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FEASIBILITY STUDY REPORT
TREOIL INDUSTRIES BIOREFINERY
4242 ALDERGROVE ROAD
FERNDALE, WASHINGTON

by
Haley & Aldrich, Inc.
Seattle, Washington

for
Washington State Department of Ecology
Shoreline, Washington

File No. 0204476-001
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FEASIBILITY STUDY REPORT
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PREPARED FOR
WASHINGTON STATE DEPARTMENT OF ECOLOGY
SHORELINE, WASHINGTON

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1. Introduction

Haley & Aldrich, Inc. (Haley & Aldrich) has prepared this feasibility study (FS) report for the Treoil Industries Biorefinery property (Property), which comprises a portion of the parcel located at 4242 Aldergrove Road in Ferndale, Washington (Cleanup Site ID number 950). The Property is a 34.24-acre parcel (#3901083260850000 of Whatcom County) currently owned by the Campbell Land Corporation and Mr. Jagroop S. Gill. The Property is located approximately 5 miles northwest of the City of Ferndale, Washington, and 8 miles south of the Canada-United States border, as depicted in Figure 1.

1.1 PURPOSE AND OBJECTIVES

The main objective of this FS is to develop and evaluate potential cleanup action alternatives to enable selection of a cleanup action that meets the requirements of the Washington Administrative Code (WAC) 173-340-360 and conforms, as appropriate, to the expectations of WAC 173-340-370. The purpose of the cleanup action alternative is to protect human health and the environment, and comply with cleanup standards and state and federal laws, to satisfy the threshold criteria as specified by WAC 173-340 under the Model Toxics Control Act (MTCA).

1.2 SITE HISTORY AND CONDITIONS

The Property was used historically for numerous industrial operations, primarily for processing tall oil, but also for refining biodiesel and other small-scale industrial ventures. Tall oil is a byproduct of kraft paper processes and contains various wood components including pitch, pine oil, fatty and resin acids, and other wood breakdown byproducts. It is used commercially as an emulsifier for asphalt, and in adhesives, inks, and rubber products. Environmental impacts are present in the former working area and surrounding vicinity (the Site) as a result of business operations over the decades. The Site has been the focus of several environmental compliance concerns and inspections dating back to the late 1980s and continuing to present day.

The Property is approximately 4 miles north of the Lummi Reservation and has been designated as a potential location of cultural and archaeological significance. Currently, the Property is zoned as Heavy Impact Industrial and Major/Port Industrial Urban Growth Area. Several residential homes are located less than half a mile to the east of the Property.

Prior to removal actions performed by the United States Environmental Protection Agency (EPA) in 2017 and 2022, there were separate tank farms within three secondary containments. Evidence suggested these secondary containments were suspected to be at least partially pervious, which would have potentially released impacted water to the subsurface. Following the removal actions, all three secondary containments have been decommissioned, and all aboveground storage tanks (ASTs) removed. Several large mixing and boiler tanks, the distillation tower, and some of the associated piping still remain.

The former working area of the Property consists of two primary warehouse buildings, designated Warehouses A and B. Warehouse A is a larger 6,400-square-foot building (oriented east to west), and Warehouse B is a smaller 3,600-square-foot building (oriented north to south). Warehouse B is located approximately 40 feet north of Warehouse A and is adjacent to the western fence line of the former working area. Along the western and southwestern portion of the Site and within the fence line, there are four dilapidated mobile home structures, two of which are partially collapsed. Adjacent to the northeast corner of Warehouse B is a distillation tower with ancillary equipment and structures.

The former working area currently contains crushed gravel in some drivable roadways surrounding the warehouses where, during the removal actions led by the EPA and their contractor in 2022, roadways were improved with imported gravel. The majority of the area is vegetated; and therefore, the former locations of several ASTs were directly on soil and vegetated ground.

The Site was previously believed to be abandoned; however, between the 2017 and 2022 EPA visits to the Property, evidence of activity in the presence of newly abandoned/wrecked vehicles was observed. Though these were removed at the Washington State Department of Ecology's (Ecology's) request prior to the August 2023 remedial investigation (RI), during the most recent Site visit (December 2024), additional abandoned vehicles, garbage and debris, and other signs of Site use were observed. Ongoing Site security remains a concern.

1.3 PREVIOUS SITE INVESTIGATIONS AND INTERIM ACTIONS

1.3.1 Initial Spill Detection

- 1989 and 1994 – The Ecology Water Quality Program files indicate a history of spills and poor maintenance operations at the Site, as recorded in the 1994 Site Hazard Assessment Inspection. An adjacent facility observed spilled oil seemingly originating from the Site, as recorded in the 1991 Ecology Notice of Violation.
- October 1991 – Ecology issued a Notice of Violation to facility operators for the discharge of approximately 1,000 gallons of spilled materials to a drainage ditch that eventually leads to the Strait of Georgia, a navigable water of the United States. The material spilled was described initially as "pine oil" in Ecology's documents but has since been referred to as "tall oil." The facility operators were not aware of the spill and were alerted by an adjacent facility.
- August 1992 – During a follow-up visit to ascertain whether Treoil Industries Ltd. (Treoil) was continuing to discharge without a National Pollutant Discharge Elimination System (NPDES) permit, evidence of oil contamination remained from an old spill surrounding the north sump. Oily sludge was also visible next to an empty drum that was staged near scattered solid waste piles.
- May 1994 – Following review by Ecology and under MTCA Chapter 70.105D Revised Code of Washington (RCW), the Treoil Site was listed on the Confirmed and Suspected Contaminated Sites List.

1.3.2 Site Hazard Assessment

- March 2000 through February 2001 – The Whatcom County Health & Human Services (WCHHS) and Ecology conducted a Site inspection, collected samples, and performed a Site Hazard Assessment (Ecology, 2001). The Site was listed on the Hazardous Sites List for confirmed contamination of soils with metals, petroleum hydrocarbons, and polycyclic aromatic hydrocarbons. Numerous substances identified in the industrial processing of tall oil impact fish mortality, elevating the concern of contamination due to the proximity of and hydraulic connection to the Strait of Georgia. The environmentally hazardous sites are ranked between 1 and 5, where 1 represents the highest level of risk to human and environmental health and 5 is the lowest; the Treoil Site was ranked with a score of 2. The Site was referred to Ecology's Spill Response Team as well.

1.3.3 Water Quality Inspection and State Environmental Policy Act (SEPA) Checklist Review

- July 2006 – Inspectors from the following agencies visited the Site to review and identify the contaminants: Ecology's Northwest Regional Office, Whatcom County Planning and Development Services, WCHHS, and Northwest Clean Air Agency. The Site operators were communicating plans to address the contamination complaints and develop the Site for biodiesel production; this was also evident in the SEPA Checklist submitted by TG Energy, Inc.

1.3.4 New Spill Reported

- June 2014 – A complaint was filed by Ecology using the Environmental Report Tracking System regarding observed oily substances covering the ground over a large portion of the Site. The complaint also documented concerns regarding soil, air, groundwater, and surface water pollution from refinery processes as well as other industrial wastes. There was no evidence that any SEPA Checklist or previously reported compliance concerns were addressed and photographs from the Inspection Report identified several newly discovered areas of potential contamination. These areas included the entirety of the driveway, where oil was observed beneath new gravel, and a large pit outside of the western fence line.

1.3.5 Formal Complaint Received

- 2014 – A formal complaint was received about the Site, prompting several inspections by WCHHS and Ecology's Hazardous Waste and Water Quality programs.
- July 2015 – Ecology issued Administrative Order #11685 (amended in September 2015, #12892) requiring actions at the Treoil property because of noncompliance with several federal and state Hazardous and Dangerous Waste Regulations, as pertaining to WAC Chapter 173-303.

1.3.6 EPA Assessment and Emergency Removal Action

- 2017 – Ecology and EPA's consultant, Environment and Ecology, Inc., supported the EPA Emergency Removal Action (also called the Removal Site Evaluation) conducted under Superfund Technical Assessment and Response Team (START) contract #EP-S7-13-07, Technical Direction Document #17-03-003 and #17-01-0012. Two Site mobilizations occurred, the first from 13 March through 7 April, and the second from 25 July through 4 August, as follow-up to the series of investigations and compliance concerns performed by Ecology. The comprehensive investigative process included photograph documentation, field sampling, waste characterization, and cleanup activities. Part of these investigations included mapping potential contamination pathways from the Site to waters of the United States. Approximately 90,000 gallons of tall oil were removed while many areas of concern remained on Site. Spill protection mechanisms were installed where feasible.
- March 2022 – The EPA performed a Site walk to document current Site conditions since their previous removal actions, observe recent Site activities, identify any new potential areas of concern, and evaluate whether additional action is warranted. Since 2017, recent activities had occurred, including an increase in volume of an unknown oily product in two ASTs (T-1 and T-3), further deterioration of Secondary Containment C, two new burned soil areas (not including the

one area outside of the western fence line), and the appearance of numerous inoperable vehicles on Site that had been picked over for salvage/scrap.

- June 2022 – The EPA mobilized to the Site to follow up on the March Site visit and collected characterization samples from numerous tanks and from oil-saturated soils adjacent to actively leaking tanks. The oily water collected in Secondary Containment C was also sampled. The purposes of the mobilization were to update the understanding of current Site conditions as well as characterize and approximate waste streams and volumes for remediation and removal.

- September 2022 – The EPA mobilized to the Site and removed 59 tanks in total from the property, remediating their contents on Site utilizing diatomaceous earth. The three secondary containments were drained and decommissioned to prevent further accumulations of impacted water. Some surface soils were removed where oily saturation was observed, specifically adjacent to identified leaking valves and ASTs; the cumulative tonnage of excavated solid materials, including Site soils, solidified tall oil, non-hazardous sludge, and non-Resource Conservation and Recovery Act debris totaled approximately 3,038 tons. Following the removal of the largest secondary containment, four soil test pits were excavated to a depth of 36 inches to evaluate the potential extent of the leak. Additionally, a total of 96 orphan containers of miscellaneous size were categorized and removed. Between the demobilization of EPA and the initial Haley & Aldrich Site visit, Ecology requested that the property owner remove the inoperable vehicles. By May 2023, the vehicles were gone.

1.3.7 Remedial Investigation

- 2023 – Thirteen borings were advanced to depths of 30 to 55 feet below ground surface (bgs) and six test pits were advanced up to 2 feet bgs. Soil samples were collected and analyzed from the borings as well as from surface soil (0.5 feet bgs). Fifty-seven soil samples were analyzed for one or more of gasoline-, diesel-, and oil-range petroleum hydrocarbons (TPH-G, TPH-D, and TPH-O, respectively), extractable petroleum hydrocarbons, volatile petroleum hydrocarbons, semi-volatile organic compounds (SVOCs), volatile organic compounds (VOCs), total metals, and polychlorinated biphenyls (PCBs). The sum of TPH-D and TPH-O, pentachlorophenol, chromium, copper, and lead were detected in one to five soil samples at concentrations greater than the screening levels (Figure 5). Groundwater was not encountered during the RI. However, two grab water samples from standing water were collected and analyzed for TPH-D, TPH-O, TPH-G, SVOCs, VOCs, total and dissolved metals, PCBs, and total suspended solids. TPH-D and TPH-O were detected in the two grab water samples.
- 2024 – Four grab water samples from Site drainage areas and ponded water, and one background grab water sample were collected and analyzed for TPH-G, TPH-D, TPH-O, SVOCs, VOCs, and total and dissolved metals.

1.4 SITE GEOLOGY AND HYDROGEOLOGY

The region's topography is generally flat. According to the Geologic Map of the Bellingham 7.5-Minute Quadrangles, Whatcom County, Washington (Lapen, 2000), the property is likely underlain primarily by Emergence (beach) deposits. The common soils in the region, and likely on the property, are generally silt and sandy loams. During the EPA Removal Action, an oily gravel layer approximately 3 inches thick was found, underlain by a uniform, gray, sandy fill layer about 1 foot thick. Beneath these layers, a native silt layer was observed, which is believed to act as a confining layer (Weston Solutions, Inc., 2023).

Soil from borings advanced during the RI consisted of 1 to 4 feet of topsoil underlain by clay with varying amounts of sand and gravel to the bottom of the borings (approximately 50 feet bgs). A site plan showing cross-sections is shown on Figure 2, and generalized subsurface cross-sections are shown on Figures 3 and 4.

Regional groundwater was not encountered in any of the borings advanced (down to approximately 50 feet bgs) during the RI. Based on the general topography and observed surface conditions, water generated by precipitation appears to flow southwest toward a wetland and larger drainage ditch. Three small drainage channels connect surface sheet flow toward the wetland (Figure 2).

1.4.1 Wetlands

A desktop review of the National Wetlands Inventory shows the Site is an emergent wetland, with the western half being forested wetland. This is due to the area's topography and nearby forested wetlands.

On 28 January 2015, Ecology confirmed the adjacent area as a palustrine emergent (PEM) wetland with indicators like a high water table, saturation, and hydrogen sulfide odor. Dominant vegetation includes reed canary grass, a non-native wetland grass. Hydric soil indicators were also noted. Additional water from the northwest and fill impacting the eastern PEM wetland were observed.

On 6 March 2017, another investigation identified surface flow connections from the Site to the wetland. During the August 2023 remedial investigations, no ponding or surface water was observed, but hydrophytic vegetation indicated the presence of wetlands adjacent to and encroaching on the Site.

On 12 December 2024, as described in the section above, Haley & Aldrich collected grab water samples from the Site in locations that appear to drain or discharge to the adjacent wetlands. Additionally, one off-Site/background water sample was collected for comparison.

1.5 CONCEPTUAL SITE MODEL

This section presents a conceptual site model (CSM) for the Site based on the data collected during the RI activities. The CSM identifies potential sources of contamination, contaminant fate and transport mechanisms/pathways, potential receptor groups (human and ecological), and exposure pathways. Development of a CSM is dynamic and iterative and may be refined as additional information becomes available. The CSM is the basis for developing technically feasible cleanup action alternatives and selecting a final cleanup action alternative as part of the FS process. The current CSM for the Site is discussed below and depicted on Figure 6.

1.5.1 COCs

- Soil: the sum of TPH-D and TPH-O, SVOCs (pentachlorophenol), and metals (chromium, copper, and lead)
- Groundwater: none
- Surface water: none
- Air: none

1.5.2 Potential Sources and Release Mechanisms

Based on the history of the Site and results from the RI activities, the source(s) are likely related to the former industrial and processing operations. Possible sources for the contaminants of concern (COCs) at the Site are the pulp kraft processing that occurred since the 1980s; unknown and known leaking secondary containments, staged drums, and miscellaneous abandoned vehicles and equipment scattered about the former working area; sand blasting grit related to metal processing in Warehouse A and on the eastern concrete pad; and possible other unknown sources. The primary release mechanisms include leaks, spills, and atmospheric deposition to soils and/or sediments and secondary release mechanisms include stormwater runoff to sediments and/or surface water.

1.5.3 Fate and Transport Processes

The fate and transport processes of heavy fuel oil depends on the composition of the contaminant and the environment affected by the contaminant. In general, when heavy fuel enters the environment, the individual products comprising the fuel partition to various environmental compartments according to their own physical-chemical properties (American Petroleum Institute, 2012).

The primary mechanisms likely to influence the fate and transport of chemicals at the Site include natural biodegradation of organic chemicals; sorption to soil; volatilization of volatile chemicals from soil; and discharge of chemically impacted soil to surface water. The relative importance of these processes varies depending on the chemical and physical properties of the released contaminant. The properties of soil, sediment, and the dynamics of surface water flow also affect contaminant fate and transport.

Contaminant releases at the Site appear to be primarily from surficial releases that have only minimally impacted subsurface soils due to the impermeable clay shown on Figures 3 and 4. These releases are primarily concentrated adjacent to the processing facilities; however, additional leaking tanks were stored on bare soil in several areas. The absence of groundwater encountered during the subsurface investigations throughout the entirety of the Site supports evidence that the surficial clay layer appears to have limited movement or penetration of water and aqueous-born contaminants to the underlain soils. For this reason, the soil-to-groundwater migration pathway is incomplete. However, the soil-to-air and soil-to-surface water/sediment migration pathways are potentially complete but likely result in minimal exposure.

COCs present on the Site and their fate and transport characteristics include the following:

- **TPH** refers to any mixture of hydrocarbons originating from crude oil. At this Site, TPH consists primarily of TPH-D and TPH-O that are less volatile and mobile than lighter products such as TPH-G. TPH can adsorb to soil particles, volatilize, and leach to and migrate in surface water. TPH in soil and surface water is very likely from the historical operations, including the pipe maze, storage tanks, and leaky secondary containment areas, as well as several documented instances of poor housekeeping and inadequate maintenance of equipment and hazardous material storage on the Site, based on observed Site conditions.

- **Metals** occur naturally and can be deposited in the environment by anthropogenic means. They are dense compared to other common materials and are persistent in the environment. They do not degrade to nontoxic forms; however, they may be transformed into insoluble and biologically unavailable forms. Metals are transported primarily by being adsorbed on or absorbed in suspended particulate matter; and therefore, soils and sediments are the most significant sink for metals. Certain metals (e.g., arsenic and lead) can be bioaccumulative.
- **SVOCs** are ubiquitous in the environment and are often associated with TPH, pesticides, and preservatives. In general, SVOCs do not dissolve easily in water and because of their low solubilities, typically partition into soils versus into surface water. Solubility and bioaccumulation potential vary among different SVOC compounds. SVOCs can be present in a variety of materials, including petroleum products, and are also formed during the incomplete burning of coal, oil and gas, or other organic substances. The presence of SVOCs (specifically pentachlorophenol) in soil is commonly linked with the use of wood-preserving agents or the handling, processing, transport, or storage of treated wood. This contamination is likely due to historical Site operations and activities involving wood preservatives and/or pesticides.

1.5.4 Potential Receptors and Exposure Pathways

The primary purpose of the CSM is to identify potential receptor groups and describe pathways through which those populations may be exposed to Site-related chemicals in the environment. The CSM outlines populations that may be exposed to contaminants at a Site and the pathways through which exposure may occur. A complete pathway requires:

- A source and mechanism for release of constituents;
- A transport or retention medium;
- A potential environmental contact (exposure point) with the affected medium; and
- An exposure route at the exposure point.

The Property is currently vacant with a security fence to the west and south of the Site. However, the Site is accessible by railway workers, Ecology Site Inspectors, and trespassers. Future Property uses are uncertain but are assumed to remain industrial.

The Property contains seasonal small drainage channels that discharge to the adjacent wetlands. Given the close proximity to the Site, there is potential for the COCs to migrate downgradient of the suspected source area and impact sediment and surface water via stormwater runoff. The potential for COCs to migrate off Property via surface water drainage is unlikely, as the only significant drainage comes from short-term sheet flow during heavy storm events.

