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| Remedial Investigation/  Feasibility Study and  Cleanup Action Plan  Former WSDOT Potlatch Maintenance Facility, Skokomish, Washington Facility/Site #14549  Cleanup Site #12397 VCP Project #SW1405 |
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Prepared for

Skokomish Indian Tribe

Skokomish, Washington

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Project Number

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Acronyms and Abbreviations

ARAR applicable or relevant and appropriate requirement

ASTM American Society for Testing and Materials

bgs below ground surface

cPAH carcinogenic polycyclic aromatic hydrocarbon

COC chain of custody

COI constituent of interest

COEC chemical of ecological concern

COPC constituent of potential concern

CSM conceptual site model

dioxins chlorinated dibenzo-p-dioxins

DO dissolved oxygen

DOI U.S. Department of the Interior

DRO diesel range organics

Ecology Washington Department of Ecology

Eh oxidation/reduction potential

EISC ecological indicator soil concentration

EMI electromagnetic induction

EPA U.S. Environmental Protection Agency

ft feet

furans chlorinated dibenzofurans

GPR ground penetrating radar

GPS global positioning system

GRO gasoline range organics

HASP health and safety plan

MCL Maximum Contaminant Level

µg/L micrograms per liter

mg/kg milligrams per kilogram

mL/min milliliters per minute

MTCA Model Toxics Control Act

NFA no further action

NTU Nephelometric turbidity units

PAH polycyclic aromatic hydrocarbon

PID photoionization detector

PVC polyvinyl chloride

QAPP quality assurance project plan

RI remedial investigation

SAP sampling and analysis plan

Site the former WSDOT Potlatch Maintenance Facility

SMP soil management plan

SVOC semivolatile organic compound

TCDD tetrachlorodibenzo-*p*-dioxin

TCE trichloroethene

TEE Terrestrial Ecological Evaluation

TEQ total toxic equivalent concentration

TPH total petroleum hydrocarbons

USCS Unified Soil Classification System

USGS U.S. Geological Survey

UST underground storage tank

VCP Voluntary Cleanup Program

VOA volatile organic analyte

VOC volatile organic compound

WAC Washington Administrative Code

WSDOT Washington State Department of Transportation

Limitations

The opinions and comments formulated during this assessment are based on observations and information available at the time of the investigation. Ramboll has no direct knowledge of, and offers no warranty regarding, the condition of concealed conditions beyond what was exposed during the RI investigation. Comments regarding concealed conditions are professional opinions, derived in accordance with current standards of professional practice based on our engineering experience and judgment. Ramboll has exercised usual and customary care in the conduct of this assessment. No guarantee or warranty as to future performance of any reviewed condition is expressed or implied.

Executive Summary

This Remedial Investigation/Feasibility Study/Cleanup Action Plan (RI/FS/CAP) report has been prepared for the former Washington State Department of Transportation (WSDOT) Potlatch Maintenance Facility in Skokomish, Washington (the Site) on behalf of the Skokomish Indian Tribe (Skokomish Tribe) in accordance with the Model Toxics Control Act (MTCA; WAC 173‑340). The 14.75-acre Site is located at 19811 North U.S. Highway 101 at milepost 336.2 in Skokomish, Washington (Figure 1). The Washington State Department of Ecology (Ecology) is providing review and assistance for this independent cleanup Site through Ecology’s Voluntary Cleanup Program (VCP) (Facility Site #14549, Cleanup Site #12397, VCP Project #SW1405).

Historical aerial photographs (Appendix A to the RI Work Plan) indicate that in 1938, the Site was undeveloped and was primarily densely forested; then, sometime between 1938 and 1951, the Site was logged. In June 1955, the State of Washington Department of Highways[[1]](#footnote-2) purchased and developed the Site as a maintenance yard, which was operated until 1995 by WSDOT. The Skokomish Tribe purchased the Site from WSDOT in April 2003 and used it for storage and filling activities until undertaking additional environmental investigations. The Skokomish Tribe intends to develop the Site as part of a master plan that includes construction of a skate park, basketball court, workout facility, and accompanying roads, parking lots, and paths. Four areas having distinct historical uses, activities, and features have been defined at the Site and are discussed in this report:

* **Area 1 (Southeast Area).** WSDOT used Area 1 as its primary maintenance yard at the Site, which included a former maintenance building with associated septic and drywell features, parts washing/degreasing, former underground storage tanks (USTs), former vehicle wash area, former heavy equipment parking/staging area, former empty container accumulation area, former sander storage rack, former drinking water well, and former shed, and fill areas. The Skokomish Tribe used Area 1 for placement of fill material stockpiles and for storage of various items, including boats and a shed that included computer components and containers of paint, oils, and solvents.
* **Area 2 (Southwest Area):** WSDOT buried waste and drums, stored sand, and conducted filling activities in Area 2. The Skokomish Tribe stockpiled fill materials in Area 2.
* **Area 3 (Northern Area):** WSDOT used Area 3 as a gravel quarry, which was subsequently used by WSDOT for placement of fill and debris including landslide soil and debris, highway debris, street sweepings, fuel spill incident response materials, and burn material. The Skokomish Tribe stockpiled fill materials and burned debris from land clearing activities and demolition projects.
* **Area 4 (Wooded Area):** Neither WSDOT or the Skokomish Tribe appear to have conducted any activities in Area 4, which includes steeper western portions of the Site that are densely covered with forest and vegetation.

Several environmental investigations and remedial activities have been conducted on the Site since 1995. Much of the soil identified as exceeding screening levels in Areas 1, 2, and 3 during previous investigations was removed during remediation activities conducted in 2014 as part of Ecology’s VCP. Approximately 1,850 tons of impacted soil were removed and disposed of offsite during the remediation activities in 2014.

The objective of the RI activities reported herein is to determine the current nature and extent of contamination and characterize the Site with the ultimate goal of attaining a “no further action” (NFA) status with Ecology in accordance with MTCA.

RI activities were completed at the Site in June, July, and August 2019 in accordance with the Ecology-approved RI Work Plan (Ecology 2019a). RI activities included geophysical surveying, test pitting, installation of soil borings, and soil and groundwater sampling. The scope of RI soil and groundwater investigations was developed based on a review of Site use and previous investigations. Soil constituent of interest (COI) categories analyzed include total petroleum hydrocarbon (TPH) as gasoline range organics (GRO), TPH as diesel range organics (DRO), TPH as heavy oils, metals, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), and chlorinated dibenzo-p-dioxins and chlorinated dibenzofurans (dioxins/furans). Groundwater COI categories analyzed include GRO, DRO, heavy oils, metals, and VOCs.

Soils encountered during RI activities were primarily fill consisting of varying mixtures of gravels, sands, and silts. Petroleum hydrocarbons (GRO, DRO, and heavy oils), lead, and dioxins/furans are the primary Site-related COIs in soil and were identified as chemicals of potential concern (COPCs). Impacts attributable to historical activities were detected at various locations across Areas 1, 2, and 3. Historical site evaluation and RI data indicate that potential sources are historical management of fluids used in vehicle maintenance including petroleum products stored in former USTs (Area 1), waste and material dumping (Area 2), fill (Areas 1, 2, and 3), landslide debris brought onto the property (Area 3), and former debris burning (Area 3).

Groundwater flows in an easterly to southeasterly direction generally toward Hood Canal, which is consistent with previously reported groundwater flow direction. The groundwater at the Site is unconfined and influenced by precipitation and surface infiltration. Trace concentrations of petroleum hydrocarbons (DRO) attributable to historical activities were detected in five locations in Area 1 and one location in Area 3. Potential petroleum hydrocarbon sources are historical management of fluids used in vehicle maintenance (Area 1), fill (Areas 1 and 3), and landslide debris brought onto the property (Area 3). Trace concentrations of petroleum hydrocarbons (DRO) and VOCs (toluene and trichloroethene) attributable to historical activities were detected in groundwater in Area 1 at very low levels below analytical reporting limits and substantially below health-based drinking water standards. Likely sources of trace petroleum hydrocarbons and VOCs observed in groundwater are fluids previously managed and used in vehicle maintenance including petroleum products stored in former USTs and solvents historically used for parts washing/degreasing. A single exceedance of Method B cleanup levels for thallium in one temporary well is attributable to soil particulates entrained in groundwater samples and isnot representative of aquifer water quality. Based on these RI findings, no COPCs are identified for groundwater.

A site-specific Terrestrial Ecological Evaluation (TEE) was performed for the Site. Petroleum hydrocarbons (GRO and DRO), lead, and dioxins/furans were identified as contaminants of ecological concern (COECs) in soil. The terrestrial ecological receptor groups of concern include vascular plants, soil-dwelling invertebrates, ground-feeding birds, and ground‑feeding small mammals. Potentially complete exposure pathways that exist at the Site include terrestrial species contact with soil and/or ingestion of soil or soil-dwelling invertebrates. In addition, plants may also take up contaminants in the soil. The exposure routes include direct contact and direct ingestion for soil invertebrates, uptake by plants, and ingestion of soil and dietary items for wildlife. Ecology’s published ecological indicator soil concentrations (EISCs) for surrogate ecological receptors were selected as protective of plants, soil biota, and wildlife at the Site.

A conceptual site model (CSM) was prepared for the Site based on the information and data collected during the RI (discussed above) and prior investigations. Potentially complete human health exposure pathways identified for Site-related constituents in soil and potential receptors include incidental ingestion of and dermal contact with constituents in Site soil by current and future commercial workers, construction workers, and trespassers. Potentially complete exposure pathways identified for Site groundwater and potential receptors include ingestion of and dermal contact with constituents in groundwater on Site by future commercial workers, and potential future adult and child residents. These exposure pathways were evaluated for groundwater in planning the RI and selecting screening levels. However, groundwater was determined to be minimally affected in one small, localized area of the Site substantially below standards established for protection of human health.

Soil cleanup standards protective of human health and ecological receptors are proposed for the Site. The proposed soil cleanup levels are based on the current and potential future receptors and exposure pathways for human health and the environment presented above, and potentially applicable or relevant and appropriate requirements (ARARs). Proposed soil cleanup levels are conservative (protective), representing the most stringent of the potentially relevant and appropriate criteria for the Site. For each COPC, the proposed cleanup level is selected as the lowest of the human health soil screening level and the EISC for ecological receptors. Note that no groundwater COPCs were identified; therefore, cleanup standards are not proposed for groundwater.

Compliance with proposed Site soil cleanup levels was evaluated by direct sample comparison (maximum concentrations) and by MTCA’s statistical method specified in WAC 173-340-740(7) and described in Ecology’s statistical guidance (Ecology 1992). COPCs above the proposed soil cleanup levels are: GRO, DRO, lead, bis(2-chloroethyl) ether, and total dioxins/furans. These impacts are attributable to historical activities at various locations across Areas 1, 2, and 3. Historical site evaluation and RI data indicate that potential sources are historical management of fluids used in vehicle maintenance including petroleum products stored in former USTs (Area 1), waste and material dumping (Area 2), fill (Areas 1, 2, and 3), exterior lead-based paint on the former maintenance building demolished in 2001 (Area 1), landslide debris brought onto the property (Area 3), and former debris burning (Area 3).

The RI presented herein provides a characterization of the nature and extent of Site-related chemicals in soil and groundwater across the Site and provides sufficient information to evaluate and select a technically feasible cleanup alternative.

The FS also presented herein was conducted for the Site based on the pre-RI and RI data. Four remedial alternatives were developed to address soil contamination at the Site, which combined different technologies, and consist of the following:

* Alternative 1 – Complete removal of cleanup level exceedances
* Alternative 2 – Partial removal of cleanup level exceedances with caps/covers and institutional controls
* Alternative 3 – Caps/covers with institutional controls
* Alternative 4 – No action

The MTCA and other threshold criteria include whether the alternative is protective of human health and the environment, complies with cleanup standards, complies with ARARs, provides for a reasonable restoration timeframe, and provides for compliance monitoring. The MTCA cleanup regulations provide the framework for a disproportionate cost analysis (DCA) in WAC 173-340-360 (3)(f). The DCA evaluates the cleanup action alternatives to determine the alternative that uses permanent solutions to the maximum extent practicable while achieving cleanup standards within a reasonable restoration timeframe and cost.

Costs and benefits of each alternative were compared and Alternative 3 was selected as the preferred cleanup action remedy. It has the lowest cost of the alternatives while still being protective of human and ecological receptors.

The preferred cleanup action alternative complies with each of the applicable remedy requirements under MTCA and provides the greatest benefit for the cost based on the DCA. Alternative 3 involves implementation of institutional controls in the form of an environmental covenant to be recorded on the deed, which will govern future land use of the Site. Additionally, engineered soil covers, pavement, and structures would be used as part of the planned site redevelopment to provide isolation of residual hazardous substances on Site.

The preferred cleanup action alternative for soil meets the minimum requirements for selection under MTCA because it is protective of human health and the environment, complies with cleanup standards, complies with ARARs, provides for a reasonable restoration timeframe, provides for compliance monitoring, and considers public concerns.

The CAP describes the process for implementing the selected alternative. Institutional controls will be implemented in the form of an environmental covenant that will restrict future land use. Caps and covers will be implemented during Site redevelopment to isolate soil with residual contaminants from Site receptors. It is anticipated that this remedy will be completed within one to two years from receiving the Ecology opinion letter on the RI/FS/CAP. The CAP includes an SMP, HASP, and compliance monitoring plan. These plans provide for management of soils, worker protection, and restoration of caps and covers during implementation of the remedy and during and following completion of any future subsurface work within the covenant areas at the Site.

1. Introduction

This RI/FS/CAP report has been prepared for the former WSDOT Potlatch Maintenance Facility in Skokomish, Washington (the Site) on behalf of the Skokomish Tribe in accordance with MTCA (WAC 173-340). The 14.75-acre Site is located at 19811 North U.S. Highway 101 at milepost 336.2 in Skokomish, Washington (Figure 1). The Ecology is providing review and assistance for this independent cleanup Site through Ecology’s VCP (Facility Site #14549, Cleanup Site #12397, VCP Project #SW1405).

* 1. Purpose

The purpose of the report is to determine the current nature and extent of contamination and characterize the Site with the ultimate the goal of attaining an NFA status with Ecology in accordance with MTCA (WAC 173-340). Ultimately, obtaining an NFA status will facilitate the placement of the property into trust for the Skokomish Tribe by the U.S. Department of Interior (DOI) and will also support development and use of the Site in a manner protective of human health and the environment. RI activities were completed at the Site in 2019 in accordance with the RI Work Plan (Exponent 2019) that Ecology concurred with on September 27, 2019 (Ecology 2019).

* 1. Report Organization

This report has been prepared in accordance with Ecology’s RI Checklist Guidance document (Ecology 2016, Publication No. 16-09-006), FS Guidance document (Ecology 2016, Publication No. 16-09-007), and CAP Guidance document (Ecology 2016, Publication No. 16-09-008) and includes the following sections:

* **Section 2—Site Information.** Presents a summary of Site information, including the environmental setting, historical activities and features of the property, previous environmental studies and removal actions at the Site, COIs, and current and potential future use of the property.
* **Section 3—Remedial Investigation Activities.** Summarizes the geophysical, soil, and groundwater data collected as part of the RI and identifies Site screening levels that will be used to evaluate the RI data.
* **Section 4—Remedial Investigation Results.** Presents and evaluates the results of the RI soil and groundwater investigation.
* **Section 5—Terrestrial Ecological Evaluation**. Assesses potential impacts to terrestrial ecological receptors at the Site.
* **Section 6—Conceptual Site Model.** Presents the CSM for the Site, including the potential or suspected sources of hazardous substances, types of hazardous substances, potentially contaminated media, receptors, and potentially complete exposure pathways.
* **Section 7—Proposed Cleanup Standards.** Identifies proposed cleanup levels for the Site, points of compliance, and ARARs.
* **Section 8—Evaluation of Compliance with Proposed Cleanup Standard.** Assesses compliance with proposed soil cleanup standards.
* **Section 9—Feasibility Study.** Presents and evaluates the cleanup action alternatives being considered for the Site.
* **Section 10—Cleanup Action Plan.** Presents the selected cleanup action alternative for the Site and the procedures for enacting the cleanup action.
* **Section 11—Conclusions.** Presents a summary of the RI activities, conclusions regarding the nature and extent of contamination, a summary of the feasibility study and the selection of the preferred cleanup action alternative, and a summary of the cleanup action plan.
* **Section 12—References.** Provides references cited in the RI/FS/CAP report.

