated and non-halogenated organic compounds were detected in subsurface soils beneath Zones C/D at depths of 50 to 60 feet bgs. A vapor sample was collected in October 2012 from monitoring well MW-55S near the southern perimeter of Zones C/D. The screened interval of MW-55S extended several feet above the water table, allowing a vadose zone vapor sample to be collected. The MW-55S vapor sample contained low but detectable concentrations of several VOCs including chloroform, trichloroethylene (TCE), toluene, ethylbenzene, total xylenes, and 1,2,4-trimethylbenzene.

3.1.6 Zone E

Section 2.5.6 of the FFS report (Anchor QEA 2017) provides a summary of key RI findings for Zone E, including of soil and soil gas evaluations. Additional soil characterization data for Zone E is presented in Appendix G of the FFS report. Soil samples were analyzed for VOCs, SVOCs, pesticides, PCBs, chlorinated herbicides, Priority Pollutant metals, and selected radionuclides. Halogenated and non-halogenated organic compounds were detected in subsurface soils beneath Zone E down to a depth of 61 feet bgs. Selected soil samples from beneath Zone E exceeded the federal toxicity characteristics limit for mercury. A vapor sample was collected in October 2012 from monitoring well MW-55S near the southern perimeter of Zones C/D and approximately 200 feet southwest of Zone E. The screened interval of MW-55S extended several feet above the water table, allowing a vadose zone vapor sample to be collected. The MW-55S vapor sample contained low but detectable concentrations of several VOCs including chloroform, TCE, toluene, ethylbenzene, total xylenes, and 1,2,4-trimethylbenzene.

The RI also included collection of surface soil samples from two additional waste management areas at the Site: Sludge Management Area and Landspread Area. Surface soils within these areas were moved to the MSW Landfill prior to its closure in 1993. The original Sludge Management and Landspread Areas are not considered ongoing areas of concern requiring additional cleanup actions, and therefore are not further addressed in this CAP.

3.2 Groundwater

3.2.1 MSW Landfill

Section 2.5.1 of the FFS report (Anchor QEA 2017) provides a summary of key RI findings for the MSW Landfill, Burn Trenches, Balefill Area, and Inert Waste Disposal Area, including groundwater sampling. Several VOCs historically were detected in MSW Landfill monitoring wells at concentrations exceeding MTCA Method B formula values in effect during the Phase II RI. Groundwater quality near the MSW Landfill has improved following installation of the Interim Action MSW Landfill cover system and startup of the landfill gas collection system in 2002. Since 2014, one VOC (perchloroethylene) has been detected intermittently in MSW Landfill monitoring wells at concentrations that have slightly exceeded the draft CULs established in 2007 to support the interim action cleanup operations.

3.2.2 Balefill and Inert Waste Area

Historically, the Balefill and Inert Waste Area was not included as an area of concern with respect to its potential for causing adverse groundwater quality impacts. FFS report Section 2.5.1 (Anchor QEA 2017) states that the potential for groundwater impacts from the Balefill Area or the Inert Waste Disposal Area is considered small given the limited volume of the waste and the limited potential for a contaminant transport pathway in the vadose zone. The FFS report does acknowledge that precipitation infiltration through the soil cover could potentially transport contaminants to soil and/or groundwater; however, direct evidence of groundwater impacts by this transport mechanism has not been documented. Monitoring wells MW-14S, EE-2, and MW-48S are located generally adjacent to, and hydraulically downgradient (southwest) from, the Balefill and Inert Waste Areas. Sampling data collected during the past decade from wells EE-2 and MW-48S indicate that the Balefill and Inert Waste Areas are not causing adverse groundwater quality impacts.

3.2.3 Burn Trench Area

Historically, the Burn Trench Area — in particular, the East-West Burn Trench BT-1 — was not included as an area of concern with respect to its potential for causing adverse groundwater quality impacts. FFS report Section 2.5.1 (Anchor QEA 2017) states that the potential for groundwater impacts from the Burn Trench Area BT-1 is considered low given the limited volume of the waste and the limited potential for a contaminant transport pathway in the vadose zone. The FFS report acknowledges, however, that precipitation infiltration through the soil cover could potentially transport contaminants to soil and/or groundwater. Monitoring wells MW-15S and MW-18S are located in close to Burn Trench Area BT-1. MW-15S is positioned hydraulically downgradient (west-southwest) of BT-1, whereas MW-18S is located hydraulically cross-gradient (south). Groundwater quality conditions at MW-15S also may be influenced by waste areas such as Zones C/D and the MSW Landfill. Groundwater sampling data collected over the past decade has consistently detected the presence of VOCs below the draft CULs at well MW-15S; VOC detections at MW-18S have been much less frequent.

3.2.4 Zone A

Section 2.5.3 of the FFS report (Anchor QEA 2017) provides a summary of key RI findings for Zone A, including groundwater sampling. A broad suite of contaminants were historically detected in monitoring wells located within the footprint and downgradient of Zone A. These include VOCs, SVOCs (including polycyclic aromatic hydrocarbons [PAHs] and PCBs), herbicides, pesticides, and metals. Contaminant concentrations have reduced over time in response to the effects of interim cleanup actions. Contaminant migration in the soil column beneath Zone A likely occurs through several mechanisms, with the primary mechanisms being the liquid-phase and vapor-phase migration.

The current presence of non-VOCs in groundwater, primarily in NAPL, is likely caused by the co-solvency of the liquid-phase transport of VOCs through the vadose zone. NAPL has been detected since 2017 beneath Zone A at well MW-52S, and absorbent socks have been deployed in that well to capture the NAPL. The NAPL has been shown to contain a broad suite of aliphatic and aromatic hydrocarbons, chlorinated and non-chlorinated VOCs and SVOCs, PCBs, chlorinated and brominated pesticides, and potentially other organic constituents based on historical Zone A chemical analyses.

Contemporary dissolved-phase contaminants detected beneath and downgradient of Zone A include VOCs and SVOCs (including PAHs). PAHs have been detected since 2014; however, these detections coincide with a 100X reporting limit reduction. PAHs are now regularly detected immediately downgradient of Zone A. Concentrations of several VOCs exceed draft CULs in groundwater beneath Zone A, and concentrations of some PAHs exceed MTCA Method B screening levels in monitoring wells located immediately downgradient of Zone A.

3.2.5 Zones C/D

Section 2.5.5 of the FFS report (Anchor QEA 2017) discusses historical groundwater contaminant observations from monitoring wells located in close proximity to Zones C/D. The FFS report notes that while waste materials at Zones C/D have historically released VOCs to subsurface soils and groundwater, the levels of residual contamination in subsurface soils are not expected to cause an exceedance of groundwater CULs. Over the past decade, occasional VOC detections have been observed at monitoring well MW-55S located directly south of Zones C/D. During the fourth quarter of 2014, benzene concentrations at MW-55S exceeded the draft CUL by over two orders of magnitude. Subsequent monitoring at this well has not shown evidence of VOC concentrations exceeding the draft CULs. As noted above, VOCs also have been detected routinely at well MW-15S located hydraulically downgradient (west-southwest) of Zones C/D. Groundwater quality at MW-15S may be influenced by other nearby waste disposal areas other than Zones C/D.

3.2.6 Zone E

Section 2.5.6 of the FFS report (Anchor QEA 2017) discusses historical groundwater contaminant observations from monitoring wells located in close proximity to Zone E. While acknowledging that VOCs and metals have been consistently detected in groundwater monitoring wells located hydraulically downgradient of Zone E (for example, MW-19S), the FFS report concludes that these contaminant detections are not likely associated with the Zone E wastes. The ongoing presence of VOCs at MW-19S, if not directly related to Zone E, implies that another undocumented contaminant source potentially is located hydraulically upgradient (northeast) of this monitoring well. Historical sludge lagoon operations northeast of the existing Zone E repository area potentially could be acting as an ongoing source for low-level VOC releases to groundwater. The sludge lagoons were cleaned out and the wastes were transferred to the MSW Landfill prior to its closure in 1993. Absent this alternative source, the only other logical source for the observed contamination at MW-19S is Zone E.

3.2.7 Off-property groundwater

The 1999 FS report (see Section 5.2.5 and Figure 5-10) describes a “plume of groundwater impacted by [contaminants of concern] COCs [which] extends approximately 9,000 feet from the sources at Zone A and the Municipal Landfill and is approximately 1,800 feet wide." This was the dimension of the plume in July 1996.

Routine groundwater sampling since 1999 has monitored the off-property groundwater contamination. Twenty-three groundwater monitoring wells have been sampled to monitor and delineate groundwater contamination downgradient of the Site. SVOCs and VOCs have historically been detected in some off-property monitoring wells; however, only VOCs have been detected more recently.

Groundwater quality conditions off the Site have continued to improve over time in response to interim actions. Off-Site VOC concentrations have remained consistently below the draft CULs during the past several years, although detectable concentrations of certain constituents are still measured in selected residential and monitoring wells.

3.3 Risks to human health and environment

A risk assessment/cleanup level analysis (RA/CLA) report (Philip Environmental, 1998b) was prepared for the site and accepted by Ecology as final in September 1998. The RA/CLA is used during the RI/FS process to:

- Identify site-specific indicator hazardous substances (IHSs)
- Evaluate reasonable maximum exposures (RMEs) under current and future exposure scenarios
- Develop site-specific risk-based CULs for the IHSs for use in the FS, FFS, and CAP

Comparing detected concentrations to background and risk-based levels identifies the IHSs for soil and groundwater. The screening method is conservative to identify the IHSs that contribute the majority of potential site-related risk. These IHSs are used in the FS and FFS to evaluate whether cleanup options protect public health and the environment.

The RA/CLA used conservative assumptions in screening IHSs and developing the site-specific CULs. For example, it was assumed that all chemicals detected in onsite and offsite groundwater monitoring wells are present at all exposure points when adjusting groundwater CULs downward for exposure to multiple chemicals. However, all chemicals have never been detected in any one location. The conservative assumptions tend to overestimate actual site risk, which results in very low CULs. In fact, CULs in groundwater calculated for the Site are much lower than levels allowed in municipal drinking water. For this reason, exceedances of these low risk-based CULs do not necessarily indicate that an actual health impact has or will occur. Rather, the exceedance indicates that the chemical warrants consideration in the FS/FFS when evaluating alternative remedial actions.

CUL development has gone through progressive phases of refinement over the years. The earliest RA/CLA report was prepared in 1998. The 1998 RA/CLA used conservative assumptions in screening IHSs and developing the site-specific CULs.

In 2007, in conjunction with PLP preparation of an Interim Action Performance Monitoring Report, Ecology re-examined CULs that had been developed previously during the 1998 RA/CLA report. The 2007 draft CULs largely have served as the CULs used to guide the interim actions that have occurred throughout the Site from 2007 to the present.

Section 4 is an updated presentation of cleanup standards and the associated CULs development process, and provides final site CULs based on review and assessment of historical characterization and monitoring data and consideration of current site conditions.

3.3.1 Off-Site domestic water supply use

Since 1996, bottled and municipal water from the City of Pasco have been provided to residents whose drinking water wells may have been impacted by landfill-related contamination. Also, the City of Pasco created a GPA to limit groundwater usage in areas where contamination was found or suspected. The GPA extends beyond the limits of the plume boundaries. This institutional control limits the type of use for existing residential water supply wells and ensures that no additional residential drinking water wells can be installed in the GPA.

At the request of Ecology, the Washington State Department of Health (WDOH) prepared a Letter Health Consultation (WDOH 2014) addressing potential health risk concerns associated with consumptive use of groundwater from 13 offsite residential water supply wells. Specifically, the evaluation focused on possible human exposure to landfill-related contaminants. The purpose of the Letter Health Consultation was to assess the potential health threat posed by these hazardous substances in the environment and, if needed, recommend steps or actions to protect public health.

The WDOH Letter Health Consultation categorized excess cancer risk values as being insignificant from a human health risk standpoint. Groundwater quality conditions in this offsite, downgradient plume area, have remained the same, or slightly improved since 2014. Recognizing the time-constrained nature of this risk evaluation, WDOH still recommended limiting groundwater use from residential water supply wells to only non-consumptive, outdoor uses such as lawn watering or garden use.

4 Cleanup Standards

MTCA requires the establishment of cleanup standards for individual sites. The two primary components of cleanup standards are CULs and points of compliance. CULs determine the concentration at which a substance does not threaten human health or the environment. All media exceeding a cleanup level is addressed through a cleanup remedy that prevents exposure to the contaminated material. Points of compliance represent the locations on the site where CULs must be met.

4.1 Overview

The process for establishing CULs involves the following:

- Determining if methods A, B, or C are applicable;
- Developing CULs for individual contaminants in each media;
- Determining which contaminants contribute the majority of the overall risk in each media (indicators); and
- Adjusting the CULs downward for carcinogenic substances based on total site risk of 1×10^{-5}, and for a hazard index of 1 for non-carcinogenic substances, if necessary.

MTCA provides three options for establishing CULs: Methods A, B, and C.

- Method A may be used to establish CULs at routine sites or sites with relatively few hazardous substances.
- Method B is the standard method for establishing CULS and may be used to establish CULs at any site.
- Method C is a conditional method used when a cleanup level under Method A or B is technically impossible to achieve or may cause significantly greater environmental harm. Method C also may be applied to qualifying industrial properties.

MTCA defines the factors used to determine whether a substance should be retained as an indicator for the Site. When defining CULs at a site contaminated with several hazardous substances, Ecology may eliminate from consideration those contaminants contributing a small percentage of the overall threat to human health and the environment. WAC 173-340-703(2) provides a substance may be eliminated from further consideration based on:

- The toxicological characteristics of the substance which govern its ability to adversely affect human health or the environment relative to the concentration of the substance;
- The chemical and physical characteristics of the substance which govern its tendency to persist in the environment;
- The chemical and physical characteristics of the substance which govern its tendency to move into and through the environment;
- The natural background concentration of the substance;
- The thoroughness of testing for the substance;
- The frequency of detection; and
- The degradation by-products of the substance.

Limits analytical chemistry are also considered (WAC 173-340-705(6)). When the practical quantitation limit (PQL) for detection of a substance is greater than its risk-based CUL, the CUL shall be established at a concentration equal to the PQL. The risk-based CUL is used in the analysis of the overall site hazard and risk in such cases, but the regulatory limit for that substance will be the PQL. Improvements in analytical technology will result in readjustment of the regulatory limit to match the new, lower PQL during any subsequent evaluation of the site.

MTCA requires that total site risk based upon established CULs must not exceed 1 x 10^{-5} and the hazard index, calculated for chemicals with similar non-carcinogenic toxicity endpoints must not exceed 1. Once a list of substances to be assessed for cumulative risks and hazards has been developed, total site risk is calculated based upon the established CULs. The established CULs are adjusted downwards to meet these thresholds, if necessary. MTCA does not define how to apportion risk and hazard index among substances, as long as individual standards for each contaminant are not violated.

4.2 Site use

The evaluation of CULs and ecological exposures depends on the nature of the Site use. Options under MTCA are either an unrestricted property or an industrial property. Industrial properties are defined in WAC 173-340-200; the definition includes properties characterized by transportation areas and facilities zoned for industrial use. Industrial properties are further described in WAC 173-340-745(1) with the following factors:

- People do not normally live on industrial property
- Access by the general public is generally not allowed
- Food is not grown/raised
- Operations are characterized by chemical use/storage, noise, odors, and truck traffic
- Ground surface is mostly covered by buildings, paved lots and roads, and storage areas
- Presence of support facilities serving the industrial facility employees and not the general public

The site includes zoned areas within the City of Pasco, and zoned areas lying within unincorporated Franklin County. Areas within the City of Pasco municipal boundaries are zoned light industrial (I-1), residential (RT, R-1, and R-2), and general business (C-3). Areas within Franklin County are predominantly zoned for agricultural production (20 acres). On-property areas are zoned for light industrial or agricultural production.

4.3 Site-specific cleanup levels development

Considering the current zoning and existing land uses and that the Site likely will continue to be operated and managed as an inactive municipal and hazardous waste disposal facility well into the future, the property qualifies as an industrial site use. Specifically, the RME scenario for soil is industrial land use. By comparison, off-Site areas to the south include residential areas to which unrestricted property standards apply. The more restrictive MTCA Method B groundwater CULs apply to all groundwater at this site.

For this Site, CUL development centers on groundwater and surface water (as the point of discharge for groundwater). Specific CULs for Site soil are not required. NAPL has been detected in one of two monitoring wells (MW-52S) located in Zone A, which requires separate consideration of cleanup expectations and requirements.

4.3.1 Groundwater

The standard Method B CUL for groundwater will be used per WAC 173-340-720(4)(b). Ecology has determined that drinking water is the highest beneficial groundwater use at this Site. Exposure to hazardous substances via ingestion of drinking water and other domestic uses, under current and potential future Site use scenarios, represents the reasonable maximum exposure.

Standards developed to protect these uses will be protective of all other uses. Groundwater from the Site flows toward and discharges to the Columbia River. Therefore, surface water CULs are also considered for the subset of Site-related contaminants that have been detected in groundwater monitoring wells closest to the river. Use designations for the Columbia River under Chapter 173-201A WAC, Water Quality Standards for Surface Waters of the State of Washington, include domestic, industrial, and agricultural water supply; stock watering; spawning/rearing; wildlife habitat; recreation; harvesting; commerce; and navigation.

4.3.2 Soil

Developing CULs for Site soil is not necessary due to the following considerations:

- Contaminated soil remains at the site; however, it is mostly under engineered cover systems with low-permeability geomembranes that minimize the potential for direct contact by human or ecological receptors.
- Some contaminated soil is in landfill disposal areas that have engineered soil cover systems without low-permeability geomembranes. In these areas, the existing soil cover systems meet the closure regulations applicable to the age and content of the MSW in these disposal areas, and these disposal areas do not, and in the future likely will not, cause adverse or unacceptable impacts to groundwater quality.
- Remediation levels will be established for subsurface soils in the vicinity of Zone A in accordance with WAC 173-340-355. Remediation levels may be developed and applied at sites where a combination of cleanup action components are used to achieve CULs at the point of compliance, or at sites where the cleanup action will involve a containment remedy as provided under WAC 173-340-740(6)(f). Installing an engineered cover system with a low-permeability geomembrane will be required as a component of the final Zone A cleanup remedy.
- Remediation levels will be presented in the Post-Excavation EDR (detailed in Section 7 and Exhibit C to the Consent Decree [CD], Scope of Work) that describes the post-excavation cleanup action work at Zone A. Remediation levels established for this cleanup subarea will result in contaminant levels that will not pose an ongoing threat to groundwater.
- Institutional controls required by the CD and its exhibits will ensure that the required remedial infrastructure will be protected and maintained. In developing the controls, Ecology assumes that human and/or ecological exposure scenarios will not change significantly over time.
- Any proposed land use changes affecting the Site will be subject to Ecology’s review and approval.

4.3.3 Non-aqueous phase liquid

Monitoring since 2017 has confirmed NAPL is in one of Zone A's two monitoring wells. The NAPL distribution within the Zone A subsurface is not specifically defined, but likely includes localized pooling at the water table and residual retention within the capillary fringe/smear zone. Existing analytical testing indicates the free-product layer is predominantly a light non-aqueous phase liquid (LNAPL). The LNAPL contains a broad suite of aliphatic and aromatic hydrocarbons, chlorinated and non-chlorinated VOCs and SVOCs, PCBs, chlorinated and brominated pesticides, and potentially other organic constituents based on historical Zone A chemical analyses. The selected remedy for Zone A is expected to eliminate NAPL beneath Zone A and meet WAC 173-340-360(2)(c)(A) requirements. The NAPL cleanup objectives will be further described in the Post-Excavation EDR (SOW Task A.5).

4.4 Terrestrial ecological evaluation

A terrestrial ecological evaluation (TEE) (WAC 173-340-7490) describes the procedures to determine the potential effects of soil contamination on ecological receptors. For sites that do not qualify for a TEE exclusion, a simplified or site-specific TEE must be done to determine if a threat to terrestrial ecological receptors exists or if the site can be removed from further ecological consideration during the RI and cleanup process. A site may be excluded from a TEE if any of the following are met:

- All contaminated soil is or will be located below the point of compliance
- All contaminated soil is or will be covered by physical barriers such as buildings or pavement
- The site meets requirements related to the nature of onsite and surrounding undeveloped land
- Concentrations of hazardous substances in soil do not exceed natural background levels

Due to past interim actions, the Site meets the second condition; contaminated areas are covered with protective, multi-layer cover systems that prevent likely exposure by terrestrial ecological receptors. To qualify for this exclusion, an institutional control shall be required under WAC 173-340-440 as part of the final Site remedy. Therefore, the TEE process for this site is completed, and no simplified or site-specific TEE is required.

4.5 Standard Method B groundwater cleanup level analysis

WAC 173-340-720(4)(b) states, Where the groundwater is based on drinking water beneficial use, standard Method B CULs shall be at least as stringent as all of the following:

(i) Applicable state and federal laws. Concentrations established under applicable state and federal laws, including the following requirements:

- Federal – Maximum contaminant levels established under the Safe Drinking Water Act and published in 40 Code of Federal Regulations (CFR) 141
- Federal – Maximum contaminant level goals for non-carcinogens established under the Safe Drinking Water Act and published in 40 CFR 141
- State – Maximum contaminant levels established by the state board of health and published in Chapter 246-290 WAC

Under WAC 173-34-720(7)(b): Where a CUL is based on an applicable state or federal law and the level of risk upon which the standard is based exceeds an excess cancer risk of 1×10^{-5} or a hazard index of 1, the CUL shall be adjusted downward so that the total excess cancer risk does not exceed 1×10^{-5} and the hazard index does not exceed 1 at the site.

(ii) Protection of surface water beneficial uses. Concentrations established in accordance with the methods specified in WAC 173-340-730 for protecting surface water beneficial uses, unless it can be demonstrated that the hazardous substances are not likely to reach surface water.

Standard Method B CULs for surface waters shall be at least as stringent as all of the following:

- Applicable state and federal laws including the following:
  - All water quality criteria published in the water quality standards for surface water of the state of Washington, chapter 173-201A WAC [Aquatic Life, Fresh Water- Acute/Chronic]
  - Water quality criteria based on the protection of aquatic organisms (acute and chronic) and human health published under section 304 of the Clean Water Act [Aquatic Life, Fresh Water- Acute/Chronic and Human Health]
  - National toxics rule (40 C.F.R. Part 131) [Aquatic Life, Fresh Water – Acute/Chronic and Human Health.
- Environmental Effects. For hazardous substances for which environmental effects-based concentrations have not been established under applicable state or federal laws, concentrations that are estimated to result in no adverse effects on the protection and propagation of wildlife, fish, and other aquatic life. Whole effluent toxicity testing may be used to make this demonstration for fish and aquatic life.
- For hazardous substances for which sufficiently protective health-based criteria or standards have not been established under applicable state and federal laws, those concentrations that are determined using the Method B equations for non-carcinogens and carcinogens.

