GROUNDWATER/LNAPL MONITORING AND CONTINGENCY PLAN

Crownhill Elementary School Site

Prepared for: Bremerton School District

Project No. 100094-003-02 • November 19, 2015

Aspect CONSULTING

earth + water

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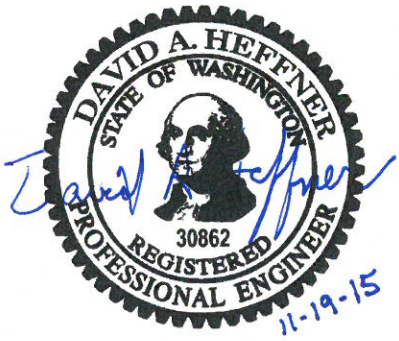

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1 Introduction

1.1 General

Historical landfill activities at the Bremerton School District (BSD) Crownhill Elementary School Site (Site) have resulted in groundwater contamination and the presence of light non-aqueous-phase liquid (LNAPL) floating on the water table. As described in the Site's *Cleanup Action Plan* (CAP; Ecology, 2014), periodic monitoring of groundwater quality and LNAPL layer thickness is a component of the selected cleanup action for the Site. This Groundwater/LNAPL Monitoring and Contingency Plan (Plan) addresses monitoring procedures, monitoring frequency, groundwater sampling and analysis protocols, and reporting requirements during the cleanup action implementation phase of the project. It also specifies how monitoring results are evaluated and the steps to be taken in the event that potential migration of LNAPL or contaminated groundwater is indicated.

The selected cleanup action also includes periodic removal and off-site recycling/disposal of LNAPL from existing monitoring wells. Those activities are prescribed in the *LNAPL Removal Work Plan* (Aspect, 2015c), a companion document to this Plan. BSD is responsible for implementing this Plan and the LNAPL Removal Work Plan in accordance with Agreed Order No. DE11107 (AO) between the Washington Department of Ecology (Ecology) and BSD.

1.2 Project Background

Crownhill Elementary School is located at 1500 Rocky Point in Bremerton, Washington (Figure 1). The Site was used for sand and gravel mining up to the 1930s, and the mined area was backfilled with municipal and industrial wastes in the 1930s and 1940s. The original school building was constructed in 1956, and partially burned down in 1993. A series of environmental investigations were conducted during the period between that fire and construction of the current school building, which was completed in 1996. Additional investigations were conducted beginning in 2009, culminating in the preparation of a Remedial Investigation (RI) report (Aspect, 2014a).

1.2.1 Remedial Investigation

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 2 shows the interpreted boundaries of these two areas. 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. Three monitoring wells (MW-1 through MW-3) were installed at the Site in December 1994/January 1995, and another 13 (MW-4 through MW-16) during the RI (between March 2011 and October 2012). This network of 2-inch-diameter wells was used to periodically monitor groundwater, which is encountered beneath the Site at roughly 110-foot depth, for a wide range of contaminants.

Periodic monitoring identified the following constituents of concern (COCs) dissolved in groundwater in the northern portion of the Site:

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

In addition to dissolved contaminants, separate-phase oil was found floating on the groundwater table (as LNAPL) beneath the deepest portion of the north landfill area. Several closely spaced monitoring wells (MW-12 through MW-16) were installed specifically to investigate the areal extent and thickness of this LNAPL accumulation.

1.2.2 Feasibility Study and Cleanup Action Plan

Site cleanup alternatives were developed and comparatively evaluated with respect to criteria specified in the Washington Model Toxics Control Act (MTCA; Chapter 173-340 WAC) in the Feasibility Study (FS) (Aspect, 2014b). Based on the FS evaluation, a cleanup action was selected for implementation that includes periodic monitoring of groundwater quality and LNAPL layer thickness, along with periodic removal of LNAPL from existing monitoring wells. Refer to the CAP (Ecology, 2014) for a full description of the selected cleanup action.

The CAP established site-specific cleanup levels for the COCs listed above (Table 1). Figure 2 shows the estimated extent of groundwater with dissolved concentrations of TPH, TCE, and arsenic exceeding those cleanup levels. Lead exceedances were detected in two wells (MW-1 and MW-4) on one occasion (the July 2011 monitoring round). However, the lead concentrations in both of those wells dropped to below the laboratory detection limit (which was well below the cleanup level for lead) in five subsequent monitoring rounds. The lead exceedances were apparently one-time concentration spikes associated with well drilling/installation.

1.2.3 Extraction Well EW-17

Following completion of the CAP, a draft of this Plan (Aspect 2015a) was developed and submitted for Ecology review. In their comment letter (Ecology, 2015), Ecology recommended the installation of a larger-diameter LNAPL extraction well near MW-13 and MW-16, to supplement the monitoring well network. Well EW-17, a 4-inch-diameter well, was installed in October 2015 at the location shown on Figure 2. In addition to having a larger diameter than the Site monitoring wells, EW-17 includes features designed to enhance entry of LNAPL into the well. Installation and initial monitoring of EW-17 are documented in Aspect, 2015b. Because of its larger diameter and special design features, EW-17 is expected to be the most productive well with respect to LNAPL removal.

1.2.4 McKinney Domestic Well

The McKinney well, located approximately 190 feet north of the School property (see Figure 2), provides drinking water to the residences at 1724 and 1728 Dora Avenue NW. Reportedly installed in the 1960s, the well is approximately 155 feet deep with a 5-foot screen at the bottom. Kitsap Public Health District (KPHD) sampled the McKinney well

water on three occasions (October 2014, and February and June 2015), and submitted the samples for laboratory analysis of TPH, selected metals (including arsenic and lead), volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), and semi-volatile organic compounds (SVOCs). Sampling results, documented in KPHD, 2015, indicated that the well water was not impacted by contamination at the Site. This is consistent with Aspect's determination that, based on monitoring well water level measurements, the McKinney well is upgradient of the Site (i.e., groundwater flow is to the southwest). KPHD informed the property owner and residents that the well water was considered safe to drink (i.e., tested constituent concentrations were all below EPA's acceptable limits for drinking water); however, because of the well's proximity to the Site, KPHD recommended that an alternative source of drinking water be sought (KPHD, 2015). KPHD has no plans to further sample the well water.

Information on the McKinney well and KPHD's October 2014 sampling event is included in Section 4.2.5 of the RI. The CAP makes no mention of the McKinney well. However, in their comment letter on the draft Plan (Ecology, 2015), Ecology recommended that BSD include the McKinney well in the Site's long-term monitoring program "to demonstrate that the water continues to be safe over a sufficient period of seasonal variations and pumping rates at this property."

1.2.5 Monitoring Record Summary

Groundwater monitoring data collected prior to December 2013 are presented in the RI. KPHD's monitoring of the McKinney well water in 2014/2015 is documented in KPHD, 2015. Groundwater monitoring data collected by BSD between December 2013 and October 2015 are summarized in Appendix C (Table C-1).

As noted on Figure 2, LNAPL has been observed to date in five wells (MW-8, MW-13, MW-14, MW-16, and EW-17). LNAPL layer thicknesses up to 4.9 feet have been reported. However, the viscous, sticky nature of the LNAPL results in inconsistent readings of the interface probe used to measure depth-to-LNAPL and depth-to-water. Therefore, the reported LNAPL layer thicknesses can only be regarded as estimates. Thickness measurements obtained prior to December 2013 are presented in the RI. Measurements obtained between December 2013 and October 2015 are summarized in Appendix C (Table C-2).

2 Groundwater/LNAPL Monitoring Program

2.1 General Requirements, Expectations, and Goals

The groundwater/LNAPL monitoring program has been developed based on the following general requirements and expectations:

- An electronic oil/water interface probe will always be used to monitor liquid depth in a Site well, and liquid depth will always be monitored prior to collecting a groundwater sample for analysis. This will help ensure that LNAPL will be detected if present, even in wells where it may not be expected.

- If LNAPL is present in a well, groundwater samples will not be collected for laboratory analysis. LNAPL layer thickness will be measured and, depending on the requirements of the LNAPL Removal Work Plan (Aspect, 2015c), LNAPL removal may be attempted.

- Well MW-15 is the conditional point of compliance (CPOC) for LNAPL migration[1]. If LNAPL is detected in MW-15, more aggressive measures than the removal methods specified in the LNAPL Removal Work Plan (Aspect, 2015c) will be considered/ implemented to prevent further LNAPL migration. (Refer to Section 3.2.)

- Well MW-10 is the CPOC for achieving groundwater cleanup levels (Table 1). If a cleanup level is exceeded at MW-10 during periodic monitoring, active measures to prevent further migration of the dissolved contaminant plume will be considered. (Refer to Section 3.1.)

- Well MW-10 will continue to be monitored for all COCs that are detected above cleanup levels in any Site well. For all other wells, monitoring for a specific COC may be terminated after four consecutive monitoring results at quarterly or greater intervals are less than or equal to the corresponding cleanup level.

- Since landfilled waste (i.e., the source of contamination) remains in place, there is no expectation that the contamination will attenuate over a "reasonable restoration time frame." The requirement for periodic monitoring under this program is expected to continue indefinitely. The primary goal of monitoring is to ensure that the LNAPL and the COCs in groundwater do not spread beyond their respective CPOCs.

2.2 Wells to be Monitored and Well-Specific COCs

The well monitoring program is summarized in Table 3, and the rationale for selecting wells to be monitored and well-specific COCs is provided in Table A-1 (Appendix A). Appendix B contains boring logs and well construction diagrams for Site wells included in the monitoring program. (There is no boring log or well construction diagram for the McKinney well.) Refer to the RI for information on Site wells not included in the monitoring program.

As noted in Section 2.1, all Site wells included in the program will be monitored for LNAPL floating on the groundwater table. If LNAPL is detected, its thickness will be measured and groundwater samples will not be collected for laboratory analysis. Among the wells that do not contain LNAPL, three will be sampled for analysis of TPH in the diesel and motor oil ranges. Two of these wells will be MW-10 and MW-15, the respective CPOCs for achieving groundwater cleanup levels and for LNAPL migration; the third well to be sampled will be selected by BSD based on recent monitoring results.

[1] The CAP specifies that MW-6 will be the CPOC for LNAPL migration. However, in their comment letter on the draft Plan (Ecology, 2015) Ecology stated that, in order for the CPOC for LNAPL migration to be as close as practicable to the source of hazardous substances [per WAC 173-340-720(8)(c)], it should be changed to MW-15.

Based on groundwater quality monitoring results to date, arsenic is the only COC with concentrations at MW-10 approaching the cleanup level. Figure 3 shows arsenic concentration trends in MW-10 and upgradient well MW-6. Arsenic in MW-10 exceeded 5 micrograms per liter (µg/L) in the first two sampling events after that well was installed in December 2011. Since early 2012, however, it has been consistently below 5 µg/L (for 11 straight sampling events). Well MW-6, on the other hand, shows an overall trend of increasing arsenic concentrations over time, with a maximum concentration of 26.7 µg/L detected in the April 2015 monitoring round (decreasing to 22.8 µg/L in the subsequent round).

TCE exceedances have been detected only in MW-9, the monitoring well furthest upgradient of MW-10, and also upgradient of the LNAPL plume. However, compliance with the arsenic and TCE cleanup levels has not been demonstrated for the five wells with LNAPL (MW-8, MW-13, MW-14, MW-16, and EW-17). Among these closely spaced wells, MW-16 has been selected for arsenic/TCE compliance monitoring because it is furthest from MW-12 (where compliance has been demonstrated) and most-directly downgradient of MW-9.[2]

Lead exceedances were detected in two wells (MW-1 and MW-4), but only on one occasion (July 2011). And, as noted in Section 1.2, compliance with the lead cleanup level was demonstrated for both wells in five subsequent monitoring rounds. Therefore, monitoring groundwater in MW-1 and MW-4 for lead is no longer required. Unlike the other COCs, lead exceedances have not been detected in any of the wells situated upgradient of MW-10, the CPOC. (Although the five LNAPL-containing wells have never been sampled for lead, there is no reason to suspect a current or future lead exceedance at that location.) Therefore, lead is not included in the monitoring program.

2.3 Monitoring Frequency

Groundwater was monitored at 3- to 4-month intervals during the Site characterization and remedy selection phase of the project, and a total of 16 monitoring rounds were completed between April 2011 and October 2015. Detected COC concentrations generally remained stable over this period, with the following exceptions:

- Several wells exhibited erratic arsenic and/or lead concentrations in the first few monitoring rounds following well installation. These were attributed to disturbances in equilibrium conditions caused by the well drilling and installation process.

- As shown on Figure 3, arsenic concentrations in well MW-6 have fluctuated significantly over time, for unknown reasons.

The CPOC well (MW-10) was sampled on 13 occasions through October 2015, and arsenic is the only COC detected at that well in any of the sampling rounds. Figure 3 shows arsenic concentrations detected at MW-10 over time. Arsenic concentrations have

[2] As noted earlier in this section, groundwater samples will not be collected for laboratory analysis from wells that contain LNAPL; monitoring MW-16 groundwater for arsenic and TCE will occur only if and when LNAPL is no longer detected in that well.

remained within a fairly narrow range in the 11 most recent monitoring rounds, fluctuating between 2.65 µg/L and 3.94 µg/L.

Based on the Site's water quality monitoring record to date, groundwater monitoring will be conducted on a semi-annual basis during the first 5 years of the remedy implementation phase of the project. Measurement of LNAPL thickness, which is an integral part of the well monitoring process, will be done on the same schedule. As discussed in Section 4, the 5-year review of remedy implementation will provide an opportunity to review the monitoring record and make adjustments if warranted.

2.4 Field Procedures

2.4.1 Monitoring Groundwater Level and LNAPL Thickness

Prior to collecting groundwater samples or bailing LNAPL from a well, an electronic oil/water interface probe graduated to 0.01 foot will be used to measure LNAPL layer thickness (if present) and depth-to-groundwater. The interface probe produces three distinct tones depending on whether its tip is in contact with air, petroleum hydrocarbon product, or water. Due to the viscous, sticky nature of the LNAPL, probe response may be problematic. Multiple readings will be taken at each LNAPL-containing well in order to improve the accuracy of this measurement technique. If LNAPL is not present in a well, depth-to-groundwater will be recorded on the *Groundwater Monitoring Record* form provided in this Plan. If LNAPL is detected, the *LNAPL Thickness Monitoring and Removal Record* form provided in the LNAPL Removal Work Plan (Aspect, 2015c) will be used to record depth-to-LNAPL and depth-to-groundwater measurements.

Field personnel will inspect the condition of each well in the monitoring program, and will note any required maintenance on the *Groundwater Monitoring Record* form.

2.4.2 Sampling Monitoring Wells

Groundwater samples will only be collected from wells that do not contain LNAPL. Samples will be collected from monitoring wells using low-flow techniques with dedicated submersible pumps and polyethylene tubing. The field geologist will document groundwater sampling activities on the *Groundwater Monitoring Record* form. Following measurement of depth-to-groundwater, the well will be purged at flow rates less than 0.5 liter per minute. The following field parameters will be monitored using a YSI (or equivalent) meter and flow-through cell:

- Temperature;
- pH;
- electrical conductance;
- dissolved oxygen (DO); and
- oxidation-reduction potential (Eh).

These field parameters will be recorded at 5-minute intervals throughout well purging until they stabilize. Stabilization is defined as three successive readings where the parameter values vary by less than 10 percent (or 0.5 mg/L DO if the DO readings are

below 1 mg/L). However, no more than three well casing volumes will be purged prior to groundwater sample collection.

Once purging is complete, the groundwater samples will be collected using the same low flow rate. Samples will be collected by directly filling laboratory-supplied pre-cleaned containers. Samples for TCE analysis are collected in three 40-mL vials (Table 4). Once filled and capped, the vials should have no headspace (i.e., no visible air bubbles).

Groundwater Sample Designation

Sample labels will be filled out using indelible ink to indicate the sample number, date, preservative added, if any, and any pertinent comments. Groundwater sample naming convention will be the well identification followed by the sample collection date (i.e., MMDDYY). For example, a sample collected on December 16, 2015 from well MW-6 would have the following name: MW-6-121615.

Field Instrument Maintenance

Prior to each field mobilization, field instruments (e.g., the meter used to measure field parameters during groundwater sampling) will be tested for proper operation and calibrated on a regular basis in accordance with manufacturer recommendations.

Field Documentation

Field personnel will complete one form for each well monitored (either a *Groundwater Monitoring Record* or an *LNAPL Thickness Monitoring and Removal Record*, depending on whether or not LNAPL is present in the well) to record measurements and summarize activities that are completed on a given day, including any pertinent events or observations. Upon completion of a monitoring round, the field personnel will provide the original field forms to the task manager.

Sample Containers and Preservation

Refer to Table 4 for a summary of the sample containers and preservation methods. Note that sample volume may be reduced if multiple method extractions may be collected from a single container.

Sample Handling

Upon collection, samples will be placed upright in a cooler. Ice will be placed in each cooler to meet sample preservation requirements. Inert cushioning material will be placed in the remaining space of the cooler to limit movement of the sample containers. If the sample coolers are being shipped, not hand-carried, to the analytical laboratory by field personnel, the chain of custody record (described below) will be placed in a waterproof bag taped to the inside lid of the cooler for shipment. Samples will be delivered to the laboratory within 3 days of sample collection.

