REMEDIAL INVESTIGATION / FEASIBILITY STUDY
WORK PLAN
BOTHELL SERVICE CENTER SITE
BOTHELL, WASHINGTON

HWA Project No. 2007-098-2022

Prepared for
City of Bothell

January 19, 2015

HWA GEOSCIENCES INC.

• *Geotechnical Engineering*
• *Hydrogeology*
• *Geoenvironmental Services*
• *Inspection & Testing*

TABLE OF CONTENTS

List of Tables

List of Figures

Appendices

REMEDIAL INVESTIGATION / FEASIBILITY STUDY
WORK PLAN
BOTHELL SERVICE CENTER
BOTHELL, WASHINGTON

1.0 INTRODUCTION

This remedial investigation / feasibility study (RI/FS) work plan describes the collection of data and information necessary to further define the extent of contamination to characterize the Bothell Service Center site (Site) in Bothell, Washington (the City) located at 18107 Bothell Way NE. Previous investigations have shown halogenated volatile organic compounds (HVOC) releases at the Site to be a source of soil and ground water contamination that has migrated downgradient into public right-of ways and City owned properties. This site is listed in the Department of Ecology's database variously as Bothell Service Center and Simon & Son Fine Drycleaning, facility number 33215922 for dry cleaning solvent contamination in soil and ground water.

The Site is owned by Bothell Service Center Associates (BSCA) and is managed by NLO Property Management. The City has initiated the process of enrolling the Site into the Washington Department of Ecology's Voluntary Cleanup Program, and is considering the subsequent negotiation of a Consent Decree with the Department of Ecology to remediate the Site, and ultimately, market the property for redevelopment.

Figure 1 is a vicinity map; Figure 2 shows the Bothell Service Center property and other nearby properties in the Bothell Crossroads area relevant to this work plan. Figure 3 shows the known HVOC occurrences in ground water and approximate extent of the Bothell Service Center RI study area as defined by the extent of tetrachloroethene (PCE) concentrations greater than Washington's Model Toxics Control Act (MTCA) Method A ground water cleanup level.

1.2 OBJECTIVE

The objective of this RI/FS work plan is to meet the requirements of the MTCA Cleanup Regulation (Washington Administrative Code (WAC) 173-340). This RI work plan is designed to collect additional data on HVOC impacts, and ultimately characterize Site conditions in order to complete a FS and select a cleanup action as described in WAC 173-340-360 through 173-340-390.

1.3 WORK PLAN ORGANIZATION

This Work Plan is prepared using the U.S. Environmental Protection Agency's (EPA's) *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (OSWER Directive 9355.3-01) (EPA, 1988) as a reference for work plan organization and content. The scope of work described in the work plan is designed to gather information required for a RI study as described in WAC 173-340-350. The organization of the Work Plan is presented below:

- Section 1: Introduction – background, objective, work plan organization, and regulatory framework

- Section 2: Site Background and Physical Setting – description and history of operations and environmental setting
- Section 3: Initial Evaluation – summary of previous investigations, known and expected contaminants, and the conceptual site model
- Section 4: Work Plan Rationale – data quality objective needs and general approach
- Section 5: Remedial Investigation Tasks – project planning, sample collection and analysis, data validation and evaluation, and assessment of risks
- Section 6: Project Management – schedule and project management staff

1.4 REGULATORY FRAMEWORK

The HVOC plume originating from the former Simon & Son Fine Drycleaning facility is known to lie on the Bothell Service Center property and adjacent and downgradient properties, including (from up- to down-gradient):

- The vacated portion of State Route 522 located immediately south of the Bothell Service Center property
- The adjoining former Al's Auto Bothell Wexler Property to the east, now owned by the City
- The former location of the Bothell Hertz Rental Facility south of the vacated portion of SR522, now vacant, undeveloped, and also owned by the City.

Figures 2 and 3 show these features and properties, as well as the general RI area. The RI will be conducted as required by MTCA Cleanup Regulation WAC 173-340. In Washington State, the administrative process and standards for investigating and cleaning up facilities impacted by hazardous substances are promulgated under MTCA (WAC 173- 340; Ecology, 2007). Under MTCA (WAC 173-340-350) site cleanup is typically preceded by a complete remedial investigation (RI) and a feasibility study (FS). The RI/FS focuses on collecting, developing, and evaluating enough information to select a cleanup action under WAC 173-340-360 through 390.

2.0 SITE BACKGROUND AND PHYSICAL SETTING

2.1 SITE BACKGROUND

The Bothell Service Center property is located at 18107 Bothell Way NE, Bothell, Washington. The Site consists of an approximately 0.6-acre parcel on the northeast comer of the intersection of 98th Avenue Northeast and the vacated portion of State Route 522 (Figures 1 and 2). Previous site use included farming until 1962, an auto dealership in the 1960s and 70s. In 1988 it was developed commercially as a small one-story retail strip mall building situated diagonally west to east across the northern portion of the Site, with the former dry cleaning operation Simon & Son Fine Drycleaning located at the west end of the building. The southern and northwestern portions of the Site are covered by asphalt-paved parking areas, with narrow landscaped areas adjacent to the western and eastern sides of the building and along the southern and northern boundaries of the Site. The strip mall building has facilities for up to five tenants.

From approximately 1989 to 1999, Simon & Son Fine Drycleaning operated in the westernmost suite of the strip mall building. A release(s) of the chlorinated dry cleaning solvent PCE occurred during this period, presumably in the vicinity of the dry cleaning machine and possibly to the landscaped area outside the west wall of the building where a remediation compound containing vapor extraction equipment is now located. The suite was vacant from 2000 through 2001. The Dive Shop, a scuba diving outfitter, occupied the suite for several months during 2002. A Quiznos restaurant operated from the suite for a while. The suite currently is leased by the retail operation Dawn's Candy & Cake Supply; other businesses currently operating in the strip mall building include Happy Lake #1 Teriyaki Wok, Papa John's Pizza, Mad Cow Yarn, and Abilities unlimited NW.

Current adjacent land uses in the vicinity of the Bothell Service Center include:

- A single-family residence to the north
- 98th Avenue Northeast, and beyond a single family residence and a vacant small two-story office building to the west
- The vacated portion of SR522 south of the Site
- South of the vacated portion of SR522 is vacant land (the Bothell Former Hertz Facility)
- A vacant lot to the east, formerly an Al’s Auto, Schucks, and O’Reilly auto parts store, which is also an Ecology listed site called Al’s Auto Bothell Wexler Property.

The Bothell Service Center building included a dry cleaning facility (Simon & Son Fine Drycleaning) from 1989 to 1999. The former Simon & Son Fine Drycleaning operation included one dry cleaning machine located in the northwestern portion of the westernmost suite of the strip mall building. The sanitary sewer line connected to the restroom area, which was located in the northeast portion of the suite. Field notes prepared by ERM (2001) indicate that one floor sump was located approximately 8 feet east of the former dry cleaning machine. Building blueprints provided by BSCA do not indicate the locations of additional floor sumps or drains within the suite (Farallon, 2008a). The dumpster area is located on the north side of the Site, on the pavement east of the three parking stalls (Farallon, 2011).

A release of chlorinated solvents to ground water was detected by ERM in 1999 and 2000 (ERM, 2001). Three soil borings were initially completed through the floor of the building near dry cleaning equipment. Subsequently, additional borings for soil and ground water sampling were completed in the building after removal of the dry cleaning equipment. Three monitoring wells and several soil borings were completed outside of the building in 2001. ERM's measurement of ground water elevations in several on site monitoring wells indicated a ground water gradient to the east and east-southeast. The chlorinated solvents PCE, trichloroethene (TCE), and dichloroethene (DCE) were detected in site soil and ground water, including the easternmost monitoring well (MW-5), less than 20 feet from the property boundary with the adjoining Al's Auto Bothell Wexler Property. PCE ground water concentrations ranging from 1,300 to 2,650 micrograms per liter (µg/L) were detected in monitoring well MW-5 from July 2001 to February 2002. PCE concentrations as high as 30,000 µg/L (approximately 15% of saturation) were detected in other wells (Farallon, 2011).

The off-property extent of this plume is generally delineated, and includes detections of HVOCs including PCE, TCE, DCE and vinyl chloride, on the Al's Auto Bothell Wexler Property to the east and Bothell Former Hertz Facility south of the Site.

Remediation via in situ chemical oxidation using potassium permanganate was attempted in 2001 (ERM, 2002). PCE concentrations initially decreased in monitoring wells adjacent to and downgradient of injection points. However, ground water concentrations increased in three monitoring wells. ERM attributed the increase to seasonal variations in ground water levels mobilizing PCE from source areas, such as contaminated soils or dense non-aqueous phase liquids (DNAPL) and recommended further injection events and ground water monitoring. Anecdotal reports by City staff describe permanganate discharging to the Sammamish River with a resultant fish kill during this event.

A soil vapor extraction (SVE) system has been in operation at the site since September 2004 (Farallon, 2008a). Periodic operations and maintenance monitoring at the SVE system indicated that vapor concentrations decreased significantly between system startup and 2007. Recent vapor monitoring at the system did not detect solvent vapors. Farallon also completed a hydrogen peroxide injection event in May 2005. The injection resulted in the temporary increase in PCE concentrations in ground water at the site; however, subsequent ground water monitoring in 2006 and 2007 indicated that PCE concentrations had decreased to pre-injection levels. Chemical oxidation cells (sodium persulfate) were installed in site monitoring wells in 2006 and 2007 for additional remedial activity. This method was found to have limited effectiveness due to the high ground water velocity, as well as limited access to the release source area (Farallon, 20110.

Farallon also implemented an additional remedial action at the site including slug tests and additional monitoring wells. Enhanced bioremediation though a combination of nutrient (emulsified vegetable oil) and bacterial injection was initiated in February 2008. Farallon reported ground water flow direction to the east and east-southeast at the site.

As of October 2014, PCE and TCE concentrations remained in the thousand to low tens of thousands of µg/L throughout the site; however, concentrations were lower than in previous years because of the remedial efforts implemented in 2004, 2005, 2006, 2007, 2008, and 2010 (Farallon, 2011; DOF, 2014).

2.2 PHYSICAL SETTING

The RI study area is within the Horse Creek valley; Horse Creek is a southerly flowing tributary to the Sammamish River. The general topography of the RI study area slopes down from north to south towards the westerly flowing Sammamish River (Figure 1). Elevations in the RI study area range between about 30 to 60 feet above mean sea level.

Locations of underground utilities at the Site are illustrated on Figure 2. Subsurface utilities in the vicinity of the Bothell Service Center building include sanitary sewer and natural gas lines, which run parallel to the inside and outside of the north wall of the strip mall building, respectively. A northwest-southeast-trending storm drain runs beneath the central portion of the strip mall building and parking lot, where it intersects a storm drain running parallel to the north side of the vacated portion of SR522 adjacent to the southern Site boundary. The City of Bothell utility map indicates that the storm drain main in the vacated portion of SR522 intersects the Horse Creek culvert approximately 250 feet east of the Site. A water main also runs parallel to the north side of the vacated portion of SR522, adjacent to the southern Site boundary (Farallon, 2011).

Geology - The Site is located within the Puget Sound Lowland, a north-south trending structural and topographic depression bordered on the west by the Olympic Mountains and on the east by the Cascade Mountains. The area is characterized by gently rolling glacial drift plains covered with small ridges, hills, and depressions formed by the continental ice sheet that covered the area during the Pleistocene Epoch and retreated approximately 12,500 years ago. Most of northwestern King County is mantled by glacial deposits (including gravel, sand, silt, clay, boulders), which are commonly over 150 feet thick (Liesch and others, 1963).

The vacated portion of SR522 immediately south of the Site is located at the mapped contact between alluvial soils associated with the Sammamish River to the south, and glacial soils to the north (HWA, 2012).

Past subsurface assessment work at the Bothell Service Center identified sand and gravel fill with minor silt to a depth of four to ten feet below ground surface (bgs), with native soil consisting of silt and fine sand below the fill. Although these silts and sands are texturally similar to alluvial soils found on the Bothell Former Hertz Facility to the south, the higher densities suggest these are glacially consolidated deposits (HWA, 2012). Figures 5 and 6 present geologic cross sections across SR522 between the Bothell Service Center and the Bothell Former Hertz Facility; lines of cross sections are shown on Figure 4. Farallon Consulting's interpretation of the Bothell Service Center's geology (Farallon, 2011) is presented as the cross section shown on Figure 7 with Figure 2 illustrating the trend of the cross section. Notable in the HWA and Farallon geologic cross sections is the discontinuous nature of several stratigraphic horizons across the Site.

Hydrogeology - Shallow ground water is encountered at the Site between 5 to 10 feet bgs, with the interpreted ground water flow direction east and east-southeasterly to the Sammamish River (Figure 8). The results of aquifer testing performed by ERM (2001) at monitoring well MW-1indicated a hydraulic conductivity of approximately 3.5×10^{-3} centimeters per second (approximately 10 feet per day), a value typical of silty and fine sands. Under a typical gradient of 0.025 foot per foot and an estimated porosity of 30 percent, the ground water velocity at the Site is estimated to be approximately 0.8 feet per day. Higher ground water velocities were measured in tracer tests, described below in Section 3.1.

3.0 INITIAL EVALUATION

3.1 SUMMARY OF PREVIOUS HVOC INVESTIGATIONS

This section is largely adapted from Farallon Consulting's 2011 letter report to the Washington Department of Ecology (Farallon, 2011). Tables 1 and 2 respectively list soil and ground water analytical data collected to date by the several environmental consulting firms that have worked at the Site and in the vicinity. Figure 2 shows Site features including buried utility locations. Figures 2 and 4 depict soil boring and monitoring well locations.

ERM conducted subsurface soil and ground water investigation activities at the Site between December 1999 and July 2001, which are summarized in ERM (2001). Hand-auger borings HA-l, HA-2, and HA-3 were advanced in December 1999 to assess soil conditions in the vicinity of the former dry cleaning equipment in the Bothell Service Center building. PCE was detected at concentrations exceeding the current MTCA Method A soil cleanup level of 0.05 milligrams per kilogram (mg/kg) in soil samples collected from depths of 1 foot to 2 feet bgs in each of the boring locations, confirming that a release of PCE had occurred at the Site.

In June and July 2000, ERM conducted subsurface investigations that involved collection of soil and ground water samples from direct-push borings B-4 through B-11 and GP-1 through GP-3. The work in June 2000 entailed chemical analyses of soil samples collected from depths up to 4.2 feet bgs. PCE was detected at concentrations exceeding the MTCA Method A soil cleanup level, with the highest concentration detected in a soil sample collected at a depth of 2.5 feet bgs from boring B-9 in the former dry cleaning equipment area. Work later in the summer of 2000 entailed chemical analyses of soil samples that confirmed PCE in excess of the MTCA Method A soil cleanup level at depths to 9 feet bgs approximately 20 feet southwest (soil boring GP-3) and 50 feet southeast (boring GP-2) of the former dry cleaning equipment area.

PCE and TCE were detected at concentrations exceeding current MTCA Method A ground water cleanup levels in reconnaissance ground water samples collected from borings GP-2 and GP-3. Chloroform and 1,1-dichloroethene (1,1-DCE) were detected at concentrations exceeding current MTCA Method B ground water cleanup levels in the reconnaissance sample collected from boring GP-3.

To further delineate the extent of PCE and related degradation compounds at the Site, ERM conducted supplemental investigation activities in 2001 that involved advancing and sampling additional direct-push (e.g., Geoprobe) borings SP-1 through SP-12, and monitoring wells MW-1 through MW-7. The reconnaissance ground water samples collected included both "shallow" and "deep" reconnaissance ground water samples (exact depths were not indicated in the information available), with results used to support the selection of monitoring well locations. Findings of the supplemental investigation indicated that PCE concentrations in ground water increased with depth, and PCE and its degradation compounds exceeded MTCA Method A or Method B cleanup levels. Chloroform also was detected at concentrations exceeding the MTCA Method B ground water cleanup level.

Farallon conducted a subsurface investigation at the Site in September and October 2002 that included drilling and installation of monitoring wells MW-8 and MW-9, and one ground water monitoring event. PCE was detected at concentrations exceeding MTCA Method A cleanup levels in a soil sample collected from boring MW-9, in reconnaissance ground water samples collected from boring SB-1, and in the borings for monitoring wells MW-8 and MW-9. PCE degradation compounds (i.e. TCE and DCE) were detected at concentrations exceeding MTCA cleanup levels in reconnaissance ground water samples collected from borings for monitoring wells MW-8 and MW-9. PCE was detected at concentrations exceeding the MTCA Method A ground water cleanup level in samples collected from monitoring wells MW-1 through MW-9, with the exception of well MW-3, located north of the former dry cleaning equipment area. PCE degradation compounds were detected at concentrations exceeding MTCA cleanup levels in ground water samples collected from monitoring wells MW-1, MW-4, MW-5, and MW-6. The subsurface investigation activities are documented in Farallon (2003).

Farallon performed additional subsurface investigations at the Site in September and October 2003 to address data gaps and provide information for the design of a remediation system. The additional subsurface investigations included advancing soil borings SB-2 through SB-6,·advancing boring MW-10 to a total depth of 47.5 feet bgs and completing the boring as a 25-feet-deep ground water monitoring well, advancing borings VE-l and VE-2 to total depths of 21.5 feet bgs and completing the borings as vapor extraction wells, conducting a soil vapor extraction (SVE) pilot test, and collecting soil and reconnaissance ground water samples for laboratory analyses. PCE was detected at concentrations exceeding the MTCA Method A soil cleanup level in soil samples collected from borings VE-l (17 feet bgs) and VE-2 (15 feet bgs), and the boring for monitoring well MW-10 (8 and 32 feet bgs). PCE also was detected at concentrations exceeding the MTCA Method A cleanup level in the reconnaissance ground water samples collected from borings SB-3, MW-10, VE-l, and VE-2.

Farallon conducted tracer dye injection tests at the Site in 2005 to evaluate migration pathways to facilitate planning for in-situ treatment alternatives (Farallon, 2008a). The first dye injection test was conducted in February 2005 and included introducing dye through the toilet in the former dry cleaner suite into the sanitary sewer system (sewer dye test). A second dye injection test was conducted in March 2005 and included injection of dye into monitoring well MW-2 (hydrogeologic tracer test). The results of the sewer dye test indicated that there may be leaks in the sewer line directly beneath the building that are impacting ground water, indicated by tracer detected at monitoring well MW-2. The results of the hydrogeologic tracer test indicated that the dye traveled a distance of approximately 45 to 65 feet from monitoring well MW-2 in 5 days (i.e., 9 to 13 feet per day).

In 2008 and 2012 HWA performed soil and ground water investigations south of the Bothell Service Center site and installed monitoring wells in the then SR522 right-of-way and Hertz Facility; the investigations indicated that HVOC contamination had migrated south of the Site onto those properties (HWA, 2008a, 2008b); analytical data are listed in Tables 1 and 2. HWA is currently performing quarterly ground water monitoring of wells located in the vacated portion of SR522 and Bothell Former Hertz Facility south of the Site and also in the Al's Auto / Wexler site immediately east of the Bothell Service Center, as part of the RI activities described under the Bothell Landing and Bothell Hertz Agreed Orders. Ground water samples collected by HWA in these properties have consistently had HVOC concentrations exceeding MTCA cleanup levels (Tables 1 and 2) indicating that the release at the Bothell Service Center Site has migrated downgradient off site. Figure 3 illustrates the current extent of PCE ground water contamination originating from the Site.

In the spring of 2014 Dalton, Olmsted, and Fuglevand, Inc. (DOF) performed ground water monitoring and data analyses for the Site (DOF, 2014). DOF's analytical data are included in Table 2.

In summary, the results of subsurface investigations conducted to date indicate the following:

- A release of an unknown quantity of PCE occurred at the Site between 1989 and 1999 during operation of Simon & Son Fine Drycleaning, and a residual source of PCE remains beneath the northwest comer of the Bothell Service Center building
- The PCE release(s) affected the soil above and below the water table as well as ground water at the Site
- Ground water is affected to a depth of at least 50 feet where a silty stratum occurs in the source area, and at a depth of 30 to 40 feet down-gradient and across much of the Site
- The ground water plume has migrated across the Site via east and east-southeasterly flowing ground water across city rights of way, and as far as the City-owned Al's Auto Bothell Wexler Property and Bothell Former Hertz Facility parcel

3.2 SUMMARY OF REMEDIAL ACTIONS

After a technology feasibility evaluation process, ERM conducted two remedial action events consisting of application of in-situ chemical oxidation at the Site in 2001 and 2002 to address concentrations of PCE in soil and ground water. During the first event in 2001, potassium permanganate solution was applied directly to soil exposed by the removal of a section of the floor in the vicinity of the former dry cleaning equipment in the Bothell Service Center building. Also in 2001, ERM applied potassium permanganate directly into the water-bearing zone at depths ranging from 10 to 20 feet bgs at eleven locations outside the south side of the building using a direct-push drill rig. Approximately 100 to 250 gallons of a 2.5 percent potassium permanganate solution was injected into each boring, with a total injection volume of 1,800 gallons of solution. Ground water monitoring indicated that HVOC concentrations were reduced in some areas 17 days after injection; however, concentrations rebounded after approximately four months. Unoxidized potassium permanganate was observed in the Sammamish River shortly after this injection event, indicating the presence of a preferential migration pathway into the Site's storm drain system which ultimately discharges to the river.

Based on results from the subsurface investigations, the ERM remedial action, and a soil vapor extraction (SVE) pilot test, Farallon implemented an additional remedial action approach incorporating several elements, including a SVE system to remove soil vapors containing concentrations of PCE in the subsurface, injection of a chemical oxidant into ground water in three monitoring wells at the Site to reduce residual HVOC concentrations in ground water, and long-term monitoring of the natural attenuation of HVOCs in ground water.

In September 2004, Farallon installed a SVE system at the Site consisting of a remediation compound on the west end of the Bothell Service Center building housing above-ground piping, a blower, electrical controls, and a vent stack; and trenching and installation of underground piping connecting the vacuum blower to vertical SVE wells VE-l and VE-2 and horizontal SVE well HVE-1 (Figure 2). The system is presumably still in operation. The SVE system has effectively removed PCE mass from the vadose zone and appears to be controlling vapor intrusion into the building at the Site.

In May 2005, Farallon conducted additional cleanup activities at the Site using in-situ chemical oxidation via hydrogen peroxide injection into monitoring wells MW-2 and MW-9. Because hydrogen peroxide degrades much more rapidly than the permanganate used by ERM in 2001 and 2002, it would not affect down-gradient surface water receptors if transported through preferential pathways. The injection included a total of 300 gallons of a solution consisting of 10 percent hydrogen peroxide and 90 percent water. Approximately 200 gallons of the solution was injected into monitoring well MW-2.

