First Periodic Review
Crownhill Elementary School Bremerton SD

1500 Rocky Point Rd NW, Bremerton, 98312, Kitsap County, Washington
Facility Site ID: 99722456; Cleanup Site ID: 4487

Toxics Cleanup Program, Northwest Region
Washington State Department of Ecology
February 2025

Document Information

This document is available on the Department of Ecology's Crownhill Elementary School Bremerton SD cleanup site page.[1]

Related Information

- Facility Site ID: 99722456
- Cleanup Site ID: 4487

Contact Information

Toxics Cleanup Program

Northwest Regional Office
Vance Atkins, Hydrogeologist 4
15700 Dayton Ave N.
Shoreline, WA 98133
Email: vance.atkins@ecy.wa.gov
Phone: 206-594-0000

Website: Washington State Department of Ecology[2]

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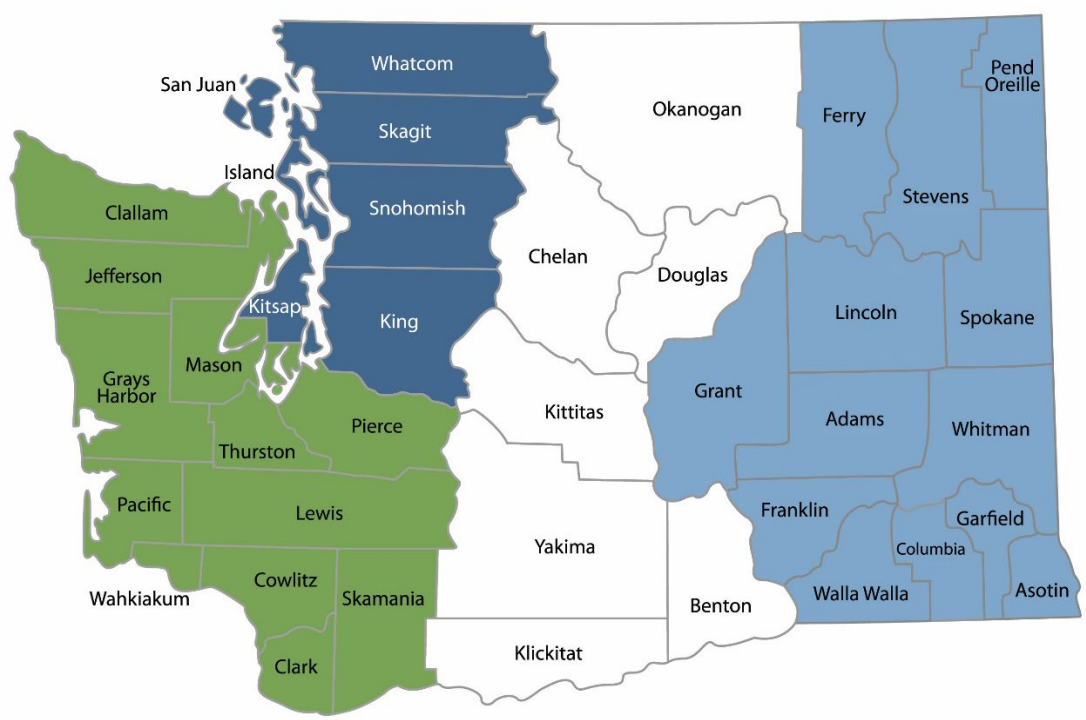
[1] https://apps.ecology.wa.gov/cleanupsearch/site/4487
[2] https://ecology.wa.gov/About-us/Who-we-are/Our-Programs/Toxics-Cleanup
[3] https://ecology.wa.gov/About-us/Accountability-transparency/Our-website/Accessibility

Department of Ecology's Regional Offices

Map of Counties Served



Southwest Region 360-407-6300	Northwest Region 206-594-0000	Central Region 509-575-2490	Eastern Region 509-329-3400

Region	Counties served	Mailing Address	Phone
Southwest	Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Mason, Lewis, Pacific, Pierce, Skamania, Thurston, Wahkiakum	PO Box 47775 Olympia, WA 98504	360-407-6300
Northwest	Island, King, Kitsap, San Juan, Skagit, Snohomish, Whatcom	PO Box 330316 Shoreline, WA 98133	206-594-0000
Central	Benton, Chelan, Douglas, Kittitas, Klickitat, Okanogan, Yakima	1250 W Alder St Union Gap, WA 98903	509-575-2490
Eastern	Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman	4601 N Monroe Spokane, WA 99205	509-329-3400
Headquarters	Across Washington	PO Box 46700 Olympia, WA 98504	360-407-6000

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Introduction

The Washington State Department of Ecology (Ecology) reviewed post-cleanup site conditions and monitoring data to ensure human health and the environment are being protected at the Crownhill Elementary School Bremerton SD cleanup site (Site). Site cleanup was implemented under the Model Toxics Control Act (MTCA) regulations, Chapter 173-340 Washington Administrative Code (WAC). This is the first periodic review conducted for this Site.

Cleanup activities at this Site were completed under a 2015 Agreed Order (AO, No. DE 11107) Concentrations of diesel- and heavy oil-range petroleum hydrocarbons, carcinogenic polycyclic aromatic hydrocarbons (cPAHs), trichloroethene (TCE), antimony, arsenic, chromium III, copper, lead, and zinc that exceeded MTCA cleanup levels remain on the property. The MTCA cleanup levels for soil and groundwater are established under WAC 173-340-740[4] and WAC 173-340-720,[5] respectively.

Ecology determined institutional controls in the form of an environmental covenant would be required as part of the cleanup action for the Site. WAC 173-340-420(2)[6] requires Ecology to conduct a periodic review of certain sites every five years. For this Site, a periodic review is required because the Site is under an agreed order and institutional controls are in place as part of the cleanup process.

When evaluating whether human health and the environment are being protected, Ecology must consider the following factors (WAC 173-340-420(4)):

a) The effectiveness of ongoing or completed cleanup actions, including the effectiveness of engineered controls and institutional controls in limiting exposure to hazardous substances remaining at the site

b) New scientific information for individual hazardous substances or mixtures present at the site

c) New applicable state and federal laws for hazardous substances present at the site

d) Current and projected site and resource uses

e) The availability and practicability of more permanent remedies

f) The availability of improved analytical techniques to evaluate compliance with cleanup levels

Ecology will publish a notice of this periodic review in the *Site Register* and provide an opportunity for public comment.