Appendices to this report include the following:

* **Appendix A**— Correspondence with Ecology Regarding Remedial Investigation Work Plan Development
* **Appendix B**—Geophysical Survey Report
* **Appendix C**—Boring and Well Logs
* **Appendix D**—Photographs and Field Notes
* **Appendix E**—Data Validation Report
* **Appendix F**—Summary of Deviations from the RI Work Plan
* **Appendix G**—Natural Background Evaluation for Chromium, Mercury, and Selenium in Soil
* **Appendix H**—RI Work Plan (including the sampling and analysis plan and quality assurance project plan [QAPP])
* **Appendix I**—Laboratory Analytical Data and Chains of Custody (provided electronically).

1. Site Information

This section presents the location and a general description of the Site and adjacent features, a summary of previous Site uses and activities, a brief summary of previous environmental investigation and removal actions, Site COIs, the current Site use, and potential future land use and development.

* 1. Location and Description

The Site consists of approximately 14.75 acres. The eastern portion of the Site (approximately nine acres) is disturbed and is predominantly covered with exotic Himalayan blackberry (*Rubus armeniacus*). This area contains compacted paths for cars and trucks and a gravel parking lot and access road that provides overflow parking for the Skokomish Tribe Community Center (Figure 2). The western portion of the Site (approximately five acres) is covered in early-to-mid successional Douglas fir (*Pseudotsuga menziesii*) forestland (Figure 2). Sub-story species include Oregon grape (*Mahonia aquifolium*), salal (*Gaultheria shallon*), blueberries (*Vaccinium* spp.), and fern species, predominately sword fern (*Polystichum munitum*). The Site is fenced along the north and west perimeters.

The Site is bound to the east by U.S. Highway 101, to the north by residences (located on North Minerva Terrace Road), to the west by undeveloped and partially forested land owned by Green Diamond Resource Company, and to the south by the Skokomish Tribe Community Center (Figure 2).

* 1. Geology and Hydrogeology

The Site is located on a localized alluvial fan terrace of recessional outwash deposits from the late Vashon glaciation (Figure 3). The outwash material is typically loose sand and gravel with varying amounts of silt and clay. The Site is in a transition zone between steep, forested bluffs to the west and forested wetlands to the east. According to Ecology (2000), a till layer may underlie the recessional outwash in the Skokomish Valley. Below the till layer, sand, gravel, silt, and some clay form the bottom of the Vashon glaciation sequence in the valley (Ecology 2000).

According to Polenz et al. (2010), the Site is underlain by alluvial fan deposits or glacial and non-glacial deposits. The alluvial fan deposits consist of cobbles, pebbles, sand, silt, and boulders. The glacial and non-glacial deposits consist of tan to reddish brown or gray compact gravel, sand, silt, clay, and diamicton (including compact tills and paleosols).

The steep, forested slope bordering the west side of the Site may be represented as three eroded layers, starting at the bottom with pre-Vashon glacial and interglacial deposits. The pre-Vashon materials are mostly till and outwash deposited before the Vashon glaciation, as well as non-glacial sediments such as the Skokomish gravels (Ecology 2000).

The next sequence upslope to the west is Vashon advance outwash, consisting of dense sand and gravel, locally containing fine-grained sediments. The uppermost, extensive sequence of Vashon till caps the slope 400–500 ft above the Site to the west (Ecology 2000).

The eastern border of the Site transitions to the forested alluvial floodplain of the Skokomish River. The wetland floodplain drains to Hood Canal about three-fourths of a mile east of the Site (Ecology 2000).

Groundwater has been encountered on the Site at depths ranging from 17 to 48 ft below ground surface (bgs), and water level measurements indicate that the groundwater flows in an easterly to southeasterly direction toward Hood Canal (Ecology 2000; HWA 2013, ESA 2013b). The groundwater at the Site is unconfined and influenced by precipitation and surface infiltration. Precipitation averages approximately 65 inches per year (HWA 2013).

Drinking water wells identified on or near the Site include:

* A drinking water well for the former WSDOT maintenance facility was installed on the Site in 1956 (Figure 2). The well log is provided in Appendix H). This well was completed to 66 ft bgs, and static water was encountered at 22.5 ft bgs (Ecology 2000).[[2]](#footnote-3)
* A drinking water well is located to the north of the Site within the Minerva Terrace mobile home park (Figure 2). This well, located just north of North Minerva Terrace Road, was installed in 1970 and was completed to 62 ft bgs. The well log is provided in Appendix H).
* A drinking water well was installed in 2016 on the parcel to the south of the Site as part of the Skokomish Tribe Community Center development (Figure 2). It was completed to 138 ft bgs, and the static water level was approximately 14 ft bgs. The well log is provided in Appendix C.
  1. Historical Activities and Features

Historically, most of the Site was densely forested (Exponent 2019; Appendix H, herein). Based on a review of aerial photographs, the Site was cleared sometime between 1938 and 1951 (Exponent 2019; Appendix H, herein). The State of Washington Department of Highways [[3]](#footnote-4) purchased the Site in June 1955 and used it as a highway maintenance yard until 1995 (Exponent 2019; Appendix H, herein). The Skokomish Tribe purchased the Site from WSDOT in April 2003 and has used it for miscellaneous storage and burning of debris from land clearing activities and the placement of fill materials from construction projects in the area (Exponent 2019; Appendix H, herein).

For ease of discussion, four areas having distinct historical uses, activities, and features have been defined at the Site (Exponent 2019; Appendix H, herein) and are discussed in this RI report. These areas are shown in Figure 2 and include the following: Area 1 (Southeast Area), Area 2 (Southwest Area), Area 3 (Northern Area), and Area 4 (Wooded Area). A general description of historical Site activities by owner is presented below. More detailed information regarding historical activities and features at the Site can be found in Section 4 of the RI Work Plan (Exponent 2019), a copy of which is provided in Appendix H to this report.

* + 1. Area 1—Southeast Area
       1. WSDOT

WSDOT’s primary maintenance yard was in the southeast corner of the Site and was used between 1955 and 1995 (Exponent 2019; Appendix H, herein). Activities conducted in this area included heavy equipment maintenance, staging, and routine fluid changes; vehicle washing, staging, and parking; and storage of various items such as empty containers (in an empty container accumulation area) and equipment (WSDOT 1995b).

Area 1 historically contained a 1,400-ft2 maintenance building (Vehicle Maintenance Building) with three service bays that was located at the southeast corner of the Site (Figure 4). The former maintenance building was used by WSDOT for heavy equipment maintenance from 1955 to 1975, and then for heavy equipment staging and routine fluid changes from 1975 to 1995. Maintenance activities conducted within the building involved the use of parts washer solvents, antifreeze, brake fluid, motor oil, and hydraulic fluid (WSDOT 1995b). The maintenance building was demolished in 2001.

According to facility drawings, a drywell was reportedly located approximately 50 ft southwest of the former maintenance building, and the septic and interior drain system for the former maintenance building was believed to drain to this drywell (WSDOT 1995b) (Figure 4). Hand-written notes and photos of the drain line and drywell excavation and removal indicate that the drywell was approximately 30 ft (not 50 ft as reported above) from the southwest corner of the building (WSDOT 1995c; 1995d; 1996). The drain line, drywell, and some petroleum-contaminated soils associated with the drywell were reportedly excavated and removed in December 1995 and January 1996 (WSDOT 1995c; 1995d; 1996).

Following removal of the concrete slab of the former maintenance building in 2013, the interior drains and underlying catch basins were found to discharge to a septic tank located at the northeast corner of the building (ESA 2013c) (Figure 4), not the drywell as shown in facility drawings (WSDOT 1995b). The septic tank was observed to be filled with sand, and one wall was demolished, indicating previous abandonment of this tank. The interior tank walls were observed to have “heavy oil staining” (ESA 2013c), which may have been oil‑related staining, or may have been a black colored coating of organic matter from general septic tank use. The drain pipe for the septic tank was connected to drain tile that extended approximately 100 ft from the northeast corner of the former maintenance building toward the eastern property line (ESA 2013c) (Figure 4).

Other features located in Area 1 and shown in Figure 4 include:

* A former vehicle wash area located to the east of the maintenance building, beyond the asphalt pad. Reportedly, wash water generated in this area was discharged to a ditch along Highway 101 and accumulated solids were removed using a front-end loader and disposed of on the north end of the Site (WSDOT 1995b).
* A former heavy equipment staging/parking area located approximately 50 ft west of the former maintenance building (WSDOT 1995b). During a site visit in November 1995, surficial staining was observed in this area (WSDOT 1995b).
* A former drinking water well (Section 2.2 above) located approximately 50 ft west of the maintenance building. Reportedly, this well was installed in 1956 to a depth of approximately 66 ft, and groundwater was encountered at approximately 22 ft bgs (Ecology 2000).
* Three former USTs and associated fuel dispensers and piping located to the east and southeast of the maintenance building. These USTs were installed in 1958 and included two 1,000-gallon diesel USTs and one 500-gallon unleaded gasoline UST. These USTs were removed in April 1995, during which time soil samples were collected and no apparent soil contamination was found (WSDOT 1995a). These removal activities were reviewed by the EPA in February 1996 and EPA deemed that these activities conformed to EPA and Ecology requirements for UST closure (U.S. EPA, 1996). However, during a Site visit in June 2013, two steel fill pipes and one vent pipe were still present along the east side of the concrete slab for the former maintenance building (ESA 2013a), suggesting that the associated UST piping may still be in place. No piping was identified in the UST area during the geophysical surveying conducted as part of the RI (Section 3.1).
* A former empty container accumulation area (e.g., empty 55-gallon drum of striping paint and empty 5-gallon containers of asphalt patch mix).
* A former (now removed) wood-framed storage shed was located to the west of the former maintenance building as indicated by review of aerial photos (Exponent 2019; Appendix H, herein).
* A former sander storage rack[[4]](#footnote-5) made of creosoted telephone poles was located west of the maintenance building. The creosoted logs from this storage rack were reportedly used by a Skokomish Tribe track-hoe operator to accelerate the burning process for burn piles on the northern portion of the Site (ESA 2013b).

WSDOT vacated the Site in 1995, and the Vehicle Maintenance Building was demolished in 2001. Before demolition activities, an asbestos and lead survey were completed (WSDOT 2001). No asbestos-containing building materials were identified; however, the exterior paint of the building (Sample P1 collected in July 1995) was found to contain lead (WSDOT 1995b). Previous investigations and removal actions are described in Section 2.4 below.

* + - 1. Skokomish Tribe

Activities conducted by the Skokomish Tribe in Area 1 included placement of fill materials, and storage of various items. As indicated by review of aerial photos (Exponent 2019; Appendix H, herein), fill materials were placed on Area 1 in approximately 2006 (see the bare, hummocky stockpile features in the 2007 aerial photograph provided in Appendix H for locations of these fill piles on the Site). Reportedly, a few hundred truckloads of soil were brought onto the Site and placed in various locations around Area 1 and around the former maintenance building (ESA 2013b) (Figure 4). These stockpiled soils were reportedly from replacement and expansion of the Lucky Dog Casino parking lot (ESA 2013b) and, possibly, from a 2005 bridge construction project on Skabob Creek (Nichols 2018). In June 2013, these stockpiles were noted to contain pipes, tires, wire, and metal fencing (ESA 2013a,b). The stockpiles were graded in 2019 in preparation for the RI Site investigation activities discussed in Section 3. The hummocky, stockpiled soils were graded to enable vegetation clearing necessary to perform the geophysical surveys, install borings, and collect samples as specified in the RI Work Plan (Exponent 2019).

A former (now removed) wood-framed storage shed that was located to the west of the former maintenance building was used by the Skokomish Tribe (Figure 4). During a site visit conducted in June 2013 (ESA 2013a), several hazardous substances and stained soil were observed inside and outside the shed. Observed substances included open and leaking paint cans, 5-gallon containers of paint/water mixtures, computer hard drives and monitors, exposed computer components, and open 5-gallon containers of hydraulic oil. These containers held a mixture of paint and water, solvents and water, and hydraulic oil and water. The soil beneath the containers was stained as a result of overfills and spills from the unsecured containers. Five-gallon buckets of tar were also observed in the area of the shed in 2005 (PGG 2005).[[5]](#footnote-6) During a site visit in June 2013, several boats were also being stored west of the former shed (ESA 2013a).

* + 1. Area 2—Southwest Area
       1. WSDOT

According to a former WSDOT employee that worked at the former maintenance facility in the 1980s, the southwest area of the Site was used to dispose of unused asphalt, solid waste removed from roadsides, absorbent material used during fuel spills, drums, and wastes (ESA 2014c,d). The drums would have likely contained striping paint, waste oil generated at the maintenance facility, and/or herbicides[[6]](#footnote-7) (ESA 2014d). A former WSDOT employee stated that after WSDOT trucks emptied unused asphalt in the southwest area of the Site, it was common practice to spray the trucks with diesel to remove residual asphalt from the truck bed. Ray Willard, State Roadside Asset Manager and WSDOT employee currently supporting WSDOT’s herbicide use, contacted the person who occupied his position in the 1960s and 1970s to inquire about historical herbicide use at the Site. This former WSDOT employee believes that the following herbicide compounds were stored at the Site and used by the crews that were based there: 2,4-Dichlorophenoxyacetic acid in various forms (2,4-D), Triclopyr, Diuron, Bromacil, Glyphosate, Atrazine, Sulfentrazone, Metsulfuron, and Ammonium Salt of Fosamine (Wynands 2018).

Other features located in Area 2 and shown in Figure 4 include:

* Burial area for animal carcasses (i.e., roadkill) located west of the former maintenance building.
* Sand storage area consisting of an asphalt pad located approximately 200 ft west of the former maintenance building (WSDOT 1995b). Reportedly, the sand stockpile was treated with salt but not with chemical deicers (WSDOT 1995b).
  + - 1. Skokomish Tribe

The Skokomish tribe stockpiled fill materials in Area 2. During a June 2013 site visit by ESA Associates, fill material observed in the southwest area of the Site contained metal fragments, tires, and car parts. As indicated by review of aerial photos (see the bare, hummocky stockpile features in the 2007 aerial photograph provided in Appendix H for locations of these fill piles on the Site), fill materials were stockpiled on the southwest area of the Site (Area 2) in approximately 2006 (Figure 4). The stockpiles were graded in 2019 in preparation for the RI Site investigation activities discussed in Section 3. The hummocky, stockpiled soils were graded to enable vegetation clearing necessary to perform the geophysical surveys, install borings, and collect samples as specified in the RI Work Plan (Exponent 2019).

* + 1. Area 3—Northern Area
       1. WSDOT

A gravel quarry located in the north central portion of the Site was operated from the late 1970s to approximately 1997 and the excavated materials were used in highway maintenance activities (WSDOT 1995b) (Figure 4). In March 1999, the quarry and area northeast of the quarry were filled with soil and debris from two landslides that occurred along Highway 101 (Ecology 2000) (Figure 4). The northern area of the Site, including the former quarry, was historically used for disposal of miscellaneous debris picked up along the highway by WSDOT crews (e.g., guardrail material, tires, wheels, and household paint cans) (WSDOT 1995b). Street sweepings were disposed of in the former quarry as well as landslide material containing remnants of burned buildings and fuel spill incident response materials (ESA 2015a).

As noted in Section 2.3.1.1 above, creosoted logs from the sander stand rack were burned by the Skokomish Tribe (ESA 2013b) and solids from the washing of WSDOT vehicles were disposed of in the northern area of the Site (WSDOT 1995b).