Selected monitoring wells at the Site were sampled in August 2005 to evaluate post-chemical oxidation injection concentrations of PCE in ground water. Concentrations of PCE in ground water had increased at the monitoring wells where hydrogen peroxide was injected (MW-2 and MW-9), and at monitoring wells MW-1 and MW-6, located downgradient of the injection wells. Injection of hydrogen peroxide likely immediately consumed PCE mass in the well boring and in soil surrounding the injection well for several feet prior to breakdown of the hydrogen peroxide. In addition to consuming PCE mass, the hydrogen peroxide oxidized native organic material in this zone. The increased PCE concentrations are attributable to release of DNAPL that previously was sorbed to the native organic material, and increased dissolution of the DNAPL to ground water.

PCE as DNAPL was initially discovered at the bottom of monitoring well MW-9 in late August 2005. Between June 2006 and June 2007, DNAPL was periodically removed from monitoring well MW-9 using a peristaltic pump and dedicated polyethylene tubing. Approximately 450 milliliters of DNAPL was recovered during September 2005. An additional 40 milliliters of DNAPL was removed in February 2006, approximately 500 milliliters each in September 2006 and May 2007, and approximately 200 milliliters in June 2007, for a total of approximately 1,690 milliliters (approximately 0.5 gallon) of DNAPL removed from monitoring well MW-9.

Farallon conducted additional cleanup action via in-situ chemical oxidation between September 2006 and May 2007 at the Site by installing chemical oxidation cells in selected monitoring wells. The chemical oxidation cells were constructed of l-inch-diameter slotted polyvinyl chloride with two end caps glued in place. Each cell consisted of two portions: a lower portion approximately 6 inches in length and filled with chelated iron; and an upper portion approximately 12 inches in length and filled with sodium persulfate. Chelated iron acts as a catalyst to activate the chemical oxidation process by sodium persulfate. The chemical oxidation cells were suspended in monitoring wells MW-1 and MW-4 through MW-9 using polyethylene cord and fully submerged in ground water.

In 2007, Farallon evaluated the progress of the chemical oxidation cells and reconsidered the range of remedial technologies assessed in November 2002. The feasibility assessment concluded that Site conditions appeared to be amenable to enhanced in-situ bioremediation and that a bioremediation approach had potential to be more effective in a shorter restoration time frame than chemical oxidation. Farallon implemented a pilot-scale in-situ enhanced bioremediation approach that entailed the following:

- Installation of six new injection wells in November 2007 for introducing a bioremediation edible oil substrate (EOS, an emulsified vegetable oil product produced by EOS Remediation, LLC) into the subsurface at monitoring wells MW-13, MW-16, and MW17, screened in the deep portion of the water-bearing zone; and monitoring wells MW-14, MW-15, and MW-18, screened in the intermediate portion.
- Injection of approximately 1,700 gallons of a 20-percent mixture of substrate and water to enhance biodegradation of PCE in the water-bearing zone at the six injection wells and eight temporary borings in February 2008 and again in March 2010.
- Bioaugmentation to supplement the existing population of *Dehalococcoides* bacteria that are responsible for the dechlorination of PCE and its degradation byproducts in ground water in July 2008.
- Continued operation of the SVE system at the Site to address residual concentrations of PCE in soil above the water table and to mitigate the potential for vapor intrusion into the existing Site building.

Dalton, Olmsted, and Fuglevand, Inc. (DOF) performed ground water monitoring and data analyses for the Site (DOF, 2014). Following are a number of general observations based on DOF's and HWA's data review:

- Figure 9 illustrates PCE concentration trends in ground water samples collected from monitoring well MW-9D located in the source area. The figure also presents a general time line of remedial actions completed by BSCA. Past concentrations have been as high as 160,000 µg/L (80% of saturation) (January 2009). The October 2014 concentration was 3,300 µg/L.

- With the exception of samples from MW-9D, the highest PCE concentrations have historically been detected in samples from the upper portion of the underlying aquifer.

- The ambient geochemical conditions are not conducive to the natural degradation of PCE. However, the edible oil substrate (EOS) treatments completed in February 2008 and March 2010 by Farallon Consulting have been successful in creating conditions where PCE will degrade to dichloroethenes (DCE) and vinyl chloride. This finding is based on the concentration trends for wells MW-2S, MW-4S, MW-6S, MW7S, MW-12I, and MW-8D showing strong evidence of EOS degradation of the chlorinated ethenes. The evidence of degradation is particularly strong based on samples from monitoring well MW-6S located directly downgradient of the PCE source area (Figure 10). PCE concentrations in well MW-6S have been as high as 30,000 µg/L caused by downgradient migration from the source area. The significant decrease in PCE concentrations (the October 2014 PCE concentration was 73 µg/L) and the increase in cis-1,2-dichloroethene and vinyl chloride concentrations indicates substantial reductive dechlorination (degradation) is occurring.

- Reductive dechlorination of chlorinated ethenes produces vinyl chloride. As expected, vinyl chloride is being produced by the degradation of parent solvents. While vinyl chloride is more resistant to degradation than PCE, available data indicate that vinyl chloride is also degrading. Vinyl chloride degrades to ethene which has been detected in samples where relatively high concentrations of vinyl chloride have been detected (e.g. MW-2S, MW-6S).

- Source reduction remedial efforts have only been partly effective downgradient near the Site property boundary with PCE concentrations in monitoring well MW-7S falling and then rebounding following EOS treatments (Figure 11). In addition, the PCE degradation product (cis) 1,2-DCE in well MW-7S has risen over time to concentrations above the MTCA cleanup level of 16 µg/L.

3.3 KNOWN AND EXPECTED CONTAMINANTS

Based on background information and analytical data from previous studies presented in Section 3.1, the Contaminants of Concern (COCs) at the Site are:

- HVOCs (PCE, TCE, cis-1,2-DCE, and vinyl chloride)

3.4 CONCEPTUAL SITE MODEL

The conceptual site model for the HVOC plume identifies the primary contaminant sources, release mechanisms, transport mechanisms, secondary contaminant sources, potential pathways, and exposure routes. Existing chemical data, site characterization data, and identification of potential human and ecological receptors were used to develop the model.

These data were used to identify the additional data needs described in this Work Plan. The model first identifies the primary contaminant sources and then describes the release mechanism from the sources into environmental media. Then, the migration of potential contaminants through media and the subsequent release mechanisms are summarized. This results in the identification of potentially contaminated media to which receptors are most likely to be exposed (exposure media). Once the exposure media are identified, the specific human and ecological receptors are incorporated into the model, completing the exposure pathway.

Figure 12 shows the conceptual site model for the HVOC plume. Each component of the conceptual site model is described below.

The conceptual site model brings together multiple environmental and anthropogenic variables to formulate an understanding of the potential pathways of contaminant movement that may exist at the site. The model also brings together the physical descriptions of the environment, the extent of the potential contamination, the fate and transport processes, and the potential routes by which human and ecological receptors are exposed to contaminants. In general, the site model consists of sequential steps that trace potential contaminants from the primary sources to the final receptors (human and ecological).

3.4.1 Primary Contaminant Sources

The primary contaminant source at the Bothell Service Center site is the dry cleaner solvent release from the former Simon & Sons Fine Drycleaning facility. The primary contaminant associated with this release is PCE, with associated breakdown products TCE, cis-1,2-DCE, and vinyl chloride.

3.4.2 Primary Release Mechanisms

The primary potential release mechanisms for contaminants associated with the former dry cleaners include leaks from equipment, or discharges (accidental or intentional) to floor drains, storm drains, or ground.

3.4.3 Primary Transport Mechanisms

Primary transport mechanisms for HVOCs include the following:

- Contaminant leaching from soils above and below the water table
- Leaching from separate phase liquids, e.g., a dense non-aqueous phase liquid (DNAPL) mass of PCE within soil pore spaces
- Volatilization from the vadose zone and water table
- Ground water discharges to surface water

The degree of contaminant leaching is controlled by chemical properties of the contaminants, ground water chemical properties, physical properties of the soil, characteristics of the ground water flow system, and precipitation recharge. Volatilization is controlled by the concentration and chemical properties of the contaminants, physical properties of the soil, and soil gas characteristics. Ground water discharges to surface water are controlled by the physical and geochemical characteristics of both the ground water and surface water flow systems.

3.4.4 Potential Pathway and Exposure Routes

Complete exposure pathways have the following components: 1) a chemical source, 2) a transport pathway, 3) an exposure point where contact can occur, and 4) an intake mechanism. Potential exposure routes for human and ecological receptors include the following:

- *Dermal/Direct Contact*. Dermal contact with soil on site is a potential intake mechanism for current and future on-site workers, future residents, and future visitors. The site is fully developed or paved, therefore vertebrate wildlife exposure is unlikely. Plants and burrowing or ground-dwelling invertebrates (e.g., earthworms) are exposed directly to the soil.
- *Inhalation*. Suspended particulates from soil can be transported by air and inhaled by potential on-site and off-site receptors. Emissions of volatile chemicals from soil and ground water (human receptors only) may also be transported as vapors by air, but are considered to be pathways of secondary concern because, in ambient conditions, such vapors are rapidly diluted and degraded.
- *Ingestion*. Accidental ingestion of chemicals in site soil and ground water are primary intake mechanisms for human receptors. Ingestion of chemicals in site soil is a primary intake mechanism for ecological receptors. The following section describes specific exposure pathways of primary concern.

Exposure Pathways of Concern - Complete exposure pathways by which chemicals may reach potential receptors include the following:

- Current/future indoor retail worker:

– Inhalation of vapors from the subsurface (ground water and soil) in indoor air

- Current/future construction/utility worker:
  – Incidental soil ingestion and dermal contact
  – Inhalation of vapors from the subsurface soil in outdoor air
  – Inhalation of vapors from or dermal contact with ground water in a trench or excavation
- Current/future Site visitor (adult and child):
  – Inhalation of vapors from the subsurface (ground water and soil) in indoor air
- Ecological receptors:
  – Incidental soil ingestion and dermal contact
  – Inhalation of vapors from the subsurface soil in outdoor air or in a burrow
  – Inhalation of vapors from or dermal contact with ground water in a burrow

4.0 WORK PLAN RATIONALE

The following section describes the general approach to the RI. A discussion of data quality objectives, a discussion of identified data gaps, and approaches to collect the data necessary to fill those gaps is presented in this section. Each subsequent section provides an overview of data gaps by media type, and the approach to collecting the necessary information in the remedial investigation. Specific sampling locations, analytes, and methods are documented in the Sampling and Analysis Plan (SAP).

4.1 DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are qualitative and quantitative statements that specify the characteristics of the data necessary to support decisions and the required quality of the data collected (EPA, 2006). Through the development of DQOs, the objectives and methods to be used in the field investigations are defined.

The objective of this RI is to meet the requirements of the Agreed Order in accordance with the MTCA Cleanup Regulation (WAC 173-340) rules for RI/FS studies. To meet the RI objective, site data will be collected that are of known, acceptable, and documented quality. To ensure that site data meet these criteria the following Quality Assurance objectives are established for the RI:

- Implement procedures described in this work plan and the SAP for field sampling, sample custody, equipment operation and calibration, laboratory analysis, and data reporting that will facilitate consistency and thoroughness of generated data.
- Achieve the acceptable level of confidence and quality required so that data generated are scientifically valid and of known and documented quality. This will be performed by establishing criteria for precision, accuracy, representativeness, completeness, and comparability, and by testing data against these criteria.

Specific DQOs to evaluate data quality and usability are provided in the sections below.

4.1.1 Detection Limits

Analytical methods have quantitative limitations at a given statistical level of confidence that are often expressed as the method detection limit (MDL). Individual instruments often can detect but not accurately quantify compounds at concentrations lower than the MDL, referred to as the instrument detection limit (IDL). Although results reported near the MDL or IDL provide insight to site conditions, quality assurance dictates that analytical methods achieve a consistently reliable level of detection known as the practical quantitation limit (PQL). The PQL is the lowest concentration level that can be reliably achieved within the specified limits of precision and accuracy, and is typically several times the MDL.

4.1.2 Precision

Precision is the measure of mutual agreement among replicate or duplicate measurements of an analyte from the same sample and applies to field duplicate or split samples, laboratory replicate analyses, and duplicate spiked environmental samples (matrix spike duplicates). The closer the measured values are to each other, the more precise the measurement process. Precision error may affect data usefulness. Good precision is indicative of relative consistency and comparability between different samples. Precision will be expressed as the relative percent difference (RPD) for spike sample comparisons of various matrices and field duplicate comparisons for water samples. This value is the difference between two measurements divided by the average, calculated by:

RPD = ((D1-D2) / (D1+D2)/2)*100

Where:
D1 = Concentration of analyte in sample, and
D2 = Concentration of analyte in duplicate sample.

The calculation applies to split samples, replicate analyses, duplicate spiked samples (matrix or blank spike duplicates), and laboratory control duplicates. The RPD will be calculated for samples and compared to the applicable criteria. Precision can also be expressed as the percent difference (%D) between replicate analyses. Acceptable precision values (QC limits) vary according to the analyte, analytical method, and specific laboratory conditions (e.g., calibration results, etc.).

4.1.3 Accuracy

Accuracy is a measure of bias in the analytic process. The closer the measurement value is to the true value, the greater the accuracy. This measure is defined as the difference between the reported value versus the actual value and is often measured with the addition of a known compound to a sample. The amount of known compound reported in the sample, or percent recovery, assists in determining the performance of the analytical system in correctly quantifying the compounds of interest. Because most environmental data collected represent one point spatially and temporally rather than an average of values, accuracy plays a greater role than precision in assessing the results. In general, if the percent recovery is low, non-detect results may indicate that compounds of interest are not present when in fact these compounds are present. Detected compounds may be biased low or reported at a value less than actual environmental conditions. The reverse is true when recoveries are high. Non-detect values are considered accurate while detected results may be higher than the true value. Accuracy will be expressed as the percent recovery of a surrogate compound (also known as “system monitoring compound”), a blank or matrix spike result, or from a standard reference material. The recovery percent is the measured amount divided by the known amount, or:

(D1-D2) / D3 x 100

Where

D1 = amount of compound detected in spiked sample
D2 = amount of compound in sample (i.e., detected before spiking)
D3 = amount of spike compound added

Accuracy criteria for surrogate spikes, matrix spikes, and laboratory control spikes are found in the SAP.

4.1.4 Representativeness, Completeness and Comparability

Representativeness expresses the degree to which data accurately and precisely represent the actual site conditions. The determination of the representativeness of the data will be performed by completing the following:

- Comparing actual sampling procedures to those delineated within the SAP and this work plan.
- Comparing analytical results of field duplicates to determine the variations in the analytical results.
- Invalidating non-representative data or identifying data to be classified as questionable or qualitative. Only representative data will be used in subsequent data reduction, validation, and reporting activities.

Completeness establishes whether a sufficient amount of valid measurements were obtained to meet project objectives. The number of samples and results expected establishes the comparative basis for completeness. Completeness goals are 90 percent useable data for samples/analyses planned. If the completeness goal is not achieved an evaluation will be made to determine if the data are adequate to meet study objectives.

Comparability expresses the confidence with which one set of data can be compared to another. Although numeric goals do not exist for comparability, a statement on comparability will be prepared to determine overall usefulness of data sets, following the determination of both precision and accuracy.

4.1.5 Holding Times

Holding times are defined as the time between sample collection and extraction, sample collection and analysis, or sample extraction and analysis. Some analytical methods specify a holding time for analysis only. For many methods, holding times may be extended by sample preservation techniques in the field. If a sample exceeds a holding time, then the results may be biased low. For example, if the extraction holding time for volatile analysis of soil sample is exceeded, then the possibility exists that some of the organic constituents have volatilized from the sample or degraded. Results for that analysis will be qualified as estimated to indicate that the reported results may be lower than actual site conditions. Holding times are presented in the SAP.

4.1.6 Blanks

According to the *National Functional Guidelines for Organic Data Review* (EPA, 1999), “The purpose of laboratory (or field) blank analysis is to determine the existence and magnitude of contamination resulting from laboratory (or field) activities. The criteria for evaluation of blanks apply to any blank associated with the samples (e.g., method blanks, instrument blanks, trip blanks, and equipment blanks).” Trip blanks are placed with samples during shipment; method blanks are created during sample preparation and follow samples throughout the analysis process. Analytical results for blanks will be interpreted in general accordance with *National Functional Guidelines for Organic Data Review* and professional judgment.

4.2 DATA GAP ANALYSIS

Previous site characterization data exist for Bothell Service Center property and many surrounding properties and right-of-ways. The scope of previous site characterizations was not designed to create a data set for an RI/FS study of the HVOC plume because the site characterizations did not evaluate off-site contamination; i.e., the RI/FS study area was truncated. This section describes data gaps in the existing data set and the rationale for collecting data necessary to fill those gaps.

4.2.1 Sources of Existing Data

Existing site data are described in numerous reports listed in the References Section 7.0.

4.2.2 Existing Exploration and Sampling Locations

Exploration and sampling locations, as described in the above-listed references, are shown on Figures 2, 3, and 4.

4.2.3 Known or Suspected Impacts to Soil and Ground Water

Based on previous investigation findings, known or suspected impacts include:

Soil:

- Chlorinated solvents (PCE) in soil at the Site, the Al's Auto / Wexler site immediately east of the Site, the vacated portion of SR522 immediately south of the Site, and the northern area of the Bothell Former Hertz Facility.

Ground Water:

- Chlorinated solvents (PCE, TCE, DCE, and vinyl chloride) at the Site, the Al's Auto / Wexler site immediately east of the Site, the vacated portion of SR522 immediately south of the Site, and the northern area of the Bothell Former Hertz Facility the extent of which is shown on Figure 4.

4.2.4 Data Gaps

The following data gaps are identified for the eventual complete RI:

1. **Soil source area** - prior to development of a cleanup plan for the Bothell Service Center site, the nature and extent of impacts to soil on the Site that might be acting as a source for the ground water plume must be delineated, in addition to addressing existing data gaps and characterizing the geology and hydrogeology of the property with respect to confining layers and vertical distribution of contaminants. The assumed source area is under the present building, and has not been thoroughly characterized to date.

2. **Extent and limits of HVOC impacts to ground water originating from the Bothell Service Center property.** The vertical extent of the solvent plume has not been completely delineated while the horizontal extent has been mostly delineated (see Figure 3). This RI will delineate the vertical extent of PCE immediately beneath the Bothell Service Center building by drilling angled borings from locations outside the building; the angled borings will be advanced to vertical depths of approximately 55 to 60 feet beneath the building (65 to 70 lineal feet). In addition, two or three shallow borings

approximately 5 to 10 feet deep will be advanced through the building's concrete slab in the vicinity of the former dry cleaning equipment. Soil and ground water samples will be collected from each boring for lithologic description and chemical analyses.

3. **Collect treatability information,** i.e., chemical and aquifer properties needed to select and design soil and ground water remediation methods.

The field sampling plan presented in the next section describes the type and location of data that will be collected to close these data gaps.

5.0 REMEDIAL INVESTIGATION AND FEASIIBILITY STUDY TASKS

The scope of work for the RI/FS includes the following tasks:

1. Develop a RI/FS project plan
2. Conduct a remedial investigation (RI) study
3. Conduct a feasibility study
4. Complete an RI/FS report
5. Complete a draft Cleanup Action Plan

5.1 PROJECT PLANNING

The project plan for the RI study consists of this work plan, a SAP (including a Quality Assurance Project Plan), and a Health and Safety Plan (HSP). The SAP and HSP are provided in Appendices B and C, respectively.

5.2 FIELD SAMPLING PLAN

The field sampling plan is designed to meet investigation objectives described in this work plan. The sampling strategy and rationale are described in this section. Detailed sampling methodology is described in the SAP.

5.2.1 Soil and Ground Water Chemical Sampling

Site soil and ground water will be sampled to characterize the magnitude and extent of contamination in selected areas, and to address existing data gaps. Proposed soil and ground water sample locations, depths, rationale, and analytes are described in Table 3. Planned soil and ground water sample locations are shown on Figure 13. Specific sample collection and chemical analytical methodologies are presented in the SAP.

Soil sampling at the Bothell Service Center site is planned for spring/summer of 2015, and will consist of sonic drilling and hand drilling methods at selected locations shown on Figure 13.

Angle borings - Angle borings will be completed under the existing building to sample soils at the source area which are not accessible via conventional vertical borings (see Figure 7 and 13). The borings will start adjacent to the building, and terminate under the building. The sonic drilling method will be used to advance the borehole, collect soil and reconnaissance ground water samples, and complete the wells.

The sonic method employs a temporary casing advanced into the soil using high frequency vibration. In addition to the vibration, sonic drilling uses both the rotational and downforce of the sonic drill casing to advance the borehole. Sonic uses both an inner core barrel and an outer sonic drill casing to penetrate the substrate. The first step is to advance the inner four inch diameter core barrel 10 to 20 feet in front of the sonic drill casing, taking the first section of the continuous sample. No fluid, air or mud is used during this coring process allowing a relatively undisturbed sample, although the vibrations tend to liquefy some granular soils, and heat very dense or cobbly soils. The second step is to advance the overriding outer sonic casing over the inner core barrel. Depending on the subsurface conditions, small quantities of potable water may be used to lubricate the outer sonic casing. In the third step, the inner core barrel with the continuous sample inside is extracted while the outer sonic drill casing remains allowing the sample to be brought to the surface and extruded into a bag or core box. The remaining sonic casing keeps the bore hole open and minimizes water intrusion into the borehole.

Reconnaissance ground water samples will be collected at selected depths via temporary monitoring wells or drive points installed in the cased borehole, to evaluate HVOC vertical concentration gradients. Permanent monitoring wells will be completed in the boreholes at varying depths. Monitoring wells will be two-inch diameter, stainless steel construction. Stainless steel will be used because PVC casing and screen material may be adversely impacted by high concentrations of PCE in the source area, as well as subject to damage if thermal cleanup methods are selected later.

Well filter packs will be emplaced via gravity and potable-water, which is considered feasible given the relatively steep angles of the boreholes. The annular seals will be placed using a cement-bentonite slurry instead of solid chips or pellets.

The new monitoring wells and existing monitoring wells will be sampled and analyzed for HVOCs and other constituents (see Table 3). The location and measuring point elevation of each monitoring well will be surveyed with respect to a common datum so that the direction of ground water flow can be accurately assessed.

Shallow hand borings - Depending on site access (not yet determined) two or three shallow borings approximately 5 to 10 feet in depth will be advanced through the building's concrete slab in the vicinity of the former dry cleaning equipment (Figure 7). Hand-operated power tools will be used to core through the slab, and advance shallow borings. Soil samples will be collected with a manual slide hammer coring device with precleaned acetate liners.