[4] https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-740
[5] https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-720
[6] https://app.leg.wa.gov/wac/default.aspx?cite=173-340-420

Summary of Site Conditions

Site description and history

Located in Bremerton, Washington, the Site includes both the Crownhill Elementary School (School) property at 1500 Rocky Point Road (Parcel No. 152401-2-027-2005, the northern parcel) and the northern portion of the Bremerton United Methodist Church (BUMC) property at 1150 Marine Drive (Parcel No. 152401-2-098-2009, the southern parcel).

The Site was used for sand and gravel mining up to the 1930s. The gravel excavation area extended across portions of the two Site parcels and is estimated to cover approximately 5.5 acres. After cessation of gravel excavation, the pit was used as a municipal/industrial landfill in the 1930s and 1940s. Site investigations indicate that the depth of fill extended from 15 to 40 feet below grade. The Site was used, in part, as a Kitsap County maintenance facility in the 1940s.

Bremerton School District acquired the northern Site parcel from Kitsap County in 1954, and the original school was constructed on the north Site parcel in 1956. That school partially burned down in 1993, and construction of the current school building was completed in 1996.

The School includes two buildings: a two-story, slab-on-grade main building (approximately 49,000 square feet) and two portable classroom buildings (approximately 3,600 square feet). An asphalt pavement driveway surrounds the main building, and a paved parking area is located to the west. The majority of the ground surface on the remainder of the property is grass and bare soil in the playfields and wood chips under the play equipment at the northeast and southwest corners of the property.

The adjacent south (BUMC) parcel was likely partially utilized for similar purposes as the School parcel through the 1940s, with landfilling occurring into the 1950s. The parcel was occupied by a paving company and other commercial listings through the mid-1960s. The transfer date of the southern parcel to BUMC ownership is unknown; however, the church building was constructed in 1965.

The BUMC property includes one building: a two-story, slab-on-grade church building (approximately 17,665 square feet). An asphalt paved parking area is located to the north and west of the building. The majority of the ground surface on the remainder of the property is grass and bare soil. The portion of the BUMC property encompassed by the Site is undeveloped and vegetated and landfill debris is not known to extend beneath any parcel structures.

The area surrounding the Site is developed primarily as single-family residential, with limited commercial/office development within 500 feet to the southwest. The closest listed cleanup site (Chevron 97960, CSID# 9369) is approximately 1,000 feet to the southeast. Oyster Bay, the closest surface water body, is approximately 1,400 feet to the southwest.

A vicinity map is in Appendix A, and a Site plan is in Appendix B.

Site investigations

A series of environmental investigations were conducted during the period between the 1993 fire and construction of the current school building, which was completed in 1996. Additional investigations were conducted beginning in 2009, culminating in preparation of the "Remedial Investigation Report" (Aspect, 2014a; herein referred to as the RI report).

Prior to the performance of the RI, a number of subsurface and environmental investigations were conducted at the Site. The findings of these investigations were summarized and incorporated into the RI report.

In 1993, a limited environmental assessment was conducted at the Site to verify the presence of petroleum hydrocarbons and metals in Site soils. Five borings were completed to depths of up to 21 feet. Petroleum hydrocarbons and metals in exceedance of MTCA cleanup levels in force at the time were identified in soil samples collected from five to 20 feet below ground surface (bgs).

In 1994, shallow soil sampling was conducted in the proposed playfield areas north and south of the proposed school building to evaluate exposure risk to contaminants. Subsurface investigations were completed to depths of up to two feet bgs, and soil samples were analyzed for petroleum hydrocarbons, metals, and volatile organic compounds (VOCs). Diesel and heavy oil petroleum hydrocarbons exceeding MTCA cleanup levels were identified in shallow soils in six of the eleven borings, and lead and other metals exceeding MTCA cleanup levels were identified in two borings.

Later in 1994, soil sampling was conducted during preliminary site construction. Soils generated during excavation activities were stockpiled and sampled for waste characterization and disposal purposes. Soil samples were also collected from excavation limits to document in-situ soil conditions. Samples were analyzed for petroleum hydrocarbons, metals, and PCBs. Air monitoring was conducted for lead and asbestos, and soil gas screening conducted for VOCs.

In 1995, a subsurface investigation was completed to assess if landfill contaminants had affected underlying soil and groundwater. Three monitoring wells and one soil boring were installed to depths of up to 131 feet below grade. Soil and groundwater samples were analyzed for petroleum hydrocarbons, VOCs, semi-volatile organic compounds (SVOCs), and VOCs. One soil sample collected from a landfill debris layer contained metals and VOCs exceeding MTCA cleanup levels. Deeper soil samples collected from native soils did not contain analytes exceeding cleanup levels. The monitoring wells were installed at the north, east, and southern portions of the School parcel, and outside of the landfilling extent. Significant groundwater impacts were not identified during that investigation.

In 2009, a shallow soil assessment was completed at the Site. Twenty-two soil samples were collected from depths of up to 2.25 feet below grade. One tap water sample was also collected. Soil and water samples were submitted for metals analysis.

A subsurface investigation was also conducted in 2009 to supplement existing data regarding the thickness of fill soil overlying landfill materials on the Site. Twenty-four soil borings were

completed to depths of up to 40 feet. Soil samples from the borings were analyzed for petroleum hydrocarbons, metals, VOCs, and SVOCs. Landfill material was identified to depths of up to 40 feet, primarily in the northwestern portion of the Site. Petroleum hydrocarbons, metals, VOCs, and cPAHs exceeding MTCA cleanup levers were identified in soil samples.

Sub-slab soil vapor sampling within the school building was initially conducted in 2010 as part of a soil vapor intrusion assessment work plan. Two rounds of sub-slab gas samples were collected from six sampling ports installed at the school building. Gas samples were analyzed for selected VOCs and hydrogen sulfide. Soil vapor sampling was not conducted on the BUMC property. The volatile contaminants at the Site are over 800 feet away from the building on the BUMC property.

The purpose of the RI was to collect data necessary to adequately characterize the nature and extent of Site contamination. Using multiple lines of evidence (e.g., historical photographs, Site assessment activity, construction observations), the RI identified two generalized areas of landfill accumulation, designated the 'north' and 'south' landfill areas. Figure 1 shows the interpreted boundaries of these two areas.