* + - 1. Skokomish Tribe

As indicated by review of aerial photos (see the bare, hummocky stockpile features in the 2007 aerial photograph provided in Appendix H for locations of these fill piles on the Site), fill material was placed on portions of the northeastern part of the Site (Area 3) in approximately 2006 (Figure 4). These stockpiles were placed in the quarry, at the southeast corner of the former quarry, and along the eastern side of the access road. The stockpiles ranged in height from approximately 5 to 8 ft. The remaining stockpiles were graded in 2019 in preparation for the RI Site investigation activities discussed in Section 3. The hummocky, stockpiled soils were graded to enable vegetation clearing necessary to perform the geophysical surveys, install borings, and collect samples as specified in the RI Work Plan (Exponent 2019).

The northern area of the Site (Area 3) was also used by the Skokomish Tribe to burn debris from land clearing activities and demolition projects (ESA 2015c). During a site visit in June 2013, large burn piles containing burned household items (e.g., plastic bottles, car parts, toys, metal fragments, and glass), a 55-gallon steel drum,[[7]](#footnote-8) asphalt shingle roofing, plywood, and lumber were observed in the northern area of the Site (ESA 2013b). Hundreds of logs and a large pile of broken-up concrete slabs and blocks were also observed in the northern area of the Site in June 2013 (ESA 2013a).

* + 1. Area 4—Wooded Area

A review of aerial photos (Exponent 2019, Appendix H, herein) indicates that Area 4 was not developed and has remained wooded. The wooded area of the Site consists of areas densely covered with trees and vegetation (Figure 4). This area is undeveloped and, therefore, environmental investigations were not conducted prior to the RI.

* 1. Previous Environmental Investigations and Removal Actions

Several environmental investigations and removal activities have been conducted on the Site since 1995. These prior environmental investigations and removal actions are summarized and discussed in detail in Section 6 of the RI Work Plan (Exponent 2019) provided in Appendix H. Historical investigation locations and Site features are shown on Figure 5. Previous environmental investigations and removal actions included the following:

* 1995 WSDOT Phase I environmental site assessment, 1995 WSDOT UST removal, and 1996 WSDOT soil removal (WSDOT 1995a,b; U.S. EPA; 1996; WSDOT 1996)
* 1999 Ecology monitoring well installation (Ecology 2000)
* 2005 PGG soil and groundwater investigation (PGG 2005)
* 2013 HWA hydrogeological study for a proposed wastewater treatment facility at the Site (HWA 2013)
* 2013 ESA Phase I environmental site assessment (ESA 2013a)
* 2013 ESA Phase II investigation (ESA 2013b)
* 2013–2014 ESA remediation and characterization (ESA 2013c, 2014a,b,c,d, 2015b,c).

Much of the soil exceeding screening levels encountered in Areas 1, 2, and 3 during previous investigations was removed during activities conducted in August, September, and December 2014 (ESA 2013c, 2014a,b,c, 2015b,c). Approximately 1,850 tons of impacted soil were removed and disposed of offsite during these remediation activities (ESA 2014b,c,d). The cleanup work was conducted as part of Ecology’s VCP (Ecology 2014, provided in Appendix A). Soil exceedances that remained on-Site following removal activities are all in Area 3 and shown in Figure 6. Three test pit locations in the northern part of Area 3 exceeded the screening levels for dioxins and furans. In the former quarry, four trench locations exceeded the screening levels for dioxins and furans, and one trench location exceeded the screening level for benzene.

Groundwater and perched water (when encountered) at the Site have historically had detections of total metals (arsenic, chromium, lead, and thallium) and/or total phosphorus above screening levels. However, the elevated metals are likely attributable to particulates in unfiltered groundwater samples submitted for total metals analyses. Dissolved concentrations of arsenic, chromium, and lead were either not detected or were detected below screening levels. Total metals results appear to be associated with soil particulates, and thus are not representative of aquifer water quality. Analysis of dissolved metals in groundwater is considered more representative of aquifer water quality.

* 1. Constituents of Interest

Based on historical land use and activities, and prior investigations, the following COI categories were identified in the RI Work Plan (Exponent 2019; Appendix H, herein) for soil and groundwater:

Soil COIs

* TPH
* Metals
* VOCs
* SVOCs
* PAHs
* dioxins/furans
* Herbicides (chlorinated and non-chlorinated).

Groundwater COIs

* TPH
* Metals
* VOCs.
  1. Current and Potential Future Land Use and Development

The property is zoned Indian Reservation (Mason County 2014). The eastern portion of the Site (approximately nine acres) is disturbed and is predominantly covered with exotic Himalayan blackberry (*Rubus armeniacus*). This area contains compacted paths for cars and trucks and, in the southwest corner of the Site, a gravel parking lot and access road that provides overflow parking for the Skokomish Tribe Community Center (Figure 2). The western portion of the Site (approximately five acres) is covered in early-to-mid successional Douglas fir (*Pseudotsuga menziesii*) forestland (Figure 2).

The Skokomish Tribe presently intends to develop the Site as part of a master plan that includes construction of a skate park, basketball court, workout facility, and accompanying roads, parking lots, and paths. The Skokomish Tribe is also considering using the land for tribal offices. The currently planned features are shown in Figure 7, along with the historical features discussed above. Ultimately, the Skokomish Tribe plans to place the entire Site (Areas 1 through 4) into trust with DOI.

1. Remedial Investigation Activities

The objective of the RI was to address data gaps identified in the RI Work Plan (Exponent 2019). The field work consisted of the following elements:

* **Geophysical Surveying:** Conducted in the fill zones across the Site to identify anomalous buried items such as drums, containers, tanks, or piping.
* **Test Pitting to Evaluate Geophysical Survey Anomalies:** Conducted to evaluate anomalies identified during the geophysical survey work.
* **Soil Boring and Soil Sampling:** Completed to characterize surface and subsurface soils and address data gaps identified in the RI Work Plan.
* **Surface Soil Sampling:** Collected to characterize the former stockpiled soils and the soils in the forested western portion of the Site (Area 4).
* **Groundwater Sampling:** Conducted to characterize shallow groundwater and address data gaps identified in the RI Work Plan.

The RI Sampling and Analysis Plan (SAP) is included in Section 10 of the RI Work Plan (Exponent 2019). Companion plans to the RI Work Plan included the QAPP (Appendix F of the RI Work Plan) and the Health and Safety Plan (HASP; Appendix G of the RI Work Plan). A copy of the work plan and its appendices is provided in Appendix H to this report, and a summary of deviations from the Work Plan (conducted with Ecology concurrence) is provided in Appendix F.

Land clearing was performed June 5 to 10, 2019, to prepare the Site for the geophysical surveys and the planned RI sampling program. Areas 1, 2, and 3 were dozed and grubbed. Trees with a diameter greater than approximately 4 inches were not removed. To facilitate vegetation clearance, the stockpiled soils, which are shown in Figure 4, were graded. Following grading of the formerly stockpiled soils, the depth of fill resulting from regrading was 3 ft or less.

Planned soil boring and surface soil sampling locations were surveyed, staked, and flagged by Parametrix on July 23, 2019. The ground surface and top of the casing at each of the permanent monitoring wells (SKOK-1 through SKOK-6) were also surveyed by Parametrix on July 23, 2019. Boring, surface soil, and monitoring well location coordinates and elevations are provided in Table 1. Field notes for all RI activities are provided in Appendix D.

* 1. Geophysical Surveys

Electromagnetic induction (EMI) and ground penetrating radar (GPR) geophysical surveys were performed at the Site from June 11 to 17, 2019, by ECA Geophysics to identify anomalous buried items such as drums, containers, tanks, or piping (if present). The approach and methodology for the geophysical investigation of the Site relied on two phases of data collection using EMI and GPR methods. The EMI survey was completed first as a reconnaissance survey. EMI identifies lateral changes in the soil conductivity and detects the presence of metal (magnetic susceptibility) in buried objects up to 12 ft bgs. Anomalies identified during the EMI survey were then imaged with GPR, which can detect competent features like buried piping, drums, or dense accumulations of trash up to 30 ft bgs at the Site. GPR was also used to image the upper 30 ft of the subsurface to determine approximate fill depths along three traverses through known fill areas at the Site. The results of each survey are described below. The detailed report prepared by ECA Geophysics summarizing the surveys and results is provided in Appendix B.

* + 1. EMI Survey

An EMI survey was completed in Areas 1, 2, and 3 (approximately 9.3 acres) with 10-ft spaced traverses (i.e., lines) in a consistent east-west direction (*EMI Anomaly Map, EMI traverses* in Appendix B). The apparently undeveloped forested area (Area 4) could not be surveyed due to the thick vegetative cover. The EMI survey of Areas 1, 2, and 3 identified 19 potential anomalies (Locations 1 through 19) that warranted follow up GPR surveying (*EMI Anomaly Map, Soil Conductivity [Q] and Metal Detection [I]* in Appendix B).

* + 1. GPR Survey

Anomalies identified during the EMI survey were then imaged with GPR. The follow up GPR survey was conducted to differentiate EMI anomalies attributable to lateral changes in soil conductivity as opposed to EMI anomalies attributable to buried items. The GPR survey consisted of isolated, 40-ft long sets of crisscross traverses over each of the 19 EMI anomaly locations, except for Locations 1, 2, and 19, where approximately 80-ft traverses were made because of dense vegetation limiting access in these areas (*EMI Anomaly Map, Soil Conductivity [Q] and Metal Detection [I]* in Appendix B). Of the 19 EMI anomaly areas that were subsequently surveyed by GPR, a total of five GPR anomalies were identified at Anomaly Locations 1, 3, 12, and 16, all at depths of 5 ft or less:

* **Anomaly Location 1:** likely a short section of piping buried at a depth of approximately 2.5 ft
* **Anomaly Location 3:** an unknown object buried at a depth of approximately 5.0 ft
* **Anomaly Locations 12a and 12b:** two separate, unknown objects, each buried at a depth of approximately 2.5 ft
* **Anomaly Location 16:** likely a short section of piping buried at a depth of approximately 2.5 ft.

To further evaluate these anomalies, exploratory test pits were dug in each of these locations, the results of which are discussed in the next section. The other EMI locations (Locations 2, 4 through 9, 11, 14 and 19) had significant EMI anomalies but produced no GPR anomalies indicating that lateral changes in soil conductivity were causing the EMI anomalies, rather than buried items.

Additionally, GPR traverses bisecting Areas 1, 2, and 3 were made to image the upper 30 ft of the subsurface and estimate the maximum depth of fill. The following three GPR transverses were implemented:

* A 744-ft north-south traverse bisecting Areas 1, 2, and 3
* A 412-ft west-east traverse bisecting Area 3
* A 318-ft west-east traverse bisecting Areas 1 and 2.

GPR profile images (radargrams) indicate that maximum fill depths in Area 1 range between approximately 11 and 15 ft (*N-S GPR Traverse* and *W-E “8-7-6-5” Traverse* in Appendix B), and maximum fill depths in Area 3 range between approximately 9 and 17 ft (*N-S GPR Traverse* and *W-E GPR Traverse* in Appendix B). These fill depths were consistent with fill depths observed in RI soil borings, which are discussed below.

* 1. Test Pits

Following completion of the geophysical survey, seven test pits were dug on July 22, 2019, to further investigate the GPR anomalies identified at Locations 1, 3, 12, and 16. Test pits were excavated using a mini excavator (trackhoe) operated by an employee of the Skokomish Tribe. After the test pits were inspected for debris that may have caused the anomaly, they were backfilled. No drums, containers, tanks, or piping were observed during the test pitting, nor was visual or olfactory evidence of contamination observed. Photographs are provided in Appendix D. The items observed in the test pits (if any) are described below:

* **Anomaly Location 1:** Test pit EX-TP-6 was excavated to a total depth of approximately 7 ft. A log was observed at 3 ft bgs, concrete and a granite boulder were observed at 3.5 ft bgs, and woody debris was observed at 3 and 4.5 ft bgs.
* **Anomaly Location 3:** Test pit EX-TP-7 was excavated to a total depth of approximately 6.5 ft. A log was observed at 3 ft bgs and woody debris likely from regrading performed in June 2019 was observed at 3 and 6 ft bgs.
* **Anomaly Location 12:** Test pits EX-TP-1 and EX-TP-2 were excavated to total depths of approximately 4.5 ft and 4.7 ft, respectively. An 18-in. piece of rebar was observed in test pit EX-TP-1 and no debris or objects were observed in test pit EX-TP-2.
* **Anomaly Location 16:** Test pit EX-TP-5 was excavated to a total depth of approximately 4.5 ft. No debris or objects were observed in this test pit.

Based on the results of the geophysical surveys (Section 3.1) and test pitting (no drums, containers, tanks, or piping were observed), the RI Work Plan approach was modified such that herbicides (both chlorinated and non-chlorinated) were to be analyzed in samples only if evidence of a container or drum was found in a soil core. This change was approved by Ecology in an email dated August 8, 2019 (Ecology 2019b).

* 1. Soil Borings and Soil Sampling

Soil borings were completed at 47 locations in Areas 1, 2, and 3 as shown in Figure 8. The borings were advanced by Cascade Drilling using direct push drilling methods between August 5 and 15, 2019. A continuous soil core was collected using a 2 in.-diameter, 5 ft‑long, stainless-steel soil sampler equipped with a disposable plastic liner. The sampler was hydraulically driven through the interval to be sampled and withdrawn from the soil boring. The liner with the soil core was then removed and cut open. The soil was immediately screened in the field using a photoionization detector (PID). Soil cores were logged using the Unified Soil Classification System (USCS) in accordance with American Society for Testing and Materials (ASTM) D2488-09a, *Standard Practice for Description and Identification of Soils* (ASTM 2009) and the RI Work Plan. Boring logs are provided in Appendix C.

Soil samples were collected from the soil cores following logging and screening activities. Soil samples were collected from each boring from the depth intervals specified in the RI Work Plan (e.g., 0 to 1, 1 to 5, 5 to 10, 10 to 15, and 15 to 20 ft bgs). Borings were advanced beyond the planned depth if a positive PID reading (i.e., a reading above zero) or visual or olfactory evidence of contamination was encountered in the deepest planned depth interval. The deepest soil sample collection interval was 20 to 25 ft bgs (in EX-B-23 in Area 2). An inventory of all soil samples collected during RI activities is provided in Table 2.

Each soil sample was placed in laboratory-supplied containers. To minimize volatilization of VOCs, samples analyzed for GRO and VOCs were collected from the soil core using Terracore® samplers and immediately placed in 40-mL volatile organic analyte (VOA) vials preserved with methanol. Soil for the remaining analyses was collected from the soil core with a stainless-steel spoon, homogenized in a stainless-steel bowl, and added to the required sample containers. Sample containers were filled to the top (as soil core recovery allowed). After sample containers were filled, they were immediately sealed, labeled, chilled, and prepared for courier delivery to the laboratory under chain of custody (COC). Reusable soil sampling equipment was decontaminated before and after each use using phosphate free detergent and two distilled water rinses. Downhole equipment was cleaned before use and decontaminated before leaving the Site.

Boreholes were abandoned immediately following soil and/or groundwater sampling in accordance with WAC 173-160-381 by sealing from borehole bottom to land surface with bentonite chips.

Soil sample analyses included the following:

* All soil samples were analyzed for metals, TPH as GRO, TPH as DRO, TPH as heavy oils, and percent solids.
* If a positive PID reading (i.e., a reading above zero), or visual or olfactory evidence of contamination was observed in a depth interval, then VOCs, SVOCs, and PAHs were analyzed.
* If charcoal was observed, then dioxins and furans were analyzed. The RI Work Plan called for dioxin and furan analysis if heavier petroleum or ash material were observed during sampling; neither of these conditions were observed during the RI sampling. However, trace charcoal was observed in some depth intervals, indicating the historical occurrence of either natural or anthropogenic burning. Therefore, dioxin and furans were analyzed if trace charcoal was observed within a depth interval.
* As discussed in Section 3.2, the RI Work Plan approach was modified such that herbicides (both chlorinated and non-chlorinated) were to be analyzed in soil samples only if visual evidence of a container or drum was found in a soil core. No evidence of a container or drum was found in a soil core; therefore, no soil samples were analyzed for herbicides.