The CSM presented in this report is developed to ensure that all potentially significant exposure pathways and receptors under current and reasonable future Site scenarios are evaluated. Based on the current and assumed future Property use, the anticipated receptors may include construction workers, railway workers, future Property employees, and trespassers, and terrestrial wildlife. The following pathways are potentially complete for human and ecological exposure:

Construction Workers – There are currently no construction workers on the Property. However, construction activities will be performed as part of any cleanup action activities. Construction workers are likely to contact chemicals in soil. Construction workers could potentially be exposed to chemicals in environmental media on the Site by the following pathways:

- Direct skin contact with and/or incidental ingestion of chemically impacted soil, sediments, or surface water during excavations or other construction work on the Site.
- Inhalation of wind-borne particulates from chemically impacted soil being handled or exposed during excavations on the Site.

Railway Employees, Future Property Employees, and Trespassers – The Property and the surrounding area is currently closed. The entrance to the Property was previously gated and not readily accessible by vehicles; however, pedestrians could access the area. The gate was also removed at some point in the fall of 2023. The Property can still be accessed by trespassers who could be exposed to chemicals migrating to the water or from the subsurface soils by the following potential pathways:

- Direct skin contact with and/or incidental ingestion of chemically impacted soil, sediments, or surface water at the Site.
- Inhalation of wind-borne particulates from chemically impacted soil.
- Inhalation of future indoor air emanating from soil or surface water with volatile chemical impacts.

Terrestrial Wildlife – There is potential for terrestrial wildlife to access the Property and be exposed to chemicals in the shallow surface soils by the following potential pathways:

- Direct contact with and/or ingestion of contaminated soil, sediments, or surface water through portions of the body contacting the ground, bathing, or through incidental contact with fugitive dust emissions from impacted areas.
- Inhalation of wind-borne particulates from chemically impacted soil.

1.6 NATURE AND EXTENT OF CONTAMINATION

This section describes the apparent extent of contaminated media discovered at the Site and is illustrated in Figure 5. Impacted material was generally observed around the former fuel storage and production areas and to the north near the location of former ASTs. Impacts were also observed further north (sample location S-01) and beyond the southwest corner of the working area (S-20 and S-22). Most impacts appear to be evenly distributed across the former working/processing area; however, additional impacts are clustered outside and beyond the primary working area. Extent of contamination is delineated in Figure 5. The total volume of soil detected above proposed cleanup levels (CULs; see *Section 1.7*) is estimated to be 4,500 bank cubic yards or approximately 6,750 tons.

TPH. The sum of TPH-D and TPH-O ranged from concentrations of 6,500 and 62,000 milligrams per kilogram (mg/kg), exceeding the proposed CUL of 6,000 mg/kg. These concentrations were generally observed in the upper 0.5 to 2.5 feet bgs around former fuel storage and production areas (Figure 5). TPH-D and TPH-O were not detected at or greater than laboratory reporting limits or the proposed CUL in samples collected below 5 feet bgs.

In general, gasoline-range hydrocarbons were either not detected or were present at very low concentrations relative to diesel- and oil-range hydrocarbons in Site soils.

VOCs. No exceedances of proposed cleanup levels for individual VOCs were encountered in Site soils. Low concentrations of benzene, toluene, ethylbenzene, and xylenes, naphthalene, and substituted aromatics were encountered in several surface soil and boring locations.

SVOCs. Pentachlorophenol was detected at a concentration of 5.8 mg/kg, exceeding the proposed CUL of 4.5 mg/kg, in one sample (B-07-S1) at a depth of approximately 1 to 2.5 feet bgs.

Metals. Lead was detected at a concentration of 280 mg/kg, exceeding the proposed CUL of 118 mg/kg, in two samples (S-10 and S-15) collected at a depth of approximately 0.5 feet bgs. Chromium and copper were detected at concentrations of 79 and 440 mg/kg, respectively, in one sample (S-07) collected at a depth of approximately 0.5 feet bgs, exceeding the proposed CULs of 67 and 217 mg/kg, respectively.

1.7 PROPOSED CLEANUP STANDARDS

Cleanup actions must comply with cleanup standards established in WAC 173-340-700 through 173-340-760. Cleanup standards include CULs for hazardous substances present at the Site, the location where these CULs must be met (i.e., point of compliance [POC]), and other regulatory requirements that apply to the Site because of the type of cleanup action and/or location of the Site (i.e., applicable local, state, and federal laws), which are discussed in the following sections.

1.7.1 CULs

Proposed CULs for COCs in the only applicable media (i.e., soil) are shown on Table 1, below. The CULs are based on the lower of the two screening levels for the applicable pathways (as discussed in *Section 1.5.4*):

- MTCA Method C Industrial direct contact CULs.
  - Lead was compared to the MTCA Method A industrial CUL since no Method C direct contact values are available.
- MTCA Ecological Indicator Soil Concentrations for Protection of Wildlife.

Table 1. Proposed Soil CULs

COC	Project CULs[1]	MTCA Method C Direct Contact (Industrial)	Site-Specific Terrestrial Ecological Evaluation (TEE) (Commercial/Industrial)
TPH[2]	6,000	70,000	6,000
Pentachlorophenol	4.5	330	4.5
Chromium, total	67	5,300,000[3]	67
Copper	217	140,000	217
Lead	118	1,000[4]	118

Notes:

Concentrations are mg/kg.

1. *CULs are the minimum between the Method C Direct Contact and TEE values.*
2. *TPH value is sum of diesel range (TPH-D) and oil range (TPH-O).*
3. *Assumed to be trivalent (Cr 3+).*
4. *Based on Method A industrial values.*

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1.7.2 POC

Soil. The standard POC for soil contamination by direct contact beneath a site is from the ground surface to 15 feet bgs, which is a reasonable estimate of the depth that could be accessed during construction activities (WAC 173-340-740[6][d]). The standard POC for soil compliance based on protection from vapors is from the ground surface to the uppermost groundwater saturated zone (WAC 173-340-740[6][c]).

As discussed in WAC 173-340-740(6)(f), for cleanup actions that involve containment of hazardous substances, the soil CULs will often not be met at the POCs listed above. In these cases, the cleanup action may be determined to comply with cleanup standards if:

- The selected cleanup action is permanent to the maximum extent practicable using the procedures in WAC 173-340-360.
- The cleanup action is protective of human health.
- The cleanup action is demonstrated to be protective of terrestrial ecological receptors.
- Institutional controls are put in place under WAC 173-340-440 that prohibit or limit activities that could interfere with the long-term integrity of the containment system.
- Compliance monitoring under WAC 173-340-410 and periodic review under WAC 173-340-430 are designed to ensure the long-term integrity of the containment system.
- The types, levels, and amount of hazardous substances remaining on Site and the measures that will be used to prevent migration and contact with those substances are specified in the Cleanup Action Plan.

1.7.3 Applicable or Relevant and Appropriate Requirements

This section identifies potential applicable or relevant and appropriate requirements (ARARs) for assessing and implementing cleanup action alternatives at the Site. The potential ARARs focus on federal, state, or local statutes, regulations, criteria, and guidelines. The types of potential ARARs evaluated for the Site include contaminant-, location-, and action-specific, as defined in the following paragraphs. Each type of potential ARAR is evaluated in Table 2 (attached), and applicable ARARs are listed below.

In general, only the substantive requirements of ARARs are applied to MTCA cleanup sites being conducted under a legally binding agreement with Ecology (WAC 173-340-710[9][b]). Thus, cleanup actions under a formal agreement with Ecology are generally exempt from the procedural requirements specified in certain state and federal laws. This exemption also applies to permits or approvals required by local governments. Ecology executed an Agreed Order (amended order docket number 12892) with the Property owner (amended in 2015).

Contaminant-specific ARARs are usually health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical contaminant values that regulatory agencies generally recognize as protective of human health and the environment.

Applicable contaminant-specific ARARs include:

- Washington MTCA (RCW 70A.305; Chapter 173-340 WAC) regulating soil CULs.

- Washington State Water Quality Standards (WAC 173-201a) set limits for various hydrocarbons and metals in surface water to protect aquatic life and human health.

Action-specific ARARs are relevant to specific cleanup action methods and technologies, and to actions conducted to support cleanup. Action-specific ARARs dictate how certain activities, such as treatment, disposal practices, and media monitoring programs, must be conducted. Typically, these ARARs are not fully defined until a preferred cleanup action has been selected and refined. However, considering the range of potential action-specific ARARs early in the process can help focus the selection a preferred cleanup action alternative.

Applicable action-specific ARARs include:

- United States (U.S.) Clean Air Act (42 United States Code [USC] § 7401 et seq. and 40 Code of Federal Regulations [CFR] Part 50) and Washington Clean Air Act and Implementing Regulations (RCW 70A.15; Chapter 173-400 WAC) to protect ambient air quality by limiting air emissions and taking reasonable precautions to prevent fugitive dust from becoming airborne, which are applicable to cleanup action alternatives involving construction.
- U.S. Resource Conservation and Recovery Act (42 USC § 6901 et seq.), Subtitle D—Managing Municipal and Solid Waste (40 CFR Parts 257 and 258), and Washington Solid Waste Handling Standards (RCW 70A.205; Chapter 173-350 WAC) to establish guidelines and criteria for management of non-hazardous solid waste, which are applicable to cleanup action alternatives involving off-Site disposal of contaminated soil designated as non-hazardous waste. Washington Solid Waste Handling Standards (RCW 70.95 and WAC 173-351 and 173-304), establishes minimum standards for handling and disposing of solid waste, including contaminated soils, construction and demolition debris, and garbage generated during site remediation.
- Solid Waste Disposal Act (42 USC Sec. 6901-6992; 40 CFR 257-258) Federal Land Disposal Requirements (40 CFR 268), promotes conservation of valuable materials and energy and establishes a regulatory framework for solid waste disposal, setting federal land disposal requirements that include safety standards for landfills and restrictions on hazardous substance storage and disposal.
- U.S. Occupational Safety and Health Act (29 CFR Parts 1904, 1910, and 1926) and Washington Industrial Safety and Health Act (RCW 49.17; Title 296 WAC) to establish site worker and visitor health and safety requirements during implementation of the cleanup action.
- Accreditation of Environmental Laboratories (RCW 43.21A.230 and WAC 173-50) required persons or organizations submitting analytical data under the purview of Ecology, Department of Health, and other entities, to use environmental laboratories which are accredited.
- U.S. Federal Water Pollution Control Act--Water Quality Certification (Clean Water Act [CWA]; 33 USC § 1341, Section 401) and Implementing Regulations to obtain certification from the state that discharges will comply with applicable water quality standards.
- Washington SEPA (RCW 43.21C; Chapter 197-11 WAC) to identify and analyze environmental impacts associated with the selected cleanup action.
- Whatcom County Stormwater and Drainage (Whatcom County Code [WCC] Chapter 20.80.630) and Stormwater Control (Ferndale Municipal Code Chapter 13.34) to provide guidelines for erosion control and construction stormwater management.

- Noise Control Act of 1974 (RCW 70.107, WAC 173-60, WCC 9.40) establishes maximum noise levels. Construction activities will be limited to normal working hours, to the extent possible, to minimize noise impacts.
- Whatcom County (WCC Chapter 20.80.734) to establish guidelines for activities requiring a Land Fill and Grade Permit within Whatcom County, applicable to cleanup action alternatives involving any grading, filling, or excavation proposed on any parcel of land within Whatcom County.
- U.S. Federal Water Pollution Control Act—NPDES (CWA; 33 USC § 1342, Section 402) and Implementing Regulations and Washington Waste Discharge General Permit Program (RCW 90.48; Chapter 173-226 WAC) to establish requirements for point source discharges, including stormwater runoff, which are applicable to cleanup action alternatives involving point source discharge of stormwater.

Location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they are in a specific location. Some examples of special locations are floodplains, wetlands, historic sites, and sensitive ecosystems or habitats.

Applicable location-specific ARARs include:

- U.S. Archaeological and Historic Preservation Act (16 USC § 469, 470 et seq.; 36 CFR Parts 65 and 800) and Washington Archaeological Sites and Resources (RCW 27.44, 27.48, and 27.53; Chapter 25-48 WAC) to establish requirements to preserve and recover significant artifacts, preserve historic and archaeological properties and resources, and minimize harm to national landmarks.
- Archaeological, Historic, and Cultural Resources (WCC 23.90.070) to provide guidance for the identification, protection, and treatment of archaeological sites in Whatcom County.

2. Cleanup Action Alternatives

This section describes the cleanup action objectives (CAOs) and candidate cleanup actions and technologies that were identified and screened to develop potential alternatives for further evaluation in this FS.

2.1 CAOS

The primary objective is to substantially eliminate, reduce, and/or control unacceptable risks to human health and the environment posed by the COCs to the greatest extent practicable. CAOs have been developed to protect receptors and provide the underlying basis for developing and evaluating cleanup action alternatives. These CAOs are presented as target goals to be achieved to the extent feasible and practicable. The CAOs consider the applicable receptors and exposure pathways for the affected media. The CAOs for the Site are:

- Prevent direct contact between human and ecological receptors and soil that exceed CULs;
- Mitigate the potential transport of contaminated surface and near-surface soil via stormwater runoff or airborne transport; and

- Minimize the potential for future building indoor air to be impacted by contaminated soil.

2.2 CLEANUP ACTION TECHNOLOGY SCREENING

Cleanup action technologies considered in the evaluation are applicable to impacted soil cleanup, appropriate for the media at the Site, and capable of achieving the CAOs. Reliability, relative cost, and feasibility given the contaminant characteristics and physical conditions at the Property were assessed.

Implementability of a technology—defined as the relative ease of installation and the time required to achieve a given level of performance—is assessed according to Property conditions. Implementability considers:

1. Constructability (ability to build, construct, or implement the technology under actual Property conditions);
2. Time required to achieve the required level of performance as defined by the CULs and POCs;
3. Permitting ability;
4. Availability of the technology; and
5. Other technology-specific factors.

To assess reliability of a prospective technology, the EPA recommends identifying its stage of development, its performance record, and any inherent construction, operation, and maintenance problems. Technologies that are not fully demonstrated, perform poorly, or are unreliable should be eliminated (EPA, 1985).

Relative costs of technologies and process options are used to distinguish between similar technologies with similar expected effectiveness. The alternatives retained for more detailed evaluation therefore are likely the most cost-effective and appropriate for the particular Property conditions.

Table 3 (attached) summarizes the screening assessment process and indicates which technologies were retained for further evaluation as cleanup action alternatives, and which were eliminated from consideration based on implementability, reliability, or cost. The following technologies were retained for potential implementation in one or more cleanup action alternatives:

- Monitoring
- Institutional controls
- Capping
- Soil removal and off-Site land disposal

2.3 CLEANUP ACTION ALTERNATIVE DESCRIPTIONS

The technologies retained in the screening process were used to develop three cleanup action alternatives for further evaluation (Alternatives 1 through 3). For the purposes of evaluating and selecting cleanup action alternatives, it is assumed that the Site will remain vacant over the foreseeable future. Per Ecology direction, existing structures, including buildings and remaining pipe maze/equipment, are not being removed as part of this remedial cleanup action. Any potentially impacted soil located beneath buildings and structures is effectively capped by the existing concrete foundations. Therefore, the removal of miscellaneous scrap and debris (e.g., scrap metal, abandoned cars), building demolitions, etc., are not included in the FS or associated cost estimates. The components of these alternatives are summarized below and illustrated in Figures 7 through 9. All cleanup action alternatives include compliance monitoring to meet WAC 173-340-410 requirements. Costs were estimated using RSMeans cost database and recent Haley & Aldrich experience with similar projects. Detailed cost estimates for each cleanup action alternative are provided in Tables 4 through 6 (attached).

2.3.1 Alternative 1

Alternative 1 consists of the following components:

- Excavation and off-Site disposal of contaminated soil (approximately 0 to 3 feet bgs) up to the wetland boundary;
- Backfill with clean soil and surfaced with gravel; and
- Institutional controls; and
- Compliance monitoring and maintenance.

Excavation and Off-Site Disposal. Alternative 1 considers excavation of soil above applicable MTCA CULs from approximately 0 to 3 feet bgs up to the wetland boundary. Lateral and vertical excavation limits may be adjusted based on the observed extent of soil contamination. If the lateral extent of soil contamination appears to extend into the wetland on the west side of the Property, excavation will only extend up to the edge of the delineated wetland boundary and an environmental covenant may be required. For purposes of this FS and based on existing soil data and engineering estimations, it is assumed that no contaminated soil will be left in-place for this alternative (except for any potentially contaminated soil located beneath existing buildings and structures since the distillation tower and building to the west of the distillation tower will remain in place), and that approximately 37,605 square feet of contaminated soil will be excavated from 0 to 3 feet bgs. Using a conversion factor of 1.5 from bank cubic yards to tonnage, this FS assumes an estimated 6,268 tons of COC-contaminated soil on the Site will be excavated and disposed of off Site.

Excavated soil will be sent off Site for disposal at a regulated landfill facility. It is assumed that the excavated soil can be characterized as non-hazardous and will be sent to a Subtitle D landfill facility for disposal.

Erosion control and Site stabilization measures would be implemented during construction activities. It is assumed that the excavated areas would be backfilled to grade using clean imported fill, properly compacted, and stabilized with gravel.

Institutional Controls. Institutional controls would be required and implemented while environmental impacts remain at the Site (i.e., leaving the COC-impacted soil in-place as part of this cleanup action alternative), which includes filing an environmental covenant for the Property. The environmental covenant is expected to place limitations on the use of the Property (i.e., prohibit compromising the cap) and require that engineering controls (i.e., cap) remain in place and be monitored appropriately. The requirements of the restrictive covenant are presented in WAC 173-340-440(9).

A Soil Management Plan (SMP) would be prepared and implemented to guide any future construction activities that might disturb contaminated soil located beneath existing buildings and structures. The SMP would outline the location and proper handling and disposal of impacted soil during any potential redevelopment (or other construction activities). The impacted soil would be addressed at the time of construction or redevelopment.

Additional institutional controls may include on-Site features (such as signs), educational programs (such as worker training), and other legal mechanisms (such as land use restrictions).

Compliance Monitoring and Maintenance. Monitoring, such as dust monitoring during excavation, will be conducted during implementation of the cleanup action alternative to confirm that human health and the environment are adequately protected during construction. Soil sampling would be conducted at excavation limits to meet regulatory compliance. Repairs of the cap will be conducted as necessary.

Alternative 1 is shown on Figure 7, and the estimated cost is $1,893,000 (Table 4).