Upon sample receipt, the laboratory will fill out a cooler receipt form to document sample delivery conditions. A designated sample custodian will accept custody of the shipped samples and will verify that the chain of custody form matches the samples received. The laboratory will notify the project manager as soon as possible of any issues noted with the sample shipment or custody.

Sample Chain of Custody Record

After collection, samples will be maintained in the sampler's custody until formally transferred to the analytical laboratory. A chain of custody record provided by the laboratory will be initiated at the time of sampling. Each sample will be listed on the chain of custody record along with sampling date and time, sample type (e.g., water), number of containers, and the specific analyses to be performed. The record will be signed by the field representative and others who subsequently take custody of the sample. Couriers or other professional shipping representatives are not required to sign the chain of custody record; however, shipping receipts will be collected and maintained as part of custody documentation in project files. A copy of the fully-signed chain of custody record will be included in the laboratory report.

2.4.3 Managing Purge Water

Purge water from the monitoring wells will be temporarily stored in 55-gallon drums at a secure site provided by BSD pending waste profiling and disposal.

2.4.4 Sampling McKinney Well Water

Consistent with KPHD's sampling protocol, the McKinney well water sample will be collected from the outdoor faucet on the north side of the residence at 1724 Dora Avenue NW (see Figure 2). The field representative will knock on the front door to notify occupants of his presence prior to sampling. He will then fully open the faucet and allow water to flow for approximately 30 seconds prior to reducing water flow and collecting the sample directly into laboratory-supplied containers. The sample will be identified as "McKinney-" followed by the collection date (MMDDYY). The field parameters discussed in Section 2.4.2 will not be monitored and a *Groundwater Monitoring Record* form will not be completed for the McKinney well water sample. However, sample containers, preservation, and handling will be the same as that described above for the monitoring well samples.

3 Contingency Planning

3.1 Groundwater Plume Migration

Based on the Site's considerable water quality monitoring record to date (discussed in Section 2.3), there is no evidence that COC concentrations in groundwater are migrating. This observation is consistent with the fact that landfilling activities occurred many decades ago; after such a long period of time, plumes of contaminants dissolved in groundwater would, in general, be expected to be either stable or shrinking. The following actions will be taken in the event that future groundwater monitoring results indicate potential COC migration:

- **Arsenic** – Although arsenic concentrations at well MW-10 appear to be stable (refer to Figure 3), they are only marginally below the arsenic cleanup level. In addition, arsenic concentrations upgradient at well MW-6 have been consistently above the cleanup level and have fluctuated significantly over time, for unknown reasons. Therefore, arsenic clearly poses the greatest threat for a future

groundwater cleanup level exceedance at the CPOC (MW-10). Both MW-6 and MW-10 will be sampled for arsenic in every groundwater monitoring round (i.e., semiannually during the first 5 years of the remedy implementation phase of the project). If arsenic is detected above 40 µg/L at MW-6 or above 4.5 µg/L (90 percent of the cleanup level) at MW-10:

a) Ecology will be notified of the detection within 3 business days of receipt of the report from the analytical laboratory;

b) The frequency of sampling MW-6 and MW-10 for arsenic will increase to quarterly; and

c) BSD will evaluate arsenic concentration trends and, within 30 calendar days of receiving the laboratory report, submit a report to Ecology that includes potential reasons for the elevated arsenic result and proposed actions.

- **TPH** – Exceedances of the groundwater cleanup level for TPH in the diesel and motor oil ranges have not been detected at well MW-15, located only a short distance downgradient of the LNAPL plume (see Figure 2). Therefore, unless the LNAPL plume itself migrates (contingency addressed below), TPH dissolved in groundwater does not appear to pose a threat of ever exceeding the cleanup level at the CPOC. Detection of TPH at MW-6 would also provide early warning of dissolved plume migration. If TPH concentrations increase significantly at MW-15 or if TPH is detected at any concentration at MW-6, BSD will include an evaluation of potential TPH plume migration and proposed actions in its next annual report to Ecology (see Section 4). If TPH is detected at any concentration at MW-10, BSD will follow Steps a) through c) above (for TPH rather than arsenic).

- **TCE** - TCE exceedances have been detected only in well MW-9, and concentrations detected in that well have remained within a tight range, fluctuating between 8.5 µg/L and 12 µg/L over 13 monitoring rounds. Like TPH, TCE is very unlikely to ever pose a threat of exceeding the cleanup level at the CPOC. If TCE is detected above 20 µg/L at MW-9, BSD will begin monitoring MW-6 for TCE along with MW-9 and MW-10, and annual reports to Ecology will include an evaluation of potential TCE plume migration and proposed actions. If TCE is detected above the cleanup level at MW-6 or at any concentration at MW-10, BSD will follow Steps a) through c) above (for TCE rather than arsenic).

3.2 McKinney Well Water

As indicated in Table 3, the McKinney well water sample will be analyzed for TCE only. The federal Maximum Contaminant Level (MCL) for TCE is 5 µg/L, which is also the Site-specific groundwater cleanup level (Table 1). As noted in Table 4, the analytical laboratory is required to achieve a reporting limit of 1 µg/L (maximum) for TCE. All sampling results to date have been below the laboratory reporting limit.

Ecology will be notified within 3 business days of receipt of the laboratory report if TCE is detected in the McKinney well water sample at a concentration greater than 1 µg/L.

3.3 LNAPL Migration

Although well-specific LNAPL thicknesses measured to date (Table C-2 in Appendix C) tend to fluctuate over a wide range, there has been no clear evidence of lateral LNAPL migration. (LNAPL was not initially present in wells MW-14 and MW-16, but that is likely due to a time-delay for entry of viscous LNAPL into a newly installed well.) It was estimated in the FS (Aspect, 2014b) that the mass of separate-phase petroleum hydrocarbon in the vadose zone soils between the base of the landfill and the water table may be an order of magnitude larger than the mass of LNAPL floating on the water table. Given the long time period since landfilling activities ceased, however, the vadose zone LNAPL is likely trapped in the soil matrix and no longer moving downward.

Well MW-15 (the CPOC for LNAPL migration) is situated approximately 40 feet downgradient of MW-8, a well in which LNAPL thicknesses up to 0.9 feet have been measured. Since LNAPL was detected in MW-8 when it was installed over 4 years ago (in October 2011), it can be inferred that the worst-case LNAPL migration rate from MW-8 toward MW-15 (if, indeed, there is any migration at all) is something less than 10 feet per year. The fact that recent water samples collected from MW-15 have been non-detect for TPH is also encouraging, since one would expect TPH concentrations in well water to be elevated if LNAPL is in contact with groundwater immediately upgradient of the well. Nonetheless, given the relatively short monitoring record to date, the prospect of LNAPL being detected in MW-15 at some time in the future certainly cannot be ruled out.

The following actions will be taken if LNAPL is detected in MW-15:

a) Ecology will be informed of the detection within 3 business days of the LNAPL monitoring event; and

b) BSD will evaluate well-specific trends in LNAPL layer thickness, LNAPL removal, and dissolved TPH and, within 30 calendar days of the detection, submit a report to Ecology with proposed modifications to the LNAPL monitoring and removal program.

One contingency action that may be proposed is installing a new monitoring well between MW-15 and MW-6, and designating it the new CPOC for LNAPL migration. For example, a new well might be installed 30 feet downgradient of MW-15, which is less than 15 percent of the distance separating MW-15 from downgradient well MW-6 (the CPOC for LNAPL migration designated in the CAP). If LNAPL were subsequently detected in the new CPOC well, the LNAPL migration rate could be much more accurately assessed, and there would still be plenty of time to develop a more aggressive LNAPL remediation strategy (e.g., before LNAPL could potentially approach the property boundary).

If it is determined that more aggressive measures than periodic LNAPL removal from wells need to be considered, potentially applicable technologies were screened in the FS, which could serve as a starting point in developing a more aggressive LNAPL

remediation strategy. However, the information presented in the FS will undoubtedly be dated at that point, and a fresh review of state-of-the-art technologies would be advised.

4 Reporting Requirements

BSD will evaluate monitoring data and document monitoring results in reports to Ecology. Reporting formats will include the following:

- **Informal Reporting** – After each monitoring round, BSD will informally transmit monitoring results to Ecology (e.g., via e-mail) within 3 weeks of receiving analytical laboratory reports. Results will primarily be in the form of updated tables, graphs, and/or figures.

- **Annual Reports** – BSD will prepare more formal reports on an annual basis. Annual reports will be comprehensive in nature, addressing not only the groundwater/LNAPL monitoring prescribed in this plan but all remedy implementation activities associated with the Site. (For example, LNAPL removal and cover system inspection and maintenance [I&M] will be documented in the same report.) They will also provide the opportunity for BSD to propose modifications to the monitoring procedures and schedules specified in this plan. Each report will cover activities completed on a calendar-year basis, and will be submitted to Ecology by January 31st of the following year.

- **Unscheduled Reports** – In the event that one of the COC concentration "triggers" specified in Section 3.1 is exceeded, or that LNAPL is detected in well MW-15, BSD will prepare an unscheduled report and submit it to Ecology in the time frame specified in Section 3.

- **Five-Year Review** – Ecology and BSD will meet at least every 5 years after initiation of the cleanup remedy to discuss the Site and the need, if any, for further remedial action. As specified in Section VIII.R of the AO, BSD will submit a summary report to Ecology at least 90 days prior to each 5-year review. The report will document whether human health and the environment are being protected based on the factors set forth in WAC 173-340-420(4). It will include a review of McKinney well monitoring results to determine whether continued monitoring of that well is necessary. It will also provide the opportunity for BSD to propose other modifications to the monitoring procedures and schedules specified in this plan.

References

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Aspect, 2014b, Feasibility Study, Crownhill Elementary School, Prepared for Bremerton School District, dated November 24, 2014.

Aspect, 2015a, Groundwater/LNAPL Monitoring and Contingency Plan, Crownhill Elementary School Site, Prepared for Bremerton School District, dated January 22, 2015 (Agency Review Draft).

Aspect, 2015b, Technical Memorandum to Washington State Department of Ecology (J. Cruz) Re: Installation and Initial Monitoring of Well EW-17, dated November 3, 2015.

Aspect, 2015c, LNAPL Removal Work Plan, Crownhill Elementary School Site, Prepared for Bremerton School District, dated November 19, 2015.

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Washington State Department of Ecology (Ecology), 2014, Cleanup Action Plan, Bremerton School District, Crownhill Elementary School Site, Washington State Department of Ecology, dated December 10, 2014.

Ecology, 2015, Letter to Bremerton School District (R. Carpenter) Re: Ecology Comments on Crownhill Elementary School LNAPL Removal Work Plan and Groundwater/LNAPL Monitoring and Contingency Plan (January 22, 2015, Review Drafts), dated August 4, 2015.

Limitations

Work for this project was performed and this report prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. It is intended for the exclusive use of Bremerton School District for specific application to the referenced property. This report does not represent a legal opinion. No other warranty, expressed or implied, is made.

TABLES

Table 1 - Groundwater Constituents of Concern and Cleanup Levels

Project No. 100094-003-02, Crownhill Elementary, Bremerton, Washington

Constituent of Concern	Groundwater Cleanup Level (µg/L)
Total Petroleum Hydrocarbon (TPH)	
Diesel Range	500
Motor Oil Range	500
Metals	
Arsenic (total)	5
Lead (total)[1]	15
Volatile Organic Compounds (VOCs)	
Trichloroethene (TCE)	5

µg/L micrograms per liter

Notes

1) Compliance with the groundwater cleanup level for total lead has already been demonstrated; refer to Section 2.

Table 2 - Well Construction Summary

Project No. 100094-003-02, Crownhill Elementary, Bremerton, Washington

Well ID	Top-of-Casing Elevation	Ground Surface Elevation	Date of Well Installation	Well Coordinates (WA SPN NAD83 ft)		Depth of Screen Interval in Feet		Screen Interval Elevation in Feet	
				Easting	Northing	Top	Bottom	Top	Bottom
MW-5	*136.95*	*137.2*	*3/30/2011*	*1188165*	*215232*	*108.0*	*133.0*	*29.2*	*4.2*
MW-6	*133.87*	*134.2*	*3/28/2011*	*1187913*	*215098*	*116.5*	*136.5*	*17.7*	*-2.3*
MW-8	*133.36*	*134.4*	*12/20/2011*	*1188100*	*215252*	*100.0*	*120.0*	*34.4*	*14.4*
MW-9	*134.39*	*135.5*	*12/19/2011*	*1188171*	*215409*	*107.0*	*127.0*	*28.5*	*8.5*
MW-10	*132.33*	*132.9*	*12/21/2011*	*1187807*	*215026*	*125.0*	*145.0*	*7.9*	*-12.1*
MW-12	*133.87*	*134.7*	*10/25/2012*	*1188139*	*215262*	*94.0*	*124.0*	*40.7*	*10.7*
MW-13	*133.61*	*134.2*	*10/25/2012*	*1188110*	*215290*	*94.0*	*124.0*	*40.2*	*10.2*
MW-14	*133.58*	*134.5*	*10/26/2012*	*1188150*	*215304*	*94.0*	*124.0*	*40.5*	*10.5*
MW-15	*133.37*	*134.2*	*10/26/2012*	*1188069*	*215227*	*94.0*	*124.0*	*40.2*	*10.2*
MW-16	*133.27*	*134.1*	*10/26/2012*	*1188062*	*215300*	*94.0*	*124.0*	*40.1*	*10.1*
EW-17	*133.68*	*134.1*	*10/13/2015*	*1188086*	*215295*	*100.5*	*120.5*	*33.6*	*13.6*

Notes

1) Only wells included in the current monitoring program are shown in this table. Refer to the Remedial Investigation report (Aspect, 2014a) for information on other wells.

2) Elevations are based on NAVD88 vertical datum.

Table 3 - Well Monitoring Program Summary

Project No. 100094-003-02, Crownhill Elementary, Bremerton, Washington

Well ID	Well-Specific COCs			Notes
	LNAPL/TPH[2]	Total Arsenic	TCE	
MW-5	X			
MW-6	X	X		3,8
MW-8	X			4
MW-9	X		X	8
MW-10	X	X	X	5
MW-12	X			
MW-13	X			4
MW-14	X			4
MW-15	X			6
MW-16	X	X	X	4
EW-17	X			4
McKinney			X	7

COC	constituent of concern
LNAPL	light non-aqueous-phase liquid
TCE	trichloroethene
TPH	total petroleum hydrocarbon (in the diesel and motor oil ranges)

Notes

1) Appendix A (Table A-1) summarizes the rationale for selection of wells to be monitored and well-specific COCs.
2) All wells except McKinney will be monitored for LNAPL. If LNAPL is detected, its thickness will be measured and groundwater samples will not be collected. Three wells that do not contain LNAPL will be sampled for TPH in the diesel and motor oil ranges. Two of these wells will be MW-10 and MW-15; the third well will be selected based on recent monitoring results.
3) Well MW-6 provides early warning of potential arsenic migration.
4) Compliance with the total arsenic and TCE cleanup levels has not been demonstrated for the 5 wells in which LNAPL has been observed (MW-8, MW-13, MW-14, MW-16, and EW-17). Among these closely spaced wells, MW-16 has been selected for compliance monitoring because it is furthest from MW-12 (where compliance has been demonstrated) and most-directly downgradient of MW-9 (where TCE exceeds its cleanup level).
5) Well MW-10 is the conditional point of compliance for achieving groundwater cleanup levels.
6) Well MW-15 is the conditional point of compliance for LNAPL migration.
7) The McKinney well water sample is collected from the outdoor faucet on the north side of the residence at 1724 Dora Ave NW.
8) If TCE is detected above 20 µg/L at MW-9, MW-6 will be monitored for TCE along with MW-9 and MW-10 in accordance with Section 3 *Contingency Planning*.

Table 4 - Sample Containers, Preservatives, Holding Times, and Reporting Limits

Project No. 100094-003-02, Crownhill Elementary, Bremerton, Washington

Constituent of Concern	Analytical Method	Container[1]	Preservative	Holding Time	Max. Reporting Limit
Diesel Range TPH	NWTPH-Dx	Two 500mL AG	HCl	7 days	50 µg/L
Motor Oil Range TPH					250 µg/L
Total Arsenic	EPA Method 6010	500mL HDPE	HNO_3	6 months	1 µg/L
Trichloroethene	EPA Method 8260 (specify chlorinated VOCs)	3 VOAs	HCl	14 days	1 µg/L

µg/L micrograms per liter
AG amber glass bottle
HCl hydrochloric acid
HDPE high-density polyethylene
HNO_3 nitric acid
mL milliliter
TPH total petroleum hydrocarbon
VOA 40 mL VOA vial
VOC volatile organic compound

Notes

1) Sample volume may be less as multiple method extrations may be collected from one container. Consult laborartory.