The RI included a summary of prior geotechnical and environmental investigation and sampling that occurred at the Site. RI-specific investigations completed in 2011 included completing soil borings on a 50-foot grid to identify the extent of landfill materials. Borings were completed to fifteen feet bgs on the School and BUMC parcels. A number of off-property borings were also completed to evaluate if landfill materials potentially extended to neighboring residential properties. Evidence of off-property landfilling was not identified. Deeper borings were completed on-property to assess landfill material depth, and four of the borings were completed as monitoring wells.

Two additional phases of investigation were conducted in 2011 and 2012 to address data gaps and further delineate areas of contamination.

In December 2011, four additional monitoring wells were installed at the Site, and additional shallow soil borings were completed in a 25-foot grid in a focused investigation area to delineate lead impacts as well as to better define shallow (0-1 foot bgs) soil exceedances near Site structures and along the parcel boundary between the School and BUMC properties.

In October and November 2012, five additional monitoring wells were installed, and limited shallow (0-3 feet bgs) soil sampling was conducted on the BUMC property to better define shallow arsenic impacts.

Groundwater conditions and light non-aqueous phase liquid (LNAPL) presence and extent was assessed via the groundwater monitoring network of sixteen wells.

Landfilled materials were found at up to 40-foot depth in the north landfill area, and at up to 20-foot depth in the south landfill area. Extensive sampling identified the following constituents of potential concern (COPCs) in Site soils and groundwater:

- Total petroleum hydrocarbon (TPH) in the diesel and motor-oil ranges
- Trichloroethene (TCE)

- Carcinogenic polycyclic aromatic hydrocarbons (cPAHs)
- The metals/metalloids antimony, arsenic, chromium III, copper, lead, and zinc

Cleanup actions

Two interim remedial actions were conducted at the Site during the RI process.

During the Spring of 2012, shallow soils within one foot bgs were excavated and disposed of from an area generally on the BUMC property, with the northern portion of the excavation extending onto the School property. Perimeter post-excavation samples were collected and analyzed for antimony, arsenic, copper, and lead and diesel- and motor oil-range petroleum hydrocarbons. Excavation was continued until analytical results for the selected contaminants of concern were below MTCA soil cleanup levels for unrestricted land use. Approximately 343 tons of soil were excavated and disposed of. The excavation was lined with a geotextile fabric to mark the base of excavation and backfilled with clean imported soils at least one foot thick.

During the Summer of 2013, a second interim remedial action was conducted on the School property to address lead-contaminated soils from depths of one to three feet bgs. Two areas north and northeast of the portable classroom building were identified with shallow lead exceedances. Because surficial soils (0-1 feet bgs) did not contain lead concentrations in exceedance of MTCA soil cleanup levels, additional soil capping was conducted at the two locations to increase surficial cover. Geotextile fabric was laid on the ground surface, and a minimum of one foot of additional imported soil fill was placed in the two areas of concern. No samples were collected as part of this interim action. A new storm drain line was also installed from the portable building to an existing catchbasin within the soil cover footprint. Approximately 2,400 square feet of additional cover was provided during this action.

A Feasibility Study (FS) and Cleanup Action Plan (CAP) for the Site was developed in 2014. The CAP was developed to address the contaminants and pathways identified through the Remedial Investigation process.

Primary elements of the CAP included: Maintaining the soil cap and adjacent impervious surfaces at the Site; addressing the soil vapor intrusion pathway by continuous operation of the school's HVAC system during occupation and periodic sub-slab soil vapor sampling; periodic manual removal of LNAPL under the north landfill area; periodic LNAPL gaging and groundwater sampling for groundwater COCs; and prohibiting groundwater well installation, groundwater extraction, or other invasive activities that may expose or mobilize LNAPL or groundwater exposure. The groundwater restrictions apply to the School property only since no groundwater concentrations exceeding MTCA cleanup levels have been detected on the BUMC property.

The above remedies were selected for meeting criteria for protectiveness to human health and the environment, regulatory compliance, and provisions for compliance monitoring.

To meet the objectives of the CAP, multiple work plans were developed to describe the remediation, monitoring, and maintenance actions outlined in the CAP.

A groundwater/LNAPL monitoring and contingency plan was developed in 2015 to address groundwater contaminants and LNAPL at the Site. The monitoring plan outlined frequency and type of analyses, defined point of compliance and indicator well locations, and provided contingency planning for plume migration, detections at the domestic water well, and LNAPL migration. The plan incorporated sampling and analysis of groundwater from eleven on-Site monitoring wells. The selected on-Site wells were monitored for groundwater level and LNAPL thickness. Wells were selectively monitored for LNAPL, petroleum hydrocarbons, arsenic, and TCE based on RI findings. One off-Site domestic well, the Mckinney well, was also sampled for TCE analysis. The selected wells are sampled on a quarterly to annual basis. The plan also provided a schedule for reporting analytical results and other groundwater findings at the Site.

An LNAPL removal work plan was developed in 2015 to address periodic removal of LNAPL from selected monitoring and extraction wells on the Site. Any well containing at least 0.3 feet of LNAPL would be bailed to manually remove accumulated product. Volumes of recovered product and water would be recorded, and the removed fluids containerized for proper disposal. Removal was scheduled to coincide with groundwater monitoring events. Reporting of the recovery efforts was incorporated into the groundwater monitoring reports.

A cover system inspection and maintenance plan was developed in 2015 to comply with the environmental covenants developed for the School and BUMC properties and soil vapor concerns with respect to the school buildings. The plan outlined responsibilities for maintenance and inspection of the soil cap and other impervious surfaces at the Site, as well as restrictions for disturbance of the cap. The school HVAC system was to be operated during school hours as a preventative measure for soil-gas intrusion within the Site structures. Sub-slab soil gas monitoring for contaminants of concern would be conducted on a five-year interval. An annual inspection report would be compiled documenting inspection, maintenance, and soil vapor sampling (if conducted).

Groundwater monitoring

Three monitoring wells (MW-1 through MW-3) were installed at the Site in December 1994/January 1995, and another 13 wells (MW-4 through MW-16) during the RI (between March 2011 and October 2012; refer to Figure 1 for well locations). This network of 2-inch diameter wells is used to periodically monitor groundwater for a wide range of contaminants. Groundwater occurs beneath the Site at roughly 110-foot depth. Significant perched groundwater does not occur at the Site. Monitoring wells are completed to depths of approximately 125 feet and are screened across the water table. Groundwater flow is generally to the southwest at the Site. Groundwater monitoring occurs at intervals as defined in the 2015 groundwater/LNAPL monitoring and contingency plan.