2.3.2 Alternative 2

Alternative 2 consists of the following components:

- Excavation and off-Site disposal of hot spots of TPH- and SVOC-contaminated soils up to the wetland boundary; Installation of a demarcation layer for areas to be capped;
- Containment via capping of residual metals-contaminated soils outside of the TPH- and SVOC-contaminated soil excavation areas;
- Institutional controls; and
- Compliance monitoring and maintenance.

Hot Spot Excavation and Off-Site Disposal. Alternative 2 considers hot spot excavation to remediate the near-surface soil (approximately 0 to 3 feet bgs) with TPH and SVOC contamination up to the wetland boundary.

Exact lateral and vertical excavation limits may be adjusted based on the observed extent of soil contamination, verification samples, accessibility, and the limits of the wetland boundary on the west side of the Property. If the lateral extent of soil contamination appears to extend into the wetland on the west side of the Property, excavation will only extend up to the edge of the delineated wetland boundary. For purposes of this FS and based on existing soil data and engineering estimations, this FS assumes that approximately 21,380 square feet of contaminated soil will be excavated from 0 to 3 feet bgs. Using a conversion factor of 1.5 from bank cubic yards to tonnage, this FS assumes an estimated 3,564 tons of contaminated soil will be excavated and disposed of off Site.

Excavated soil will be sent off Site for disposal at a regulated landfill facility. the excavated soil is assumed to be characterized as non-hazardous and will be sent to a Subtitle D landfill facility for disposal.

Erosion control and site stabilization measures would be implemented during construction activities. Excavated hot spot areas are assumed to be backfilled to grade using clean imported fill, properly compacted, and stabilized with gravel.

Containment via Capping. Near-surface soil contamination that is not excavated will be capped with clean imported fill and properly compacted. Potential near-surface soil contamination located beneath existing buildings and structures is capped by the existing concrete foundations. For purposes of this FS and based on existing soil data and engineering estimations, this FS assumes that approximately 16,225 square feet (approximately 2,700 tons) of contaminated soil will be capped and remain in-place. A continuous high-visibility (orange) demarcation geotextile (nonwoven) shall be installed over the existing ground surface of areas to be capped, prior to capping. This layer will act as a visual barrier to provide warning to future works that potentially contaminated soil remains beneath the barrier in the event that work requires penetration of the ground surface in this area. The cap material should have low permeability with drainage controls (i.e., graded and sloped and containing underlying plastic [or an equivalent impermeable barrier] or covered with asphalt or concrete, to ensure stormwater will runoff or drainage beyond the cap). The cap shall consist of a minimum of 1 foot of clean cover material (or be covered with asphalt or concrete). For cost estimating purposes, the cap is assumed to consist of 0.5 feet of gravel underlain by 0.5 feet of (compacted) common fill and a demarcation layer. The cap would be monitored and maintained to continue to prevent human health and terrestrial wildlife exposure.

Institutional Controls. Institutional controls would be required and implemented while environmental impacts remain at the Site (i.e., leaving the COC-impacted soil in-place as part of this cleanup action alternative), which includes filing an environmental covenant for the Property. The environmental covenant is expected to place limitations on the use of the Property (i.e., prohibit compromising the cap) and require that engineering controls (i.e., cap) remain in place and be monitored appropriately. The requirements of the restrictive covenant are presented in WAC 173-340-440(9).

A SMP would be prepared and implemented to guide any future construction activities that might disturb the soil in the area. The SMP would outline the location and proper handling and disposal of impacted soil during any potential redevelopment (or other construction activities). The impacted soil would be addressed at the time of construction or redevelopment.

Additional institutional controls may include on-Site features (such as signs), educational programs (such as worker training), and other legal mechanisms (such as land use restrictions).

Compliance Monitoring and Maintenance. Monitoring, such as dust monitoring during excavation, will be conducted during implementation of the cleanup action alternative to confirm that human health and the environment are adequately protected during construction. Soil sampling would be conducted at excavation limits to meet regulatory compliance. A long-term monitoring plan will be prepared and implemented to assess the integrity and long-term effectiveness of the cap, and maintenance and/or repairs of the cap will be conducted as necessary.

Alternative 2 is shown on Figure 8, and the estimated cost is $1,670,000 (Table 5).

2.3.3 Alternative 3

Alternative 3 consists of the following components:

- Installation of a demarcation layer;
- Containment via capping;

- Institutional controls; and
- Compliance monitoring and maintenance.

Containment via Capping. This alternative assumes that near-surface soil contamination will not be excavated, and all soil contamination will be capped with clean imported fill and properly compacted. For purposes of this FS and based on existing soil data and engineering estimations, this FS assumed that approximately 37,605 square feet (approximately 6,268 tons) of contaminated soil will be capped. Similar to Alternative 2, a demarcation layer will be installed over existing surface at all areas to be capped. The cap material should have low permeability with drainage controls (i.e., graded and sloped and containing underlying plastic [or an equivalent impermeable barrier] or covered with asphalt or concrete, to ensure stormwater will runoff or drainage beyond the cap). The cap shall consist of a minimum of 1 foot of clean cover material (or be covered with asphalt or concrete). For cost estimating purposes, the cap is assumed to consist of 0.5 feet of gravel underlain by 0.5 feet of (compacted) common fill and a demarcation layer. The cap would be monitored and maintained to continue to prevent human health and terrestrial wildlife exposure.

Institutional Controls. Institutional controls would be implemented while environmental impacts remain at the Site (i.e., leaving the COC-impacted soil in-place as part of this cleanup action alternative), which includes filing an environmental covenant for the Property. The environmental covenant is expected to place limitations on the use of the Property (i.e., prohibit compromising the cap) and require that engineering controls (i.e., cap) remain in place and be monitored appropriately. The environmental covenant is also expected to include requirements for vapor intrusion assessment and/or mitigation if future buildings are constructed near residual TPH or SVOC contamination. The requirements of the restrictive covenant are presented in WAC 173-340-440(9).

Similar to Alternative 2, a SMP would be prepared and implemented to guide any future construction activities that might disturb the soil in the area. The SMP would outline the location and proper handling and disposal of impacted soil during any potential redevelopment (or other construction activities). The impacted soil would be addressed at the time of construction or redevelopment. Additional institutional controls may include on-Site features (such as signs), educational programs (such as worker training), and other legal mechanisms (such as land use restrictions).

Compliance Monitoring and Maintenance. A long-term monitoring plan will be prepared and implemented to assess the integrity and long-term effectiveness of the cap, and maintenance and/or repair of the cap will be conducted as necessary.

Alternative 3 is shown on Figure 9, and the estimated cost is $709,000 (Table 6).

3. Evaluation of Cleanup Action Alternatives

As described in WAC 173-340-360(3), 10 general requirements must be met for an alternative to be considered for selection as a remedy. Finally, several action- and media-specific requirements—which vary depending on the nature of the Site and the alternatives being considered—and consideration of public concerns and tribal rights and interests are used to further refine the cleanup action selection if applicable. Each of these evaluation criteria are described in the following sections.

3.1 GENERAL REQUIREMENTS

3.1.1 Protect Human Health and the Environment

The alternative must provide for overall protection of human health and the environment, including likely vulnerable populations and overburdened communities.

All three alternatives prevent human and ecological exposure by removing or capping soil at the Site with COC concentrations above the CULs.

3.1.2 Comply With Cleanup Standards

The alternative must comply with cleanup standards (CULs and the POCs where such CULs must be met) as established in WAC 173-340-700 through 173-340-760.

All three alternatives comply with cleanup standards as proposed in *Section 1.7* by removing and permanently disposing of contaminated soil and/or containing contaminated soil under the requirements specified in WAC 173-340-740(6)(f).

3.1.3 Comply with Applicable State and Federal Laws

The alternative must comply with both applicable requirements and requirements determined to be relevant and appropriate, as defined through WAC 173-340-710. Additionally, the alternative must address local, state, and federal laws related to environmental protection, health and safety, transportation, and disposal.

All three cleanup action alternatives will attain and comply with all applicable ARARs, which are summarized in Table 2 and listed in *Section 1.7.3*.

3.1.4 Prevent or Minimize Releases and Migration of Hazardous Substances

The alternative must prevent or minimize present and future releases and migration of hazardous substances in the environment.

It is assumed that the Site will remain vacant over the foreseeable future. All three cleanup action alternatives prevent or minimize the present and future release and migration of COCs by removing contaminated soil and/or by containing contaminated soil beneath a low-permeability cap.

3.1.5 Provide Resilience to Climate Change Impacts

The alternative must provide resilience to climate change impacts that have a high likelihood of occurring and severely compromising its long-term effectiveness.

All three cleanup action alternatives comply with climate change resilience by removing and permanently disposing of contaminated soil or by continuously monitoring capped soil in an area that is not highly vulnerable to climate impacts (e.g., sea level rise and wildfires).

3.1.6 Provide for Compliance Monitoring

The alternative must provide for compliance monitoring, as established under WAC 173-340-410 and WAC 173-340-720 through 173-340-760. There are three types of compliance monitoring: protection, performance, and confirmational. Protection monitoring is designed to protect human health and the environment during the construction and operation and maintenance phases of the cleanup action. Performance monitoring confirms that the cleanup action has met cleanup and/or performance standards. Confirmational monitoring confirms the long-term effectiveness of the cleanup action once cleanup standards have been met or other performance standards have been attained.

All three cleanup action alternatives would meet requirements for compliance monitoring, as they require varying levels of all three types of compliance monitoring as described in *Sections 2.3.1* through *2.3.3*.

3.1.7 Not Rely Primarily on Institutional Controls and Monitoring

A cleanup action should not rely primarily on institutional controls and monitoring where it is technically possible to implement a more permanent cleanup action.

All three of the cleanup action alternatives meet this requirement because they do not primarily rely on institutional controls and monitoring.

3.1.8 Not Rely Primarily on Dilution and Dispersion

The regulations state that cleanup actions should not rely primarily on dilution and dispersion unless the incremental costs of any active cleanup action measures over the costs of dilution and dispersion grossly exceed the incremental degree of benefits of active cleanup action measures over the benefits of dilution and dispersion.

All three cleanup action alternatives do not rely on dilution or dispersion.

3.1.9 Reasonable Restoration Time Frame

The alternative must provide a reasonable restoration time frame. As laid out in WAC 173-340-360(4), determining whether an alternative provides for a reasonable restoration time frame involves balancing risks against the practicability of achieving a shorter time frame. The factors considered in evaluating whether the restoration time frame is reasonable are listed in WAC 173-340-360(4)(b) and include:

- The potential risks posed by the Site to human health and the environment, including likely vulnerable populations and overburdened communities.
- The practicability of achieving a shorter restoration time frame.
- Long-term effectiveness of the alternative. A longer restoration time frame may be selected if the remedy has a greater degree of long-term effectiveness than one that primarily relies on disposal, isolation, or containment.
- Current uses of the Site, surrounding areas, and associated resources that are or may be affected by releases from the Site.

- Potential future uses of the Site, surrounding areas, and associated resources that are or may be affected by releases from the Site.
- Availability of alternative water supplies.
- Likely effectiveness and reliability of institutional controls.
- Ability to control and monitor migration of hazardous substances from the Site.
- Toxicity of the hazardous substances.
- Natural processes that reduce concentrations of hazardous substances and have been documented to occur at the Site or under similar Site conditions.
- Public concerns and Indian tribes' rights and interests for Ecology-conducted or Ecology-supervised cleanup actions.

The restoration time frame, as defined in WAC 173-340-360, is the period needed for a cleanup action to achieve the CULs at the POC. For purposes of this FS, the restoration time frames are assumed to be two years for all Alternatives 1, 2, and 3. All three alternatives provide for a reasonable restoration time frame. The restoration time frame includes one year to complete cleanup action construction activities (excavation and/or capping) and one year to establish institutional controls.

3.1.10 Use Permanent Solutions to the Maximum Extent Practicable

As outlined in WAC 173-340-360(5), evaluation of this requirement involves conducting a disproportionate cost analysis (DCA), wherein the costs and benefits of each alternative are assessed, as defined by several evaluation criteria. The specific criteria that must be evaluated are specified in WAC 173-340-360(5)(d) and are discussed in *Section 3.5*, and the results of the DCA are discussed in *Section 3.6*.

3.2 ACTION-SPECIFIC REQUIREMENTS

A number of action-specific requirements are also listed in WAC 173-340-360(3)(b), although not all of these requirements are applicable to the Site or the alternatives being considered. The alternatives all meet the action-specific requirements, if applicable, as described below.

3.2.1 Remediation Levels

Remediation levels are defined as the particular concentration of a hazardous substance in any media above which a particular cleanup action component will be required as part of a cleanup action at the site; see WAC 173-340-200. Specific requirements pertaining to use of remediation levels are in WAC 173-340-355. The alternatives being considered in this evaluation do not involve use of remediation levels; therefore, this requirement is not relevant.

3.2.2 Institutional Controls

Institutional controls must comply with the specific requirements of WAC 173-340-440 and should demonstrably reduce risks to ensure a protective cleanup action. This requirement is applicable because two of the alternatives include institutional controls to maintain the cap. The alternatives that include institutional controls will meet this requirement because they will comply with the requirements of

WAC 173-340-440, including documenting institutional controls in a restrictive covenant on the Property and notifying local governments.

3.2.3 Financial Assurances

Financial assurances must be provided at sites where the remedy includes engineered and/or institutional controls, in accordance with WAC 173-340-440(11). This requirement is applicable because all three of the cleanup alternatives include institutional controls to maintain the cap. Financial assurances shall be of sufficient amount to cover all costs associated with operation and maintenance of the cleanup action, including institutional controls, compliance monitoring, and corrective measures.

3.2.4 Periodic Reviews

Periodic reviews must be conducted in accordance with WAC 173-340-420(2), including whenever Ecology conducts a remedy and whenever Ecology approves a remedy under an order, agreed order or consent decree. This requirement is applicable since Ecology is conducting the remedy. The alternatives will meet this requirement because they will comply with the requirements of WAC 173-340-420(2).

3.3 MEDIA-SPECIFIC REQUIREMENTS

A number of media-specific requirements are also listed in WAC 173-340-360(3)(c), although not all of these requirements are applicable to the Site or the alternatives being considered. The alternatives all meet the media-specific requirements, if applicable, as described below.

3.3.1 Soil at Current or Potential Future Residential Areas and Childcare Centers

Specific requirements pertaining to soil cleanup at current or potential future residential areas, schools, and childcare centers are found in WAC 173-340-360(3)(c)(i). Since the Property is zoned as industrial, these requirements are not applicable to the cleanup action alternatives.

3.3.2 Groundwater Cleanup Actions

This requirement states that a permanent cleanup action shall be used to achieve the CULs for groundwater at the standard POCs where a permanent cleanup action is practicable or determined by the department to be in the public interest (WAC 173-340-360[3][c][ii]). The requirement also states that a nonpermanent groundwater cleanup action must treat or remove the source of groundwater contamination and contain contaminated groundwater to the maximum extent practicable (WAC 173-340-360[3][c][iii]).

These requirements are not applicable since groundwater is not a medium of concern.

3.4 CONSIDERATION OF PUBLIC CONCERNS AND TRIBAL RIGHTS AND INTERESTS

Consideration of public concerns, including the concerns of likely vulnerable populations and overburdened communities, and Indian tribes' rights and interests is mandated for Ecology-conducted or Ecology-supervised cleanup actions. For this remedy, Ecology will provide a mandatory public review and comment period on the FS. All public comments and concerns will be taken into consideration when finalizing the FS.

3.5 DCA CRITERIA AND PROCEDURE

Alternatives that meet requirements for cleanup actions are assessed to determine which use permanent solutions to the maximum extent practicable per WAC 173-340-360(5). This assessment is conducted by performing a DCA. A DCA was conducted for all three alternatives since all alternatives meet the cleanup action requirements, as described in *Sections 3.1* through *3.4*.

3.5.1 DCA Criteria

The alternatives are compared by evaluating the following criteria: protectiveness, permanence, cost, effectiveness over the long term, management of implementation risks, and technical and administrative implementability. These evaluation criteria are defined below. The regulation gives a general discussion of the types of factors to consider when evaluating each criterion.

3.5.1.1 Protectiveness

The overall protectiveness provided by the alternative to human health and the environment, including likely vulnerable populations and overburdened communities. The degree to which existing risks are reduced, the time required to reduce risks at the Site and attain cleanup standards, the on-Site and off-Site risks remaining after implementing the alternative, and the improvement of the overall environmental quality provided by the alternative are evaluated against this criterion. For the purposes of the DCA evaluation, it is assumed that the Site will remain vacant over the foreseeable future.

3.5.1.2 Permanence

This criterion evaluates the degree to which the alternative permanently reduces the toxicity, mobility, or mass of hazardous substances, including the adequacy of the alternative in destroying the hazardous substances, the reduction or elimination of hazardous substance releases and sources of releases, the degree of irreversibility of waste treatment processes, and the characteristics and quantity of treatment residuals generated.

3.5.1.3 Cost

This criterion evaluates the costs associated with the alternative, including construction costs (e.g., preconstruction engineering design and permitting, physical construction, waste management and disposal, compliance monitoring, establishment of institutional controls, and regulatory oversight) and postconstruction costs (e.g., operation and maintenance activities, replacement or repair of equipment, permit renewal, compliance monitoring, institutional controls, financial assurances, periodic reviews, and regulatory oversight).

3.5.1.4 Long-Term Effectiveness

Long-term effectiveness includes the degree of certainty that the alternative will be successful, the reliability of the alternative during the period of time hazardous substances are expected to remain on-Site at concentrations that exceed CULs, the resilience of the alternative to climate change impacts, the magnitude of residual risk with the alternative in place, and the effectiveness of controls required to manage treatment residues or remaining wastes. The following types of cleanup action components can be used as a guide, in descending order, when assessing the relative degree of long-term effectiveness: reuse or recycling; destruction or detoxification; immobilization or stabilization; on-Site or off-Site disposal in an engineered, lined, and monitored facility; on-Site isolation or containment with attendant engineering controls; and institutional controls and monitoring.

3.5.1.5 Implementation Risks

This criterion evaluates the risk to human health and the environment, including likely vulnerable populations and overburdened communities, associated with the alternative during construction and implementation, and the effectiveness of measures taken to manage such risks.

3.5.1.6 Technical and Administrative Implementability

This criterion assesses the ability of the alternative to be implemented, including consideration of the technical difficulty of designing, constructing, and implementing the alternative in a reliable and effective manner; availability of necessary off-Site facilities, services, and materials; administrative and regulatory requirements; scheduling, size, and complexity; monitoring requirements; access for construction operations and monitoring; and integration with existing Property operations and other current or potential cleanup actions.