5.2.2 Cross Contamination Issues

Proper care will be taken to minimize the risk of cross contamination, or potentially spreading source material to previously uncontaminated depths and hydrogeologic units. Cross contamination may result during drilling by migration of NAPL or impacted ground water down the borehole, or after the well is complete via an incomplete annular seal or a screened interval that crosses a restricting layer. Methods used to minimize the risk of cross contamination include:

- Minimize the time during which borings are left open.
- Borings will be drilled with temporary telescoping casing, i.e., eight-inch diameter outer steel casing will be advanced to the maximum known depth where significant contamination is known to exist (around 50 feet vertical depth), then grouted in place with bentonite slurry. Then a second, six-inch casing will be advanced to deeper depths and sampled.
- Short screens (5 foot) will be used, and not placed across low permeability layers.
- Use of numerous stainless steel centralizers around the screen and casing to ensure it remains near the center of the borehole.

- Use of a cement/bentonite grout for annular and bottom (if needed) seals. The grout will include 9 pounds (around 10 percent) bentonite powder with around 7 gallons of water (adjusted for flowability) per 94 pounds of Portland cement.
- The annular seal will be emplaced via tremie pipe placed at the bottom of the sealing interval under pressure, to ensure complete filling of the entire sealed interval and displacement of liquids and solids prior to sealing.
- Evaluation of geology and boring depth during drilling, i.e., if more than 3 feet of low permeability soil is encountered below 50 vertical feet in any boring, the boring will be terminated and the bottom low permeability section sealed.

5.2.3 Sample Analyses

Soil samples will be analyzed for HVOCs, with selected samples also analyzed for total organic carbon (TOC).

All ground water samples will be analyzed for HVOCs and field parameters, including dissolved oxygen, oxygen reduction potential (ORP), and pH. Selected samples will also be analyzed for:

- Total organic carbon (TOC)
- Methane/ethene/ethane
- Nitrate
- Sulfate
- Soluble ferrous iron
- Chloride (source area and upgradient)

These parameters will be monitored to indicate whether aquifer conditions are conducive to degradation of chlorinated ethenes.

5.3 FEASIBILITY STUDY

A FS will be conducted following completion of the RI. The study will be conducted in accordance with WAC 173-340-350 (8). This regulation describes the elements that must be included in the FS. The feasibility study will identify remedial alternatives to achieve cleanup levels as set forth in MTCA regulations.

5.4 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY REPORT

A RI/FS report will be prepared after field data have been collected and the FS is complete. The report will transmit information consistent with MTCA for RI/FS reports.

The completion of the report will allow the selection of a cleanup alternative, production of a draft cleanup action plan (dCAP), and implementation of the cleanup alternative to reduce or remove site hazardous substances posing unacceptable risks to human health and the environment.

5.5 DATA VALIDATION AND EVALUATION

Data management and documentation will include checking all QA parameters, including holding times, method blanks, surrogate recoveries, spike recoveries, field and laboratory duplicates, completeness, detection limits, laboratory control samples, and Chain-of-Custody forms. After the data have been checked, they will be entered into the project database with any assigned data qualifiers.

The project electronic database will be in a format compatible with the Ecology Environmental Information Management (EIM) system, and all analytical data will be entered into the EIM system.

Results of the sampling and laboratory testing will be summarized in a spreadsheet, plotted on a site map, and the data compared to established site cleanup levels. A report will describe any significant field sampling issues, laboratory QA/QC testing, water level monitoring data and water quality testing results.

6.0 PROJECT MANAGEMENT

6.1 SCHEDULE

The proposed RI schedule is presented in Table 4. Initial RI activities are scheduled for spring/summer 2015.

6.2 PROJECT MANAGEMENT STAFF

Project management staff for the RI are presented in the SAP.

7.0 REFERENCES

Dalton, Olmsted, and Fuglevand, 2014, *Results of October Ground water Sampling, Bothell Service Center, Bothell, Washington.* Memorandum to Norm Olsen dated November 10, 2014.

ERM, 2001, Letter to Norman L. Olsen. *Interim Site Characterization Summary Report, Bothell Service Center, 18107 Bothell Way Northeast, Bothell, Washington*, Dated October 17, 2001.

ERM, 2002, Letter to Norman L. Olsen. *Interim Site Remediation Summary Report, Bothell Service Center, 18107 Bothell Way Northeast, Bothell, Washington*, Dated March 25, 2002.

Farallon Consulting, 2003, *Subsurface Investigation Report, 18107 Bothell Way Northeast, Bothell, Washington*, Dated January 27, 2003.

Farallon Consulting, 2008a, *Cleanup Action Progress Report, June 2006 Through June 2007, Bothell Service Center, 18107 Bothell Way Northeast, Bothell, Washington*, Dated March 12, 2008.

Farallon Consulting, 2008b, *Interim Action Status Report, November 2007 through August 2008, Bothell Service Center, 18107 Bothell Way Northeast, Bothell, Washington*, Dated November 4, 2008.

Farallon Consulting, 2011, *Project Status Summary, Bothell Service Center Associates Property, 18107 Bothell Way Northeast, Bothell, Washington*, Dated November 18, 2011.

HWA GeoSciences, 2008a, *Limited Phase II Environmental Site Assessment, Highway 522 Right-of-Way, 18030 Bothell Way NE, Bothell, WA*. Prepared for City of Bothell, April 15, 2008.

HWA GeoSciences, 2008b, *Phase II Site Assessment, Hertz Rentals Property, Bothell, WA.* Prepared for City of Bothell, October 10, 2008.

HWA GeoSciences, 2012, Remedial Investigation Feasibility Study Final Work Plan, Bothell Former Hertz Facility, Bothell, Washington, prepared for City of Bothell, September 10, 2012.

Liesch, B.A., C.E. Price, and K. Walters. 1963. *Geology and Ground-Water Resources of Northwestern King County, Washington.* US Geological Survey.

U.S. EPA, 1988, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*, EPA/540/G-89/004 (OSWER Directive 9355.3-01).

U.S. EPA, 1999, *Contract Laboratory Program National Functional Guidelines for Organic Data Review*, EPA 540/R-99/008.

U.S. EPA, 2006, *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G4.

Table 3A
Sample Analytes and Rationale (Soil)
See Figure 13 for Sampling Locations

Location	Depth (feet)	Analytes	Analytical Method	Rationale
Under building at source area: shallow hand borings	1 to 10	HVOCs Optional: Total organic carbon Bulk density Effective porosity	EPA 8260 SM5310B/EPA9060A ASTM 4253/4 ASTM D7063	To delineate the mass and distribution (horizontal and vertical extent) of HVOCs in the source area and to determine if there are strata present that limit vertical migration of HVOCs
Under building at source area: Angled Sonic boreholes	10 to 60			

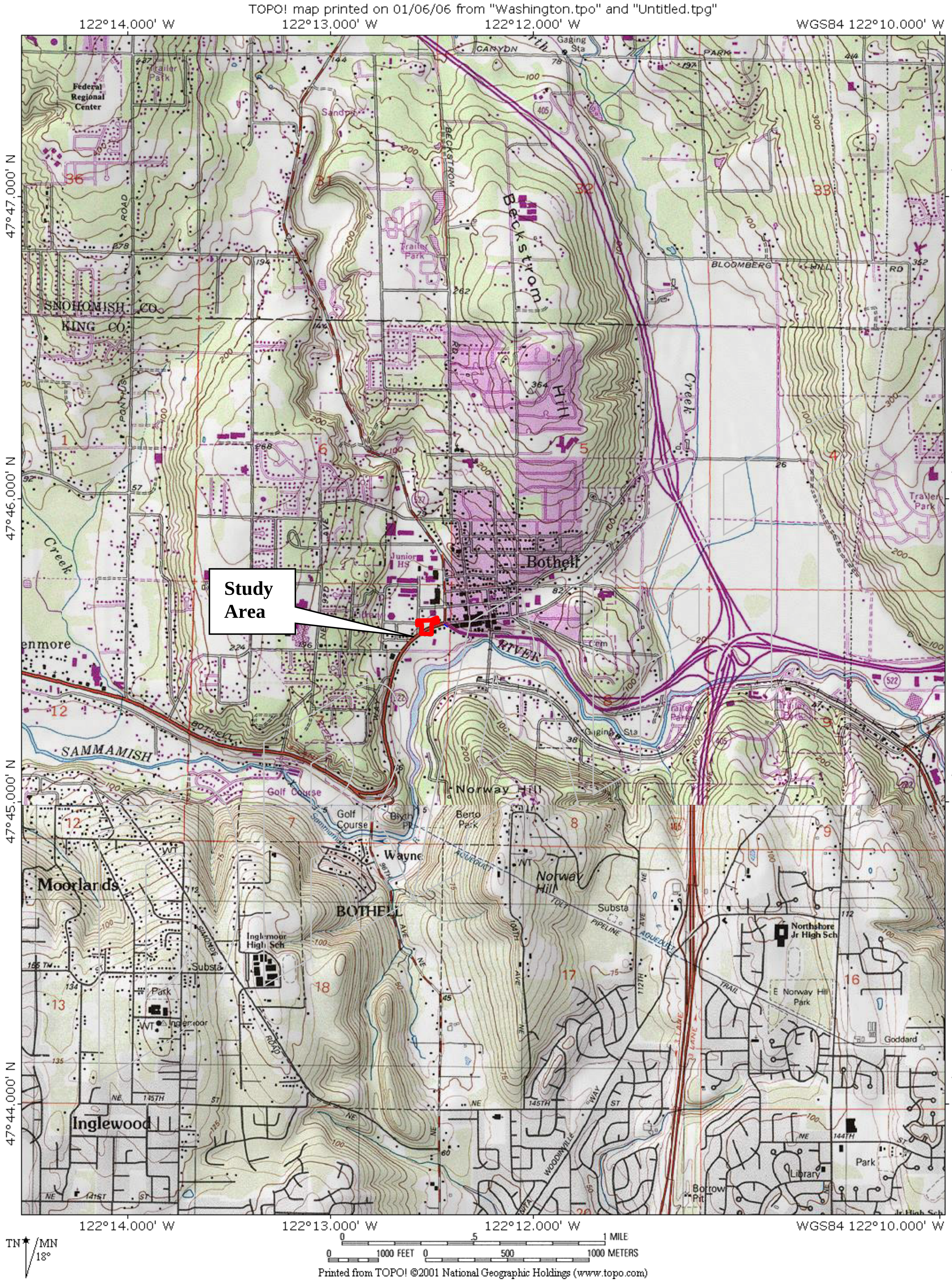
Number of samples and/or analytes are subject to change based on results of field screening activities during the field investigation.

Table 3B
Sample Analytes and Rationale (Ground water)
See Figure 13 for Sampling Locations

Location	Depth (feet)	Analytes	Analytical Method	Rationale
Under building at source area	15-20 25-30 45-50 55-60	HVOCs Optional: Oxidation-Reduction Potential, (ORP) Nitrate Sulfate Soluble ferrous iron Chloride Methane/ethene/ethane	EPA 8260 Field EPA 353.2 ASTM D516-07 HACH IR-18C SM 4500-Cl EPA 8260C	To delineate the horizontal and vertical extent of HVOCs in ground water at the source area and downgradient
Existing wells	15-55			

Table 4
Proposed RI Schedule

Task	Anticipated Completion
RI at Bothell Service Center site	Spring/Summer 2015
Ground water monitoring	One round, Spring/Summer 2015



HWA GEOSCIENCES INC.

SITE VICINITY

BOTHELL SERVICE CENTER
REMEDIAL INVESTIGATION WORK PLAN
BOTHELL, WASHINGTON

FIGURE NO.
1

PROJECT NO.
2007-098

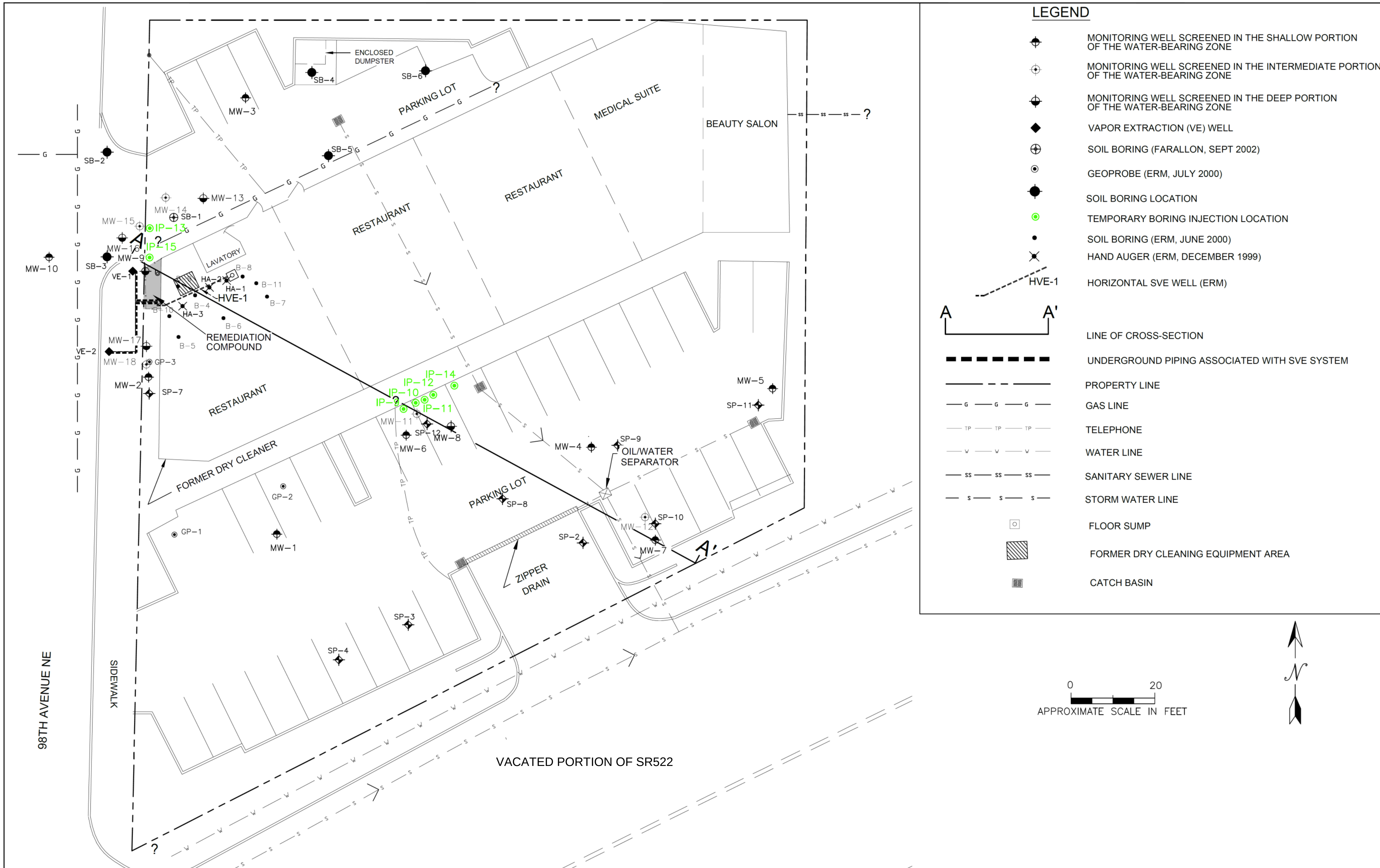


Figure Source: Farallon, 2011

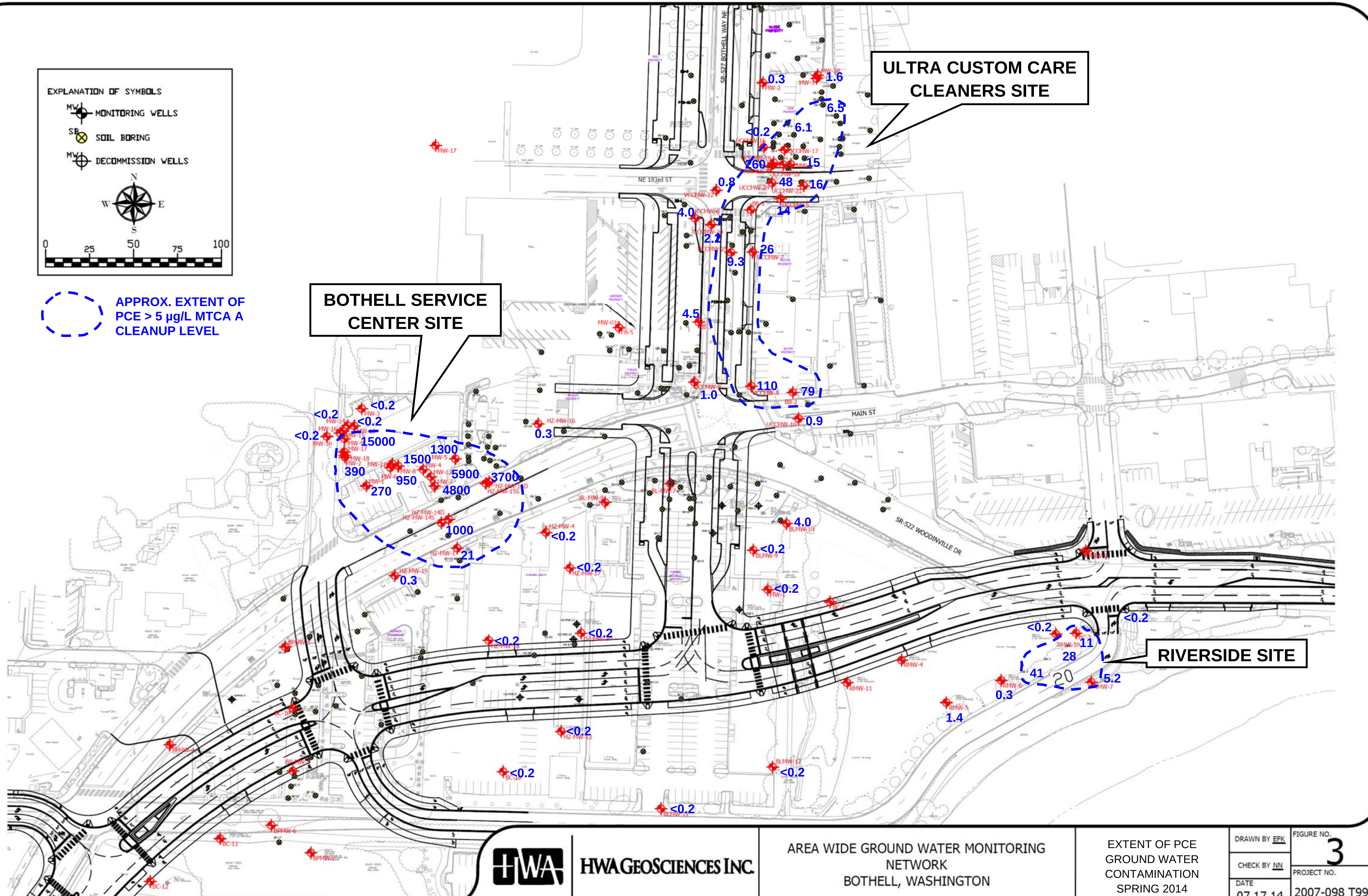
HWA GEOSCIENCES INC.

SITE PLAN

BOTHELL SERVICE CENTER
REMEDIAL INVESTIGATION WORK PLAN
BOTHELL. WASHINGTO

PROJECT NO.
2007-098-2022

FIGURE NO.
2



HWA HWAGEOSCIENCES INC.