An inventory of RI soil analyses is provided in Table 2.

* 1. Surface Soil Sampling

Surface soil sampling (i.e., 0 to 0.5 ft bgs) was conducted in the area of the former stockpiled soils and in Area 4. The samples were collected between August 12 and 15, 2019. A description of each of these sampling activities is below.

* + 1. Former Stockpiled Soils in Areas 1, 2, and 3

Twenty-four composite surface soil samples were collected in Areas 1, 2, and 3 from locations where former stockpiled soils were identified as shown in Figure 8. As discussed above in the introduction to Section 3, land clearing was performed to prepare the Site for the geophysical surveys and the RI sampling program. Areas 1, 2, and 3 were dozed and grubbed. Part of the land clearing included grading the hummocky, stockpiled soils, which were covered with vegetation that prevented conducting the planned RI activities (i.e., geophysical surveys, boring installation). Therefore, the planned stockpile sampling was replaced by composite surface soil sampling and was described in the RI Work Plan (Exponent 2019). No additional stockpiles were identified during the RI activities.

Each composite sample was composed of 10 approximately equal aliquots collected from 0 to 0.5 ft bgs with a stainless-steel trowel. Aliquots were collected from around the staked location. The 10 aliquots were collected in a stainless-steel bowl and the soil was screened in the field using a PID prior to homogenizing. To minimize volatilization of VOCs, samples analyzed for GRO were collected from the bowl using Terracore® samplers and immediately placed in 40-mL VOA vials preserved with methanol. Soil for the remaining analyses were homogenized with a stainless-steel spoon and placed in laboratory-supplied containers and sample containers were filled to the top. After sample containers were filled, they were immediately sealed, labeled, chilled, and prepared for courier delivery to the laboratory under COC. Reusable soil sampling equipment was decontaminated before and after each use using phosphate free detergent and two distilled water rinses.

A summary of the analyses is as follows:

* Metals, TPH as GRO, TPH as DRO, TPH as heavy oils, and percent solids were analyzed in all samples from the former soil stockpiles.
* VOCs, SVOCs, and PAHs were not analyzed because there were no positive PID readings (i.e., a reading above zero), or visual or olfactory evidence of contamination observed in the stockpiled samples.
* If charcoal was observed in an aliquot, then dioxins and furans were analyzed in the composite sample. As discussed above, the RI Work Plan called for dioxin and furan analysis if heavier petroleum or ash material were observed during sampling; neither of these conditions were observed during the RI sampling. However, trace charcoal was observed in some of the aliquots, indicating the historical occurrence of either natural or anthropogenic burning. Therefore, dioxin and furans were analyzed in the composite sample if trace charcoal was observed in an aliquot.
* As discussed in Section 3.2, the RI Work Plan approach was modified such that herbicides (both chlorinated and non-chlorinated) were to be analyzed in soil samples only if evidence of a container or drum was found. No evidence of a container or drum was found; therefore, no stockpiled soil samples were analyzed for herbicides.

An inventory of RI soil analyses is provided in Table 2.

* + 1. Surface Soils in Area 4

One surface soil composite sample was collected in Area 4. The composite sample was composed of 10 subsamples that were collected from locations EX-SS-1 through EX-SS-10 (Figure 8). Each subsample was collected with a stainless-steel trowel from 0 to 0.5 ft bgs and placed in a stainless-steel bowl, and the soil was screened in the field using a PID. The subsample was homogenized and equal aliquots (i.e., two spoonfuls) of each homogenized subsample were placed into a stainless-steel bowl to prepare the Area 4 composite sample. Soil analyzed for GRO was collected from the bowl using a Terracore® sampler and immediately placed in 40-mL VOA vials preserved with methanol. Soil for the remaining analyses were collected with a stainless-steel spoon and placed in laboratory-supplied containers and sample containers were filled to the top. After sample containers were filled, they were immediately sealed, labeled, chilled, and prepared for courier delivery to the laboratory under COC. Reusable soil sampling equipment was decontaminated before and after each use using phosphate free detergent and two distilled water rinses.

Discrete samples from locations EX-SS-3 and EX-SS-6 were also submitted for laboratory analyses.[[8]](#footnote-9) These two surface soil samples were collected because debris (i.e., 0.5 in. thick metal wire on the ground surface) was observed near location EX-SS-3 and trace charcoal was observed in EX-SS-6.

A summary of the analyses is as follows:

* Metals, TPH as GRO, TPH as DRO, TPH as heavy oils, and percent solids were analyzed in all soil samples.
* VOCs, SVOCs, and PAHs were not analyzed because there were no positive PID readings (i.e., a reading above zero), or visual or olfactory evidence of contamination observed in any of the samples.
* As discussed above, the RI Work Plan called for dioxin and furan analysis if heavier petroleum or ash material were observed during sampling; neither of these conditions were observed during the RI sampling. However, trace charcoal was observed in soil from EX-SS-6, indicating burning, likely natural, given its location in the wooded and largely undisturbed Area 4. Given the presence of trace charcoal, dioxin and furans were analyzed in this sample.

An inventory of RI soil analyses is provided in Table 2.

* 1. Groundwater Sampling

Groundwater samples were collected from six permanent monitoring wells and 18 temporary monitoring wells between August 5 and 15, 2019. The locations of these samples are shown in Figure 8. An inventory of RI groundwater samples and analyses is provided in Table 2. Groundwater sampling at the permanent and temporary monitoring wells is discussed below.

* + 1. Permanent Monitoring Wells

Groundwater samples were collected from the two permanent wells (SKOK-2 and SKOK-5) in Area 1, the two permanent wells (SKOK-4 and SKOK-6) in Area 2, and the two permanent wells (SKOK-1 and SKOK-3) in Area 3. Well construction details are summarized in Table 3 and the locations of these wells are shown in Figure 8. The ground surface and top of the casing at each of the permanent monitoring wells (SKOK-1 through SKOK-6) were surveyed as part of the RI activities (Table 1).

Prior to well purging, water level measurements were taken to the nearest 0.01 ft at each of the permanent monitoring wells. Purging was conducted at a low flow rate of less than 1,000 mL/min with either a peristaltic pump or bladder pump. Field measurements of pH, specific conductance, temperature, oxidation/reduction potential (Eh), dissolved oxygen (DO), and turbidity were taken during purging and are summarized in Table 4.[[9]](#footnote-10) Well purging continued until at least three well volumes were removed, and the field parameters stabilized. The turbidity goal of 5 Nephelometric turbidity units (NTU) or lower[[10]](#footnote-11) was achieved for samples collection at all 6 permanent monitoring wells. Each of the permanent monitoring wells produced water sufficient to purge the well, stabilize field parameters, and collect adequate sample volume for planned analytes.

Groundwater samples were collected using disposable silicon tubing at each well. Samples collected for dissolved metals analysis were filtered in the field using a disposable, in-line 0.45‑micron filter during sample collection. Laboratory-supplied containers appropriate for the required laboratory analyses were filled directly from the disposable silicon tubing. Care was taken not to overfill containers with preservative. After sample containers were filled, they were immediately sealed, labeled, chilled, and prepared for courier delivery to the laboratory under COC.

* 1. Temporary Monitoring Wells

Temporary monitoring well installation and groundwater sampling was attempted at 29 of the soil boring locations (Section 3.3) as specified in the RI Work Plan (Exponent 2019). These 29 planned locations included 15 locations in Area 1, seven locations in Area 2, and seven locations in Area 3. All planned groundwater sampling (15 samples) was completed in Area 1. Depth to groundwater in Area 1 temporary wells (after equilibration) ranged from 16.60 to 31.18 ft bgs (Table 4). The locations sampled in Area 1 are shown in Figure 8.

The depth to groundwater in Area 2 and the western portion of Area 3 was deeper than anticipated given available information from previous investigation activities. In Area 2, the depth to groundwater was anticipated to be between 20 and 25 ft bgs (Exponent 2019). However, refusal was encountered before groundwater was encountered in the seven planned locations in Area 2. Refusal depths in Area 2 ranged from 25 to 40 ft bgs (Table 2). In Area 3, the depth to groundwater in the western portion of was anticipated to be 29 ft bgs (Exponent 2019). However, refusal was encountered before groundwater was encountered in four of the seven planned locations in Area 3. Refusal depths in Area 3 ranged from 24 to 45 ft bgs (Table 2). The three locations that were sampled in Area 3 (EX-B-26, EX-B-27, and EX-B-45) are located along the eastern property boundary (Figure 8).

As noted in the RI Work Plan (Exponent 2019), perched groundwater was observed during previous investigation activities at the Site (August 2013, November 2013, and April 2014). Depths to previously observed perched water ranged from 4 ft bgs (TP-27 in Area 3; ESA 2013c) to 15 ft bgs (B-7 in Area 3; ESA 2014a). Perched water was not encountered during RI activities.

At locations where groundwater was encountered, soil borings (Section 3.3) were advanced approximately 5 ft beyond the depth where groundwater was observed to enable temporary well construction and grab groundwater sample collection. A temporary, small diameter (0.75 in.) polyvinyl chloride (PVC) well with a 5-ft screen was installed, and the groundwater was allowed to equilibrate. Prior to well purging, a water level measurement was taken with a water level probe and the depth to groundwater (from the ground surface) was recorded.

Well purging was conducted at a low flow rate of less than 1,000 mL/min with a peristaltic pump. Field measurements of pH, specific conductance, temperature, Eh, DO, and turbidity were taken during purging and the final field measurements taken prior to sample collection are summarized in Table 4. The turbidity goal for groundwater samples was 5 NTU or lower, where practicable, and was achieved at 12 of the 18 temporary wells (Table 4). In the six temporary wells that exceeded the 5 NTU goal, turbidity values ranged from approximately 6 to 44 NTU (Table 4). Each of the temporary monitoring wells produced water sufficient to purge the well and collect adequate sample volume for planned analyses.

Groundwater samples were collected using disposable silicon tubing at each temporary well. Samples collected for dissolved metals analysis were filtered in the field using a disposable, in-line 0.45-micron filter during sample collection. Laboratory-supplied containers appropriate for the required laboratory analyses were filled directly from the disposable silicon tubing. Care was taken not to overfill containers with preservative. After sample containers were filled, they were immediately sealed, labeled, chilled, and prepared for courier delivery to the laboratory under COC.

* 1. Investigation Derived Waste

Excess soil sample material was contained in a labeled 55-gal drum and stored in Area 2 of the Site, pending disposal. Purge water and decontamination rinse water was contained in a labeled 55-gal drum and stored in Area 2 of the Site, pending disposal.

* 1. Sample Analyses and Data Validation

Soil, groundwater, and quality control samples collected during August 2019 RI sampling activities were analyzed by Eurofins TestAmerica, an environmental laboratory accredited by Ecology. Samples were analyzed via the following analytical methods:

* Petroleum hydrocarbons: NWTPH-Gx, NWTPH-Dx
* Metals: EPA Method 6020A, 7470A/7471A (mercury)
* VOCs: EPA Method 8260C
* SVOCs: EPA Method 8270D
* PAHs: EPA Method 8270D-SIM
* Dioxins and furans: EPA Method 8290A.

The data were reviewed and validated using guidance and quality control criteria documented in the analytical methods, the QAPP (Appendix F of Exponent 2019), the *National Functional Guidelines for Organic Superfund Data Review* (U.S. EPA 2008, 2014), the *National Functional Guidelines for Inorganic Superfund Data Review* (U.S. EPA 2010), and the *National Functional Guidelines for Chlorinated Dibenzo-p-Dioxins (CDDs) & Chlorinated Dibenzofurans (CDFs) Data Review* (U.S.EPA 2011). A detailed data validation report (prepared by EcoChem) is provided in Appendix E. Laboratory analytical data and chains of custody is provided in Appendix I. The data, as qualified, were determined acceptable for use. The qualified data are presented and discussed in Section 4.

* 1. Determination of Screening Levels

Human health screening levels were selected as described in the sections below to evaluate the RI data and assess the nature and extent of contamination at the Site. A site-specific TEE has also been prepared to assess potential impacts to natural habitats, soil biota, and wildlife at the Site and to determine chemicals of ecological concern; this evaluation is presented in Section 5.

As discussed in Section 2.5, soil and groundwater samples collected during the RI were analyzed for select COIs based on historical land use and activities, and prior investigation results. Screening levels were developed in consideration of current and potential future exposure pathways and receptors, as presented in the CSM discussion in Section 6, and potentially applicable or relevant and appropriate regulatory criteria. The screening levels are conservative, representing the most stringent of human health criteria for all potentially complete exposure pathways. The determination of the screening levels for soil and groundwater COIs is discussed below.

* + 1. Soil

Method B (universal method) for unrestricted land use (WAC 173-340-740(3)) was used to determine soil screening levels protective of human health. Standard Method B cleanup levels (WAC 173-340) were used as soil screening levels except in the following instances:

* Where Standard Method B soil cleanup levels are not published, the Method A cleanup levels (WAC Table 740-1) were used as soil screening levels. Specifically, the Method A cleanup levels for TPH (as GRO, DRO, and heavy oils), lead, and mercury were used as the soil screening level.
* Where the Standard Method B soil cleanup value was below natural background, the screening level was established to be equal to the natural background value (WAC 173‑340-700(6)(d)) using the following:
* Natural background values published in *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994). Specifically, the published background value for arsenic was used as the Site soil screening level.
* Natural background values calculated for chromium, mercury, and selenium in accordance with WAC 173-370-709 using relevant data from the U.S. Geological Society (USGS) National Geochemical Database for Soil (USGS 2016); this evaluation is presented in Appendix G. The calculated background value for chromium was used as the Site soil screening level.[[11]](#footnote-12)

Human health screening levels selected for soil are provided in Table 5 and referred to in this report as “soil screening levels.”

* + 1. Groundwater

Method B (universal method) based on the beneficial use of groundwater as a source of drinking water (WAC 173-340-720(1)(a)) was used to determine groundwater screening levels. Standard Method B cleanup levels (WAC 173-340) were used as groundwater screening levels except in the following instances:

* Where Standard Method B groundwater cleanup levels are not published, the Method A cleanup levels (WAC Table 720-1) were used as groundwater screening levels. Specifically, the Method A cleanup levels for TPH (as GRO, DRO, and heavy oils), chromium, lead, and mercury were used as the Site groundwater screening level.
* Where the Standard Method B groundwater cleanup value is below natural background, the groundwater screening level was established to be equal to the natural background value (WAC 173-340-700(6)(d)). The Method A cleanup level for arsenic, which is based on natural background concentrations for the State of Washington (WAC Table 720-1), was used as the groundwater screening level.
* Where the Federal and Washington State Maximum Contaminant Levels (MCLs) were below the Standard Method B cleanup value, the MCL was used as the groundwater screening level. The MCLs for barium, cadmium, selenium, and eight VOCs[[12]](#footnote-13) were used as the groundwater screening level.

Screening levels selected for groundwater are presented in Table 6.

1. Remedial Investigation Results

This section presents the results of the RI soil and groundwater investigation, and a discussion of the nature and extent of COIs in Site soil and groundwater. Summaries of soil and groundwater analyses and detections is provided in Tables 7 and 8, respectively. Soil and groundwater results are discussed in the following sections.

* 1. Soil Investigation Results

Soil borings were completed during the RI to depths between 5 and 45 ft bgs. Soil sampling locations and depth intervals are identified on Figure 8, in Table 2, and on the boring logs provided in Appendix C.

The following sections present findings for Site stratigraphy and discussion of the nature and extent of COIs in Site soil.

* + 1. Site Stratigraphy

Soils encountered during RI activities were primarily fill consisting of varying mixtures of gravels, sands, and silts (Figures 9 through 14 and Appendix C). Native, undisturbed soils were positively identified at one boring location, EX-B-21 in Area 2. Boring EX‑B‑21 was completed in the southwestern part of the Site (Figure 8) and contained fill material from 0 to 5 ft bgs and poorly graded sand with identifiable native soil horizons observed below 5 ft bgs (see the boring log in Appendix C and cross section discussion below).