(iii) Human health protection. For hazardous substances for which sufficiently protective health-based criteria or standards have not been established under applicable state and federal laws, those concentrations determined by the groundwater Method B formula for non-carcinogens and carcinogens.

Criteria (i) and (iii) determine the concentration that is protective of groundwater. Table 1 (page 75) lists the groundwater applicable, relevant, and appropriate requirements and adjusted values as necessary under (i), the Method B formula concentrations for carcinogens and non-carcinogens under (iii), and the groundwater protection Method B criteria. Contaminants detected in off-property wells closest to the Columbia River are considered to have the potential to discharge to surface water. Table 2 (page 84) lists the surface water criteria specified under (ii) and the Method B surface water protection criteria for the constituents that were detected at the closest monitoring well to the Columbia River (MW-54i).

The screening for groundwater IHSs was conducted using groundwater data in the FFS and Site-specific groundwater data downloaded from Ecology's Environmental Information Management database. Table 3 (page 85) shows the screening for groundwater indicator substances based on the following:

- All contaminants with maximum concentrations less than the groundwater and surface water criteria and/or those with <5 percent detection were not considered indicators.

Contaminants detected at less than 5 percent, like methylene chloride and toluene, are still considered indicators. The data indicate that these contaminants are being treated by the interim action systems, thus the significant decrease in concentrations and frequencies of detection. Some contaminants exceed the general thresholds to be considered an IHS but were not selected as an IHS. These include chloroform, 1,2-dichloroethene, 1-methylnaphthalene, and several naturally occurring metals. Chloroform and 1,2-dichloroethene were not selected to be IHSs because they are marginally over the thresholds, have been effectively treated by interim actions, and are expected to be effectively treated by the final remedy.

While 1-methylnaphthalene and other PAHs were not selected as IHSs, detections (and screening level exceedances) of these contaminants beneath and immediately downgradient of Zone A have become prevalent. It is believed PAHs (and possibly other typically less mobile chemical constituents) are migrating through the vadose zone to groundwater via transport by and with other Zone A wastes. VOCs are a primary NAPL component and likely have enhanced or influenced the downward mobilization and migration of certain constituents to the water table.

NAPL has been detected beneath Zone A since 2017, and PAHs have been detected since 2014; however, these PAH detections coincide with a 100X reporting limit reduction. PAHs are now regularly detected immediately downgradient of Zone A. PAHs are not believed to be significantly remediated by the existing SVE-based interim actions at Zone A. While these PAH detections are concerning to Ecology, the final remedy at Zone A is expected to effectively remediate PAHs. Potential short-term changes in groundwater quality may occur in response to final cleanup actions at the site — most notably in areas close to Zone A. Therefore, groundwater monitoring for Zone A will include provisions for assessing potential short-term changes in groundwater quality during active Zone A remediation. This may include a modified analytical suite and monitoring frequency to evaluate potential groundwater quality changes during periods of intrusive or disruptive remediation work (excavation and in-situ treatment).

Because the total cancer risk exceeds 1 x 10^{-5} and the hazard index for one non-cancer end effect (hepatotoxicity) exceeds 1, some preliminary CULs must be adjusted to meet the 1 x 10^{-5} cancer risk and hazard index of 1 for each of the end effects. These cancer risk/hazard index calculations and the final CULs are shown in Table 4 (page 88). No adjustment due to PQL was necessary as the PQL for each IHS is below the final CUL.

4.6 Final Site cleanup levels for groundwater

Table 4 (page 88) shows the cancer risks and hazard quotient calculations at the proposed CULs for groundwater. The threshold criteria of 1 x 10^{-5} cancer risk and hazard indices of 1 at the different end points are met. The final site CULs, therefore, are as follows:

GROUNDWATER	CUL, ug/L	BASIS	PQL, ug/L
VOCs			
Benzene	1.2	Protection of SW	0.028
1,1-Dichloroethane	7.68	Protection of GW	0.02
1,2-Dichloroethane	0.38	Protection of SW	0.0141
1,1-Dichloroethene	0.057	Protection of SW	0.02
cis-1,2-Dichloroethene	12	Protection of GW	2
Methylene chloride	5	Protection of GW	1
Tetrachloroethylene	0.69	Protection of SW	0.05
Toluene	157	Protection of GW	1
1,1,1-Trichloroethane	200	Protection of GW	2
Trichloroethylene	2.5	Protection of SW	0.0534
Vinyl chloride	0.053	Protection of GW	0.02
METALS			
Total chromium	100	Protection of GW	0.59

Notes: CUL – cleanup level, GW – groundwater, PQL – practical quantitation limit, SW – surface water, ug/L – micrograms per liter

4.7 Point of compliance

The point of compliance is defined in MTCA as the points or points where CULs established in accordance with WAC 173-340-720 through -760 shall be attained (WAC 173-340-200). For groundwater, WAC 173-340-720(8) governs the definition of the point of compliance. CULs must be attained at the point of compliance for a site to comply with cleanup standards. The standard point of compliance is throughout the site from the uppermost level of the saturated zone extending vertically to the lowest depth that potentially could be affected by the site. The groundwater point of compliance for the Pasco Landfill Site will be the standard point of compliance.

5 Cleanup Action Selection

5.1 Remedial action objectives and exposure pathways

RAOs describe the actions necessary to protect human health and the environment by eliminating, reducing, or otherwise controlling risks posed through each exposure pathway and migration route. They are developed considering the characteristics of the contaminated media, the characteristics of the hazardous substances present, migration and exposure pathways, and potential receptor points.

Humans can be exposed to Site contaminants either on- or off-property by different pathways and mechanisms. The Site is zoned industrial and expected to remain industrial for the foreseeable future.

5.1.1 Human health exposure pathways

Past Site activities have contaminated soil and groundwater. Contaminated soil is within the footprint of the landfill property and is not present in off-property areas. Both on-property and off-property areas historically have shown evidence of groundwater contamination. The groundwater plume associated with the Site once extended from the landfill property to the Columbia River. Current monitoring shows that trace levels of site-related contaminants remain in downgradient, off-property areas. The measured concentrations are well below the CULs presented in Section 4.6, and are not adversely impacting surface water quality in the river.

Given the status of the Site, people may be potentially exposed to contaminated soil via the following pathways.

5.1.1.1 Potential on-property exposure pathways

The following human receptors may potentially contact contaminants on the Site:

- **General maintenance/construction worker.** This receptor represents various personnel who occasionally or regularly visit the property in connection with routine maintenance or monitoring of the area. They might contact shallow surface soil, groundwater, soil vapor, treatment system air emissions, and condensate. This receptor is expected to access the Site in compliance with the Site Health and Safety Plan. Worker compliance with the plan should help minimize potential exposure to contaminants and associated risk.
- **Trespassers.** These receptors are assumed to have contact with shallow surface soil, exposed waste, soil vapors, and/or treatment system emissions. Exposure could occur primarily through inhalation, incidental ingestion, or dermal contact.
- **Potential current or future construction worker.** This receptor may be exposed to contaminants in subsurface soil underlying engineered caps or clean soil cover. This exposure could occur through either incidental ingestion, inhalation, or dermal exposure.

Currently, no water supply well is operated within the landfill area footprint, thereby limiting the potential for direct exposure to contaminated groundwater.

5.1.1.2 Potential off-property exposure pathways

Existing institutional controls limit the potential for human exposure to contaminated groundwater within the defined groundwater plume area south of the landfill site. Specifically, the existing GPA implemented by the City of Pasco restricts potential consumptive use of groundwater from within a defined area of East Pasco. Some existing groundwater wells located within the GPA boundaries still are used for irrigation and other non-potable purposes. These existing restrictions limit the potential for direct human exposure to contaminated groundwater.

In 2003, possible subsurface vapor intrusion into buildings that overlie areas of known groundwater contamination were evaluated (Environmental Partners Inc. 2003). The analysis included off-property residential areas south of the Site and considered 12 VOCs that had been historically detected in Site groundwater. The analysis relied upon the Johnson and Ettinger Model for Subsurface Vapor Intrusion into Buildings as revised in December 2000. The vapor intrusion analysis concluded that no unacceptable risk of exposure to indoor air was associated with offsite groundwater conditions.

This finding eliminates the indoor air pathway from additional CUL development consideration (WAC 173-340-750). Air monitoring and action thresholds to support protection monitoring of site workers and the public during various phases of active site cleanup will be addressed in Compliance Monitoring Plans prepared in conjunction with task-specific EDRs.

5.1.2 Terrestrial ecological exposure pathways

As a result of past interim actions, all contaminated soil is or will be covered by physical barriers; more specifically, contaminated areas have been covered with adequately protective, multi-layer cover systems that prevent likely exposure by terrestrial ecological receptors. To ensure continued ecological protection, an institutional control shall be required by the department under WAC 173-340-440 as part of the final Site remedy.

5.1.3 Remedial action objectives

RAOs are general descriptions of what the remedial action is expected to accomplish and site-specific goals for cleanup. RAO statements typically specify broad, overarching cleanup goals that seek to address the following concerns:

- Media of interest (soil, groundwater, waste, air)
- Types of contaminants
- Potential receptors (human and ecological)
- Exposure pathways (direct contact/dermal absorption, ingestion, or inhalation)

Clear definition of RAOs for a particular site cleanup can help guide and refine the list of potential candidate remedial technologies and actions to achieve overall cleanup goals.

The RAOs should fundamentally help refine the selection of remedial alternatives that will:

- Protect human health and the environment

- Comply with applicable, relevant, and appropriate requirements
- Provide cost-effective remediation of the Site consistent with planned future land use
- Favor use of permanent remedies whenever practicable.

A cleanup alternative must achieve all RAOs to be considered a viable cleanup action.

Considering the potential exposure pathways, the following RAOs have been developed for the Site:

- Prevent direct exposure to contaminants in waste materials and soil
- Prevent contaminant releases to the atmosphere
- Minimize transport of contaminants to subsurface soils and groundwater
- Prevent ingestion, inhalation or dermal absorption with contaminated groundwater
- Prevent inhalation of contaminated exhaust air emissions from treatment systems

RAOs for all cleanup subareas at the Site are in Table 4.3-1 of the FFS.

5.2 Cleanup action alternatives

Cleanup alternatives to meet these RAOs are evaluated as part of the FS. The 1999 FS evaluated multiple alternatives for addressing all contaminated media at the Site. Ecology approved the preferred remedy described in the FS Report (PSC 1999) as an interim remedy. Several key interim actions were implemented in 2000/2001, including RCRA Subtitle C cover systems over the industrial waste areas (zones A, B, C/D, and E), a gas collection and control system (GCCS) and RCRA Subtitle D cover system over the MSW Landfill, and installation of an expanded SVE system and a NoVOCs™ groundwater treatment system at Zone A. The 2017 FFS was prepared to provide an updated evaluation of cleanup action alternatives that could meet updated RAOs. The cleanup action alternatives below align with the alternatives in the two 2017 FFS reports. For more detailed explanations of each remedial alternative, please refer to these FFS documents.

5.2.1 Municipal Solid Waste Landfill

The MSW Landfill is the largest subarea at the Site. The Landfill Group FFS (Aspect 2017) notes that the MSW composition received at the Pasco Sanitary Landfill was consistent with the definition of MSW at the time, and included intact and shredded tires. In addition, MSW that was managed in the Septic Lagoon, Landspread Areas, and Sludge Management Areas was eventually moved to the MSW Landfill or used as daily cover as part of routine operations.

The FFS included three remedial alternatives for the MSW Landfill:

> **MSW-1:** Leave MSW in place, and continue operation, maintenance, and monitoring of the engineered cover and landfill GCCS
>
> **MSW-2:** MSW-1 and an expanded landfill GCCS to enhance capture and treatment of vapor-phase contaminants

MSW-3: MSW-1 and a groundwater collection and treatment system to capture and treat landfill-related contaminants immediately adjacent (hydraulically downgradient) to the MSW Landfill area

5.2.1.1 Alternative MSW-1

Alternative MSW-1 consists of leaving the MSW Landfill in place with existing institutional controls. Post-closure care will continue as required under WAC 173-351-500(2) and detailed in the Updated MSW Disposal Areas Operations & Maintenance (O&M) Manual. Major engineering components of the previous interim action would be maintained:

- RCRA Subtitle D engineered cover system
- Landfill GCCS (landfill gas extraction wells, mechanical blowers, and landfill gas collection and conveyance piping)
- Landfill gas condensate collection system
- Enclosed landfill gas flare system
- Stormwater collection system piping and lined stormwater evaporation ponds

The existing network of perimeter gas monitoring wells will remain in use to monitor potential landfill gas migration. Existing groundwater monitoring wells in the vicinity of the MSW Landfill will be retained, and two more monitoring wells will be installed along the downgradient margins of the MSW Landfill to support future long-term compliance monitoring. Alternative MSW-1 historically has addressed the RAOs by controlling potential landfill gas migration and treating collected landfill gas with the existing GCCS. As landfill gas generation rates continue to decline over time, the existing GCCS will not be able to achieve its original design and operational objectives. An alternative approach for collecting and treating landfill gas will then become necessary to maintain proper control and treatment of landfill gas. The FFS estimates it will be necessary, due to declining gas generation rates, to replace the existing enclosed flare unit with an alternative treatment system by 2022. Details of an alternative gas collection and treatment system will be presented in an EDR. Upon Ecology approval, a modified landfill gas treatment technology (with associated O&M specifications) will be implemented.

To confirm the long-term integrity and functionality of the MSW cover system, routine inspection and geotechnical/material testing analysis will be required. Routine visual inspection of landfill components would occur at least semi-annually, and any required destructive testing of cover system membrane materials would coincide with the periodic reviews. Institutional controls required by covenant, deed restrictions, or other agency mechanisms will remain in place to ensure the property is managed according to its planned end use and long-term custodial care requirements.

The MSW Landfill is expected to transition from post-closure care to custodial care when landfill stability can be demonstrated (little to no settlement, gas production, or leachate generation) to Ecology's satisfaction. The FFS estimates this could occur within 15 years (approximately 2032), and progress toward stability will be assessed no less frequently than during 5-year Periodic Reviews. However, considering the nature of waste materials placed into the MSW Landfill, demonstration of the long-term functionality of the landfill cover system will be required well into the future (2032 and beyond, or until a land use change satisfying Ecology and local jurisdictional requirements is granted).

5.2.1.2 Alternative MSW-2

Alternative MSW-2 consists of all elements of Alternative MSW-1, but includes provisions to expand the GCCS, if necessary. Alternative MSW-2 provides a contingency in the event that Alternative MSW-1 does not meet the RAOs. Alternative MSW-2 would involve installing up to four additional landfill gas extraction wells at selected locations deemed most effective for reducing waste-to-groundwater gas migration. However, before new extraction wells were installed, flows from the existing GCCS would be increased in an attempt to improve landfill gas collection. Remedial optimization measures would be conducted in accordance with the Updated MSW Disposal Areas O&M Manual.

If changes in landfill gas extraction rates are successful at meeting the RAOs, then Alternative MSW-2 would not be pursued. If, however, the RAOs cannot be achieved, then new extraction wells would be located and installed in the MSW to replace or supplement existing wells, or new SVE wells would be located just beyond the edge of MSW landfill perimeter to prevent potential lateral landfill gas migration. Areas at the north end of the MSW Landfill likely would be targeted for installation of new extraction wells.

5.2.1.3 Alternative MSW-3

Alternative MSW-3 consists of all elements of Alternative MSW-1, and includes a provision to install an active groundwater collection and treatment system. Alternative MSW-3 provides a next step if Alternative MSW-1 and contingent Alternative MSW-2 do not meet the RAOs, groundwater concentrations at the MSW Landfill monitoring wells exceed CULs due to concentrations not mitigated by the GCCS, and potential exposure to impacted groundwater cannot be prevented by institutional controls. Existing groundwater quality conditions near the MSW Landfill and the potential to provide targeted management of landfill gas impacts to groundwater by measures described in Alternative MSW-2 suggest a low likelihood that Alternative MSW-3 would need to be implemented.

If Alternative MSW-3 is necessary, a groundwater “pump-and-treat” system would be designed and installed on the property and downgradient of the likely source(s) of groundwater impacts. The FFS estimates that up to five groundwater pumping well(s) up to 50 feet deep would be installed. The wells would operate with a combined flow of approximately 20 gallons per minute, targeting contaminated groundwater from shallow portions of the local aquifer system. Pumped water would be treated using a 10,000-gallon aeration/sedimentation basin system to reduce concentrations, and then re-infiltrated at a location beyond the influence of the groundwater collection system. The pump-and-treat system would be monitored for proper operation and effectiveness.

5.2.2 Balefill and Inert Waste Disposal Areas

One remedial alternative (BA-1) was presented in the FFS report to address MSW disposed in the Balefill and Inert Waste Disposal Areas. The potential extent of the Balefill and Inert Waste

Disposal Area has been refined from the FFS Report (Aspect 2017) to include an area north of Zone A where additional quantities of MSW are known to be located.

RAOs for the Balefill and Inert Waste Disposal Areas were established in the FFS Report (Aspect 2017):

- Prevent direct exposure to waste and soil
- Minimize or prevent contaminant releases to the atmosphere
- Minimize transport of contaminants from MSW materials to subsurface soils and groundwater

The Landfill Group FFS (Aspect 2017) notes that the MSW composition received at the Pasco Sanitary Landfill was consistent with the definition of MSW at the time, and included intact and shredded tires. The MSW composition is stated to vary within the individual MSW Disposal Areas. Baled MSW was accepted from approximately 1976–1993, and these wastes were landfilled up to near the eastern edge of Zone A. Landfill fires occurred within the Balefill Area during the period of active disposal. Considering the disposal and management history of this area, residual hazardous substances including various combustion by-products can be expected within the Balefill Area along with other chemical constituents typically associated with non-combusted MSW.

The waste in the Balefill and Inert Waste Disposal Areas appear to be largely stable based on data and observations related to landfill gas generation, leachate production, and ground settlement. Ecology Publication 11-07-006 *Preparing for Termination of Post-Closure Activities at Landfills Closed Under Chapter 173-304 WAC* and an associated 2013 addendum provide guidance on how these stability metrics can be used to evaluate post-closure care requirements. Post-closure and long-term custodial care of the cover system over the Balefill and Inert Waste Disposal Areas will be a necessary and ongoing cleanup requirement.

The cover system design for the Balefill and Inert Waste Disposal Area, including the area immediately north of Zone A, will satisfy WAC 173-304-460(3)(e) minimum functional standards. A soil cover will help protect the MSW from potential surface fires. Given the age and nature of the wastes in these disposal areas, no additional design components for managing landfill gas or surface water runoff beyond industry-standard best management practices are required.

Alternative BA-1 consists of leaving the Balefill and Inert Waste Disposal Areas in place and restoring the existing soil cover to a minimum thickness of 30 inches. The cover system design also will include enhanced measures, such larger-sized rock or other appropriate design components, to minimize the potential for soil cover losses in areas most prone to wind erosion. The restored soil cover will have established vegetation that will store, evaporate, and eventually evapotranspire precipitation, effectively minimizing potential liquid-phase transport to subsurface soil and groundwater.

The PLPs will prepare an EDR describing the soil cover restoration work, including a preliminary assessment of the limits of waste, current MSW area topography and monitoring features, and existing soil cover characteristics. Required long-term maintenance and monitoring of the restored cover system will be described in an Updated MSW Disposal Areas O&M Manual. Existing gas probes and thermocouple arrays completed within the MSW will be decommissioned. Replacement gas probes will be installed, as needed.

An environmental covenant prohibiting excavation of any portion of the cover system over the Balefill and Inert Waste Disposal Areas would be recorded on the property deed.

5.2.3 Burn Trenches

Two burn trench areas (BT-1: East-West Burn Trenches; BT-2: North-South Burn Trench) are located in close proximity to existing industrial waste disposal areas. BT-1 is located immediately west of Zones C/D and is partially under their engineered cap or otherwise covered by soil cover. BT-2 is located immediately west of Zone A, and its limits of waste are believed to be entirely beneath the Zone A engineered cap.

The Landfill Group FFS (Aspect 2017) notes that the MSW composition received at the Pasco Sanitary Landfill was consistent with the definition of MSW at the time, and included intact and shredded tires. The composition of MSW is stated to vary within the individual MSW Disposal Areas. Disposal and open burning took place from 1959–1965 in the two defined Burn Trench areas. Considering the disposal and management history, residual hazardous substances including various combustion by-products can be expected within the Burn Trench area wastes along with other chemical constituents typically associated with non-combusted MSW.

The FFS included three remedial alternatives for Burn Trench BT-1:

Alternative BT-A: Leave the Burn Trenches in place, as is

Alternative BT-B: BT-A and confirming soil cover thickness over portions of the burn trenches not already beneath the Zone C/D engineered cover system

Alternative BT-C: BT-B and restoring the cover system to a thickness of at least 30 inches, if necessary

5.2.3.1 Alternative BT-A

Alternative BT-A consists of leaving Burn Trench BT-1 in place, as is. According to the RI report, the east-west-oriented burn trenches were covered with approximately 2 feet of soil. The burn trenches are each approximately 350 feet long and 50 feet wide. Much of the spatial footprint of BT-1 is within a fenced-off area. The Alternative BT-A scope would include minor maintenance of the existing cover, and continuation of site-wide groundwater monitoring activities at nearby monitoring wells. The FFS anticipates transitioning to custodial care with institutional controls. Maintenance, as needed, would be performed as described in an Updated MSW Disposal Areas O&M Manual.

RAOs for Burn Trench Areas were established and presented in the 2017 FFS Reports:

- Prevent direct exposure to waste and contaminated soil
- Minimize or prevent contaminant releases to the atmosphere

- Minimize transport of contaminants from MSW materials to subsurface soils and groundwater

The waste in the burn trenches appears to be largely stable based on data and observations related to landfill gas generation, leachate production (absence of evident groundwater impacts), and ground settlement. Ecology Publication 11-07-006 *Preparing for Termination of Post-Closure Activities at Landfills Closed Under Chapter 173-304 WAC* and an associated 2013 addendum provide guidance on how these stability metrics can be used to evaluate post-closure care requirements. Post-closure and long-term custodial care of the soil cover over Burn Trench Area BT-1 will be a necessary and ongoing cleanup requirement.

The cover system design for the burn trench area will satisfy WAC 173-304-460(3)(e) minimum functional standards. A soil cover will help protect any residual MSW materials from potential surface fires. Given the age and nature of the wastes in the burn trenches, no additional design components for managing landfill gas or surface water runoff beyond industry-standard best management practices are required.

An environmental covenant prohibiting excavation of any portion of the cover system over the burn trench area would be recorded on the property deed.