Groundwater Monitoring Record Form

Aspect CONSULTING

Project Name: **Crownhill Elementary School** **Well ID:**_____

GROUNDWATER MONITORING RECORD

Project No.: _____ **Page:**____ **of** ____

Date: _____

Monitored by:_____

Measuring Point of Well:_____

Screened Interval (ft. TOC)_____

Filter Pack Interval (ft. TOC) _____

Starting Water Level*(ft TOC):_____

Casing Stickup (ft):_____

Total Depth (ft TOC):_____

Casing Diameter (inches):_____

* If LNAPL is detected, use LNAPL Monitoring & Removal Record in LNAPL Removal Work Plan (Do not collect water sample)

Casing Volume _____ ft Water x _____ gpf = _____ gal

Sample Intake Depth (ft TOC):_____

Casing volume for 2-inch well = 0.16 gpf Casing volume for 4-inch well = 0.64 gpf

PURGING MEASUREMENTS

Criteria:		Typical 0.1-0.5 Lpm	Stable	na	± 3%	± 10%	± 0.1	± 10 mV	± 10%	
Time	Cumul. Volume (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (°C)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	ORP (mv)	Turbidity (NTU)	Comments

Total Gallons Purged:_____

Total Casing Volumes Removed:_____

Ending Water Level (ft TOC):_____

Ending Total Depth (ft TOC):_____

SAMPLE INVENTORY

Sample Name:_____

Time	Volume	Bottle Type	Quantity	Filtration	Preservation	Appearance		Remarks
						Color	Turbidity & Sediment	

METHODS

Parameters measured with (instrument model & serial number): _____

Purging Equipment: _____ Decon Equipment: _____

Disposal of Discharged Water:

Observations/Comments: _____

_____

_____

_____

_____

_____

FIGURES

Vicinity Map

Groundwater/LNAPL Monitoring and Contingency Plan
Crownhill Elementary, Bremerton, Washington

Aspect Consulting	NOV-2015	BY: PPW	FIGURE NO. 1
	PROJECT NO. 100094	REV BY: SCC	

GIS Path: T:\projects_8\CrownHillElementary\Delivered\GW Monitoring and Contingency Plan\Final\01_VicinityMap.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 11/10/2015 || User: scudd || Print Date: 11/10/2015

1724 Dora Avenue NW (Note 2)

North Landfill Area

MW-2

Estimated Extent of TPH Cleanup Level Exceedance

Estimated Extent of TCE Cleanup Level Exceedance

BERTHA AVE NW

MW-9

MW-16 (Note 1)

MW-14

EW-17

MW-13

MW-12

MW-8

MW-5

MW-15

ROCKY POINT RD

Estimated Extent of Arsenic Cleanup Level Exceedance

PORTABLE CLASSROOM BUILDING

MW-4

MW-6

MAIN SCHOOL BUILDING

MW-3

MW-10

South Landfill Area

MW-1

MW-7

MW-11

MARINE D

VE

0 100 200

Feet

Well Locations:

- Extraction Well Included in Monitoring Program
- Monitoring Well Included in Monitoring Program
- Monitoring Well Not Included in Monitoring Program
- McKinney Domestic Well (Note 2)

Other Site Features and Interpretation:

- Interpreted Extent of Landfill Activity
- Bremerton School District Property Boundary
- Inferred Direction of Groundwater Flow

Note:

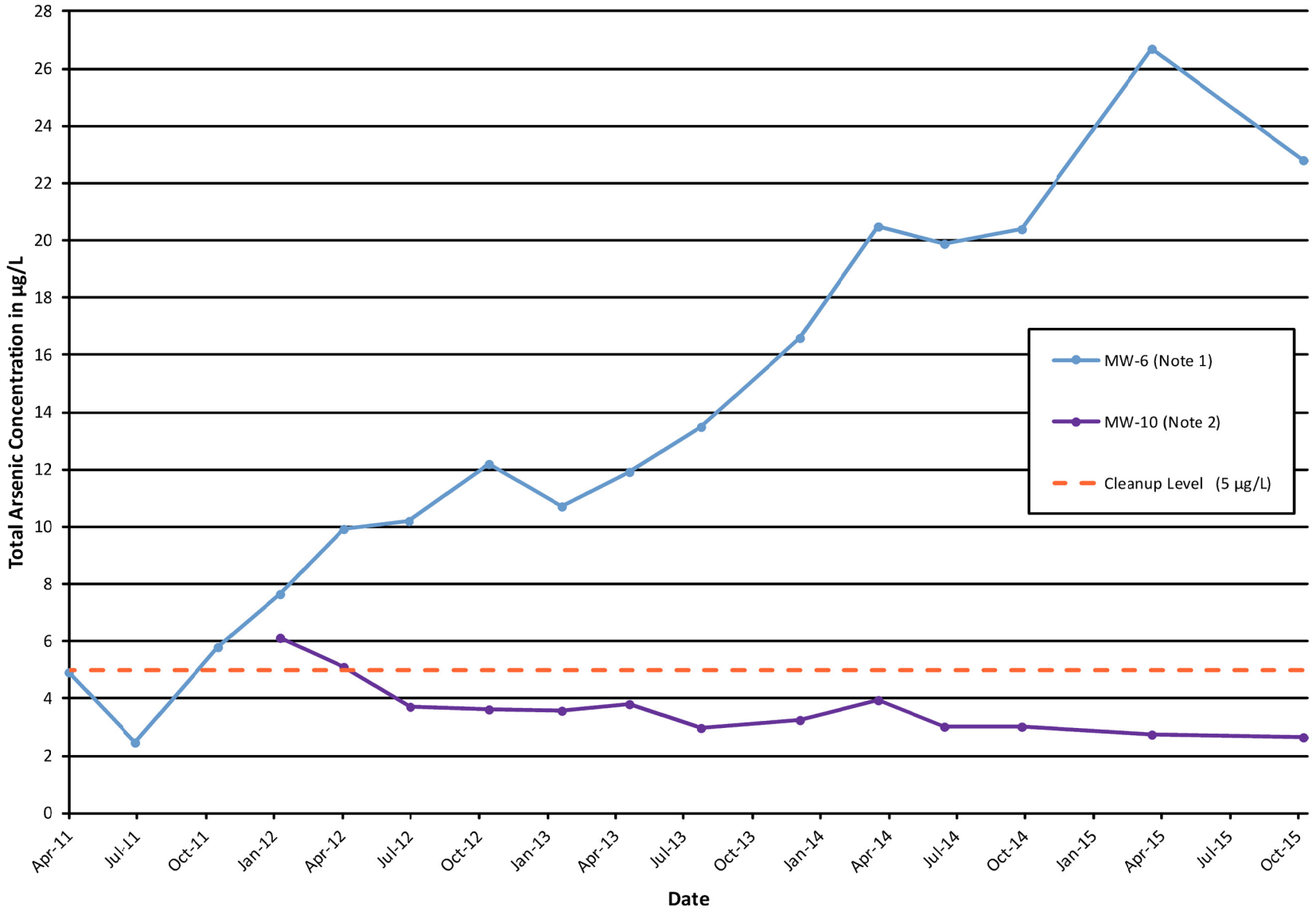
(1) LNAPL has been observed in Wells EW-17, MW-8, MW-13, MW-14, and MW-16.
(2) Collect McKinney well water sample from the outdoor faucet on the north side of the residence at 1724 Dora Avenue NW.

Site Plan

Groundwater/LNAPL Monitoring and Contingency Plan
Crownhill Elementary, Bremerton, Washington

Aspect CONSULTING	NOV-2015	BY: DLH / PPW	FIGURE NO. 2
	PROJECT NO. 100094	REV BY: SCC	

GIS Path: T:\projects_8\CrownHillElementary\Delivered\GW Monitoring and Contingency Plan\Final\02_Site Plan.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 11/13/2015 || User: scudd || Print Date: 11/13/2015



Notes:

1. Well MW-6 provides early warning of potential arsenic migration.
2. Well MW-10 is the conditional point of compliance for achieving groundwater cleanup levels.

Arsenic Concentration Trends in Wells MW-6 and MW-10

Groundwater/LNAPL Monitoring and Contingency Plan
Crownhill Elementary, Bremerton, Washington

Aspect Consulting	NOV-2015	BY: DAH/SCC	FIGURE NO. 3
	PROJECT NO. 100094	REVISED BY: -	

APPENDIX A

Rationale for Selection of Wells to be Monitored and Well-Specific COCs

Table A-1 - Rationale for Selection of Wells to be Monitored and Well-Specific COCs

Project No. 100094-003-02, Crownhill Elementary, Bremerton, Washington

Well ID	Well Installation Date	Groundwater/LNAPL Monitoring Summary	Include in Monitoring Program?		Well-Specific COCs				Notes
			Yes	No	LNAPL/ TPH	Total Arsenic	Total Lead	TCE	
MW-1	12/28/1994	Groundwater samples were analyzed on 7 occasions between April 2011 and October 2012. Total lead exceeded its cleanup level on 1 occasion (July 2011), followed by 5 lead results below the cleanup level. All other COCs were consistently below cleanup levels.		X			Compliance with the groundwater cleanup level has been demonstrated (see Note 1). Therefore, total lead is not included in the monitoring program.		
MW-2	12/31/1994	Groundwater samples were analyzed on 7 occasions between April 2011 and October 2012. All COCs were consistently below cleanup levels.		X					
MW-3	1/3/1995	This well, installed prior to the remedial investigation in a perched groundwater zone, was excluded from the RI monitoring program.		X					
MW-4	3/30/2011	Groundwater samples were analyzed on 14 occasions between April 2011 and October 2014. Total arsenic exceeded its cleanup level in 2 of the first 3 sampling events (July and October 2011), followed by 11 arsenic results below the cleanup level. Total lead exceeded its cleanup level on 1 occasion (July 2011), followed by 8 lead results below the cleanup level. All other COCs were consistently below cleanup levels.		X					
MW-5	3/30/2011	Groundwater samples were analyzed on 14 occasions between April 2011 and October 2014. Diesel range TPH was consistently above its cleanup level. Motor oil range TPH was above its cleanup level from July 2011 through April 2014, followed by 2 results below the cleanup level (July and October 2014). All other COCs were consistently below cleanup levels.	X		X				
MW-6	3/28/2011	Groundwater samples were analyzed on 14 occasions between April 2011 and October 2014. Total arsenic exceeded its cleanup level in all except the first 2 sampling events. All other COCs were consistently below cleanup levels.	X		X	X			2
MW-7	3/28/2011	Groundwater samples were analyzed on 7 occasions between April 2011 and October 2012. All COCs were consistently below cleanup levels.		X					
MW-8	12/20/2011	LNAPL has been consistently observed in this well; no groundwater samples have been submitted for analysis.	X		X				3
MW-9	12/19/2011	This is the only site well with TCE detections above the cleanup level. TCE concentrations over 11 sampling events have ranged between 8.5 and 12 ug/L. All other COCs were consistently below cleanup levels.	X					X	
MW-10	12/21/2011	Groundwater samples were analyzed on 11 occasions between January 2012 and October 2014. Total arsenic exceeded its cleanup level in the first 2 sampling events (January and April 2012), followed by 9 arsenic results below the cleanup level. All other COCs were consistently below cleanup levels.	X		X	X		X	4
MW-11	12/23/2011	Groundwater samples were analyzed on 4 occasions between January and October 2012. All COCs were consistently below cleanup levels.		X					
MW-12	10/25/2012	Groundwater samples were analyzed on 8 occasions between November 2012 and October 2014. Diesel range TPH was consistently above its cleanup level. Motor oil range TPH was above its cleanup level from November 2012 through April 2014, followed by 2 results below the cleanup level (July and October 2014). All other COCs were consistently below cleanup levels.	X		X				
MW-13	10/25/2012	LNAPL has been consistently observed in this well. However, groundwater samples were collected from beneath the LNAPL on 1 occasion (November 2012) and analyzed for TPH and TCE. TPH detections in both the diesel and motor oil ranges were above cleanup levels, and TCE was <1 µg/L.	X		X				3
MW-14	10/26/2012	LNAPL was not observed in this well until August 2013. Groundwater samples were analyzed for TPH and TCE in November 2012, and for all COCs in February and May 2013. TPH in the diesel and motor oil range was consistently above cleanup levels, while TCE, arsenic, and lead were below cleanup levels. LNAPL has been consistently observed in this well in subsequent monitoring events.	X		X				3
MW-15	10/26/2012	Groundwater samples were analyzed on 8 occasions between November 2012 and October 2014. All COCs were consistently below cleanup levels.	X		X				5
MW-16	10/26/2012	LNAPL was not observed in this well during its initial monitoring event (November 2012), and groundwater samples were analyzed for TPH and TCE. TPH detections in both the diesel and motor oil ranges were above cleanup levels, and TCE was <1 µg/L. LNAPL has been consistently observed in this well in subsequent monitoring events.	X		X	X		X	3
EW-17	10/13/2015	This LNAPL extraction well was installed and is included in the monitoring program in response to an Ecology recommendation (Ecology, 2015). LNAPL was observed in the well following installation, and no groundwater samples have been submitted for analysis.	X		X				3
McKinney	1960s	This domestic well, located upgradient of the Site, is included in the monitoring program in response to an Ecology recommendation (Ecology, 2015). It was sampled on three occasions in 2014/2015 by KPHD for a wide variety of potential contaminants, including Site COCs. No contaminant concentrations of concern were detected. TCE is the only COC for which the Site groundwater monitoring record is "unbounded" to the north (i.e., in the direction of the McKinney well).						X	

µg/L	micrograms per liter	LNAPL	light non-aqueous-phase liquid
COC	constituent of concern	TCE	trichloroethene
KPHD	Kitsap Public Health District	TPH	total petroleum hydrocarbon (in the diesel and motor oil ranges)

Notes

1) The cleanup level for total lead was exceeded on only 1 occasion (July 2011) in two wells (MW-1 and MW-4). Subsequent sampling of those wells demonstrated compliance with the cleanup level (i.e., four consecutive results less than or equal to the cleanup level).
2) Well MW-6 provides early warning of potential arsenic migration.
3) Compliance with the total arsenic and TCE cleanup levels has not been demonstrated for the 5 wells in which LNAPL has been observed (MW-8, MW-13, MW-14, MW-16, and EW-17). Among these closely spaced wells, MW-16 has been selected for compliance monitoring because it is furthest from MW-12 (where compliance has been demonstrated) and most-directly downgradient of MW-9 (where TCE exceeds its cleanup level).
4) Well MW-10 is the conditional point of compliance for achieving groundwater cleanup levels.
5) Well MW-15 is the conditional point of compliance for LNAPL migration.

APPENDIX B

Boring Logs and Well Construction Diagrams

Coarse-Grained Soils - More than 50% [1] Retained on No. 200 Sieve	Gravels - More than 50% [1] of Coarse Fraction Retained on No. 4 Sieve	≦5% Fines [5]	GW	Well-graded gravel and gravel with sand, little to no fines
			GP	Poorly-graded gravel and gravel with sand, little to no fines
		≧15% Fines [5]	GM	Silty gravel and silty gravel with sand
			GC	Clayey gravel and clayey gravel with sand
	Sands - 50% [1] or More of Coarse Fraction Passes No. 4 Sieve	≦5% Fines [5]	SW	Well-graded sand and sand with gravel, little to no fines
			SP	Poorly-graded sand and sand with gravel, little to no fines
		≧15% Fines [5]	SM	Silty sand and silty sand with gravel
			SC	Clayey sand and clayey sand with gravel
Fine-Grained Soils - 50% [1] or More Passes No. 200 Sieve	Silts and Clays Liquid Limit Less than 50		ML	Silt, sandy silt, gravelly silt, silt with sand or gravel
			CL	Clay of low to medium plasticity; silty, sandy, or gravelly clay, lean clay
			OL	Organic clay or silt of low plasticity
	Silts and Clays Liquid Limit 50 or More		MH	Elastic silt, clayey silt, silt with micaceous or diato-maceous fine sand or silt
			CH	Clay of high plasticity, sandy or gravelly clay, fat clay with sand or gravel
			OH	Organic clay or silt of medium to high plasticity
Highly Organic Soils			PT	Peat, muck and other highly organic soils

Terms Describing Relative Density and Consistency

	Density	SPT [2] blows/foot
Coarse-Grained Soils	Very Loose	0 to 4
	Loose	4 to 10
	Medium Dense	10 to 30
	Dense	30 to 50
	Very Dense	>50

	Consistency	SPT [2] blows/foot
Fine-Grained Soils	Very Soft	0 to 2
	Soft	2 to 4
	Medium Stiff	4 to 8
	Stiff	8 to 15
	Very Stiff	15 to 30
	Hard	>30

Test Symbols

FC = Fines Content
G = Grain Size
M = Moisture Content
A = Atterberg Limits
C = Consolidation
DD = Dry Density
K = Permeability
Str = Shear Strength
Env = Environmental
PiD = Photoionization Detector

Component Definitions

Descriptive Term	Size Range and Sieve Number
Boulders	Larger than 12"
Cobbles	3" to 12"
Gravel	3" to No. 4 (4.75 mm)
Coarse Gravel	3" to 3/4"
Fine Gravel	3/4" to No. 4 (4.75 mm)
Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)
Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	Smaller than No. 200 (0.075 mm)

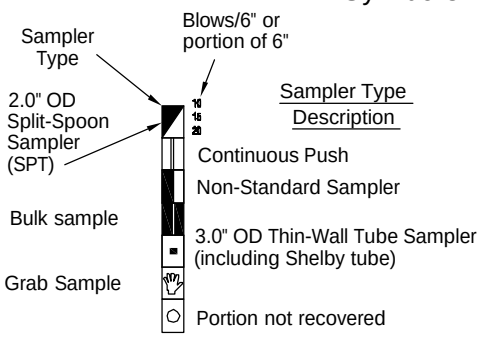
[3] Estimated Percentage

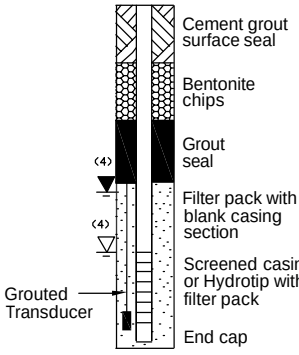
Percentage by Weight	Modifier
<5	Trace
5 to 15	Slightly (sandy, silty, clayey, gravelly)
15 to 30	Sandy, silty, clayey, gravelly)
30 to 49	Very (sandy, silty, clayey, gravelly)

Moisture Content

Dry - Absence of moisture, dusty, dry to the touch
Slightly Moist - Perceptible moisture
Moist - Damp but no visible water
Very Moist - Water visible but not free draining
Wet - Visible free water, usually from below water table

Symbols





(1) Percentage by dry weight
(2) (SPT) Standard Penetration Test (ASTM D-1586)
(3) In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)
(4) Depth of groundwater — ATD = At time of drilling; Static water level (date); BGS = below ground surface
(5) Combined USCS symbols used for fines between 5% and 15% as estimated in General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)

Classifications of soils in this report are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.