3.5.2 DCA Procedure

To conduct the DCA, the benefits and costs of each alternative are determined using the criteria outlined in *Section 3.5.1*. Per draft Ecology DCA guidance, each benefit has been given equal weighting. Ecology has chosen not to weight the criteria to favor or disfavor qualitative benefit.

We used our professional judgment to score the alternatives on a scale of 1 (lowest) to 10 (highest) against the five non-cost DCA criteria outlined in *Section 3.5.1*.

The non-cost DCA criteria were weighted accordingly:

- **Protectiveness:** 20 percent. This weighting factor of 30 percent is the greatest value of all categories, which is justified based on its overarching importance relative to the ultimate goal of environmental cleanup and protection of human health and the environment.
- **Permanence:** 20 percent. This weighting factor is second highest because permanence, along with long-term effectiveness, is of second-greatest importance to remediation of the Site. A high level of permanence will reduce the need for future cleanup actions.
- **Long-term effectiveness:** 20 percent. This weighting factor is second highest because it represents the need for a high level of confidence that the remedy will be successful to reduce the need for future cleanup actions.
- **Implementation Risks:** 20 percent. This weighting factor is lower based on the limited temporal aspect associated with the short-term risks; and therefore, the reduced risk to human health and the environment. Short-term risks are less important at this Site to select an alternative because each alternative can be easily modified to reduce the short-term risk.
- **Technical and Administrative Implementability:** 20 percent. This weighting factor is lower because implementability is less important at this Site to select an alternative because each alternative may be able to be modified to improve implementability.

A total weighted benefits score is obtained for each alternative by multiplying the five non-cost scores by their corresponding weighting factors and summing the weighted values.

The alternatives are then ranked by degree of permanence and the alternative that provides the greatest degree of permanence shall be the baseline cleanup action alternative (WAC 173-340-360[5][c][iii]).

When assessing whether a cleanup action uses permanent solutions to the maximum extent practicable, the test used (WAC 173-340-360[5][c][iv]) is as follows:

> *First, compare the costs and benefits of the baseline alternative with the costs and benefits of only the next most permanent alternative (not any of the other alternatives); and second, determine whether the incremental costs of the baseline alternative over the next most permanent alternative are disproportionate to the incremental degree of benefits of the baseline alternative over the next most permanent alternative.*
>
> *If the incremental costs are not disproportionate to the incremental degree of benefits, then the baseline alternative uses permanent solutions to the maximum extent practicable and the analysis under this subsection is complete.*
>
> *If the benefits of the two alternatives are the same or similar, then the lower cost alternative uses permanent solutions to the maximum extent practicable and the analysis under this subsection is complete.*
>
> *If the incremental costs are disproportionate to the incremental degree of benefits, then eliminate the baseline alternative from further analysis and make the next most permanent alternative the baseline for future analysis.*

3.6 DISPROPORTIONATE COST ANALYSIS EVALUATION

We evaluated the alternatives against the DCA criteria outlined in *Section 3.5.1,* to determine whether the costs associated with each cleanup alternative are disproportionate relative to the incremental benefit of a lower-cost alternative. For the purposes of the DCA evaluation, it is assumed that the Site will remain vacant over the foreseeable future. The evaluation of the DCA criteria for each alternative is summarized below and in Table 7 (attached).

- **Protectiveness.** Alternative 1 is judged to be the most protective due to the excavation and removal of most COC-contaminated soil on the Site, which will improve the overall environmental quality and reduce on-Site risks the most. Alternative 3 is the least protective because no contaminated soil will be removed; and therefore, on-Site risks will remain after implementing the alternative. Alternative 2 is more protective than Alternative 3 because some of the COC-contaminated soil will be excavated and removed, which will reduce the risks remaining after implementing the alternative.
- **Permanence.** Alternative 1 is judged to be the most permanent because the soil removal and off-Site disposal at a landfill will reduce contaminant mobility. Alternative 3 is the least permanent because no COC-contaminated soil will be removed. Alternative 2 is more permanent than Alternative 3 because hot spots of COC-contaminated soil will be removed and disposed of off Site at a landfill.

- **Effectiveness over the long term**: Alternative 1 is the most effective over the long term because there is a higher degree of certainty that it will be successful in attaining cleanup standards than the other alternatives due to the excavation and removal of all COC-contaminated soil on the Site. Alternative 3 is the least effective over the long term because no contaminated soil will be removed off-Property, and on-Site containment with engineering controls and institutional controls and monitoring are less effective over the long term than off-Site disposal. Alternative 2 is more permanent than Alternative 3 because hot spots of COC-contaminated soil will be removed off-Property.
- **Management of implementation risks.** Alternative 3 is judged to have the least short-term risks because it does not involve the excavation and disposal of COC-contaminated soil off Property, reducing implementation risks during construction activities. Alternatives 2 is judged to have less short-term risks than Alternative 1 because there is less excavation and disposal of COC-contaminated soil off Property, reducing implementation risks during construction activities.
- **Technical and administrative implementability.** Alternative 3 is judged to be the most implementable because capping and institutional controls have less complexity than excavation and off-Site disposal of soil. Alternatives 1 is more implementable than Alternative 2 because it does not have monitoring requirements or administrative requirements (i.e., institutional controls) following construction activities.

The total weighted benefit score ranged from 6.20 for Alternative 3 to 8.20 for Alternative 1, and the costs ranged from $637,000 for Alternative 3 to $1,913,000 for Alternative 1. The components of these costs and assumptions made in the estimates are detailed in Tables 4 through 6.

The cleanup action alternatives are ranked by degree of permanence. This FS determined that Alternative 1 was the most permanent, followed by Alternatives 2 and 3. The most permanent alternative is used as the baseline cleanup action alternative against which other alternatives are compared. Therefore, Alternative 1 is the baseline alternative against which the other alternatives are compared. Table 8 outlines the DCA evaluation, which is discussed further below.

The baseline alternative (Alternative 1) was compared to the next most permanent alternatives (Alternatives 2 and 3, respectively). The incremental costs of Alternatives 1 and 2 were determined by the DCA process to be sufficiently disproportionate to the incremental degree of benefits; therefore, Alternative 3 was selected as the apparent permanent to the maximum extent practicable (PMEP) alternative.

4. Selected Cleanup Action Alternative

Alternative 3 is the selected cleanup action alternative because it is the apparent PMEP alternative, as determined by the DCA. Alternative 3 consists of capping and compliance monitoring. Implementation of this cleanup action alternative will address the CAOs for the Site. However, it is imperative that none of the cleanup actions be implemented until the Property is secured from the ongoing illegal dumping activities that would cause potential damage to any remedial action implemented at the Property.

As discussed previously, it was assumed that the Site will remain vacant over the foreseeable future. If the Site is redeveloped, the future landowner will need to evaluate if the selected alternative is protective of the proposed land use.

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TABLES

TABLE 2
POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
TREOIL INDUSTRIES PROPERTY
FERNDALE, WASHINGTON

Authority	Resource	Implementing Laws/Regulations	ARAR?	Applicability
Contaminant-Specific ARARs				
Federal	Surface Water	EPA Clean Water Act (CWA)	No	The CWA is not applicable to this Site since there is no waters of the United States as defined in the CWA.
State	Surface Water	Washington State Water Quality Standards (WAC 173-201a)	Yes	The state water quality standards are applicable as there is a wetland located within the Property, downgradient of the source area.
Federal	Drinking Water	National Primary Drinking Water Regulations	No	Maximum contaminant levels (MCLs) for metals in drinking water are not applicable since there is no groundwater that could be used for drinking water.
State	Soil	MTCA [RCW 70A.305; Chapter 173-340 WAC]	Yes	The MTCA soil cleanup levels are applicable.
State	Groundwater	MTCA [RCW 70A.305; Chapter 173-340 WAC] and WAC 173-200	No	The MTCA groundwater cleanup levels (and water quality standards) are not applicable as groundwater is not a media of concern.
State	Air	MTCA [RCW 70.305; Chapter 173-340 WAC]	No	The MTCA air cleanup levels are not applicable as indoor air is not a media of concern.
Action-Specific ARARs				
Federal	Air	Clean Air Act [42 USC § 7401 et seq.; 40 CFR Part 50]	Yes	The federal Clean Air Act creates a national framework designed to protect ambient air quality by limiting air emissions.
State	Air	Clean Air Act and Implementing Regulations [RCW 70A.15; Chapter 173-400 WAC]	Yes	These regulations require the owner or operator of a source of fugitive dust to take reasonable precautions to prevent fugitive dust from becoming airborne and to maintain and operate the source to minimize emissions primarily during construction. These regulations are applicable to cleanup action alternatives involving construction.
Local	Air Emissions	Northwest Clean Air Agency (Regulation of The Northwest Clean Air Agency Section 550)	Yes	This requirement is similar to the CAA above but is more localized, addressing performance standards for land uses within the city. The Northwest Clean Air Agency regulations cover specific air quality issues within its regional jurisdiction. These air quality standards and pollution control regulations are applicable to cleanup action alternatives involving construction.
Federal	Solid Waste	Solid Waste Disposal Act (42 USC Sec. 6901-6992; 40 CFR 257-258) Federal Land Disposal Requirements (40 CFR 268)	Yes	Sets safety standards for landfills and regulates hazardous substance storage and disposal, ensuring cleanup sites meet federal requirements to protect health and the environment.
Federal	Solid Waste	RCRA [42 USC § 6901 et seq.], Subtitle D -- Managing Municipal and Solid Waste [40 CFR Parts 257 and 258]	Yes	Subtitle D of RCRA establishes a framework for management of non-hazardous solid waste. These regulations establish guidelines and criteria from which states develop solid waste regulations. These requirements are applicable to cleanup action alternatives that involve off-site disposal of impacted soil designated as non-hazardous waste.

Action-Specific ARARs (Cont.)				
Federal/State	Solid Waste	U.S. Transportation of Hazardous Materials [49 CFR Part 105 to 177] Washington Transportation of Hazardous Materials [Chapter 446-50 WAC]	No	Transportation of hazardous waste or materials must meet state and federal requirements. These requirements are likely not applicable because soil will likely not be designated as hazardous waste.
Federal/State	Solid Waste	U.S. Land Disposal Restrictions [40 CFR Part 268] Washington Land Disposal Restrictions [Chapter 173-303-140 WAC]	No	Best management practices for dangerous wastes are required to meet state and federal requirements. These requirements are likely not appliable because soil will likely not be designated as hazardous waste.
Federal/State	Solid Waste	U.S. RCRA [42 USC § 6901 et seq.], Subtitle C -- Hazardous Waste Management [40 CFR Parts 260 to 262] Washington Dangerous Waste Regulations [Chapter 173-303 WAC]	No	Subtitle C of RCRA pertains to the management of hazardous waste. This requirement is likely not applicable because soil will likely not be designated as hazardous waste.
State	Solid Waste	Solid Waste Handling Standards [RCW 70A.205; Chapter 173-350 WAC] and Washington Solid Waste Handling Standards (RCW 70.95 and WAC 173-351 and 173-304)	Yes	Washington Solid Waste Handling Standards apply to facilities and activities that manage solid waste. The regulations set minimum functional performance standards for proper handling and disposal of solid waste; describe responsibilities of various entities; and stipulate requirements for solid waste handling facility location, design, construction, operation, and closure. These requirements are applicable to cleanup action alternatives that involve off-site disposal of impacted soil.
Federal/State	Remedy Construction	U.S. OSHA [29 CFR Parts 1904, 1910, and 1926] WISHA [RCW 49.17; Title 296 WAC]	Yes	Site worker and visitor health and safety requirements established by OSHA/WISHA are to be met during implementation of the cleanup action.
State	Remedy Construction	UIC Program [Chapter 173-218 WAC]	No	UIC regulations apply to cleanup action alternatives that include injection of biological or chemical oxidants into injection wells or trenches. This is not applicable as the cleanup action alternatives are not expected to include injections.
State	Remedy Construction	Accreditation of Environmental Laboratories (RCW 43.21A.230 and WAC 173-50)	Yes	Required persons or organizations submitting analytical data under the purview of Ecology, Department of Health, and other entities, to use environmental laboratories which are accredited.
State/ Local	Remedy Construction	SEPA [RCW 43.21C; Chapter 197-11 WAC]	Yes	A SEPA review identifies and analyzes environmental impacts associated with the selected cleanup action alternative. A SEPA review is required for local permitting and pursuant to MTCA.

Action-Specific ARARs (Cont.)				
Local	Remedy Construction	Whatcom County Stormwater and Drainage [WCC Chapter 20.80.630]	Yes	Guidelines for erosion control and construction stormwater management. These regulations are applicable to cleanup action alternatives involving construction.
State/ Local	Remedy Construction	Washington Noise Control [RCW 70A.20; Chapter 173-60 WAC] Whatcom County Disorderly House (WCC Chapter 9.40)	Yes	Potentially relevant, depending on construction activities and equipment selected. Construction activities will be limited to normal working hours, to the extent possible, to minimize noise impacts.
Local	Remedy Construction	General Review Thresholds [WCC Chapter 20.80.734]	Yes	Guidelines for activities requiring a Land Fill and Grade Permit within Whatcom County.
Federal	Surface Water	Federal Water Pollution Control Act--Water Quality Certification [CWA; 33 USC § 1341, Section 401] and Implementing Regulations	Yes	Section 401 of the CWA provides that applicants for a permit to conduct any activity involving potential discharges into waters or wetlands shall obtain certification from the state that discharges will comply with applicable water quality standards. Stormwater discharged during construction activities for proposed cleanup action alternatives could potentially discharge into nearby wetlands.
Federal/State	Surface Water	U.S. Federal Water Pollution Control Act--NPDES [CWA; 33 USC § 1342, Section 402] and Implementing Regulations Washington Waste Discharge General Permit Program [RCW 90.48; Chapter 173-226 WAC]	Yes	The NPDES program establishes requirements for point source discharges, including stormwater runoff. These requirements would be applicable for any cleanup action alternatives involving point source discharge of stormwater during construction or following cleanup.
State	Surface Water	Hydraulic Code [RCW 77.55; Chapter 220-660 WAC]	No	The Hydraulic Code requires that any construction activity that uses, diverts, obstructs, or changes the bed or flow of state waters must be done under the terms of a Hydraulic Project Approval permit issued by the Washington State Department of Fish and Wildlife. These activities are not expected as part of the cleanup action alternatives.
State	Groundwater	Minimum Standards for Construction and Maintenance of Wells [RCW 18.104; Chapter 173-160 WAC]	No	Washington state has developed minimum standards for constructing water and monitoring wells, and for the decommissioning of wells. These regulations are not applicable as there are no known monitoring wells on the Site.

Location-Specific ARARs				
Federal	Endangered Species; Critical Habitats	ESA [16 USC §§ 1531-1544] and Implementing Regulations	No	The ESA protects species of fish, wildlife, and plants that are listed as threatened or endangered with extinction. It also protects designated critical habitat for listed species. The ESA outlines procedures for federal agencies to follow, including consultation with resource agencies, when taking actions that may jeopardize listed species. No threatened or endangered species or habitat areas are expected to be impacted by the cleanup action alternatives.
Federal/State	Historic Areas	U.S. Archaeological and Historic Preservation Act [16 USC § 469, 470 et seq.; 36 CFR Parts 65 and 800] Washington Archaeological Sites and Resources [RCW 27.44, 27.48, and 27.53; Chapter 25-48 WAC]	Yes	Actions must be taken to preserve and recover significant artifacts, preserve historic and archaeological properties and resources, and minimize harm to national landmarks. There is the potential for historic or archaeological sites to be discovered on the Site.
Local	Historic Areas	Archaeological, Historic, and Cultural Resources [WCC 23.90.070]	Yes	Provides guidance for the identification, protection, and treatment of archaeological sites in Whatcom County. Upon receipt of application for a shoreline permit or request for a statement of exemption for development on properties within 500 feet of a site known to contain an historic, cultural or archaeological resource(s), the county shall require a cultural resource site assessment. The Site is not within 500 feet of known historic, cultural, or archaeological resources and the cleanup action alternatives do not require a shoreline permit; however, there is the potential for an archaeological site to be discovered during cleanup action alternative activities.
State	Aquatic Lands	Aquatic Land Management [RCW 79.105; Chapter 332-30 WAC]	No	The Aquatic Lands Management law develops criteria for managing state-owned aquatic lands. Aquatic lands are to be managed to promote uses and protect resources as specified in the regulations. The cleanup action alternatives do not occur on state-owned aquatic lands.
State	Shorelines and Surface Water	Shoreline Management Act of 1971 [RCW 90.58] and Implementing Regulations	No	Actions are prohibited within 200 feet of shorelines of statewide significance unless permitted. Cleanup action alternatives do not occur within 200 feet of a shoreline.
State	Wetlands	Shoreline Management Act of 1971 [RCW 90.58] and Implementing Regulations	No	The construction or management of property in wetlands is required to minimize potential harm, avoid adverse effects, and preserve and enhance wetlands. The cleanup action alternatives do not occur within a wetland.
State	Public Lands	Public Lands Management [RCW 79.02]	No	Activities on public lands are restricted, regulated, or proscribed. The cleanup action alternatives do not occur on state-owned public lands.
Local	Shoreline	Shoreline Use Policies and Regulations [WCC Chapter 23.100]	No	Shoreline use and development shall be classified by the administrator and regulated under one or more of the following applicable sections of Chapter 23.100 WCC. Unless otherwise stated, all use and development shall also comply with all of the general policies and regulations of Chapter 23.90 WCC and, if applicable, the policies of Chapter 23.40 WCC. The Site is not located along a shoreline.

TABLE 2
POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
TREOIL INDUSTRIES PROPERTY
FERNDALE, WASHINGTON

ABBREVIATIONS AND NOTES:

ARAR = Applicable or Relevant and Appropriate Requirement.
CFR = Code of Federal Regulations.
CWA = Clean Water Act.
DAHP = Washington Department of Archaeology and Historic Preservation.
DPD = Department of Planning and Development.
ESA = Endangered Species Act.
MTCA = Model Toxics Control Act.
NPDES = National Pollutant Discharge Elimination System.
NRHP = National Register of Historic Places.
OSHA = Occupational Safety and Health Act.
RCRA = Resource Conservation and Recovery Act.
RCW = Revised Code of Washington.
SEPA = State Environmental Policy Act.
UIC = Underground Injection Controls.
USC = United States Code.
WAC = Washington Administrative Code.
WCC = Whatcom County Code
WISHA = Washington Industrial Safety and Health Act.