Five geologic cross sections were prepared at the locations shown in Figure 9:

* Cross Section A-A’ (Figure 10): a west-northwest-east-southeast section through Areas 1 and 2
* Cross Section B-B’ (Figure 11): a north-south section through Areas 1 and 3
* Cross Section C-C’ (Figure 12): a north-northeast-south-southwest section through Area 2
* Cross Section D-D’ (Figure 13): a west-east section through Area 3
* Cross Section E-E’ (Figure 14): a north-south section through Areas 1, 2, and 3.

Area 1 contains fill material comprised of sands and silts near the surface, and gravels and sands at depth (Cross Sections A-A’ and B-B’, Figures 10 and 11). GPR profile images (Section 3.1.2 and Appendix B) within Area 1 indicate that fill is present between approximately 11 and 15 ft bgs (*N-S GPR Traverse, Section C* and *W-E “8-7-6-5” Traverse, Sections A and B* in Appendix B). The fill depths estimated with GPR were consistent with field observations (Cross Sections A-A’ and B-B’, Figures 10 and 11).

Area 2 contains fill material comprised of gravels, sands, and silts (Cross Sections A-A’ and C-C’, Figures 10 and 12). The mixtures of gravels, sands, and silts indicate that fill depths in Area 2 are variable and as deep as 25 ft bgs (Cross Section A-A’, Figure 10). The fill depth estimated with GPR at the northern edge of Area 2 was 15 ft, which is consistent with shallower fill depths on the north side of this former burial area.

The former quarry area in Area 3 contains fill material comprised of silty sands and silty gravels (Cross Sections D-D’ and E-E’, Figures 13 and 14). Fill depths are variable across the former quarry area. GPR profile images of Area 3 indicate that fill depths in the northern portion of the former quarry area (*N-S GPR Traverse, Section A* in Appendix B) are approximately 15 ft and fill depths in the eastern portion of the former quarry area (*N-S GPR Traverse, Section B* and *W-E GPR Traverse, Sections A + B* in Appendix B) are between approximately 9 and 17 ft. Field observations of the gravel, sand, and silt mixtures indicate that fill depths in the former quarry area are as deep as 25 ft bgs (EX-B-42 shown in Cross Section E-E’, Figure 14). RI boring locations (field observations) and GPR survey areas were not co-located.

The eastern portion of Area 3, where landslide soil and debris were placed, is comprised of gravel, sand, and silt mixtures (Cross Sections B-B’ and D-D’, Figures 11 and 13). GPR profile images indicate that fill is present in the western and southeastern portions of the landslide soil and debris area from approximately 10 to 15 ft bgs (*N-S GPR Traverse, Section A* and *W-E GPR Traverse, Section C* in Appendix B). The fill depths estimated with GPR were consistent with field observations (Cross Sections B-B’ and D-D’, Figures 11 and 13).

* + 1. Nature and Extent of Soil Constituents of Interest

A summary of RI soil sampling is presented in Table 7, including the count of detected and undetected results, and minimum and maximum concentrations. Comparisons of RI soil sample concentrations to soil screening levels are presented in Tables 9 through 15 and Figures 15 through 18. The nature and extent of soil COIs are discussed below by COI category, followed by a soil investigation summary.

* + - 1. Petroleum Hydrocarbons

Petroleum hydrocarbon impacts attributable to historical activities were detected at various locations across Areas 1, 2, and 3 (Tables 7 and 9). Historical site evaluation and RI data indicate that potential petroleum sources are historical management of fluids used in vehicle maintenance including petroleum products stored in former USTs (Area 1), waste and material dumping (Area 2), fill (Areas 1, 2, and 3), and landslide debris brought onto the property (Area 3) (Figure 8). In these areas, localized soil staining and petroleum hydrocarbon odors were observed at some locations (Appendix C), and elevated petroleum hydrocarbons were detected in soils with GRO up to 440 mg/kg, DRO up to 2,500 mg/kg, and heavy oils up to 3,100 mg/kg (Table 9). The highest petroleum concentrations were identified in the waste dumping area in the western portion of Area 2, in the vicinity of the former Vehicle Maintenance Building in Area 1, and at locations on the north and south sides of Area 3 where fill and landslide debris were placed.

Many petroleum hydrocarbon detections across the Site are believed to be attributable to natural organics and anthropogenic debris observed in the soil matrix. Specifically, some low-level petroleum hydrocarbon concentrations (<200 mg/kg) detected in the RI appear to be natural organics in soil as evidenced by the following:

* Lack of field observations of TPH impact in soils (i.e., no staining or odor)
* Low petroleum hydrocarbon levels detected in soil samples collected in undeveloped, forested Area 4 (up to 7.9 mg/kg GRO, 25 mg/kg DRO, and 170 mg/kg heavy oils).

Pieces of asphalt were encountered in soils across the Site (Appendix C). The sampling team made an effort to avoid this material during sample collection; however, small particles are expected to be present and entrained in the soil matrix. Petroleum in asphalt is released in solvent extraction and is quantified in the hydrocarbon analysis. As an example, asphalt was observed in one of the surface samples with heavy oils detected at 1,300 mg/kg (sample EX‑B-34-0-1, Table 9), although no staining or odors were noted in the field (Appendix C).

Three samples exceed one or more GRO, DRO, and heavy oils soil screening levels: EX‑B‑5‑0-1 in Area 1, EX-B-18-1-5 in Area 2, and EX-B-35-1-5 in Area 3. The soil screening level exceedances are summarized in Table 9, shown in Figure 15, and discussed below.

Sample EX-B-5-0-1 from 0 to 1 ft bgs in Area 1 (Figure 15) was collected in the area of the former diesel dispenser and fill (Table 2 and Section 2.3.1). Pieces of asphalt were observed on the ground surface at this location (Appendix C). Concentrations of GRO, DRO, and heavy oils were quantified in this sample at 13 mg/kg, 510 mg/kg, and 3,100 mg/kg, respectively (Table 9).

Sample EX-B-18-1-5 from 1 to 5 ft bgs in Area 2 (Figure 15) was collected in a former waste dumping area for unused asphalt, where diesel was sprayed on truck beds to remove the asphalt (Table 2 and Section 2.3.2). A tar-like material with a PID reading of 10.2 ppm and petroleum odor was observed in the boring at approximately 5 ft bgs (Appendix C). This boring location is at the periphery of an area that was remediated in 2014 (Exponent 2019), annotated as the “Drum Area 2 Excavation” on Figure 15. Concentrations of GRO, DRO, and heavy oils were quantified in this sample at 440 mg/kg, 1,200 mg/kg, and 3,100 mg/kg, respectively (Table 9).

Sample EX-B-35-5-10 from 5 to 10 ft bgs in Area 3 (Figure 15) was collected in a landslide debris dumping area (Section 2.3.3) where fill material was encountered during the RI (Section 4.1.1) and previous investigations (Table 2 and Exponent 2019). This sample had a PID reading of 131.6 ppm (see Table 2). A small piece (2 cm long) of rubbery material with a strong odor was observed in this soil core at 9 ft bgs (Appendix C). The effect of the small piece of rubbery material appeared to be limited to the soil immediately surrounding it given the sharp decrease in PID readings away from the material. This material was not observed at any other location during RI activities (Appendix C). Concentrations of GRO, DRO, and heavy oils were quantified in this sample at 230 mg/kg, 2,500 mg/kg, and 1,700 mg/kg, respectively (Table 9).

* + - 1. Metals

Metals were detected in soils across the Site (Tables 7 and 10). Arsenic, barium, cadmium, chromium, mercury, selenium, and silver concentrations were consistent with natural background values (Tables 5 and 10; Appendix G). Concentrations of these metals were generally similar across the Site, including in the undeveloped, forested Area 4 (Table 10).

Lead was detected in all 193 samples collected at the Site with a range of concentrations from 1 to 120 mg/kg (Tables 7 and 10). Most sample results ranged from 1 to 17.1 mg/kg, which is the natural background value for Washington State (Table 5). The natural background for lead in Site soil was measured in samples collected from the undeveloped, forested Area 4 and ranged from 12 to 24 mg/kg (Table 10). Across the Site, 16 samples were greater than the natural background concentration of 24 mg/kg for lead measured in Area 4 (Table 10). Elevated lead in these soil samples is likely associated with waste and material dumping (Area 2), fill (Areas 1, 2, and 3), exterior lead-based paint on the former maintenance building demolished in 2001 (Area 1), and landslide debris brought onto the property (Area 3) (Figure 8). The highest lead concentrations were identified in the waste dumping area and access road in the western portion of Area 2 (up to 120 mg/kg). All detected lead concentrations are below the soil screening level of 250 mg/kg (Table 10).

* + - 1. Volatile Organic Compounds

VOCs were detected at trace and low-level concentrations at three locations in Area 2 and five locations in Area 3 (Tables 7 and 11). Trace concentrations were detected below laboratory reporting limits for 1,2,4‑trimethylbenzene, 4-chlorotoluene, 4-isopropyltoluene, carbon disulfide, chlorobenzene, ethylbenzene, N-butylbenzene, N-propylbenzene, and naphthalene in the waste and material dumping and fill area (Area 2). Low-level concentrations of 4-isopropyltoluene, carbon disulfide, toluene, and trichlorofluoromethane were detected in the area where landslide debris was placed on the property (Area 3). None of the detected trace and low-level VOC concentrations exceed soil screening levels, where available (Table 11).

Acetone and 2-butanone were also detected at trace concentrations below laboratory reporting limits in several samples (Table 11). These constituents are common laboratory contaminants and the trace detections are likely attributable to laboratory contamination.

* + - 1. Semivolatile Organic Compounds

SVOCs were detected at low concentrations at one location in Area 1, two locations in Area 2, and seven locations in Area 3 (Tables 7 and 12). Trace concentrations were detected below laboratory reporting limits for 1-methylnaphthalene, fluoranthene, N-nitrosodiphenylamine in fill near the former drywell (Area 1). Low-level concentrations (below reporting limits) of 2,4,5-trichlorophenol, anthracene, benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[ghi]perylene, chrysene, fluoranthene, indeno[1,2,3-cd]pyrene, N-nitrosodiphenylamine, phenanthrene, and pyrene were detected in soils in the waste and material dumping area (Area 2). Low-level concentrations (below reporting limits) of 1-methylnaphthalene, 2‑chloronaphthalene, 3- & 4-methylphenol, aniline, anthracene, benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[ghi]perylene, benzyl alcohol, bis (2-chloroethyl) ether, chrysene, di-n-butyl phthalate, di-n-octyl phthalate, fluoranthene, indeno[1,2,3-cd]pyrene, N-nitrosodiphenylamine, naphthalene, phenol, and pyrene were detected in areas where landslide debris was placed on the property (Area 3). Localized soil staining and odors were observed at some locations where SVOCs were detected (Appendix C). None of the detected trace and low level SVOC concentrations exceed soil screening levels, where available (Table 12), except bis(2-chloroethyl) ether in one soil sample (discussed below).

One SVOC, bis (2-chloroethyl) ether, was detected and exceeds the soil screening level in one soil sample out of 33 analyzed (Tables 7 and 12, Figure 16). Sample EX-B-35-5-10 from 5 to 10 ft bgs in Area 3 (Figure 16) was in a landslide soil and debris dumping area (Section 2.3.3) where fill material was encountered during previous investigations (Table 2 and Exponent 2019) and during the RI. As discussed above in Section 4.1.2.1, this sample had a PID reading of 131.6 ppm (Table 2), and a small piece (2 cm long) of rubbery material with a strong odor was observed in the soil core at 9 ft bgs (Appendix C).

Bis (2-ethylhexyl) phthalate was detected at trace concentrations below laboratory reporting limits in several samples (Table 12). This constituent is a common laboratory contaminant and the trace detections are likely attributable to laboratory contamination.

Note that PAHs were analyzed along with the SVOCs discussed above by EPA Method 8270D, and by EPA Method 8270D-SIM to achieve lower laboratory detection limits for analysis and comparison to soil screening levels. Elevated PAHs were detected in the SVOC analysis; however, a discussion of PAHs in Site soil is provided in the next section only.

* + - 1. Polycyclic Aromatic Hydrocarbons

PAHs analyzed by EPA Method 8270D-SIM were detected at locations in Areas 1, 2, and 3 (Tables 7 and 13). PAHs were detected in areas of waste and material dumping (Area 2), fill (Areas 1, 2, and 3), and landslide debris brought onto the property (Area 3). Localized soil staining and odors were also noted at some locations where PAH detections were observed. Most of the PAH detections appear to be present as a component of petroleum. Specifically, the PAH detections were observed near the former drywell in Area 1, in the waste dumping area and access road in the western portion of Area 2, and at locations on the north and south sides of Area 3 where fill and landslide debris were placed.

As required in MTCA (WAC 173-340-708(8)), total toxicity equivalent concentrations (TEQs) were calculated for carcinogenic PAHs (cPAHs) based on benzo[a]pyrene (Table 13).[[13]](#footnote-14) One sample exceeds the soil screening level for cPAHs (Figure 17 and Table 13). The TEQ for cPAHs in sample EX-B-18-1-5 was 0.215 mg/kg (Table 13). This sample was collected from 1 to 5 ft bgs in Area 2 (Figure 17), the former waste disposal area where unused asphalt was disposed and where diesel was used to spray truck beds down to remove asphalt (Table 2 and Section 2.3.2). As discussed above in Section 4.1.2.1, a tar-like material with a PID reading of 10.2 ppm and petroleum odor was observed in the boring at the bottom of this depth interval (approximately 5 ft bgs) (Appendix C).

* + - 1. Dioxins and Furans

Dioxins and furans were detected in soils across the Site (Tables 7 and 14) in areas of waste and material dumping (Area 2), fill (Areas 1, 2, and 3), and debris burning (Area 3). In these areas, ash and/or small pieces of charcoal were observed at many locations (Appendix C). As required by MTCA (WAC 173-340-708(8)), TEQs for dioxins/furans were calculated based on 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) (Table 15). TEQ values for total dioxins/furans in Site soils were mostly below the published natural background value of 5.2 x 10-6 (Ecology 2010) and the soil screening level of 1.3 x 10-5 (Table 15). The highest total dioxins/furans were present in fill near the former drywell in Area 1, in the waste dumping area in the eastern portion of Area 2, and at locations on the north side of Area 3 where debris was burned.

Total dioxins/furans exceed the soil screening level in two samples (Table 15 and Figure 18). Sample EX-B-15-0-1 from 0 to 1 ft bgs was collected in Area 2, the former waste disposal area (Table 2 and Section 2.3.2), and a 2-in interval of soil with ash/charcoal was observed in the sampling interval (Appendix C). Sample EX-B-41-0-1 from 0 to 1 ft bgs was collected in Area 3, the location of a former burn pile (Table 2 and Section 2.3.3). Total dioxins/furans detected in these two samples are 8.0 x 10-5 mg/kg and 2.0 x 10-5 mg/kg, respectively (Table 15).

As discussed in Section 2.4, some burn material with dioxin/furan detections remained in‑place after 2014 removal activities in Area 3, as shown on Figure 6. One past investigation sample from soil that remained in place, DT-2-1, located in Trench 2 at 8 ft bgs, is shown on Figure 6 because it exceeds the soil screening level for total dioxins/furans. The concentrations of dioxins/furans in other burn material remaining in-place (Figure 6) are below the published natural background value of 5.2 x 10-6 (Ecology 2010).

* + 1. Soil Investigation Summary

The nature and extent of COIs and COPCs in Site soil has been determined using the results of past investigations and the RI.

Soils encountered during RI activities were primarily fill consisting of varying mixtures of gravels, sands, and silts (Figures 9 through 14 and Appendix C). Borings depths were between 5 and 45 ft bgs (Table 2), and the deepest soil sampled was 25 ft bgs (Figures 9 through 14 and Appendix C). The fill depths estimated with GPR (Appendix B) were consistent with field observations (Appendix C).