Aspect CONSULTING

Exploration Log Key

DATE:
DESIGNED BY:
DRAWN BY:
REVISED BY:

PROJECT NO.

FIGURE NO.
B-1

Q:_ACAD Standards\Standard Details\Exploration Log Key A1.dwg

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-5 (NG-F5)	1 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev:
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Method: Cascade Drilling- Scott / Hollow Stem Auger
Depth to Water (ft BGS): 115 ATD
Sampling Method: D & M / Hammer Weight: 300 lb jars / Hammer Drop: 30"
Start/Finish Date: 3/30/2011

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Drive/ Recovery	Material Type	Description	Depth (ft)
0	8" Flush mount monument set in concrete						Asphalt.	0
							Dense, slightly moist, brown to dark gray, slightly gravelly, silty SAND (SM); fine to medium sand. Landfill material: fabric, charcoal, metal, glass, wire, nails.	
5		NG-F5-5-6.5	TOC		50 20 20			5
10								10
15								15
20	2" Sch. 40 PVC riser	G-F5-20-21.5	TOC		5 5 5		Medium dense, slightly moist, yellow-brown, slightly gravelly, silty SAND (SM); fine to coarse sand. Landfill material: glass, ceramic, nails, wire.	20
25					3 5 10			25
30					7 10 10			30
35					9 10 15		Petroleum-like odor	35
40	3/8" Bentonite chips	G-F5-40-41.5	TOC		10 12 15		Very stiff, slightly moist, yellow-gray, sandy SILT (ML). Medium dense, slightly moist, gray, silty SAND (SM); fine to medium sand, petroleum-like odor and liquid present.	40
45					8 11 15		Very stiff, slightly moist, yellow-brown to gray SILT (ML); petroleum-like odor.	45

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

PID - Photoionization Detector (Headspace Measurement)

- Static Water Level
- Water Level (ATD)

Logged by: JSL
Approved by: RRH
Figure No.

_ENV BORING LOG CROWNHILL.GPJ May 24, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-5 (NG-F5)	2 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev:
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Method: Cascade Drilling- Scott / Hollow Stem Auger
Depth to Water (ft BGS): 115 ATD
Sampling Method: D & M / Hammer Weight: 300 lb jars / Hammer Drop: 30"
Start/Finish Date: 3/30/2011

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Drive/ Recovery	Material Type	Description	Depth (ft)
					7 9 10		Medium dense to very dense, moist to very moist, olive brown, silty SAND (SM); fine to medium sand. Petroleum sheen at 50'.	
55					38 50		Trace gravel.	55
60					10 23 28			60
65					18 20 26		Very dense, slightly moist to moist, brown-gray SAND (SW); trace gravel, fine to coarse sand.	65
70					33 50			70
75	3/8" Bentonite chips				38 50			75
80					33 50			80
85					38 50			85
90					42 50		Very gravelly.	90
95					46 50			95

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

PID - Photoionization Detector (Headspace Measurement)
- Static Water Level
- Water Level (ATD)

Logged by: JSL
Approved by: RRH
Figure No.

_ENV BORING LOG CROWNHILL.GPJ May 24, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-5 (NG-F5)	3 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev:
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Method: Cascade Drilling- Scott / Hollow Stem Auger
Depth to Water (ft BGS): 115 ATD
Sampling Method: D & M / Hammer Weight: 300 lb jars / Hammer Drop: 30"
Start/Finish Date: 3/30/2011

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Drive/ Recovery	Material Type	Description	Depth (ft)
105	3/8" Bentonite chips				49 50			105
					49 50		Slightly silty, trace gravel.	
	10-20 Silica sand						Very dense, very moist, brown, silty, sandy GRAVEL (GM); fine to coarse, rounded gravel.	
110					48 50		Very dense, very moist, brown, very sandy GRAVEL (GP); trace silt.	110
115					46 50		Slightly silty.	115
	2" Sch. 40 prepacked screen 0.020" slot							
120					41 50		Very dense, very moist to wet, gray SAND (SP); trace gravel; fine to coarse sand, predominantly fine.	120
125					50			125
130					41 50			130
	Threaded cap							
135	Slough				38 50		Bottom of Boring at 136' BGS	135
140								140
145								145

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

PID - Photoionization Detector (Headspace Measurement)
- Static Water Level
- Water Level (ATD)

Logged by: JSL
Approved by: RRH
Figure No.

_ENV BORING LOG CROWNHILL.GPJ May 24, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-6 (NG-A2)	1 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev:
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Method: Cascade Drilling-Scott / Hollow Stem Auger
Depth to Water (ft BGS): 126.8 ATD
Sampling Method: D & M / Hammer Weight: 300 lb jars / Hammer Drop: 30"
Start/Finish Date: 3/28/2011

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Drive/ Recovery	Material Type	Description	Depth (ft)
0	8" Flush mount monument set in concrete						Asphalt	0
							Very dense, slightly moist, gray brown, slightly gravelly SAND (SP); trace silt, fine to medium sand, predominantly medium.	
5		NG-A2-5-6.5	TOC		19 20 23			5
10					19 25 27		Very dense, slightly moist, gray brown SAND (SW); fine to coarse sand; trace gravel.	10
15					12 15 18			15
20	2" Sch. 40 PVC riser	NG-A2-20-21	TOC		36 50			20
25					28 36 40		Very dense, slightly moist, gray brown SAND (SP); trace gravel; fine to medium sand.	25
30					31 50		Very dense, slightly moist, brown, very sandy GRAVEL (GW); trace silt, fine to coarse gravel; fine to coarse sand.	30
35					16 18 28		Very dense, slightly moist, gray brown, gravelly SAND (SP); trace silt, fine to medium sand.	35
40	3/8" Bentonite chips	G-A2-40-41.5	TOC		18 23 30			40
45					20 23 35			45

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

PID - Photoionization Detector (Headspace Measurement)
- Static Water Level
- Water Level (ATD)

Logged by: JSL
Approved by: RRH
Figure No.

_ENV BORING LOG CROWNHILL.GPJ May 24, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-6 (NG-A2)	2 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev:
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Method: Cascade Drilling-Scott / Hollow Stem Auger
Depth to Water (ft BGS): 126.8 ATD
Sampling Method: D & M / Hammer Weight: 300 lb jars / Hammer Drop: 30"
Start/Finish Date: 3/28/2011

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Drive/ Recovery	Material Type	Description	Depth (ft)
					27 35 38		Very dense, slightly moist, brown, silty SAND (SM); fine sand.	
55					31 50		Trace silt.	55
60					38 50			60
65					42 50			65
70					34 50			70
75	3/8" Bentonite chips				28 38 45		Very dense, slightly moist, gray brown, slightly silty SAND (SP-SM); fine to medium sand.	75
80					32 38 40			80
85					37 50			85
90					34 50			90
95					39 50		Very dense, moist, dark brown, very silty SAND (SM); fine sand.	95

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

PID - Photoionization Detector (Headspace Measurement)
- Static Water Level
- Water Level (ATD)

Logged by: JSL
Approved by: RRH
Figure No.

_ENV BORING LOG CROWNHILL.GPJ May 24, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-6 (NG-A2)	3 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev:
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Method: Cascade Drilling-Scott / Hollow Stem Auger
Depth to Water (ft BGS): 126.8 ATD
Sampling Method: D & M / Hammer Weight: 300 lb jars / Hammer Drop: 30"
Start/Finish Date: 3/28/2011

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Drive/ Recovery	Material Type	Description	Depth (ft)
	3/8" Bentonite chips				39 50		Very dense, slightly moist, gray brown SAND (SP); trace silt; fine to medium sand.	
105					42 50			105
110					39 50		Hard, slightly moist, dark gray SILT and CLAY (ML/CL); thinly laminated; highly fractured and slickensided to brecciated texture.	110
115	10-20 Silica sand				44 50			115
120					41 50		Very dense, slightly moist, brown with iron-oxide staining, slightly silty SAND (SP-SM); fine to medium sand; trace organic fragments.	120
125	2" Sch. 40 prepacked screen 0.020" slot				41 50		Very dense, wet, dark brown, silty SAND (SM); fine to coarse sand.	125
130					48 50		Hard, wet, gray, slightly sandy SILT (ML); fine sand; trace fine organic fragments.	130
135	Threaded cap				48 50		Very dense, wet, gray, silty SAND (SM); fine sand. Bottom of Boring at 136.7' BGS	135
140								140
145								145

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

PID - Photoionization Detector (Headspace Measurement)
- Static Water Level
- Water Level (ATD)

Logged by: JSL
Approved by: RRH
Figure No.

_ENV BORING LOG CROWNHILL.GPJ May 24, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-8	1 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev:
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Method: Cascade Drilling-Dave / Hollow Stem Auger
Depth to Water (ft BGS): 109 ATD
Sampling Method: D & M / Hammer Weight: 300 lb jars / Hammer Drop: 30"
Start/Finish Date: 12/20/2011-12/21/2011

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Drive/ Recovery	Material Type	Description	Depth (ft)
0	8" Flush mount monument set in concrete				7		Light brown TOPSOIL.	0
					10		Very stiff, moist, brown with iron stain mottling, gravelly, very sandy SILT (ML) FILL.	
					8			
					10		Loose, moist, dark brown, gravelly, silty SAND (SM) FILL; with LANDFILL DEBRIS; including glass, brick, plastic, charcoal, cermaic, organics, wood.	
5					12			5
					12			
					9			
					13			
					15			
					5			
					3			
					3			
					4			
10					4			10
					4			
					3			
	Bentonite chips (NSF/ANSI 60)				2			
					2			
					3		Very moist, very silty.	
					4		Very dense, moist, gravelly SAND (SW); fine to coarse sand; gravel up to 2" diameter.	
15					5			15
					4			
					4			
					4			
					2			
					4			
					4			
20		MW-8-20	NWTPH-Dx, total As, total Pb		50		Medium dense, moist, gray brown, gravelly, very silty SAND (SM).	20
					12			
					12			
					16			
25					7			25
					8		Medium dense, moist, brown, gravelly SAND (SW); fine to coarse sand; subrounded gravel.	
					9			
30					8		Medium dense, moist, brown SAND (SP); iron stained strata.	30
					8			
					8			
35	2" Sch. 40 PVC casing				6		Faint stratification.	35
					7			
					7			
40					9		Gravelly; rounded gravel up to 2" in diameter.	40
					10			
					11			
45					16		Very dense, moist, gray SAND (SP); iron stained stratification; fine to medium sand; trace silt.	45
					50			

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

PID - Photoionization Detector (Headspace Measurement)

- Static Water Level
- Water Level (ATD)

Logged by: MV/AET
Approved by: RRH
Figure No.

ENV BORING LOG CROWNHILL.GPJ May 24, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-8	2 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev:
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Method: Cascade Drilling-Dave / Hollow Stem Auger
Depth to Water (ft BGS): 109 ATD
Sampling Method: D & M / Hammer Weight: 300 lb jars / Hammer Drop: 30"
Start/Finish Date: 12/20/2011-12/21/2011

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Drive/ Recovery	Material Type	Description	Depth (ft)
					50		Pockets of light gray, silty sand; trace gravel.	
55	Bentonite grout				50			55
60					50		Basaltic gravel.	60
65					50		Faint stratification delineated by brown stained sand.	65
70					50		Stratification may be non-horizontal.	70
75					50			75
80		MW-8-80	NWTPH-Dx, total As, total Pb		50		Faint non-horizontal stratification.	80
85					50		1"silty sand layer.	85
90					50			90
95	Bentonite chips (NSF/ANSI 60)				50		Very dense, moist, light gray, gravelly SAND (SW); fine to coarse sand; fine gravel; mixed granitic and basaltic lithology.	95
							Very dense, moist, gray, SAND (SP); fine to medium sand.	

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

PID - Photoionization Detector (Headspace Measurement)
- Static Water Level
- Water Level (ATD)

Logged by: MV/AET
Approved by: RRH
Figure No.

_ENV BORING LOG CROWNHILL.GPJ May 24, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-8	3 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev:
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Method: Cascade Drilling-Dave / Hollow Stem Auger
Depth to Water (ft BGS): 109 ATD
Sampling Method: D & M / Hammer Weight: 300 lb jars / Hammer Drop: 30"
Start/Finish Date: 12/20/2011-12/21/2011

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Drive/ Recovery	Material Type	Description	Depth (ft)
105	#2/12 sand filter pack				50		Light gray, trace gravel.	105
					50			
110	2" Sch. 40 prepacked screen 0.020" slot	MW-8-110	NWTPH-Dx, total As, total Pb		50 18 21		Separate phase black viscous petroleum-like liquid.	110
115					13 18 21		Dense, wet, gray, sandy GRAVEL (GP); fine gravel; medium to course sand; separate phase black viscous petroleum-like liquid.	115
120	Threaded PVC endcap				50		Very dense, wet, gray, SAND (SW); fine to coarse sand. Bottom of Boring at 120.5' BGS	120
125								125
130								130
135								135
140								140
145								145

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

PID - Photoionization Detector (Headspace Measurement)

- Static Water Level
- Water Level (ATD)

Logged by: MV/AET
Approved by: RRH
Figure No.

ENV BORING LOG CROWNHILL.GPJ May 24, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-9	1 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev:
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Method: Cascade Drilling-Dave / Hollow Stem Auger
Depth to Water (ft BGS): 116 ATD
Sampling Method: D & M / Hammer Weight: 300 lb jars / Hammer Drop: 30"
Start/Finish Date: 12/19/2011-12/20/2011

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Drive/ Recovery	Material Type	Description	Depth (ft)
0	8" Flush mount monument set in concrete				5		Light brown TOPSOIL.	0
					5 5 5		Loose, moist, brown to dark brown, silty, gravelly SAND (SM) FILL; brown at 0.5'; subrounded gravel up to 1"; fine to medium sand.	
					3 3 3		Reddish brown silt pockets.	
5					5		Gray sandy pockets.	5
					7 4		Loose, brown and gray mottled, sandy SILT (ML) FILL; trace gravel.	
	Bentonite chips (NSF/ANSI 60)				5 2 1		Loose, moist, brown-gray, very silty, gravely SAND (SM) FILL; rare organics; petroleum-like droplets; gravel up to 2"; subrounded; fine to medium sand.	
10					2 3 8		Medium dense LANDFILL DEBRIS; including wood, glass, brick and plastic in a sandy gravelly silt matrix.	10
					16		Loose, moist, light gray, silty SAND (SM).	
					20 6 5		Gray and brown mottled, gravelly. 2" pocket of gray silt.	
15		MW-9-15	NWTPH-Dx, total As, total Pb		6 4		Very stiff, moist, gray and brown mottled SILT (ML); mm to cm scale blocky fractures; oxidized fracture surfaces and slickensides stops.	15
					4 4 3 3		Medium dense, moist, slightly sitly, gravelly SAND (SP-SM); strong petroleum-like odor; fine subrounded gravel; fine to medium sand.	
20					3 3 8 8		Trace gravel.	20
					5 6 7			
25					10		Medium dense, moist, gray SAND (SP); fine to medium sand; mild petroleum-like odor.	25
					9 10 10 10 10			
30					11 12 16			30
35	2" Sch. 40 PVC casing				4 17 20		Dense, trace silt; pocket of gravelly silty sand; granitic gravel.	35
40					12 24 27		Very dense, gray brown. 1 cm oxidized brown layer at 40.3' bgs	40
45					22 50		faint stratification; thin vertical dark brown laminae.	45

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

PID - Photoionization Detector (Headspace Measurement)
- Static Water Level
- Water Level (ATD)

Logged by: AET/MV
Approved by: RRH
Figure No.