TABLE 3
CLEANUP ACTION TECHNOLOGY SCREENING FOR SOIL
TREOIL INDUSTRIES PROPERTY
FERNDALE, WASHINGTON

Remediation Technology	Description	Implementability	Reliability	Relative Cost	Screening Comments	Technology Retained?
No remediation technology involved.	There in no intentional approach involved to remediate or monitor contamination.	Nothing to implement.	Not reliable, as contamination will not be addressed or monitoring.	No capital or O&M cost.	Although this action is the least costly, it is not considered an effective or responsible approach.	No
Monitoring	Monitoring to assure compliance with CAOs, to assess performance of cleanup action technology during operation, and to measure continued effectiveness over time.	Technically implementable.	Effective for assessing soil conditions at the site.	Negligible capital cost. Low O&M cost.	Applicable in combination with other technologies.	Yes
Monitored natural attenuation	Naturally occurring physical, chemical, and biological processes that reduce contaminant mobility or concentration.	Technically implementable. Cleanup time frame longer than for other remedial options for soil.	Ineffective for site contaminants in soil as the sole remedy.	Negligible capital cost. Low O&M cost.	Long cleanup time frame. Inadequate effectiveness for treatment of site contaminants.	No
Governmental and proprietary controls; enforcement and permit tools; information devices	Physical and administrative measures to control access or exposure to contaminated soil. Placement of an environmental covenant on the affected property.	Technically implementable.	Reliable conventional administrative measures.	Low capital and O&M cost.	Applicable in combination with other technologies.	Yes
Capping	Placement of a surface cap over impacted soil areas to minimize water infiltration and mobilization of contaminants, and to minimize direct-contact risk for human and ecological receptors.	Technically implementable.	Effective for minimizing access, direct-contact risk, and mobility of contaminants. Less effective than source removal and does not provide treatment of contaminants.	Low to moderate capital and O&M cost.	Applicable in locations where contaminants remain in place. The cap would need to be resistant to erosion and disturbances caused by industrial activities.	Yes
Solidification, stabilization	Chemicals are introduced to physically bind or enclose contaminants, or to induce chemical reactions between the stabilizing agent and contaminants to reduce contaminants' mobility.	Technically implementable.	May be less effective for treatment of site contaminants.	Moderate to high capital cost. Low O&M cost.	Inadequate effectiveness for treatment of site contaminants.	No
In situ enhanced bioremediation	Enhanced biodegradation through addition of nutrients and electron acceptors to stimulate microbial growth and breakdown of contaminants. Moisture may need to be added to provide a medium where microbes can metabolize contaminants.	Technically implementable. Permitting and/or infrastructure required (e.g., injection wells for liquid-phase bioremediation or piping and blower for bioventing). Soil heterogeneities may interfere with consistent distribution of amendments. May require more than one application to attain CAOs. Cleanup time frame longer than for other remedial options for soil.	Established technology. Effective for some site contaminants (TPH and SVOCs).	Moderate to potentially high capital and O&M costs.	Ineffective for some site contaminants (metals). Moderate to high cost.	No

Remediation Technology	Description	Implementability	Reliability	Relative Cost	Screening Comments	Technology Retained?
Chemical treatment	Injection of chemicals to degrade or destroy contaminants in place.	Technically implementable. Requires handling large quantities of hazardous chemicals. Presence of organics in soil may increase required chemical application rates. May require multiple applications of chemical to attain CAOs. Regulatory concerns over injection of chemicals into subsurface, which may make permitting difficult.	Established technology. Effective for some site contaminants (TPH and SVOCs).	High capital and O&M costs.	Ineffective for some site contaminants (metals). High cost.	No
Soil vapor extraction (SVE)	Removal of volatile contaminants through vacuum extraction in the vadose (unsaturated) zone of subsurface. Could be used in conjunction with other technologies including air sparging (AS), steam injection, or six-phase soil heating.	Technically implementable. Would require design and construction of subsurface infrastructure for SVE and AS system.	Moisture content, organic content, and air permeability of the soil will affect SVE effectiveness. Naturally occurring organic content in soil may reduce effectiveness. Effectiveness may be improved if SVE is combined with steam injection or six-phase soil heating. Oxygen introduced through the induced air flow by SVE may promote biodegradation of organic compounds. Limited effectiveness to ineffective for some site contaminants (metals and SVOCs).	High capital cost for new system installation. Moderate to high O&M costs.	Limited effectiveness to ineffective for some site contaminants (metals and SVOCs). High cost.	No
Phytoremediation	Use growing plants to remove, transfer, stabilize, and destroy contaminants in soil. The mechanisms of phytoremediation include enhanced rhizosphere biodegradation, phyto-extraction, phyto-degradation, and phyto-stabilization.	Difficult to implement because of future site use and limited accessibility. Cleanup time frame is typically long.	Potentially effective as a polishing step for site contaminants in soil.	Low capital and O&M cost.	Long cleanup time frame. Not compatible with expected site use (industrial).	No
Thermal treatment	Application of heat via subsurface steam injection, electrical resistive heating, or other method to remove strippable contaminants. Volatilized compounds captured and treated at surface.	Technically implementable. Requires off-gas capture and treatment.	Effective for some site contaminants (TPH and SVOCs). Requires off-gas capture and treatment to be effective. Buried objects or debris may interfere with operation and effectiveness.	High capital and O&M costs.	Buried objects may interfere with treatment. Ineffective for some site contaminants (metals). High cost.	No
Soil flushing	A surfactant or solvent solution is applied to soil in place to remove leachable contaminants. The solution and leached contaminants are recovered from the underlying aquifer and treated.	Difficult to implement. Requires capture and treatment of injected solution and leached contaminants. Regulatory concerns over complete capture of leached contaminants, which may make permitting difficult.	Effective for recovery of site contaminants. Soil flushing is a developing technology; evidence supporting effectiveness is limited.	High capital and O&M costs.	High cost. Difficult to implement with regards to regulatory concerns and capture of injected solution.	No

TABLE 3
CLEANUP ACTION TECHNOLOGY SCREENING FOR SOIL
TREOIL INDUSTRIES PROPERTY
FERNDALE, WASHINGTON

Remediation Technology	Description	Implementability	Reliability	Relative Cost	Screening Comments	Technology Retained?
Soil removal	Removal of impacted soil using common excavation techniques. Excavated soil treated on site or sent off site for disposal.	Technically implementable.	Effective for all site soil contaminants.	Moderate capital cost. Negligible O&M cost.	Commonly used, established technology effective for all site soil contaminants.	Yes
Land disposal	Disposal of impacted soil at an offsite, lined, permitted landfill.	Technically implementable. Impacted soil requires profiling and must meet land disposal requirements. Soil treatment may be required if disposal requirements are not met.	Effective for site soil contaminants.	Moderate capital cost, depending on type of contaminant. Negligible O&M cost.	Common and cost-effective disposal option for excavated soil.	Yes
Ex Situ bioremediation, thermal desorption, soil washing, chemical treatment, solidification/ stabilization, etc.	Treatment of excavated soil by enhancing biodegradation through modification of soil conditions and provision of substrate necessary for microbial growth, heating to volatilize contaminants, using water and surfactants to leach contaminants from soil, using chemicals to degrade contaminants, binding or enclosing contaminants, etc.	Difficult to implement. May require leachate or off-gas collection and treatment. Homogenization of heterogeneous soil and debris screening may be required. Presence of moisture or organics in soil may affect treatment.	Effective for some site soil contaminants (TPH and SVOCs) except solidification/stabilization may be less effective or ineffective for treatment of organic compounds.	Moderate to high capital and O&M costs.	Difficult to implement. Moderate to high cost. Not effective for all site contaminants.	No

ABBREVIATIONS AND NOTES:

AS = Air sparging.
CAOs = Cleanup action objectives.
O&M = Operation and maintenance.
SVE = Soil vapor extraction.

Location: TREOIL INDUSTRIES BIOREFINERY 4242 ALDERGROVE ROAD FERNDALE, WASHINGTON **Phase:** Feasibility Study (-35% to +50%) **Base Year:** 2025 **Date:** June 2025	**Description:** Alternative 1 consists of the excavation and off-site disposal of all contaminated soil (down to 3 feet bgs) up to the wetland boundary, backfill/restoration, and compliance monitoring. The estimate assumes that institutional controls, such as a restrictive covenant and a soil management plan, will be prepared and implemented. Costs have been estimated using the RSMeans cost database and recent Haley & Aldrich experience with similar items on other projects.

CAPITAL COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Soil Excavation					
Mobilization	1	LS	$25,000	$25,000	Engineer's estimate.
TESC measures	1	LS	$10,000	$10,000	Engineer's estimate.
Excavation, loading, transportation, and disposal	6,268	TON	$140	$877,476	Cost based on similar project experience. Non-dangerous waste to Subtitle D landfill. Assumes conversion factor of 1.5 from bank cubic yards to tonnage.
Backfill Common Fill, compaction	5,223	TON	$56	$292,492	Engineer's estimate. Assumes conversion factor 1.5 from bank cubic yards to tonnage and imported soil will be used as backfill.
Backfill Gravel Borrow, compaction	1,219	TON	$90	$109,684	Engineer's estimate. Assumes conversion factor 1.75 from bank cubic yards to tonnage and imported soil will be used as backfill.
Performance sampling and analysis	1	LS	$20,000	$20,000	Cost based on similar project experience. Includes expedited chemical analysis.
Soil Excavation Subtotal				*$1,334,652*	
Contingency	20%	--	--	*$266,930*	EPA 540-R-00-002. Scope and bid contingency. Percentage of capital costs.
Professional/Technical Services					Costs exclude Ecology review fees.
Independent Cleanup Action Report	1	LS	$50,000	$50,000	Engineer's estimate. Includes revisions and discussions with Ecology.
Restrictive covenant and signage	1	LS	$25,000	$25,000	Engineer's estimate.
Soil management plan	1	LS	$15,000	$15,000	Engineer's estimate.
Project management	1	LS	$11,000	$11,000	Engineer's estimate.
Remedial design	1	LS	$50,000	$50,000	Engineer's estimate.
Construction oversight & management	1	LS	$60,000	$60,000	Engineer's estimate.
Professional/Technical Services Subtotal				*$211,000*	
TOTAL CAPITAL COSTS				**$1,813,000**	

ANNUAL O&M COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Compliance Monitoring	1	EA	$3,000	*$3,000*	Engineer's estimate. Annual inspections of the cap to verify integrity of the engineering controls. Includes annual report.
Contingency	20%	--	--	*$600*	EPA 540-R-00-002. Scope and bid contingency. Percentage of annual cost.
Professional/Technical Services	10%	--	--	*$360*	EPA 540-R-00-002. Costs exclude Ecology review fees. Project management. Percentage of annual cost and contingency.
TOTAL ANNUAL O&M COSTS				**$3,960**	

PERIODIC COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Cap Maintenance	1	EA	$5,000	*$5,000*	Engineer's estimate. Years 5, 10, 15, 20, 25, 30. Assumes foundation repairs needed.
Reporting	1	EA	$5,000	*$5,000*	Engineer's estimate. Years 5, 10, 15, 20, 25, 30. Five-year reviews and reporting.
Contingency (Years 5, 10, 15, 20, 25, 30)	20%	--	--	*$2,000*	EPA 540-R-00-002. Scope and bid contingency. Percentage of periodic cost.
Professional/Technical Services (Years 5, 10, 15, 20, 25, 30)	10%	--	--	*$1,200*	EPA 540-R-00-002. Costs exclude Ecology review fees. Project management. Percentage of periodic cost and contingency.
TOTAL PERIODIC COSTS (YEARS 5, 10, 15, 20, 25, 30)				**$13,200**	

PRESENT VALUE ANALYSIS

Discount rate 4.84%
Total years 30

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR	NET PRESENT VALUE
Capital	0	$1,813,000	$1,813,000	1.000	$1,813,000
Annual O&M	1-30	$118,800	$3,960	15.657	$62,001
Periodic	5	$13,200	$13,200	0.790	$10,422
	10	$13,200	$13,200	0.623	$8,228
	15	$13,200	$13,200	0.492	$6,496
	20	$13,200	$13,200	0.389	$5,129
	25	$13,200	$13,200	0.307	$4,049
	30	$13,200	$13,200	0.242	$3,197
		$1,984,600			$1,912,523
TOTAL NET PRESENT VALUE					**$1,913,000**

NOTES

Cost estimate does not include sales tax.

Present value analysis uses the U.S. Treasury 30-year discount rate of 4.84 percent. (WAC 173-340-360)

Notes:
Ecology = Washington State Department of Ecology
EPA = United States Environmental Protection Agency
LS = lump sum
O&M = operation and maintenance
SF = square feet
SY = square yards
TESC = Temporary erosion and sediment control

Location:	TREOIL INDUSTRIES BIOREFINERY 4242 ALDERGROVE ROAD FERNDALE, WASHINGTON
Phase:	Feasibility Study (-35% to +50%)
Base Year:	2025
Date:	June 2025

Description: Alternative 2 consists of the excavation and off-site disposal of hot spots of near-surface soil contamination (down to 3 feet bgs) up to the wetland boundary along with backfill and restoration. This includes the placement of a demarcation layer, and containment via capping. The estimate assumes that institutional controls, such as a restrictive covenant and a soil management plan, will be prepared and implemented. Costs have been estimated using the RSMeans cost database and recent Haley & Aldrich experience with similar items on other projects.

CAPITAL COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Soil Capping and Excavation					
Mobilization	1	LS	$25,000	$25,000	Engineer's estimate.
TESC measures	1	LS	$10,000	$10,000	Engineer's estimate.
Excavation, loading, transportation, and disposal	3,564	TON	$140	$498,937	Cost based on similar project experience. Non-dangerous waste to Subtitle D landfill. Assumes conversion factor of 1.5 from bank cubic yards to tonnage.
Demarcation layer	10,900	SY	$5	$54,500	Geotextile, non-woven 120 lb tensile strength. RSMeans 31321916155.
Backfill Common Fill, compaction (includes capping)	4,322	TON	$56	$242,031	Engineer's estimate. Assumes conversion factor 1.5 from bank cubic yards to tonnage and imported soil will be used as backfill. Includes material to be used for the cap.
Backfill Gravel Borrow, compaction (includes capping)	2,270	TON	$90	$204,340	Engineer's estimate. Assumes conversion factor 1.75 from bank cubic yards to tonnage and imported soil will be used as backfill. Includes material to be used for the cap.
Performance sampling and analysis	1	LS	$14,900	$14,900	Cost based on similar project experience. Includes expedited chemical analysis.
Soil Capping and Excavation Subtotal				*$1,049,708*	
Contingency	20%	--	--	*$209,942*	EPA 540-R-00-002. Scope and bid contingency. Percentage of capital costs.
Professional/Technical Services					Costs exclude Ecology review fees.
Soil Cap Monitoring and Maintenance Plan	1	EA	$15,000	$15,000	Engineer's estimate.
Independent Cleanup Action Report	1	EA	$50,000	$50,000	Engineer's estimate. Includes revisions and discussions with Ecology.
Restrictive covenant and signage	1	LS	$25,000	$25,000	Engineer's estimate.
Soil management plan	1	LS	$15,000	$15,000	Engineer's estimate.
Project management	1	LS	$11,000	$11,000	Engineer's estimate.
Remedial design	1	LS	$50,000	$50,000	Engineer's estimate.
Construction oversight & management	1	LS	$50,000	$50,000	Engineer's estimate.
Professional/Technical Services Subtotal				*$216,000*	
TOTAL CAPITAL COSTS				**$1,475,649**	

ANNUAL O&M COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Compliance Monitoring	1	EA	$5,000	*$5,000*	Engineer's estimate. Annual inspections of the cap to verify integrity of the engineering controls. Includes annual report.
Contingency	20%	--	--	*$1,000*	EPA 540-R-00-002. Scope and bid contingency. Percentage of annual cost.
Professional/Technical Services	10%	--	--	*$600*	EPA 540-R-00-002. Costs exclude Ecology review fees. Project management. Percentage of annual cost and contingency.
TOTAL ANNUAL O&M COSTS				**$6,600**	

PERIODIC COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Cap Maintenance	1	EA	$5,000	*$5,000*	Engineer's estimate. Years 5, 10, 15, 20, 25, 30. Assumes minor erosion replacement needed, not extensive repairs.
Reporting	1	EA	$5,000	*$5,000*	Engineer's estimate. Years 5, 10, 15, 20, 25, 30. Five-year reviews and reporting.
Contingency (Years 5, 10, 15, 20, 25, 30)	20%	--	--	*$2,000*	EPA 540-R-00-002. Scope and bid contingency. Percentage of periodic cost.
Professional/Technical Services (Years 5, 10, 15, 20, 25, 30)	10%	--	--	*$1,200*	EPA 540-R-00-002. Costs exclude Ecology review fees. Project management. Percentage of periodic cost and contingency.
TOTAL PERIODIC COSTS (YEARS 5, 10, 15, 20, 25, 30)				**$13,200**	

PRESENT VALUE ANALYSIS

Discount rate 4.84%
Total years 30

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR	NET PRESENT VALUE
Capital	0	$1,475,649	$1,475,649	1.000	$1,475,649
Annual O&M	1-30	$198,000	$6,600	15.657	$103,335
Periodic	5	$13,200	$13,200	0.790	$10,422
	10	$13,200	$13,200	0.623	$8,228
	15	$13,200	$13,200	0.492	$6,496
	20	$13,200	$13,200	0.389	$5,129
	25	$13,200	$13,200	0.307	$4,049
	30	$13,200	$13,200	0.242	$3,197
		$1,726,449			$1,616,506
TOTAL NET PRESENT VALUE					**$1,617,000**

NOTES

Cost estimate does not include sales tax.

Present value analysis uses the U.S. Treasury 30-year discount rate of 4.84 percent. (WAC 173-340-360)

Notes:
Ecology = Washington State Department of Ecology
EPA = United States Environmental Protection Agency
LS = lump sum
O&M = operation and maintenance
SF = square feet
SY = square yards
TESC = Temporary erosion and sediment control

TABLE 6
CLEANUP ACTION ALTERNATIVE 3 COST ESTIMATE
TREOIL INDUSTRIES PROPERTY
FERNDALE, WASHINGTON

Location: TREOIL INDUSTRIES BIOREFINERY 4242 ALDERGROVE ROAD FERNDALE, WASHINGTON **Phase:** Feasibility Study (-35% to +50%) **Base Year:** 2025 **Date:** June 2025	**Description:** Alternative 3 consists of the placement of a demarcation layer, and containment via capping. The estimate assumes that institutional controls, such as a restrictive covenant and a soil management plan, will be prepared and implemented. Costs have been estimated using the RSMeans cost database and recent Haley & Aldrich experience with similar items on other projects.