Petroleum hydrocarbons, lead, and dioxins/furans are the primary Site-related COIs in soil. Impacts attributable to historical activities were detected at various locations across Areas 1, 2, and 3. Historical site evaluation and RI data indicate that potential sources are historical management of fluids used in vehicle maintenance including petroleum products stored in former USTs (Area 1), waste and material dumping (Area 2), fill (Areas 1, 2, and 3), landslide debris brought onto the property (Area 3), and former debris burning (Area 3).

Six COIs exceed a soil screening level: GRO, DRO, heavy oils, bis(2-chloroethyl) ether, cPAHs, and total dioxins/furans. Therefore, these COIs are identified as constituents of potential concern (COPCs) for further evaluation. One or more COPCs exceeds a soil screening level in five RI samples (Figures 15 through 18):

* Near the former diesel dispenser and in fill in Area 1:
* Sample EX-B-5-0-1 from 0 to 1 ft bgs exceeded the soil screening level for heavy oils
* In the former waste dumping area in Area 2:
* Sample EX-B-15-0-1 from 0 to 1 ft bgs exceeded the soil screening level for total dioxins/furans
* Sample EX-B-18-1-5 from 1 to 5 ft bgs exceeded the soil screening level for GRO, heavy oils, and cPAHs
* In the landslide debris dumping area in Area 3:
* Sample EX-B-35-5-10 from 5 to 10 ft bgs exceeded the soil screening levels for GRO, DRO, and bis (2-chloroethyl) ether
* At the location of a former burn pile in Area 3:
* Sample EX-B-41-0-1 from 0 to 1 ft bgs exceeded the soil screening level for total dioxins/furans.
  1. Groundwater Investigation

The following sections present findings for site hydrogeology and nature and extent of groundwater COIs, followed by a groundwater investigation summary.

* + 1. Site Hydrogeology

Groundwater was encountered on the Site at depths between about 19 and 36 ft bgs in permanent monitoring wells (Table 4). Water level measurements indicate that groundwater flows in an easterly to southeasterly direction (Figure 19), consistent with previous observations (Ecology 2000; HWA 2013, ESA 2013b). The groundwater at the Site is unconfined and influenced by precipitation and surface infiltration. The horizontal gradient between SKOK-1, which is the western-most monitoring well at the Site, and SKOK-5, which is approximately 400 ft to the east near the Site boundary (Figure 19), was approximately 0.011 ft/ft during RI groundwater sampling.

* + 1. Nature and Extent of Groundwater Constituents of Interest

A summary of RI groundwater sampling is presented in Table 8, including the count of detected and undetected results, and minimum and maximum concentrations. Comparisons of RI groundwater sample concentrations to groundwater screening levels are presented in Tables 16 through 18. RI data indicate that Site groundwater appears to be minimally affected by historical activities at the Site. The nature and extent of groundwater COIs is discussed below by chemical category.

* + - 1. Petroleum Hydrocarbons

Trace concentrations of DRO (110 to 150 µg/L) were detected below laboratory reporting limits in five locations in Area 1 and one location in Area 3 (Tables 8 and 16). Historical site evaluation and RI data indicate that potential petroleum sources are historical management of fluids used in vehicle maintenance (Area 1), fill (Areas 1 and 3), and landslide debris brought onto the property (Area 3) (Figure 8). Specifically, detections of DRO were observed in groundwater in the vicinity and downgradient of the former Vehicle Maintenance Building in Area 1, adjacent to the former shed in Area 1, and downgradient of where fill and landslide debris were placed in Area 3. As discussed in Section 4.1.2.1, localized soil staining and petroleum hydrocarbon odors were observed at some locations (Appendix C), and elevated petroleum hydrocarbons were detected in soils across the Site (Table 9). Surface infiltration of water and desorption of petroleum hydrocarbons from soils could have resulted in the observed trace groundwater DRO detections, which are below the groundwater screening level of 500 µg/L (Table 16).

* + - 1. Metals

Dissolved metals in groundwater across the Site were mostly undetected or detected at levels similar to or below laboratory reporting limits, and all detections are below Federal and Washington State MCLs (Table 17). There is a single exceedance of Method B cleanup levels, specifically for thallium at temporary well location EX-B-2 (Table 17). A review of past investigations during preparation of the RI Work Plan (Exponent 2019) demonstrated that turbidity in Site groundwater samples resulted in some elevated metals detections during past groundwater monitoring events. Therefore, sampling personnel implemented measures to reduce turbidity to the degree possible during the RI field program. As a result, turbidity was reduced (Table 4) and effects from soil particulates were minimized in samples collected from temporary wells. Effects from soil particulates resulting in groundwater screening level exceedances were observed in only one sample collected from temporary well location EX‑B‑2 with thallium above the groundwater screening level (Table 17). This is not unexpected for temporary wells that are not permanently constructed and developed. Samples influenced by soil particulates entrained in groundwater are not representative of aquifer water quality.

* + - 1. Volatile Organic Compounds

Trace concentrations of toluene and trichloroethene (TCE) were detected below laboratory reporting limits in groundwater at five locations in Area 1 (Table 18). Trace toluene was detected in one location downgradient of the former unleaded UST and is likely associated with historical fluids management in this area. Trace TCE was detected in two locations downgradient of the Vehicle Maintenance Building and in two locations near the former drywell; TCE is likely associated with historical parts washing/degreasing. Toluene was not detected in RI soil samples from Area 1 (Table 11); however, toluene has been detected in past investigations in soils near the former USTs (Exponent 2019). TCE has not been detected in Site soils (see Table 11 and Exponent 2019). Trace concentrations of toluene and TCE in groundwater are below laboratory reporting limits and orders of magnitude below groundwater screening levels (Table 18).

* + 1. Groundwater Investigation Summary

Groundwater flows in an easterly to southeasterly direction generally toward Hood Canal, which is consistent with previously reported groundwater flow direction (Ecology 2000; HWA 2013, ESA 2013b) (Figure 19). The groundwater at the Site is unconfined and influenced by precipitation and surface infiltration. Trace concentrations of petroleum hydrocarbons (DRO) attributable to historical activities were detected below reporting limits in five locations in Area 1 and one location in Area 3. Potential petroleum hydrocarbon sources are historical management of fluids used in vehicle maintenance (Area 1) and fill (Area 1). Trace concentrations of VOCs attributable to historical activities were detected in five locations in Area 1. Likely sources of trace VOCs observed in groundwater are fluids previously managed and used in vehicle maintenance including petroleum products stored in former USTs (toluene) and solvents historically used for parts washing/degreasing (TCE). A single exceedance of Method B cleanup levels for thallium at temporary well EX-B-2 is attributable to soil particulates entrained in groundwater samples and isnot representative of aquifer water quality. Based on these RI findings, no COPCs are identified for groundwater.

1. Terrestrial Ecological Evaluation

This section presents the Site-specific TEE that has been prepared in accordance with WAC 173-340-7493 in consultation with Ecology (Ecology 2018). The purpose of this TEE is to determine whether a release of hazardous substances to soil may pose a threat to the terrestrial environment, to characterize existing or potential threats to terrestrial plants or animals exposed to hazardous substances in soil, and to establish site-specific cleanup standards for the protection of terrestrial plants and animals (WAC 173-340-7490).

* 1. Regulatory Framework

MTCA’s TEE process provides the regulatory framework to evaluate potential threats from soil impacts to ecological receptors. This process must be completed at cleanup sites with formal Ecology oversight and sites in Ecology’s VCP seeking an NFA determination. The first steps in this process are to characterize the site and conduct an exclusion evaluation to determine if further TEE is warranted, and if so, select the evaluation method (i.e., simplified or site-specific).

MTCA’s TEE exclusionary criteria (WAC 173-340-7491) were reviewed against Site information and RI soil data and it was determined that none of the criteria apply to exclude the Site from further TEE. Further, the exclusion evaluation demonstrated that a site-specific TEE was required. A summary of the Site exclusion evaluation is presented below.

If a site meets any of the following MTCA four primary exclusion criterion, no further ecological evaluation is required (Ecology 2017):

* Contamination below the point of compliance
* Incomplete exposure pathway
* Type of contamination and proximity to ecological receptors, and,
* Concentrations below background levels.

The first exclusion criterion involves the determination that the contamination exists only below the point of compliance. MTCA’s standard point of compliance in soil for ecological evaluation is 15 ft, which is assumed to be “a reasonable estimate of the depth of soil that could be excavated and distributed at the soil surface as a result of site development activities, resulting in exposure by ecological receptors.” (WAC 172-340-7490(4)(b)). This exclusion criterion does not apply at the Site because soil contamination is present above 15 ft in some areas of the Site.

The second exclusion criterion applies in cases where there is an incomplete exposure pathway preventing exposure of ecological receptors to soil contamination. Exposure pathways may be rendered incomplete by the construction of physical barriers, buildings, paved areas, etc. Although there is gravel cover in the southern portion of the Site used for parking and the Site is partially fenced, this criterion does not apply because existing physical barriers do not prevent exposure of ecological receptors to soil contamination at the Site. Thus, the Site does not meet this exclusion criterion.

The third exclusion may apply when a site is located on or near a limited area of undeveloped land. For this exclusion to apply, sites with soil impacts must have contiguous undeveloped land less than the allowable area (0.25 or 1.5 acres, depending on the contaminant(s) present) or within 500 ft of any area on the site. The Site does not meet this exclusion criterion because the Site contains and is located adjacent to a greenbelt with a Douglas fir forest (Figure 2) that is larger than 1.5 acres (Section 2.1).

The fourth exclusion criterion applies if all contaminant soil concentrations are below natural background levels. The Site does not meet this exclusion criterion because contaminant concentrations were measured above natural background concentrations during the RI (Section 4.1.2.2).

The Site does not qualify for an exclusion from a TEE under WAC 173-340-7491; therefore, the next step is to select the TEE method, simple or site-specific. The process for determining the required method is provided in WAC 173-340-7492. According to procedures outlined in WAC 173-340-7491(2), either the presence of threatened, endangered, or otherwise protected species, or proximity to native vegetation, trigger the need for a site‑specific TEE. The presence of undeveloped land on and connected to the western portion of the Site (Douglas fir forestland, Figure 2) necessitates a site-specific TEE.

A site-specific TEE consists of two steps: 1) completing the problem formulation step to define the site-specific evaluation and identify issues that will be addressed to determine if further evaluation is necessary (chemicals of ecological concern, receptors, exposure pathways, and toxicological assessment), and 2) selecting appropriate terrestrial ecological evaluation methods, if warranted. These two steps are discussed in the following sections.

* 1. Chemicals of Ecological Concern

To identify COECs, COI concentrations were compared to EISCs published in WAC Table 749-3. The EISCs are expected to be protective at any MTCA site. Natural background concentrations for dioxins/furans (Ecology 2010), and chromium, mercury, and selenium (Appendix G) were substituted for EISCs as permitted in MTCA.[[14]](#footnote-15) The EISCs are summarized in Table 5. Sample by sample comparison of COIs to their respective EISCs, where available, are presented in Tables 9 through 15.

As specified in MTCA, a COI is identified as a COEC where the maximum or 95% UCL[[15]](#footnote-16) soil concentration at the Site exceeds applicable EISCs. The statistical method was used to identify COECs rather than direct comparison using the maximum sample concentration. Using the statistical method, four COIs exceed an EISC and are identified as COECs: GRO, DRO, lead, and total dioxins/furans (Table 19 and Appendix G).

* 1. Terrestrial Ecological Receptors of Concern

A portion of the Site is covered with Douglas fir forest that abuts a larger greenbelt area to the west (Figure 2). This area likely acts as habitat for wildlife species in the general Site area. Terrestrial species that may be present on and in the vicinity of the Site include herbivorous, invertivorous and carnivorous birds and mammals, as well as small terrestrial reptiles and amphibians (snakes and toads). A list of protected species in Mason County is provided in the RI Work Plan (Exponent 2019; Appendix E, therein). Terrestrial ecological receptors also include soil or soil-dwelling invertebrates that may be in contact with or ingested by terrestrial species. The group of terrestrial ecological receptors of concern considered for the Site includes vascular plants, soil-dwelling invertebrates, ground-feeding birds, and ground-feeding small mammals.

According to Ecology (2017), appropriate surrogate receptors for determination of risk to these categories of terrestrial ecological receptors are shrew (ground-feeding mammalian predator), robin (ground-feeding avian predator), and earthworm (soil biota). Toxicological models based on these representative species provide the basis for Ecology’s published EISCs published in WAC Table 749-3.

* 1. Exposure Pathways

Potentially complete exposure pathways that exist at the Site include contact with soil and/or ingestion of soil. As discussed above, terrestrial species may ingest impacted soil or soil‑dwelling invertebrates. In addition, plants may also take up contaminants in the soil. The exposure routes include direct contact and direct ingestion for soil invertebrates, uptake by plants, and ingestion of soil and dietary items for wildlife.

* 1. Toxicological Assessment

A site-specific toxicological assessment can be conducted, or the EISCs listed in WAC Table 749-3 based on accepted Ecology toxicity data may be used as the cleanup level (WAC 173‑340-7493(3)) when terrestrial ecological risk is the driver (Ecology 2017). For this Site, the latter approach was used, and is expected to be protective of plants, soil biota, and wildlife at the Site (see the EISCs listed in Table 5). The following sections discuss COEC exceedances of EISCs by constituent category.

* + 1. Petroleum Hydrocarbons

As discussed in Section 4.1.2.1, petroleum hydrocarbon impacts attributable to historical activities were detected at various locations in Areas 1, 2, and 3 (Tables 7 and 9). Four locations exceed at least one petroleum hydrocarbon EISC: one in Area 1, two in Area 2, and one in Area 3 (Figure 20, Tables 5 and 9). Elevated petroleum hydrocarbons in these locations (GRO up to 440 mg/kg and DRO up to 2,500 mg/kg, Table 9) exceed EISCs for the protection of soil biota (100 mg/kg for GRO, 200 mg/kg for DRO). These exceedances are in the vicinity of the former USTs in Area 1 (DRO), in the waste dumping area in the western portion of Area 2 (GRO and DRO), and where fill and landslide debris were placed in Area 3 (GRO and DRO). All petroleum hydrocarbon concentrations are below EISCs for the protection of wildlife (5,000 mg/kg for GRO, 6,000 mg/kg for DRO) (Tables 5 and 9). Petroleum hydrocarbon EISCs for the protection of plants are not published in MTCA (Table 5).

* + 1. Lead

As discussed in Section 4.1.2.2, elevated lead (above 24 mg/kg, the natural background concentration in undeveloped, forested Area 4) was detected at various locations in Areas 1, 2, and 3 (Tables 7 and 10). Three locations in Area 2 exceed at least one EISC (Figure 21, Tables 5 and 10). Elevated lead in these locations (up to 120 mg/kg) exceed the EISC for the protection of plants (50 mg/kg) in the waste and material dumping Area 2. Lead at one of these locations also exceeds the EISC for the protection of wildlife (118 mg/kg). All lead concentrations are below the EISC for the protection of soil biota (500 mg/kg) (Tables 5 and 9).

* + 1. Dioxins and Furans

As discussed in Section 4.1.2.6, dioxins and furans were detected in soils across the Site (Tables 7 and 15) in areas of waste and material dumping (Area 2), fill (Areas 1, 2, and 3), and debris burning (Area 3). TEQ values for total dioxins/furans in Site soils are mostly below the EISC for total dioxins/furans, which is the natural background value of 5.2 x 10-6 for Washington State soils (Ecology 2010) (Table 15). Total dioxins and furans exceed this natural background value at four locations: one in Area 1, one in Area 2, and two in Area 3 (Figure 22, Table 15). Total dioxins/furans are present above this natural background value in fill near the former drywell in Area 1, in fill near the former shed in Area 2, and at locations on the northern side of Area 3 where debris was burned.