_ENV BORING LOG CROWNHILL.GPJ May 24, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-9	2 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev:
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Method: Cascade Drilling-Dave / Hollow Stem Auger
Depth to Water (ft BGS): 116 ATD
Sampling Method: D & M / Hammer Weight: 300 lb jars / Hammer Drop: 30"
Start/Finish Date: 12/19/2011-12/20/2011

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Drive/ Recovery	Material Type	Description	Depth (ft)
55	Bentonite grout				50			55
					26 50		1" layer of fine sand. Gray.	
60					20 22 50/5		1" pockets of gray silt	60
65					27 50		faint stratification	65
70					20 50			70
75		MW-9-75	NWTPH-Dx, total As, total Pb		50		Diagonal, light gray, 1cm bed.	75
80					50		Brown, trace to slightly gravelly, isolated beds of silty sand.	80
85					50/4		Very dense, moist, brown, trace to slightly gravelly, slightly silty SAND (SP-SM); metamorphic gravel up to 1", subrounded to subangular; diamict structure.	85
90					10 14 22		Dense, moist, gray-brown, slightly gravelly SAND (SW); fine to coarse sand.	90
95					10 14 14		Medium dense, moist, gray-brown SAND (SP); trace gravel; fine to medium sand. Medium dense, moist, gray-brown SAND (SW); fine to coarse sand. Medium dense, moist, gray-brown SAND (SP); fine to medium sand.	95

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

PID - Photoionization Detector (Headspace Measurement)
- Static Water Level
- Water Level (ATD)

Logged by: AET/MV
Approved by: RRH
Figure No.

ENV BORING LOG CROWNHILL.GPJ May 24, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-9	3 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev:
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Method: Cascade Drilling-Dave / Hollow Stem Auger
Depth to Water (ft BGS): 116 ATD
Sampling Method: D & M / Hammer Weight: 300 lb jars / Hammer Drop: 30"
Start/Finish Date: 12/19/2011-12/20/2011

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Drive/ Recovery	Material Type	Description	Depth (ft)
	Bentonite chips (NSF/ANSI 60)				7 7 8		Medium dense, moist, brown, gravelly SAND (SW); fine to coarse sand; fine, subrounded to subangular gravel, metamorphic clasts.	
105					50		Very dense.	105
110	#2/12 sand filter pack				50			110
115					2 4 6		Loose, wet, brown, very silty fine SAND (SM). Medium dense, wet, brown, SAND (SP); fine to medium sand, trace silt.	115
120	0.020" slot 2" Sch. 40	MW-9-120	NWTPH-Dx, total As, total Pb		50		Very dense.	120
125					50			125
	Threaded PVC endcap				50		Bottom of Boring at 127.5' BGS	
130								130
135								135
140								140
145								145

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

PID - Photoionization Detector (Headspace Measurement)
- Static Water Level
- Water Level (ATD)

Logged by: AET/MV
Approved by: RRH
Figure No.

ENV BORING LOG CROWNHILL.GPJ May 24, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-10	1 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev:
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Method: Cascade Drilling-Dave / Hollow Stem Auger
Depth to Water (ft BGS): 135 ATD
Sampling Method: D & M / Hammer Weight: 300 lb jars / Hammer Drop: 30"
Start/Finish Date: 12/21/2011-12/29/2011

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Drive/ Recovery	Material Type	Description	Depth (ft)
0	8" Flush mount monument set in concrete						Asphalt.	
					7		Medium dense, dry, brown, slightly gravelly, silty SAND (SM) FILL; fine to medium sand.	
					7			
5		MW-10-5	NWTPH-Dx, total As, total Pb		8		Medium dense, dry, brown, slightly gravelly SAND (SP) FILL; trace silt, trace organics.	5
					7			
					5			
					6			
					8		Very dense, dry, brown, slightly silty, slightly gravelly SAND (SP-SM); wood, fine to medium sand, medium fine subrounded gravel.	
10					3			10
					6			
					50			
					50			
					50			
					50/5			
	Bentonite chips (NSF/ANSI 60)							
15					50			15
20					50		Very dense, slightly moist, brown, trace to slightly gravelly SAND (SP); fine to medium sand; predominately fine subrounded gravel.	20
25					50		Very dense, moist, brown, slightly gravelly SAND (SW); fine to coarse sand; fine subrounded gravel.	25
30					50			30
35	2" Sch. 40 PVC casing				22		Trace to slightly gravelly; fine subrounded gravel.	35
					50			
40					50			40
45					50		Gravelly.	45

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

PID - Photoionization Detector (Headspace Measurement)
- Static Water Level
- Water Level (ATD)

Logged by: AET/MV
Approved by: RRH
Figure No.

ENV BORING LOG CROWNHILL.GPJ May 24, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-10	2 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev:
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Method: Cascade Drilling-Dave / Hollow Stem Auger
Depth to Water (ft BGS): 135 ATD
Sampling Method: D & M / Hammer Weight: 300 lb jars / Hammer Drop: 30"
Start/Finish Date: 12/21/2011-12/29/2011

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Drive/ Recovery	Material Type	Description	Depth (ft)
					50		Very dense, moist, brown SAND (SP); trace gravel, fine to medium sand.	
55					50		Gravelly.	55
60	Bentonite grout				50		Trace gravel.	60
65					50			65
70		MW-10-70	NWTPH-Dx, total As, total Pb		50		Gray-brown, faint stratification.	70
75					50			75
80					50			80
85					50			85
90					50			90
95					50		Very dense, moist, brown, silty sand (SM); fine sand.	95

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

PID - Photoionization Detector (Headspace Measurement)
- Static Water Level
- Water Level (ATD)

Logged by: AET/MV
Approved by: RRH
Figure No.

_ENV BORING LOG CROWNHILL.GPJ May 24, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-10	3 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev:
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Method: Cascade Drilling-Dave / Hollow Stem Auger
Depth to Water (ft BGS): 135 ATD
Sampling Method: D & M / Hammer Weight: 300 lb jars / Hammer Drop: 30"
Start/Finish Date: 12/21/2011-12/29/2011

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Drive/ Recovery	Material Type	Description	Depth (ft)
105					50		Very dense, very moist, gray-brown, very sandy SILT (ML); fine sand, faint iron stain stratification.	105
					50		1" thick dark brown fine sand layer Very dense, moist, gray-brown SAND (SP); fine to medium sand.	
110					50		Very dense, very moist, gray-brown, sandy SILT (ML); fine sand.	110
							Very Dense, moist, gray-brown SAND (SP); fine to medium sand.	
115	Bentonite chips (NSF/ANSI 60)				50			115
120					50		Very dense, moist, gray-brown, SAND (SW); fine to coarse sand; trace gravel.	120
							Hard, slightly moist, gray-purple CLAY (CL).	
125					50			125
130	#2/12 sand filter pack 0.010" slot 2" Sch. 40				50		Very dense, moist, gray-purple and brown mottled, silty SAND (SM); fine to medium sand; trace gravel; pocket of brown fine sandy silt and trace organics; charcoal.	130
135		MW-10-135	NWTPH-Dx, total As, total Pb		50		Very dense, wet, gray-purple, SAND (SW); fine to coarse sand (predominately fine to medium); trace silt.	135
140					50		Very dense, very moist, gray-blue, SAND (SP); fine to medium sand, predominately fine. could not tag water level, too much heave	140
145	Threaded PVC endcap				50		Wet, trace gravel. Bottom of Boring at 145.5' BGS	145

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

PID - Photoionization Detector (Headspace Measurement)
- Static Water Level
- Water Level (ATD)

Logged by: AET/MV
Approved by: RRH
Figure No.

ENV BORING LOG CROWNHILL.GPJ May 24, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-12	1 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev: 134.72
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Equipment: Cascade Drilling-Dave / CME 75
Depth to Water (ft BGS): 115
Drilling Method/Hammer: HSA / D & M / 300 lb jars / 30"
Start/Finish Date: 10/25/2012

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	Blows/ 6"	N-value / Water Content % (0 10 20 30 40 50)	Material Type	Description	Depth (ft)
	8" Flush mount monument set in concrete						Grass over topsoil	
5 / 130			PID = 0	50			**LANDFILL** Moist, dark brown LANDFILL DEBRIS in a sandy SILT (ML) matrix; debris includes plastic, metal, white powdery debris. (Blow count not representative of soil density)	5
10 / 125			PID = 1.3	6 5 4			Loose, with PVC debris.	10
15 / 120			PID = 0.0 PID = 0.8 PID = 0.0	3 3 3			Becomes gravelly, debris includes glass, rope, white powder, fabric, screws, charred material.	15
20 / 115			PID = 1.0 PID = 0.0	7 9 9			Becomes red; debris includes plastic, metal wire, charred material, fabric, glass, nails. (Blow count not representative of soil density)	20
25 / 110	Bentonite chips (NSF/ANSI 60)		PID = 0.0 PID = 0.0 PID = 0.0	7 9 20			Becomes red, dark brown, black, and white mottled; debris includes glass, drywall, charred material, nails, yellow plastic pieces. (Blow count not representative of soil density)	25
30 / 105			PID = 4.3 PID = 1.7	7 7 7			Moist, gray, sandy GRAVEL (GW) to very gravelly SAND (SW); fine to coarse sand, fine to coarse gravel, with cobbles up to 3", landfill debris includes wire. (Blow count not representative of soil density)	30
35 / 100	2" Sch. 40 PVC casing		PID = 1.8 PID = 13.1	10 50				35
40 / 95		MW-12-41	PID = 130. NWTPH-Dx	12 13 14			**VASHON ADVANCE OUTWASH** Medium dense, moist, dark gray SAND (SW); fine to coarse sand, trace silt, petroleum-like odor and sheen, blebs.	40
45 / 90			PID = 191 PID = 30.1	12 13 15			Medium dense, moist, dark gray SAND (SP); with cobbles, fine to medium sand, petroleum-like odor and sheen, blebs.	45
85								

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

Drilling Method:
HSA: Hollow Stem Auger
MR: Mud Rotary

Logged by: AET
Approved by: RRH
Figure No.

GEOTECH BORING LOG CROWNHILL.GPJ November 30, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-12	2 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev: 134.72
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Equipment: Cascade Drilling-Dave / CME 75
Depth to Water (ft BGS): 115
Drilling Method/Hammer: HSA / D & M / 300 lb jars / 30"
Start/Finish Date: 10/25/2012

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	Blows/ 6"	N-value / Water Content % (0 10 20 30 40 50)	Material Type	Description	Depth (ft)
			PID = 16.2	8			Very stiff, moist, gray and tan-mottled SILT (ML) interbedded with medium dense, moist, dark gray and dark brown SAND (SP); fine to medium sand, stratification at approximately 45 degrees from horizontal, petroleum-like odor.	
			PID = 182	11				
			PID = 32.1	12				
55 / 80			PID = 1.7	12 14 15				55
60 / 75		MW-12-61.5	PID = 15.7 PID = 6.8 PID = 13.5, NWTPH-Dx	10 12 18			Medium dense, moist, gray, brown, slightly silty, gravelly SAND (SW-SM); fine to coarse sand, fine gravel, slight petroleum-like odor.	60
65 / 70			PID = 2.9	15 15 15			Hard, moist, brown, gravelly, sandy SILT (ML) interbedded with very thin beds gray SAND (SP); medium to coarse sand, beds at approximately 45 degrees from horizontal, blocky fractures in silt, slight petroleum-like odor.	65
70 / 65	Bentonite chips (NSF/ANSI 60)		PID = 0.0	13 50				70
75 / 60			PID = 4.9	21 50			Very dense, moist, gray, brown, slightly gravelly SAND (SP); medium to coarse sand, slight petroleum-like odor	75
80 / 55		MW-12-81	PID = 7.7 NWTPH-Dx	18 50				80
85 / 50			PID = 20.7	50				85
90 / 45			PID = 12.8	50			Very dense, moist, brown to gray, very sandy GRAVEL (GW); fine sand, subangular fine to coarse gravel, slight petroleum-like odor. Thin bed brown, gray, slightly gravelly, slightly silty SAND (SP-SM); fine to medium sand, slight petroleum-like odor.	90
	#2/12 sand filter pack							
95 / 40	0.020" slot 2" Sch. 40		PID = 28.7	50/3				95
35								

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

Drilling Method:
HSA: Hollow Stem Auger
MR: Mud Rotary

Logged by: AET
Approved by: RRH
Figure No.

GEOTECH BORING LOG CROWNHILL.GPJ November 30, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-12	3 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev: 134.72
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Equipment: Cascade Drilling-Dave / CME 75
Depth to Water (ft BGS): 115
Drilling Method/Hammer: HSA / D & M / 300 lb jars / 30"
Start/Finish Date: 10/25/2012

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	Blows/ 6"	N-value / Water Content % (0 10 20 30 40 50)	Material Type	Description	Depth (ft)
105 / 30			PID = 2.7	50			Very dense, moist, gray, very gravelly SAND to very sandy GRAVEL (SW-GW); fine to coarse sand, fine to coarse gravel.	
		MW-12-105.5	PID = 8.0, NWTPH-Dx	50			Very dense, moist, gray, very gravelly SAND (SW); fine to coarse sand, fine to coarse gravel, slight petroleum-like odor at 105'.	105
110 / 25	0.020" slot 2" Sch. 40		PID = 1.8	50				110
115 / 20	▽ 10/25/2012	MW-12-115.5	PID = 10.3, NWTPH-Dx	50			Very dense, wet, gray, gravelly SAND (SP); fine to medium sand, coarse gravel	115
120 / 15			PID = 2.0 PID = 1.4	12 16 18			Dense, wet GRAVEL (GP); coarse gravel.	120
125 / 10	Threaded PVC endcap		PID = 0.2	20 50/5			Very dense, wet, gravelly SAND (SW); trace silt, fine to coarse sand, fine, subangular gravel.	125
							Bottom of boring at 125' BGS.	
130 / 5								130
135 / 0								135
140 / -5								140
145 / -10								145
-15								

Sampler Type:
- ◯ No Recovery
- ◧ 3.25" OD D&M Split-Spoon Ring Sampler

Drilling Method:
HSA: Hollow Stem Auger
MR: Mud Rotary

Logged by: AET
Approved by: RRH
Figure No.

GEOTECH BORING LOG CROWNHILL.GPJ November 30, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-13	1 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev: 134.22
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Equipment: Cascade Drilling-Dave / CME 75
Depth to Water (ft BGS): 114.5
Drilling Method/Hammer: HSA / D & M / 300 lb jars / 30"
Start/Finish Date: 10/25/2012

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	Blows/ 6"	N-value / Water Content % (0 10 20 30 40 50)	Material Type	Description	Depth (ft)
0 / 134	8" Flush mount monument set in concrete						Grass over topsoil	
5 / 130			PID = 0	10 19 16			**LANDFILL** Dense, dark brown, slightly silty, very gravelly SAND (SP-SM).	5
10 / 125			PID = 0	8 6 5			Medium dense, moist, dark brown to brown-yellow, slightly silty, gravelly SAND (SP-SM); abundant landfill debris including brick, paper, glass, copper, steel.	10
15 / 120			PID = 0.5	6 5 6			Abundant landfill debris including brick, glass, steel.	15
20 / 115			PID = 0	6 5 6			Medium dense, very moist, dark brown, gravelly, very silty SAND (SM); abundant landfill debris including wood, brick, nails, paper.	20
25 / 110	Bentonite chips (NSF/ANSI 60)		PID = 0	7 6 5			Trace gravel, trace landfill debris includes brick, glass.	25
30 / 105			PID = 0	7 16 15			**VASHON ADVANCE OUTWASH** Dense, moist, brown, very sandy GRAVEL (GP); subrounded gravel, fine to coarse sand.	30
35 / 100	2" Sch. 40 PVC casing		PID = 0	17 10 12			Medium dense, moist, brown, gravelly SAND (SW); fine to coarse sand, trace silt.	35
40 / 95			PID = 0	16 15 15			Dense, medium to coarse sand.	40
45 / 90		MW-13-45	PID = 84.4, NWTPH-Dx	10 16 17			Strong petroleum-like odor, saturated in product, heavy sheen.	45
85								

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

Drilling Method:
HSA: Hollow Stem Auger
MR: Mud Rotary

Logged by: RRH/AET
Approved by: RRH
Figure No.