5.2.3.2 Alternative BT-B

Alternative BT-B includes all elements of Alternative BT-A and additional assessment work to confirm the soil cover thickness over Burn Trench BT-1 in areas not already beneath the Zones C/D engineered cover system. The estimated limits of the waste in the trenches also would be determined during this assessment. The same RAOs apply to this alternative as BT-A. If an insufficient thickness of cover soil was determined to exist over the burn trench wastes, this alternative would not, in itself, result in an associated action to install the requisite thickness of cover material. The requirements described in an Updated MSW Disposal Areas O&M Manual would ensure cover system compliance with WAC 173-304-460. An environmental covenant prohibiting excavation of any portion of the cover system over the Burn Trench area would be recorded on the property deed.

5.2.3.3 Alternative BT-C

Alternative BT-C incorporates all elements of Alternative BT-B and necessary material selection, transport, and grading to establish a minimum 30-inch-thick cover system over Burn Trench BT-1. The FFS report assumed that approximately 25 percent of the area of Burn Trench BT-1 would need to be restored. An enhanced soil cover also will help protect residual MSW materials from potential surface fires. An environmental covenant prohibiting excavation of any portion of the cover system over the burn trench area would be recorded on the property deed.

5.2.4 Zone A

The FFS included nine remedial alternatives for Zone A:

Alternative A-1: Monitoring and maintenance of the existing RCRA C cover system, continue SVE treatment for Zone A source area, groundwater performance monitoring, and institutional controls

Alternative A-2: A-1 and an enhanced SVE system and a contingent groundwater treatment remedy consisting of SVE combined with air sparging and ozone injection that would treat groundwater impacts if contaminant concentrations exceed CULs at the point of compliance

Alternative A-3: A-2 and a contingent groundwater treatment system with vertical injection wells that would deliver chemical oxidants to the upper portions of the underlying aquifer

Alternative A-4: A-2 and a contingent treatment of contaminated soils immediately beneath the Zone A drum repository with horizontal wells that would inject chemical oxidants into the vadose zone

Alternative A-5: Remove the RCRA C cover system, excavate waste/mixed debris and impacted soils to the top of the Touchet Beds, dispose contaminated soils/bulked drums in an onsite RCRA C area of contamination (AOC) cell, dispose overpacked drum waste offsite, backfill excavation area, install a RCRA C cover, continue SVE treatment during construction, treat Touchet Beds soils long-term with deep horizontal SVE wells, monitor groundwater performance, and maintain institutional controls

Alternative A-6: A-5 and in-situ thermal treatment of Touchet Beds soils and installation of deep horizontal SVE wells instead of long-term SVE treatment of Touchet Beds soils

Alternative A-7: A-5 and excavation and onsite disposal of Touchet Bed soils in an AOC cell without SVE treatment of Touchet Beds soils

Alternative A-8: Implement A-2 with potential future waste/soil excavation described in A-7 if the enhanced SVE system and contingent air/sparge and ozone treatment are not protective

Alternative A-9: Similar to A-7, including excavation down to the top of the Upper Pasco Gravels, offsite disposal of all drummed waste/mixed debris and contaminated soil, but A-9 does not include an AOC cell

5.2.4.1 Alternative A-1: Ongoing SVE

This alternative would include ongoing operation, maintenance, and monitoring of the existing SVE system to achieve cleanup of the Zone A source area. Recovered SVE gasses would be treated through thermal oxidation at the RTO. The FFS estimates the SVE system would continue to be operated for approximately 30 years or less if the rate of VOC removal has declined and stabilized over a shorter period. The SVE system would then be operated intermittently with periodic assessment of VOC vapor concentration rebound. Groundwater sampling would continue during and after SVE system shutdown to ensure contaminants were not migrating into groundwater at concentrations above CULs at the point of compliance or any of the performance wells. The SVE system would be restarted if rebound in concentrations is shown at any of the performance wells or any contaminant exceedance of CULs at the point of compliance.

The existing RCRA C cover system would be monitored and maintained in accordance with an Updated Industrial Waste Area Cover System O&M Manual. The FFS assumes the Zone cover system would be replaced twice over the 30-year restoration timeframe for this alternative (at years 1 and 15, following implementation of the CAP).

Groundwater monitoring would occur until CULs are achieved and maintained in all Site areas at the points of compliance. Alternative A-1 would continue to use the current network of monitoring wells adjacent to and downgradient from Zone A for a 30-year period to verify the attainment of groundwater CULs. Institutional controls would be implemented at the Site, including an environmental covenant to prohibit the development and use of groundwater for drinking water and/or irrigation purposes, and to limit excavation in areas containing residual soil contamination. The environmental covenant would remain in place until CULs are achieved.

5.2.4.2 Alternative A-2: Enhanced SVE and air sparging/ozone treatment of groundwater

Alternative A-2 is the same as Alternative A-1 and adds air sparging and ozone injection wells as a contingent action to address groundwater downgradient of Zone A if CULs cannot be attained and sustained at the point of compliance. This alternative also proposes to install new intermediate-depth SVE wells to increase mass removal in close proximity to the drummed wastes. Within the area west of Zone A where sparge wells would operate and ozone injection would occur, the new network of SVE wells would be installed to collect VOCs and other gases from the vadose zone. Air sparging would be employed to remove VOCs and some SVOCs from groundwater. Ozone treatment would oxidize VOCs, SVOCs, and PAHs from the groundwater.

The FFS estimates eight air sparging and ozone injection wells and three SVE wells would be positioned in a north-south alignment, west of Dietrich Road. Gases and vapors captured by the three SVE wells would be treated using a granular activated carbon treatment system, or they would be routed to the RTO system. The FFS notes that additional treatability testing may be needed to evaluate the optimum operating conditions for air sparging and ozone injection prior to full-scale implementation. The PLPs would prepare a pilot air sparge test plan and an ozone treatability test plan to guide pilot testing to help refine critical operational considerations such as sparge well radius of influence and the effectiveness of ozone on target compounds. An EDR would be prepared following completion of pilot testing to guide the final installation and operation of the air sparge, ozone injection, and SVE operational systems.

Alternative A-2 would use the current network of monitoring wells adjacent to and downgradient from Zone A for a 30-year period. Institutional controls will be required as described for A-1.

5.2.4.3 Alternative A-3: Enhanced SVE and chemical oxidation treatment of groundwater

This alternative includes the non-contingent components of Alternative A-2 and includes the contingent use of chemical oxidation treatment of contaminated groundwater delivered via a series of vertical injection wells. The FFS indicates that before a contingent groundwater treatment system would be installed, the PLPs would optimize the existing SVE system operations and further reduce groundwater contaminant levels. The decision to implement a contingent groundwater treatment system would be identified during periodic reviews.

The linear array of injection wells would be installed hydraulically upgradient (northeast) of Zone A, allowing the treatment chemicals to migrate passively beneath Zone A. A strong oxidizing agent (sodium persulfate used with ferrous sulfate) would be applied to promote rapid oxidation of VOCs, SVOCs, and PAHs. The chemical oxidant injection system would be implemented as a contingent action if SVE was unable to protect groundwater and meet CULs at the point of compliance. For FFS costing purposes, a single amendment injection is assumed. Underground Injection Control (UIC) permit requirements would need to be met.

Alternative A-3 would use the network of monitoring wells adjacent to and downgradient from Zone A for a 30-year period. Institutional controls will be required as described for A-1.

5.2.4.4 Alternative A-4: Enhanced SVE and chemical oxidation treatment of subsurface soil

This alternative includes the non-contingent components of Alternative A-2 and includes contingent chemical oxidation treatment of contaminated soil immediately beneath the Zone A drum repository. The FFS indicates that before a contingent groundwater treatment system would be installed, the PLPs would optimize SVE system operations and further reduce groundwater contaminant levels.

Chemical oxidants would be delivered to Zone A subsurface soils using horizontal injection wells. The chemicals would oxidize contaminants beneath Zone A that are adsorbed to Touchet Bed soils within an approximate 12-foot-thick treatment zone. A strong oxidizing agent (sodium persulfate used with ferrous sulfate) would be applied to promote rapid oxidation of VOCs, SVOCs, PAHs, and other non-VOC organics. The chemical oxidant injection system would be implemented as a contingent action if SVE was unable to protect groundwater and meet CULs at the point of compliance. For FFS costing purposes, a single amendment injection is assumed. UIC permit requirements would need to be met.

Alternative A-4 would use the network of monitoring wells adjacent to and downgradient from Zone A for a 30-year period. Institutional controls will be required as described for A-1.

5.2.4.5 Alternative A-5: Excavate drummed waste/debris/soil, new onsite waste repository, and SVE treatment

Alternative A-5 would excavate and remove Zone A drums, mixed debris, and varying degrees of contaminated soil. The wastes, debris, and contaminated soil would be profiled for disposal. Field hazard categorization of the excavated drummed or bulk waste would be performed at an onsite staging area. Certain waste categories would be transported offsite for treatment and disposal. A new RCRA-C-compliant onsite AOC cell would be constructed for disposal of the remaining waste materials, debris, and contaminated soil. Once the removal actions were completed, the Zone A excavation pit would be backfilled with acceptably clean fill material, compacted, and a new RCRA-C-compliant cover system would be installed over the footprint. Design details, specifications, and supporting documents would be provided in an EDR.

This alternative assumes ongoing operation of the SVE and RTO systems to address residual soil contamination remaining in-place between the top of the Touchet Bed soils and the water table to minimize contaminant impacts to groundwater. Only the deep SVE wells would remain in operation during the early excavation stages. Three new deep horizontal SVE wells would be installed in the Upper Pasco Gravels prior to waste and soil removal to minimize vertical migration of contaminants to groundwater during drum removal. Two new intermediate-depth SVE wells would be installed within the Touchet Bed soils and/or top of the Upper Pasco Gravels concurrent with final cover system installation.

The FFS provides material quantity estimates for each of the individual elements of this removal action and AOC cell construction. Alternative A-5 assumes a total excavation area of 4.61 acres for Zone A, including the drum disposal area, adjacent and surrounding impacted soils, and associated layback soils, down to the top of the Touchet Beds at approximately 27 feet bgs. The FFS assumes excavation and removal of approximately 25,000 drums of which approximately two-thirds contain materials and substances (liquids and sludges) designating as characteristic RCRA hazardous wastes and approximately one-third containing casting residue sands (State only dangerous waste). Once removed, segregated, staged, and profiled, the FFS assumes approximately 4,000 drums would be individually overpacked and transported offsite for disposal. Of these, approximately 20 percent would require incineration and 80 percent would be disposed at a Subtitle C landfill. The remaining 20,000+ drums, when decanted of free liquids, are assumed to be handled as bulked waste, consolidated, and disposed of in the new onsite AOC cell. Alternative A-5 assumes the new AOC cell will cover an estimated 7.7 acres (RCRA C cover area) within which wastes would be placed to a depth of approximately 10 feet.

The FFS assumes long-term cover monitoring, maintenance, and inspection would be carried out for a 30-year period. Monthly inspections, maintenance, upgrades, and equipment replacement of the SVE system are assumed to occur over a 30-year operational period. Alternative A-5 would use the network of monitoring wells adjacent to and downgradient from Zone A for a 30-year period. Institutional controls will be required as described for A-1.

5.2.4.6 Alternative A-6: Excavate waste/debris to top of Touchet Beds and in-situ thermal treatment

This alternative is a removal action similar to Alternative A-5, but includes in-situ thermal treatment of residual soil contamination within the Touchet Beds rather than long-term SVE operation. The in-situ thermal treatment system is expected to remove solvent and organic compound source mass between the top of the Touchet Beds and the top of the Upper Pasco Gravels more rapidly than an SVE-based capture and treatment approach.

Alternative A-6 assumes the same RCRA-C-compliant AOC cell as A-5. The same waste acceptability criteria for determining onsite and offsite disposal requirements would apply. The deep wells of the SVE system would be operated until waste removal activities start. Three new deep horizontal SVE wells would be installed beneath Zone A to provide additional groundwater protection during active removal of drums, waste debris, and contaminated soils. Design details, specifications, and supporting documents would be provided in an EDR.

The in-situ thermal treatment system would extend entirely over Zone A, treating approximately 2.2 acres of contaminated Touchet Bed soils. A one-foot-thick asphalt cover would be constructed in the Zone A depression to facilitate installation and operation of the thermal treatment equipment. Electrical resistance heating would be used to heat the soil to temperatures approximating the boiling point of water. An average target VOC mass percent reduction of 96 percent is estimated with this technology. The FFS indicates the treated area would be broken into four subareas, where approximately 380 25-foot-long electrodes and co-located vapor recovery wells would be installed. VOCs and potentially other organic constituents would be volatilized, captured by the vapor recovery wells, and treated with an above-ground thermal destruction process. The FFS estimates six to eight months to treat each subarea.

After in-situ thermal treatment was complete, Zone A would be backfilled and compacted with acceptable fill material up to an agreed-upon final grade, and a new RCRA-C-compliant cover would be installed over Zone A. Routine cover inspection, maintenance, monitoring, and evaluation would be required. The FFS assumes SVE operation would continue for 10 years following completion of the thermal treatment to address residual soil contamination within the Upper Pasco Gravels. Monthly inspections, maintenance, upgrades, and equipment replacement of the SVE system are assumed to occur over a 10-year operational period. Alternative A-6 would use the network of monitoring wells adjacent to and downgradient from Zone A for a 30-year period. Institutional controls will be required as described for A-1.

5.2.4.7 Alternative A-7: Excavate waste/debris/contaminated soil to top of Upper Pasco Gravels and disposal in an onsite AOC cell

This alternative is a removal action similar to Alternative A-5, but includes removing the Touchet Bed soil horizon beneath Zone A and disposing contaminated soils in an onsite AOC cell rather than using in-situ thermal treatment as proposed for Alternative A-6. Alternative A-7 differs from A-5 and A-6 in the size and volume of the Zone A excavation and the corresponding AOC footprint. Excavating to the base of the Touchet Beds will deepen the hole by as much as 15 feet beyond what would be done for alternatives A-5 or A-6. The larger excavated soil volume requires constructing a larger AOC cell (11.7 acres) as compared to the 7.7 acres in alternatives A-5 and A-6. The FFS assumes the AOC cell design and construction requirements for alternatives A-5 and A-6 would apply.

Alternative A-7 assumes excavating 6.04 acres compared to 4.61 acres for alternatives A-5 and A-6. This includes areas of stacked drums, adjacent and surrounding impacted soils, and associated layback soils, down to the top of the Upper Pasco Gravels at about 42 feet bgs. Drummed waste, waste debris, and impacted soils that are excavated from Zone A would be profiled for disposal in a similar to Alternative A-5.

After excavating and removing waste material, mixed debris, and contaminated soil, the Zone A excavation would be backfilled and compacted with acceptable fill material up to an agreed-upon final grade. A new RCRA-C-compliant cover would then be installed over the entire footprint of

Zone A. Routine cover inspection, maintenance, monitoring, and evaluation would be required. For Alternative A-7, this O&M period is assumed to occur over a 10-year operational period. The FFS also assumes SVE operation would continue for10 years following the removal action to address residual soil contamination within the Upper Pasco Gravels. Alternative A-7 would use the network of monitoring wells adjacent and downgradient to Zone A for a 30-year period, as assumed for alternatives A-5 and A-6. Institutional controls will be required as described for A-1.

5.2.4.8 Alternative A-8: Hybrid of Alternative A-2 and Alternative A-7

This alternative combines enhanced SVE with contingent air sparging/ozone injection treatment from A-2 with and removal with onsite disposal in an AOC cell from A-7. Alternative A-8 would involve a progressive transition from a baseline implementation of Alternative A-2 to full implementation of Alternative A-7 as a contingent action based on the effectiveness of A-2. The FFS assumes A-2 is an appropriate Zone A remedy but incorporates Alternative A-7 as a contingency to address future conditions that may preclude or severely limit implementing A-2 by itself over time. The FFS describes specific “data triggers” or monitoring metrics that would guide the progressive and iterative transition from enhanced SVE operation (Alternative A-2) into a full-scale implementation of Alternative A-7. The PLPs would prepare a series of EDRs to support each progressive phase of the contingent cleanup operations.

The FFS assumes that the A-2 phase would continue for 10 years with A-7 initiated at year 11, if necessary. To verify the protection of groundwater quality, Alternative A-8 would use the network of monitoring wells adjacent and downgradient to Zone A for 20 years after the excavation. Institutional controls will be required as described for A-1.

5.2.4.9 Alternative A-9: Excavate waste/debris/contaminated soil to top of Upper Pasco Gravels and offsite disposal

This alternative includes the same removal action, excavation area, and waste characterization and profiling processes as Alternative A-7. All drummed waste, contaminated mixed debris, and contaminated soils would be removed down to the top of the Upper Pasco Gravels. Alternative A-9 does not include an onsite AOC cell. Instead, all wastes, mixed debris, and contaminated soils would be disposed offsite at acceptable waste disposal facilities.

Alternative A-9 assumes continued SVE system operations and treatment of the recovered SVE vapors through thermal oxidation to address residual soil contamination remaining between the top of the Upper Pasco Gravels and the water table. Three deep horizontal SVE wells also would be installed similar to alternatives A-5, A-6, and A-7. For FFS costing purposes, the SVE operation would continue for10 years following the removal action. Monthly SVE system inspections, maintenance, upgrades, and equipment replacement are assumed to occur during the 10-year operation period.

To verify the protection of groundwater quality, Alternative A-9 would use the network of monitoring wells adjacent and downgradient to Zone A for 30 years.

The FFS selectively pared down the full list of Zone A remedial alternatives and performed a disproportionate cost analysis (DCA) as described in WAC 173-340-360(3)(e). The six remedial alternatives that were carried forward for final evaluation included alternatives A-1, A-2, A-6, A-7, A-8 and A-9.

5.2.5 Zone C/D

The FFS presented three remedial alternatives for Zone C/D:

> **Alternative CD-1:** Maintaining and monitoring the RCRA-C-compliant cover, groundwater performance monitoring, and institutional controls
>
> **Alternative CD-2:** CD-1 and a contingent in-situ chemical amendment to treat waste materials and impacted soil immediately beneath the Zone C/D disposal cells
>
> **Alternative CD-3:** Removing the RCRA C cover system, excavating and disposing all waste and underlying contaminated soil offsite, installing a low permeability geomembrane within the excavation pit, backfilling to grade, reinstalling a RCRA-C-compliant cover, monitoring groundwater performance, and institutional controls

5.2.5.1 Alternative CD-1

This alternative includes ongoing maintenance and monitoring of the existing RCRA-C-compliant cover installed in 2001. The cover provides a high degree of protection to human health and the environment from residual contamination still present in this area. The cover prevents precipitation from infiltrating through contaminated soil, erosion and dispersal of contaminated soil by water or wind, and potential receptor contact with waste and contaminated soil. Alternative CD-1 centers on maintaining the cover and institutional controls and monitoring groundwater.

Remedies involving in-place containment of waste require maintenance and monitoring in perpetuity, or until soil sampling beneath a cover system indicates that contamination is below applicable regulatory thresholds. The existing cover would be monitored and maintained in accordance with an Updated Industrial Waste Area Cover System O&M Manual. The FFS assumes maintenance and monitoring of the cover would continue for at least 30 years, including cover replacement 15 years after final cleanup remedy implementation.

Compliance monitoring to confirm attainment of CULs for all IHSs at the designated point of compliance will continue as described in a Site-Wide Groundwater Compliance Monitoring Plan. If IHSs consistently exceed the CUL, the FFS indicates that a field program would be conducted to identify the apparent source(s) of the release. Contingent actions would treat/reduce these IHS concentrations to below CULs. Details of these additional actions are highlighted in Central Groundwater Area Alternative ONP-1.

Institutional controls include access restrictions with fencing and warning signs, limiting landfill facility use in Zone C/D, and property deed restrictions that ban construction, control excavation, and restrict groundwater use. Institutional controls would be maintained and operated in accordance with the Site-Wide Institutional Controls Report.

5.2.5.2 Alternative CD-2

Alternative CD-2 includes all components of Alternative CD-1, plus contingent in-situ chemical treatment to address contaminants within the Zone C/D waste cell and in soil directly beneath the cell. The contingent treatment would be implemented if groundwater concentrations downgradient of Zones C/D show a persistent exceedance of CULs. An EDR would be prepared to address design details of the contingent action, possibly including treatability studies. The chemical reagents would primarily target organic compounds in the waste cell and within underlying vadose zone soils.

The FFS indicates that if contingent treatment is required, the chemical reagents would be injected during a single delivery event. The volume of injected chemical reagent would be sufficient to treat the residual wastes within the capped waste cell and residual contamination within an approximate 10-foot-thick soil zone beneath the Zone C/D cell. The reagents would be delivered to the waste cell immediately below the RCRA C cap through a series of four horizontal injection wells each with a lateral length of approximately 150 feet. The reagents, once injected, would interact with the wastes and passively percolate downward into the underlying soils. Reagent injection into the subsurface would meet UIC permit requirements. The FFS notes that additional treatability testing may be needed to evaluate the likelihood of negative effects caused by the use of chemical reagents.

Alternative CD-2 will involve in-place containment of waste that will require maintenance and monitoring in perpetuity, or until confirmatory soil sampling indicates residual contamination is below applicable regulatory thresholds. The cover would be monitored and maintained in accordance with an Updated Industrial Waste Area Cover System O&M Manual. Groundwater compliance monitoring would be the same as Alternative CD-1. Institutional controls would be maintained and operated in accordance with the Site-Wide Institutional Controls Report.

5.2.5.3 Alternative CD-3

This alternative would remove the cover, excavate and dispose of all wastes and the underlying contaminated soil offsite, install a low-permeability membrane within the excavation pit, backfill with clean fill material, and cap the excavation area with a new RCRA-C-compliant cover system. Soil excavation would be limited to the subsurface soil horizon that contains the highest levels of residual contamination remaining beneath Zones C/D. The wholesale removal of industrial waste material from Zones C/D is similar to remedial alternatives A-9, B-5, and E-3. Installing a replacement cover recognizes the need for a containment system to address residual contaminants within the underlying vadose zone soil. This alternative meets all Zone C/D RAOs.

Following cover removal, the FFS indicates an estimated 6 to 9 feet of waste would be excavated and removed from Zone C and Zone D cell areas, respectively, along with an estimated 2 to 5 feet of contaminated soils directly beneath the waste cells' floors. This alternative assumes a total excavation area of approximately 0.6 acres for Zones C/D, including areas of waste, soils in between the separate waste cells, and set-back for excavation side-slopes.

The wastes and contaminated soil would be characterized, transported offsite, and disposed at a Subtitle C hazardous waste landfill. Sampling would verify that residual contamination in vadose zone soil is below applicable regulatory thresholds. A low-permeability membrane would be installed at the bottom of the remedial excavation, and the excavation pit would be backfilled with acceptably clean fill material. A new RCRA-C-compliant cover would be installed over the Zone C/D footprint and graded accordingly. New monitoring wells would be installed to support compliance monitoring. Design details, specifications, and supporting documents would be provided in an EDR.