* 1. TEE Summary

A site-specific TEE was performed for the Site. Petroleum hydrocarbons (GRO and DRO), lead, and dioxins/furans were identified as COECs in soil. The terrestrial ecological receptor groups of concern include vascular plants, soil-dwelling invertebrates, ground-feeding birds, and ground-feeding small mammals. Potentially complete exposure pathways that exist at the Site include terrestrial species contact with soil and/or ingestion of soil or soil-dwelling invertebrates. Ecology’s published EISCs for surrogate ecological receptors were selected (WAC Table 749-3; surrogates discussed in Section 5.3) as protective of plants, soil biota, and wildlife at the Site.

One or more COECs exceeds an EISC for protection of plants, soil biota, and/or wildlife in 11 RI soil samples (Figures 20 through 22):

* Near the former diesel dispenser and fill in Area 1:
* Sample EX-B-5-0-1 from 0 to 1 ft bgs exceeded an EISC (soil biota) for DRO
* Near the former drywell in Area 1:
* Sample EX-B-49-1-5 (which is a field duplicate of EX-B-7-1-5) from 1 to 5 ft bgs exceeded the EISC (defined at the natural background value) for total dioxins/furans
* In fill in Area 2:
* Sample EX-B-15-0-1 from 0 to 1 ft bgs exceeded the EISC (defined at the natural background value) for total dioxins/furans (this sample also exceeds human health soil screening levels for total dioxins/furans, see Section 4.1.3)
* In the former waste dumping area in Area 2:
* Sample EX-B-18-1-5 from 1 to 5 ft bgs exceeded an EISC (soil biota and plants) for GRO, DRO, and lead (this sample also exceeds human health soil screening levels for GRO, heavy oils, and cPAHs, see Section 4.1.3)
* Sample EX-B-18-1-5 from 5 to 10 ft bgs in exceeded an EISC (plants) for lead
* Sample EX-B-22-5-10 from 5 to 10 ft bgs exceeded an EISC (soil biota) for DRO
* Sample EX-SS-25 from 0 to 0.5 ft bgs exceeded an EISC (plants) for lead
* Sample EX-B-23-10-15 from 10 to 15 ft bgs in Area 2 exceeded two EISCs (plants and wildlife) for lead
* In the landslide debris dumping area in Area 3:
* Sample EX-B-35-5-10 from 5 to 10 ft bgs exceeded an EISC (soil biota) for GRO and DRO (this sample also exceeds human health soil screening levels for GRO and DRO, see Section 4.1.3)
* At the location of former burn piles in Area 3:
* Sample EX-B-32-0-1 from 0 to 1 ft bgs exceeded the EISC (defined at the natural background value) for total dioxins/furans
* Sample EX-B-41-0-1 from 0 to 1 ft bgs exceeded the EISC (defined at the natural background value) for total dioxins/furans (this sample also exceeds human health soil screening levels for total dioxins/furans, see Section 4.1.3).

The EISCs are proposed as Site cleanup levels for COECs (WAC 173-340-7493(3) and Ecology 2017) as further discussed in Section 7.

1. Conceptual Site Model

This section presents a CSM for the Site based on the information and data collected during the RI and prior investigations (Exponent 2019). The Site is currently undeveloped in the western forested portion (Area 4), and largely cleared in the eastern portion (Areas 1, 2, and 3). Areas 1, 2, and 3 were cleared of smaller vegetation in 2019 in preparation for the RI field work. In the southern portion of the Site, a gravel lot is present along the southern property boundary and is used for overflow parking for the Skokomish Tribe Community Center. The Skokomish Tribe intends to develop the Site as part of a master plan that includes construction of a skate park, basketball court, workout facility, and accompanying roads, parking lots, and paths (Figure 5). Surrounding properties are residential (mobile home park) to the north, commercial (the Skokomish Tribe Community Center) to the south, and undeveloped partially forested land to the west. Highway 101 borders the Site to the east. These land uses are expected to continue for the foreseeable future.

Based on these current and potential future uses, this RI evaluates unrestricted land use and beneficial use of groundwater as a drinking water source. The following sections discuss contaminant sources, receptors, and potentially complete human health exposure pathways that have been identified for Site-related contaminants. A discussion of potential ecological receptors and exposure pathways is presented in the TEE (Section 5).

* 1. Soil Contaminant Sources

Petroleum hydrocarbons, lead, and dioxins/furans are the primary Site-related COIs in soil (Section 4.1.3). Impacts attributable to historical activities were detected at various locations in Areas 1, 2, and 3. Historical site evaluation and RI data indicate that potential sources are historical management of fluids used in vehicle maintenance including petroleum products stored in former USTs (Area 1), waste and material dumping (Area 2), fill (Areas 1, 2, and 3), exterior lead-based paint on the former maintenance building demolished in 2001 (Area 1), landslide debris brought onto the property (Area 3), and former debris burning (Area 3).

* 1. Groundwater Contaminant Sources

Groundwater is present at the Site at depths between about 19 and 36 ft bgs, and water level measurements indicate that groundwater flows in an easterly to southeasterly direction (Section 4.2.1). Groundwater within a 1-mile radius of the Site is used for domestic purposes, which may include drinking water, irrigation, and animal watering. Private wells on and in the vicinity of the Site include a well in the mobile home park to the north and upgradient of the Site installed in 1970, and a well to the south of the Site installed as part of the Tribe’s Community Center development in 2016 (Section 2.2). RI results demonstrate that trace concentrations of Site-related constituents (petroleum hydrocarbons and VOCs in the area of historical WSDOT operations in the vicinity of the former vehicle maintenance building) are substantially below drinking water standards, are limited to a localized area on Site, and are not migrating off of the property (Section 4.2.3). Site groundwater ultimately discharges to Hood Canal less than 1 mile east of the Site, and this beneficial use is similarly unaffected given the trace concentrations that are localized onsite.

* 1. Receptors

**Soil.** In the Site’s current state, potential receptors for Site-related contaminants in soil include visitors using overflow parking for the Community Center, commercial workers who maintain and utilize the Site for storage, and construction workers who are expected to redevelop the Site in the future. In addition, trespassers may enter the Site since access is not fully restricted and the Site borders residential areas. Residents are also considered to be potential future receptors. Although Site development plans involve continued use of the property, residential use is not prohibited.

**Groundwater.** In the Site’s current state, potential receptors for Site-related contaminants in groundwater include Site commercial workers (if a new well is constructed on Site) and potential future Site residents. Construction worker exposure to groundwater is not expected to occur since groundwater is encountered greater than 15 ft bgs. Off-site residents and visitors at the Community Center using extracted water for domestic purposes are not considered to be potential receptors because only trace groundwater impacts were observed in a localized area on-Site and no off-Site impacts as evidenced by water quality in downgradient Site wells. Trace concentrations include petroleum hydrocarbons (DRO) and VOCs (toluene and TCE) detected in groundwater on Site at very low levels below analytical laboratory reporting limits and substantially below health-based drinking water standards.

This identification of current and potential future receptors is based on the land and water uses described above and Site reconnaissance during the RI.

* 1. Potentially Complete Exposure Pathways

An exposure pathway is defined by four elements:

* A source and mechanism of constituent release to the environment
* An environmental transport medium for the released constituent
* A point of potential contact with the impacted medium (the exposure point)
* An exposure route at the exposure point.

The objective of the exposure assessment is to estimate the types and magnitudes of hypothetical exposures to impacted media at the Site. Exposure occurs when released constituents are transported to and contact a receptor. Without exposure, there is no risk.

The following potentially complete exposure pathways have been identified for Site-related constituents and potential receptors:

* Incidental ingestion of and dermal contact with constituents in Site soil by current and future commercial workers, construction workers, and trespassers
* Ingestion of and dermal contact with constituents in Site groundwater by future commercial workers, and potential future adult and child residents.

Inhalation is not included as an exposure route for groundwater and soil based on characterization findings presented in this RI. Only two volatile chemicals were detected at low and trace levels below analytical laboratory reporting limits in groundwater in a localized area of the Site. Soil impacts are primarily non-volatile, aged heavy petroleum, PAHs, and dioxins/furans.

1. Proposed Cleanup Standards

This section identifies proposed soil cleanup standards for the Site protective of human health and ecological receptors. Note that no groundwater COPCs were identified (Section 4.2.3), therefore cleanup standards are not proposed for groundwater.

The proposed cleanup standards for soil are consistent with the requirements of MTCA and WAC 173-340-700(3), which states that cleanup standards “…consist of the following: (a) cleanup levels for hazardous substances present at the site; (b) the location where these cleanup levels must be met (point of compliance); and (c) other regulatory requirements that apply to the site because of the type of action and/or location of the site (‘applicable state and federal laws’).” The elements of the proposed cleanup standards are discussed below.

* 1. Cleanup Levels

Proposed soil cleanup levels are based on the current and potential future receptors and exposure pathways for human health and the environment presented in Sections 5 and 6, and ARARs discussed below. Proposed soil cleanup levels are conservative (protective), representing the most stringent of the potentially relevant and appropriate criteria for the Site. For each COPC, the proposed cleanup level is selected as the lowest of the human health soil screening level described in Section 3.7.1 and the EISC for ecological receptors. Proposed cleanup levels are summarized in Table 21.

* 1. Point of Compliance

MTCA’s standard point of compliance is proposed for soil, which is throughout the Site from ground surface to a depth of 15 feet bgs in accordance with WAC 173-340-740(6)(d) and WAC 173-340-7490(4)(b). According to MTCA, this represents a reasonable estimate of the depth of soil that could be excavated and distributed at the soil surface as a result of site development activities.

* 1. Potentially Applicable or Relevant and Appropriate Requirements

A preliminary list of ARARs is provided in Table 20. These ARARs address regulatory cleanup standards, standards of control, and other environmental requirements, criteria, or limitations established under state or federal law that specifically address a contaminant, remedial action, location, or other circumstances at a site. These potential ARARs were considered in selecting screening levels and cleanup levels for the Site. In addition, cleanup levels (Method B) incorporate ARARs.

1. Evaluation of Compliance with Proposed Cleanup Standards

This section presents an evaluation of RI and pre-RI[[16]](#footnote-17) soil concentrations, and compliance with the proposed soil cleanup standards discussed in Section 7. These cleanup standards include proposed soil cleanup levels, MTCA’s standard point of compliance for soil, and consideration of potential ARARs. No groundwater COPCs were identified (Section 4.2.3); therefore, cleanup standards are not proposed for groundwater.

Compliance with proposed Site soil cleanup levels is evaluated by direct sample comparison (maximum concentrations) and by MTCA’s statistical method specified in WAC 173‑340‑740(7) and described in Ecology’s statistical guidance (Ecology 1992). First, direct comparison of sample concentrations to soil cleanup levels was completed for samples collected across the Site to a depth of 15 ft bgs (the standard point of compliance). For COPCs with maximum concentrations that exceed a proposed soil cleanup level, MTCA’s statistical method was employed to evaluate compliance. The statistical compliance evaluation is described below for COPCs that exceeded screening levels as discussed in Sections 4 and 5.

**COPCs in Compliance with Cleanup Standards**. By direct comparison, heavy oils concentrations exceed soil cleanup levels in two locations (Areas 1 and 2, Figure 15) and cPAH concentrations exceed soil cleanup levels in one location (Area 1, Figure 17). Arsenic had a detection above soil cleanup level at one location (Area 3, Figure 23). Using MTCA’s statistical method, heavy oils, cPAHs, and arsenic soil concentrations across the Site are in compliance with the proposed soil cleanup levels summarized in Table 22.

**COPCs Not in Compliance with Cleanup Standards.** Using direct comparison and MTCA’s statistical method, the following COPCs are not in compliance with the proposed soil cleanup levels as summarized in Table 22: GRO, DRO, lead, bis(2-chloroethyl) ether, and total dioxins/furans. Individual sampling locations that exceed one or more proposed cleanup level are shown in Figure 23.As discussed in Section 4.1.3, these impacts are attributable to historical activities at various locations across Areas 1, 2, and 3 (Figure 23). Historical site evaluation and RI data indicate that potential sources are historical management of fluids used in vehicle maintenance including petroleum products stored in former USTs (Area 1), waste and material dumping (Area 2), fill (Areas 1, 2, and 3), exterior lead-based paint on the former maintenance building demolished in 2001 (Area 1), landslide debris brought onto the property (Area 3), and former debris burning (Area 3).

1. Feasibility Study

The remedial investigation identified exceedances of proposed cleanup levels for soil at the Site (Figure 23 through Figure 27, Table 23). Figure 23 depicts exploration locations where a constituent exceeds the MTCA CULs. Figures 24 through 27 depict exceedances by depth interval.

The following sections present the FS, including remedial action objectives (RAOs), identification of remedial technologies and cleanup action alternatives, detailed evaluation of alternatives, and selection of a preferred alternative remedy for addressing CUL exceedances at the Site.

* 1. Remedial Action Objectives

The remedial action objectives (RAOs) at the Site are to achieve compliance with soil cleanup levels to be protective of human health and the environment.

* 1. Identification of Remedial Technologies

The following active and passive remedial technologies have been identified as potentially suitable technologies for use at the Site.

* **Removal.** Excavation can be used for removal of soils exceeding cleanup levels.
* **Disposal.** Excavated contaminated soil can be transported to a regional landfill for disposal.
* **Containment.** Physical barriers or other deterrents can be used to prevent or minimize potential exposure. An example is the use of caps and covers, such as engineered soil covers, pavement, and structures to isolate contaminants remaining on the Site.
* **Institutional Controls.** Includes the use of deed restrictions through the use of a restrictive environmental covenant.
  1. Identification of Cleanup Action Alternatives

The remedial technologies identified in Section 9.2 are combined into various remedial alternatives to achieve the RAOs for the Site, as discussed below.

* + 1. Alternative 1 – Complete Removal of Cleanup Level Exceedances

Alternative 1 would involve excavation and disposal of soils exceeding cleanup levels at each of the exceedance locations, down to the 15 ft point of compliance. Complete removal of exceedances shallower than the 15 ft point of compliance would allow for unconditional closure. Confirmation sampling would be completed following the excavation to determine if the cleanup levels have been achieved. Confirmation samples would be analyzed for pertinent constituents based on the RI data for each area. One sidewall sample would be collected every 20 linear feet, approximately halfway between the top and bottom of the excavation. One base sample would be collected for every 400 ft2 or at a minimum, one sample per excavation area. If samples exceed the cleanup level for a particular constituent, additional excavation and confirmation sampling would be completed in that area. Excavation would continue until confirmation sampling verifies soils at the extent of the excavation are below cleanup levels or the excavation extends down to the 15 ft point of compliance, whichever is shallower. This option is required to be evaluated per WAC 173‑340-350. This alternative is depicted on Figure 28.

* + 1. Alternative 2 – Partial Removal of Cleanup Level Exceedances with Caps/Covers and Institutional Controls

Alternative 2 would involve defining a single area within the Site requiring institutional controls (i.e., via an environmental covenant) where dioxins/furans that exceed CULs would be left in place. Outside of this covenant area, excavation and disposal would be implemented for soils exceeding CULs for other constituents down to the 15 ft point of compliance. For excavation locations, confirmation sampling would be implemented as described for Alternative 1. Contaminants above CULs within the institutional control area would be left in place. This alternative is depicted on Figure 29.

* + 1. Alternative 3 – Caps/Covers with Institutional Controls

Alternative 3 would define one composite area (comprised of the entirety of Areas 1, 2, and 3) within the Site requiring institutional controls (i.e., via an environmental covenant) where constituents of concern that exceed CULs would be left in place. In these areas, engineered soil covers, pavement, and structures would be used as part of the planned Site redevelopment to isolate residual contaminants in soils, with associated institutional controls and monitoring. This alternative is depicted on Figure 30.

* + 1. Alternative 4 – No Action

Alternative 4, no action, is included for comparison purposes per WAC 197-11-440(5)(ii).

* 1. Detailed Evaluation of Alternatives

This section presents the final part of the alternatives’ evaluation process by comparing the four alternatives to the MTCA threshold and other criteria as well as the disproportionate cost analysis. The DCA compares the costs and benefits of the alternatives and selects the alternative that is permanent to the maximum extent practicable. The evaluation criteria are summarized in Table 25, and each alternative is evaluated against the criteria in Tables 26 through 29. Table 30 summarizes the estimated excavation soil volumes for Alternatives 1 and 2. The results of these evaluations are discussed below.