AREA WIDE GROUND WATER MONITORING NETWORK
BOTHELL, WASHINGTON

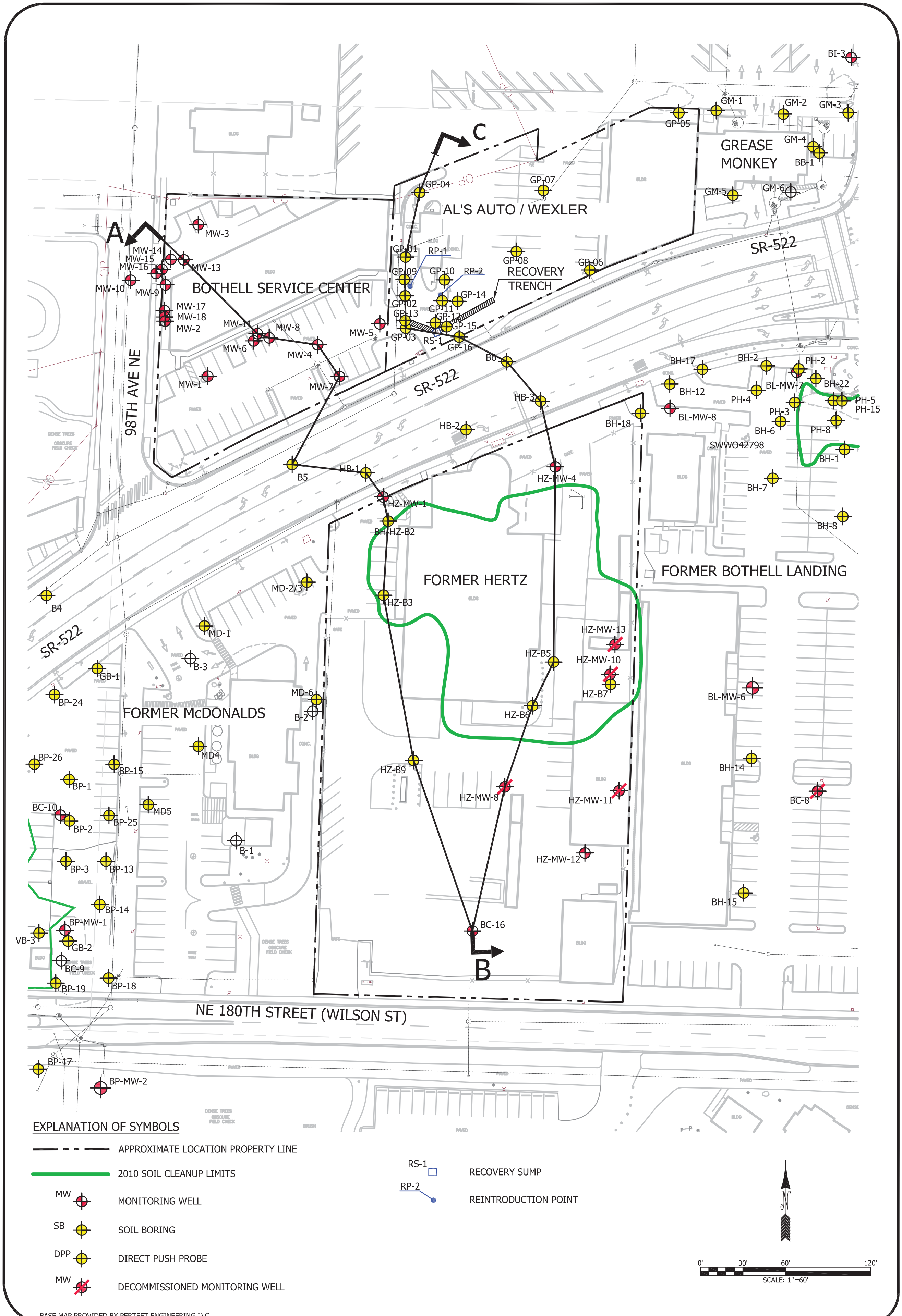
EXTENT OF PCE GROUND WATER CONTAMINATION
SPRING 2014

DRAWN BY EFK
CHECK BY NN
DATE 07.17.14

FIGURE NO. 3

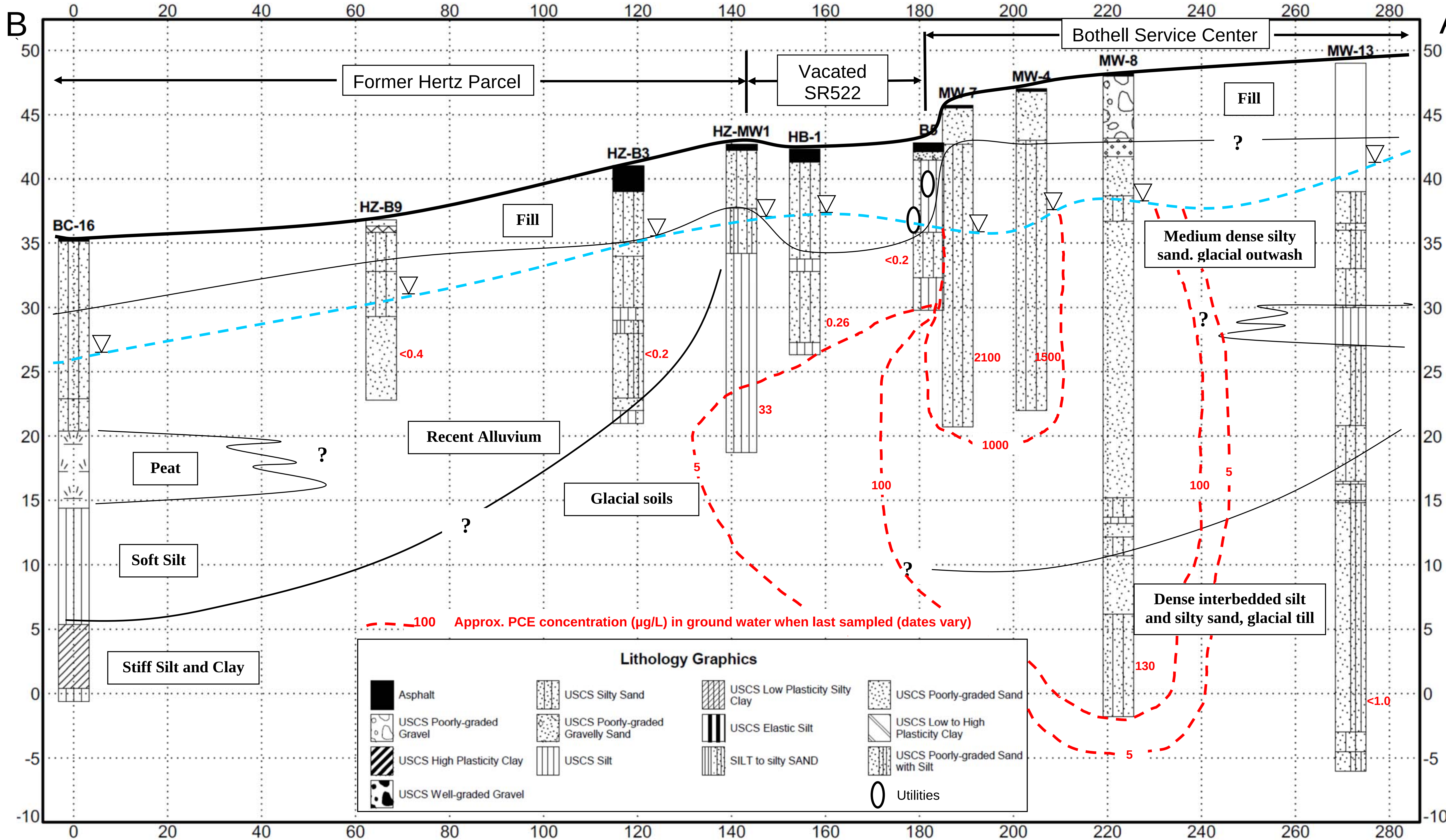
PROJECT NO. 2007-098 T998

S:\2007 PROJECTS\2007-098-22 BOTHELL CROSSROADS\CAD\HWA 2007-098-21 T998.DWG <11x17 all wells> Plotted: 7/17/2014 3:42 PM



HWA GEOSCIENCES INC.	BOTHELL SERVICE CENTER REMEDIAL INVESTIGATION BOTHELL, WASHINGTON	CROSS SECTION LOCATIONS	DRAWN BY EFK CHECK BY AS DATE 08.07.12	FIGURE NO. 4 PROJECT NO. 2007-098 T943

S:\2007 PROJECTS\2007-098-22 BOTHELL CROSSROADS\CAD\HWA 2007-098-21 T943B.DWG <FIG 3 T943> Plotted: 9/11/2012 2:09 AM



See Figure 3 for lines of section

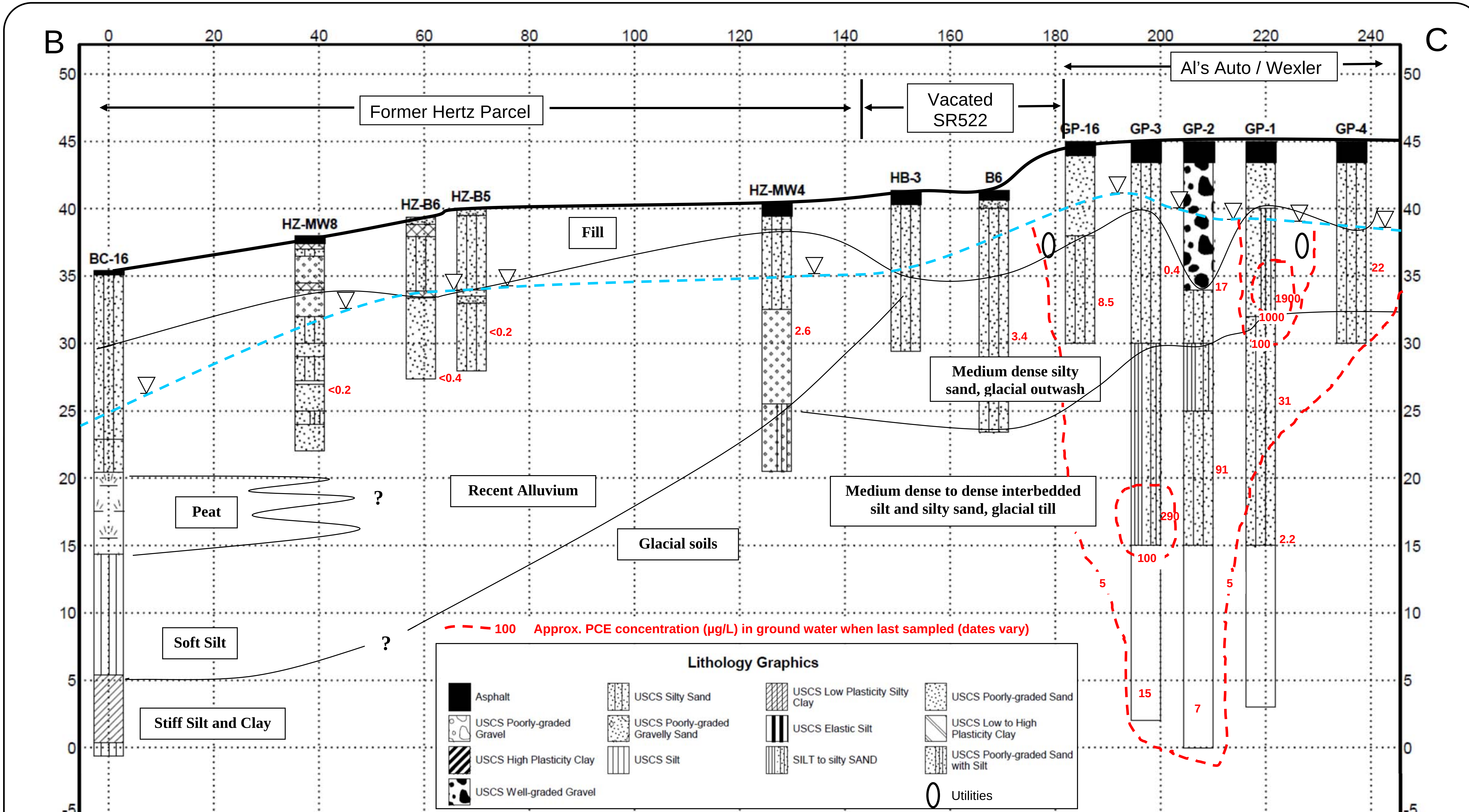
HWA GEOSCIENCES INC.

CROSS SECTION B – A
HERTZ TO BOTHELL SERVICE CENTER

BOTHELL SERVICE CENTER
REMEDIAL INVESTIGATION WORK PLAN
BOTHELL, WASHINGTON

PROJECT NO. 2007-098

FIGURE NO. 5



See Figure 3 for lines of section

HWA GEOSCIENCES INC.

CROSS SECTION B - C
HERTZ TO AL'S AUTO / WEXLER

BOTHELL SERVICE CENTER
REMEDIAL INVESTIGATION WORK PLAN
BOTHELL, WASHINGTON

PROJECT NO. 2007-098

FIGURE NO. 6

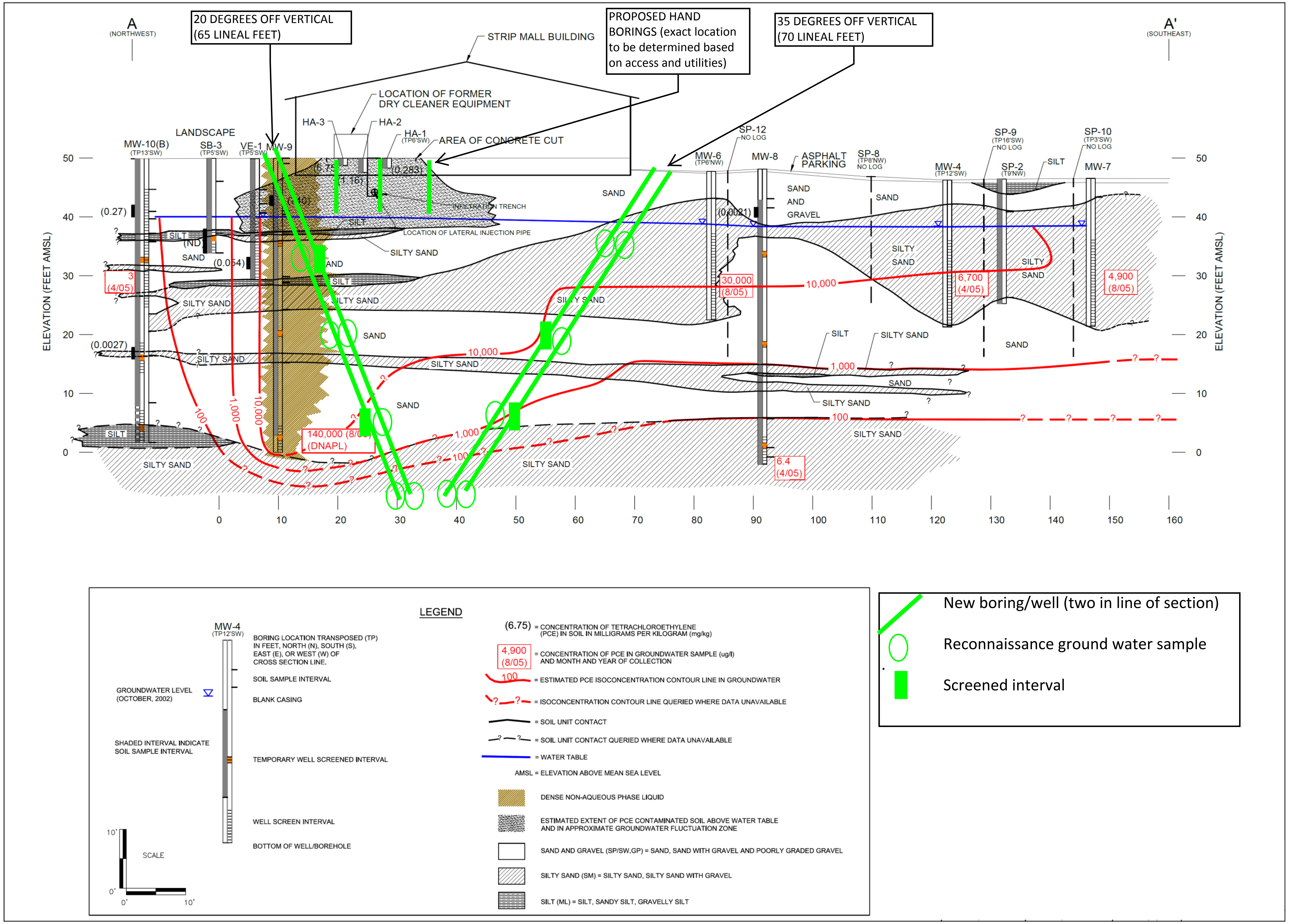


Figure Source: Farallon, 2011

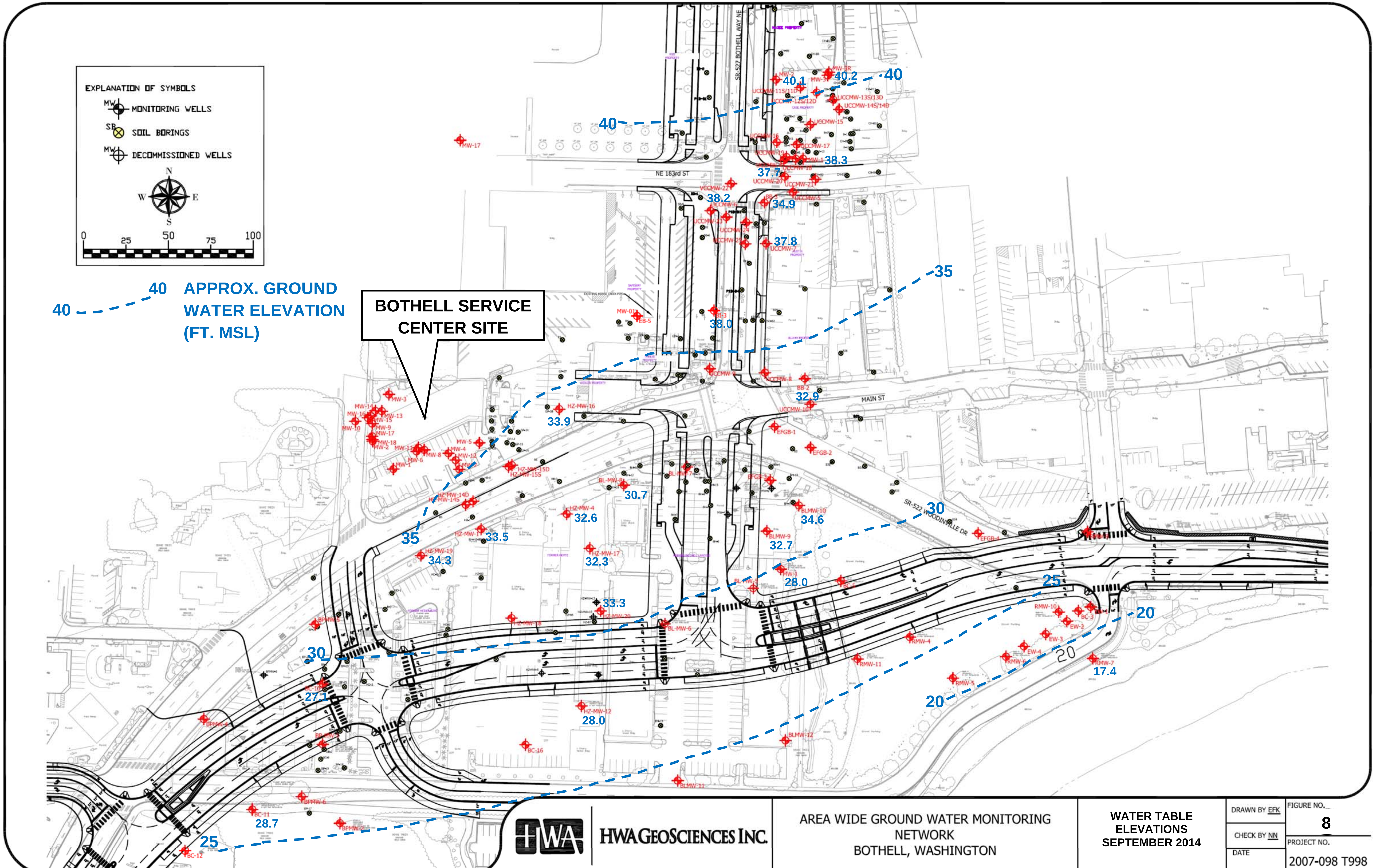
HWA GEOSCIENCES INC.

CROSS SECTION A-A'

BOTHELL SERVICE CENTER
REMEDIAL INVESTIGATION WORK PLAN
BOTHELL. WASHINGTO

PROJECT NO.
2007-098-2022

FIGURE NO.
7



HWA GEOSCIENCES INC.

AREA WIDE GROUND WATER MONITORING NETWORK
BOTHELL, WASHINGTON

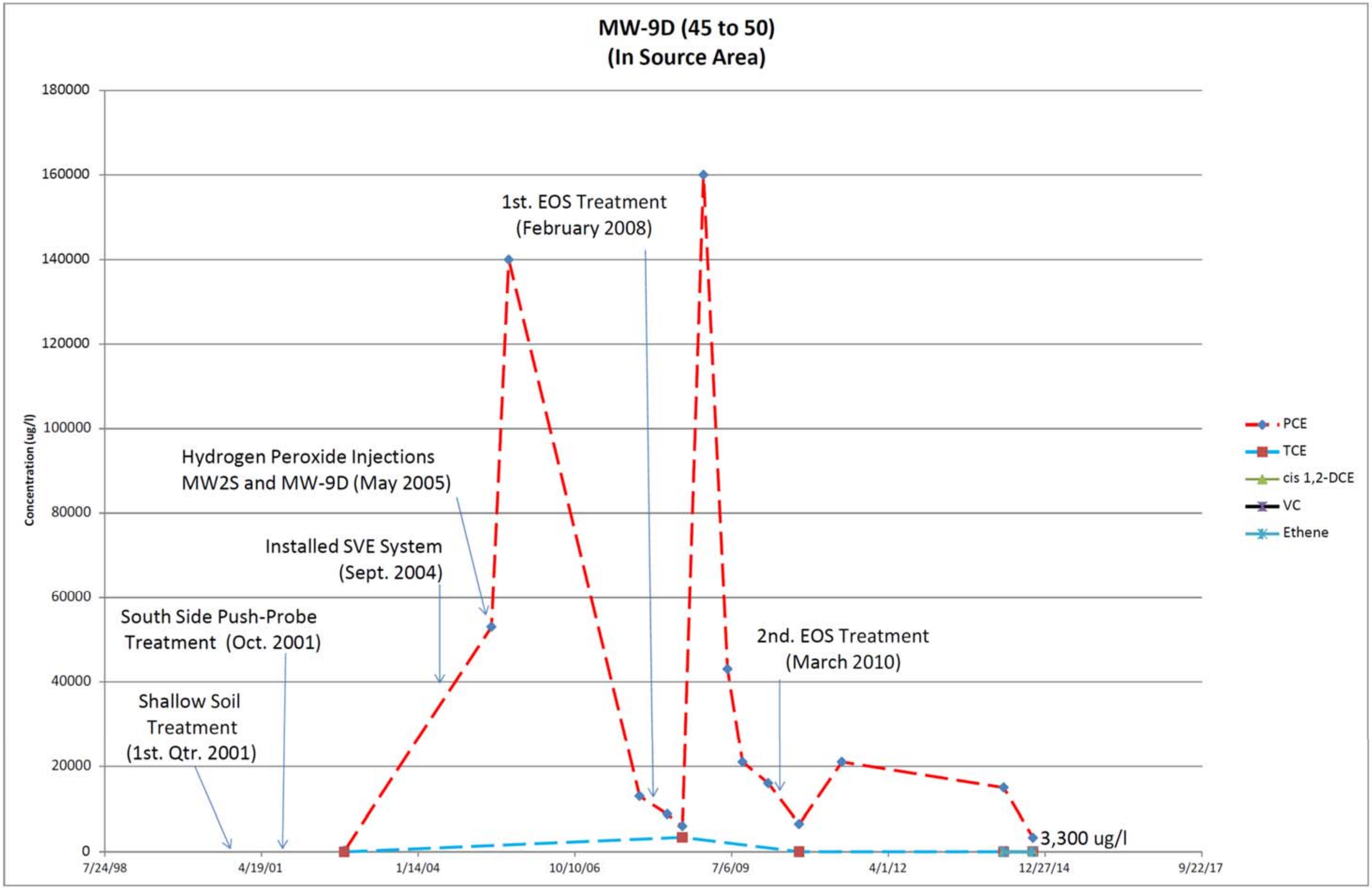
WATER TABLE ELEVATIONS
SEPTEMBER 2014

DRAWN BY EFK
CHECK BY NN
DATE

FIGURE NO. 8

PROJECT NO. 2007-098 T998

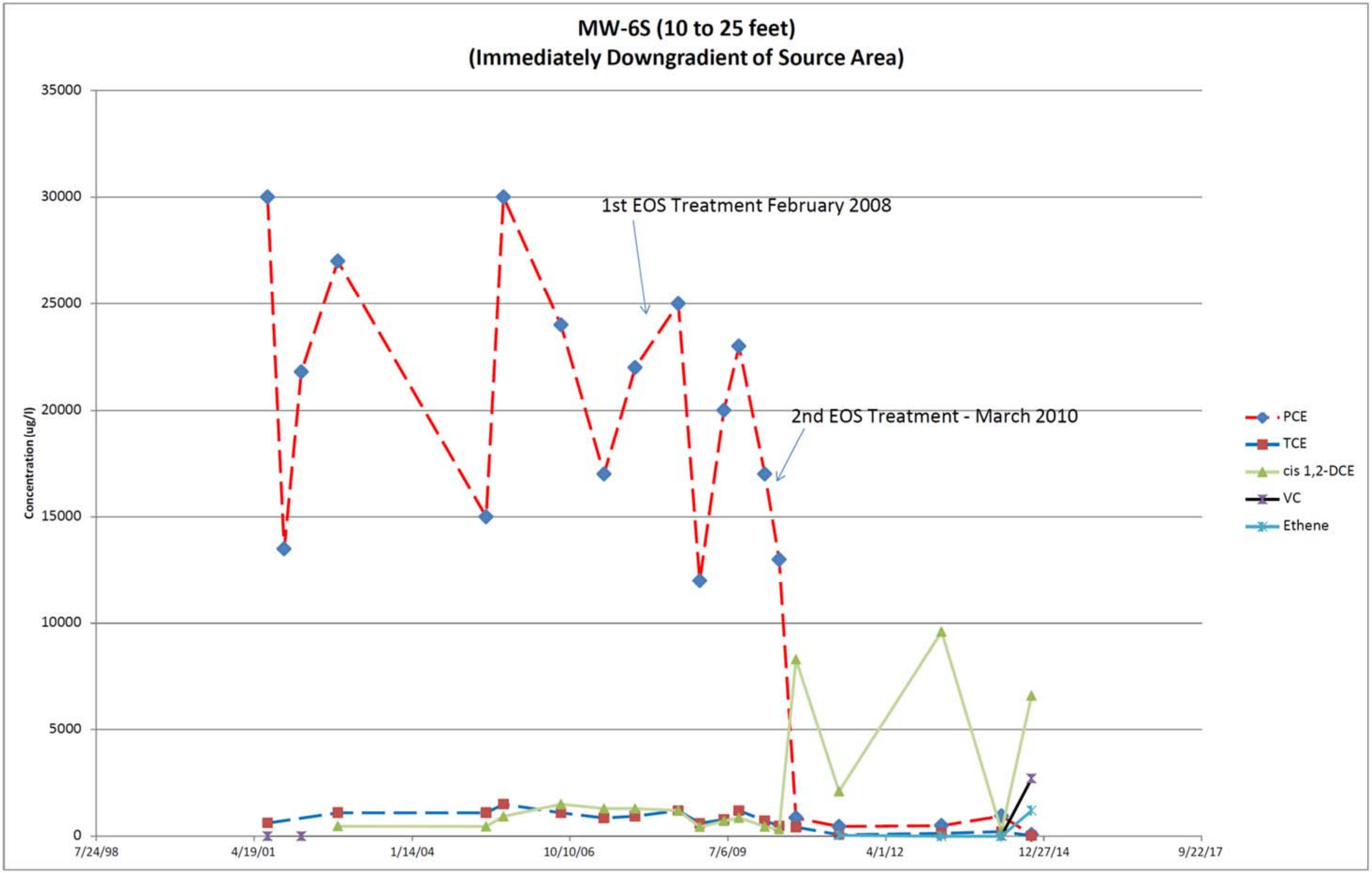
S:\2007 PROJECTS\2007-098-22 BOTHELL CROSSROADS\CAD\HWA 2007-098-21 T998.DWG <11x17 all wells> Plotted: 10/16/2014 11:59 AM



Source: DOF, 2014

HWA GEOSCIENCES INC.