The new cover would be monitored and maintained in accordance with an Updated Industrial Waste Area Cover System O&M Manual. The FFS assumes cover maintenance and monitoring would continue for at least 30 years. Alternative CD-3 anticipates groundwater compliance monitoring for 10 years to confirm attainment of CULs for all IHSs at the designated point of compliance as described in a Site-Wide Groundwater Compliance Monitoring Plan. Institutional controls would be maintained and operated in accordance with the Site-Wide Institutional Controls Report.

5.2.6 Zone E

The FFS included three remedial alternatives for Zone E:

> **Alternative E-1:** Monitoring and maintenance of existing RCRA C cover system, groundwater performance monitoring, and institutional controls
>
> **Alternative E-2:** E-1 and contingent ex-situ waste stabilization
>
> **Alternative E-3:** Removal of RCRA C cover system, excavation and offsite disposal of waste/soil, installation of a low-permeability geomembrane within the excavation pit, backfilling to grade, reinstallation of a RCRA C compliant cap, groundwater performance monitoring, and institutional controls

5.2.6.1 Alternative E-1

This alternative includes ongoing maintenance and monitoring of the existing RCRA-C-compliant cover installed in 2001. The cover provides a high degree of protection to human health and the environment from residual contamination still present in this area. The cover prevents precipitation from infiltrating through contaminated soil, erosion and dispersal of contaminated soil by water or wind, and potential receptor contact with waste and contaminated soil. Alternative E-1 centers on maintaining the cover and institutional controls and monitoring groundwater.

Remedies involving in-place containment of waste require maintenance and monitoring in perpetuity, or until confirmatory soil sampling beneath a cover system indicates that contamination is below applicable regulatory thresholds. The cover would be monitored and maintained in accordance with an Updated Industrial Waste Area Cover System O&M Manual. The FFS assumes cover maintenance and monitoring would continue for at least 30 years, including replacing the cover 15 years after final cleanup remedy implementation.

Compliance monitoring to confirm attainment of CULs for all IHSs at the point of compliance will continue as described in a Site-Wide Groundwater Compliance Monitoring Plan. If groundwater IHSs consistently exceed the CUL during post-remedy compliance monitoring, the FFS indicates that a field program would identify the apparent source(s) of the release. Contingent actions would treat/reduce these IHS concentrations to below CULs. Details of these additional actions are highlighted in Central Groundwater Area Alternative ONP-1.

Applicable institutional controls include access restrictions with fencing and warning signs, a limitation on landfill facility use in Zone E, and property deed restrictions that ban construction, control excavation, and restrict groundwater use. Institutional controls would be maintained and operated in accordance with the Site-Wide Institutional Controls Report.

5.2.6.2 Alternative E-2

This alternative includes the same components as Alternative E-1, plus contingent ex-situ waste stabilization to control the possible release of contaminants. The specific purpose of ex-situ stabilization would be to limit the potential mobility of contaminants from mercury-enriched brine sludge disposed at Zone E. The contingent treatment would address potential future groundwater impacts at Zone E.

Contingent ex-situ waste stabilization would involve removing the cover and clean grading soil, removing and temporarily stockpiling the waste material near Zone E, placing the waste material back into the excavation area in 1-foot lifts, mixing cement into each 1-foot lift, placing clean stockpiled soil over the stabilized waste material, grading the area to drain, and capping the area with a low-permeability geomembrane liner and a hydroseeded topsoil layer. Any larger-sized debris found in the waste material would be screened out before placing the waste lifts back into the excavation. An EDR would be prepared to address design details of the contingent action.

Alternative E-2 would require maintenance and monitoring in perpetuity, or until confirmatory soil sampling beneath the cover indicates that contamination is below applicable regulatory thresholds. The cover would be monitored and maintained in accordance with an Updated Industrial Waste Area Cover System O&M Manual. The FFS assumes maintenance and monitoring of the cover would continue for at least 30 years. Groundwater compliance monitoring and the application and maintenance of institutional controls will continue as described for Alternative E-1.

5.2.6.3 Alternative E-3

This alternative would remove the RCRA-C-compliant cover, excavate and dispose of all wastes within the Zone E cell offsite, install a low-permeability membrane within the excavation pit, backfill with clean material, and cap the excavation area with a new RCRA-C-compliant cover. Soil excavation would be limited to the subsurface soil horizon that contains the highest levels of residual contamination remaining beneath Zones E. The replacement cover would be required to address residual contaminants within the underlying vadose zone soil.

Following cover removal, the FFS indicates an estimated 10 to 16 feet of waste would be removed from the Zone E waste cell along with an additional 2 feet of contaminated soil directly beneath the waste cell. This alternative assumes a total excavation area of approximately 1.32 acres, including the waste disposal cell and set-back for excavation side-slopes.

The wastes and contaminated soil would be characterized, transported offsite, and disposed at a Subtitle C hazardous waste landfill. Confirmation sampling would verify that residual contamination in vadose zone soil is below applicable regulatory thresholds. A low-permeability membrane would be installed at the bottom of the remedial excavation, and the excavation pit would be backfilled with clean fill material. A new RCRA-C-compliant cover would be installed over the footprint of Zone E and graded accordingly. New monitoring wells would be installed to support compliance monitoring. Design details, specifications, and supporting documents would be provided in an EDR.

The cover would be monitored and maintained in accordance with an Updated Industrial Waste Area Cover System O&M Manual. The FFS assumes cover maintenance and monitoring for a period of at least 30 years. Alternative E-3 anticipates groundwater compliance monitoring for 10 years to confirm attainment of CULs for all IHSs at the designated point of compliance as described in a Site-Wide Groundwater Compliance Monitoring Plan. Institutional controls would be maintained and operated in accordance with the Site-Wide Institutional Controls Report as described in Alternative E-1.

5.2.7 Central Area Groundwater

One alternative (ONP-1) was presented in the FFS report to address groundwater contamination in the Central Area. The Central Area includes the southern end of the MSW Landfill southward to north of Zone A and from the western property boundary to east of the Landspread Area (see Figure 2, page 74). RAOs are to prevent ingestion, inhalation, or dermal absorption of on-property groundwater.

Alternative ONP-1 includes contingent implementation of focused SVE to capture low-level VOCs in soil gas. The FFS assumes installation of three deep SVE wells that would be integrated with the existing Zone A SVE system, with gas/vapor treatment at the RTO unit. The SVE wells would be installed and operated if concentrations of IHSs in Central Area groundwater monitoring wells are detected consistently at levels that result in CUL exceedances at the point of compliance. The FFS indicates that a field program prior to SVE well installation would identify the apparent source(s) of the release and guide the siting and positioning of the wells.

Compliance monitoring to confirm attainment of CULs for all IHSs at the designated point of compliance will be performed at Central Area monitoring wells as described in a Site-Wide Groundwater Compliance Monitoring Plan. Institutional controls would be maintained and operated in accordance with the Site-Wide Institutional Controls Report. Applicable institutional controls include access restrictions with fencing and warning signs, a limitation on landfill facility use within the Central Area, and property deed restrictions that ban construction, control excavation, and restrict groundwater use in this area.

5.2.8 Off-property groundwater

Section 5.2.5 of the 1999 FS report noted that a "plume of groundwater impacted by [contaminants of concern] COCs extends approximately 9,000 feet from the sources at Zone A and the Municipal Landfill and is approximately 1,800 feet wide." The report goes on to state that the combination of nutrient and contaminant loading from the MSW Landfill and from Zone A to groundwater causes an anaerobic environment where contaminant biodegradation occurs. Within approximately 500 feet down-gradient of Zone A or of the MSW Landfill, groundwater is reoxygenated and biodegradation stalls.

Historically, a component of the interim remedial actions for Zone A involved groundwater treatment using an in-well stripping technology (NoVOCs™ system). Installing and operating a NoVOCs™ system was initiated in 2002, and eventually four treatment wells were put into operation. The NoVOCs™ wells were positioned to provide on-property capture and treatment of groundwater contaminants primarily from Zone A, with the goal of limiting impacts to off-property areas. The NoVOCs™ system was discontinued in 2008 due to data indicating insufficient treatment effectiveness. At Ecology's direction, the NoVOCs™ wells were decommissioned in 2010.

Groundwater quality conditions in off-property areas of the Site have improved over time in response to on-property interim actions. Off-property VOC concentrations have remained consistently below the draft CULs during the past several years, although detectable concentrations of certain constituents are still measured in selected residential and monitoring wells. In view of these conditions, no active remediation of off-property groundwater is required.

Attenuation of off-property IHS concentrations will be demonstrated by routine monitoring of off-property wells. The FFS assumes monitoring of 8 to 16 off-property wells for 30 years. During this period when natural attenuation is occurring, downgradient water users will be protected by institutional controls, including the City of Pasco GPA ordinance and continued monitoring of residential wells in this area.

5.3 Regulatory requirements

MTCA sets forth the minimum requirements and procedures for selecting a cleanup action. A cleanup action must meet each of the minimum requirements specified in WAC 173-340-360(2), including certain threshold and other requirements.

5.3.1 Threshold requirements

WAC 173-340-360(2)(a) requires that the cleanup action shall:

- Protect human health and the environment;
- Comply with cleanup standards (see Section 4);
- Comply with applicable state and federal laws (see Section 5.3.4); and
- Provide for compliance monitoring.

5.3.2 Other requirements

In addition, WAC 173-340-360(2)(b) states the cleanup action shall:

- Use permanent solutions to the maximum extent practicable;
- Provide for a reasonable restoration time frame; and
- Consider public concerns.

WAC 173-340-360(3) describes the specific requirements and procedures for determining whether a cleanup action uses permanent solutions to the maximum extent practicable. A permanent solution is defined as one where CULs can be met without further action being required at the Site other than the disposal of residue from the treatment of hazardous substances. To determine whether a cleanup action uses permanent solutions to the maximum extent practicable, a DCA is conducted. This analysis compares the costs and benefits of the cleanup action alternatives and involves the consideration of several factors, including:

- Protectiveness;
- Permanent reduction of toxicity, mobility, and volume;
- Cost;
- Long-term effectiveness;
- Short-term risk;
- Implementability; and
- Consideration of public concerns.

The comparison of benefits and costs may be quantitative, but will often be qualitative and require the use of best professional judgment.

WAC 173-340-360(4) describes the specific requirements and procedures for determining whether a cleanup action provides for a reasonable restoration time frame.

5.3.3 Cleanup action expectations

WAC 173-340-370 sets forth the following expectations for developing cleanup action alternatives and selecting cleanup actions. These expectations represent the types of cleanup actions Ecology considers likely results of the remedy selection process; however, we recognize cleanup actions conforming to these expectations may be inappropriate at some sites.

- Treatment technologies will be emphasized at sites with liquid wastes, areas with high concentrations of hazardous substances, or with highly mobile and/or highly treatable contaminants;
- To minimize the need for long-term management of contaminated materials, hazardous substances will be destroyed, detoxified, and/or removed to concentrations below CULs throughout sites with small volumes of hazardous substances;
- Engineering controls, such as containment, may need to be used at sites with large volumes of materials with relatively low levels of hazardous substances where treatment is impracticable;
- To minimize the potential for migration of hazardous substances, active measures will be taken to prevent precipitation and runoff from coming into contact with contaminated soil

or waste materials;

- When hazardous substances remain onsite at concentrations which exceed CULs, they will be consolidated to the maximum extent practicable where needed to minimize the potential for direct contact and migration of hazardous substances;
- For sites adjacent to surface water, active measures will be taken to prevent/minimize releases to that water; dilution will not be the sole method for demonstrating compliance;
- Natural attenuation of hazardous substances may be appropriate at sites under certain specified conditions (see WAC 173-340-370(7)); and
- Cleanup actions will not result in a significantly greater overall threat to human health and the environment than other alternatives.

5.3.4 Applicable, relevant, and appropriate state and federal laws, and local requirements

WAC 173-340-710(1) requires that all cleanup actions comply with all applicable local, state, and federal law. It further states the term "applicable state and federal laws" shall include legally applicable requirements and those requirements that the department determines "…are relevant and appropriate requirements." This section discusses applicable state and federal law, relevant and appropriate requirements, and local permitting requirements that were considered and were of primary importance in selecting cleanup requirements. If other requirements are identified later, they will be applied to the cleanup actions at that time.

MTCA provides an exemption from the procedural requirements of several state laws and from any laws authorizing local government permits or approvals for remedial actions conducted under a consent decree, order, or agreed order (RCW 70.105D.090). However, the substantive requirements of a required permit must be met. The procedural requirements of the following state laws are exempted:

- Ch. 18.104 RCW, Water Well Construction;
- Ch. 43.21C RCW, State Environmental Policy Act;
- Ch. 49.17 RCW, Washington Industrial Safety and Health;
- Ch. 70.94 RCW, Washington Clean Air Act;
- Ch. 70.95 RCW, Solid Waste Management, Reduction, and Recycling;
- Ch. 70.105 RCW, Hazardous Waste Management;
- Ch. 70.105D RCW, Model Toxics Control Act;
- Ch. 75.20 RCW, Construction Projects in State Waters;
- Ch. 90.48 RCW, Water Pollution Control;
- Ch. 90.54 RCW, Water Resources Act; and
- Ch. 90.58 RCW, Shoreline Management Act of 1971.

WAC 173-340-710(4) sets forth the criteria Ecology evaluates when determining whether certain requirements are relevant and appropriate for a cleanup action. FFS Tables 4.4-1 and 4.4-2 list the local, state, and federal laws containing the applicable or relevant and appropriate requirements that apply to the cleanup action at the Site. Local laws, which may be more stringent than specified state and federal laws, will govern where applicable.

5.4 Evaluation of cleanup action alternatives

The requirements outlined in this section are used to conduct a comparative evaluation of the cleanup action alternatives for each subarea at the Site, and to select a cleanup action from those alternatives. This evaluation of cleanup action alternatives includes:

- MSW Landfill alternatives MSW-1 through MSW-3
- Balefill and Inert Waste Areas Alternative BA-1
- Burn Trenches alternatives BT-A through BT-C
- Zone A alternatives A-1 through A-9
- Zones C/D alternatives CD-1 through CD-3
- Zone E alternatives E-1 through E-3
- Central Groundwater Area Alternative ONP-1

FFS Table 4.3-1 summarizes each cleanup action alternative, and qualitatively ranks the area-specific alternatives against the evaluation criteria described in WAC 173-340-360.

5.4.1 Threshold requirements

5.4.1.1 Protection of human health and the environment

MSW Landfill: Alternative MSW-1 is expected to be protective of human health and the environment with maintenance and operation of existing engineering controls and interim actions, including the engineered RCRA D cover and the GCCS. Alternative MSW-2 would further reduce risk by expanding the GCCS and capturing and treating more landfill gas, thereby reducing the potential for vapor-to-groundwater transport of landfill-related contaminants. Alternative MSW-3 would further reduce risk by capturing and treating shallow groundwater containing contaminants sourced from the MSW Landfill.

Balefill and Inert Waste Areas: Alternative BA-1 would reduce risk to human health and the environment by minimizing the potential for direct contact with or exposure to the waste, helping reduce the potential for gaseous or vapor-phase contaminant releases, and reducing precipitation infiltrating into the wastes, thereby reducing the potential for contaminant transport from waste mass to groundwater.

Burn Trenches: The FFS suggests that Burn Trenches BT-1 and BT-2 are not sources of contaminants to groundwater or ambient air, based on observed and calculated environmental conditions. The thickness of the soil cover over BT-1 has not been confirmed throughout. BT-2 lies almost entirely beneath the existing Zone A cover. Alternative BT-A provides some protection from direct contact with or exposure to the BT-1 wastes. Alternative BT-B provides no additional protection beyond what BT-A provides. Alternative BT-C would increase protection by ensuring soil cover thickness of at least 30 inches over the wastes in BT-1.

The potential for humans contacting BT-2 wastes will increase during drum and waste debris excavation. In-situ treatment of Zone A mixed debris and contaminated soil will likely require peripheral treatment of some or all burn trench wastes in BT-2. This action would reduce the potential risk associated with certain BT-2 hazardous substances, and would enhance long-term protection of human health and the environment.

Zone A: The cover and related institutional controls associated with alternatives A-1 through A-4 and A-8 would limit the potential risk to humans and ecological receptors from contact with residual subsurface contamination. However, these alternatives do not address the human health and ecological risk posed by the ongoing release of contaminants from the source zone. Similarly, reliance upon SVE-based cleanup technologies does not address a broad spectrum of other contaminants in Zone A, which, like VOCs, pose a risk to human health and the environment. SVE-based cleanup technologies (alternatives A-1 through A-4) will not readily reduce potential risk and concerns associated with subsurface combustion processes or eliminate the potential waste-to-soil-to-groundwater pathway. In addition, the differential settlement that has and could continue to occur under these alternatives may cause cover system failure and potential exposure pathways.

Alternatives A-5, A-6, A-7, and A-9 would rely on excavation, transport, and either onsite or offsite disposal of waste and impacted soils. Complete removal of the drummed wastes and contaminants in mixed debris and subsurface soil provides a high degree of protection to human health and the environment. The concerns identified above would be reduced or eliminated under these alternatives. Placing waste, mixed debris, and soil into an onsite, lined, RCRA-C-compliant AOC cell or an offsite RCRA-compliant repository would eliminate the potential waste-to-soil-to-groundwater pathway.

Zones C/D: Alternative CD-1 reduces the potential risk to humans and ecological receptors from contact with residual subsurface contamination. However, this alternative may not eliminate the potential soil-to-groundwater pathway. Alternative CD-2 may further reduce or eliminate risk posed by soil-to-groundwater transport of remaining contamination by decreasing the contaminant mass in the waste zone and upper soil horizon. Alternative CD-3 would provide the highest level of comparative risk reduction by removing waste materials and the upper soil horizon containing the most residual contamination.

Zone E: The cover and related institutional controls associated with Alternative E-1 reduce the potential risk to humans and ecological receptors from contacting residual subsurface contamination. However, this alternative may not eliminate the potential soil-to-groundwater transport pathway. Alternative E-2 would further reduce or possibly eliminate risk posed by waste-to-soil-to-groundwater transport of residual subsurface contaminants by stabilizing the waste mass. Alternative E-3 would provide the highest level of comparative risk reduction by removing waste materials and the upper soil horizon containing the most residual contamination.

Central Area Groundwater: Alternative ONP-1 may reduce potential risk to human health and the environment by further reducing contaminant concentrations in groundwater if action thresholds are triggered. As stated in sections 5.2.6, 5.2.7, and 5.2.8, Alternative ONP-1 is contingent depending on groundwater quality observations. If groundwater impacts within the Central Area trigger contingent cleanup actions, targeted investigation work would first occur. This work would determine the likely source for the release(s), and support the development (via EDR) of a proposed cleanup approach to enhance or improve existing source control actions at Zones C/D and Zone E, or to address other documented contamination source areas affecting Central Area groundwater quality.

5.4.1.2 Compliance with cleanup standards

MSW Landfill: Groundwater cleanup standards have largely been achieved under Alternative MSW-1. As the landfill becomes more stable over time, contaminant flux to groundwater should progressively decline, assuming cover maintenance and custodial care continues in perpetuity. Ongoing maintenance and operation of the cover and GCCS would sufficiently capture contaminants and meet groundwater cleanup standards. Alternatives MSW-2 and MSW-3 would enhance contaminant removal, thereby providing a higher level of assurance that cleanup standards would be met.

Balefill and Inert Waste Areas*:* Alternative BA-1 should reduce potential contaminant transport to subsurface soils and groundwater. In doing so, Alternative BA-1 will help to ensure groundwater cleanup standards continue to be met throughout this MSW disposal area.

Burn Trenches: Alternative BT-A, as applied to Burn Trench BT-1, potentially can meet cleanup standards for groundwater. Subsurface processes occurring in Burn Trench BT-2 may influence contaminant migration and groundwater cleanup standards may not be met for selected IHSs. Anticipated Zone A cleanup likely will reduce the transport of BT-2 contaminants to subsurface soils and groundwater. Alternative BT-B would not enhance the likelihood of meeting cleanup standards at BT-1 or BT-2. However, Alternative BT-C is expected to reduce the potential transport of contaminants to subsurface soils and groundwater near BT-1. In doing so, Alternative BT-C would increase the likelihood that groundwater cleanup standards continue to be met throughout this MSW disposal area.

Zone A: Alternatives A-1 through A-4 and A-8 cannot achieve cleanup standards. These alternatives do not control the contaminant source to the maximum extent practicable (WAC 173-340-370), as they do not prevent the release of contaminants from waste zone to soil. They may not prevent further NAPL releases to groundwater. Alternatives A-5 through A-7 and A-9 likely would achieve compliance with cleanup standards, although over different restoration time frames.

Alternative A-6 likely would involve using remediation levels to establish interim cleanup targets for subsurface soils that would be protective of groundwater. These remediation levels would be set based on the expected average VOC mass percent reduction of 96 percent as described in Section 5.2.4.6 of this CAP and in the FFS.

Zones C/D: Alternative CD-1 potentially can meet groundwater cleanup standards, based on historical monitoring performance of cover and associated institutional controls. Alternative CD-2 would further reduce the potential for soil-to-groundwater transport of IHSs and provide a higher likelihood that groundwater cleanup standards will continue to be met. Alternative CD-3 would largely eliminate the soil-to-groundwater transport pathway.

Zone E: Alternative E-1 potentially can meet groundwater cleanup standards, based on historical monitoring performance of the cover and associated institutional controls. Alternative E-2 would further reduce potential soil-to-groundwater transport of IHSs and provide a higher likelihood that groundwater cleanup standards will continue to be met. Alternative E-3 would largely eliminate the soil-to-groundwater transport pathway.

Central Area Groundwater: Groundwater conditions in the Central Area largely comply with cleanup standards, based on monitoring data from the interim action period. Low-level detections of selected VOCs continue to be observed in selected monitoring wells in this area, and have not recently exceeded draft CULs. Alternative ONP-1, if implemented as a contingent remedy, would further reduce contaminant concentrations and increase the likelihood that groundwater cleanup standards would be met.

5.4.1.3 Compliance with state and federal laws

All remedial alternatives would be performed in compliance with applicable state and federal laws listed in FFS tables 4.4-1 and 4.4-2. Local laws, which can be more stringent, will govern actions when they are applicable. These will be established, where applicable, during the design phases associated with the tasks in the SOW.

5.4.1.4 Provisions for compliance monitoring

Site-wide monitoring will comply with WAC 173-340-410. Groundwater compliance monitoring is a core element of all remedial action alternatives. A groundwater compliance monitoring plan will be developed after the CAP is final. Other types of monitoring will track remedy performance and determine if cleanup has achieved the cleanup standards. These additional monitoring activities will be described in each subarea's O&M plan. Health and safety plans will include protection monitoring requirements for remedial construction and final remedy O&M.