* + 1. Evaluation of Threshold and Other Requirements under MTCA

The MTCA and other threshold criteria include whether the alternative is protective of human health and the environment, complies with cleanup standards, complies with ARARs, provides for a reasonable restoration timeframe, and provides for compliance monitoring (Table 25).

* + 1. Disproportionate Cost Analysis

In addition to the MTCA threshold and other requirements, the DCA requires seven criteria to be evaluated for each remedial alternative per WAC 173-340-360(3)(f). This includes the overall protectiveness of human health and the environment, the degree to which the alternative is permanent, the total cost, the effectiveness over the long-term, the short-term risks related to construction and implementation of the alternative, the ability for the alternative to be implemented, and the extent to which the alternative addresses public concerns, if there are any (Table 25).

**Alternative 1 – Complete Removal of Cleanup Level Exceedances.** Alternative 1 would involve excavation of soil exceeding CULs to below the depth of the deepest exceedance or to the 15 ft point of compliance depth, whichever is shallower, as depicted in Figure 28. Excavation would be followed by backfilling and surface restoration. This alternative would allow for an unconditional closure and be the most protective of human health and the environment. Long-term monitoring would not be needed under this alternative since contaminated soil would be virtually eliminated. Implementing this alternative may not be feasible due to the very low-level CULs for dioxin/furans. Multiple rounds of excavation and confirmation sampling could occur, and even then, it may not be possible to meet the CULs for this constituent. The cost estimate assumes that “live loading” of soil would be permitted by the receiving landfill.[[17]](#footnote-18) To do so requires that the landfill approve a soil profile based on the RI data collected in 2019. If live loading is not approved, stockpiling and sampling of individual soil stockpiles would be needed, which would increase costs significantly. Total cost for Alternative 1 is estimated to be approximately $8.0M, and a summary of evaluation against the criteria is provided in Table 26.

**Alternative 2 – Partial Removal of Cleanup Level Exceedances with Caps/Covers and Institutional Controls.** Alternative 2 would involve excavation of CUL exceedances outside of the land use covenant area and leave CUL exceedances in place inside the land use covenant area, as depicted in Figure 29. Engineered soil covers, pavement, and structures (as part of the planned Site redevelopment) would be used to provide isolation of the contaminated soils from human and ecological receptors. Additionally, institutional controls in the form of an environmental covenant would be used to prescribe future land use requirements. Periodic inspections and maintenance of surface covers would ensure long-term effectiveness of this alternative. Together these remedies would be protective of human health and the environment. The cost estimate assumes that live loading of soil would be permitted. If stockpiling and sampling of soil are needed, costs would increase significantly. Total cost for Alternative 2 is estimated to be $3.6M, and a summary of evaluation against the criteria is provided in Table 27.

**Alternative 3 – Caps/Covers with Institutional Controls.** Alternative 3 would leave residual soil contaminants in place, as depicted in Figure 30. Engineered soil covers, pavement, and structures (as part of the planned Site redevelopment) would be used to isolate the contaminated soils from human and ecological receptors. Additionally, institutional controls in the form of an environmental covenant would be used to prescribe future land use requirements. Periodic inspections and maintenance of surface covers would ensure long-term effectiveness of this alternative. Together these remedies would be protective of human health and the environment. Total cost for Alternative 3 is estimated to be $2.3M, and a summary of evaluation against the criteria is provided in Table 28.

**Alternative 4 – No Action**. Alternative 4 would include no active remediation efforts, no engineering or institutional controls, and no long-term monitoring. Natural recovery may occur through biodegradation for the petroleum hydrocarbon contaminants given enough time. However, metals would not degrade, and dioxins/furans would not be expected to naturally degrade within a reasonable timeframe. No remedial costs would be incurred for this alternative. A summary of evaluation against the criteria is provided in Table 29.

Costs were estimated for each alternative and include costs for construction, maintenance, monitoring, permitting, and agency oversight. In addition, each cost estimate includes a scope and bid contingency. Costs including asphalt and concrete paving and other surfacing items are not included in the remedial cost estimate, as these costs would be part of redevelopment costs and would be implemented following completion of remedial actions. A breakdown of capital costs and periodic costs are summarized in Table 31 for each alternative and detailed estimates for Alternatives 1, 2, and 3 are provided in Tables 32 through 34. The estimated total costs for each alternative are summarized below.

|  |  |
| --- | --- |
| Alternative | Estimated Total Cost |
| Alternative 1 - Complete Removal of Cleanup Level Exceedances | $8.0M |
| Alternative 2 - Partial Removal of Cleanup Level Exceedances with Caps/Covers and Institutional Controls | $3.6M |
| Alternative 3 - Caps/Covers with Institutional Controls | $2.3M |

* 1. Selection of Preferred Cleanup Action Alternative Remedy

Based on the evaluation of the alternatives discussed in the previous sections and in Tables 26 through 34, the preferred remedy is Alternative 3. Alternative 3 is the lowest cost of the alternatives that would be protective of human health and the environment (i.e., lowest cost of Alternatives 1, 2, and 3; Alternative 4 is not protective). Alternative 3 accomplishes protection of human health and the environment by using caps and covers to prevent receptors from contacting residual contaminants in soil, and by using an environmental covenant to prescribe requirements for future land use in covenant areas.

1. Cleanup Action Plan

This section presents a cleanup action plan consistent with the requirements of WAC 173-340-380.

The selected remedy (Alternative 3, discussed in Section 9.6) will leave soils with residual contaminants in place, and would use engineered clean soil covers, pavement, and structures (as part of the planned Site redevelopment) to isolate these soils from human and ecological receptors. Additionally, institutional controls in the form of an environmental covenant would be used to prescribe future land use requirements. Periodic inspections and maintenance of surface covers will be used to ensure long-term effectiveness of this alternative. Together these remedies will be protective of human health and the environment. The following sections provide an overview of anticipated implementation schedule and restoration timeframe, compliance monitoring, institutional controls, and public participation for the cleanup action.

* 1. Implementation Schedule and Restoration Timeframe

The estimated implementation schedule for the selected remedy, Alternative 3, is one to two years following receipt of an Ecology opinion letter approving the RI/FS/CAP. The remedy is anticipated to achieve protection of human health and the environment by using caps and covers as well as institutional controls (via an environmental covenant), which will be completed during Site redevelopment. Since the implementation schedule will occur in tandem with Site redevelopment, the restoration timeframe will align with the one-to-two-year implementation schedule for the selected remedy.

* + 1. Investigation Derived Waste Disposal

There are currently two 55-gallon drums, one water and one soil, staged on the Site from the remedial investigation field activities. Prior to redevelopment and implementation of caps and covers at the Site, the drums will be properly disposed of using existing analytical data or additional waste characterization, if required by the disposal facility.

* 1. Institutional Controls

Since soil with residual contaminants at concentrations above cleanup levels will remain in place at the Site, an institutional control is required under WAC 173-340-440. This will be implemented in the form of an environmental covenant recorded on the property deed that provides land use restrictions for the environmental covenant areas of the Site. Engineered soil covers, pavements, and structures will physically isolate the residual contaminants in soils from human and ecological receptors. Inspections of caps and covers in addition to timely repairs to these surfaces will ensure Site receptors continue to be protected from exposure (see Section 10.3 for the Compliance Monitoring Plan).

In unpaved or unimproved environmental covenant areas, the engineered soil cover will include a mesh fabric layer installed above the contaminated soil and a 1-foot-thick soil cover consisting of clean fill material placed on top of the fabric layer to isolate soils with residual contaminants.

The soil management plan (SMP; Appendix J) describes how contamination that remains in place will be addressed during implementation of the remedy, and during any future Site work involving subsurface activities. The SMP and Health and Safety Plan (HASP; Appendix K) provide guidance for work in the clean fill zone, and in the underlying zone where residual soil impacts remain. These plans, along with the compliance monitoring plan described below, provide for worker protection, management of soils, and restoration of caps and covers following completion of subsurface work.

* 1. Compliance Monitoring Plan

Compliance monitoring will be implemented in a manner consistent with WAC 173-340-410, including protection, performance, and confirmational monitoring, as described further below.

Protection monitoring will be implemented to confirm that human health and the environment are protected during the construction and the operation and maintenance periods of the cleanup action, as described in the SMP (Appendix J) and HASP (Appendix K).

Performance monitoring will include oversight of construction activities for Alternative 3 to confirm the soil caps and covers are implemented as planned in the environmental covenant areas. The performance monitoring will be documented in a future closure report for the Site, following implementation of the remedy.

Confirmation monitoring will include long-term monitoring of cap and cover integrity in the environmental covenant areas. This monitoring is assumed to include an annual inspection one year after completion of construction, followed by one additional inspection five years after completion of construction (i.e., a “five-year review”). Based on the findings of the confirmation monitoring inspections, repairs will be implemented as needed to maintain the 1-foot-thick soil cover and underlying mesh fabric barrier, paved areas, and foundations. If necessary, additional five-year reviews will be planned following the initial five-year review. The SMP (Appendix J) provides additional guidance for future Site work.

* 1. Public Participation

A public comment period will be scheduled and public notice issued by Ecology for review of the RI/FS/CAP. Following the comment period, both Ecology comments and public comments will be addressed in finalizing the RI/FS/CAP document.

1. Conclusions

This RI/FS/CAP report presents an evaluation of the current nature and extent of contamination and characterization of the Site in consideration of the ultimate goal of attaining an NFA status with Ecology in accordance with MTCA (WAC 173-340). The RI program was developed in consideration of historical Site use and previous investigations. RI activities were completed at the Site in June, July, and August 2019 in accordance with the Ecology-approved RI Work Plan (Exponent 2019). RI activities included geophysical surveying, test pitting, installation of soil borings, and soil and groundwater sampling.

Groundwater was determined to be minimally affected with trace concentrations of petroleum hydrocarbons (DRO) and VOCs (toluene and TCE) detected in groundwater on Site at very low levels below analytical reporting limits and substantially below health-based drinking water standards. No COPCs were identified for groundwater. Potential petroleum hydrocarbon sources are historical management of fluids used in vehicle maintenance (Area 1) and fill (Area 1). Likely sources of trace VOCs observed in groundwater are fluids previously managed and used in vehicle maintenance including petroleum products stored in former USTs and solvents historically used for parts washing/degreasing.

Primary Site-related impacts to soil were determined to be petroleum hydrocarbons, lead, and dioxins/furans at locations in Areas 1, 2, and 3. Historical site evaluation and RI data indicate that potential sources are historical management of fluids used in vehicle maintenance including petroleum products stored in former USTs (Area 1), waste and material dumping (Area 2), fill (Areas 1, 2, and 3), exterior lead-based paint on the former maintenance building demolished in 2001 (Area 1), landslide debris brought onto the property (Area 3), and former debris burning (Area 3). The following soil COPCs were identified: GRO, DRO, heavy oils, bis(2-chloroethyl) ether, cPAHs, and total dioxins/furans. Heavy oils and cPAHs in Site soil were determined to be in compliance with the soil cleanup standards. The remaining COPCs exceed the selected soil cleanup levels at select locations shown on Figure 23 and summarized in Table 23, including cleanup levels based on the protection of ecological species as discussed in Section 5.

The RI provides a characterization of the nature and extent of Site-related chemicals in soil and groundwater across the Site and provides sufficient information to evaluate and select a technically feasible cleanup alternative.

Remedial alternatives for the Site were developed and evaluated in the FS. This FS reviewed three alternatives in addition to a no action alternative. Alternative 3, caps and covers with institutional controls, was selected because it has the lowest cost while providing protection for human and ecological receptors.

The CAP describes the process for implementing the selected alternative. Institutional controls will be implemented in the form of an environmental covenant that will restrict future land use. Caps and covers will be implemented during Site redevelopment to isolate soil with residual contaminants from Site receptors. It is anticipated that this remedy will be completed within one to two years from receiving the Ecology opinion letter on the RI/FS/CAP. The CAP includes an SMP, HASP, and compliance monitoring plan. These plans provide for management of soils, worker protection, and restoration of caps and covers during implementation of the remedy and during and following completion of any future subsurface work within the covenant areas at the Site.

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Tables

Figures

Appendix A

Correspondence with Ecology Regarding Remedial Investigation Work Plan Developmen

Appendix B

Geophysical Survey Report

Appendix C

Boring and Well Logs

Appendix D

Photographs and Field Notes

Appendix E

Data Validation Report

Appendix F

Deviations from the Remedial Investigation Work Plan

Appendix G

Natural Background Calculation of Chromium, Mercury, and Selenium in Soil

Appendix H

Remedial Investigation Work Plan (provided as a separate PDF file)

Appendix I

Laboratory Analytical Data and Chains of Custody (to be provided electronically)

Appendix J

soil management plan

Appendix K

Health and safety plan

1. In 1964, the State of Washington Department of Highways was renamed WSDOT. [↑](#footnote-ref-2)
2. There is no information regarding decommissioning/abandonment of this well in Skokomish Tribe records or in Ecology’s Well Report Viewer (https://appswr.ecology.wa.gov/wellconstruction/map/WCLSWebMap/default.aspx). [↑](#footnote-ref-3)
3. In 1964, the State of Washington Department of Highways was renamed WSDOT. [↑](#footnote-ref-4)
4. A “sander” is a truck attachment for dispensing sand on the highway for improved traction during snow/ice conditions. The “sander storage rack” was likely for storage and/or loading of the sander onto the truck. [↑](#footnote-ref-5)
5. The condition of the 5-gallon buckets of tar was not noted (PGG 2005). [↑](#footnote-ref-6)
6. The former WSDOT employee is presumably referring to herbicides used for roadside spraying, not pesticides, which are not expected to have been used. [↑](#footnote-ref-7)
7. ESA (2013b) does not specify if the drum was full or empty, just that “One burn pile had a 55-gallon steel drum placed on top of the brush, which had not yet been burned.” [↑](#footnote-ref-8)
8. Note that surface soil from EX-SS-3 and EX-SS-6 were also part of the Area 4 composite sample collected from locations EX-SS-1 through EX-SS-10 discussed in the paragraph above. [↑](#footnote-ref-9)
9. Field parameters were measured in purged groundwater (not downhole). Therefore, field measurements of Eh and DO were not representative of aquifer conditions. [↑](#footnote-ref-10)
10. A turbidity goal was set out in the RI Work Plan, Exponent (2019, Appendix H, herein) in order to obtain samples more representative of dissolved metals in groundwater. Dissolved metals are expected to be more representative of aquifer water quality, whereas total metals are expected to be influenced by soil particulates. [↑](#footnote-ref-11)
11. Although natural background values were calculated for mercury and selenium, these calculated background values are below the Method A cleanup levels (Table 5). Therefore, the Method A cleanup levels for mercury and selenium are used as the soil screening levels. [↑](#footnote-ref-12)
12. The VOCs with MCLs that are lower than the Standard Method B cleanup level are: 1,1-dichloroethene, 1,1-dichloropropene, 1,2-dichlorobenzene, chlorobenzene, ethylbenzene, styrene, tetrachloroethene, trans-1,2-dichloroethene (Table 6). [↑](#footnote-ref-13)
13. PAH results from EPA Method 8270D-SIM (Table 13) were used to calculate TTECs because this analytical method has lower analytical detection limits than EPA Method 8270D (Table 12). [↑](#footnote-ref-14)
14. See WAC Table 749-3, Footnote a. [↑](#footnote-ref-15)
15. Methods described in WAC 173-340-7493(2)(a)(i) and Ecology (2017). [↑](#footnote-ref-16)
16. Pre-RI data includes samples of soils that have not been removed from the Site during prior excavation work. Locations and sample dates for pre-RI investigations can be found in the RI Work Plan (Exponent 2019). [↑](#footnote-ref-17)
17. “Live loading” refers to direct loading of excavated soils into haul trucks without intermediate stockpiling. [↑](#footnote-ref-18)