Monitoring identified TPH in the diesel and motor oil ranges, TCE, arsenic, and lead as COPCs dissolved in groundwater in the northern portion of the Site. TPH exceedances are limited to the north landfill area, where petroleum disposed of in the former landfill area infiltrated to groundwater. The petroleum plume appears to be generally stable, and detections to date have not exceeded MTCA cleanup levels at well MW-15, the conditional point of compliance well for

LNAPL along the southwest side of the north landfill area. TCE exceedances are limited to one well, MW-9, at the northern end of the Site. TCE has not been detected at laboratory reporting limits at the one monitored off-Site domestic water well. Arsenic has been detected above the MTCA cleanup level in MW-6, located southwest of the north landfill area. The value has fluctuated and appears to be generally increasing. The PLP's consultant proposed assessing selected wells for landfill gas concentrations, particularly caron dioxide, as a potential mechanism for mobilization of arsenic in groundwater at the Site. Elevated carbon dioxide can cause reducing conditions and increase groundwater acidity, thus mobilizing metals. Arsenic concentrations in well MW-10, the downgradient point of compliance well, have not exceeded Site cleanup or action levels, and have remained generally stable.

In addition to dissolved contaminants, separate-phase oil was observed floating on the groundwater table (as LNAPL) in well MW-8, which is installed in the north landfill area. The primary reason for installing the last five RI monitoring wells (MW-12 through MW-16) was to investigate the areal extent and thickness of the LNAPL accumulation. LNAPL was observed in three of these wells (MW-13, MW-14, and MW-16), and periodic removal of LNAPL via bailing began in November 2012. At the recommendation of Ecology, a 4-inch diameter well designed specifically for LNAPL extraction (EW-17) was installed in October 2015. LNAPL removal by bailing is attempted when a thickness of 0.3 feet or greater is measured in a well.

Soil gas monitoring

Sub-slab soil gas monitoring is conducted on five year intervals in accordance with the Soil Vapor Intrusion Assessment Work Plan (Aspect, 2010). Soil gas samples are collected from six permanent sampling points (SSV-1 through SSV-6) installed in the floor slab of the main school building. The samples are analyzed for fifteen VOC compounds (including TCE) and hydrogen sulfide. In each of the sampling events to date, soil gas COCs were either not detected at laboratory reporting limits, or were detected at concentrations well below their respective soil gas screening levels.

Cleanup standards

Cleanup standards include cleanup levels, the location where these cleanup levels must be met (point of compliance), and any other regulatory requirements that apply to the Site. WAC 173-340-704[7] states MTCA Method A may be used to establish cleanup levels at sites that have few hazardous substances, are undergoing a routine cleanup action, and where numerical standards are available for all indicator hazardous substances in the media for which the Method A cleanup level is being used. Method B may be used at any site and is the most common method for setting cleanup levels when sites are contaminated with substances not listed under Method A.

MTCA Method A cleanup levels for unrestricted land use were determined to be appropriate for contaminants at this Site. The cleanup actions conducted at the Site were determined to be

[7] https://app.leg.wa.gov/WAC/default.aspx?cite=173-340-704

routine, few hazardous substances were found at the Site, and numerical standards were available in the MTCA Method A table for each hazardous substance.

The point of compliance is the area where the cleanup levels must be attained. For soil cleanup levels based on the protection of groundwater, as they are for this Site, the point of compliance is established as soils throughout the Site (standard point of compliance). Cleanup levels are not met throughout the Site, since a containment remedy was selected in general accordance with WAC 173-340-740(6)(f).

The Site has a conditional point of compliance for groundwater, which was established at the property boundary. Monitoring well MW-10, located near the School property boundary and hydraulically downgradient of the areas of contaminated groundwater, is used to evaluate compliance with cleanup standards.

Well MW-15 is used as a conditional point of compliance for LNAPL migration. Well MW-15 is located within the School property on the downgradient edge of the LNAPL plume. If LNAPL is detected in well MW-15, more aggressive measures than the removal methods specified in the LNAPL Removal Work Plan would be implemented to prevent further LNAPL migration towards the property boundary.

Environmental Covenant

Ecology determined that institutional controls would be required as part of the cleanup action to document the remaining contamination, protect the cleanup action, and protect human health and the environment. On April 14, 2015, institutional controls in the form of two environmental covenants (Covenants) were recorded for the Site, one for the School property[8] and one for the BUMC property[9].

The Covenant restrictions that apply to both Covenants are summarized below (see the two Covenant documents for detailed restrictions and conditions for each property):

- Interference with Remedial Action. The Grantor shall not engage in any activity on the Property that may impact or interfere with the remedial action and any operation, maintenance, inspection or monitoring of that remedial action without prior written approval from Ecology.

- Protection of Human Health and the Environment. The Grantor shall not engage in any activity on the Property that may threaten continued protection of human health or the environment without prior written approval from Ecology. This includes, but is not limited to, any activity that results in the release of residual contamination that was contained as a part of the remedial action or that exacerbates or creates a new exposure to residual contamination remaining on the Property.

[8] https://apps.ecology.wa.gov/cleanupsearch/document/45970
[9] https://apps.ecology.wa.gov/cleanupsearch/document/45969

- Continued Compliance Required. Grantor shall not convey any interest in any portion of the Property without providing for the continued adequate and complete operation, maintenance and monitoring of remedial actions and continued compliance with this Covenant.

- Leases. Grantor shall restrict any lease for any portion of the Property to uses and activities consistent with this Covenant and notify all lessees of the restrictions on the use of the Property.

- Containment of soil/waste materials. The remedial action for the Property is based on containing contaminated soil and waste materials under a cap consisting of the Crownhill Elementary School and associated paved parking lots and roadways, and a minimum one-foot-thick soil cap in playfields and yard areas. Any activity that would compromise the integrity of the cap is prohibited without prior written approval by Ecology. In addition, the Grantor shall not alter of remove the existing structures on the Property in any manner that would expose contaminated soil and waste materials, result in a release to the environment of contaminants, or create a new exposure pathway, without prior written approval by Ecology.

- Access. Authorized representatives of Ecology shall have the right to enter the Property at reasonable times with reasonable notice for the purposes of evaluating compliance with the terms of this Covenant.

The Covenant for the School property has the following additional restrictions and conditions due to contaminated groundwater that remains on the property:

- Groundwater Use. The groundwater beneath the Property remains contaminated and shall not be extracted for any purpose other than temporary construction dewatering, investigation, monitoring or remediation. Drilling of a well for any water supply purpose is strictly prohibited. Groundwater extracted from the Property for any purpose shall be considered potentially contaminated and any discharge of this water shall be done in accordance with state and federal law.