MTCA describes three types of compliance monitoring (WAC 173-340-410): protection, performance, and confirmational. Protection monitoring is designed to protect human health and the environment during the construction, operation, and maintenance phases of the cleanup action. Performance monitoring confirms the cleanup action has met cleanup and/or performance standards. Confirmational monitoring confirms the long-term effectiveness of the cleanup action once cleanup standards have been met or other performance standards have been attained.

The cleanup alternatives associated with each cleanup subarea require varying levels of all three types of compliance monitoring. All remedial alternatives for each subarea of the Site satisfy the threshold requirement of WAC 173-340-360(2)(a)(iv).

5.4.2 Other requirements

5.4.2.1 Use of permanent solutions to the maximum extent practicable

To determine whether a cleanup action uses permanent solutions to the maximum extent practicable, a DCA is used. The analysis compares the costs and benefits of the cleanup action alternatives and considers several factors. The comparison of costs and benefits may be quantitative, but is often qualitative and requires using best professional judgment. Because Zone A alternatives A-1 through A-4 and A-8 did not meet threshold requirements, they are not eligible to be considered viable remedies for Zone A, and are not evaluated in the process below.

- Protectiveness measures the degree to which existing risks are reduced, time required to reduce risk and attain cleanup standards, on- and offsite risks resulting from implementing the alternative, and improvement of overall environmental quality.

MSW Landfill: Alternative MSW-1 is expected to protect of human health and the environment through existing engineering controls, including the cover and GCCS. Alternative MSW-1 addresses the RAOs for this cleanup subarea. Alternatives MSW-2 and MSW-3 are contingent remedies that could be implemented if MSW-1 did not achieve the RAOs.

Balefill and Inert Waste Areas: Alternative BA-1 will be protective of human health and the environment through engineering controls (enhanced soil cover) and ongoing maintenance and monitoring. Alternative BA-1 addresses the RAOs for this cleanup subarea. Implementing BA-1 will reduce surface fire risk. Currently, terrestrial ecological receptors could be exposed to MSW below the soil cover and in areas where the existing cover soil is thin or absent. Potential human or terrestrial ecological receptor exposure to waste debris will be minimized by installing and maintaining a 30-inch soil cover.

Burn Trenches: Alternative BT-A is expected to protect human health and the environment and can achieve the RAOs for this cleanup subarea. Some uncertainty exists about the thickness of the Burn Trench BT-1 soil cover (BT-2 is under the Zone A cover). Alternative BT-C would be more protective than BT-A by confirming existing soil cover thickness and adding provisions for cover improvements to establish and maintain a minimum 30-inch soil cover. Portions of Burn Trench BT-2 likely will be disturbed during the Zone A cleanup work. Potential human or terrestrial ecological receptor contact with BT-2 wastes will increase during drum and waste debris excavation. In-situ treatment of Zone A mixed debris and contaminated soil will likely require peripheral treatment of some or all of the BT-2 waste area. This action would reduce the potential risk from certain BT-2 hazardous substances and improve the overall environmental quality within this combined waste area.

Zone A: Alternatives A-5 through A-7 and A-9 would protect human health and the environment, assuming removal of all source zone wastes, and perpetual operation, monitoring, and maintenance of the remediation systems (new AOC cell and cover).

Zones C/D: All alternatives for Zones C/D protect human health and the environment. Each alternative addresses the RAOs for this cleanup subarea. Alternative CD-3 would provide the greatest long-term protectiveness and improve overall environmental quality by removing the bulk of the contamination. Potential future risks to groundwater quality would be the lowest for Alternative CD-3. Implementing Alternative CD-3 potentially introduces higher comparative onsite and offsite risks due to the excavation, handling, transport, and offsite disposal of contaminated soil. Use of chemical amendments under Alternative CD-2 potentially could increase risk to site workers.

Zone E: All Zone E alternatives protect human health and the environment. Each alternative addresses the RAOs for this cleanup subarea. Alternative E-3 would provide the greatest long-term protectiveness and improve overall environmental quality by removing the bulk of the contamination. Potential future risks to groundwater quality would be the lowest for Alternative E-3. Implementation of Alternative E-3 potentially introduces higher comparative onsite and offsite risks due to the excavation, handling, transport, and offsite disposal of contaminated soil. Ex-situ stabilization of Zone E wastes under Alternative E-2 potentially could increase risk to site workers.

Central Area Groundwater: Alternative ONP-1 would protect human health and the environment and improve overall environmental quality in the treatment area. This alternative would address the RAOs for this cleanup subarea. If triggered as a contingent remedy, this alternative would increase contaminant capture and destruction. This would reduce risk to groundwater beyond what would be collectively accomplished by implementing the MSW Landfill, Zones C/D, and Zone E cleanup alternatives.

- Permanence measures the adequacy of the alternative to destroy the hazardous substance(s), the reduction or elimination of releases or sources of releases, the degree of irreversibility of any treatment process, and the characteristics and quantity of any treatment residuals.

MSW Landfill: All MSW Landfill alternatives will contain the MSW in-place and are equally permanent. Each MSW Landfill alternative would rely on maintaining the existing cover (and potentially replacing the cover). The MSW Landfill is expected to require management, stewardship, and/or custodial care in perpetuity. Ongoing waste biodegradation will occur into the future, helping to reduce or destroy hazardous substances in the waste mass. GCCS and MSW flare unit operation permanently destroys landfill gas. At some point, however, landfill gas generation due to waste biodegradation will stop. Some persistent contaminants (for example, metals and selected organic compounds) will remain within the waste mass and likely will not experience a demonstrable reduction in contaminant toxicity, mobility or volume over time. While Alternative MSW-2 potentially would capture more VOCs from beneath the waste mass, it would not affect the permanence of persistent hazardous substances that will remain once the landfill stabilizes. A cover will need to be permanently in place and maintained to minimize potential contaminant leaching/migration.

Balefill and Inert Waste Areas: Alternative BA-1 will contain the MSW in-place, and is a solution that is permanent to the maximum extent practicable. The installation of an enhanced soil cover would help promote an overall reduction or minimization of potential releases from these wastes. Ongoing waste biodegradation will occur into the future, reducing or destroying certain hazardous substances. Management, stewardship, and/or custodial care of the soil cover would occur in accordance with Washington State Solid Waste Landfill regulations and local jurisdictional health district requirements.

Burn Trenches: All three alternatives will contain the MSW in-place and are equally permanent to the maximum extent practicable. Installing an enhanced soil cover at BT-1 would further minimize potential hazardous substance releases. To ensure ongoing reduction or elimination of potential releases, appropriate management, stewardship, and/or custodial care of the soil cover would occur in accordance with Washington State Solid Waste Landfill regulations and local jurisdictional health district requirements. Ongoing waste biodegradation will occur into the future, reducing or destroying certain hazardous substances. The anticipated Zone A cleanup actions (in-situ thermal treatment) should provide an additional measure of permanent destruction or immobilization of hazardous substances in BT-2 wastes in the treatment zone.

Zone A: Alternatives A-5 through A-7, which include offsite disposal of certain wastes, would reduce their volume and mobility. Wastes placed into an onsite AOC cell using micro- or macro-encapsulation treatment, or other methods of waste stabilization, would permanently affect potential waste toxicity and mobility. Alternative A-9 removes and disposes all Zone A wastes offsite. This alternative would permanently reduce waste toxicity, mobility, and volume.

Zones C/D: In-place waste containment in Alternative CD-1 provides a lower level of permanence compared to alternatives CD-2 and CD-3. The FFS identifies a similar level of permanence for alternatives CD-2 and CD-3, but recognizes CD-3 as the most practicable permanent alternative, minimizing the quantity of contamination remaining onsite.

Zone E: In-place waste containment associated with Alternative E-1 provides a lower level of permanence compared to alternatives E-2 and E-3. Alternative E-3 removes the waste from Zone E and, therefore, displays the most permanence.

Central Area Groundwater: Alternative ONP-1 would reduce or eliminate releases of hazardous substances from their source(s) and provide a remedial approach that would enhance the permanent destruction of any captured contaminants.

- Cleanup costs are shown in terms of net present value and are estimated based on design assumptions and implementation timeframes for each alternative. Although the costs are estimates based on design assumptions that might change, the relative costs can be used for this evaluation. For a detailed description of the costs involved with each alternative, please refer to the corresponding FFS report (Anchor QEA 2017, Aspect 2017).

MSW Landfill:

MSW-1:	$1,359,000
MSW-2:	$1,608,000
MSW-3:	$3,329,000

Balefill and Inert Waste Areas:

BA-1:	$450,000

Burn Trenches:

BT-A:	$14,000
BT-B:	$51,000
BT-C:	$141,000

Zone A:

A-1:	$16,100,000
A-2:	$18,300,000
A-3:	$17,300,000
A-4:	$62,400,000
A-5:	$56,000,000
A-6:	$62,100,000
A-7:	$60,300,000
A-8:	$49,900,000
A-9:	$128,100,000

Zones C/D:

CD-1:	$712,000
CD-2:	$1,568,000
CD-3:	$7,233,000

Zone E:

E-1:	$844,000
E-2:	$2,241,000
E-3:	$20,092,000

Central Area:

ONP-1:	$1,474,000

- Long-term effectiveness measures the degree of success, the reliability of the alternative during the period that hazardous substances will remain above CULs, the magnitude of residual risk after implementation, and the effectiveness of controls required to manage remaining wastes.

  MSW Landfill: Alternative MSW-1 shows the highest long-term effectiveness based on historical effectiveness of the existing engineered systems. Each alternative will still rely on onsite waste containment, engineering controls, and long-term O&M and institutional controls. These actions would ensure long-term effectiveness of this remedy and its ability to achieve RAOs.

Balefill and Inert Waste Areas: Alternative BA-1 will include onsite waste containment and long-term soil cover and institutional control O&M. Proper soil cover design and installation should ensure this alternative would provide a reasonable degree of long-term effectiveness and successfully achieve the RAOs.

Burn Trenches: All alternatives provide an equal degree of long-term effectiveness based on historical performance of the existing BT-1 soil cover. For BT-1, Alternative BT-C has the highest degree of long-term effectiveness with its minimum 30-inch soil cover over the entire waste disposal area. The long-term success and reliability of this alternative will be supported by long-term O&M of the soil cover and institutional controls. These actions would help ensure long-term effectiveness of this remedy and its ability to achieve the RAOs. The long-term effectiveness of cleanup actions in BT-2 will be influenced by the scope and effectiveness of Zone A cleanup actions.

Zone A: Alternatives A-5 through A-7 and A-9 provide enhanced long-term effectiveness; however, the first three will require long-term management of wastes placed in a new AOC cell and of residual contaminants remaining beneath the replacement cover. Alternative A-9 would not require long-term, onsite waste management, but would require long-term management of residual contaminants beneath the replacement cover.

Zones C/D: All three alternatives offer an acceptable level of long-term effectiveness. Considering the cleanup action hierarchy in WAC 173-340-360(3)(f)(iv), Alternative CD-3 would provide the highest degree of long-term effectiveness given considerations of potential success and reliability as compared to CD-2. Long-term effectiveness of CD-1 relies on continuing onsite containment with long-term O&M of the cover and institutional controls.

Zone E: All three alternatives offer an acceptable level of long-term effectiveness. Considering the cleanup action hierarchy in WAC 173-340-360(3)(f)(iv), Alternative E-3 would provide the highest degree of long-term effectiveness given considerations of potential success and reliability as compared to E-2. Long-term effectiveness of E-1 relies on continuing onsite containment with long-term O&M of the cover and institutional controls.

Central Area Groundwater: Alternative ONP-1 would be implemented as a contingent remedy to reduce risk by capturing and treating more contamination. The long-term effectiveness of this remedial alternative will be affected by the design, construction, operation, maintenance, and monitoring of the engineered system.

- Short-term risk measures the risks related to an alternative during construction and implementation, and the effectiveness of measures that will be taken to manage such risks.

MSW Landfill: Drilling and excavation activities, and operating the supplemental remediation components associated with alternatives MSW-2 and MSW-3 would pose a higher short-term risk than Alternative MSW-1. Risks associated with these supplemental activities would be managed through task-specific health and safety protocols and field audits. Alternatives MSW-2 and MSW-3 would use standard construction techniques and best management practices, along with employing experienced, well-trained staff, to mitigate short-term risks.

Balefill and Inert Waste Areas: Short-term risks associated with Alternative BA-1 soil cover construction activities would be managed through task-specific health and safety protocols and field audits. Cover construction work would use standard construction techniques and best management practices, along with employing experienced, well-trained staff, to mitigate short-term risks.

Burn Trenches: The excavation and construction associated with alternatives BT-B and BT-C potentially would increase short-term risk more than Alternative BT-A. Short-term risks from soil cover investigation and construction would be managed through task-specific health and safety protocols and field audits. Cover construction work would use standard construction techniques and best management practices that would mitigate short-term risks. For the BT-2 area, short-term risks would be driven by associated Zone A cleanup work. These risks also would be managed using standard construction techniques and best management practices that would mitigate short-term risks.

Zone A: Alternatives A-5, A-6, A-7, and A-9 pose similar short-term risks to human health and the environment during removal of drummed waste and impacted soils and onsite or offsite disposal. Drum, waste, debris, and soil removal are higher-risk activities influenced by construction and drum condition uncertainties, physical hazards and safety considerations for workers, potential worker exposure during segregation and handling of waste/soil and drum overpacking, potential uncontrolled releases, and potential contaminant release and mobilization to the atmosphere, soils, and groundwater. Many of these expressed short-term risks would be managed with appropriate planning, contractor selection, worker training, health and safety monitoring and auditing, and job safety analysis procedures.

Zones C/D: Short-term risks are higher for Alternative CD-3 than CD-1 or CD-2 due to excavation, transport, and stockpiling of Zones C/D wastes prior to offsite disposal. A higher degree of potential short-term risk to workers is assigned to Alternative CD-2 because of chemical reagent use. The lowest short-term risk is assigned to Alternative CD-1 because it involves little or no direct contact and exposure to waste and contamination by humans and ecological receptors. Short-term risks associated with any of the proposed Zones C/D alternatives would be managed through task-specific health and safety protocols and field audits, along with using standard construction techniques, best management practices, and experienced, well-trained staff.

Zone E: Short-term risks are higher for Alternative E-3 compared to E-1 or E-2 due to waste excavation, transport, and stockpiling prior to offsite disposal. Higher potential short-term risk to site workers is assigned to Alternative E-2 because of the ex-situ chemical stabilization process. The lowest short-term risk was assigned to Alternative E-1 because it involves little or no direct contact and exposure to waste and contamination by humans and ecological receptors. Short-term risks associated with any of the proposed Zone E alternatives would be managed through task-specific health and safety protocols and field audits, along with using standard construction techniques, best management practices, and experienced, well-trained staff.

Central Area Groundwater: Short-term risks for Alternative ONP-1 would be associated with construction, operation, maintenance, and monitoring of the engineered system implemented as a contingent remedy. Any short-term risks would be managed through task-specific health and safety protocols and field audits, along with the use of standard construction techniques, best management practices, and experienced, well-trained staff.

- Implementability considers whether the alternative is technically possible, the availability of necessary offsite facilities, services, and materials, administrative and regulatory requirements, scheduling, size, complexity, monitoring requirements, access for operations and monitoring, and integrations with existing facility operations.

MSW Landfill: All three alternatives are implementable. MSW-1 is the most straight-forward to implement and operate in the long-term.

Balefill and Inert Waste Areas: Alternative BA-1 is readily implementable.

Burn Trenches: All three alternatives are equally implementable at addressing soil cover conditions at area BT-1. Alternative BT-A requires no construction work, whereas BT-C likely would involve spreading and grading additional soil to cover the BT-1 footprint and achieve minimum cover thickness requirements.

Zone A: Alternatives A-5 through A-7 and A-9 are implementable. Expressed uncertainty over thermal treatment effectiveness and the need for treatability testing to resolve site-specific considerations resulted in a lower implementability ranking for Alternative A-6. While treatability testing is a necessary step to develop and refine any thermal treatment alternative, this requirement is not an impediment to implementability. Similarly, although the removal action alternatives (A-5 through A-7 and A-9) include logistical, material handling, and waste management challenges, they are all readily implementable with proper planning and execution.

Zones C/D: All alternatives are implementable. However, these alternatives would pose varying degrees of technical challenges based on the combinations of engineered controls used. Alternative CD-1 is the most readily implemented. Demonstrated performance and implementation of the existing cover is the primary basis for this ranking. Alternative CD-3 requires a comprehensive construction project plan due to the excavation activities, reducing its ranking. There is a degree of uncertainty over the technical practicability and implementability of applying in-situ chemical amendments to the Zones C/D wastes and underlying soils. As such, Alternative CD-2 received the lowest implementability ranking.

Zone E: All alternatives are implementable. These alternatives, however, pose varying degrees of technical challenges based on the combinations of engineered controls used. Alternative E-1 is most readily implemented due to the demonstrated performance and implementation of the existing cover. Alternative E-3 requires a comprehensive construction project plan due to the associated excavation activities, reducing its relative ranking. There is a degree of uncertainty over the technical practicability and implementability of using ex-situ stabilization. As such, Alternative E-2 received the lowest implementability ranking.

Central Area Groundwater: Alternative ONP-1 is fully implementable and will be influenced by the complexity of the engineering system and controls determined to be most suitable for contaminant capture and treatment.

- To understand and consider public concerns, Ecology presented the draft FFS for public review and comment September 12 to October 26, 2018. We held a well-attended public meeting on September 26, 2018. This draft CAP will also undergo public review and comment.

  Ecology published our Response to Comments for the FFS[1] in December 2018. Three of the five parties who submitted comments are PLPs; the other two were government health agencies. You may learn more by reading the document.

5.4.2.2 Provide for a reasonable restoration time frame

WAC 173-340-360(4) describes the requirements and procedures for determining whether a cleanup action provides for a reasonable restoration time frame (RTF), as required under subsection (2)(b)(ii). The factors used to determine whether a cleanup action provides a reasonable RTF are in WAC 173-340-360(4)(b).

MSW Landfill: The FFS prepared by the Landfill Group (Aspect 2017) states that the MSW Landfill will have an RTF of approximately 15 years based on observed and predicted landfill gas collection and groundwater monitoring trends. This FFS suggests that no alternative can alter the RTF, because the decomposition rate is dictated by the MSW age, volume, and methane-generating capacity. Leaching and mobilizing of hazardous substances within the MSW materials can occur if the long-term integrity and functionality of the cover is compromised. Compromising factors include geomembrane degradation (for example, progressive depletion of antioxidants and polymer), changes in physical and/or mechanical properties of the geomembrane, and/or structural disturbance (Koerner et al. 2011, Peggs 2003). The RTF for all the alternatives will likely exceed a 15-year timeframe. The selected alternative will need to

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[1] https://apps.ecology.wa.gov/gsp/DocViewer.ashx?did=79415

provide for the long-term containment of the wastes (>15 years) even after functional stability is demonstrated. This will minimize the potential for future infiltration and leaching of residual contaminants from the waste mass to groundwater, and to satisfy the other RAOs.

Balefill and Inert Waste Areas: The FFS (Aspect 2017) states that the Balefill/Inert Waste/Mixed Debris Areas RTF will be approximately 15 years. This timeframe would be necessary to demonstrate the Alternative BA-1 soil cover is adequate, including potential erosion and maintenance requirements. The age and composition of the Balefill/Inert Waste/Mixed Debris Area wastes potentially will allow for a more abbreviated RTF than what would be expected for the MSW Landfill Area. However, long-term custodial care (>15 years) of the soil cover will be necessary to satisfy the RAOs.

Burn Trenches: The FFS (Aspect 2017) states that the Burn Trenches will have an RTF of approximately 15 years. This timeframe would be necessary to demonstrate the soil cover is adequate, including potential erosion and maintenance requirements. The age and composition of the Burn Trench wastes potentially will allow for a more abbreviated RTF than what would be expected for the MSW Landfill Area. Long-term custodial care of the selected Burn Trench soil cover system will be necessary to satisfy the RAOs. The RTF for wastes in BT-2 is expected to be the same as the RTF for Zone A following implementation of its final remedy.

Zone A: The FFS (Anchor QEA 2017) states that alternatives A-6 through A-9 provide overall shorter RTFs due to waste removal or destruction through thermal treatment. Alternative A-5 would involve long-term management and monitoring of the wastes in a new AOC cell in addition to extended SVE operation, cap maintenance, and long-term groundwater monitoring. This area would require management in perpetuity. Ecology considers alternatives A-5 through A-7 and A-9 as practicable alternatives and concurs that they would result in shorter RTFs as noted in the FFS.

Zones C/D: The FFS (Anchor QEA 2017) states that all alternatives provide for reasonable RTFs and satisfy the RTF evaluation factors. Alternative CD-3 is expected to provide a shorter RTF compared to the other two alternatives since the least residual contamination would be left onsite. For alternatives CD-1 and CD-2, achieving and sustaining compliance with CULs and cleanup goals would require long-term waste containment and associated maintenance and management of the cover — even if groundwater CULs in nearby wells have been met.

Zone E: The FFS (Anchor QEA 2017) states that all alternatives provide for reasonable RTFs and satisfy the RTF evaluation factors. Alternative E-3 is expected to provide a shorter RTF compared to the other two alternatives since the least residual contamination would be left onsite. For Alternatives E-1 and E-2, achieving and sustaining compliance with CULs and cleanup goals would require long-term waste containment and associated maintenance and management of the cover — even if groundwater CULs in nearby wells have been met.

Central Area Groundwater: The FFS (Anchor QEA 2017) states that Alternative ONP-1 would provide for a reasonable RTF and satisfy the RTF evaluation factors. For Alternative ONP-1, the RTF will depend on the conditions that trigger the contingent remedy. If the source area causing the observed groundwater impacts is not identified and source control actions implemented, the ONP-1 remedy could require long-term operation and maintenance to achieve and sustain compliance with groundwater CULs.

5.4.3 Groundwater cleanup requirements

Cleanup actions that address groundwater must meet the requirements described in WAC 173-340-360(2)(c). A permanent groundwater cleanup action must be capable of meeting WAC 173-340-720 cleanup standards without further action being required at the site, other than the approved disposal of any residue from treatment of hazardous substances.

MSW Landfill: Alternatives MSW-1 through MSW-3 all meet the requirements for a permanent groundwater cleanup action.

Balefill and Inert Waste Areas: Alternative BA-1 meets the requirements for a permanent groundwater cleanup action.

Burn Trenches: Alternatives BT-A, BT-B, and BT-C all meet the requirements for a permanent groundwater cleanup action.