GEOTECH BORING LOG CROWNHILL.GPJ November 30, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-13	2 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev: 134.22
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Equipment: Cascade Drilling-Dave / CME 75
Depth to Water (ft BGS): 114.5
Drilling Method/Hammer: HSA / D & M / 300 lb jars / 30"
Start/Finish Date: 10/25/2012

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	Blows/ 6"	N-value / Water Content % (0 10 20 30 40 50)	Material Type	Description	Depth (ft)
55 / 80			PID = 150	14 14 19			Dense, very moist to wet, dark gray, silty, sandy GRAVEL (GP-GM); saturated in product.	55
			PID = 31.5	19 19 15			Becomes wet, gray; strong odor, heavy sheen with blebs.	
60 / 75			PID = 91.5	25 26 20			Becomes moist, dark brown to brown, thin beds brown fine sand, strong petroleum-like odor, visible product.	60
65 / 70		MW-13-65	PID = 162 NWTPH-Dx	25 25 20				65
70 / 65	Bentonite chips (NSF/ANSI 60)		PID = 43	25 26 20			Becomes blue-gray; strong petroleum-like odor, heavy sheen with blebs.	70
75 / 60			PID = 82	20 20 20				75
80 / 55				>50	50+		Very dense, wet, gray, slightly silty, sandy GRAVEL (GP); with cobbles, strong petroleum-like odor, heavy sheen with blebs down to 115'.	80
85 / 50		MW-13-85	NWTPH-Dx	>50	50+			85
90 / 45			PID = 56.5	>50	50+			90
95 / 40	#2/12 sand filter pack 0.020" slot 2" Sch. 40		PID = 83.5	>50	50+			95
35								

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

Drilling Method:
HSA: Hollow Stem Auger
MR: Mud Rotary

Logged by: RRH/AET
Approved by: RRH
Figure No.

GEOTECH BORING LOG CROWNHILL.GPJ November 30, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-13	3 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev: 134.22
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Equipment: Cascade Drilling-Dave / CME 75
Depth to Water (ft BGS): 114.5
Drilling Method/Hammer: HSA / D & M / 300 lb jars / 30"
Start/Finish Date: 10/25/2012

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	Blows/ 6"	N-value / Water Content % (0 10 20 30 40 50)	Material Type	Description	Depth (ft)
105			PID = 75	>50	50+		Very dense, wet, gray, slightly silty, sandy GRAVEL (GP); with cobbles, strong petroleum-like odor, heavy sheen with blebs down to 115'.	105
		MW-13-105	PID = 84, NWTPH-Dx	>50	50+		Thin beds fine sand.	
110	0.020" slot 2" Sch. 40		PID = 65	>50	50+		Thin beds fine sand.	110
	▽ 10/25/2012							
115			PID = 0.0	>50	50+		Very dense, wet, gray-brown, silty, gravelly SAND (SM); fine to coarse sand, slight petroleum-like odor, no visible sheen.	115
120		○		>50	50+		No recovery.	120
125	Threaded PVC endcap	○		>50	50+		Bottom of boring at 125' BGS.	125
130								130
135								135
140								140
145								145

30 25 20 15 10 5 0 -5 -10 -15

Sampler Type:
○ No Recovery
3.25" OD D&M Split-Spoon Ring Sampler

Drilling Method:
HSA: Hollow Stem Auger
MR: Mud Rotary

Logged by: RRH/AET
Approved by: RRH
Figure No.

GEOTECH BORING LOG CROWNHILL.GPJ November 30, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-14	1 of 3

Project Name: Crownhill Elementary School
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Equipment: Cascade Drilling-Dave / CME 75
Drilling Method/Hammer: HSA / D & M / 300 lb jars / 30"

Ground Surface Elev: 134.53
Depth to Water (ft BGS): 115
Start/Finish Date: 10/26/2012

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	Blows/ 6"	N-value ▲ / Water Content % ● (0 10 20 30 40 50)	Material Type	Description	Depth (ft)
0 / 134	8" Flush mount monument set in concrete						Grass over topsoil	0
5 / 130			PID = 1.7	9 16 21			**LANDFILL** Moist, brown, slightly silty, gravelly SAND (SP-SM). (Blow count not representative of soil density.) Moist, gray, gravelly SAND (SW); trace silt, fine to coarse sand. (Blow count not representative of soil density.)	5
10 / 125			PID = 0.0	7 8 7			Moist, dark brown LANDFILL DEBRIS in a gravelly SAND (SW) matrix; debris includes nails, metal, plastic, and glass.	10
15 / 120			PID = 0.0	3 4 5			Sandy SILT matrix; debris includes nails, brick, white powder, plastic, glass, large screws.	15
20 / 115			PID = 0.0	3 3 3			Silty SAND matrix; Landfill debris includes kiln firing, metal, plastic, nails.	20
25 / 110	Bentonite chips (NSF/ANSI 60)		PID = 0.0	11 12 12			Landfill debris includes rebar, glass, nails, plastic, metal. (Blow count not representative of soil density.)	25
30 / 105			PID = 1.5	50			Dark brown, sheen present. (Blow count not representative of soil density.)	30
35 / 100	2" Sch. 40 PVC casing		PID = 11.2	50			Wet, silty, sandy GRAVEL matrix; debris includes metal, wire. Free-phase petroleum product present in sample, sheen, strong odor, blebs. (Blow count not representative of soil density.)	35
40 / 95		MW-14-40	PID = 51.2, NWTPH-Dx	50			**VASHON ADVANCE OUTWASH** Medium dense, moist, black, slightly gravelly, silty SAND (SM); fine sand, fine to coarse gravel, strong petroleum-like odor.	40
45 / 90			PID = 223	20 10 10			Medium dense, moist, black, lightly silty SAND SP-SM); fine to coarse sand, fine gravel, strong petroleum-like odor and staining	45
85								

Sampler Type:
- ◯ No Recovery
- ◧ 3.25" OD D&M Split-Spoon Ring Sampler

Drilling Method:
HSA: Hollow Stem Auger
MR: Mud Rotary

Logged by: AET
Approved by: RRH
Figure No.

GEOTECH BORING LOG CROWNHILL.GPJ November 30, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-14	2 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev: 134.53
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Equipment: Cascade Drilling-Dave / CME 75
Depth to Water (ft BGS): 115
Drilling Method/Hammer: HSA / D & M / 300 lb jars / 30"
Start/Finish Date: 10/26/2012

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	Blows/ 6"	N-value / Water Content % (0 10 20 30 40 50)	Material Type	Description	Depth (ft)
80			PID = 176 PID = 201	20 21 21			Dense, moist, gray to black, veriy silty, sandy GRAVEL (GM); fine to coarse sand, strong petroleum-like odor, blebs, heavy sheen	
55								55
75			PID = 213	10 10 15			Medium dense, moist, black to tan with brown mottling, slightly silty, slightly gravelly SAND (SP); fine sand, strong petroleum-like odor, heavy sheen, blebs.	
60		MW-14-60	PID = 410, NWTPH-Dx	10 15 18			Medium dense, very moist, gray and brown mottled, gravelly, silty SAND (SM); gravel to 3", fine sand, petroleum-like odor, heavy sheen, blebs.	60
70								
65			PID = 293	10 8 11			Medium dense, moist, gray and brown, mottled, slightly silty SAND (SP); trace coarse gravel, fine to medium sand, predominately fine, petroleum-like odor, sheen.	65
65								
70	Bentonite chips (NSF/ANSI 60)		PID = 285	10 18 11			Gray and dark brown alternating layers of SAND (SP); fine sand.	70
60								
75			PID = 389	8 10 11			Thin, gray crossbeds.	75
55								
80		MW-14-80	PID = 67.1, NWTPH-Dx	10 11 16			Petroleum-like odor, sheen present.	80
50								
85			PID = 85.9	11 24 50			Becomes trace silt, petroleum-like odor, sheen present.	85
45								
90			PID = 37	50			Very dense, moist, gravelly SAND (SW); fine to coarse sand, fine to coarse gravel, trace silt, petroleum-like odor, sheen present.	90
40	#2/12 sand filter pack 0.020" slot 2" Sch. 40							
95			PID = 59.7	50			Very dense, very moist, gray sandy GRAVEL (GP); coarse sand, fine to coarse gravel, predominately coarse, trace silt, petroleum-like odor, sheen, blebs.	95
35								

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

Drilling Method:
HSA: Hollow Stem Auger
MR: Mud Rotary

Logged by: AET
Approved by: RRH
Figure No.

GEOTECH BORING LOG CROWNHILL.GPJ November 30, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-14	3 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev: 134.53
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Equipment: Cascade Drilling-Dave / CME 75
Depth to Water (ft BGS): 115
Drilling Method/Hammer: HSA / D & M / 300 lb jars / 30"
Start/Finish Date: 10/26/2012

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	Blows/ 6"	N-value / Water Content % (0 10 20 30 40 50)	Material Type	Description	Depth (ft)
105 / 30		MW-14-100	PID = 14.0, NWTPH-Dx	50			Very dense, very moist, gray sandy GRAVEL (GP); coarse sand, fine to coarse gravel, predominately coarse, trace silt, petroleum-like odor, sheen, blebs.	105
			PID = 33.1	50			Slight petroleum-like odor.	
110 / 25	0.020" slot 2" Sch. 40		PID = 13.0	50				110
115 / 20	▽ 10/26/2011		PID = 1.3	50				115
120 / 15			PID = 0.0	50			Very dense, wet, gray, brown, gravelly SAND (SW); fine gravel, fine to coarse sand.	120
125 / 10	Threaded PVC endcap		PID = 0.0	50			Very dense, wet, gray-brown SAND (SP); trace gravel, medium to coarse sand.	125
							Bottom of boring at 124.5' BGS.	
130 / 5								130
135 / 0								135
140 / -5								140
145 / -10								145
-15								

Sampler Type:
- ○ No Recovery
- ◧ 3.25" OD D&M Split-Spoon Ring Sampler

Drilling Method:
HSA: Hollow Stem Auger
MR: Mud Rotary

Logged by: AET
Approved by: RRH
Figure No.

GEOTECH BORING LOG CROWNHILL.GPJ November 30, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-15	1 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev: 134.18
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Equipment: Cascade Drilling-Dave / CME 75
Depth to Water (ft BGS): 115
Drilling Method/Hammer: HSA / D & M / 300 lb jars / 30"
Start/Finish Date: 10/26/2012

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	Blows/ 6"	N-value / Water Content % (0 10 20 30 40 50)	Material Type	Description	Depth (ft)
0 / 134	8" Flush mount monument set in concrete						Grass over topsoil.	0
5 / 130			PID = 5.7	50			**LANDFILL** Moist, brown, silty, gravelly SAND (SM); fine to coarse sand, landfill debris includes: wood, glass, metal. (Blow count not representative of soil density)	5
10 / 125			PID = 1.8	5 5 6			Medium dense.	10
15 / 120			PID = 0	50			Moist, gray, slightly silty, gravelly SAND (SW-SM); fine to coarse sand, landfill debris includes metal. (Blow count not representative of soil density)	15
20 / 115			PID = 0	50			Brown to gray, moist, slightly silty, sandy GRAVEL (GM-GW); coarse gravel, fine to coarse sand, landfill debris includes wood, concrete rubble. (Blow count not representative of soil density)	20
25 / 110	Bentonite chips (NSF/ANSI 60)		PID = 0	50			**VASHON ADVANCE OUTWASH** Very dense, moist, gray to brown, slightly silty, sandy GRAVEL (GM-GP); fine to coarse sand, fine gravel.	25
30 / 105			PID = 0	50/4				30
35 / 100	2" Sch. 40 PVC casing		PID = 0	50				35
40 / 95			PID = 0	50			Very dense, moist, gray, slightly silty SAND (SP-SM); fine to coarse sand, predominately medium to coarse sand.	40
45 / 90		MW-15-45	PID = 0, NWTPH-Dx	50				45
85								

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

Drilling Method:
HSA: Hollow Stem Auger
MR: Mud Rotary

Logged by: MV
Approved by: RRH
Figure No.

GEOTECH BORING LOG CROWNHILL.GPJ November 30, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-15	2 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev: 134.18
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Equipment: Cascade Drilling-Dave / CME 75
Depth to Water (ft BGS): 115
Drilling Method/Hammer: HSA / D & M / 300 lb jars / 30"
Start/Finish Date: 10/26/2012

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	Blows/ 6"	N-value / Water Content % (0 10 20 30 40 50)	Material Type	Description	Depth (ft)
80			PID = 0	32 50			Very dense, moist, gray, slightly silty SAND (SP-SM); fine to coarse sand, predominately medium to coarse sand.	
55			PID = 0	50			Becomes brown	55
75			PID = 0	50				60
70			PID = 0	50			3" interbeds of fine sand, grades to grey-brown.	65
65	Bentonite chips (NSF/ANSI 60)		PID = 0	50				70
60			PID = 0	27 50				75
55			PID = 0	50			Predominately fine sand.	80
50			PID = 0	50			Very dense, moist, gray SAND (SP); trace silt, fine to medium sand.	85
45			PID = 0	50			Trace coarse sand, trace fine gravel	90
40	#2/12 sand filter pack 0.020" slot 2" Sch. 40		PID = 0	50			Very dense, moist, grey-brown, slightly silty SAND (SP-SM); fine to medium sand	95
35								

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

Drilling Method:
HSA: Hollow Stem Auger
MR: Mud Rotary

Logged by: MV
Approved by: RRH
Figure No.

GEOTECH BORING LOG CROWNHILL.GPJ November 30, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-15	3 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev: 134.18
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Equipment: Cascade Drilling-Dave / CME 75
Depth to Water (ft BGS): 115
Drilling Method/Hammer: HSA / D & M / 300 lb jars / 30"
Start/Finish Date: 10/26/2012

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	Blows/ 6"	N-value / Water Content % (0 10 20 30 40 50)	Material Type	Description	Depth (ft)
105 / 30			PID = 0	50			Very dense, moist, grey-brown, slightly silty SAND (SP-SM); fine to medium sand	105
			PID = 0	50				
110 / 25	0.020" slot 2" Sch. 40	MW-15-110	PID = 0, NWTPH-Dx	50				110
115 / 20	▽ 10/26/2012		PID = 0	50			Wet at 115' BGS.	115
120 / 15			PID = 0	50				120
125 / 10	Threaded PVC endcap						Bottom of boring at 125' BGS.	125
130 / 5								130
135 / 0								135
140 / -5								140
145 / -10								145
-15								

Sampler Type:
- ◯ No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

Drilling Method:
HSA: Hollow Stem Auger
MR: Mud Rotary

Logged by: MV
Approved by: RRH
Figure No.

GEOTECH BORING LOG CROWNHILL.GPJ November 30, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-16	1 of 3

Project Name: Crownhill Elementary School
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Equipment: Cascade Drilling-Dave / CME 75
Drilling Method/Hammer: HSA / D & M / 300 lb jars / 30"

Ground Surface Elev: 134.07
Depth to Water (ft BGS): 115
Start/Finish Date: 10/26/2012

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	Blows/ 6"	N-value / Water Content % (0 10 20 30 40 50)	Material Type	Description	Depth (ft)
0 / 130	8" Flush mount monument set in concrete						Grass over topsoil.	0
5 / 125			PID = 0	15 13 12			**LANDFILL** Medium dense, moist, dark gray, slightly gravelly, silty SAND (SM); fine to coarse sand.	5
10 / 120			PID = 0	11 13 16			Dark brown, gravelly, woody debris.	10
15 / 115			PID = 0	50			Very dense, moist, brown to gray, silty, sandy GRAVEL (GM); fine to coarse gravel, fine to coarse sand, landfill debris including metal and wood.	15
20 / 110		MW-16-20-20.5	PID = 0, NWTPH-Dx	19 20 20			**VASHON ADVANCE OUTWASH** Dense, moist, brown, sandy GRAVEL (GW); trace silt, fine to coarse gravel, fine to coarse sand.	20
25 / 105	Bentonite chips (NSF/ANSI 60)		PID = 0	50			Very dense.	25
30 / 100			PID = 0	50				30
35 / 95	2" Sch. 40 PVC casing		PID = 0	50			Very dense, moist, gray SAND (SW); trace silt, fine to medium sand.	35
40 / 90			PID = 0	50				40
45 / 85			PID = 0	21 21 20			Dense, light brown, faint stratification.	45

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

Drilling Method:
HSA: Hollow Stem Auger
MR: Mud Rotary

Logged by: MV
Approved by: RRH
Figure No.

GEOTECH BORING LOG CROWNHILL.GPJ November 30, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-16	2 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev: 134.07
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Equipment: Cascade Drilling-Dave / CME 75
Depth to Water (ft BGS): 115
Drilling Method/Hammer: HSA / D & M / 300 lb jars / 30"
Start/Finish Date: 10/26/2012

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	Blows/ 6"	N-value / Water Content % (0 10 20 30 40 50)	Material Type	Description	Depth (ft)
80			PID = 0	50			Very dense, moist, gray SAND (SW); trace silt, fine to medium sand.	
55			PID = 0	50				55
75								
60			PID = 0	50			Very dense, moist, gray, sandy GRAVEL (GW); trace silt, fine to coarse gravel, fine to coarse sand.	60
70								
65			PID = 0	50			Very dense, moist, light gray-brown, slightly silty. slightly gravelly SAND (SP-SM); fine to medium sand, fine gravel.	65
65								
70	Bentonite chips (NSF/ANSI 60)		PID = 0	50				70
60								
75			PID = 0	50			Faint stratification. Strata dip at 45 degrees	75
55								
80			PID = 0	50			Trace gravel.	80
50								
85			PID = 0	50			Very dense, moist, dark gray-brown SAND (SP); trace silt, fine to medium sand.	85
45								
90			PID = 0	50				90
40	#2/12 sand filter pack							
95	0.020" slot 2" Sch. 40		PID = 0	50				95
35								

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

Drilling Method:
HSA: Hollow Stem Auger
MR: Mud Rotary

Logged by: MV
Approved by: RRH
Figure No.