CAPITAL COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Soil Capping					
Mobilization	1	LS	$25,000	$25,000	Engineer's estimate.
TESC measures	1	LS	$10,000	$10,000	Engineer's estimate.
Backfill Common Fill, compaction	1,045	TON	$56	$58,499	Engineer's estimate.
Backfill Gravel Borrow, compaction	1,219	TON	$90	$109,686	
Demarcation layer	6,100	SY	$5	$30,500	Geotextile, non-woven 120 lb tensile strength. RSMeans 31321916155.
Soil Capping Subtotal				*$233,685*	
Contingency	20%	--	--	*$46,737*	EPA 540-R-00-002. Scope and bid contingency. Percentage of capital costs.
Professional/Technical Services					Costs exclude Ecology review fees.
Independent Cleanup Action Report	1	EA	$50,000	$50,000	Engineer's estimate. Includes revisions and discussions with Ecology.
Soil Cap Monitoring and Maintenance Plan	1	EA	$15,000	$15,000	Engineer's estimate.
Restrictive covenant and signage	1	LS	$25,000	$25,000	Engineer's estimate.
Soil management plan	1	LS	$15,000	$15,000	Engineer's estimate.
Project management	1	LS	$11,000	$11,000	Engineer's estimate.
Remedial design	1	LS	$50,000	$50,000	Engineer's estimate.
Construction oversight & management	1	LS	$40,000	$40,000	Engineer's estimate.
Professional/Technical Services Subtotal				*$206,000*	
TOTAL CAPITAL COSTS				**$486,422**	

ANNUAL O&M COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Compliance Monitoring	1	EA	$5,000	*$5,000*	Engineer's estimate. Annual inspections of the cap to verify integrity of the engineering controls. Includes annual report.
Contingency	20%	--	--	*$1,000*	EPA 540-R-00-002. Scope and bid contingency. Percentage of annual cost.
Professional/Technical Services	10%	--	--	*$600*	EPA 540-R-00-002. Costs exclude Ecology review fees. Project management. Percentage of annual cost and contingency.
TOTAL ANNUAL O&M COSTS				**$6,600**	

PERIODIC COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Cap Maintenance	1	EA	$7,500	*$7,500*	Engineer's estimate. Years 5, 10, 15, 20, 25, 30. Assumes minor erosion replacement needed, not extensive repairs.
Reporting	1	EA	$5,000	*$5,000*	Engineer's estimate. Years 5, 10, 15, 20, 25, 30. Five-year reviews and reporting.
Contingency (Years 5, 10, 15, 20, 25, 30)	20%	--	--	*$2,500*	EPA 540-R-00-002. Scope and bid contingency. Percentage of periodic cost.
Professional/Technical Services (Years 5, 10, 15, 20, 25, 30)	10%	--	--	*$1,500*	EPA 540-R-00-002. Costs exclude Ecology review fees. Project management. Percentage of periodic cost and contingency.
TOTAL PERIODIC COSTS (YEARS 5, 10, 15, 20, 25, 30)				**$16,500**	

PRESENT VALUE ANALYSIS

Discount rate 4.84%
Total years 30

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR	NET PRESENT VALUE
Capital	0	$486,422	$486,422	1.000	$486,422
Annual O&M	1-30	$132,000	$6,600	15.657	$103,335
	5	$16,500	$16,500	0.790	$13,027
	10	$16,500	$16,500	0.623	$10,285
	15	$16,500	$16,500	0.492	$8,120
	20	$16,500	$16,500	0.389	$6,411
	25	$16,500	$16,500	0.307	$5,062
	30	$16,500	$16,500	0.242	$3,996
		$684,422			$636,660

TOTAL NET PRESENT VALUE **$637,000**

NOTES

Cost estimate does not include sales tax.

Present value analysis uses the U.S. Treasury 30-year discount rate of 4.84 percent. (WAC 173-340-360)

Notes:
Ecology = Washington State Department of Ecology
EPA = United States Environmental Protection Agency
LS = lump sum
O&M = operation and maintenance
SF = square feet
SY = square yards
TESC = Temporary erosion and sediment control

TABLE 7
ALTERNATIVES EVALUATION AND BENEFIT SCORING
TREOIL INDUSTRIES PROPERTY
FERNDALE, WASHINGTON

DCA Benefit Criteria	Criteria and Weighting(%)[a]	Alternative 1. Excavation and Offsite Disposal and Compliance Monitoring	Relative Degrees of Benefit[b]	Alternative 2. Hot Spot Excavation and Offsite Disposal, Capping, Institutional Controls, and Compliance Monitoring and Maintenance	Relative Degrees of Benefit	Alternative 3. Capping, Institutional Controls, and Compliance Monitoring and Maintenance	Relative Degrees of Benefit
Protectiveness	20%	This alternative achieves the highest level of protectiveness because it assumes the excavation and removal of all COC-contaminated soil on the Site to the extent practical, which will meet cleanup standards for soil in the shortest amount of time.	9.0	This alternative reduces contaminant mass in soil through physical processes (i.e., excavation) and protects against human exposure with a cap. This alternative is less protective than Alternative 1 because some residual contamination will remain in place.	8.0	This alternative does not reduce contaminant mass in soil and protects against human exposure with a cap. This alternative is less protective than Alternative 2 because contamination will remain in place.	5.0
Permanence	20%	This alternative provides the highest level of permanent reduction in mobility of contaminants by removing contaminated soil to the extent practical, and placing it at an off-site engineered, lined, and monitored facility.	9.0	This alternative provides permanent reduction in mobility of contaminants by removing contaminated soil and placing it at an off-site engineered, lined, and monitored facility. This alternative is less permanent than Alternative 1 because some residual contamination will remain in place.	7.0	This alternative relies on the reduction of contaminant mobility due to capping. This alternative is the least permanent than because all contamination will remain in place.	5.0
Long-term effectiveness	20%	This alternative achieves the highest level of long-term effectiveness due to the off-site disposal of COC-contaminated soil on the Site in an engineered, lined, and monitored facility. Landfills are a proven technology and are expected to be effective over the long term, though are less effective than contaminant destruction.	9.0	Off-site disposal in an engineered, lined, and monitored facility. Landfills are a proven technology and are expected to be effective over the long term, though are less effective than contaminant destruction. This alternative achieves less long-term effectiveness than Alternative 1 because residual on-site contamination will be contained with a cap, which is less effective than landfills.	6.0	This alternative achieves the lowest level of tong-term effectiveness because all on-site contamination will be contained with a cap which is less effective than landfills.	4.0
Implementation risks	20%	Moderate short-term risks associated with waste excavation and transport to landfill, which can be mitigated with a health and safety plan (HASP). This alternative has the lowest score because it involves the most amount of COC-contaminated soil excavation.	6.0	Moderate short-term risks associated with waste excavation and transport to landfill and import of capping material, which can be mitigated with a health and safety plan (HASP). This alternative has a less short-term risks than Alternative 1 because there is less export of COC-contaminated soil.	7.0	Moderate short-term risks associated with import of capping material, which can be mitigated with a health and safety plan (HASP). This alternative achieves the highest score for implementation risks because no COC-contaminated soil will be hauled offsite	8.0
Implementability	20%	Uses typical construction practices and equipment for the excavation. The potential need to remove scrap material, debris, or buildings on the Site to excavate contaminated soils requires additional complexity. This alternative is more implementable than Alternative 2 because it assumes no additional monitoring or administrative requirements will be needed following cleanup action activities.	8.0	Uses typical construction practices and equipment for the hot spot excavation and cap construction. The potential need to remove scrap material, debris, or buildings on the Site to excavate contaminated soils requires additional complexity. Also requires cap monitoring and maintenance over the life of the remedy and an environmental covenant and soil management plan. This alternative is the least implementable because it involves potential complications related to excavation and post cleanup activity monitoring and administrative requirements.	7.0	Uses typical construction practices and equipment for the cap construction. Also requires cap monitoring and maintenance over the life of the remedy and an environmental covenant and soil management plan. This alternative is the most implementable because no excavation activities will be performed.	9.0
Total weighted benefits score[c]	**100%**	**8.20**		**7.00**		**6.20**	
Estimated Cost[d]		$1,913,000.00		$1,617,000.00		$637,000.00	

Notes:

a. Weighting factors equal. See justification described in Section 3.5.2.

b. Ranking score based on relative ability to achieve criteria on 1 (lowest) to 10 (highest) scale.

c. Total weighted benefit score is obtained by multiplying the rating for each criterion by its weighting factor, and summing the results for the five criteria.

d. Net present value costs are estimated in 2025 dollars, and were calculated using a 4.97 percent discount rate. Itemized estimates are provided in Tables 4-6

TABLE 8
DCA CALCULATIONS
TREOIL INDUSTRIES PROPERTY
FERNDALE, WASHINGTON

	Alternative	Cost ($ millions)	Degrees of Benefit	Permanence		alternatives in order of decreasing permanence →	DCA Order	Alternative	Permanence Score	Cost ($millions)	Degrees of Benefit	**Cost Effectiveness ($/B)**	Incremental Costs and Benefits					**Apparent PMEP Alternative**
				Score	Rank								ΔC	ΔCprop	ΔB	ΔBprop	ΔCprop /ΔBprop	
Estimated costs and degrees of benefit from the FS	Alternative 1	1.913	8.2	9	1		1	Alternative 1	9	$1.91	8.2	$0.23	n/a	n/a	n/a	n/a	n/a	NO
	Alternative 2	1.617	7	7	2		2	Alternative 2	7	$1.62	7.0	$0.23	$0.30	0.18	1.2	0.17	1.07	NO
	Alternative 3	0.637	6.2	5	3		3	Alternative 3	5	$0.64	6.2	$0.10	$0.98	1.54	0.8	0.13	11.92	PMEP

Notes:

ΔC = Incremental costs

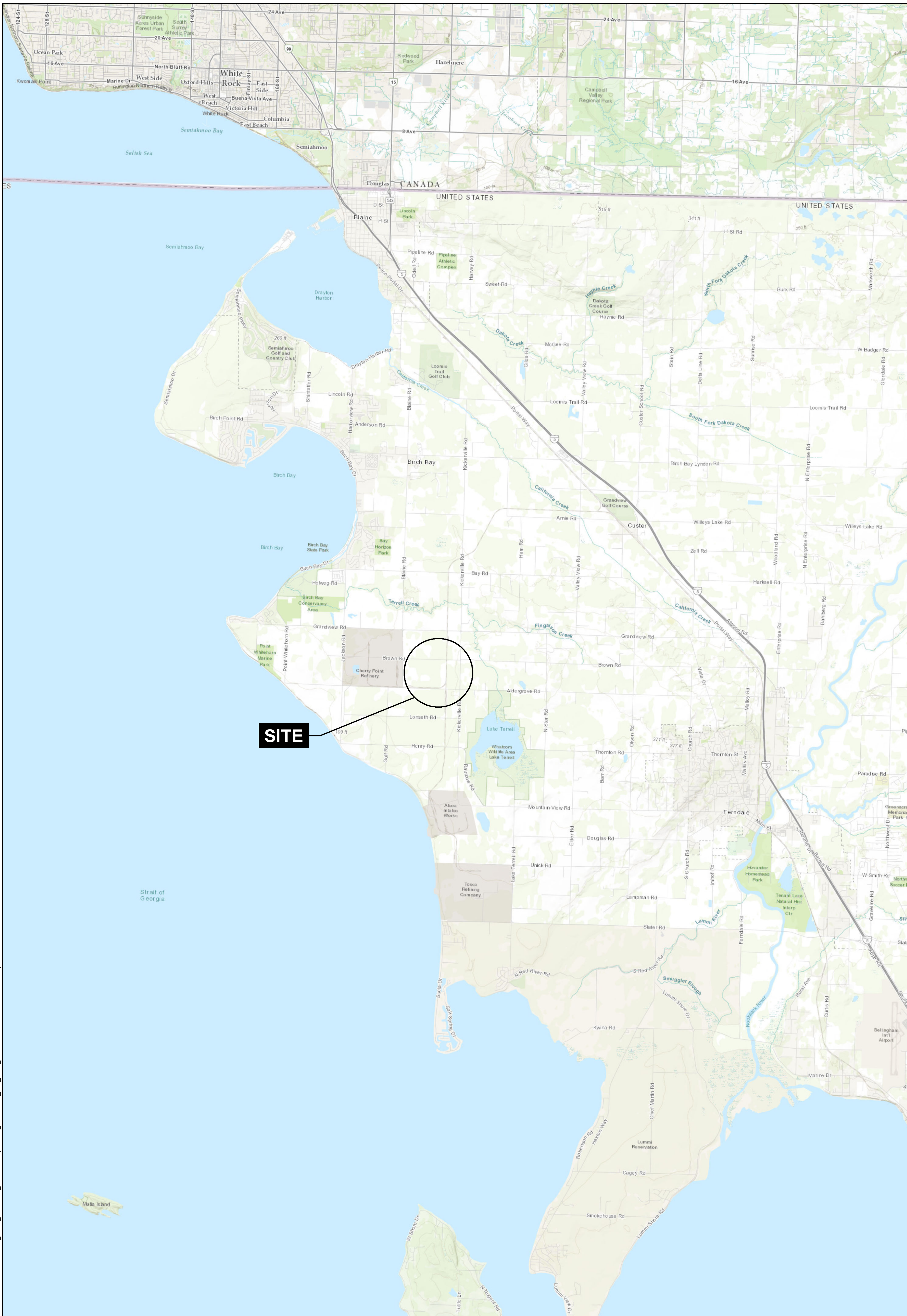
ΔCprop = Proportional change in costs

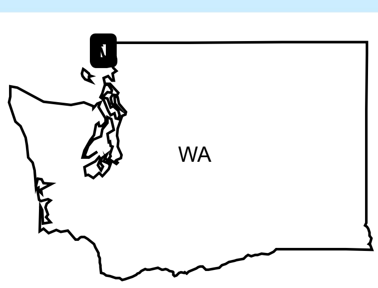
ΔB = Incremental benefit

ΔBprop = Proportional change in benefit

PMEP = Permanent to the Maximum Extent Practicable

FIGURES





0 1 2
SCALE IN MILES

N

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. BASEMAP IMAGERY SOURCE: ESRI

HALEY ALDRICH

TREOIL INDUSTRIES SITE
FERNDALE, WASHINGTON

VICINITY MAP

JUNE 2025

FIGURE 1

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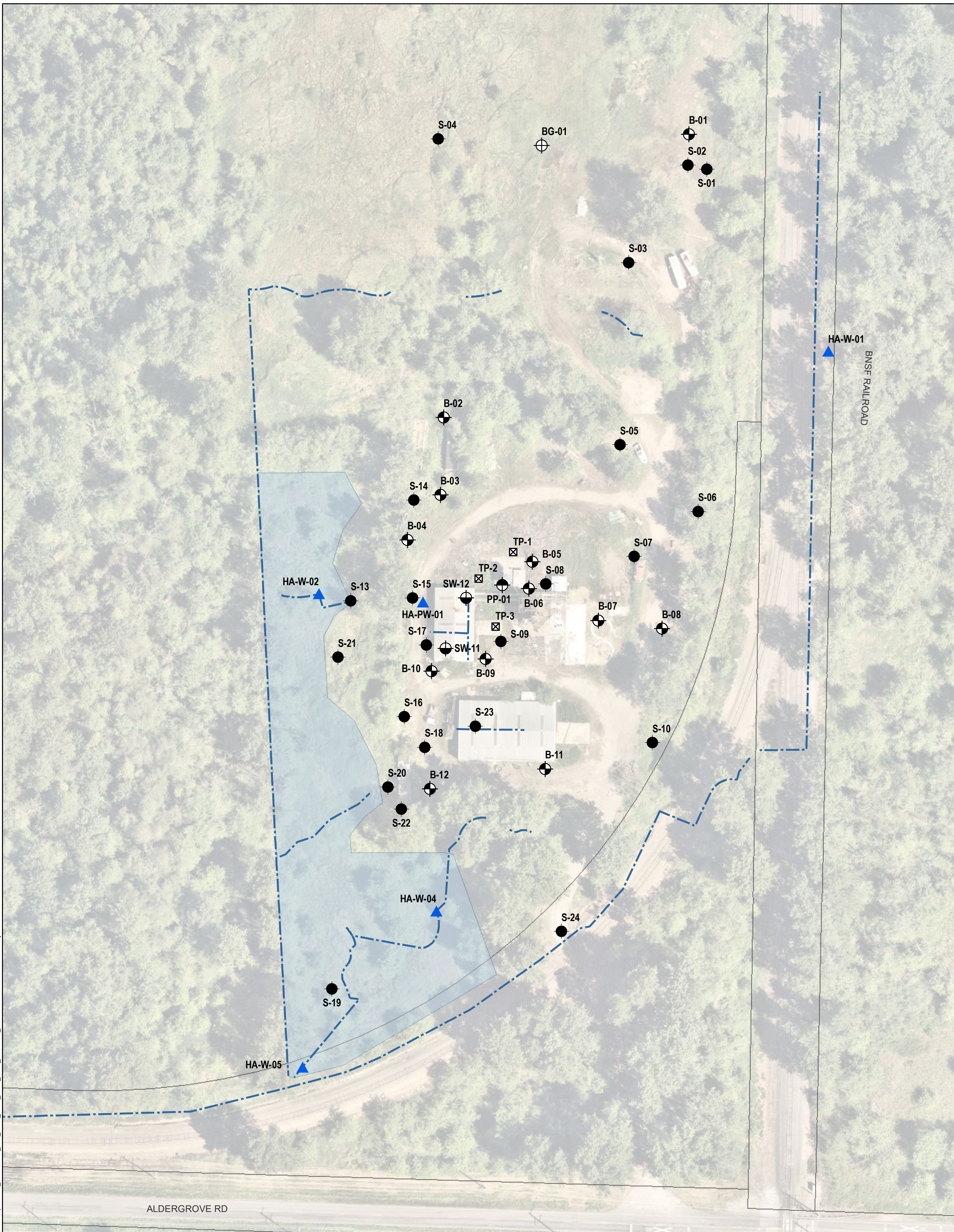

LEGEND

- ▲ SUPPLEMENTAL GRAB WATER SAMPLE
- BACKGROUND SAMPLE
- RECONNAISSANCE BORING
- SURFICIAL SOIL SAMPLE
- SURFICIAL WATER SAMPLE
- PRODUCT SAMPLE
- ⊠ TEST PIT
- DRAINAGE
- DELINEATED WETLAND
- PARCEL BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. DRAINAGE IN RAILROAD RIGHT OF WAY IS ASSUMED TO EXTEND NORTHWARD TO BROWN ROAD. FULL PATH NOT SHOWN.
3. THE DRAINAGES SHOWN ARE BASED ON CONDITIONS OBSERVED IN 2017 BY ECOLOGY STAFF. SINCE THAT TIME, THE EPA HAS CONDUCTED MULTIPLE REMOVAL ACTIONS AND SITE CONDITIONS HAVE CHANGED.
4. ASSESSOR PARCEL DATA SOURCE: WHATCOM COUNTY
5. AERIAL IMAGERY SOURCE: NEARMAP, 10 MAY 2024