- Monitoring. Several groundwater monitoring wells are located in the Property to monitor the performance of the remedial action. The Grantor shall maintain clear access to these devices and protect them from damage. The Grantor covenants and agrees that it shall comply with the Ecology-approved Groundwater/LNAPL Monitoring and Contingency Plan.

Periodic Review

Ecology conducted a Site visit on November 21, 2023. Ecology was accompanied by the PLP's consultant and a representative of the Bremerton School District. The Site is currently operating as a public elementary school with surrounding parking, playfields, and landscaped areas. A portion of the Site extends south to a neighboring parcel developed as a church. This portion of the Site (the northern portion of the church parcel) is currently vacant and undeveloped. A photo log is in Appendix C.

Effectiveness of completed cleanup actions

Current Site Conditions

Soils with COC concentrations higher than MTCA CULs are still present at the Site, particularly northwest of the main school building. However, Ecology determined in 2018 that no further action is necessary to remediate soils at the Site and that compliance for soils at the Site will be evaluated based on compliance with the Environmental Covenant and Cover System Inspection and Maintenance Plan. Ongoing groundwater monitoring and LNAPL measurement/removal is required in accordance with the Groundwater/LNAPL Monitoring and Contingency Plan. School building HVAC operation is also required during the school day in accordance with the Cleanup Action Plan.

Based upon the Site visit conducted on November 21, 2023, the Site remedy continues to eliminate exposure to contaminated soils by ingestion and direct contact. The asphalt paving and grass/landscaping in the playfields and church property appeared in satisfactory condition. The depth of residual contamination is maintained on-Site to a depth of greater than one foot bgs, as designed in the Cleanup Action Plan, and maintained via the surface cap combination of asphalt paving and grass/landscaping.

Monitoring wells were generally in good condition. Wells are protected on-site by a combination of utility vaults and either surface-mount or stickup casing monuments. All Site monitoring wells were located during the visit.

Other than routine monitoring well maintenance, no other repair, maintenance, or contingency actions have been required.

Six soil vapor sampling points are located inside the main school building. One sampling point located in a public access way was located and inspected as part of the Site visit. It was found to be in good condition. The remaining sampling points are located within classrooms and were not accessible at the time of the Site visit.

Direct contact

The cleanup actions were intended to eliminate exposure to contaminated soil and groundwater at the Site. Exposure pathways to contaminated soils by ingestion and direct contact were reduced by removal of surficial soils exceeding cleanup levels, installation of a soil

cap, and the recording of an environmental covenant. The soil cap appears to be in satisfactory condition, and no repair, maintenance, or contingency actions are required at this time. The School District monitors and maintains the cap as part of Site landscaping, and communicates with the PLP's consultant if soil disturbance is required or identified. Ecology is also notified as a requirement of the environmental covenants.

Protection of groundwater

Soils with petroleum hydrocarbons, cPAHs, TCE and arsenic at concentrations exceeding MTCA Method A cleanup levels remain at the Site. Free product is removed periodically by bailing, although the recovered volume is limited due to the viscosity of the petroleum. Regular groundwater monitoring has demonstrated that the free product and associated petroleum hydrocarbon contamination do not appear to be migrating.

Arsenic exceedances in groundwater are also present at the Site. Arsenic occurs both naturally in alluvial aquifers in the State, as well as being mobilized by high hydrocarbon concentrations and groundwater chemistry associated with other contaminant sources. Arsenic exceeds the current groundwater cleanup level of 5 micrograms per liter (µg/l) in monitoring wells in the north former landfill area. The on-Site contingency threshold of 40 µg/l level has been exceeded at MW-6 once in 2022, but has not exceeded the groundwater cleanup level of 5 µg/l at MW-10 at the Site conditional point of compliance. The PLP's consultant has planned to conduct soil gas sampling to evaluate potential geochemical mechanisms for mobilization of arsenic. An addendum to the Groundwater/LNAPL Monitoring and Contingency Plan was prepared in 2022 and included soil gas screening for common landfill gases from on-Site monitoring wells. If the on-Site groundwater contingency threshold level at well MW-6 continues to be exceeded, a contingency plan will be prepared to address the exceedance.

TCE has consistently exceeded the Site cleanup level of 5 µg/l at MW-9. TCE has not been detected in MW-10 at the conditional point of compliance, or in the off-Site domestic well that is sampled annually for the contaminant. The estimated extent of TCE impacted groundwater is shown in the Site Plan in Appendix B. However, the extent was estimated based on groundwater flow direction (southwest) relative to well MW-9. Groundwater data does not appear to be available to the north or east of well MW-9, so the exact extent of TCE is unknown.

Protection of indoor air

TCE exceeds the Site cleanup level of 5 µg/l at well MW-9 in the northeast corner of the property, with concentrations ranging from 5 to 12 µg/l. These concentrations exceed the Method B groundwater screening level for vapor intrusion of 1.4 µg/l. This value is a screening level (not a cleanup level) from Ecology's Cleanup Levels and Risk Calculation (CLARC) spreadsheet (updated July 2024) that is being used to evaluate the potential risk of vapor intrusion at the Site.

Adjacent residences may be located within 100 feet of the TCE impacted groundwater, which could indicate a vapor intrusion risk (Ecology, 2022). The estimated extent of TCE impacted

groundwater is shown in the Site Plan in Appendix B. However, the extent was estimated based on groundwater flow direction (southwest) relative to well MW-9. Groundwater data does not appear to be available to the north or east of well MW-9, so the exact extent of TCE is unknown. Therefore, the likelihood of impacts to indoor air quality in the adjacent residences is unknown.

Periodic sub-slab soil gas monitoring at the school building has not detected TCE or other COCs above soil gas screening levels.

Institutional controls

Institutional controls in the form of two Environmental Covenants were implemented at the Site in 2015. The Covenants remain active and discoverable through the Kitsap County Auditor's Office. Ecology found no evidence a new instrument has been recorded that limits the effectiveness or applicability of the Covenants. The Covenants prohibit activities that will result in the release of contaminants contained as part of the cleanup action and prohibits any use of the properties that is inconsistent with the Covenants, unless approved by Ecology in advance. These Covenants ensure the long-term integrity of the cleanup action will be protected.