GEOTECH BORING LOG CROWNHILL.GPJ November 30, 2012

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100094	MW-16	3 of 3

Project Name: Crownhill Elementary School
Ground Surface Elev: 134.07
Location: 1500 Rocky Point Road, Bremerton WA 98312
Driller/Equipment: Cascade Drilling-Dave / CME 75
Depth to Water (ft BGS): 115
Drilling Method/Hammer: HSA / D & M / 300 lb jars / 30"
Start/Finish Date: 10/26/2012

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	Blows/ 6"	N-value / Water Content % (0 10 20 30 40 50)	Material Type	Description	Depth (ft)
105			PID = 0	50			Very dense, moist, dark gray-brown SAND (SP); trace silt, fine to medium sand. Trace fine gravel	105
110	0.020" slot 2" Sch. 40	MW-16-110-110.5	PID = 0, NWTPH-Dx	50			Very dense, moist, gray, dark brown to black, slightly silty SAND (SP-SM); fine to medium sand, strong petroleum-like odor, sheen present.	110
115	▽ 10/26/2012		PID = 0	50			Wet, stratified, trace gravel, strong petroleum-like odor.	115
120			PID = 0	50			Gray, trace silt, faint petroleum-like odor.	120
125	Threaded PVC endcap						Bottom of boring at 125' BGS.	125
130								130
135								135
140								140
145								145

30 25 20 15 10 5 0 -5 -10 -15

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

Drilling Method:
HSA: Hollow Stem Auger
MR: Mud Rotary

Logged by: MV
Approved by: RRH
Figure No.

GEOTECH BORING LOG CROWNHILL.GPJ November 30, 2012

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
100094	EW-17	1 of 3

Project Name:	Crownhill Elementary School	Ground Surface Elev	134.1
Location:	1500 Rocky Point Road, Bremerton WA 98312	Top of Casing Elev.	133.68
Driller/Method:	Holt / Sonic	Depth to Water (ft BGS)	114.6 - 10/13/2015
Sampling Method:	8" Continuous Core	Start/Finish Date	10/12/2015-10/13/2015

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Laboratory Tests	PID (ppm)	Density	Material Type	Description	Depth (ft)
0 / 135	12" Flush mount monument set in concrete						Grass over moist, brown, silty, sandy TOPSOIL; trace fine gravel	
				0.0			Moist, brown, silty, sandy, FILL; trace fine gravel	
5 / 130							Gray, moist, silty, sandy GRAVEL (GM); fine to coarse sand, fine to coarse subrounded gravel, abundant debris: metal, wire, glass	5
10 / 125	Bentonite chips (NSF/ANSI 60)						Gray, moist, sandy, very gravelly SILT (ML); fine to coarse subrounded gravel, predominantly fine sand, abundant debris: metal, glass	10
				0.0			Brown, moist, silty, very gravelly SAND to very sandy GRAVEL (SM-GM); fine to coarse rounded to subrounded gravel, predominantly fine to medium sand, glass and metal debris Becomes dark brown with woody debris at 11' Becomes very moist at 14'	
15 / 120	4" Sch. 40 PVC casing						Very moist, dark brown, silty, sandy, GRAVEL (GM); fine to medium sand, fine to coarse subrounded gravel, glass and metal debris	15
20 / 115				0.0			**VASHON ADVANCE OUTWASH** Moist, brown, sandy GRAVEL(GW); trace silt, predominantly medium to coarse sand, fine to coarse rounded to subrounded gravel with cobbles, no visible debris	20
				0.0				
25 / 110				0.0				25
30 / 105				0.0				30
				0.0				
35 / 100				0.0				35
				0.0			Moist, brown, gravelly SAND (SW); trace silt, fine to coarse sand, fine rounded to subrounded gravel, no odor	
40 / 95				0.0			Becomes slightly gravelly with finer sand overall at 41'	40
45 / 90				0.0				45
				0.0			Moist, brown SAND (SP); predominantly medium sand, scattered very thinly bedded slightly silty fine sand, no odor	
85								

Sampler Type:
- ◯ No Recovery
- ▮ Continuous Core

PID - Photoionization Detector
- ▼ Static Water Level
- ▽ Water Level (ATD)

Logged by: MML

Approved by: RRH

Figure No.

_MONITORING WELL_SONIC CROWNHILL.GPJ October 29, 2015

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
100094	EW-17	2 of 3

Project Name:	Crownhill Elementary School	Ground Surface Elev	134.1
Location:	1500 Rocky Point Road, Bremerton WA 98312	Top of Casing Elev.	133.68
Driller/Method:	Holt / Sonic	Depth to Water (ft BGS)	114.6 - 10/13/2015
Sampling Method:	8" Continuous Core	Start/Finish Date	10/12/2015-10/13/2015

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Laboratory Tests	PID (ppm)	Density	Material Type	Description	Depth (ft)
80 / 55	Bentonite chips (NSF/ANSI 60)		Soil: EW-17-50	0.0				55
75 / 60				0.0				60
70 / 65	4" Sch. 40 PVC casing			0.0				65
65 / 70			Soil: EW-17-70	0.0			Grades to very gravelly at 70.5	70
60 / 75				0.0			Moist, gray, sandy GRAVEL (GW); fine to coarse rounded gravel, predominantly medium sand, strong petroleum odor, visible product	75
55 / 80				0.0				80
				60.1				
50 / 85			Soil: EW-17-84	145			Moist, gray SAND (SP); fine to medium sand, strong petroleum odor, medium sheen, no visible product	85
				61.6				
45 / 90							Petroleum odor becomes faint at 90'	90
40 / 95							Product visible below 95.25'	95
35	#8/12 sand filter pack			319				

Sampler Type:
- ◯ No Recovery
- ▮ Continuous Core

PID - Photoionization Detector
- ▼ Static Water Level
- ▽ Water Level (ATD)

Logged by: MML

Approved by: RRH

Figure No.

_MONITORING WELL_SONIC CROWNHILL.GPJ October 29, 2015

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
100094	EW-17	3 of 3

Project Name:	Crownhill Elementary School	Ground Surface Elev	134.1
Location:	1500 Rocky Point Road, Bremerton WA 98312	Top of Casing Elev.	133.68
Driller/Method:	Holt / Sonic	Depth to Water (ft BGS)	114.6 - 10/13/2015
Sampling Method:	8" Continuous Core	Start/Finish Date	10/12/2015-10/13/2015

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Laboratory Tests	PID (ppm)	Density	Material Type	Description	Depth (ft)
105				0.0			Trace fine to coarse rounded gravel below 100'	105
							Becomes slightly gravelly at 105'	
110			Soil: EW-17-110	0.0				110
115	▼ 10/13/2015 ▽						Product no longer visible below 115'	115
	0.040" slot Vee Wrap/Sch. 40 PVC			0.0			Silty fine sand in scattered, very thin beds below 117.5'	
120	Bentonite chips and sand			0.0			Moderate to weak petroleum odor at 120'	120
							Becomes wet at approximately 122'	
125							Bottom of boring at 125', groundwater encountered at 122'	125
130								130
135								135
140								140
145								145

30 25 20 15 10 5 0 -5 -10 -15

Sampler Type:
- ◯ No Recovery
- ▮ Continuous Core

PID - Photoionization Detector
- ▼ Static Water Level
- ▽ Water Level (ATD)

Logged by: MML

Approved by: RRH

Figure No.

_MONITORING WELL_SONIC CROWNHILL.GPJ October 29, 2015

APPENDIX C

Groundwater/LNAPL Monitoring Data, December 2013 to October 2015

Table C-1 - Groundwater Monitoring Data, December 2013 through October 2015

Project No. 100094-003-02, Crownhill Elementary, Bremerton, Washington

Monitoring Well ID		MW-5					MW-6						MW-9					
Sampling Date		12/18/2013	4/3/2014	7/1/2014	10/13/2014	4/7/2015	12/18/2013	4/3/2014	7/1/2014	10/13/2014	4/7/2015	10/28/2015	12/17/2014	4/3/2014	7/1/2014	10/13/2014	4/7/2015	10/28/2015
Constituent of Concern	**Cleanup Level**																	
Diesel-Range TPH	500	**2,100 x**	**2,400 x**	**2,000 x**	**1,300**	**2,000**	50 U	50 U	50 U	50 U	na	na	110 x	210 x	180 x	180 x	na	na
Motor-Oil-Range TPH	500	**750 x**	**770 x**	490 x	260 x	430 x	250 U	250 U	250 U	250 U	na	na	250 U	280 x	250 U	250 U	na	na
Trichloroethene (TCE)	5	1.8	na	na	na	na	1 U	na	na	na	na	na	**11**	**11**	**12**	**10**	**11**	**10**
Total Arsenic	5	1 U	1.15	1 U	1 U	na	**16.6**	**20.5**	**19.9**	**20.4**	**26.7**	**22.8**	1 U	1 U	1 U	1 U	na	na
Field Parameters																		
Dissolved Oxygen in mg/L		0.8	0.5	0.02	3.7	0.1	2.1	0.6	4.8	2.5	0.3	0.82	2.2	1.9	2.4	1.9	1.2	1.85
ORP in mVolts		175	25	-49	4	42	69	12	-27	16	35	46	150	161	-79	75	18	69
pH in pH Units		6.9	6.9	6.9	6.8	7.0	6.7	6.6	6.6	6.5	6.5	6.51	6.4	6.4	5.9	5.9	6.5	6.35
Specific Conductance in µs/cm		143	1,507	1,558	1,514	1,487	593	739	668	650	628	645	453	561	640	578	622	711
Temperature in deg C		13.1	13.1	14.3	16.4	12.5	12.0	12.9	14.2	14.6	12.5	14.1	11.9	11.8	12.3	12.8	12.0	12.8
Turbidity in NTU		23.1	3.2	3.7	2.7	0.4	2.7	4.9	2.8	1.2	5.0	3.6	4.3	4.5	1.0	3.4	1.2	nm
Groundwater Elevation Measurements[4]																		
Depth to Water in feet Below TOCE		117.36	117.17	116.23	117.56	116.49	124.36	124.70	124.40	124.54	124.61	124.84	114.49	114.35	113.44	114.71	114.5	115.3
Groundwater Elevation in feet		19.59	19.78	20.72	19.39	20.46	9.51	9.17	9.47	9.33	9.26	9.03	19.90	20.04	20.95	19.68	19.89	19.09

Monitoring Well ID		MW-10[4]						MW-12					MW-15					
Sampling Date		12/18/2013	4/3/2014	7/1/2014	10/13/2014	4/7/2015	10/28/2015	12/17/2013	4/3/2014	7/1/2014	10/13/2014	10/28/2015	12/17/2013	4/3/2014	7/1/2014	10/13/2014	4/7/2015	10/28/2015
Constituent of Concern	**Cleanup Level**																	
Diesel-Range TPH	500	50 U	50 U	50 U	50 U	50 U	80 U	**2,000 x**	**2,800 x**	**1,800 x**	**1,600**	**2,400 x**	50 U	50 U	50 U	50 U	50 U	50 U
Motor-Oil-Range TPH	500	250 U	250 U	250 U	250 U	250 U	400 U	**800 x**	**850 x**	420 x	250 U	**620 x**	250 U	250 U	250 U	250 U	250 U	250 U
Trichloroethene (TCE)	5	1 U	1 U	1 U	1 U	1 U	1 U	1 U	na	na	na	na	1 U	na	na	na	na	na
Total Arsenic	5	3.26	3.94	3.01	3.02	2.76	2.65	1.45	1.38	1.7	1.7	na	4.63	1.16	1 U	1.11	na	na
Field Parameters																		
Dissolved Oxygen in mg/L		1.2	0.7	1.0	0.4	0.3	0.44	0.7	0.4	0.1	1.1	0.35	4.1	2.6	3.5	5.1	2.7	3.73
ORP in mVolts		29	-50	-121	47	82	50	97	9	-49	67	97	142	104	-6	79	18	63
pH in pH Units		7.3	7.1	6.7	6.8	7.0	7.02	7.1	6.9	6.9	6.7	6.92	7.0	6.8	6.5	6.5	7.0	6.82
Specific Conductance in µs/cm		421	517	479	460	492	490	1,424	1,611	1,611	1,508	1,609	637	746	655	633	660	651
Temperature in deg C		11.6	11.6	13.2	12.8	11.8	13.1	13.2	13.1	14.8	13.8	13.8	11.9	12.1	12.9	14.0	12.0	13.5
Turbidity in NTU		2.3	7.5	2.7	1.7	1.0	9.15	mn	8.7	6.5	10.9	13.5	97.1	19.3	2.9	13.0	1.5	60
Groundwater Elevation Measurements[5]																		
Depth to Water in feet Below TOCE		120.87	121.21	120.55	121.48	120.60	121.3	114.24	114.11	113.17	114.45	115.02	nm[6]	nm[6]	nm[6]	nm[6]	nm[6]	nm[6]
Groundwater Elevation in feet		11.46	11.12	11.78	10.85	11.73	11.03	19.63	19.76	20.70	19.42	18.85						

µs/cm	microsiemens per centimeter	ORP	oxidation/reduction potential
mg/L	milligrams per liter	TOCE	top-of-casing elevation
na	not analyzed	TPH	total petroleum hydrocarbon
nm	not measured	U	Analyte was not detected at or above the reported result.
NTU	nephelometric turbidity units	x	The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

Notes

1) All concentrations are in micrograms per liter (µg/L). Cleanup level exceedances are bolded.
2) For groundwater monitoring data prior to December 2013, refer to the Remedial Investigation report (Aspect, 2014a).
3) Water from the McKinney domestic well was sampled by Kitsap Public Health District (KPHD) on three occasions in 2014/2015 for a wide variety of potential contaminants; refer to KPHD, 2015 for sampling results. It was also sampled for TCE only in BSD's 10/28/2015 monitoring round; TCE was not detected at a detection limit of 1 µg/L.
4) Well MW-10 is the conditional point of compliance for achieving groundwater cleanup levels.
5) Elevations are based on NAVD88 vertical datum. Refer to Table 2 for top-of-casing elevations.
6) Water level was below top of pump and could not be measured.

Table C-2 - LNAPL Thickness Monitoring Data, December 2013 through October 2015

Project No. 100094-003-02, Crownhill Elementary, Bremerton, Washington

Well ID	Date	Depth to LGI in feet below TOCE	LGI Elevation in feet[2]	LNAPL Thickness in feet[3]
MW-8	12/17/13	114.60	18.76	0.86
	04/02/14	104.51	28.85	0.39[4]
	05/23/14	104.97	28.39	0.38[4]
	07/01/14	105.18	28.18	0.23
	10/13/14	107.06	26.30	0.28
	04/07/15	104.81	28.55	0.27
	10/28/15	108.61	24.75	0.90
MW-13	12/17/13	118.60	15.01	4.90
	04/02/14	114.10	19.51	1.35[4]
	05/23/14	114.44	19.17	2.08[4]
	07/01/14	113.39	20.22	0.84
	10/13/14	117.22	16.39	3.39
	04/07/15	113.28	20.33	1.00
	10/28/15	117.20	16.41	4.15
MW-14	12/17/13	111.03	22.55	0.10
	04/02/14	114.37	19.21	0.08
	05/23/14	113.53	20.05	0.09
	07/01/14	113.84	19.74	0.46
	10/13/14	115.29	18.29	0.71
	04/07/15	114.34	19.24	0.23
	10/28/15	116.59	16.99	1.48
MW-16	12/17/13	111.03	22.24	2.83
	04/02/14	105.30	27.97	3.02[4]
	05/23/14	108.50	24.77	4.25[4]
	07/01/14	108.90	24.37	3.79
	10/13/14	111.07	22.20	3.25
	04/07/15	106.57	26.70	2.64
	10/28/15	110.58	22.69	2.18
EW-17	10/28/15	115.01	18.67	0.45

LGI LNAPL/groundwater interface
LNAPL light non-aqueous-phase liquid
TOCE top-of-casing elevation

Notes

1) For LNAPL thickness measurements prior to December 2013, refer to the Remedial Investigation report (Aspect, 2014a).
2) Elevations are based on NAVD88 vertical datum. Refer to Table 2 for top-of-casing elevations.
3) The viscous, sticky nature of the LNAPL results in inconsistent readings of the interface probe (used to measure depth-to-LNAPL and depth-to-LGI). Therefore, the reported LNAPL thicknesses can only be regarded as estimates.
4) LNAPL was bailed from the well after LNAPL thickness was measured. Refer to the LNAPL Removal Work Plan (Aspect, 2015c) for additional information.

APPENDIX D

Health and Safety Plan

PROJECT-SPECIFIC HEALTH AND SAFETY PLAN

Property Name	Crownhill Elementary School		
Project Number	100094		
Prepared by	Delia Massey	Date	December 16, 2014
Reviewed by	Bob Hanford	Date	

INTRODUCTION

This project-specific health and safety plan establishes procedures and practices to protect employees of Aspect Consulting, LLC (Aspect) from potential hazards posed by field activities at the subject site. In this health and safety plan, measures are provided to minimize potential exposure, accidents, and physical injuries that may occur during daily activities and adverse conditions. Contingency arrangements are also provided for emergency situations.