CONCENTRATION TRENDS MW-9D	FIGURE NO. 9
BOTHELL SERVICE CENTER **REMEDIAL INVESTIGATION WORK PLAN** **BOTHELL, WASHINGTON**	PROJECT NO. 2007-098



Source: DOF, 2014

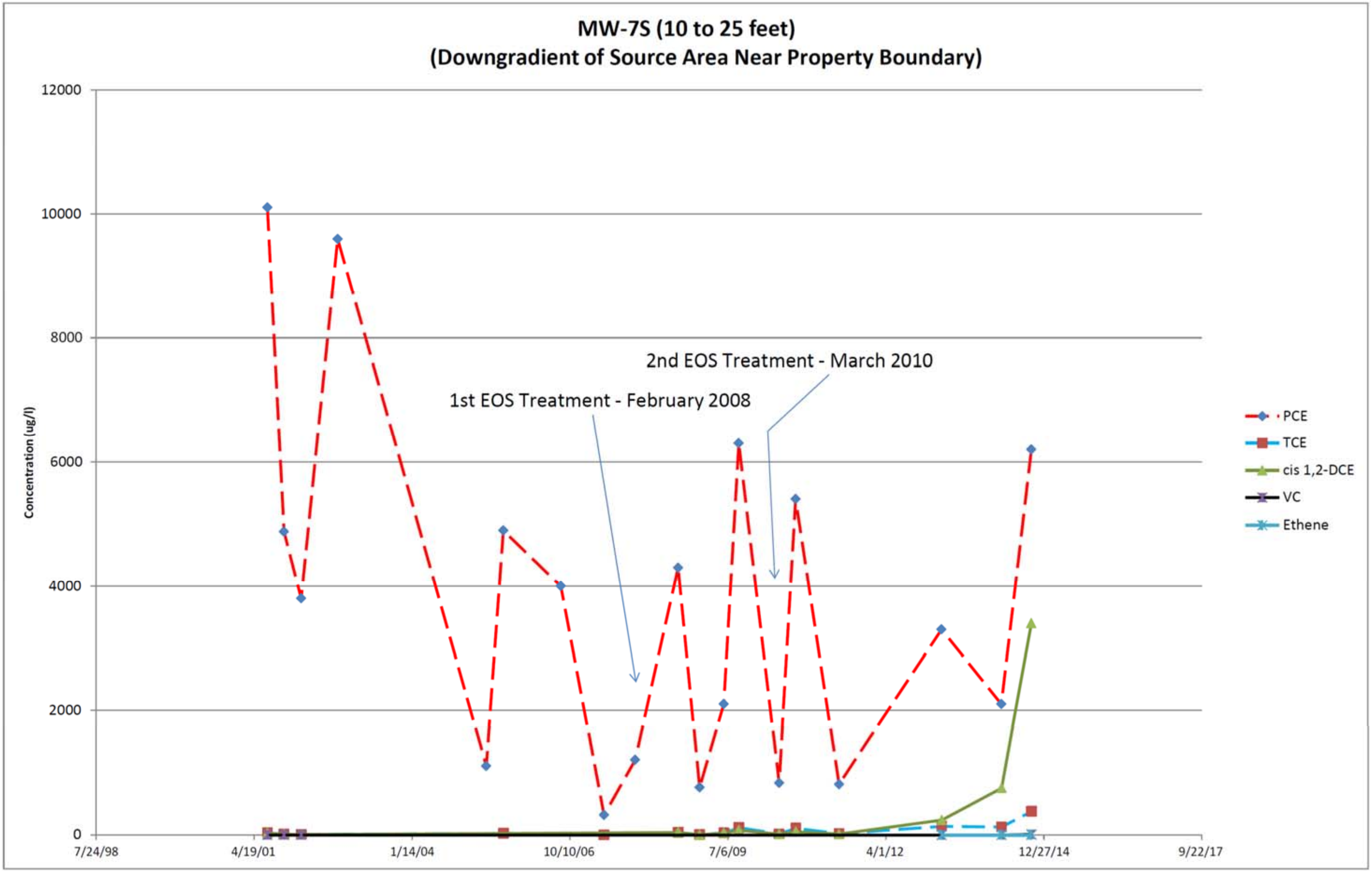
HWA GEOSCIENCES INC.

CONCENTRATION TRENDS MW-6S

BOTHELL SERVICE CENTER
REMEDIAL INVESTIGATION WORK PLAN
BOTHELL, WASHINGTON

FIGURE NO.
10

PROJECT NO.
2007-098



Source: DOF, 2014

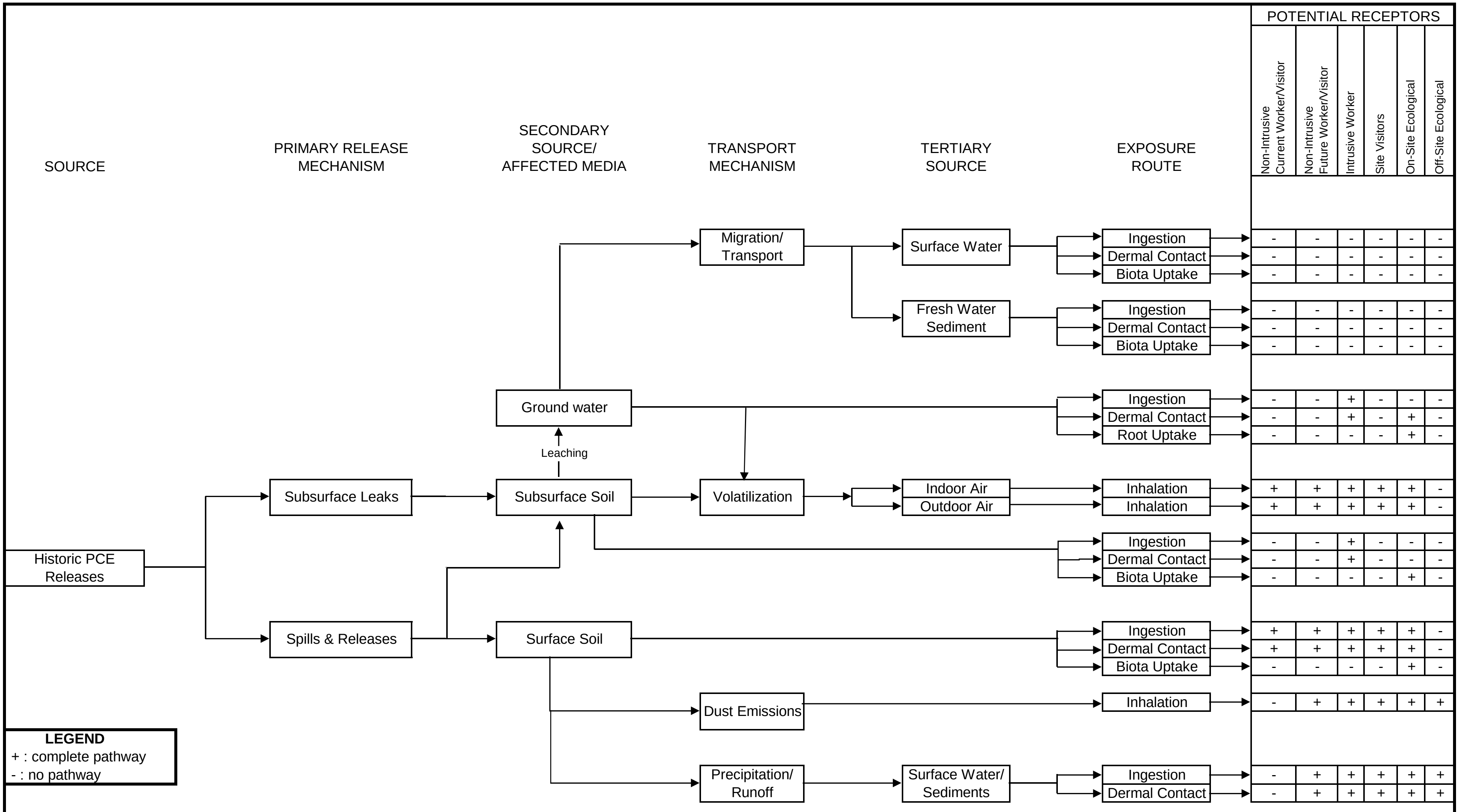
HWA GEOSCIENCES INC.

CONCENTRATION TRENDS MW-7S

BOTHELL SERVICE CENTER
REMEDIAL INVESTIGATION WORK PLAN
BOTHELL, WASHINGTON

FIGURE NO. 11

PROJECT NO. 2007-098



Source / Exposure Route	Non-Intrusive Current Worker/Visitor	Non-Intrusive Future Worker/Visitor	Intrusive Worker	Site Visitors	On-Site Ecological	Off-Site Ecological
Surface Water – Ingestion	-	-	-	-	-	-
Surface Water – Dermal Contact	-	-	-	-	-	-
Surface Water – Biota Uptake	-	-	-	-	-	-
Fresh Water Sediment – Ingestion	-	-	-	-	-	-
Fresh Water Sediment – Dermal Contact	-	-	-	-	-	-
Fresh Water Sediment – Biota Uptake	-	-	-	-	-	-
Ground water – Ingestion	-	-	+	-	-	-
Ground water – Dermal Contact	-	-	+	-	+	-
Ground water – Root Uptake	-	-	-	-	+	-
Indoor Air – Inhalation	+	+	+	+	+	-
Outdoor Air – Inhalation	+	+	+	+	+	-
Subsurface Soil – Ingestion	-	-	+	-	-	-
Subsurface Soil – Dermal Contact	-	-	+	-	-	-
Subsurface Soil – Biota Uptake	-	-	-	-	+	-
Surface Soil – Ingestion	+	+	+	+	+	-
Surface Soil – Dermal Contact	+	+	+	+	+	-
Surface Soil – Biota Uptake	-	-	-	-	+	-
Dust Emissions – Inhalation	-	+	+	+	+	+
Surface Water/Sediments – Ingestion	-	+	+	+	+	+
Surface Water/Sediments – Dermal Contact	-	+	+	+	+	+

HWA GEOSCIENCES INC.

CONCEPTUAL SITE MODEL

BOTHELL SERVICE CENTER SITE
REMEDIAL INVESTIGATION WORK PLAN
BOTHELL, WASHINGTON

FIGURE 12

PROJECT 2007-098-

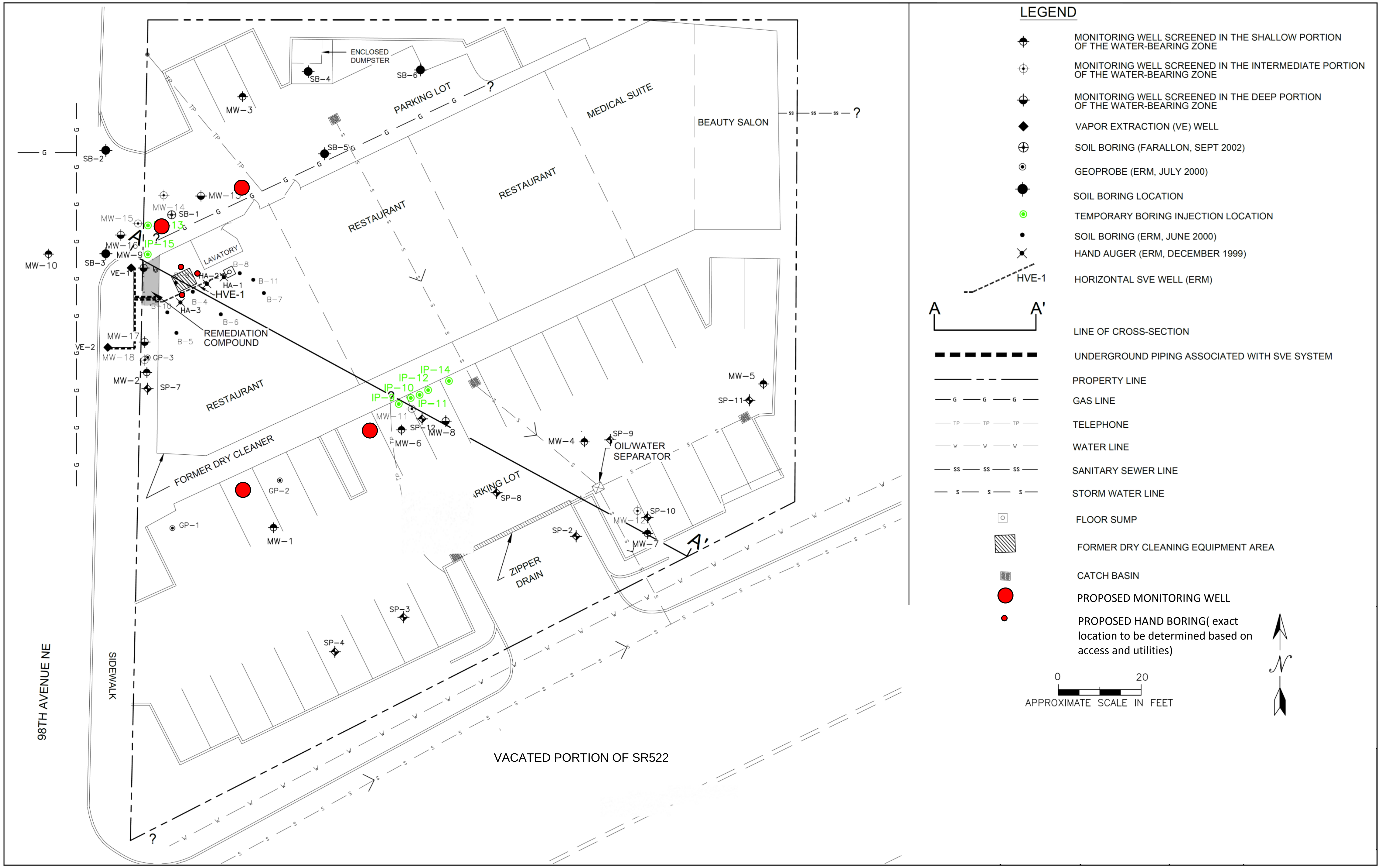


Figure Source: Farallon, 2011

HWA GEOSCIENCES INC.

SITE PLAN

BOTHELL SERVICE CENTER
REMEDIAL INVESTIGATION WORK PLAN
BOTHELL. WASHINGTO

PROJECT NO.
2007-098-2022

FIGURE NO.
13

APPENDIX A

Sampling and Analysis Plan

REMEDIAL INVESTIGATION FEASIBILITY STUDY
SAMPLING & ANALYSIS PLAN
BOTHELL SERVICE CENTER SITE
BOTHELL, WASHINGTON

Project No. 2007-098-2022

Prepared for
City of Bothell

January 19, 2015

HWA GEOSCIENCES INC.

- *Geotechnical Engineering*
- *Hydrogeology*
- *Geoenvironmental Services*
- *Inspection & Testing*

TABLE OF CONTENTS

1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) provides the scope and rationale for field sampling efforts associated with a remedial investigation / feasibility study (RI/FS) conducted for the City of Bothell at the Bothell Service Center site (Site) in Bothell, Washington.

This plan was prepared in accordance with Chapter 173-340-820 WAC in the Washington State Model Toxics Control Act (MTCA) Cleanup Regulation. The main body of this plan outlines our field investigation and laboratory analytical methods.

1.1 PURPOSE AND OBJECTIVES

Previous investigations have shown halogenated volatile organic compounds (HVOC) releases of the chlorinated solvent tetrachloroethene (PCE) at the Site to be a source of soil and ground water contamination that has migrated downgradient into public right-of ways and City owned properties. This site is listed in the Department of Ecology's database variously as Bothell Service Center and Simon & Son Fine Drycleaning, facility number 33215922 for dry cleaning solvent contamination in soil and ground water.

The objective of this RI/FS is to meet the requirements of the Model Toxics Control Act (MTCA) Cleanup Regulation (Washington Administrative Code [WAC] 173-340). The RI/FS is designed to collect additional preliminary data on HVOC impacts, in selected areas that are currently accessible.

1.2 PROJECT ORGANIZATION

Personnel involved with this project and roles are listed below:

- VCP Site manager (TBD) Washington State Department of Ecology
- Bob Stowe, City Manager/VCP point of contact, City of Bothell (425) 486-3256
- Steven Morikawa, P.E., Capital Division Manager, City of Bothell (425) 486-2768
- Nduta Mbuthia, City of Bothell, PLP Technical Contact (425) 486-2768
- Arnie Sugar, HWA Project Manager (425) 774-0106
- David Baumeister, OnSite Environmental, Inc. Laboratory Project Manager (425) 883-
- 3881
- Drilling Contractor – TBD/to be determined

1.3 PROJECT SCHEDULE

A proposed project schedule is provided in the Work Plan, assuming no delays due to site access issues.

1.4 SITE LOCATION

The Site consists of an approximately 0.6-acre parcel on the northeast comer of the intersection of 98th Avenue Northeast and the vacated portion of State Route 522 (Figures 1 and 2). The Site address is 18107 Bothell Way NE. The Site is owned by Bothell Service Center Associates (BSCA) and is managed by NLO Property Management.

From approximately 1989 to 1999, Simon & Son Fine Drycleaning operated in the westernmost suite of the strip mall building. A release(s) of PCE occurred during this period, presumably in the vicinity of the dry cleaning machine and possibly to the landscaped area outside the west wall of the building where a remediation compound containing vapor extraction equipment is now located (Figure 2). The former Simon & Son Fine Drycleaning suite currently is leased by the retail operation Dawn's Candy & Cake Supply; other businesses currently operating in the strip mall building include Happy Lake #1 Teriyaki Wok, Papa John's Pizza, Mad Cow Yarn, and Abilities Unlimited NW.

2.0 FIELD AND LABORATORY INVESTIGATION TASKS

There are two major field and laboratory investigation tasks in the RI/FS work plan. These are:

1. Investigation and characterization of ground water HVOC contamination
2. Investigation and characterization of soil HVOC contamination

Field and laboratory investigation methodologies to accomplish these major tasks are presented in the following subsections.

2.1 SOIL & GROUND WATER SAMPLING

The vertical extent of the HVOC plume at the Site has not been completely delineated while the horizontal extent has been mostly delineated (see Figure 3 in the Work Plan). The RI will delineate the vertical extent of PCE immediately beneath the Bothell Service Center building by drilling angled borings from locations outside the building; the angled borings will be advanced to vertical depths of approximately 60 feet beneath the building. In addition, two or three shallow borings approximately 5 to 10 feet will be advanced through the building's concrete slab in the vicinity of the former dry cleaning equipment. Soil and ground water samples will be collected from each boring for lithologic description and chemical analyses. Proposed soil and ground water sample locations, depths, rationale, and analytes are described in Table 3 in the Work Plan.

Soil sampling at the Bothell Service Center site will consist of sonic and hand auger drilling methods at selected locations shown on Figure 13. Reconnaissance ground water samples will be collected at various depths during drilling to evaluate the vertical extents of the HVOC plume. Monitoring wells will be completed in the sonic drilling boreholes at varying depths. The new monitoring wells and existing monitoring wells will be sampled and analyzed for HVOCs. The location and measuring point elevation of each monitoring well will be surveyed with respect to a common datum so that the direction of ground water flow can be accurately assessed.