Zone A: While alternatives A-1 through A-4 and A-8 did not meet threshold requirements, it is important to note that these alternatives do not meet the requirements for a permanent groundwater cleanup action. Specifically, these alternatives cannot prevent the ongoing release of hazardous substances from Zone A wastes, or prevent these substances from migrating to the underlying groundwater system, which has already occurred. NAPL was detected on groundwater beneath Zone A in 2017, and persists to the present. Interim measures to reduce the NAPL quantity have been implemented, but provide only a stop-gap approach for capturing small quantities from a limited area. Alternatives A-5 through A-7 and A-9 would meet the requirements for a permanent groundwater cleanup action. These alternatives involve excavation and removal of source zone hazardous substances, and include other actions that constitute a permanent cleanup action.

Zones C/D: Alternatives CD-1 through CD-3 all meet the requirements for a permanent groundwater cleanup action.

Zone E: Alternatives E-1 through E-3 all meet the requirements for a permanent groundwater cleanup action.

Central Area Groundwater: Alternative ONP-1 meets the requirements for a permanent groundwater cleanup action.

Off-Property Groundwater: While landfill-related contaminants are detectable in selected off-property wells, the levels are below CULs. No specific action is proposed to address residual groundwater contamination within the off-property groundwater plume. On-property cleanup activities and natural attenuation eventually will restore groundwater quality in areas hydraulically downgradient (south) of the landfill. Unrestricted potable consumption of groundwater from within the existing City of Pasco GPA likely will not be practicable until after the final cleanup remedy has been implemented and the long-term performance remedy has been adequately assessed and confirmed.

5.4.4 Cleanup action expectations

Cleanup action expectations are outlined in WAC 173-340-370 and are described in Section 5.3.3. The alternatives, if successful, would address applicable expectations in the following manner.

MSW Landfill

- Alternatives MSW-1 through MSW-3 maintain the existing engineering controls to manage and contain the generally low levels of hazardous substances here, minimize precipitation infiltration into the waste mass, and likely would achieve functional stability within similar RTFs.
- For alternatives MSW-1 through MSW-3, no further waste consolidation is necessary or practical to minimize the potential for direct contact and migration of hazardous substances.
- Alternatives MSW-1 through MSW-3 would rely on natural attenuation and biodegradation to reduce risk to human health and the environment posed by residual contamination in the waste mass and subsurface soils.
- MSW-2 would enhance capture and destruction of landfill gases and vapor-phase contaminants, reduce VOC impacts to groundwater, and potentially shorten long-term compliance monitoring.
- MSW-3 would capture and treat VOCs in shallow groundwater near the downgradient landfill boundary, minimizing the potential for off-property migration of hazardous substances.

Balefill and Inert Waste Areas

- Alternative BA-1 uses engineering controls to contain low-level hazardous substances typically associated with common MSW materials. No further waste consolidation is necessary or practical to minimize potential direct contact and migration of hazardous substances. This alternative also would rely upon natural attenuation to reduce risk to human health and the environment posed by residual contamination in the waste mass and subsurface soils.

Burn Trenches

- Alternatives BT-A, BT-B, and BT-C use engineering controls to contain low-level hazardous substances within the waste mass. No further waste consolidation is necessary or practical to minimize the potential for direct contact and migration of hazardous substances. These alternatives would rely on natural attenuation to reduce risk to human health and the environment posed by residual subsurface contamination.

Zone A

- Alternatives A-1 through A-4 and A-8 would use engineering controls to contain a large volume of highly concentrated hazardous substances, some of which are highly mobile and require long-term management. These alternatives, as presented, do not meet WAC 173-340-370.

- Alternatives A-5 through A-7 and A-9 would remove all drummed liquid wastes and other pooled wastes found outside the drums from the site for offsite treatment and disposal.
- Alternatives A-5 through A-7 would contain non-liquid wastes, contaminated debris, and contaminated soils in an onsite AOC cell requiring long-term monitoring. The footprint of the AOC cell would be larger than the original Zone A footprint.
- Alternative A-6 would involve treatment technologies to promote the destruction, detoxification, and/or stabilization of residual contaminants.
- Alternatives A-5 through A-7 and A-9 would use engineering controls to contain, capture, and treat a large volume of low-to-moderate-level hazardous substances that would remain after source removal was completed. These alternatives would rely on natural attenuation to reduce risk to human health and the environment posed by residual subsurface contamination.
- Alternative A-9 would remove all liquid wastes, contaminated mixed debris, and most of the contaminated soil, reducing the timeframe to perform supplemental cleanup activities and long-term risk to groundwater.

Zones C/D

- Alternatives CD-1 and CD-2 would use engineering controls to contain a large volume of moderate-to-high-level hazardous substances, and minimize the potential for precipitation infiltration and associated hazardous substance migration.
- Alternative CD-2 would involve treatment technologies to promote the destruction, detoxification, and/or stabilization of residual contaminants in the waste mass and contaminated soil zone.
- Alternative CD-3 would remove all wastes and the most contaminated subsurface soils, minimizing the potential for hazardous substance migration and the need for long-term management.
- Alternatives CD-1 through CD-3 would rely on natural attenuation to reduce risk to human health and the environment posed by residual subsurface contamination.

Zone E

- Alternatives E-1 and E-2 would use engineering controls to contain a large volume of moderate-to-high level hazardous substances, and minimize the potential for precipitation infiltration and associated hazardous substance migration.
- Alternative E-2 would involve treatment technologies to promote the destruction, detoxification, and/or stabilization of residual contaminants in the waste mass and contaminated soil zone.
- Alternative E-3 would remove all wastes and the most contaminated subsurface soils, minimizing the potential for hazardous substance migration and the need for long-term

management.

- Alternatives E-1 through E-3 would rely on natural attenuation to reduce risk to human health and the environment posed by residual subsurface contamination.

Central Area Groundwater

- Alternative ONP-1 would involve treatment technologies to promote the capture and destruction of residual contaminants in groundwater, minimizing the need for long-term management at one or more of the subareas in the Central Area.

Off-Property Groundwater

- All cleanup alternatives discussed above, with the exception of certain Zone A alternatives, would, separately or in concert, minimize hazardous substance migration to groundwater and/or intercept and treat hazardous substances at or near their source. These actions would reduce the need for long-term management of off-property groundwater.

5.5 Decision

Ecology believes many of the preferred remedial alternatives proposed by the PLPs in the two August 2017 FFS documents can satisfactorily meet WAC 173-340-360 minimum cleanup action requirements. Specifically, Ecology has determined that the preferred alternatives for the MSW Landfill, Balefill and Inert Waste Area, Zones C/D, Zone E, and the Central Area Groundwater are permanent to the maximum extent practicable.

The PLPs' preferred alternative for Zone A (A-1) was not selected because alternatives A-1 through A-4 and A-8 do not meet threshold requirements or expectations for cleanup action alternatives as described in MTCA. This is due to concerns regarding potential combustion, differential settlement, NAPL migration to groundwater, and indeterminate RTFs. Therefore, Ecology and the PLPs developed an alternative that combines elements from alternatives A-6 and A-9 and is considered a more appropriate, effective, and permanent remedial action for Zone A. The developed alternative, involving waste removal followed by in-situ treatment, is described in detail in the SOW (Exhibit C of the CD).

In addition, Ecology prefers a more comprehensive alternative for Burn Trench BT-1 to ensure long-term protection of human health and the environment.

Details and associated requirements for all of the selected remedial alternatives are outlined in Section 6. The selected cleanup action, involving coordinated cleanup activities at each of the individual cleanup subareas, along with additional activities involving site-wide cleanup requirements and responsibilities, will meet each of the minimum requirements for remedial actions. The selected cleanup action will provide reliable, long-term protection of human health and the environment, and will include contingencies in the event that environmental conditions change and require supplemental actions to achieve CULs throughout the Site.

6 Selected Cleanup Action

The selected cleanup action for the Site includes a combination of remedial alternatives for each of the individual cleanup subareas. This suite of actions will coordinated to create an integrated final cleanup remedy for the entire Site. Ecology recognizes that certain subareas will require minimal construction-related activities, whereas other areas will require a more prolonged period of remedial construction. The suite of actions will protect human health and the environment. This includes measures that provide for the safety and protection of onsite workers and the local community, and long-term protection of groundwater.

6.1 MSW Landfill

The selected action for the MSW Landfill generally aligns with Alternative MSW-1, with the exception of additions outlined in the SOW and Schedule (Exhibit C of the CD). The remedy includes operating, monitoring, and maintaining the existing engineering controls. The action will include groundwater monitoring, institutional controls, and a series of system modifications implemented progressively over time as environmental conditions at the MSW Landfill change. Adapting operations to changing conditions will support the long-term operability, functionality, and integrity of the engineered components of the MSW Landfill and associated Site-wide cleanup goals. These anticipated actions and operational milestones include:

- Performing post-closure care required under WAC 173-351-500(2), and detailed in the scheduled O&M Manual update.
- Installing two groundwater monitoring wells hydraulically downgradient (along western edge) from the MSW Landfill to improve spatial coverage of the existing monitoring network.
- Maintaining the engineered cover system and monitoring for potential methane gas emissions at ground surface.
- Maintaining the GCCS and flare system.
- Maintaining the 13 perimeter soil gas monitoring probes as compliance points for methane gas control (WAC 173-351-200(4)).
- Future transition from the enclosed flare system to a passive landfill gas treatment system or direct venting.
- Future transition from active landfill gas collection to passive landfill gas collection.
- Transition to custodial care when functional stability is demonstrated using Ecology-approved metrics.

The specific tasks, requirements, deliverables, and timing are detailed in the SOW. These include submitting a draft and final Updated MSW Disposal Areas O&M Manual, execution of the work described in the Final O&M Manual, cover repair or replacement (if necessary), design documentation for, and the implementation of, modifications to the landfill gas treatment system (if necessary), and functional stability documentation when that is achieved. To confirm the long-term integrity and functionality of the cover system, routine inspection and geotechnical/material testing analysis will be required. Any destructive testing of the cover system membrane would occur with subsequent periodic reviews.

Compliance monitoring will be outlined in the Site-Wide Groundwater Compliance Monitoring Plan described in Task H of the SOW. Institutional controls, including access restrictions with fencing and warning signs, and property deed restrictions that prohibit unauthorized construction, limit excavation, and restrict groundwater use will be implemented as described in the Site-Wide Institutional Control Report described in Section 6.9 and Task G of the SOW.

6.2 Balefill and Inert Waste Areas/Burn Trench BT-1/Burn Trench BT-2

The selected action for the Balefill and Inert Waste Area generally aligns with Alternative BA-1 for the Balefill Area, with the exception of additions outlined in the SOW. The remedy for Burn Trench BT-1 aligns with Alternative BT-C and includes leaving waste in place, installation and maintenance of soil cover systems that will satisfy WAC 173-304 closure requirements, groundwater monitoring, and institutional controls. The action will consist of the following:

- Conducting test-pit evaluations and engineering surveys to provide pre- and post-cover installation topography, elevations, and approximate limits-of-waste determinations
- Decommissioning in-waste gas probes and thermocouples in the Balefill and Inert Waste Area
- Investigating the soil cover thicknesses and restoring the soil covers to a minimum of 30 inches
- Installing up to six soil gas monitoring probes as compliance points for methane gas control (WAC 173-351-200(4)) in the Balefill and Inert Waste Area
- Monitoring, maintenance, and reporting
- Demonstrating functional stability and transitioning to custodial care

The tasks, requirements, deliverables, and timing are detailed in the SOW. These include submitting a draft and final Soil Cover Investigation and Restoration EDR, executing the work in the EDR, submitting a draft and final Soil Cover Investigation and Restoration Completion Report, and a draft and final Functional Stability Report when functional stability is achieved at these areas.

Compliance monitoring at the Balefill, Inert Waste, and Burn Trench BT-1 areas will include surface, gas probe (WAC 173-351-200(4)), and groundwater monitoring, which will be outlined in the Site-Wide Groundwater Compliance Monitoring Plan described in Task H of the SOW. Gas compliance monitoring at Burn Trench BT-1 will include ongoing methane monitoring within the Landfill Shop building to confirm that applicable action levels are not exceeded. Institutional controls, including access restrictions with fencing and warning signs, and maintenance of property deed restrictions that prohibit unauthorized construction, limit excavation, and restrict groundwater use will be implemented as described in the Site-Wide Institutional Control Report described in Task H of the SOW.

Burn Trench BT-2 will require a verification assessment upon excavation of the Zone A wastes. The assessment will document the lateral limits of the BT-2 waste disposal area as informed by the Zone A excavation and the degree to which BT-2 wastes are impacted by Zone A contaminants. Some BT-2 wastes may need to be removed or isolated during the Zone A drum removal work should they be within the limits of ground disturbed by the Zone A construction activities. This includes large mechanically separable pieces of potentially combustible waste. MSW debris within the BT-2 trench that has not been impacted by Zone A industrial wastes (if any) may be closed in-place if these wastes will not create potential adverse consequences to the subsequent in-situ thermal treatment at Zone A. The final Zone A cover design may need to extend westward to cover the entire footprint of the BT-2 waste area, or BT-2 wastes will be relocated to be under the final Zone A cover.

6.3 Zone A

The selected action for Zone A combines alternatives A-6 and A-9 with additions and modifications outlined in the SOW. This section summarizes the remedy; the SOW has more detail regarding the tasks, requirements, deliverables, and timing. The action includes removal of all material, unless specifically excluded, to the agreed-upon vertical (base of waste) and lateral limits estimated to define the extent of industrial waste, illustrated in Exhibit C, Figure 1 (SOW). Drums, drum contents, free liquids, material that likely was sourced from a drum or other waste container, and potentially combustible material that is readily separable will be managed for offsite treatment and/or disposal. Materials may remain within the AOC cell to the extent they are not considered contaminated, are not expected to impact groundwater, or are determined to be acceptable for in-situ treatment supported by SVE.

In the event Ecology and the PLPs jointly determine, for any reason, that any material should not be placed back into Zone A, it will be transported offsite to an appropriate waste disposal facility (or facilities) permitted to accept the waste. All waste leaving the Site will be characterized to meet requirements for waste packaging, transport, treatment, and/or disposal at an acceptable facility.

Following waste removal, waste segregation, and backfilling of the Zone A excavation, the material within the lateral limit of Zone A, including the underlying native soil down to the water table, will be characterized per an Ecology-approved Sampling and Analysis Plan to inform in-situ treatment design and implementation. In-situ treatment technologies will be implemented for the contaminated media and mixed debris remaining within the footprint of Zone A. The treatment performance standards will be based on achieving and maintaining remediation levels that are protective of groundwater at the point of compliance and will be developed in the Post-Excavation EDR. The final remedy shall satisfy all RAOs. Following completion of any in-situ treatment, a low-permeability geomembrane will be installed over Zone A to control infiltration and limit direct contact with residual contaminants. No monitoring wells will be installed within the limits of the final cover system.

The completion of the Zone A remedy in a safe, controlled, and organized manner is paramount. Compliance Monitoring Plans will be developed for the excavation and post-excavation in-situ treatment work, and will include health and safety plans and performance monitoring plans. These plans must be developed and executed so that risk to the public (local community, nearby property owners, operators, and business patrons, etc.), onsite workers, and environmental receptors due to these cleanup actions is minimized.

The tasks, requirements, deliverables, and timing detailed in the SOW include:

- Submitting a draft and final Zone A Removal Action EDR
- Executing the work described in the final Removal Action EDR
- Submitting a draft and final Zone A Excavation, Removal, and Offsite Disposal Construction Completion Technical Memorandum
- Submitting a draft and final Zone A Post-Excavation EDR
- Executing the work described Final Post-Excavation EDR
- Submitting a draft and final Zone A Cleanup Action Completion Report
- Submitting a draft and final Zone A O&M Plan
- Executing the work described in the Final Zone A O&M Plan

Compliance monitoring, including groundwater monitoring, will be outlined in the Site-Wide Groundwater Compliance Monitoring Plan described in Task H of the SOW. Institutional controls, including access restrictions, fencing, and warning signs, and property deed restrictions that prohibit unauthorized construction, limit excavation, and restrict groundwater use will be implemented as described in the Site-Wide Institutional Control Report described in Section 6.9 and in Task G of the SOW.

6.4 Zones C/D

The selected action for Zones C/D aligns with Alternative CD-1 with the additions outlined in the SOW. The remedy includes leaving wastes in place, long-term monitoring and maintenance of the cover system installed in 2001, groundwater monitoring, and institutional controls.

The tasks, requirements, deliverables, and timing are detailed in the SOW. These include submitting a draft and final Zones C/D O&M Plan, executing the work described in the final O&M Plan, and cover repair or replacement (if necessary). To confirm the long-term integrity and functionality of the cover, routine inspection and geotechnical/material testing analysis will be required as described in the Final O&M Plan. Any destructive testing of cover system membrane materials would occur with subsequent periodic reviews.

Compliance monitoring, including groundwater monitoring, will be outlined in the Site-Wide Groundwater Compliance Monitoring Plan described in Task H of the SOW. Institutional controls, including access restrictions, fencing, and warning signs, and property deed restrictions that prohibit unauthorized construction, limit excavation, and restrict groundwater use will be implemented as described in the Site-Wide Institutional Control Report described in Section 6.9 and in Task G of the SOW.

6.5 Zone E

The selected action for Zone E aligns with Alternative E-1 with the additions outlined in the SOW. The remedy includes leaving wastes in place, long-term monitoring and maintenance of the cover system installed in 2001, groundwater monitoring, and institutional controls.

The tasks, requirements, deliverables, and timing are detailed in the SOW. These include submitting a draft and final Zone E O&M Plan, executing the work described in the final O&M Plan, and cover repair or replacement (if necessary). To confirm the long-term integrity and functionality of the cover system, routine inspection and geotechnical/material testing analysis will be required as described in the O&M Plan. Any destructive testing of cover system membrane materials would occur with subsequent periodic reviews.

Compliance monitoring, including groundwater monitoring, will be outlined in the Site-Wide Groundwater Compliance Monitoring Plan described in Task H of the SOW. Institutional controls, including access restrictions, fencing, and warning signs, and property deed restrictions that prohibit unauthorized construction, limit excavation, and restrict groundwater use will be implemented as described in the Site-Wide Institutional Control Report described in Section 6.9 and in Task G of the SOW.

6.6 Central Area Groundwater

The selected action for the Central Area Groundwater aligns with Alternative ONP-1 with the additions outlined in the SOW. The remedy would employ contingent remedial actions should groundwater quality conditions trigger the need for such actions.

The tasks, requirements, deliverables, and timing are detailed in the SOW. This includes routine groundwater monitoring as part of the Site-Wide Groundwater Compliance Monitoring Plan (Task H of the SOW). If groundwater monitoring indicates that action thresholds have been exceeded, the PLPs will prepare and execute a Post-Remedy Source Evaluation Work Plan, develop a technical memorandum describing the findings of the source evaluation work, and prepare an EDR that describes the proposed remedy for contamination source areas affecting groundwater quality.

Institutional controls, including access restrictions, fencing, and warning signs, and property deed restrictions that prohibit unauthorized construction, limit excavation, and restrict groundwater use will be implemented as described in the Site-Wide Institutional Control Report described in Section 6.9 and in Task G of the SOW.

6.7 Off-Property Groundwater

As described in Section 5.2.9, groundwater quality conditions in off-property areas of the Site have continued to improve measurably over time in response to on-property interim cleanup actions implemented since 2001. As groundwater passes beneath the landfill property and flows toward its discharge point of the Columbia River, landfill-sourced contaminants within the groundwater plume may experience contaminant reduction due to natural attenuation. Existing contaminant concentrations are below the final CULs in Section 5. For this reason, detailed verification of natural attenuation is required, although the final remedy will include groundwater monitoring in accordance with the Site-Wide Groundwater Compliance Monitoring Plan (SOW Task H). Current and accurate access agreements shall be maintained for each groundwater monitoring well and residential well not located within property owned by Pasco Sanitary Landfill, Inc. The City of Pasco GPA will be maintained as described in Section 6.9.

6.8 Institutional controls

Institutional controls limit or prohibit activities that may interfere with the integrity of a cleanup action or result in exposure to hazardous substances at the Site. Such measures assure the continued protection of human health and the environment and the integrity of the cleanup action whenever hazardous substances remain at the Site at concentrations exceeding CULs. Institutional controls can include physical measures and legal and administrative mechanisms. WAC 173-340-440 covers institutional controls and the conditions under which they may be removed.

As described in the SOW, institutional controls will be identified and implemented as part of the area-specific O&M Plans and documented in the Site-Wide Institutional Controls Report (Task G of the SOW). As described in the SOW, the environmental covenant (Uniform Environmental Covenants Act, Chapter 64.70 RCW) shall be developed as part of the Zone A Cleanup Action Completion Report and executed by the property owner on the schedule described in the CD Scope of Work.

The City of Pasco GPA restricts domestic consumptive use of local groundwater and will remain in place after implementation of the final cleanup remedy and until post-remedy groundwater performance objectives have been met, including attainment of groundwater CULs. Ecology will provide input and recommendations to the City of Pasco about terminating the GPA ordinance, based on assessment of groundwater quality conditions and trends. This input likely will be provided during post-remedy periodic reviews.

6.9 Financial assurance

WAC 173-340-440 states that financial assurance shall be required at sites where the cleanup action includes engineered and/or institutional controls. Financial assurance is required at this Site because institutional controls will be used to assure protection of human health and the environment. Financial assurance shall be of sufficient amount to cover all costs associated with the operation and maintenance of the cleanup action, including institutional controls, compliance monitoring and corrective measures. Financial assurance requirements are further described in Section VI of the CD.

6.10 Periodic review

As long as CULs have not been achieved, WAC 173-340-420 states that at sites where a cleanup action requires an institutional control, a periodic review shall be completed every five years after the initiation of a cleanup action. Periodic reviews will be required at this Site because institutional controls are a required part of the remedy. Periodic reviews will follow the review criteria described in WAC 173-340-420(4). This includes, but is not limited to, reviewing compliance monitoring results and overall compliance with Site CULs. As part of the periodic review and assessment of remedy effectiveness, Ecology may recommend changes to the compliance monitoring program.

Periodic review written reports will be published every five years, informed by the PLP-generated Progress Reports and Groundwater Monitoring Reports (see tasks H and I of Exhibit B to the CD). Periodic reviews will be required at this Site as long as institutional controls are a required and are further described in Section XXIII of the CD.