EMERGENCY CONTACT INFORMATION

PROPERTY LOCATION	Crownhill Elementary School 1500 Rocky Point Road Bremerton, WA
NEAREST HOSPITAL	Harrison Memorial Hospital 2520 Cherry Ave Bremerton, WA 98310 (360) 377-3911 **Figure 1 shows the route to hospital.**
EMERGENCY RESPONDERS	Police, Ambulance, Fire.....911
OTHER CONTACTS	Dave Heffner, Aspect Consulting (cell)……(206) 949-1564 Aspect Consulting, Seattle Office……..(206) 328-7443 Ron Carpenter, Bremerton School District (cell)….(425) 257-8967
IN EVENT OF EMERGENCY, CALL FOR HELP AS SOON AS POSSIBLE	Give the following information: ✓ **Where You Are**. Address, cross streets, or landmarks ✓ **Phone Number** you are calling from ✓ **What Happened** Type of accident, injury ✓ **How many persons** need help ✓ **What is being done** for the victim(s) ✓ **You hang up last** Let whomever you called hang up first

In case of serious injuries or other emergency, the Aspect Consulting Corporate Safety Officer must be notified immediately (Bob Hanford; 206-780-7729 or 206-276-9256). If no response, call Dave Heffner at 206-328-7443 or Tim Flynn at 206-780-9370.

PERSONNEL ORGANIZATION AND CHAIN OF COMMAND

The Aspect Project Manager assigns the Site Safety Supervisor and other field personnel for this project, and has ultimate responsibility for developing this project-specific health and safety plan and ensuring it is complied with during project execution. The Aspect Site Safety Supervisor has responsibility and authority for Aspect employees' safety during site activities. Other Aspect personnel on site have responsibility to comply with this project-specific health and safety plan in coordination with the Site Safety Supervisor.

Aspect Consulting Personnel			
Role	**Name**	**Office Telephone**	**Mobile (Cell) Phone**
Aspect Project Manager:	Dave Heffner	206-838-5831	206-949-1564
Aspect Site Safety Supervisor:	Bob Hanford	206-780-7729	206 276-9256
Other Aspect Field Personnel:	Amy Tice	206-838-6585	206-334-7690
	Jared Bean	206-838-5851	206-641-4887
	Aaron Pruitt	206-838-6587	206-595-6615

Aspect will inform its subcontractors working on site of potential fire, explosion, health, safety or other hazards associated with planned site activities, and can make available to them this project-specific health and safety plan. However, **all subcontractors are solely responsible for preparation of their own health and safety plan, and for the safety of their employees.**

Aspect Consulting Training and Medical Monitoring

Aspect employees who perform site work are responsible for understanding potential health and safety hazards of the site. All Aspect site workers will have health and safety training for hazardous waste operations, in accordance with WAC 296-843-200. In addition, Aspect Consulting requires medical monitoring for all employees potentially exposed to chemical hazards in concentrations in excess of the PEL for more than 30 days per year, as required under WAC 296-843-210. Employees who use respirators for their work will have a respirator medical evaluation as required under Chapter 296-842 WAC. Documentation of this training and medical monitoring is kept on file at Aspect's office. All subcontractors are solely responsible for providing appropriate safety training to their employees.

SITE CONTROL PLAN

Property Description

Property name:	Crownhill Elementary School		
Property location or address:	1500 Rocky Point Road Bremerton, Washington 98312		
Owners/tenants:	Bremerton School District		
Current property use:	Elementary School (K-5).		
Past use of property (if different):	Quarry, landfill, maintenance facility.		
Designated hazardous waste site?	Yes	(federal, state, other):	State
Industrial facility?	No		
Topography:	Relatively flat.		
Surrounding land use/nearest population:	Primarily residential with a church to the south.		
Drinking water/sanitary facilities:	On site.		
Site Map:	Available in Sampling and Analysis Plan.		

Site Access Control

Describe controls to be used to prevent entry by unauthorized persons:

The property is open to the public but check-in is required to be on school property.

Describe how exclusion zones and contamination reduction zones will be designated:

The area immediately adjacent to each monitoring well location will be considered an exclusion zone. Aspect Consulting field personnel will remain vigilant about preventing unauthorized persons from approaching the exclusion zone.

Worker Hygiene Practices

Aspect Consulting personnel will employ the following hygiene practices while working on site:

- No person will eat, drink, or chew gum or tobacco in potentially contaminated areas. Drinking of replacement fluids for heat stress control will be permitted only in areas that are free from contamination, except in emergency situations.
- Smoking is prohibited on School property.
- Long hair will be secured away from the face so that it does not interfere with any activities.
- All personnel leaving potentially contaminated areas will wash their hands and face prior to entering any eating areas.
- Personnel leaving potentially contaminated areas will shower (including washing hair) and change to clean clothing as soon as practical after leaving the property.

Emergency Communications

Aspect workers on site will have a mobile (cell) phone on site, which will be used for communications should an emergency arise. Phone numbers for Aspect site personnel are listed under Project Personnel Organization.

Nearest Medical Assistance

The route from the site to the nearest hospital is attached as Figure 1.

WORK PLAN

Proposed work activities on site:	Groundwater sampling using submersible pumps.	
Objectives of site activities:	Characterize nature and extent of potential site contamination.	
Proposed work dates:	Beginning Spring 2015	
Will on-site personnel potentially be exposed to hazardous substances?		yes
If yes, describe:	The property historically included a landfill. Based on review of existing chemical data, potential chemical hazards include: • Petroleum hydrocarbons including PAHs and aromatic volatile organic compounds • Metals	
Do personnel conducting site activities have training in accordance with WAC 296-843-200?		yes

Decontamination

To prevent the cross-contamination of samples, the following procedures will be used to decontaminate sampling equipment:

Decontamination process involving alconox wash, tap water rinse, and deionized water rinse (w/ air dry). Dedicated tubing used for groundwater sampling will be disposed of or retained (bagged) for future use, but not decontaminated.

To minimize or prevent worker exposure to hazardous substances, all personnel working in the exclusion zone and contamination reduction zones will comply with the following decontamination procedures:

Dispose of disposable PPE (gloves, Tyvek) into DOT-approved 55-gallon drum, labeled appropriately. To prevent the distribution of contaminants outside the exclusion zone, unnecessary vehicles will not be allowed inside the exclusion zone.

Monitoring well purge water and decontamination wastewater will be managed in the following manner:

- Decontamination wastewater and purge water from purging will be combined in DOT-approved 55-gallon drums (appropriately labeled).
- Drums containing water will be stored on site in a secure location pending waste profiling and disposal.

HAZARD ANALYSIS

The potential hazards and corresponding control measures for planned site work activities are as follows:

Work Activity	Primary Potential Hazards	Control Measures
Groundwater sampling	• Chemical exposure (skin or eye contact, ingestion).	• Modified Level D PPE. • Ensure pump tubing etc. is joined securely.
All	• Getting hit by other trucks working on property.	• Wear traffic vest. Stay back from roads. Stay alert.
	• Heat stress.	• Take breaks, seek shade, increase fluid intake.

Potentially hazardous chemicals known or suspected at the property, and permissible exposure limits (air):

Substance	Medium	OSHA PEL	OSHA STEL	IDLH	Carcinogen or Other Hazard
Diesel- and Oil-Range Petroleum	Soil, GW	1 ppmv	5 ppmv	500 ppmv	T
PCBs	Soil, GW	--	150 ppmv	900 ppmv	C
cPAHs	Soil, GW	0.2 mg/m^3	--	--	C
Heavy metals (lead, arsenic)	Soil, GW	As: 0.01 mg/m^3 Pb: 0.05 mg/m^3	As: -- Pb: --	As: 5 mg/m^3 Pb: 100 mg/m^3	Arsenic: C

Notes:

-- - none established
C - carcinogen
cPAH - carcinogenic polycyclic aromatic hydrocarbon
GW - groundwater
IDLH - immediately dangerous to life or health
N/A - not applicable/not available
T - toxic
PCB - polychlorinated biphenyl
PEL - permissible exposure level (8-hr time-weighted average)
STEL - short-term exposure level

Characteristics of chemicals known or suspected on site:	Known	Possible	Unlikely
Corrosive			X
Ignitable		X	
Reactive			X
Volatile		X	
Radioactive			X
Explosive			X
Biological agent			X
Particulate or fibers			X
If known or likely, describe:			

Could the following conditions be expected. If so, specify.

- o Corrosive? No. If yes, specify:
- o Ignitable? Yes____ No_X___

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Based on the hazards identified above, the following personal protective equipment will be required for the following field activities. Specify both an initial level of protection and a more protective (contingency) level of protection in the event conditions should change (e.g., based on air monitoring results). The contingency defines the PPE that will be available on site.

Work Activity	Level of Protection	
	Initial	Contingency
GW sampling	D	Mod. D or C
Sample handling	D	Mod. D or C
Other activities (list)		

Each level of protection will incorporate the following equipment (specify type of coveralls, boots, gloves, respiratory cartridges or other protection, safety glasses, hardhat, and hearing protection):

Level D:	Work clothing, traffic vest, rubber (nitrile) gloves, steel toe and shank boots, safety glasses, hearing protection, hard hat, PID, decon equipment, first aid kit
Modified D:	Level D plus Tyvek coveralls or rain gear, and neoprene outer gloves
Level C:	Level D plus air-purifying respirator with combination organic vapor/HEPA dust cartridges

NOTE: Project personnel are not permitted to deviate from the specified levels of protection without the prior approval of the Site Safety Supervisor. A traffic vest is not needed if work clothes worn are suitably visible (e.g., orange or yellow rain gear).

Safety Equipment

The following safety equipment will be on site during the proposed field activities:

Other Required Items (Check the items required for this project)

First Aid Kit	X	Wind sock	
Eyewash (e.g., bottle water)	X	Brush fan	
Drinking water	X	Other	
Fire extinguisher			

SPILL CONTAINMENT

Will the proposed field work include the handling of bulk chemicals?	Yes	No X
If yes, describe spill containment provisions for the property:		

CONFINED SPACE ENTRY

Will the proposed field work include confined space entry?	Yes	No X
If yes, attach to this plan the confined space entry checklist and permit.		

DISCLAIMER

Aspect Consulting, LLC does not guarantee the health or safety of any person entering these property. Because of the potentially hazardous nature of this property and the activity occurring thereon, it is not possible to discover, evaluate, and provide protection for all possible hazards that may be encountered. Strict adherence to the health and safety guidelines set forth herein will reduce, but not eliminate, the potential for injury and illness at this property. The health and safety guidelines in this plan were prepared specifically for this site and should not be used on any other property without prior evaluation by trained health and safety personnel.

FIELD SAFETY PLAN CONSENT AGREEMENT

Aspect Consulting Employees

I have reviewed the project-specific health and safety plan, dated December 16, 2014, for the Crownhill Elementary School fieldwork. I understand the purpose of the plan and I consent to adhere to its procedures and guidelines while conducting activities on site that are described in the plan.

Employee signature_____Date_____

Employee signature_____Date _____

Employee signature_____Date _____

Employee signature_____Date_____

Site Visitors

I have been briefed on the contents of the project-specific health and safety plan. I am responsible for my own health and safety.

Visitor signature_____Organization_____Date_____

Visitor signature_____Organization_____Date_____

Visitor signature_____Organization_____Date_____

FIELD SAFETY MEETING MINUTES

Site Name _____ Project No. _____

Meeting Location _____

Meeting Date _____ Time _____ Conducted by _____

Pre-field Work Orientation ___ Weekly Safety Meeting ___ Other _____

Subjects Discussed _____

_____

_____

_____

Site Safety Supervisor Comments _____

_____

_____

_____

Name and Signature of Participating Personnel (list company name if subcontractor)

_____

_____

_____

_____

_____

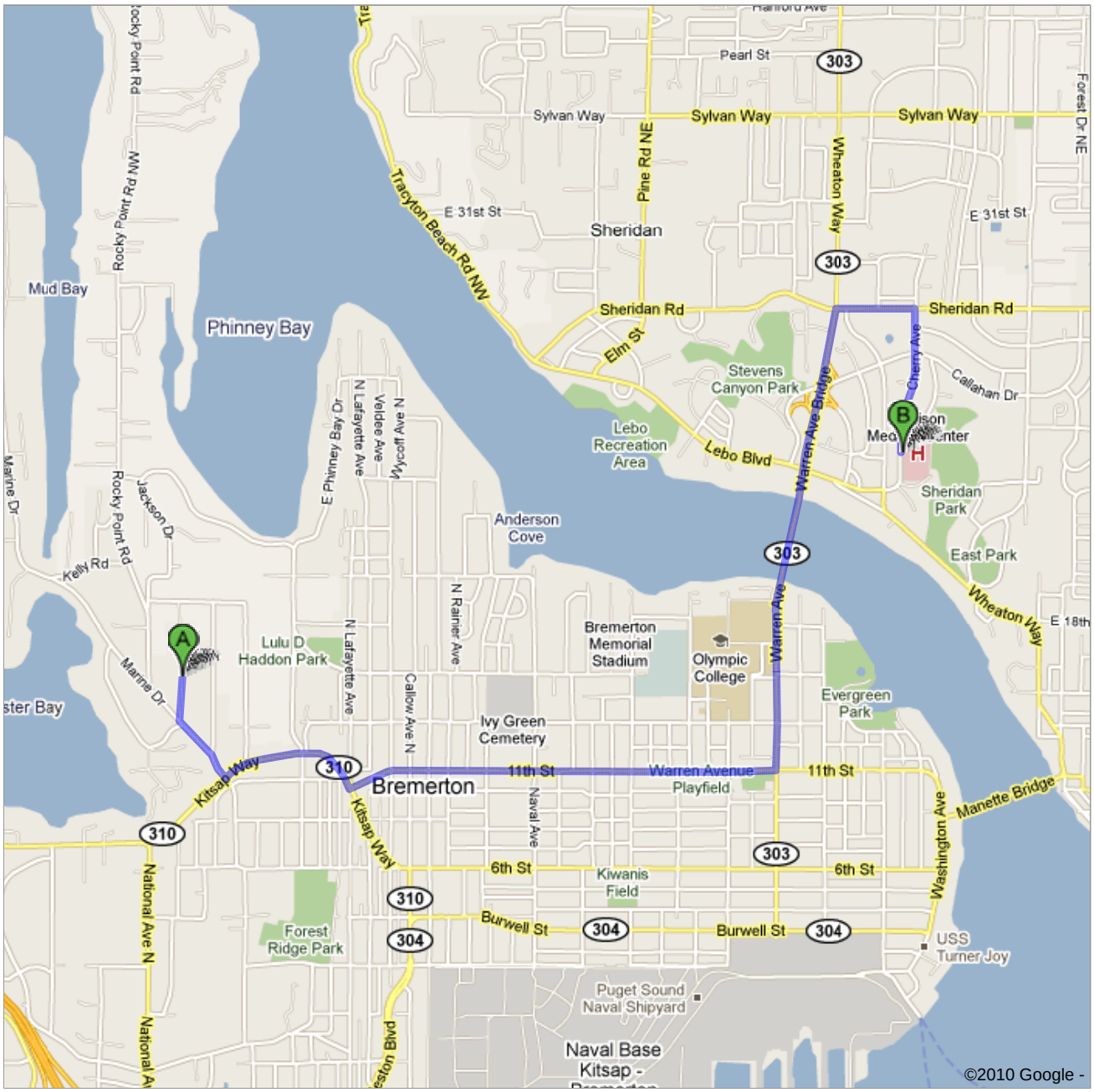
_____

_____

_____

Google maps

Directions to Harrison Medical Center-Emrgncy Rm
2520 Cherry Avenue, Bremerton, WA 98310-4229
- (360) 744-6710
3.6 mi – about **11 mins**



Bremerton School District 100-C: Crownhill Elementary
1500 Rocky Point Rd NW, Bremerton, WA 98312-2613 - (360) 473-4200

1.	Head **south** on **Dora Ave** toward **Marine Dr**	go 0.1 mi total 0.1 mi
2.	Slight left at **Marine Dr** About 1 min	go 0.2 mi total 0.3 mi
3.	Take the 2nd left onto **Kitsap Way** About 2 mins	go 0.4 mi total 0.7 mi
4.	Turn left at **11th Ave** About 3 mins	go 1.1 mi total 1.8 mi
5.	Turn left at **Warren Ave** About 2 mins	go 0.7 mi total 2.5 mi
6.	Continue onto **Warren Ave Bridge**	go 0.5 mi total 3.0 mi
7.	Turn right at **Sheridan Rd**	go 0.2 mi total 3.2 mi
8.	Take the 2nd right onto **Cherry Ave** Destination will be on the left About 1 min	go 0.4 mi total 3.6 mi

Harrison Medical Center-Emrgncy Rm
2520 Cherry Avenue, Bremerton, WA 98310-4229 - (360) 744-6710