Sonic drilling - The sonic method employs a temporary casing advanced into the soil using high frequency vibration. In addition to the vibration, sonic drilling uses both the rotational and downforce of the sonic drill casing to advance the borehole. Sonic uses both an inner core barrel and an outer sonic drill casing to penetrate the substrate. The first step is to advance the inner four inch diameter core barrel 10 to 20 feet in front of the sonic drill casing, taking the first section of the continuous sample. No fluid, air or mud is used during this coring process allowing a relatively undisturbed sample, although the vibrations tend to liquefy some granular soils, and heat very dense or cobbly soils. The second step is to advance the overriding outer sonic casing over the inner core barrel. Depending on the subsurface conditions, small quantities of potable water may be used to lubricate the outer sonic casing. In the third step, the inner core barrel with the continuous sample inside is extracted while the outer sonic drill casing remains allowing the sample to be brought to the surface and extruded into a bag or core box. The remaining sonic casing keeps the bore hole open and minimizes water intrusion into the borehole.

Reconnaissance ground water samples will be collected at selected depths via temporary monitoring wells or drive points installed in the cased borehole, to evaluate HVOC vertical concentration gradients. Permanent monitoring wells will be completed in the boreholes at varying depths. Monitoring wells will be two-inch diameter, stainless steel construction. Stainless steel will be used because PVC casing and screen material may be adversely impacted by high concentrations of PCE in the source area, as well as subject to damage if thermal cleanup methods are selected later.

Well filter packs will be emplaced via gravity and potable-water, which is considered feasible given the relatively steep angles of the boreholes. The annular seals will be placed using a cement-bentonite slurry instead of solid chips or pellets.

The new monitoring wells and existing monitoring wells will be sampled and analyzed for HVOCs and other constituents (see Table 3). The location and measuring point elevation of each monitoring well will be surveyed with respect to a common datum so that the direction of ground water flow can be accurately assessed.

Cross Contamination Issues - Proper care will be taken to minimize the risk of cross contamination, or potentially spreading source material to previously uncontaminated depths and hydrogeologic units. Cross contamination may result during drilling by migration of NAPL or impacted ground water down the borehole, or after the well is complete via an incomplete annular seal or a screened interval that crosses a restricting layer. Methods used to minimize the risk of cross contamination include:

- Minimize the time during which borings are left open.
- Borings will be drilled with temporary telescoping casing, i.e., eight-inch diameter outer steel casing will be advanced to the maximum known depth where significant contamination is known to exist (around 50 feet vertical depth), then grouted in place with bentonite slurry. Then a second, six-inch casing will be advanced to deeper depths and sampled.
- Short screens (5 foot) will be used, and not placed across low permeability layers.
- Use of numerous stainless steel centralizers around the screen and casing to ensure it remains near the center of the borehole.
- Use of a cement/bentonite grout for annular and bottom (if needed) seals. The grout will include 9 pounds (around 10 percent) bentonite powder with around 7 gallons of water (adjusted for flowability) per 94 pounds of Portland cement.
- The annular seal will be emplaced via tremie pipe placed at the bottom of the sealing interval under pressure, to ensure complete filling of the entire sealed interval and displacement of liquids and solids prior to sealing.
- Evaluation of geology and boring depth during drilling, i.e., if more than 3 feet of low permeability soil is encountered below 50 vertical feet in any boring, the boring will be terminated and the bottom low permeability section sealed.

Shallow hand borings – Depending on site access (not yet determined) two or three shallow borings approximately 5 to 10 feet in depth will be advanced through the building's concrete slab in the vicinity of the former dry cleaning equipment. Hand-operated power tools will be used to core through the slab, and advance shallow borings. Soil samples will be collected with a manual slide hammer coring device with precleaned acetate liners.

Soil Sample Logging and Collection

A goal of the RI is to depth-profile HVOC concentrations adjacent to and beneath the Bothell Service Center building. Thus a soil sample will be collected for chemical analysis every five feet of borehole. Laboratory chemical analysis are described in Section 2.2. At each sampling interval, field staff will log the soil samples and obtain and record pertinent information including soil sample depths, stratigraphy, ground water occurrence, and any visual or olfactory observations regarding the presence of contamination. Samples will be logged for lithology according to the Unified Soil Classification System (USCS), and field screened for organic vapors by headspace analysis using a photoionization detector (PID). Samples with elevated PID head space readings or discernible visual/olfactory contamination may be selected for

Field Screening

Soil samples will be screened for organic vapors by photoionization detector (PID) headspace analysis. Although the PID is not capable of quantifying or identifying specific organic compounds, this instrument is capable of measuring relative concentrations of a variety of organic vapors. The geologist/engineer collecting samples will place approximately two to sixteen ounces of soil in a resealable (i.e. ziplock) plastic bag with ample air headspace. After a minimum of five minutes at ambient temperature, the sampler will agitate the sample for ten seconds, insert the PID probe through a small opening in the plastic bag, and record the highest reading within ten seconds.

Underground Utilities/Site Access

Underground utilities will be identified by calling the Utilities Underground Location Center before drilling. A subcontracted private locating service may also be employed attempt to locate and mark underground utilities at proposed borehole locations inside and outside of the building.

Drill Cuttings Disposal

Drill cuttings will be removed as the boring is advanced. A member of the drilling crew will shovel cuttings into Department of Transportation-approved, 55-gallon steel drums equipped with locking rings. The drums will be stored prior to transport and disposal at a temporary fenced storage location on City-owned property.

Equipment Decontamination

To prevent potential cross-contamination of samples, appropriate decontamination procedures will be employed. Between sampling intervals in each borehole all sampling devices will be washed in a detergent solution, rinsed with tap water, and then rinsed again with deionized water.

Monitoring Well Installation

Angle borings will be completed as monitoring wells with two-inch diameter, stainless steel casing and screen. Stainless steel will be used because PVC casing and screen material may be adversely impacted by high concentrations of PCE in the source area, as well as subject to damage if thermal cleanup methods are selected later. Well filter packs will be emplaced via gravity and potable-water, which is considered feasible given the relatively steep angles of the boreholes.

Short screens (5 feet) will be used, and not placed across low permeability layers. Numerous stainless steel centralizers around the screen and casing will be utilized to ensure they remain near the center of the borehole. A cement/bentonite grout for annular and bottom (if needed) seals will be emplaced via tremie pipe placed at the bottom of the sealing interval under pressure, to ensure complete filling of the entire sealed interval and displacement of liquids and solids prior to sealing. The grout will include 9 pounds (around 10 percent) bentonite powder with around 7 gallons of water (adjusted for flowability) per 94 pounds of Portland cement.

The drillers will develop each monitoring well by surging and then pumping sediment containing water into 55-gallon steel drums equipped with locking rings. The drums will be stored prior to transport and disposal at a temporary fenced storage location on City-owned property.

The location and measuring point elevation of each new monitoring well and existing monitoring wells will be surveyed with respect to a City datum.

2.2 SOIL CHEMICAL ANALYSIS

This major investigation task consists of collecting soil samples for chemical analysis from the sonic drilling borings.

2.2.2 Soil Analyses

Soil samples will be submitted to a Washington Department of Ecology-accredited analytical laboratory for analyses for one or more of the following analytes by using the following test methods:

- Volatile Organic Compounds (VOCs) by EPA Method #8260
- Total Organic carbon (selected samples) by SM5310B/EPA9060A
- Bulk density (selected samples) by ASTM methods 4253/4
- Effective porosity (selected samples) by ASTM D7063

Specific analytical testing will be based on visual and field screening results. Samples will be submitted for standard turnaround time analysis (5-10 days). Follow-up analyses, based on initial analytical results may result in a total turnaround time of up to 4 weeks.

Field staff will determine the number, depth and location of samples in the field, based on field screening results. The sample bottle requirements are as follows:

Bottle Type	Method	Holding Time
VOAs – see below	VOCs	14 days
4 oz. Glass	Moisture Content	14 days
	TOC	14 days
At least 16 oz.	Density, Porosity	90 days

After collection, the samples will be labeled, placed in a cooler with ice, and shipped to the analytical laboratory for analysis.

Method 5035A for Collection of VOC Soil Samples

Bottle Type	Method	Holding Time
(2) tared VOAs w/stir bar (1) tared VOAs no stir bar (1) 4 oz. glass jar (moisture)	VOCs / 5035A	14 days

* deliver to lab within 48 hours

<u>VOAs are pre-weighed (tared) at the lab</u>

- Do not add any labels, tape, etc.
- Keep the same cap with each VOA

<u>Collect Core Sample</u>

- Sonic drilling - core immediately after opening liners, core from middle liner or inside end of outer liners (top one is usually slough)

<u>Soil types</u>

- Cohesive granular - use core
- Cemented (e.g. till) - break up with stainless steel spoon, place in VOA & cap as soon as possible
- Non cohesive (won’t stay in core) - place in VOA & cap as soon as possible

<u>Extrude core into VOA</u>

- Wipe threads with clean tissue or dry wipe
- Cap VOA
- Label - ball point pen (e.g., write in the rain) only, no markers

<u>Note in field notebook</u>

- Soil type, moisture

- Any bias e.g., gravels, organics (avoid both in core sample)
- Weather (temp, humidity, wind)
- Coring method used
- Preservation and storage method used

Health and Safety issues

- Skin contact (use gloves), inhalation hazards (ensure adequate ventilation)
- Check shipping restrictions

2.3 GROUND WATER SAMPLING

New monitoring wells will be allowed to stabilize for a minimum of 48 hours following development prior to sampling. Ground water will be sampled using low-flow purging methods. Sampling staff will measure ground water levels to the nearest 0.01-foot using a decontaminated electronic well probe prior to collection of samples. The volume pumped will be determined in the field based on stabilization of field parameters: specific conductance, dissolved oxygen, and pH, if flow is sufficient to continuously measure field parameters in a flow-through cell. Sampling points will be purged by very slowly lowering semi-rigid polyethylene tubing to a depth corresponding to roughly the midpoint of the well screen, securing the tubing to prevent vertical movement, connecting it to a peristaltic pump, and then pumping at a rate not to exceed 0.5 liters/minute (0.13 gallons/minute). At a minimum, two pump and tubing volumes will be purged (1/2-inch I.D. tubing = 0.010 gallon/lineal foot, 0.17-inch I.D. tubing = 0.001 gallon/lineal foot = 5 ml/lineal foot). Samples will be collected once the parameter values have stabilized over the course of three sets of measurements as follows:

specific conductance	10 μS/cm
dissolved oxygen	2 mg/L
pH	0.1

When filling the sample bottles, the following procedures and precautions will be adhered to:

1. Sample bottles will be filled directly from the pump discharge tubing with minimal air contact.
2. Bottle caps will be removed carefully so that the inside of the cap is not touched. Caps must never be put on the ground. Caps for volatile organic compound (VOC) vials will contain a Teflon-lined septum. The Teflon side of the septum must be facing the sample to prevent contamination of the sample through the septum.
3. The sampling team will wear appropriate nonpowdered latex or nitrile gloves (PVC or vinyl gloves can leave trace levels of phthalate or vinyl chloride). Gloves will be changed between wells or more often.
4. Tubing or hoses from the sampling systems must not touch or be placed in the sample bottles.
5. VOC vials must be filled so that they are headspace-free. These sample bottles therefore need to be slightly overfilled (water tension will maintain a convex water surface in the

bottle). The caps for these bottles will be replaced gently, to eliminate air bubbles in the sample. The bottles must then be checked by inverting them and tapping them sharply with a finger. If air bubbles appear, open the bottle, add more water, and repeat the process until all air bubbles are gone. Do not empty the bottle and refill it, as VOC bottles already contain preservatives.

6. Sample bottles, caps, or septums that fall on the ground before filling will be discarded.
7. Metals sampling will be conducted with “clean technique.” Bottles will be bagged in plastic and the cap placed in the bag during sampling.

If a monitoring well is pumped dry prior to reaching the desired purge volume, it will be allowed to recover prior to sampling, using the minimum time between purging and sampling that would allow collection of sufficient sample volume. Samples will be pumped directly into the appropriate containers, as provided by the laboratory. A Field Data Sampling Sheet (provided in Appendix A) will be filled out for each sample. New tubing will be used at each location.

2.3.1 Water Analyses

Water samples will be submitted to the analytical laboratory for one or more of the following analyses:

- Volatile Organic Compounds (VOCs) - EPA Method #8260

The sample bottle requirements are as follows:

Bottle Type	Analytes	Preservative	Holding Time
(2) 40 ml VOA	VOCs Methane/ethene/ethane	HCl to pH<2	14 days
250mL HDPE	Nitrate, Sulfate, Chloride	<6ºC	2 days

After collection, the samples will be labeled, chilled in a cooler, and shipped to the laboratory for analysis. Samples will be submitted for standard laboratory turnaround time (5-10 days).

2.4 QUALITY ASSURANCE/QUALITY CONTROL

Samples will be collected and analyzed with sufficient quality assurance/quality control (QA/QC) to ensure representative and reliable results. The overall QA objective for this investigation is to ensure that all laboratory and field data on which decisions are based are technically sound, statistically valid, and properly documented. There are two parts to the QA/QC program for this project: field and laboratory.

Field QA/QC includes proper documentation of field activities and sampling/handling procedures. Field QA/QC samples will consist of the following:

SOIL

- One equipment blank (a.k.a., rinsate blank) at a minimum frequency of 5% of soil samples collected – not needed if using disposable sample liners. Contaminant-free water is poured over sampling equipment and then collected for analyses. The presence of measurable concentrations of contaminants in an equipment blank indicates the potential for cross contamination between sampling locations when sample collection equipment is used to collect samples at more than one location. Because equipment blanks are a measure of cross contamination, they may be helpful in assessing the accuracy and representativeness of field measurements. The detection of measurable concentrations of contaminants in an equipment blank is indicative of the potential for the reported concentrations to be higher than the actual concentrations in the samples (false positives).

- One matrix spike/matrix spike duplicate (MS/MSD) at a minimum frequency of 5% of soil samples collected. MS/MSD samples will be selected by the field geologist/engineer and three times the normal sample volume will be collected to accommodate the extra sample required to perform the MS/MSD analysis. It is critical that the sample submitted to the laboratory for MS evaluation is representative of the potentially contaminated matrix. The sample selected for MS/MSD evaluation should not contain significant concentrations of the contaminants as compared with the spike concentrations as this may prevent accurate measurements of the spiked compound's recovery.

- One trip blank per cooler of samples (analysis for VOCs only). For solid samples, trip blanks consist of a vial containing methanol. Trip blanks accompany the empty sample containers from the laboratory to the field and return with the collected samples from the field to the laboratory.

GROUND WATER

- One field duplicate at a minimum frequency of 5% of water samples collected.

- One matrix spike/matrix spike duplicate (MS/MSD) at a minimum frequency of 5% of water samples collected. MS/MSD samples will be selected by the field geologist and three times the normal sample volume will be collected to accommodate the extra sample required to perform the MS/MSD analysis.

- 1 trip blank per cooler of samples (analysis for VOCs only)

Field Duplicates are used to confirm analytical results from a given sample point. Duplicate samples are collected in the field using a matching set of laboratory-supplied bottles and sampling from the selected well, as requested. Each duplicate should be sampled by alternating between the regular and the duplicate sample bottles, proceeding in the designated sampling order (VOCs first). The location where the duplicate is collected must be identified on the field sampling data sheet. All duplicates shall be blind-labeled (i.e., the well designation is not listed on the sample bottle or Chain-of-Custody form). Once a duplicate is collected, it is handled and shipped in the same manner as the rest of the samples. Duplicate results will be reported in the laboratory results as separate samples, using the designation DUP-(#).

Trip blanks are used to detect contamination that may be introduced in bottle preparation, in transit to or from the sampling site, or in the field. Trip blanks are samples of volatile-organic-free, laboratory-quality water (Type II reagent grade) that are prepared at the laboratory. They remain with the sample bottles while in transit to the site, during sampling, and during the return trip to the laboratory. Trip blank sample bottles are not opened at any time during this process. Trip blanks are to be reported in the laboratory results as separate samples, using the designation TB-(#). Each sample cooler that includes bottles for VOC analysis must include a trip blank, whether it was requested or not.

Equipment blanks are used to detect residue from decontaminated equipment. Equipment blanks are to be reported in the laboratory results as separate samples, using the designation EB-(#).

Laboratory QA/QC analyses provide information about accuracy, precision, and detection limits. Method-specific QA/QC samples may include the following, depending on the analysis:

- Method blanks
- Duplicates
- Instrument calibration verification standards
- Laboratory control samples
- Surrogate spiked samples
- Performance evaluation QC check samples

2.4.1 Data Evaluation

Data evaluation will include checking holding times, method blank results, surrogate recovery results, field and laboratory duplicate results, completeness, detection limits, laboratory control sample results, and Chain-of-Custody forms.

2.6 FIELD DOCUMENTATION AND CHAIN-OF-CUSTODY

The following sections describe the recording system for documenting all site field activities, and the sample chain-of-custody program.

2.6.1 Field Log Book

An accurate chronological recording of all field activities is vital to the documentation of any environmental investigation. To accomplish this, field team members will maintain field log books providing a daily record of significant events, observations, deviations from the sampling plan and measurements collected during the field activities.

2.6.2 Sample Identification

Following sample collection, field personnel will affix labels to each sample container. Samplers will use waterproof ink, plastic bags, or clear tape to ensure labels remain legible even when wet. Samplers will record the following information on the labels:

- Project name and number
- Sample identification number
- Date and time of collection
- Required test methods
- Name of sample collector

2.6.3 Chain-Of-Custody Record

The objective of the chain-of-custody program is to allow the tracking of possession and handling of individual samples from the time of field collection through laboratory analysis. Once a sample is collected, it becomes part of the chain-of-custody process. A sample is "in custody" when (1) it is in someone's possession, (2) it is within visual proximity of that person, (3) it is in that person's possession, but locked up and sealed (e.g., during transport), or (4) it is in a designated secure sample storage area. Sampling staff will complete a chain-of-custody record (Appendix A) which will accompany each batch of samples. The record will contain the following information:

- Project name and number
- Names of sampling team members
- Requested testing program
- Required turnaround time
- Sample number
- Date and time collected
- Sample type
- Number of containers
- Special Instructions
- Signatures of persons involved in the chain of possession

When sample custody is transferred to another individual, the samples must be relinquished by the present custodian and received by the new custodian. This will be recorded at the bottom of the chain-of-custody report where the persons involved will sign, date and note the time of transfer.

Sampling team members will keep sample coolers in locked vehicles while not in active use or visual range. If couriers are used to transport samples, chain of custody seals will be affixed to coolers.

2.6.4 Photographic Records

The field team leader will determine situations requiring photographic documentation. The field logbook will include the following information for each site photograph:

- Date, time, location photograph was taken
- Description of photograph taken

- Sequential number of the photograph
- Direction of photographic view

2.7 PRELIMINARY ARAR'S AND DETECTION LIMITS

Applicable state and federal laws include legally applicable requirements and those requirements that are relevant and appropriate. According to MTCA (WAC-340-710), legally applicable requirements are cleanup standards, standards of control, and other environmental protection requirements, criteria, or limitations adopted under state or federal law that specifically address a hazardous substance, cleanup action, location or other circumstances at the site.

Relevant and appropriate requirements are those cleanup standards, standards of control, and other environmental requirements, criteria, or limitations established under state or federal law that, while not legally applicable to the hazardous substance, cleanup action, location, or other circumstance at a site, address problems or situations sufficiently similar to those encountered at the site that their use is well suited to the particular site.

Table 1 summarizes potential Applicable or Relevant and Appropriate Requirements (ARARs) identified for the Bothell Service Center RI/FS. These ARARs are chosen based on a knowledge of site contaminants, potential exposure pathways, and potentially applicable state and federal laws and rules. The table includes method detection and practical quantitation limits for the relevant chemicals. Final determination of site specific ARARs will occur during RI/FS report preparation.

TABLE 1
POTENTIAL ARARs & LABORATORY REPORTING LIMITS

Compound	Ground Water ARAR - Federal Primary Maximum Contaminant Level (MCL) (mg/L)	Ground Water ARAR - State Primary Maximum Contaminant Level (MCL) (mg/L)	Soil, Method A, Unrestricted Land Use, Table Value (mg/kg)	Soil, Method B, Carcinogen, Standard Formula Value, Direct Contact (ingestion only), Unrestricted land use (mg/kg)	Soil, Method B, Non-carcinogen, Standard Formula Value, Direct Contact (ingestion only), Unrestricted land use (mg/kg)	Method Detection Limit (soil - mg/kg)	Laboratory Reporting Limit (soil - mg/kg)	Method Detection Limit (water - mg/L)	Laboratory Reporting Limit (water - mg/L)
Tetrachloroethene	5.0E-03	5.0E-03	5.0E-02	1.9E+00	8.0E+02	2.52E-03	1.00E-02	4.97E-04	2.00E-03
Trichloroethene	5.0E-03	5.0E-03	3.0E-02	1.1E+01	2.4E+01	2.88E-03	1.00E-02	2.86E-04	2.00E-03
Cis-1,2-Dichloroethene	70	70	NV	NV	8E+02	2.76E-03	1.00E-02	3.41E-04	2.00E-03
Vinyl Chloride	2.0E-03	2.0E-03	NV	6.7E-01	2.4E+02	5.88E-04	1.00E-02	4.70E-02	2.00E-01
1,2-Dichloroethane	5.0E-03	5.0E-03	NV	1.1E+01	1.6E+03	3.95E-04	1.00E-02	2.77E-02	2.00E-01

Note: NV – No established value

3.0 QUALITY ASSURANCE PROJECT PLAN

The purpose of this Quality Assurance Project Plan (QAPP) is to ensure that all necessary steps are taken to acquire data of the type and quality needed. To accomplish this purpose the QAPP will contain the following elements:

- Field QA/QC
- Chain of custody procedures
- Decontamination procedures
- Laboratory analysis and QA/QC methods
- Sample custody procedures including holding times, containers, and preservation

3.1 Field QA/QC Methods

Field QA/QC methods include the collection of equipment blanks, MS/MSD samples, and trip blanks for soil samples. For ground water samples these methods include the collection of field duplicates, MS/MSD samples, and trip blanks. A detailed description of these samples is provided in Section 2.4.

3.2 Chain of Custody Procedures

Chain-of-custody procedures allow the tracking of possession and handling of individual samples from the time of field collection through laboratory analysis. Detailed chain of custody handling procedures are described in Section 2.8.

3.3 Decontamination Procedures

In order to mitigate the potential for cross-contamination, all sample-contacting, and downhole equipment used in the collection and sampling processes will be decontaminated before sample collection.

The following steps will constitute the decontamination procedure:

1. Wash items in a solution of non-phosphate (e.g., Alconox) detergent and tap water
2. Rinse with tap water
3. Rinse with deionized water
4. Air dry in a clean environment

Decontaminated equipment will be stored and transported in clean containers or wrapping.