The PLP's consultant conducts a Site visit and inspection twice yearly to confirm Site conditions in accordance with the Cover System Inspection and Maintenance Plan, as required in the Covenants. The School's HVAC system is operational during occupied hours in order to mitigate potential vapor intrusion risks. Surface repairs are conducted if the cap condition is found to be degraded. Additionally, on-site maintenance personnel perform incidental maintenance and communicate observed issues with the PLP's consultant.

One unauthorized soil disturbance was reported to Ecology in October 2021, when a volunteer installed fence posts at a garden area at the Site. The fence post holes did not penetrate the protective soil cap, however, they were installed in violation of the Environmental Covenant. The installation was reported to Ecology, and the fence posts removed and area restored. Other elements of the garden area did not contradict the Environmental Covenant, as they consisted of above-ground planters and work tables set on a bed of wood chips.

New scientific information for individual hazardous substances or mixtures present at the Site

Arsenic

In January 2022, Ecology published a study on Natural Background Groundwater Arsenic Concentrations in Washington State (Ecology, 2022a). A statistical analysis was conducted on groundwater arsenic data from public supply wells throughout the state. The study calculated a background threshold value for arsenic in groundwater in the Puget Sound Basin of 8 µg/L. The current MTCA Method A level is 5 µg/L; both of these concentrations are considered to be within the range of natural background of 5 to 15 µg/L (Ecology, 2022a).

Ecology's recommendations in the 2022 study included: *"Ecology should develop an implementation memo to provide guidance on how to use data from this study. This memo would be used to make site-specific decisions and demonstrate the appropriate use of background levels as targets for cleanup.*"

Only one monitoring well at the Site (MW-6) exceeds the Site cleanup level for arsenic of 5 µg/L. Well MW-6 also consistently exceeds the natural background value of 8 µg/L. Therefore, no change to the Site CUL is recommended since it would not affect decisions made for the Site at this time.

Iron and Manganese

Iron and manganese were analyzed as part of the arsenic evaluation completed by the PLP's consultant in 2022 to evaluate the groundwater geochemistry. Iron and manganese in well MW-10 at the conditional point of compliance (with concentrations up to 2,530 µg/L and 1,440 µg/L, respectively) exceed the Method B groundwater screening levels of 300 µg/L and 50 µg/L, respectively. However, no cleanup levels were selected for iron and manganese in the Cleanup Action Plan for the Site.

TCE

As previously discussed, TCE concentrations at well MW-9 have ranged from 5 to 12 µg/l, which exceeds the Method B groundwater screening level for vapor intrusion of 1.4 µg/l (Ecology, 2024). Adjacent residences may be located within 100 feet of the TCE impacted groundwater, which could indicate a vapor intrusion risk.

TCE concentrations during the last four monitoring events also exceeded the short-term groundwater screening level for vapor intrusion for residential receptors of 8 µg/l (per Ecology's 2019 Implementation Memo No. 22 "*Vapor Intrusion (VI) Investigations and Short-term Trichloroethene (TCE) Toxicity").* If TCE is present in indoor air, it can result in health impacts to building occupants, the most urgent of which are to pregnant women. U.S. EPA has concluded that brief exposures to TCE in air may affect women in the first trimester of pregnancy by increasing the risk of heart malformations to a developing fetus.[10]

New applicable state and federal laws for hazardous substances present at the Site

There are no new applicable or relevant state or federal laws for hazardous substances remaining at the Site.

Ecology reviewed the Site cleanup levels (CULs) established in the Cleanup Action Plan, summarized in Tables 1 and 2. The most recent CLARC tables were reviewed for changes to the

[10] See U.S. EPA, August 2014, Office of Solid Waste and Emergency Response Memorandum: Compilation of Information Relating to Early/Interim Actions at Superfund Sites and the TCE IRIS Assessment.

CULs for the Site contaminants of concern (dated August 2023 as of the time of this report). No significant changes were noted and the established Site CULs remain valid.

Current and projected Site and resource uses

The Site parcels are currently used for school and church-related purposes. There have been no changes in current or projected future Site or resource uses. The current Site use is not likely to have a negative impact on the protectiveness of the cleanup action.

Availability and practicability of more permanent remedies

The remedy implemented included containing hazardous substances. While more permanent remedies may be available, they may not be practicable at this Site.

Availability of improved analytical techniques to evaluate compliance with cleanup levels

The analytical methods used at the time of the cleanup action were capable of detection below the selected MTCA cleanup levels. The presence of improved analytical techniques would not affect decisions or recommendations made for the Site.

Conclusions

The periodic review concluded that more information is needed to determine if the cleanup is protective of human health and the environment. The findings include:

- Groundwater compliance monitoring at the Site indicates that diesel- and oil-range TPH, TCE, and arsenic are present above MTCA cleanup levels, and LNAPL is present in Site monitoring wells. However, these contaminants of concern do not exceed cleanup levels at well MW-10 at the conditional point of compliance.
- The on-Site contingency threshold level for arsenic of 40 µg/l has been exceeded at well MW-6 once (in 2022) but has not exceeded the cleanup level of 5 µg/l at well MW-10 (at the conditional point of compliance). The PLP's consultant plans to conduct soil gas sampling to evaluate potential geochemical mechanisms for mobilization of arsenic. If the contingency threshold level at well MW-6 continues to be exceeded, a contingency plan will be prepared to address the exceedance.
- Iron and manganese in well MW-10 at the conditional point of compliance exceed the Method B groundwater screening levels. However, no cleanup levels were selected for iron and manganese in the Cleanup Action Plan for the Site. Iron and manganese were analyzed as part of the arsenic evaluation completed in 2022.
- TCE concentrations in well MW-9 in the northeast corner of the property have ranged from 5 to 12 µg/l, which exceeds the Method B groundwater screening level for vapor intrusion of 1.4 µg/L. TCE concentrations during the last four groundwater monitoring events also exceeded the short-term groundwater screening level for vapor intrusion for residential receptors of 8 µg/l. The exact extent of TCE impacted groundwater is unknown based on limited groundwater data to the north and east of well MW-9. Adjacent residences may be located within 100 feet of the TCE impacted groundwater. Potential impacts to indoor air in the residences are unknown. To further characterize this impact and assess off-property risk, the PLP should either install additional monitoring wells between MW-9 and the north and east fence lines, or collect soil gas samples along the fence lines (at depths of at least 15 feet bgs, to minimize dilution from ambient air). Ecology sent a notification letter regarding the short-term TCE screening level exceedance to the PLP in September 2024 based on the preliminary findings in this Periodic Review. The PLP's consultant team is preparing a work plan to evaluate soil gas levels along the Site parcel boundaries in areas of concern.
- TCE concentrations in well MW-9 also exceed the groundwater cleanup level of 5 µg/l. The exact extent of TCE impacted groundwater is unknown based on limited groundwater data to the north and east of well MW-9, and may impact adjacent properties.
- The PLP has been diligent in inspection and maintenance of the Site soil cap and associated institutional controls. However, to improve communication with school district staff and volunteers, posting of informational signs warning against soil disturbance is recommended to avoid other inadvertent soil cap damage.