7 References

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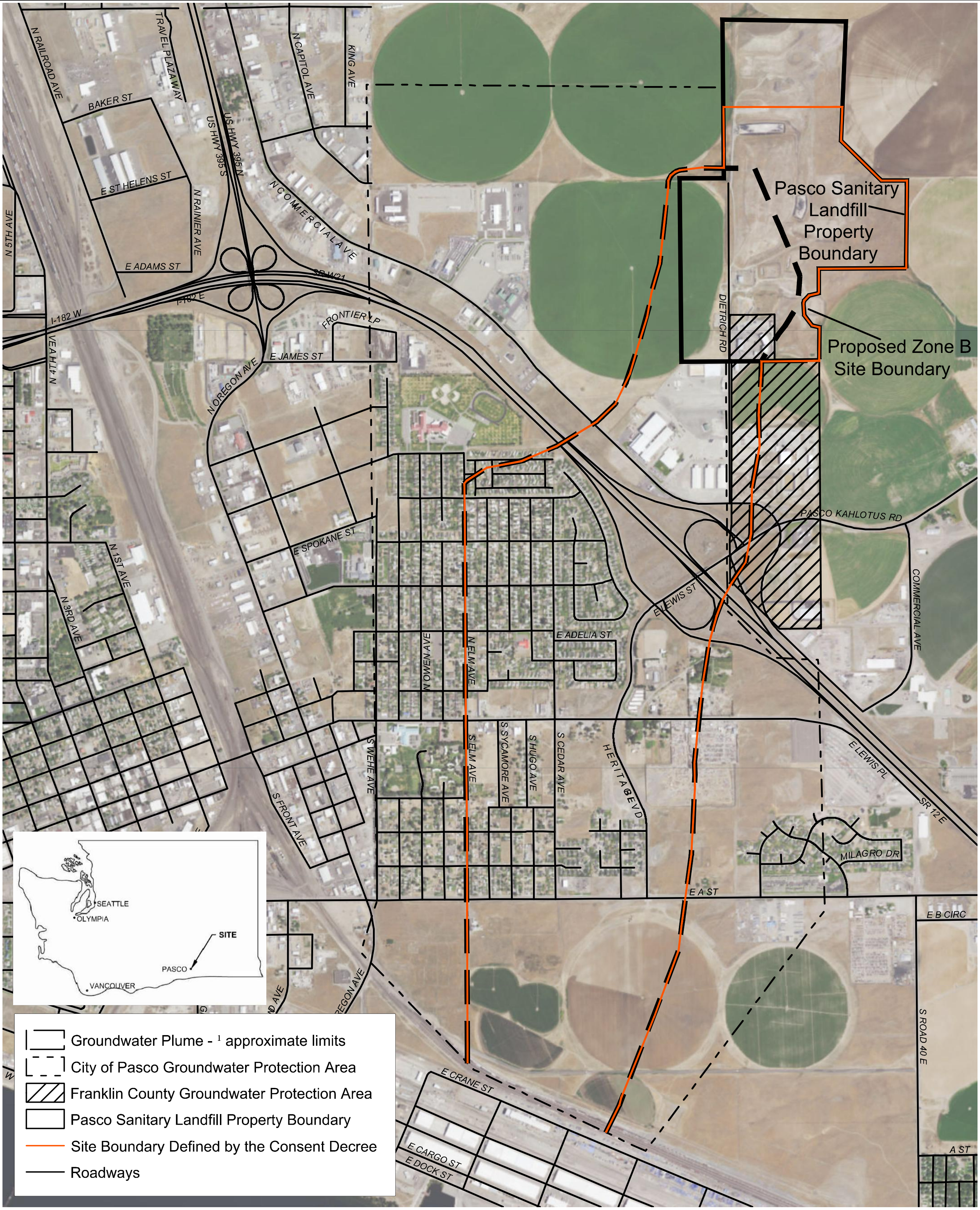

NOTES:

1. THE SITE ENCOMPASSES BOTH THE LANDFILL PROPERTY AS WELL AS THE OFF-SITE GROUNDWATER PLUME AREA. LANDFILL CONTAMINANTS ARE PRESENT AND DETECTABLE IN OFF-PROPERTY GROUNDWATER AT CONCENTRATIONS THAT HAVE REMAINED BELOW THE EXISTING SITE CLEANUP LEVELS.
2. ORIGINAL FIGURE SOURCE: IWAG 2017 FFS REPORT. FIGURE MODIFIED BY PBS.

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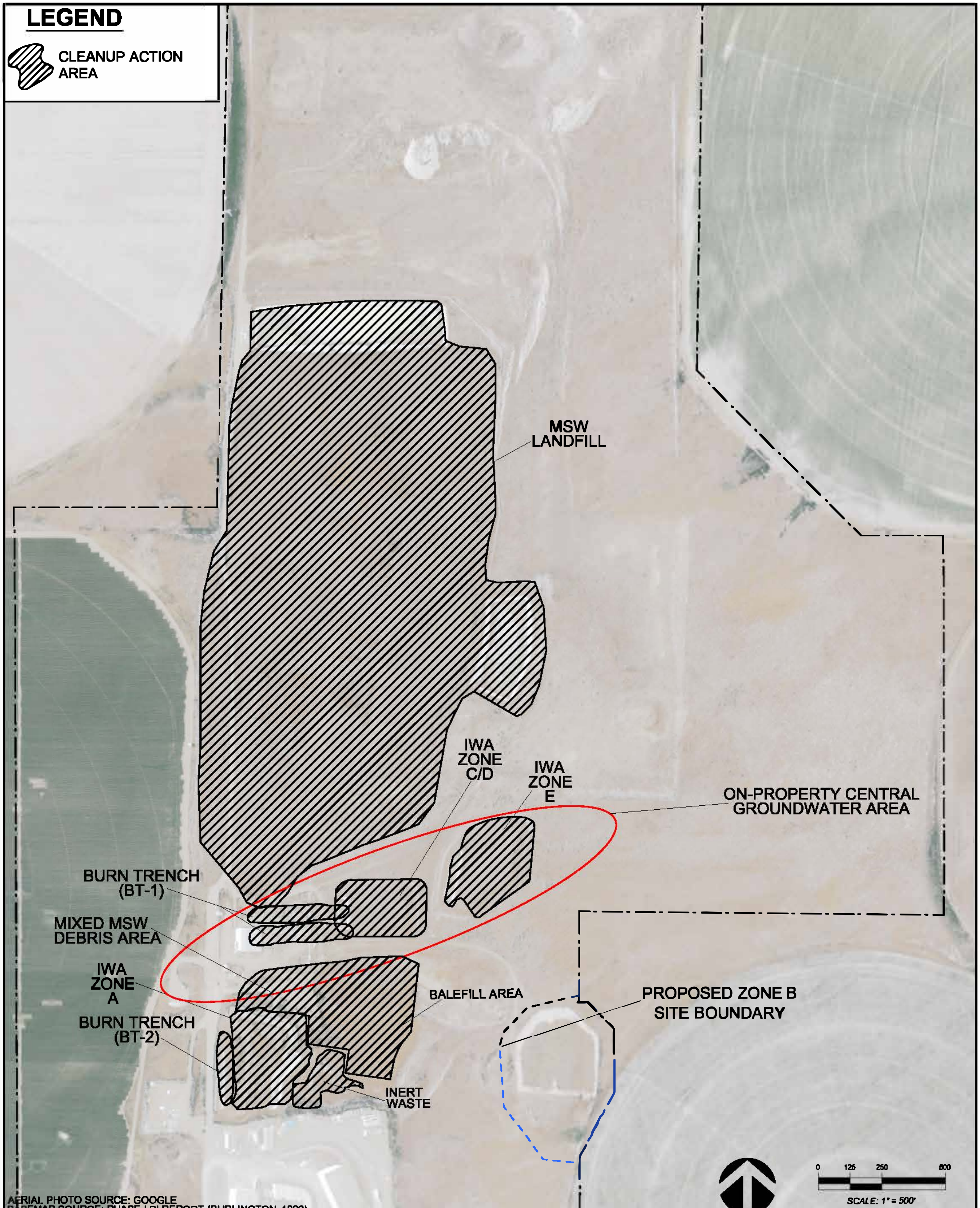
SITE MAP
PASCO SANITARY LANDFILL NPL SITE
PASCO, WA

PROJECT:	64180
DATE:	JULY 2019

FIG. 1



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SITE-WIDE CLEANUP ACTION AREAS
PASCO LANDFILL
PROPERTY

PROJECT:	64180
DATE:	JULY 2019
FIG:	2

TABLE 1. GROUNDWATER CRITERIA UNDER WAC 173-340-720(4)(b)(i) AND (iii)

CONTAMINANT	WAC 173-340-720(4)(b)(i) POTABLE GROUNDWATER ARARS Federal MCL, ug/L	State MCL, ug/L	Federal MCL Goal, ug/L	MTCA Cancer Risk @ at MCL	MTCA HQ @ MCL	Protective?	MCL adjusted to cancer risk of 1X10^{-5} or hazard quotient of 1, ug/L	WAC 173-230-720(4)(b)(iii) MTCA METHOD B FORMULA, ug/L Carcinogen	Noncarcinogen	Ground Water Screening Levels, ug/L	Basis
VOCs											
Acetone	NR	NR	NR					NR	7200	**7200**	Method B, Noncarcinogen
Acrolein	NR	NR	NR					NR	4	**4**	Method B, Noncarcinogen
Acrylonitrile	NR	NR	NR					0.081	320	**0.081**	Method B, Carcinogen
Benzene	5	5	0	6.29E-06	0.156	YES		0.795	32	**5**	MCL
Bromodichloromethane	80	0.3	0	4.25E-07	0.002	YES		0.706	160	**0.3**	State MCL
Bromoform (Tribromomethane)	80	80	0	1.44E-05	0.500	NO	55.4	5.54	160	**55.4**	MCL adjusted to 1x10-5 cancer risk
Bromomethane (Methyl Bromide)	NR	NR	NR					NR	11.2	**11.2**	Method B, Noncarcinogen
2-butanone	NR	NR	NR					NR	4800	**4800**	Method B, Noncarcinogen
Carbon disulfide	NR	NR	NR					NR	800	**800**	Method B, Noncarcinogen
Carbon tetrachloride	5	5	0	8.00E-06	0.156	YES		0.625	32	**5**	MCL
Chlorobenzene	100	100	100		0.625	YES		NR	160	**100**	MCL/MCLG
Chloroform	80	80	70	5.67E-05	1.000	NO	14.1	1.41	80	**14.1**	MCL adjusted to 1x10-5 cancer risk
2-Chlorotoluene	NR	NR	NR					NR	160	**160**	Method B, Noncarcinogen
1,2-Dibromo-3-chloropropane	0.2	0.2	0	3.66E-06	0.125	NO	0.547	0.0547	1.6	**0.547**	MCL adjusted to 1x10-5 cancer risk
Dibromochloromethane	80	80	60	1.54E-04	0.500	NO	5.21	0.521	160	**5.21**	MCL adjusted to 1x10-5 cancer risk

TABLE 1. GROUNDWATER CRITERIA UNDER WAC 173-340-720(4)(b)(i) AND (iii)

CONTAMINANT	WAC 173-340-720(4)(b)(i) POTABLE GROUNDWATER ARARS Federal MCL, ug/L	State MCL, ug/L	Federal MCL Goal, ug/L	MTCA Cancer Risk @ at MCL	MTCA HQ @ MCL	Protective?	MCL adjusted to cancer risk of $1X10^{-5}$ or hazard quotient of 1, ug/L	WAC 173-230-720(4)(b)(iii) MTCA METHOD B FORMULA, ug/L Carcinogen	Noncarcinogen	Ground Water Screening Levels, ug/L	Basis
1,2-Dibromoethane	0.05	0.05	0	2.28E-06	0.001	YES		0.0219	72	**0.05**	MCL
Dibromomethane	NR	NR	NR					NR	80	**80**	Method B, Noncarcinogen
Dichlorodifluoromethane	NR	NR	NR					NR	1600	**1600**	Method B, Noncarcinogen
1,1-Dichloroethane	NR	NR	NR					7.68	1600	**7.68**	Method B, Carcinogen
1,2-Dichloroethane	5	5	0	1.04E-05	0.104	NO	4.81	0.481	48	**4.81**	MCL adjusted to 1 x10-5 cancer risk
1,1-Dichloroethene	7	7	7		0.018	YES		NR	400	**7**	MCL
1,2-Dichloroethene	NR	NR	NR					NR	72	**72**	Method B, Noncarcinogen
cis-1,2-Dichloroethene	70	70	70		4.375	NO	16	NR	16	**16**	MCL adjusted to hazard quotient of 1
trans-1,2-Dichloroethene	100	100	100		0.625	YES		NR	160	**100**	MCL/MCLG
1,2-Dichloropropane	5	5	0	4.10E-06		YES		1.22	720	**5**	MCL
cis-1,3-Dichloropropene	NR	NR	NR					0.438	240	**0.438**	Method B, Carcinogen
trans-1,3-Dichloropropene	NR	NR	NR					0.438	240	**0.438**	Method B, Carcinogen
1,4-Dioxane	NR	NR	NR					0.438	240	**0.438**	Method B, Carcinogen
Ethylbenzene	700	700	700		0.875	YES		NR	800	**700**	MCL
Hexachlorobutadiene	NR	NR	NR					0.561	8	**0.561**	Method B, Carcinogen
Isopropylbenzene	NR	NR	NR					NR	800	**800**	Method B, Noncarcinogen

TABLE 1. GROUNDWATER CRITERIA UNDER WAC 173-340-720(4)(b)(i) AND (iii)

CONTAMINANT	WAC 173-340-720(4)(b)(i)							WAC 173-230-720(4)(b)(iii)		Ground Water Screening Levels, ug/L	
	POTABLE GROUNDWATER ARARS			MTCA Cancer Risk @ at MCL	MTCA HQ @ MCL	Protective?	MCL adjusted to cancer risk of 1X10^{-5} or hazard quotient of 1, ug/L	MTCA METHOD B FORMULA, ug/L			
	Federal MCL, ug/L	State MCL, ug/L	Federal MCL Goal, ug/L					Carcinogen	Noncarcinogen		Basis
Methyl ethyl ketone	NR	NR	NR					NR	4800	**4800**	Method B, Noncarcinogen
Methyl isobutyl ketone	NR	NR	NR					NR	640	**640**	Method B, Noncarcinogen
Methylene chloride	5	5	0	2.28E-07	0.104	YES		21.9	48	**5**	MCL
n-Propylbenzene	NR	NR	NR					NR	800	**800**	Method B, Noncarcinogen
Styrene	100	100	100		0.063	YES		NR	1600	**100**	MCL
1,1,1,2-Tetrachloroethane	NR	NR	NR					1.68	240	**1.68**	Method B, Carcinogen
1,1,2,2-Tetrachloroethane	NR	NR	NR					0.219	160	**0.219**	Method B, Carcinogen
Tetrachloroethene	5	5	0	2.40E-07	0.104	YES		20.8	48	**5**	MCL
Toluene	1000	1000	1000		1.563	NO	640	NR	640	**640**	MCL/MCLG adjusted to hazard quotient of 1
1,1,1-Trichloroethane	200	200	200		0.125	YES		NR	1600	**200**	MCL/MCLG
1,1,2-Trichloroethane	5	5	3	6.51E-06	0.156	YES		0.768	32	**5**	MCL
Trichloroethene	5	5	0	9.26E-06	1.250	NO	4	0.54	4	**4**	MCL adjusted to hazard quotient of 1
1,2,3-Trichloropropane	NR	NR	NR					0.00146	32	**0.00146**	Method B, Carcinogen
1,1,2-Trichlorotrifluoroethane	NR	NR	NR					NR	24000	**24000**	Method B, Noncarcinogen
Trichlorofluoromethane	NR	NR	NR					NR	2400	**2400**	Method B, Noncarcinogen
1,3,5-Trimethylbenzene	NR	NR	NR					NR	80	**80**	Method B, Noncarcinogen

TABLE 1. GROUNDWATER CRITERIA UNDER WAC 173-340-720(4)(b)(i) AND (iii)

CONTAMINANT	WAC 173-340-720(4)(b)(i)							WAC 173-230-720(4)(b)(iii)		Ground Water Screening Levels, ug/L	
	POTABLE GROUNDWATER ARARS			MTCA Cancer Risk @ at MCL	MTCA HQ @ MCL	Protective?	MCL adjusted to cancer risk of $1X10^{-5}$ or hazard quotient of 1, ug/L	MTCA METHOD B FORMULA, ug/L			
	Federal MCL, ug/L	State MCL, ug/L	Federal MCL Goal, ug/L					Carcinogen	Noncarcinogen		Basis
Vinyl acetate	NR	NR	NR					NR	8000	**800**	Method B, Noncarcinogen
Vinyl chloride	2	2	0	6.90E-05	0.083	NO	0.29	0.029	24	**0.29**	MCL adjusted to 1x10-5 cancer risk
Total Xylenes	10000	10000	10000					NR	1600	**1600**	Method B, Noncarcinogen
m,p-Xylene	NR	NR	NR					NR	1600	**1600**	Method B, Noncarcinogen
o-Xylene	NR	NR	NR					NR	1600	**1600**	Method B, Noncarcinogen
SVOCs											
Aniline	NR	NR	NR					7.68	56	**7.68**	Method B, Carcinogen
Azobenzene	NR	NR	NR					0.795	NR	**0.795**	Method B, Carcinogen
Benzoic acid	NR	NR	NR					NR	64000	**64000**	Method B, Noncarcinogen
Benzyl alcohol	NR	NR	NR					NR	800	**800**	Method B, Noncarcinogen
bis(2-Chloroethyl)ether	NR	NR	NR					0.0398	NR	**0.0398**	Method B, Carcinogen
Bis(2-Ethylhexyl)phthalate	6	6	0	9.60E-07	0.019	YES		6.25	320	**6**	MCL
Butyl benzyl phthalate	NR	NR	NR					4.61	3200	**4.61**	Method B, Carcinogen
4-Chloroaniline	NR	NR	NR					0.219	32	**0.219**	Method B, Carcinogen
2-Chloronaphthalene	NR	NR	NR					NR	640	**640**	Method B, Noncarcinogen

TABLE 1. GROUNDWATER CRITERIA UNDER WAC 173-340-720(4)(b)(i) AND (iii)

CONTAMINANT	WAC 173-340-720(4)(b)(i) POTABLE GROUNDWATER ARARS Federal MCL, ug/L	State MCL, ug/L	Federal MCL Goal, ug/L	MTCA Cancer Risk @ at MCL	MTCA HQ @ MCL	Protective?	MCL adjusted to cancer risk of 1X10^{-5} or hazard quotient of 1, ug/L	WAC 173-230-720(4)(b)(iii) MTCA METHOD B FORMULA, ug/L Carcinogen	Noncarcinogen	Ground Water Screening Levels, ug/L	Basis
2-Chlorophenol	NR	NR	NR					NR	40	**40**	Method B, Noncarcinogen
Dibenzofuran	NR	NR	NR					NR	16	**16**	Method B, Noncarcinogen
3-3'-Dichlorobenzidine	NR	NR	NR					0.194	NR	**0.194**	Method B, Carcinogen
2,4-Dichlorophenol	NR	NR	NR					NR	24	**24**	Method B, Noncarcinogen
Diethyl phthalate	NR	NR	NR					NR	12800	**12800**	Method B, Noncarcinogen
2,4-Dimethylphenol	NR	NR	NR					NR	160	**160**	Method B, Noncarcinogen
2,4-Dinitrophenol	NR	NR	NR					NR	32	**32**	Method B, Noncarcinogen
Di-n-butylphthalate	NR	NR	NR					NR	1600	**1600**	Method B, Noncarcinogen
2,4-Dinitrotoluene	NR	NR	NR					0.282	32	**0.282**	Method B, Carcinogen
2,6-Dinitrotoluene	NR	NR	NR					0.0583	4.8	**0.0583**	Method B, Carcinogen
Hexachlorobenzene	1	1	0	1.83E-05	0.078	YES	0.547	0.0547	12.8	**0.547**	MCL adjusted to 1x10-5 cancer risk
Hexachlorocyclopentadiene	50	50	50		1.042	NO	48	NR	48	**48**	MCL/MCLG adjusted to hazard quotient of 1
Hexachloroethane	NR	NR	NR					1.09	5.6	**1.09**	Method B, Carcinogen
Isophorone	NR	NR	NR					46.1	1600	**46.1**	Method B, Carcinogen
2-Methylphenol (O-Cresol)	NR	NR	NR					NR	400	**400**	Method B, Noncarcinogen
2-Nitroaniline	NR	NR	NR					NR	160	**160**	Method B, Noncarcinogen

TABLE 1. GROUNDWATER CRITERIA UNDER WAC 173-340-720(4)(b)(i) AND (iii)

CONTAMINANT	WAC 173-340-720(4)(b)(i)							WAC 173-230-720(4)(b)(iii)		Ground Water Screening Levels, ug/L	
	POTABLE GROUNDWATER ARARS			MTCA Cancer Risk @ at MCL	MTCA HQ @ MCL	Protective?	MCL adjusted to cancer risk of $1X10^{-5}$ or hazard quotient of 1, ug/L	MTCA METHOD B FORMULA, ug/L			
	Federal MCL, ug/L	State MCL, ug/L	Federal MCL Goal, ug/L					Carcinogen	Noncarcinogen		Basis
Nitrobenzene	NR	NR	NR					NR	16	**16**	Method B, Noncarcinogen
N-Nitrosodimethylamine	NR	NR	NR					0.000858	0.064	**0.000858**	Method B, Carcinogen
Pentachlorophenol	1	1	0	4.57E-06	0.013	NO		0.219	80	**1**	MCL
Phenol	NR	NR	NR					NR	2400	**2400**	Method B, Noncarcinogen
Pyridine	NR	NR	NR					NR	8	**8**	Method B, Noncarcinogen
2,3,4,6-Tetrachlorophenol	NR	NR	NR					NR	480	**480**	Method B, Noncarcinogen
1,2,4-Trichlorobenzene	70	70	70	4.64E-05	0.875	NO	15.1	1.51	80	**15.1**	MCL adjusted to 1x10-5 cancer risk
2,4,5-Trichlorophenol	NR	NR	NR					NR	800	**800**	Method B, Noncarcinogen
2,4,6-Trichlorophenol	NR	NR	NR					3.98	8	**3.98**	Method B, Carcinogen
PESTICIDES/HERBICIDES											
2,4,5-TP	50	50	50		0.391	YES		NR	128	**50**	MCL/MCLG
2,2-Dichloropropionic Acid (Dala	200	200	200		0.833	YES		NR	240	**200**	MCL/MCLG
2,4,-D	70	70	70		0.438	YES		NR	160	**70**	MCL/MCLG
2,4-DB	NR	NR	NR					NR	128	**128**	Method B, Noncarcinogen

TABLE 1. GROUNDWATER CRITERIA UNDER WAC 173-340-720(4)(b)(i) AND (iii)