3.4 Laboratory Analysis and QA/QC Methods

Laboratory QA/QC samples will consist of the following:

- One matrix spike (MS) per sampling batch
- One matrix spike duplicate (MSD) per sampling batch

Method-specific QA/QC samples may include the following:

- Method blanks
- Duplicates
- Instrument calibration verification standards
- Laboratory control samples
- Surrogate spiked samples
- Performance evaluation QC check samples

3.5 Sample Custody Procedures

Sample custody procedures for soil and water samples are described in Sections 2.2 and 2.3 respectively.

4.0 HEALTH AND SAFETY

Personnel conducting this field program are required to follow the health and safety protocol presented in the site specific Health and Safety Plan. Subcontractors and other authorized visitors to the site are responsible for their own health and safety. The Health and Safety Plan will be made available to subcontractors and other site visitors who request it. Health and Safety precautions will be communicated to subcontractors by project personnel in site safety briefings at the beginning of each field day. To acknowledge review and comprehension of this plan, all field personnel must sign the appropriate section included in the back of the document. The Health and Safety Plan is provided as a separate document.

APPENDIX A of SAP

CHAIN OF CUSTODY FORM
FIELD SAMPLING DATA SHEET

HWA GEOSCIENCES INC.
19730 64th Ave. W., Suite 200, Lynnwood, WA 98036 (425)774-0106
4500 Kruse Way, Suite 300, Lake Oswego, OR 97035 (503)675-2424

Chain of Custody and Laboratory Analysis Request

DATE: ______
PAGE: ___ of ___

PROJECT NAME: ______ #: ______
SITE CODE: ______
SAMPLERS NAME: ______ PHONE: ______
SAMPLERS SIGNATURE: ______
HWA CONTACT: ______ PHONE: ______

HWA SAMPLE ID	DATE	TIME	MATRIX	LAB ID	# OF BOTTLE	ANALYSIS REQUESTED															REMARKS

	PRINT NAME	SIGNATURE	COMPANY	DATE	TIME	REMARKS
Relinquished by:						
Received by:						
Relinquished by:						
Received by:						

DISTRIBUTION: WHITE - Return to HWA; YELLOW - Retain by Lab; PINK - Retain by Sampler

HWA GEOSCIENCES INC.
19730 64th Avenue West, Suite 200 Lynnwood, WA 98036
Tel: 425-774-0106 / Fax: 425-774-2714 / E-Mail: hwa@hongwest.com

FIELD SAMPLING DATA SHEET

Project Name: ______________________
Project Number: ______________________
Project Location: ______________________
Client/Contact: ______________________

Well Number: ______________________
Sample Number: ______________________
Weather: ______________________
Date: ______________________

WELL MONITORING:

Time	Well Depth	Depth to Water	Measuring Point (TOC?)	Measuring Point Elevation	Water Level Elevation	Gallons in Well (Pore Volume)

(2" case = 0.163 gal/ft)
(4" case = 0.653 gal/ft)

WELL PURGING:

Time	Method	Gallons	Pore Volumes	pH	Conductivity	Temperature		

WELL SAMPLING:

Time	Sampling Method	Sample Analysis	Container Number	Container Volume	Container Type	Field Filtered (Y/N)	Preservative	Iced (Y/N)

COMMENTS/NOTES: (Include equipment used: Bailers, Filters, Well Probe, pH/Conductivity Meter, etc.)

Total # of Bottles: ______ Sampler: ______________ Signature: ______________________

APPENDIX B

Health and Safety Plan

REMEDIAL INVESTIGATION FEASIBILITY STUDY
HEALTH AND SAFETY PLAN
BOTHELL SERVICE CENTER SITE
BOTHELL, WASHINGTON

Project No. 2007-098-2022

Prepared for
City of Bothell

January 19, 2015

HWA GEOSCIENCES INC.

- Geotechnical Engineering
- Hydrogeology
- Geoenvironmental Services
- Inspection & Testing

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

SITE HEALTH AND SAFETY PLAN

SUMMARY INFORMATION

SITE LOCATION	18107 Bothell Way NE Site Telephone - None
NEAREST HOSPITAL	Care Plus Medical Ctr: 17511 68th Ave NE Kenmore, WA 98028 425-486-8300 The route from the facility to the hospital is depicted on Figure 1.
EMERGENCY RESPONDERS	Police Department .... 911 Fire Department .... 911 Ambulance 911
EMERGENCY CONTACTS	HWA Bothell Office ....(425) 774-0106 HWA H&S Officer, Tink Kinney ..(425) 774-0106 cellular.(206) 794-3380 HWA PM Arnie Sugar ....(425) 774-0106 cellular.................. (206) 794 3130 National Response Center..............(800) 424-8802

In the event of an emergency, call for help as soon as possible.
Give the following information:

- WHERE the emergency is - use cross street or landmarks
- PHONE NUMBER - you are calling from
- WHAT HAPPENED - type of injury
- HOW MANY - persons need help
- WHAT - is being done for the victim(s)
- YOU HANG UP LAST - let the person you called hang up first

SITE HEALTH AND SAFETY PLAN SUMMARY

LOCATION: 18107 Bothell Way NE

PROPOSED DATES OF ACTIVITIES: Spring 2015

TYPE OF FACILITY: Dry cleaning

LAND USE OF AREA SURROUNDING FACILITY: Commercial and government

POTENTIAL SITE CONTAMINANTS: Volatile organic compounds (VOCs)

POTENTIAL SITE HAZARDS:

1. Chemical – Exposure to site contaminants listed above
2. Physical – site traffic, drilling machinery, noise, overhead and underground utilities, heat/cold stress, slips, trips and falls, fire, explosion

ROUTES OF ENTRY: Airborne vapors and dust; skin contact with soil, free product, or groundwater; and incidental ingestion of soil.

PROTECTIVE MEASURES: Engineering controls, safety glasses, safety boots, hard hat, gloves, protective clothing, and respirators.

MONITORING EQUIPMENT: Photoionization detector

SITE ACTIVITIES: Subsurface investigation to assess the presence and/or extent of affected soils and ground water resulting from historic releases at the site.

1.0 INTRODUCTION

1.1 Purpose and Regulatory Compliance

This site-specific Health and Safety Plan (H&S Plan) addresses procedures to minimize the risk of chemical exposures and physical accidents to on-site workers, as described above. The H&S Plan covers each of the 11 required plan elements as specified in WAC 296-843-12005. To help the reader find this required information, Table 1 shows the major sections where each of these elements are discussed. Additional supporting information is presented throughout this plan, and the reader is advised to thoroughly review the entire plan. When used together with the HWA GeoSciences Inc. (HWA) Corporate H&S Plan, this site-specific plan meets applicable regulatory requirements.

Table 1 - Location of Required Health and Safety Plan Elements

Required Health and Safety Plan Elements *		Location in this Health and Safety Plan (Section number shown)
Required Elements		
(i)	Safety and hazard analysis	2.0 Hazard Evaluation and Control Measures (see also 2.7 Hazard Analysis by Task)
(ii)	Organization chart	1.3 Chain of Command
(iii)	Comprehensive work plan	1.4 Work Activities (and Site-Specific Sampling and Analysis Plan, by reference)
(iv)	Site control plan	Introduction. Health and Safety Plan Summary 1.5 Site Location and Description 5.0 Exclusion Areas 9.0 Site Security and Control
(v)	Personal protective equipment	3.0 Protective Equipment 4.0 Safety Equipment List
Additional Elements		
	Monitoring program	2.3 Air Monitoring and Action Levels
	Site Control Measures	9.0 Site Security and Control
	Decontamination	7.0 Decontamination
	Spill containment	10.0 Spill Containment
	Standard operating procedures for sampling, managing and handling drums and containers	Not Applicable, or Site-Specific Sampling and Analysis Plan, by reference
	Confined space entry	2.6 Confined Spaces
	Training, briefing and information	13.0 Training Requirements
	Medical surveillance	12.0 Medical Surveillance
	Emergency response plan	11.0 Emergency Response Plan
	Lighting	Corp H&S Plan Sec. 8.7
	Excavations	Corp H&S Plan Sec. 8.7

*Required H&S Plan elements are numbered according to their listing in WAC 296-843-12005

1.2 Distribution and Approval

This H&S Plan will be made available to all HWA personnel involved in field work on this project. It will also be made available to subcontractors and other non-employees who may need to work on the site. Subcontractors and non-employees will follow the provisions in this plan as minimum recommendations. Specific work activities of a subcontractor may require different or more stringent safety measures than contained in this plan. For non-HWA employees, it must be made clear that this plan represents minimum safety procedures and that they are responsible for their own health and safety and regulatory compliance while present on site.

The plan has been approved by the HWA Health and Safety (H&S) Manager. By signing the documentation form provided with this plan, project workers also certify their approval and agreement to comply with the plan.

1.3 Chain of Command

The chain of command for Health and Safety in HWA projects involves the following individuals: the Corporate H&S Manager, Project Manager, Project H&S Manager, and the Field H&S Manager. In some cases, based on the complexity of the project and level of staffing, the project and field related H&S positions may be combined. If the specified Field H&S Manager is unable to be present on-site during work activities, the Project H&S Officer will serve as the on-site safety officer or, alternatively, another Field H&S Manager will be named.

Project Manager: Arnie Sugar. The Project Manager is charged with overall responsibility for the successful outcome of the project. The Project Manager, in consultation with Corporate H&S Manager, makes decisions regarding the implementation of the Site H&S Plan. The Project Manager may delegate this authority and responsibility to the Project and /or Field H&S Managers

Corporate H&S Officer: Tink Kinney. The HWA Corporate H&S Officer has overall responsibility for preparation and modification of this H&S Plan. In the event that health and safety issues arise during site operations, he will attempt to resolve them in discussion with the appropriate members of the project team.

Project H&S Officer: Norm Nielsen. The Project H&S Manager has overall responsibility for health and safety on this project. This individual ensures that everyone working on this project understands this H&S Plan. He will maintain liaison with the HWA Project Manager so that all relevant safety and health issues are communicated effectively to project workers.

Field H&S Manager: Norm Nielsen. The Field H&S Manager is responsible for implementing this H&S Plan in the field. This individual also observes subcontractors to verify that they are following these procedures, at a minimum. The Field H&S Manager will also assure that proper protective equipment is available and used in the correct manner, decontamination activities are carried out properly, and that employees have knowledge of the local emergency medical system should it be necessary.

1.4 Work Activities

Planned site work includes hollow-stem auger soil boring, soil sampling, and ground water sampling

1.5 Site Location and Description

The site is located at 18107 Bothell Way NE, Bothell, WA.

2.0 HAZARD EVALUATION AND CONTROL MEASURES

2.1 Toxicity of Chemicals of Concern

Based on previous site information and knowledge of the types of activities conducted at this location, halogenated volatile organic compounds may be present in the soils or ground water at several of the sampling locations.

Pertinent toxicological properties of these chemicals are discussed below. This information generally covers potential toxic effects which may occur from relatively significant acute and/or chronic exposures, and is not meant to indicate that such effects will occur from the planned site activities. In general, chemicals which may be encountered at this site are not expected to be present at concentrations which could produce significant exposures. The types of planned work activities should also limit potential exposures at this site. Furthermore, appropriate protective and monitoring equipment will be used as discussed below to further minimize any exposures which might occur.

As a point of reference, standards for occupational exposures to these chemicals are included where available. Site exposures are generally expected to be of short duration and well below the level of any of these exposure limits. These standards are presented using the terminology defined by the Washington State General Occupational Health Standards (WAC 296-62, Part H) as follows:

PEL - Permissible exposure limit.

TLV – Threshold Limit Value for any 8-hour work shift or 40-hour work week

TWA - Time-weighted average exposure limit for any 8-hour work shift or 40-hour work week.

STEL - Short term exposure limit expressed as a 15-minute time-weighted average and not to be exceeded at any time during a work day.

C - Ceiling exposure limit not to be exceeded at any time during a work day.

IDLH - The concentration at which a compound is considered immediately dangerous to life and health.

Tetrachloroethene. Tetrachloroethene, also known as perchloroethylene, or PCE, is a commonly used solvent in dry cleaning and degreaser, and is a common environmental contaminant. PCE is a colorless liquid with a somewhat sweet odor. PCE vapor can be irritating to the eyes, nose and throat. Inhalation can cause nausea, sleepiness, dizziness, confusion, and loss of consciousness. PCE is a is a potential human carcinogen, with a PEL-TWA of 100 ppm (OSHA) and a STEL of 200 ppm.

Trichloroethylene. Trichloroethylene, also known as trichloroethene, or TCE, is a commonly used solvent and degreaser, and is one of the most common environmental contaminants. TCE vapor can be irritating to the eyes, nose and throat. Inhalation can cause nausea, difficult breathing, and loss of consciousness. TCE is a potential human carcinogen, with a PEL-TWA of 25 ppm (NIOSH), 50 ppm (OSHA) and a STEL of 200 ppm.

1,2-Dichloroethane. 1,2-Dichloroethane, also known as ethylene dichloride, EDC, or 1,2-DCA is used in the manufacturing of vinyl chloride, PCE, and TCE. It is also used as a solvent and as a gasoline additive. 1,2-DCA is a colorless liquid with a somewhat sweet odor. 1,2-DCA vapor can be irritating to the eyes, nose and throat. Inhalation can cause bronchitis, central nervous system depression, dizziness, vomiting, partial paralysis, and liver and kidney damage. 1,2-DCA is a is a potential human carcinogen, with a PEL-TWA of 1 ppm (4 mg/m^3) (NIOSH), 50 ppm (OSHA) and a STEL of 2 ppm (8 mg/m^3) (NIOSH).

2.2 Potential Exposure Routes

Inhalation. Exposure via this route could occur if volatile chemicals become airborne during site activities, especially upon exposure to open air, warm temperatures, and sunlight. Air monitoring and control measures specified in this plan will minimize the possibility for inhalation of site contaminants.

Skin Contact. Exposure via this route could occur if contaminated soil, water or product contacts the skin or clothing. Dusts generated during soil movement may also settle on exposed skin and clothing of site workers. Protective clothing and decontamination activities specified in this plan will minimize the potential for skin contact with the contaminants.

Ingestion. Exposure via this route could occur if individuals eat, drink, use tobacco products, or perform other hand-to-mouth contact in the contaminated (exclusion) zones.

Decontamination procedures established in this plan will minimize the inadvertent ingestion of contaminants.

2.3 Air Monitoring and Action Levels

Air monitoring will be conducted to determine possible hazardous conditions and to confirm the adequacy of personal protection equipment. The results of the air monitoring will be used as the basis for specifying engineering controls, personnel protective equipment (PPE) and determining the need to upgrade protective measures. If possible, engineering controls should be implemented to meet air monitoring action levels before upgrading protective measures. Engineering controls include applying water for dust control, forced air ventilation (brush fans), and moving work activities upwind of contaminant sources.

All air monitoring equipment will be calibrated prior to use as specified by the instrument manuals and results will be documented in the instrument log. All equipment will be maintained as specified by the manufacturer or more frequently as required by use conditions, and repair records will be maintained with the instrument log.

PID Monitoring. Air monitoring will be conducted with a photoionization detector (PID) to measure organic vapor concentrations during site work activities. PID readings will be taken at the beginning of each day, at each new test pit or boring location, and whenever field personnel report or detect organic or other odors. If PID measurements are 5 ppm above ambient background levels in the worker's breathing zones for five consecutive minutes, then site workers exposed to these levels will use air purifying respirators with organic vapor cartridges. At this point, air monitoring downwind from the work site will also be initiated. If the downwind monitoring indicates potential for off-site exposure, work will cease pending re-evaluation of the task. If PID measurements exceed 100 ppm in the breathing zone, site work will cease pending re-evaluation of the situation by the H&S Manager.

Table 2 summarizes site action levels and response measures.

TABLE 2 - ACTION LEVELS (use engineering controls first)

PID* (BZ)	PID* (SB)	LEL (BZ)	OXYGEN (BZ)	ACTION
< 5 ppm		<10%	19.5 - 23.5%	Level D
5-50 ppm		<10%		Upgrade to level C or modified level D** Begin downwind air monitoring
>50 ppm	>5 ppm	>10%	<19.5% >23.5%	Cease Operations ***

* Concentrations above ambient background concentrations
** See Section 3.2 for conditions for respiratory protection
*** If <u>any</u> of the listed conditions are met
BZ - Breathing zone
SB - Site boundary

2.4 Fire and Explosion Hazard

Potentially explosive conditions may be encountered where hydrocarbon or other flammable gases or vapors have accumulated. Care will be exercised at all times during field activities where flammables are known or suspected to be present.

If flammable chemical products are encountered as a separate phase or as vapors, constant attention to readings obtained from the CGM will be necessary to avoid exceeding the lower explosive limit. Observe basic precautions such as no smoking or creation of sparks or open flames.

2.5 Heat and Cold Stress

Heat Stress. Use of impermeable clothing reduces the cooling ability of the body due to evaporation reduction. This may lead to heat stress. If such conditions occur during site activities, employees will maintain appropriate work-rest cycles and drink water or electrolyte-rich fluids (Gatorade or equivalent) to minimize heat stress effects. Water will be available either in capped bottles or dispensed into clean disposable cups. Refilling of open containers will not be permitted. Also, when ambient temperatures exceed 70^{o} F, employees will conduct monitoring of pulse rates. Personnel will plan for the weather and arrange to take breaks in the shade as much as possible.

Each employee will check his or her own pulse rate at the beginning of each break period. Take the pulse at the wrist for 6 seconds, and multiply by 10. If the pulse rate exceeds 110 beats per minute, then reduce the length of the next work period by one-third.

Example: After a one-hour work period at 80 degrees, a worker has a pulse rate of 120 beats per minute. The worker must therefore shorten the next work period by one-third, resulting in a work period of 40 minutes until the next break.

Hypothermia. Hypothermia can result from abnormal cooling of the core body temperature. It is caused by exposure to a cold environment, and wind-chill as well as wetness or water immersion can play a significant role. The following sections discuss signs and symptoms as well as treatment for hypothermia.

Signs of Hypothermia. Typical warning signs of hypothermia include fatigue, weakness, lack of coordination, apathy, and drowsiness. A confused state is a key symptom of hypothermia. Shivering and pallor are usually absent, and the face may appear puffy and pink. Body temperatures below 90^{o} F require immediate treatment to restore temperatures to normal.

Treatment of Hypothermia. Current medical practice recommends slow rewarming as treatment for hypothermia, followed by professional medical care. This can be accomplished by moving the person into a sheltered area and wrapping with blankets in a warm room. In emergency situations where body temperature falls below 90^{o} F and heated shelter is not available, use a sleeping bag, blankets and/or body heat from another individual to help restore normal body temperature.

2.6 Other Physical Hazards

Trips/Falls. As with all field work sites, caution will be exercised to prevent slips on wet surfaces, stepping on sharp objects, etc. Work will not be performed on elevated platforms without fall protection.

Confined Spaces. Confined space entry is not anticipated for this project. Personnel will not enter any confined space without specific approval of the Project Manager and H&S Manager. In addition, no entry into a confined space will be attempted until the atmosphere of the confined space is properly tested and documented by the Field H&S Manager or designated representative and a self contained breathing apparatus is available on-site. A confined space entry permit must also be issued and followed. All specified precautions must be carefully followed, including upgrading of personal protective equipment as directed by the Field H&S Manager or designated representative.

Noise. Appropriate hearing protection (ear muffs or ear plugs) will be used if high noise levels are generated. High noise is determined by having difficulty hearing or conversing in a normal tone of voice.

2.7 Hazard Analysis and Applicable Safety Procedures by Task

Drilling. Drilling activities will be conducted with appropriate splash protection as discussed under personnel protective equipment requirements. Noise protection must also be available and used whenever drilling activities are in progress. In addition, exclusion zones will be established for worker protection as discussed below.

Atmosphere Testing/Conditioning for Soil Borings. The following procedures are designed to address the atmosphere testing/conditioning procedures necessary for soil borings which may involve release of flammable and/or toxic gases .

1. If gas or vapor venting occurs from a soil boring or other source, immediately position upwind from the source. If necessary, use respiratory protection as discussed below.

   If the odor of natural gas is detected or if it is suspected that a pipeline has been hit, immediately stop work, evacuate the area, and contact the proper authorities.

2. Always keep the following points in mind when soil venting or other release of gas or vapor occurs:

- Never work in an area which is above 10% of the combustible gas LEL or above the hydrogen sulfide warning limit, as discussed below.

- Never continue to work in an area, even if LEL and hydrogen sulfide tests are acceptable, if you begin to notice strange odors or symptoms of overexposure (such as dizziness, nausea, tearing of the eyes, etc.). If this occurs, always stop work and evacuate the area pending further evaluation.

3. If natural gas or other pipeline material is not involved and the venting continues, stop work and perform appropriate testing using a combustible gas/hydrogen sulfide gas monitor (e.g., MSA 361 or equivalent). Proceed as follows:

   - If testing indicates no hazard, resume work and continue periodic testing.

   - If testing indicates combustible gases present below 10% of the LEL, verify the absence of hydrogen sulfide and resume work with continued monitoring. If vapors are detected in the work area, use fans or other means to disperse as appropriate. Consult with the H&S Manager to determine whether other types of testing may be required to verify that exposure levels are within acceptable limits. Use respiratory protection as necessary, based on testing results and other site-specific information.

   - If testing indicates combustible gases present above 10% of the LEL, assume that an explosion hazard exists. Do not resume work until testing shows the hazard had been removed. In some cases, this may be accomplished by allowing the gas to dissipate by natural or fan-forced ventilation. It also may be necessary or useful to inert a well or boring by introducing nitrogen or carbon dioxide through a non-conductive line. Water or drilling mud may be used to replace air in some bore holes and thereby eliminate the explosion risk. Verify the absence of hydrogen sulfide and resume work only when testing shows the explosion hazard has been removed. Continue to test on a regular basis to ensure that the atmosphere remains inert.

   - If testing indicates presence of hydrogen sulfide, apply the same ventilation or inerting procedures as described above. Do not work in areas where the hydrogen sulfide concentration is above the applicable exposure level (the Washington State PEL-TWA for hydrogen sulfide is 10 ppm, with STEL of 15 ppm) without appropriate respiratory protection (supplied air). Resume work only when testing shows that the exposure level is within acceptable limits. Continue to monitor on a regular basis to ensure that the atmosphere remains safe.

4. Prior to any welding, cutting, or other hot work at the borehole, test the borehole atmosphere with a CGM. If the work area atmosphere exceeds 10 % LEL, do not proceed with the work until engineering controls can be implemented and the hot work area atmosphere reduced to below 10 % LEL. Test the work area continuously during hot work to ensure safe conditions for the duration of the work. Full-face shield welding masks will be worn during any welding or cutting at the borehole.