N

0 100 200
MAIN MAP SCALE IN FEET

HALEY ALDRICH

TREOIL INDUSTRIES SITE
FERNDALE, WASHINGTON

SITE MAP AND SAMPLE LOCATIONS

JUNE 2025

FIGURE 2

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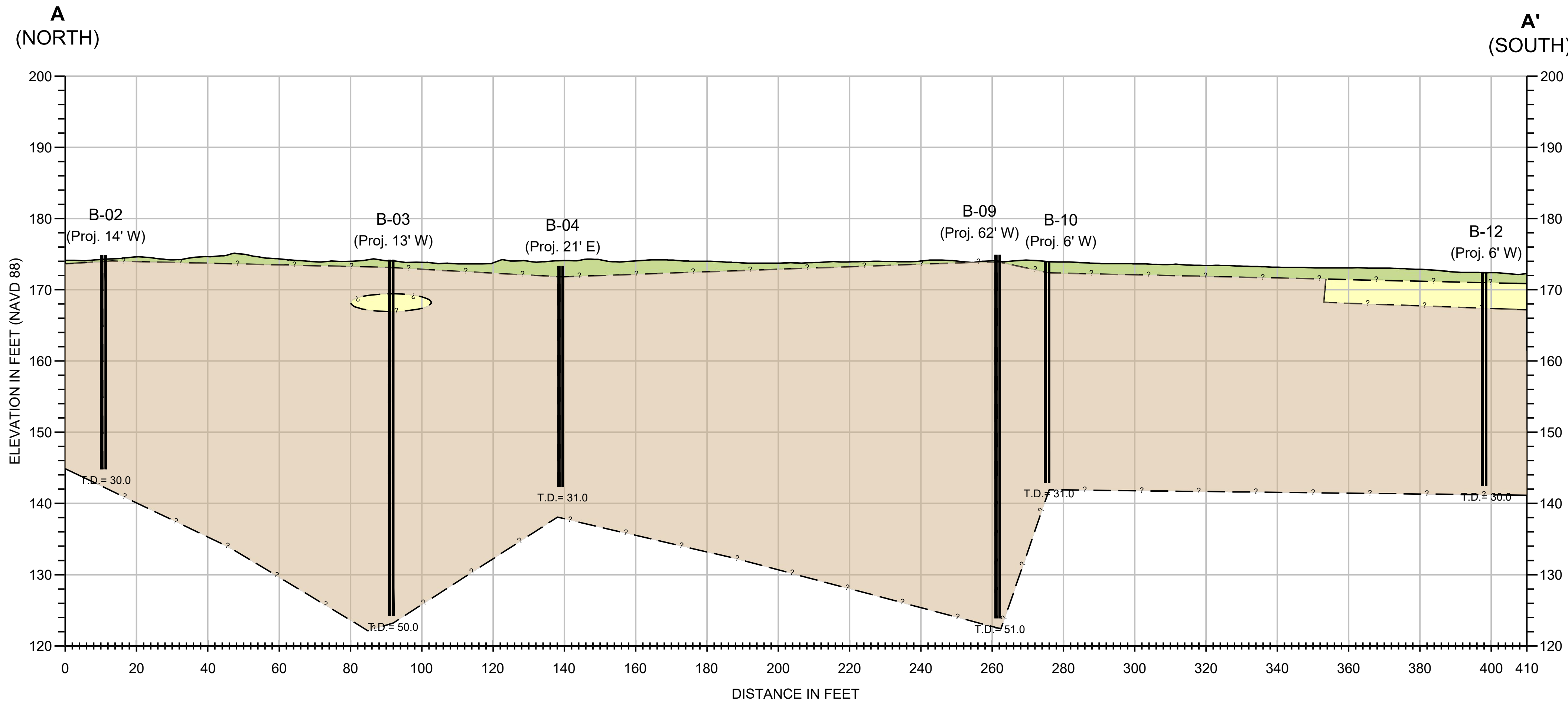

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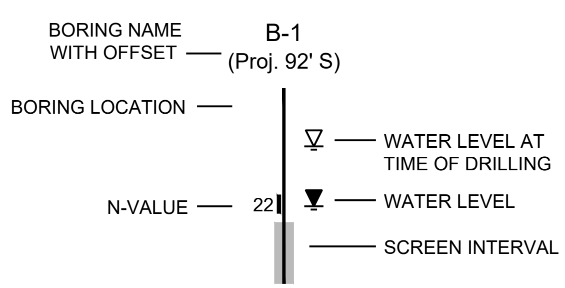


LEGEND

- TOP SOIL
- SAND TO SILTY OR CLAYEY SAND
- CLAY

NOTES

1. THIS SUBSURFACE PROFILE IS GENERALIZED FROM MATERIALS OBSERVED IN SOIL BORINGS. VARIATIONS MAY EXIST BETWEEN PROFILE AND ACTUAL CONDITIONS.
2. GROUNDWATER WAS NOT ENCOUNTERED IN ANY OF THE BORING LOCATIONS.

HORIZ. 0 40 80
VERT. 0 20 40
SCALE IN FEET

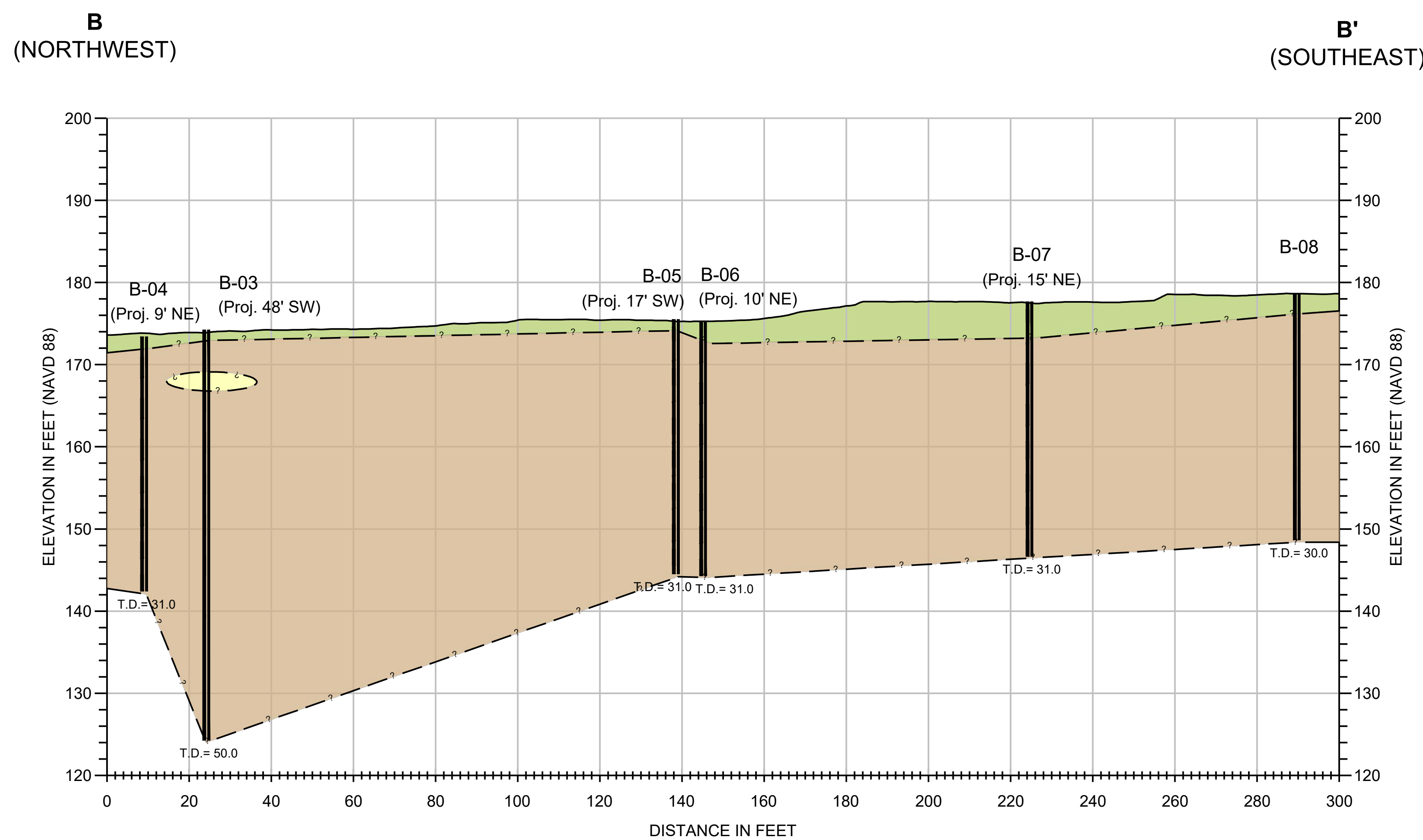
HALEY ALDRICH

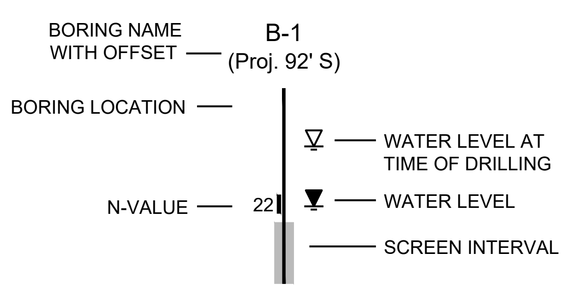
TREOIL INDUSTRIES SITE
FERNDALE, WASHINGTON

CROSS SECTION A-A'

JUNE 2025

FIGURE 3





LEGEND

- TOP SOIL
- SAND TO SILTY OR CLAYEY SAND
- CLAY

NOTES

1. THIS SUBSURFACE PROFILE IS GENERALIZED FROM MATERIALS OBSERVED IN SOIL BORINGS. VARIATIONS MAY EXIST BETWEEN PROFILE AND ACTUAL CONDITIONS.
2. GROUNDWATER WAS NOT ENCOUNTERED IN ANY OF THE BORING LOCATIONS.

HORIZ. 0 40 80
VERT. 0 20 40
SCALE IN FEET

HALEY ALDRICH

TREOIL INDUSTRIES SITE
FERNDALE, WASHINGTON

CROSS SECTION B-B'

JUNE 2025

FIGURE 4

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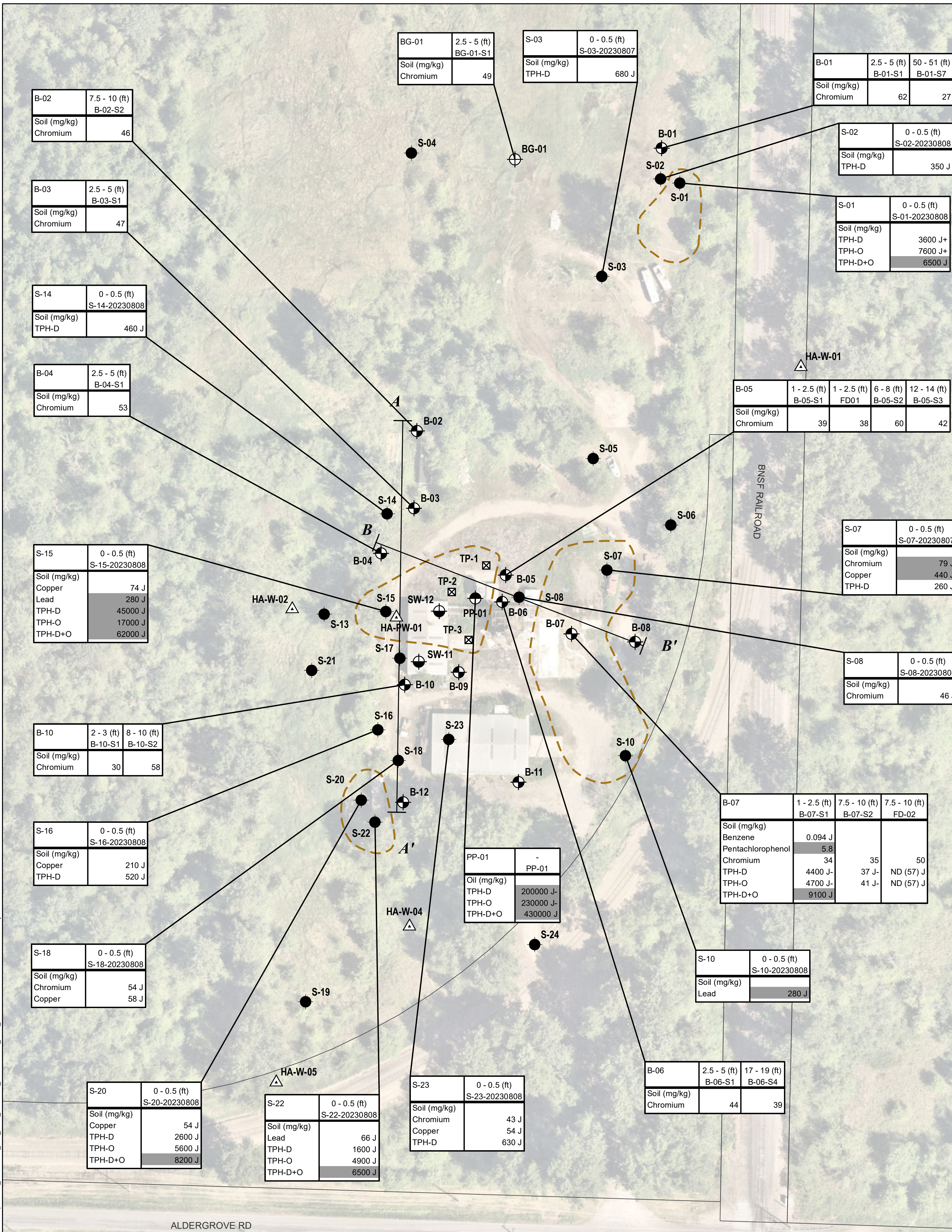

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LEGEND

- SUPPLEMENTAL GRAB WATER SAMPLE
- BACKGROUND SAMPLE
- RECONNAISSANCE BORING
- SURFICIAL SOIL SAMPLE
- ACCUMULATED WATER SAMPLE
- PRODUCT SAMPLE
- TEST PIT
- CROSS SECTION
- INFERRED EXTENT OF CONTAMINATED SOIL
- PARCEL BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. GREY SHADING INDICATES CONCENTRATIONS THAT EXCEED MODEL TOXICS CONTROL ACT (MTCA) SCREENING LEVELS AND/OR SITE-SPECIFIC TERRESTRIAL ECOLOGICAL EVALUATION.
3. DEFINITIONS:
   J = RESULT IS AN ESTIMATE
   J+ = RESULT IS AN ESTIMATE, BIASED HIGH
   J- = RESULT IS AN ESTIMATE, BIASED LOW
   cPAH-TEQ = CARCINOGENIC POLYCYCLIC AROMATIC HYDROCARBONS TOXICITY EQUIVALENCY FACTORS
   TPH-D = DIESEL-RANGE TOTAL PETROLEUM HYDROCABON
   TPH-O = OIL-RANGE TOTAL PETROLEUM HYDROCARBON
   TPH-D+O = SUM OF DIESEL- AND OIL-RANGE TOTAL PETROLEUM HYDROCARBONS
4. CONCENTRATIONS IN mg/kg (MILLIGRAMS PER KILOGRAM)
5. ASSESSOR PARCEL DATA SOURCE: WHATCOM COUNTY
6. NO MATERIAL COLLECTED AT TEST PIT
7. EXTENT OF IMPACTS APPEAR LIMITED TO SURFACE SOILS AND EXTENT SHOWN IS INFERRED BASED ON RI RESULTS.
8. AERIAL IMAGERY SOURCE: NEARMAP, 10 MAY 2024

0 100 200
SCALE IN FEET

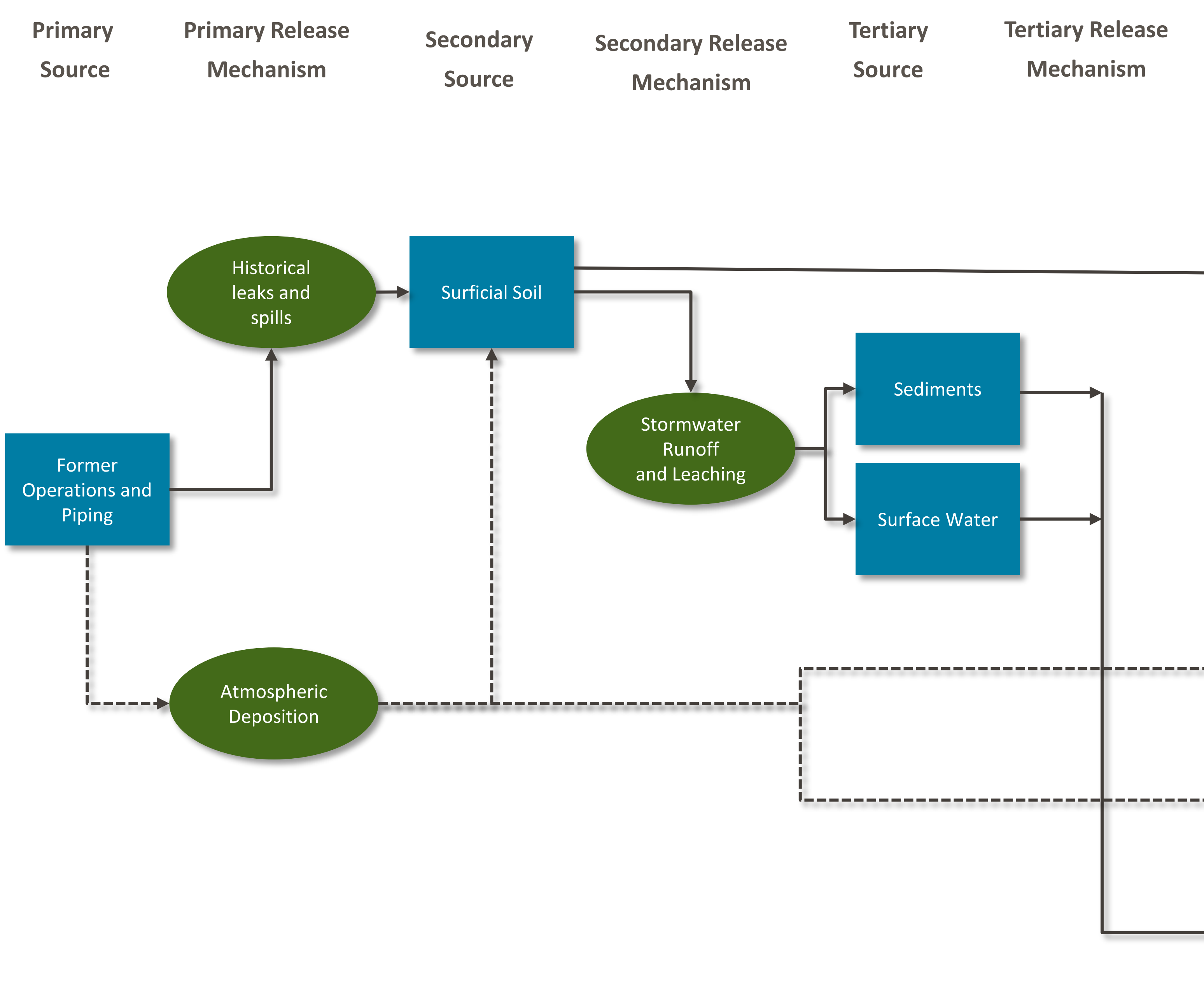
HALEY ALDRICH

TREOIL INDUSTRIES SITE
FERNDALE, WASHINGTON

SAMPLE LOCATIONS AND EXCEEDANCES

JUNE 2025

FIGURE 5



Current and Potential Future Receptors

Point of Contact	Exposure Route	Construction Workers	Occupational Workers/ Residents	Terrestrial/ Wildlife
Subsurface Soil <15 ft bgs	Ingestion Dermal Contact Inhalation	✓ ✓ ✓	I I I	✓ ✓ ✓
Perched Groundwater	Ingestion Dermal Contact Inhalation	Ø Ø Ø	Ø Ø Ø	Ø Ø Ø
Groundwater	Ingestion Dermal Contact Inhalation	Ø Ø Ø	Ø Ø Ø	Ø Ø Ø
Indoor Air	Inhalation	O	O	O
Outdoor Air	Inhalation	? / I	? / I	? / I
Surface Water and Sediment	Ingestion Dermal Contact	I I	I I	I I