The property owner is responsible for continuing to inspect the Site to ensure the integrity of the cleanup action is maintained, particularly the surface cover/cap and HVAC operations during school occupancy periods.

Next review

Ecology will schedule the next review for the Site five years from the date of this periodic review. If additional cleanup actions or institutional controls are required, the next periodic review will be scheduled five years after those activities are completed.

Table 1. Cleanup levels for soil and groundwater contaminants

Contaminant	Soil cleanup level (mg/kg)	Groundwater cleanup level (µg/L)
Petroleum Hydrocarbons		
TPH - Diesel	2,000	500
TPH - Oil	2,000	500
Metals		
Antimony	5.4	N/A
Arsenic	20	5
Chromium III	1,000	N/A
Copper	260	N/A
Lead	250	15
Zinc	6,000	N/A
Volatile Organic Compounds (VOCs		
Trichloroethene (TCE)	0.03	5
Polycyclic Aromatic Hydrocarbons (PAHs)		
cPAHs TEF	0.14 (TEF)	N/A

µg/L = micrograms per liter
mg/kg = milligrams per kilogram
TPH = total petroleum hydrocarbons
N/A = Not identified as a constituent of concern in groundwater
TEF = The cPAHs TEF is calculated from the concentrations of seven carcinogenic PAHs, using the method described in WAC 173-340-708.

Table 2. Cleanup levels for air contaminants

Constituent of Potential Concern[1]	Air cleanup level, 2015 (µg/m³)[2]		Sub-Slab Screening Level[3]	Air cleanup level, 2024 (µg/m³)[4]	
	Non-Carcinogen	Carcinogen		Non-Carcinogen	Carcinogen
Freon 12 (Dichlorodifluoromethane)	45.7		1,520	46	
Vinyl Chloride	45.7	0.28	9.33	46	0.28
1,1-Dichloroethene	91.4		3,050	91	
Trans-1,2-Dichloroethene				18	
1,1-Dichloroethane		1.56	52		1.6
Cis-1,2-Dichloroethene				18	
Chloroform	44.8	0.109	3.63	45	0.11
Benzene	13.7	0.32	10.7	14	0.32
1,2-Dichloroethane	3.2	0.0962	3.21	3.2	0.096
Trichloroethene	0.914	0.37	12.3	0.91	0.33
Tetrachloroethene	18.3	9.62	321	18	9.6
Ethylbenzene	457		15,200	460	
Xylenes (total)	45.7		1,520	46	
1,2,4-Trimethylbenzene	3.2		107	27	
Naphthalene	1.37	0.0735	2.45	1.4	0.074
Hydrogen sulfide	0.914		30.5	0.91	

µg/m³ = micrograms per cubic meter

1 = Constituents of potential concern (COPC's) were identified in consultation with Ecology during development of the site-specific Soil Vapor Intrusion Assessment Work Plan (Aspect, 2010, revised 2015).

2 = Based on the more restrictive of the carcinogenic and non-carcinogenic MTCA Method B values presented in Ecology's CLARC database at the time of Plan preparation.

3 = Sub-slab screening levels were obtained by dividing the most stringent MTCA Method B air cleanup level by 0.03, to conservatively account for soil vapor attenuation across the floor slab in accordance with Ecology guidance.

4 = Carcinogenic and non-carcinogenic MTCA Method B values presented in Ecology's CLARC database as of February 2024.

Blank = No value provided in CLARC database ("not researched" or "researched - no data").

References

Aspect Consulting. Soil Vapor Intrusion Assessment, November 2010 Sub-Slab Sampling, Crownhill Elementary School. December 22, 2010.