3.0 PROTECTIVE EQUIPMENT

In this plan, Level D is presented as a protection level, incorporating respiratory or skin contact protection only where required by site conditions or as specified under the previous discussion. Situations requiring Level A or B protection are not anticipated for this project. Should they occur, work will stop and the H&S Plan will be amended as required prior to resuming work

3.1 Level D Activities

Workers performing general site activities where skin contact with free product or contaminated materials is not likely and inhalation risks are not expected will wear regular work clothes, regular or polyethylene coated Tyvek coveralls if needed, eye protection and hard hat (as required) nitrile or neoprene coated work gloves (as required), and safety boots.

Workers performing site activities where skin contact with free product or contaminated materials is possible will wear chemical-resistant gloves (nitrile, neoprene, or other appropriate outer gloves, surgical inner gloves) and saranex or polyethylene coated Tyvek or other chemically-resistant suit. Make sure the protective clothing and gloves are suitable for the types of chemicals which may be encountered on site. Use face shields or goggles as necessary to avoid splashes in the eyes or face.

3.2 Level C Activities

Upgrading to Level C will occur if inhalation and skin contact hazards exist. Level C will consist of Level D equipment plus air purifying respirators (APRs) with organic vapor cartridges, surgical inner gloves, Nitrile outer gloves, rubber work boots or rubberized overboots, and saranex or polyethylene-coated Tyvek or other chemically-resistant suit. If inhalation hazards exist without skin contact hazards, a modified level D protection level can be used, consisting of level D protection plus APRs.

The following conditions must be met prior to any respirator use:

- Employee must be trained in proper respirator use, maintenance, selection, and limitations.
- Employee must have a current fit test for the respirator being used.

- Respirator must be in proper working order and inspected before use.
- In the event a positive pressure, supplied air breathing apparatus or positive pressure respirator becomes necessary, individual instructions detailing the need, use and limitations of these systems will be provided by the H&S officer.

An air purifying respirator (APR) should be used only if:

- Contaminants are known and measurable with proper monitoring equipment. APRs will not offer protection from hydrogen sulfide (H_2S), hydrogen cyanide (HCN), carbon monoxide (CO), other toxic gases, and oxygen deficient atmospheres.
- Contaminant has adequate warning properties.
- Concentrations are < IDLH (immediately dangerous to life and health).
- Ambient atmosphere contains 19.5 - 23.5 percent oxygen.
- Concentrations are < maximum use limit of the cartridge.
- Appropriate and fresh cartridges are used.
- Air monitoring is continued during APR use.
- Concentrations are < PF x PEL or TLV (see below).

	PF
1/4 or 1/2 mask APR	10*
1/4 or 1/2 mask PD SCBA	10
1/4 or 1/2 mask supplied air	10
full face APR	100*
full face PD SCBA	100
PP SCBA / supplied air	100

PF - Protection factor | PEL - Permissible exposure limit
TLV - Threshold limit value | SCBA - Self contained breathing apparatus
PD - Pressure demand | PP - Positive pressure
* or maximum use limit of cartridge, whichever is less

- If any of the following danger signals are sensed while using the respirator, immediate evacuation to fresh air is compulsory (the cartridge or filter may be spent and abnormal conditions may create vapor concentrations which are beyond the limit of the respirator):

  a. Smell or taste of chemicals.
  b. Irritation of the eyes, nose and/or throat.
  c. Difficulty in breathing.
  d. Temperature elevation of inspired air.
  e. Loss of equilibrium, nausea, and/or dizziness.

- Positive and negative pressure tests should be performed each time a respirator is used, and intermittently during use.

- Before and after entering an area of known exposure, cartridges should be discarded and replaced. If there is no known exposure, the maximum life of a cartridge is 15 working days, as long as preventative maintenance techniques are observed.

4.0 SAFETY EQUIPMENT LIST

The following Safety Equipment must be available on site:

- First Aid Kit
- Mobile Telephone
- Half or full face APR - Organic Vapor/HEPA Cartridge (MSA GMA or equivalent) or Combination Cartridge (MSA GMC-H or equivalent)
- Hard Hat
- Tyvek Coveralls/Polyethylene coated Tyvek Coveralls
- PVC (or similar) Rain suit
- Safety Boots (Steel-toe and shank)
- Nitrile Outer Gloves/Latex Inner Gloves
- Hearing protection

5.0 EXCLUSION AREAS

If migration of chemicals from the work area is a possibility, or as otherwise required by regulations or client specifications, site control will be maintained by establishing clearly identified work zones. These will include the exclusion zone, contaminant reduction zone, and support zone, as discussed below.

5.1 Exclusion Zone

Exclusion zones will be established as needed around each hazardous waste activity location. Only persons with appropriate training and authorization from the Field H&S Manager will enter this perimeter while work is being is being conducted there. Traffic cones, barrier tapes, and warning signs will be used as necessary to establish the zone boundary. Plastic stanchions or temporary fencing will be placed as required to prevent unauthorized access to within 10 feet from the sides of open excavations.

5.2 Contamination Reduction Zone

A contamination reduction zone will be established as needed just outside each temporary exclusion zone to decontaminate equipment and personnel as discussed below. This zone will be clearly delineated from the exclusion zone and support zone using the means noted above. Care will be taken to prevent the spread of contamination from this area.

5.3 Support Zone

A support zone will be established as needed outside the contamination reduction area to stage clean equipment, don protective clothing, take rest breaks, etc. This zone will be clearly delineated from the contaminant reduction zone using the means noted above.

6.0 MINIMIZATION OF CONTAMINATION

In order to make the work zone procedure function effectively, the amount of equipment and personnel allowed in contaminated areas must be minimized. In addition, the amounts of soil, water, or other media collected should not exceed what is needed for typical laboratory analysis. Do not kneel on contaminated ground, stir up unnecessary dust, or perform any practice that increases the probability of hand-to-mouth transfer of contaminated materials. Use plastic drop cloths and equipment covers where appropriate. Eating, drinking, chewing gum, smoking or using smokeless tobacco are forbidden in the exclusion and contamination reduction zones.

7.0 DECONTAMINATION

Decontamination is necessary to limit the migration of contaminants from the work zone(s) onto the site or from the site into the surrounding environment. Equipment and personnel decontamination are discussed in the following sections, and the following types of equipment may be used to perform these activities:

- Boot and Glove Wash Bucket
- Scrub Brushes - Long Handled
- Spray Rinse Applicator
- Plastic Garbage Bags
- 5-Gallon Container with Alconox Decontamination solution or household detergent and water.

7.1 Equipment Decontamination

Proper decontamination (decon) procedures will be employed to ensure that contaminated materials do not contact individuals and are not spread from the site. These procedures will also ensure that contaminated materials generated during site operations and during decontamination are managed appropriately.

All non-disposable equipment will be decontaminated in the contamination reduction zone. Prior to demobilization, all contaminated portions of heavy equipment should be thoroughly cleaned. Heavy equipment may require steam cleaning. Soil and water sampling instruments should be cleaned with detergent solutions in buckets.

7.2 Personnel Decontamination

If contamination of personnel or PPE is observed or suspected, personnel working in exclusion zones will perform a mini-decontamination in the contamination reduction zone prior to changing respirator cartridges (if worn), taking rest breaks, drinking liquids, etc. They will decontaminate fully before eating lunch or leaving the site. The following describes the procedures for mini-decon and full decon activities.

Mini-decon procedure:

1. In the contamination reduction zone, wash and rinse outer gloves and boots in buckets.
2. Inspect protective outer suit, if worn, for severe contamination, rips or tears.
3. If suit is highly contaminated or damaged, full decontamination as outlined below will be performed.
4. Remove outer gloves. Inspect and discard if ripped or damaged.
5. Remove respirator (if worn) and clean using premoistened towelettes. Deposit used cartridges in plastic bag.
6. Replace cartridges and outer gloves, and return to work.

Full decontamination procedure:

1. In the contamination reduction zone, wash and rinse outer gloves and boots in buckets.
2. Remove outer gloves and protective suit and deposit in labeled container for disposable clothing.
3. Remove respirator, and place used respirator cartridges (if end of day) in container for disposable clothing.
4. If end of day, thoroughly clean and dry respirator then store properly in a sealed container.
5. Remove inner gloves and discard into labeled container for disposable clothing.
6. Remove work boots without touching exposed surfaces, and put on street shoes. Put boots in individual plastic bag for later reuse.
7. Immediately wash hands and face using clean water and soap.
8. Shower as soon after work shift as possible.

8.0 DISPOSAL OF CONTAMINATED MATERIALS

All disposable sampling equipment and materials will be placed inside two plastic bags or other appropriate containers and placed in storage as directed by the client.

9.0 SITE SECURITY AND CONTROL

Site security and control will be the responsibility of the Project Manager, The "buddy-system" will be used when working in designated hazardous areas. Any security or control problems will be reported to appropriate authorities.

10.0 SPILL CONTAINMENT

Sources of bulk chemicals subject to spillage are not expected to be encountered in this project. Accordingly, a spill containment plan should not be needed for this project. The only chemicals likely to be on site are vehicle fuels kept in the vehicles. In the event of a spill, if it is safe to do so, personnel will put absorbent materials onto the spilled material and keep it from entering drains or water bodies. If the spill is large and a potential safety or environmental hazard personnel will call 911 as soon as possible. Only properly trained personnel will respond to an emergency or to a spill larger or more serious than what can easily be wiped up.

11.0 EMERGENCY RESPONSE PLAN

The HWA Emergency Response Plan outlines the steps necessary for appropriate response to emergency situations. The following paragraphs summarize the key Emergency Response Plan procedures for HWA projects.

11.1 Plan Content and Review

The principal hazards addressed by the Emergency Response Plan include the following: fire or explosion, medical emergencies, uncontrolled contaminant release, and situations such as the presence of chemicals above exposure guidelines or inadequate protective equipment for the hazards present. However, in order to help anticipate potential emergency situations, field personnel shall always exercise caution and look for signs of potentially hazardous situations, including the following as examples:

- visible or odorous chemical contaminants;
- drums or other containers;
- general physical hazards (traffic, moving equipment, sharp or hot surfaces, slippery or uneven surfaces, etc.);
- possible sources of radiation;
- live electrical wires or equipment;
- underground pipelines or cables; and
- poisonous plants or dangerous animals

These and other problems should be anticipated and steps taken to avert problems before they occur.

The Emergency Response Plan shall be reviewed and rehearsed, as necessary, during the on-site health and safety briefing. This ensures that all personnel will know what their duties shall be if an actual emergency occurs.

11.2 Plan Implementation

The Field H&S Manager shall act as the lead individual in the event of an emergency situation and evaluate the situation. He/she will determine the need to implement the emergency procedures, in concert with other resource personnel including client representatives, the Project Manager, and the Corporate H&S Manager. Other on-site field personnel will assist the Manager as required during the emergency.

In the event that the Emergency Response Plan is implemented, the Field H&S Manager or designee is responsible for alerting all personnel at the affected area by use of a signal device (such as a hand-held air horn) or visual or shouted instructions, as appropriate.

Emergency evacuation routes and safe assembly areas shall be identified and discussed in the on-site health and safety briefing, as appropriate. The buddy-system will be employed during evacuation to ensure safe escape, and the Field H&S Manager shall be responsible for roll-call to account for all personnel.

11.3 Emergency Response Contacts

Site personnel must know whom to notify in the event of Emergency Response Plan implementation. The following information will be readily available at the site in a location known to all workers:

- Emergency Telephone Numbers -- see list at the beginning of this plan;
- Route to Nearest Hospital -- see list at the beginning of this plan and route map at the end of this plan;
- Site Descriptions -- see the description at the beginning of this plan; and
- If significant environmental release of contaminants occurs, the federal, state, and local agencies noted in this plan must be immediately notified. If the release to the environment includes navigable waters also notify:

    - National Response Center (800) 424-8802
    - EPA (908) 321-6660

In the event of an emergency situation requiring implementation of the Emergency Response Plan (fire or explosion, serious injury, tank leak or other material spill, presence of chemicals above exposure guidelines, inadequate personnel protection equipment for hazards present, etc.), cease all work immediately. Offer whatever assistance is required, but do not enter work areas without proper protection equipment. Workers not needed for immediate assistance will decontaminate per normal procedures (if possible) and leave work area, pending approval by the Field Safety Manager for re-start of work. The following general emergency response safety procedures should be followed.

11.4 Fires

HWA personnel will attempt to control only <u>very small</u> fires if the person is comfortable doing so and only after 911 has been called. If an explosion appears likely, evacuate the area immediately. If a fire occurs which cannot be controlled, then immediate intervention by the local fire department or other appropriate agency is imperative. Use these steps:

- Evacuate the area to a previously agreed upon, upwind location
- Contact fire agency identified in the site specific plan; and
- Inform Project Manager or Field H&S Manager of the situation.

11.5 Medical Emergencies

Contact the agency listed in the site-specific plan if the medical emergency occurs. If a worker leaves the site to seek medical attention, another worker should accompany the patient. When in doubt about the severity of an accident or exposure, always seek medical attention as a conservative approach. Notify the Project Manager of the outcome or the medical evaluation as soon as possible. For minor cuts and bruises, an on-site first aid kit will be available.

- If a worker is seriously injured or becomes ill or unconscious, immediately request assistance from the emergency contact sources noted in the site-specific plan. Do not attempt to assist an unconscious worker in a confined space without applying confined space entry procedures. Do not attempt to assist an unconscious worker in an untested or known dangerous atmosphere area without using proper respiratory protection.

- In the event that a seriously injured person is also heavily contaminated, use clean plastic sheeting to prevent contamination of the inside of the emergency vehicle. Less severely injured individuals may also have their protective clothing carefully removed or cut off before transport to the hospital.

11.6 Uncontrolled Contaminant Release

In the event of a tank rupture or other material spill, attempt to stop and contain the flow of material using absorbents, booms, dirt, or other appropriate material, if it is safe to do so. Prevent migration of liquids into streams or other bodies of water by building trenches, dikes, etc. Drum the material for proper disposal or contact a spill removal firm for material cleanup and disposal, as required. Observe all fire and explosion precautions while dealing with spills.

11.7 Potential Chemical Exposure/Inadequate PPE

In some emergency situations, workers may encounter a localized work area where exposure to previously unidentified chemicals could occur. A similar hazard includes the situation where chemicals are present above permissible exposure levels and or/above the levels suitable for the personnel protective equipment at hand on-site. If these situations occur, immediately stop work and evacuate the work area. Do not reenter the area until appropriate help is available and/or appropriate personnel protective equipment is obtained. Do not attempt to rescue a downed worker from such areas without employing confined space entry procedures. Professional emergency response assistance (fire department, HAZMAT team, etc.) may be necessary to deal with this type of situation.

11.8 Other Emergencies

Depending on the type of project, other emergency scenarios may be important at a specific work site. These scenarios will be considered as part of the site-specific plan and will be discussed during the on-site safety briefing, as required.

11.9 Plan Documentation and Review

The Field H&S Manager will notify the Project H&S Manager as soon as possible after the emergency situation has been stabilized. The Project Manager or H&S Manager will notify the appropriate client contacts, and regulatory agencies, if applicable. If an individual is injured, the Field H&S Manager or designate will file a detailed Accident Report with the Corporate H&S Manager within 24 hours.

The Project Manager and the Field, Project, and Corporate H&S Managers will critique the emergency response action following the event. The results of the critique will be used in follow-up training exercises to improve the Emergency Response Plan.

12.0 MEDICAL SURVEILLANCE

A medical surveillance program has been instituted for HWA employees having exposure to hazardous substances. Exams are given before assignment, annually thereafter, and upon termination. Content of exams is determined by the Occupational Medicine physician in compliance with applicable regulations and is detailed in the General H&S Plan.

Each team member will have undergone a physical examination as noted above in order to verify that he/she is physically able to use protective equipment, work in hot environments, and not be predisposed to occupationally-induced disease. Additional exams may be needed to evaluate specific exposures or unexplainable illness.

13.0 TRAINING REQUIREMENTS

HWA employees who perform site work must understand potential health and safety hazards. All employees potentially exposed to hazardous substances, health hazards, or safety hazards will have completed 40 hours of off-site initial hazardous materials health and safety training or will possess equivalent training by past experience. They will also have a minimum of three days of actual field experience under the direct supervision of a trained supervisor. All employees will have in their possession evidence of completing this training. Employees will also complete annual refresher, supervisor, and other training as required by applicable regulations.

Prior to the start of each work day, the Field H&S Manager will review applicable health and safety issues with all employees and subcontractors working on the site, as appropriate. These briefings will also review the work to be accomplished, with an opportunity for questions to be asked.

14.0 REPORTING, REPORTS, AND DOCUMENTATION

HWA staff will sign the Acknowledgment of Understanding (Attachment 1), which will be kept on site during work activities and recorded in the project files. The Daily Safety Meeting Checklist (Attachment 2) will also be completed daily by the HWA Field Representative. In the event that accidents or injuries occur during site work, the Health and Safety Manager and the client shall be immediately notified.

Attachment 1

Employee Acknowledgment Form

January 19, 2015
Project 2007-098-2022

HWA GeoSciences Inc.
EMPLOYEE ACKNOWLEDGMENT FORM

To be Executed by HWA GeoSciences Inc. Employees Following Their Review of:

Bothell Service Center Site
18107 Bothell Way NE
Bothell, WA
Sampling Plans
&
Health and Safety Plan

I hereby certify that I have read and understand the health and safety guidelines contained in the above referenced plan.

Employee Name: ____
Employee Signature: ____________________________ Date: ____________________

In case of emergency, please contact:

1. Name: _____________________Relationship: _________ Telephone No.: __________

2. Name: _____________________Relationship: _________ Telephone No.: __________

Received By: ____

Site Safety Manager: ____

Signature: __________________________________ Date: ___________________________

Attachment 2

Daily Safety Meeting Checklist

Daily Safety Meeting Checklist

___________________________________ _____________
Site Safety Manager Date

Attendee Signatures:

Print Name____________________ Print Name____________________
Signature______________________ Signature______________________

Print Name____________________ Print Name____________________
Signature______________________ Signature______________________

Print Name____________________ Print Name____________________
Signature______________________ Signature______________________

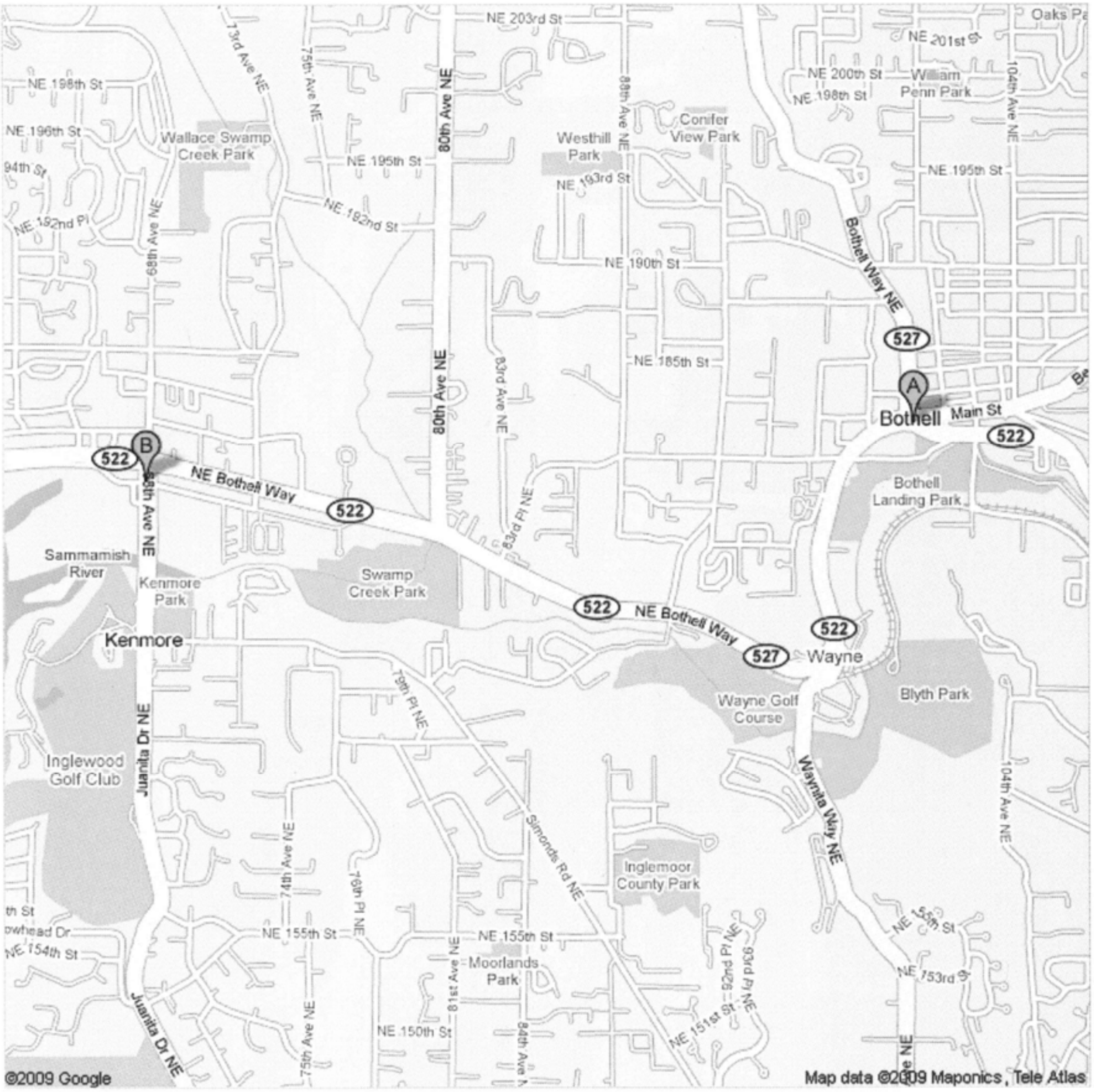
Print Name____________________ Print Name____________________
Signature______________________ Signature______________________

Meeting Topics

Topic	Site Safety manager Initials
Days planned work activities	
Site hazards	
Route to hospital	
Safety equipment and equipment operation	
Review assigned duties	
Confirm review of HSP	
Review site action levels	

Directions to 17511 68th Ave NE, Kenmore, WA 98028

2.8 mi – about **6 mins**



(A) 10001 Woodinville Dr, Bothell, WA 98011

(522)	1. Head **southeast** on **WA-522/Woodinville Dr** toward **NE 180th St**	go 492 ft total 492 ft
↱	2. Turn **right** at **NE 180th St** About 1 min	go 0.3 mi total 0.4 mi
(522)	3. Turn **left** at **NE Bothell Way/WA-522/WA-527** Continue to follow NE Bothell Way/WA-522 About 5 mins	go 2.4 mi total 2.8 mi
↰	4. Turn **left** at **68th Ave NE** Destination will be on the right	go 308 ft total 2.8 mi

(B) 17511 68th Ave NE, Kenmore, WA 98028