CONTAMINANT	WAC 173-340-720(4)(b)(i) POTABLE GROUNDWATER ARARS: Federal MCL, ug/L	State MCL, ug/L	Federal MCL Goal, ug/L	MTCA Cancer Risk @ at MCL	MTCA HQ @ MCL	Protective?	MCL adjusted to cancer risk of $1X10^{-5}$ or hazard quotient of 1, ug/L	WAC 173-230-720(4)(b)(iii) MTCA METHOD B FORMULA, ug/L: Carcinogen	Noncarcinogen	Ground Water Screening Levels, ug/L	Basis
Dicamba	NR	NR	NR					NR	480	**480**	Method B, Noncarcinogen
MCPA	NR	NR	NR					NR	8	**8**	Method B, Noncarcinogen
Mecoprop (MCPP)	NR	NR	NR					NR	16	**16**	Method B, Noncarcinogen
PAHs											
1-Methylnaphthalene	NR	NR	NR					1.51	560	**1.51**	Method B, Carcinogen
2-Methylnaphthalene	NR	NR	NR					NR	32	**32**	Method B, Noncarcinogen
Acenaphthene	NR	NR	NR					NR	960	**960**	Method B, Noncarcinogen
Anthracene	NR	NR	NR					NR	4800	**4800**	Method B, Noncarcinogen
Benzo(a)anthracene	NR	NR	NR					0.12	NR	**0.12**	Method B, Carcinogen
Benzo(a)pyrene	0.2	0.2	0	1.67E-05		NO	0.12	0.012	NR	**0.12**	MCL adjusted to 1x10-5 cancer risk
Benzo(b)fluoranthene	NR	NR	NR					0.12	NR	**0.12**	Method B, Carcinogen
Benzo(k)fluoranthene	NR	NR	NR					1.2	NR	**1.2**	Method B, Carcinogen
Chrysene	NR	NR	NR					12	NR	**12**	Method B, Carcinogen
Dibenzo(a,h)anthracene	NR	NR	NR					0.012	NR	**0.012**	Method B, Carcinogen
Fluoranthene	NR	NR	NR					NR	640	**640**	Method B, Noncarcinogen

TABLE 1. GROUNDWATER CRITERIA UNDER WAC 173-340-720(4)(b)(i) AND (iii)

CONTAMINANT	WAC 173-340-720(4)(b)(i)							WAC 173-230-720(4)(b)(iii)			
	POTABLE GROUNDWATER ARARS			MTCA Cancer Risk @ at MCL	MTCA HQ @ MCL	Protective?	MCL adjusted to cancer risk of 1X10^{-5} or hazard quotient of 1, ug/L	MTCA METHOD B FORMULA, ug/L		Ground Water Screening Levels, ug/L	
	Federal MCL, ug/L	State MCL, ug/L	Federal MCL Goal, ug/L					Carcinogen	Noncarcinogen		Basis
Fluorene	NR	NR	NR					NR	640	**640**	Method B, Noncarcinogen
Indeno(1,2,3-c,d)pyrene	NR	NR	NR					0.12	NR	**0.12**	Method B, Carcinogen
Naphthalene	NR	NR	NR					NR	160	**160**	Method B, Noncarcinogen
Pyrene	NR	NR	NR					NR	480	**480**	Method B, Noncarcinogen
METALS											
Antimony	6	6	6		0.938	YES		NR	6.4	**6**	MCL/MCLG
Arsenic	10	10	0	1.72E-04	2.083	NO	0.583	0.0583	4.8	**0.583**	MCL adjusted to 1x10-5 cancer risk
Barium	2000	2000	2000		0.625	YES		NR	3200	**200**	MCL/MCLG
Berryllium	4	4	4		0.125	YES		NR	32	**4**	MCL/MCLG
Cadmium	5	5	5		0.625	YES		NR	8	**8**	MCL/MCLG
Total Chromium	100	100	100					NR	NR	**100**	MCL/MCLG
Chromium VI	NR	100	100		2.083	NO	48	NR	48	**48**	MCL/MCLG adjusted to hazard quotient of 1
Copper	1300	1300	1300		2.031	NO	640	NR	640	**640**	MCL/MCLG adjusted to hazard quotient of 1
Iron	NR	NR	NR					NR	11200	**11200**	Method B, Noncarcinogen
Lead	15	15	0					NR	NR	**15**	MCL

TABLE 1. GROUNDWATER CRITERIA UNDER WAC 173-340-720(4)(b)(i) AND (iii)

CONTAMINANT	WAC 173-340-720(4)(b)(i) POTABLE GROUNDWATER ARARS Federal MCL, ug/L	State MCL, ug/L	Federal MCL Goal, ug/L	MTCA Cancer Risk @ at MCL	MTCA HQ @ MCL	Protective?	MCL adjusted to cancer risk of $1X10^{-5}$ or hazard quotient of 1, ug/L	WAC 173-230-720(4)(b)(iii) MTCA METHOD B FORMULA, ug/L Carcinogen	Noncarcinogen	Ground Water Screening Levels, ug/L	Basis
Manganese	NR	NR	NR					NR	2240	**2240**	Method B, Noncarcinogen
Nickel	ND	100	NR		0.31250	YES		NR	320	**100**	State MCL
Selenium	50	50	50		0.62500	YES		NR	80	**50**	MCL
Silver	NR	NR	NR					NR	80	**80**	Method B, Noncarcinogen
Thallium	2	2	0.5		12.50000	NO	0.16	NR	0.16	**0.16**	MCL/MCLG adjusted to hazard quotient of 1
Vanadium	NR	NR	NR					NR	80	**80**	Method B, Noncarcinogen
Zinc	NR	NR	NR					NR	4800	**4800**	Method B, Noncarcinogen

Yellow	Not protective - Exceeds 1x10-5 cancer risk and/or Hazard Quotient of 1
Green	Method B Formula values not applicable because existing ARAR is protective of was adjusted to be protective
Orange	State MCL was lowest applicable ARAR

TABLE 2. SURFACE WATER CRITERIA UNDER WAC 173-340-720(4)(b)(ii) AND 173-340-730(2)(b)

CONTAMINANT	SURFACE WATER ARARS								Lowest Surface Water ARAR	Cancer Risk @ Lowest ARAR	HQ @ Lowest ARAR	Is ARAR protective?	ARAR Adjusted to cancer risk of 1 x 10^{-5} or hazard quotient of 1	MTCA METHOD B FORMULA, ug/L		Surface Water Protection Criteria, ug/L	
	AQUATIC LIFE						HUMAN HEALTH										
	Ch. 173-201A, ug/L		CWA Section 304, ug/L		NTR (40 CFR 131), ug/L		CWA Section 304, ug/L	NTR (40 CFR131), ug/L									
	Acute	Chronic	Acute	Chronic	Acute	Chronic								Carcinogen	Noncarcinogen		Basis
VOCs																	
Benzene	NR	NR	NR	NR	NR	NR	2.2	1.2	1.2	6.03E-10	0.053	YES		1990	22.7	1.2	Human Health - NTR
1,2-Dichloroethane	NR	NR	NR	NR	NR	NR	0.38	0.38	0.38	6.397E-09	3E-05	YES		59.4	13000	0.38	Human Health - CWA, NTR
1,1-Dichloroethene	NR	NR	NR	NR	NR	NR	330	0.057	0.057	NA	2E-06	YES		NR	23100	0.057	Human Health - NTR
Tetrachloroethene	NR	NR	NR	NR	NR	NR	0.69	0.8	0.69	6.928E-09	0.001	YES		99.6	502	0.69	Human Health - CWA
Trichloroethene	NR	NR	NR	NR	NR	NR	2.5	2.7	2.5	1.953E-07	0.212	YES		12.8	11.8	2.5	Human Health - CWA
	Method B Formula values not applicable because existing ARAR is protective of was adjusted to be protective																
	*Note: Only contaminants that had reached the groundwater monitoring wells closest to the Columbia River require Surface Water Protection Criteria																

TABLE 3. SCREENING FOR GROUNDWATER INDICATORS

CONTAMINANT	Screening Criteria, ug/L			IHS Analysis					INDICATOR?	
	Protection of Ground Water	Protection of Surface Water	Back-ground	No. of Samples	No of Detections	Frequency of Detection (%)	Maximum Concentration Detected, ug/L	No. of samples Exceeding Criteria		Data Source
VOCs										
Acetone	7200			4901	118	2.4%	20000	1	No	All data collected up to FFS
Acrolein	4			918	0	0.0%		0	No	All data collected up to FFS
Acrylonitrile	0.081			919	7	0.8%	0.85	3	No	All data collected up to FFS
Benzene	5			5386	292	5.4%	51	86	**Yes**	All data collected up to FFS
Bromodichloromethane	0.3			4901	0	0.0%		0	No	All data collected up to FFS
Bromoform (Tribromomethane	55.4			4901	2	0.0%	0.807	0	No	All data collected up to FFS
Bromomethane (Methyl Bromi	11.2			4901	2	0.0%	1.7	0	No	All data collected up to FFS
2-butanone	4800			4915	52	1.1%	38000	2	No	All data collected up to FFS
Carbon disulfide	800			4901	67	1.4%	22	0	No	All data collected up to FFS
Carbon tetrachloride	5			3458	32	0.9%	83	5	No	All data collected up to FFS
Chlorobenzene	100			4908	44	0.9%	5	0	No	All data collected up to FFS
Chloroform	14.1			3460	366	10.6%	86	42	No	All data collected up to FFS
2-Chlorotoluene	160			4315	1	0.0%	2	0	No	All data collected up to FFS
1,2-Dibromo-3-chloropropane	0.547			4860	0	0.0%		0	No	All data collected up to FFS
Dibromochloromethane	5.21			4899	2	0.0%	16	2	No	All data collected up to FFS
1,2-Dibromoethane	0.05			4921	1	0.0%	0.021	0	No	All data collected up to FFS
Dibromomethane	80			4858	1	0.0%	13	0	No	All data collected up to FFS
Dichlorodifluoromethane	1600			1412	83	5.9%	103	0	No	All data collected up to FFS
1,1-Dichloroethane	7.68			3470	1031	29.7%	830	326	**Yes**	All data collected up to FFS
1,2-Dichloroethane		0.38		5329	1493	28.0%	460	1220	**Yes**	All data collected up to FFS
1,1-Dichloroethene		0.057		6249	1065	17.0%	250	845	**Yes**	All data collected up to FFS
1,2-Dichloroethene	72			41	7	17.1%	170	3	No	All data collected up to FFS
cis-1,2-Dichloroethene	16			4887	2046	41.9%	3200	648	**Yes**	All data collected up to FFS
trans-1,2-Dichloroethene	100			3436	125	3.6%	110	1	No	All data collected up to FFS
1,2-Dichloropropane	5			3460	91	2.6%	1.7	0	No	All data collected up to FFS
cis-1,3-Dichloropropene	0.438			3460	5	0.1%	1.2	5	No	All data collected up to FFS
trans-1,3-Dichloropropene	0.438			3460	1	0.0%	33	1	No	All data collected up to FFS
1,4-Dioxane	0.438			11	0	0.0%		0	No	All data collected up to FFS
Ethylbenzene	700			4904	149	3.0%	2070	1	No	All data collected up to FFS
Hexachlorobutadiene	0.561			4811	2	0.0%	1	1	No	All data collected up to FFS
Isopropylbenzene	800			4316	59	1.4%	11	0	No	All data collected up to FFS
Methyl ethyl ketone	4800			3474	44	1.3%	6500	1	No	All data collected up to FFS
Methyl isobutyl ketone	640			4915	48	1.0%	1300	2	No	All data collected up to FFS
Methylene chloride	5			4901	237	4.8%	360	103	**Yes**	All data collected up to FFS
n-Propylbenzene	800			4316	80	1.9%	26	0	No	All data collected up to FFS
Styrene	100			4901	19	0.4%	46	0	No	All data collected up to FFS
1,1,1,2-Tetrachloroethane	1.68			4857	1	0.0%	0.11	0	No	All data collected up to FFS
1,1,2,2-Tetrachloroethane	0.219			4945	5	0.1%	0.251	1	No	All data collected up to FFS
Tetrachloroethene		0.69		5544	1743	31.4%	74	969	**Yes**	All data collected up to FFS
Toluene	640			4919	225	4.6%	3400	38	**Yes**	All data collected up to FFS
1,1,1-Trichloroethane	200			4927	710	14.4%	950	25	**Yes**	All data collected up to FFS
1,1,2-Trichloroethane	5			4901	169	3.4%	9	4	No	All data collected up to FFS
Trichloroethene		2.5		5520	2392	43.3%	280	937	**Yes**	All data collected up to FFS
1,2,3-Trichloropropane	0.00146			4857	2	0.0%	6.6	2	No	All data collected up to FFS
1,1,2-Trichlorotrifluoroethane	24000			44	15	34.1%	1440	0	No	All data collected up to FFS
Trichlorofluoromethane	2400			4860	111	2.3%	47	0	No	All data collected up to FFS
1,3,5-Trimethylbenzene	80			4316	105	2.4%	63	0	No	All data collected up to FFS
Vinyl acetate	800			1534	1	0.1%	0.054	0	No	All data collected up to FFS
Vinyl chloride	0.29			6367	693	10.9%	31	209	**Yes**	All data collected up to FFS
Total Xylenes	1600			3424	141	4.1%	1500	0	No	All data collected up to FFS
m,p-Xylene	1600			47	1	2.1%	8	0	No	All data collected up to FFS
o-Xylene	1600			4877	203	4.2%	540	0	No	All data collected up to FFS
SVOCs										
Aniline	7.68			228	0	0.0%		0	No	All data collected up to FFS
Azobenzene	0.795			26	0	0.0%		0	No	All data collected up to FFS
Benzoic acid	64000			228	2	0.9%	30.5	0	No	All data collected up to FFS
Benzyl alcohol	800			228	1	0.4%	12.2	0	No	All data collected up to FFS

TABLE 3. SCREENING FOR GROUNDWATER INDICATORS

CONTAMINANT	Screening Criteria, ug/L			IHS Analysis					INDICATOR?	
	Protection of Ground Water	Protection of Surface Water	Back-ground	No. of Samples	No of Detections	Frequency of Detection (%)	Maximum Concentration Detected, ug/L	No. of samples Exceeding Criteria		Data Source
bis(2-Chloroethyl)ether	0.0398			254	0	0.0%		0	No	All data collected up to FFS
Bis(2-Ethylhexyl)phthalate	6			228	1	0.4%	138	1	No	All data collected up to FFS
Butyl benzyl phthalate	4.61			228	0	0.0%		0	No	All data collected up to FFS
4-Chloroaniline	0.219			228	0	0.0%		0	No	All data collected up to FFS
2-Chloronaphthalene	640			228	0	0.0%		0	No	All data collected up to FFS
2-Chlorophenol	40			228	0	0.0%		0	No	All data collected up to FFS
Dibenzofuran	16			228	0	0.0%		0	No	All data collected up to FFS
3-3'-Dichlorobenzidine	0.194			202	0	0.0%		0	No	All data collected up to FFS
2,4-Dichlorophenol	24			228	0	0.0%		0	No	All data collected up to FFS
Diethyl phthalate	12800			228	0	0.0%		0	No	All data collected up to FFS
2,4-Dimethylphenol	160			228	0	0.0%		0	No	All data collected up to FFS
2,4-Dinitrophenol	32			228	0	0.0%		0	No	All data collected up to FFS
Di-n-butylphthalate	1600			228	0	0.0%		0	No	All data collected up to FFS
2,4-Dinitrotoluene	0.282			228	0	0.0%		0	No	All data collected up to FFS
2,6-Dinitrotoluene	0.0583			228	0	0.0%		0	No	All data collected up to FFS
Hexachlorobenzene	0.547			254	0	0.0%		0	No	All data collected up to FFS
Hexachlorocyclopentadiene	48			228	0	0.0%		0	No	All data collected up to FFS
Hexachloroethane	1.09			228	0	0.0%		0	No	All data collected up to FFS
Isophorone	46.1			228	0	0.0%		0	No	All data collected up to FFS
2-Methylphenol (O-Cresol)	400			228	1	0.4%	19	0	No	All data collected up to FFS
2-Nitroaniline	160			228	0	0.0%		0	No	All data collected up to FFS
Nitrobenzene	16			228	0	0.0%		0	No	All data collected up to FFS
N-Nitrosodimethylamine	0.000858			26	0	0.0%		0	No	All data collected up to FFS
Pentachlorophenol	1			350	0	0.0%		0	No	All data collected up to FFS
Phenol	2400			228	0	0.0%		0	No	All data collected up to FFS
Pyridine	8			26	0	0.0%		0	No	All data collected up to FFS
2,3,4,6-Tetrachlorophenol	480			26	0	0.0%		0	No	All data collected up to FFS
1,2,4-Trichlorobenzene	15.1			3813	23	0.6%	6	0	No	All data collected up to FFS
2,4,5-Trichlorophenol	800			228	0	0.0%		0	No	All data collected up to FFS
2,4,6-Trichlorophenol	3.98			228	0	0.0%		0	No	All data collected up to FFS
PESTICIDES/HERBICIDES										
2,4,5-TP	50			327	0	0.0%		0	No	All Data in EIM
2,2-Dichloropropionic Acid (Da	200			282	0	0.0%		0	No	All Data in EIM
2,4,-D	70			323	3	0.9%	0.96	0	No	All Data in EIM
2,4-DB	128			329	0	0.0%		0	No	All Data in EIM
Dicamba	480			330	1	0.3%	0.9	0	No	All Data in EIM
MCPA	8			316	3	0.9%	0.4	0	No	All Data in EIM
Mecoprop (MCPP)	16			319	0	0.0%		0	No	All Data in EIM
PAHs										
1-Methylnaphthalene	1.51			73	16	21.9%	6.8	6	No	All Data in EIM
2-Methylnaphthalene	32			437	24	5.5%	18	0	No	All Data in EIM
Acenaphthene	960			436	9	2.1%	0.32	0	No	All Data in EIM
Anthracene	4800			437	2	0.5%	0.029	0	No	All Data in EIM
Benzo(a)anthracene	0.12			430	1	0.2%	0.047	0	No	All Data in EIM
Benzo(a)pyrene	0.12			424	3	0.7%	0.24	2	No	All Data in EIM
Benzo(b)fluoranthene	0.12			335	2	0.6%	0.19	2	No	All Data in EIM
Benzo(k)fluoranthene	1.2			337	2	0.6%	0.22	0	No	All Data in EIM
Chrysene	12			430	1	0.2%	0.044	0	No	All Data in EIM
Dibenzo(a,h)anthracene	0.012			429	3	0.7%	0.24	3	No	All Data in EIM
Fluoranthene	640			432	0	0.0%		0	No	All Data in EIM
Fluorene	640			432	5	1.2%	0.063	0	No	All Data in EIM
Indeno(1,2,3-c,d)pyrene	0.12			425	3	0.7%	0.2	2	No	All Data in EIM
Naphthalene	160			4061	78	1.9%	280	4	No	All Data in EIM
Pyrene	480			428	8	1.9%	0.093	0	No	All Data in EIM

TABLE 3. SCREENING FOR GROUNDWATER INDICATORS

CONTAMINANT	Screening Criteria, ug/L			IHS Analysis					INDICATOR?	
	Protection of Ground Water	Protection of Surface Water	Back-ground	No. of Samples	No of Detections	Frequency of Detection (%)	Maximum Concentration Detected, ug/L	No. of samples Exceeding Criteria		Data Source
METALS										
Antimony	6		11.4	1310	223	17.0%	102	17	No	All Data in EIM
Arsenic	0.583		7.2	1297	1170	90.2%	10.4	5	No	All Data in EIM
Barium	200		68.1	1196	1157	96.7%	673	37	No	All Data in EIM
Berryllium	4		0.9	1297	91	7.0%	0.1	0	No	All Data in EIM
Cadmium	8		2.2	1311	14	1.1%	12.5	2	No	All Data in EIM
Total Chromium	100		7.76	1691	1140	67.4%	1890	42	**Yes**	All Data in EIM
Chromium VI	48			295	14	4.7%	23	0	No	All Data in EIM
Copper	640		73.43	1297	683	52.7%	268	0	No	All Data in EIM
Iron	11200		104	1577	470	29.8%	18600	12	No	All Data in EIM
Lead	15		4	1297	171	13.2%	17	2	No	All Data in EIM
Manganese	2240		6.95	1554	522	33.6%	5290	56	No	All Data in EIM
Nickel	100		17.25	1297	916	70.6%	128	4	No	All Data in EIM
Selenium	50		15	1297	666	51.3%	8	0	No	All Data in EIM
Silver	80		15	1297	7	0.5%	1	0	No	All Data in EIM
Thallium	0.16		2.6	1297	17	1.3%	12	8	No	All Data in EIM
Vanadium	80		21.04	1238	1082	87.4%	142	1	No	All Data in EIM
Zinc	4800		32.78	1326	327	24.7%	286	0	No	All Data in EIM

Table 4
Final Groundwater Cleanup Levels Adjusted for Risk

INDICATOR	MTCA METHOD B FORMULA, ug/L		Preliminary Method B CUL, ug/L	Adjusted Method B CUL, ug/L	Carcinogenic Risk	Non-Carcinogenic Risk						PQL, ug/L
						nephrotoxicity	hepatotoxicity	neurotoxicity	hematotoxicity	Liver cell polymorphism	Other	
VOCs	Carcinogen	Noncarcinogen		**SEE KEY**								
Benzene	0.795	32	0.795	**1.2**	1.51E-06						0.038	0.028
1,1-Dichloroethane	7.680	1600	7.680	**7.68**	1.00E-06	0.005	0.005	0.005			0.005	0.02
1,2-Dichloroethane	0.48	48	0.38	**0.38**	7.92E-07						0.008	0.0141
1,1-Dichloroethene	NR	400	0.057	**0.057**			0.000					0.020
cis-1,2-Dichloroethene	NR	16	16	**12**		0.750						2
Methylene chloride	21.90	48	5	**5**	2.28E-07		0.104					1
Tetrachloroethene	20.8	48	0.69	**0.69**	3.32E-08			0.014				0.05
Toluene	NR	640	640	**157**		0.245		0.245				1
1,1,1-Trichloroethane	NR	16000	200	**200**			0.013	0.013			0.013	2
Trichloroethene	0.54	4	0.54	**2.5**	4.63E-06						0.625	0.0534
Vinyl chloride	0.029	24	0.029	**0.053**	1.83E-06		0.002			0.002		0.02
				.								
METALS												
Chromium III	NR	24000	100	**100**							0.004	0.59
				Total Cancer Risk =	**1.00E-05**							
				Total Hazard Index =		**1.000**	**0.124**	**0.277**	**0.000**	**0.002**	**0.692**	

KEY

CUL dictated by Method B, No MCL

Adjusted to result in non-carcinogenic risk (Hazard Index) of 1

Surface Water Criteria applicable to Indicator

CUL dictated by Surface Water Criteria

CUL is MCL, adjusted to be protective if necessary, then adjusted down to meet total cancer risk of 1x10^-5

CUL dictated by MCL