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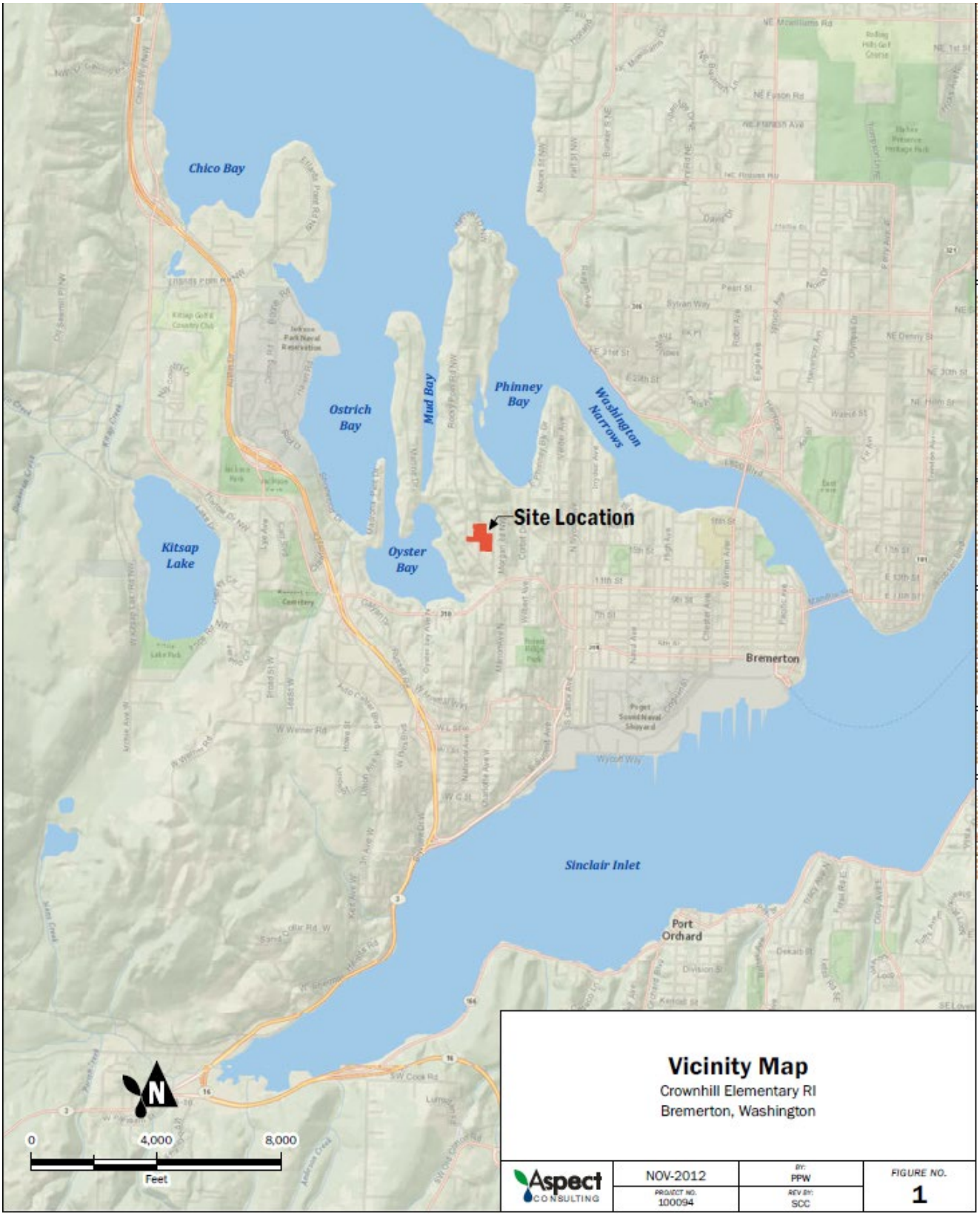
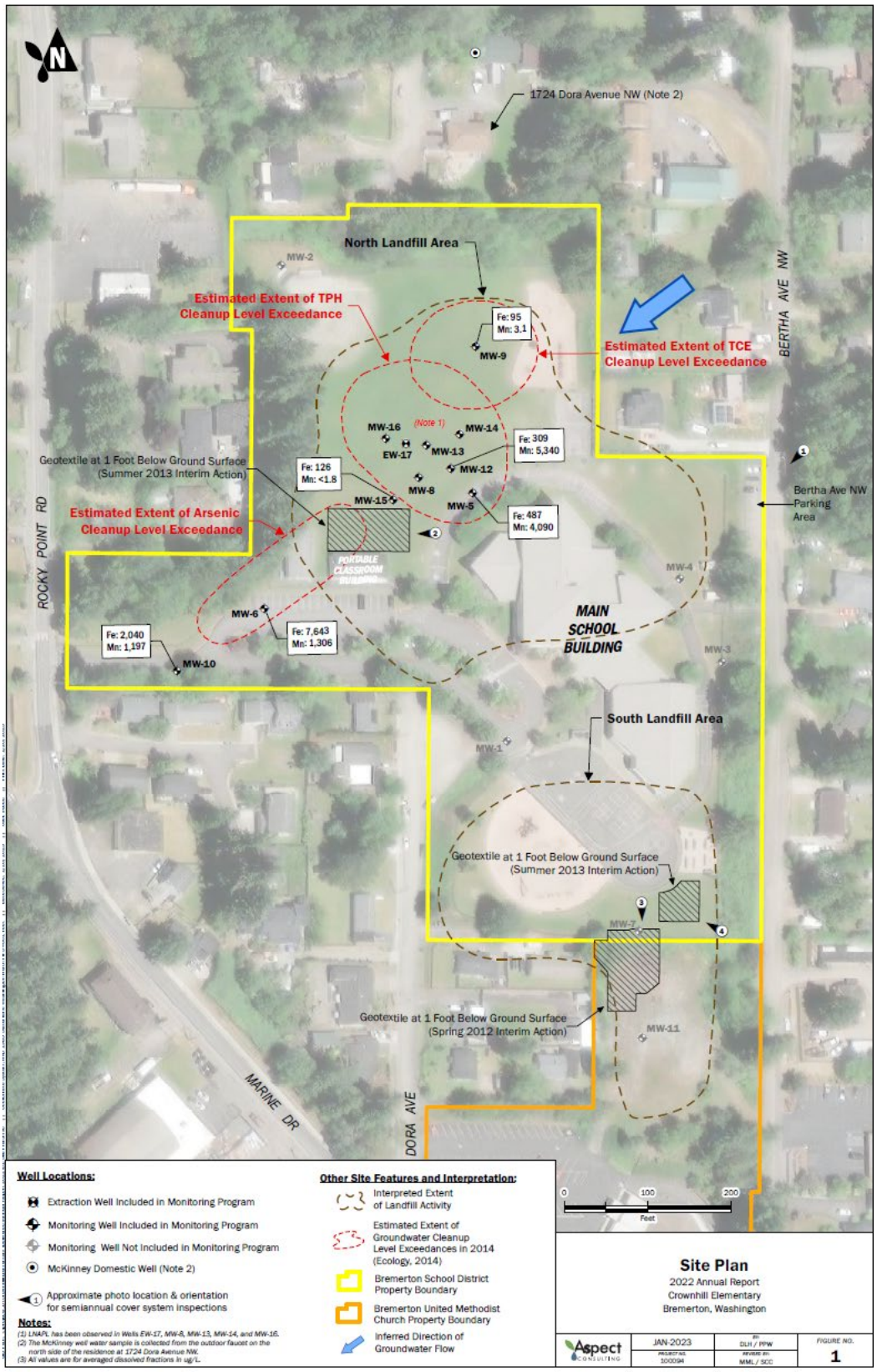
Ecology. Site Visit. November 21, 2023.

Ecology. Vapor Intrusion Investigations and Short-term Trichloroethene (TCE) Toxicity. Implementation Memorandum No. 22. October 1, 2019.

Appendix A. Vicinity Map



Appendix B. Site Plan



Appendix C. Photo Log

Photo 1: Main School Building, photo from west

Photo 2: Portable Classrooms and landscaped cover, photo to north

Photo 3: Landscaped cover, play area, photo to northeast

Photo 4: Above-ground planting containers and monitoring well (typical), photo to south

Photo 5: Play area with ground cover, photo to west

Photo 6: Main school building and asphalt play area, photo to north

Photo 7: School Driveway, monitoring well MW-10 in foreground, photo to east

Photo 8: Soil gas monitoring point, school building interior

Photo 9: South edge of School parcel and north edge of BUMC parcel, view to west

Photo 10: Portion of BUMC parcel within Site, photo to north