LEGEND

- POTENTIALLY COMPLETE PATHWAY (solid arrow)
- UNKNOWN PATHWAY (dashed arrow)
- CURRENTLY INCOMPLETE, BUT POTENTIAL FUTURE PATHWAY (grey arrow)
- ✓ POTENTIALLY COMPLETE EXPOSURE ROUTE
- Ø INCOMPLETE EXPOSURE ROUTE
- I INSIGNIFICANT EXPOSURE ROUTE
- ? UNKOWN EXPOSURE ROUTE
- O CURRENTLY INCOMPLETE, BUT POTENTIAL FUTURE EXPOSURE ROUTE

NOTES

1. FT BGS = FEET BELOW GROUND SURFACE.
2. IT IS ASSUMED THAT GIVEN THE LACK OF GROUNDWATER, VOLATILIZATION WILL NOT OCCUR.

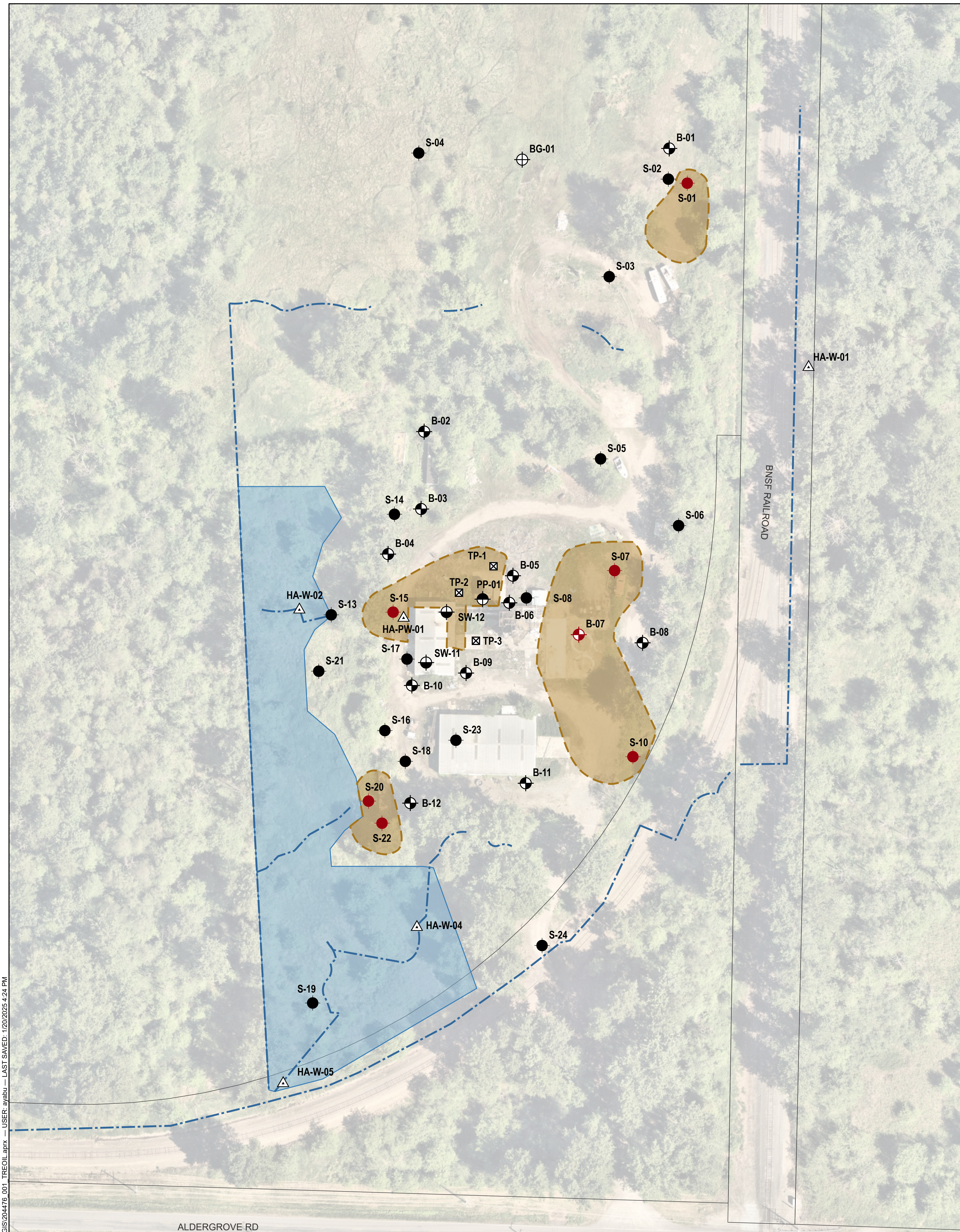
HALEY ALDRICH

TREOIL INDUSTRIES BIOREFINERY
4242 ALDERGROVE ROAD
FERNDALE, WASHINGTON

CONCEPTUAL SITE MODEL

JUNE 2025

FIGURE 6



LEGEND

- SUPPLEMENTAL GRAB WATER SAMPLE
- BACKGROUND SAMPLE
- RECONNAISSANCE BORING
- SURFICIAL SOIL SAMPLE
- ACCUMULATED WATER SAMPLE
- PRODUCT SAMPLE
- TEST PIT
- PREVIOUSLY DELINEATED DRAINAGE
- APPROXIMATE AREA OF EXCAVATION AND OFF-SITE DISPOSAL OF ON-PROPERTY SOIL WITH CONCENTRATIONS OF COCS GREATER THAN PROPOSED CLEANUP LEVELS
- DELINEATED WETLAND
- PARCEL BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. RED SYMBOLS INDICATE LOCATIONS THAT EXCEED SOIL CLEANUP LEVELS.
3. COC= CHEMICAL OF CONCERN
4. ASSESSOR PARCEL DATA SOURCE: WHATCOM COUNTY
5. AERIAL IMAGERY SOURCE: NEARMAP, 10 MAY 2024

0 100 200
SCALE IN FEET

HALEY ALDRICH

TREOIL INDUSTRIES SITE
FERNDALE, WASHINGTON

CLEANUP ACTION ALTERNATIVE 1

JUNE 2025

FIGURE 7

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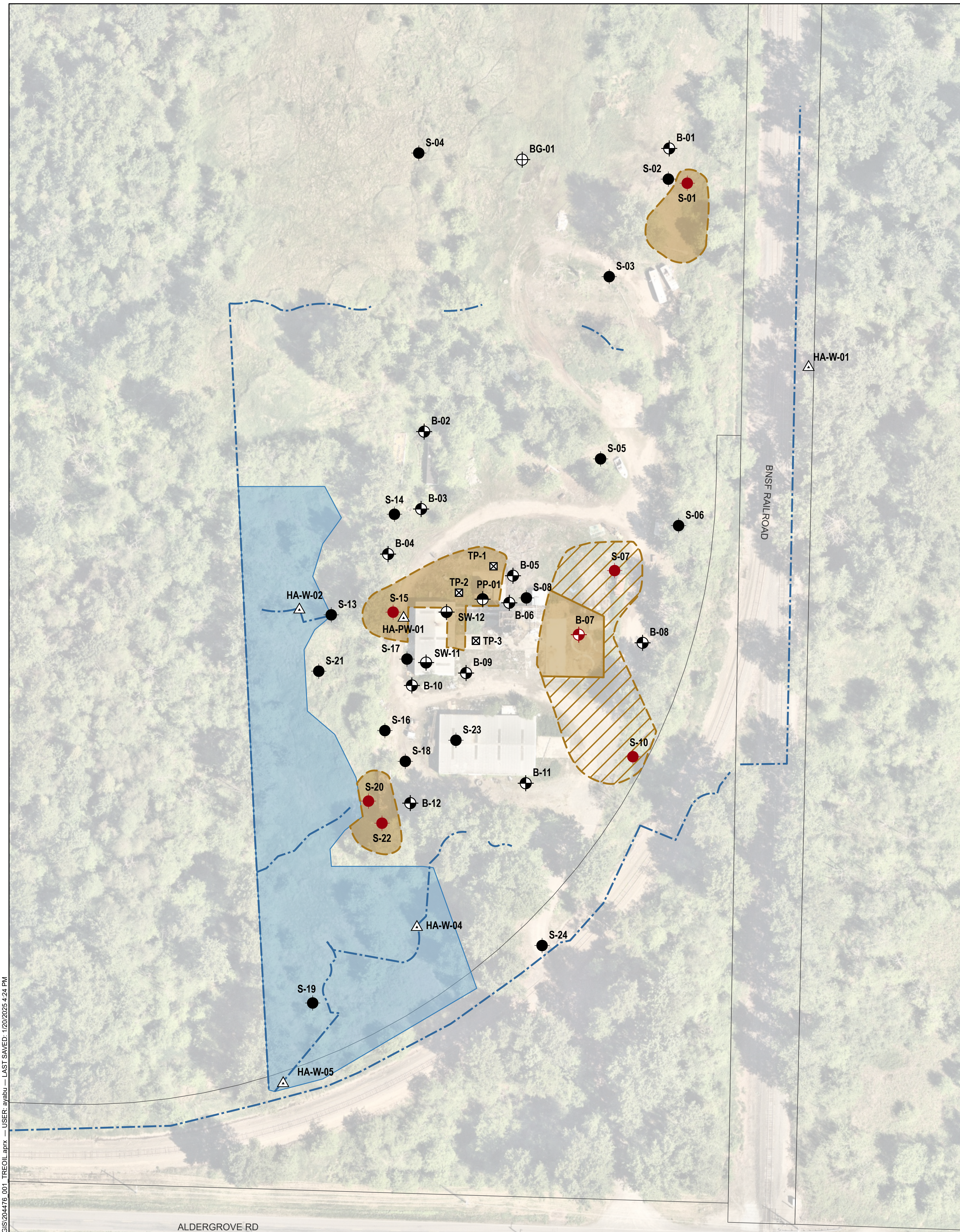


LEGEND

- SUPPLEMENTAL GRAB WATER SAMPLE
- BACKGROUND SAMPLE
- RECONNAISSANCE BORING
- SURFICIAL SOIL SAMPLE
- ACCUMULATED WATER SAMPLE
- PRODUCT SAMPLE
- TEST PIT
- PREVIOUSLY DELINEATED DRAINAGE
- APPROXIMATE AREA OF CAPPING OF ON-PROPERTY SOIL WITH CONCENTRATIONS OF COCS GREATER THAN PROPOSED CLEANUP LEVELS
- APPROXIMATE AREA OF EXCAVATION AND OFF-SITE DISPOSAL OF ON-PROPERTY SOIL WITH CONCENTRATIONS OF COCS GREATER THAN PROPOSED CLEANUP LEVELS
- DELINEATED WETLAND
- PARCEL BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. RED SYMBOLS INDICATE LOCATIONS THAT EXCEED SOIL CLEANUP LEVELS.
3. COC= CHEMICAL OF CONCERN
4. ASSESSOR PARCEL DATA SOURCE: WHATCOM COUNTY
5. AERIAL IMAGERY SOURCE: NEARMAP, 10 MAY 2024

N

0 100 200
SCALE IN FEET

HALEY ALDRICH

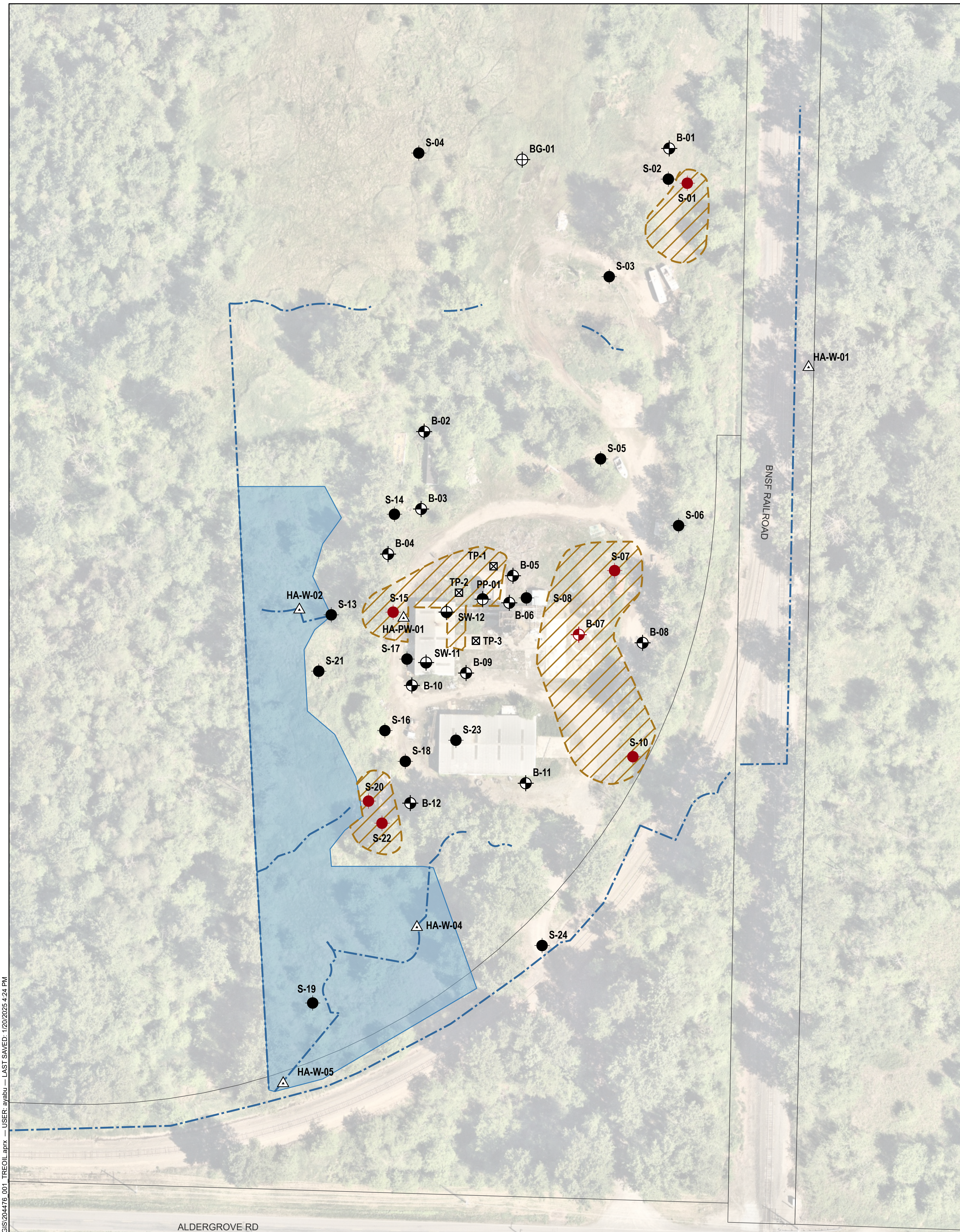
TREOIL INDUSTRIES SITE
FERNDALE, WASHINGTON

CLEANUP ACTION ALTERNATIVE 2

JUNE 2025

FIGURE 8

GIS FILE PATH: \\haleyaldrich.com\share\sea_projects\Notebooks\0204476-000_Treoil_Industries_Site\GIS\204476_001_TREOIL.aprx — USER: ayabu — LAST SAVED: 1/20/2025 4:24 PM



LEGEND

- SUPPLEMENTAL GRAB WATER SAMPLE
- BACKGROUND SAMPLE
- RECONNAISSANCE BORING
- SURFICIAL SOIL SAMPLE
- ACCUMULATED WATER SAMPLE
- PRODUCT SAMPLE
- TEST PIT
- PREVIOUSLY DELINEATED DRAINAGE
- APPROXIMATE AREA OF CAPPING OF ON-PROPERTY SOIL WITH CONCENTRATIONS OF COCS GREATER THAN PROPOSED CLEANUP LEVELS
- DELINEATED WETLAND
- PARCEL BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. RED SYMBOLS INDICATE LOCATIONS THAT EXCEED SOIL CLEANUP LEVELS.
3. COC= CHEMICAL OF CONCERN
4. ASSESSOR PARCEL DATA SOURCE: WHATCOM COUNTY
5. AERIAL IMAGERY SOURCE: NEARMAP, 10 MAY 2024

0 100 200
SCALE IN FEET

HALEY ALDRICH

TREOIL INDUSTRIES SITE
FERNDALE, WASHINGTON

CLEANUP ACTION ALTERNATIVE 3

JUNE 2025

FIGURE 9

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