INTERIM ACTION WORK PLAN
BOTHELL RIVERSIDE SITE
BOTHELL, WASHINGTON

Prepared for
City of Bothell

January 7, 2013

HWA GEOSCIENCES INC.

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

TABLE OF CONTENTS

LIST OF TABLES (FOLLOWING TEXT)

LIST OF FIGURES (FOLLOWING TABLES)

APPENDICES

INTERIM ACTION WORK PLAN
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1.0 INTRODUCTION

This interim action work plan is prepared for the Bothell Riverside site (Site) in Bothell, Washington (Figure 1). The interim action is being conducted under Agreed Order DE 6295, as amended in April 2010 between the City of Bothell (City) and the Washington State Department of Ecology (Ecology). The purpose of the Agreed Order is to conduct a remedial investigation/feasibility study (RI/FS), submit a cleanup plan to address known soil contamination related to historical releases of hazardous substances at the Site, and implement interim remedial action(s).

The City currently owns the Riverside property, a portion of which will accommodate the realignment of State Route (SR) 522, which is currently under construction through 2013. Remnant portions of the property will be redeveloped as part of the City's overall Downtown Revitalization Plan. Final delineation of the Riverside Site has not been defined, and will be established during the RI process.

The Riverside Site is currently in the RI process (RI/FS work plans, draft RI/FS Report and dCAP Report completed in 2009), with one interim action for petroleum contaminated soil already completed in 2010; however, Ecology has requested another interim action to address chlorinated solvents / halogenated volatile organic compounds (HVOCs) in ground water discharging to the Sammamish River at the Riverside property. The HVOC impacts are not collocated with the Riverside Site petroleum impacts, and likely originate from, and are part of, another site. This interim action work plan presents a description of the interim action. Alternatives evaluated for the interim action are described in the HWA Riverside site Focused Feasibility Study (HWA, 2012).

1.1 PURPOSE

This interim action work plan will be completed per Amendment No. 2 of the Agreed Order and Washington Administrative Code (WAC) 173-340-380, Model Toxics Control Act (MTCA) (Ecology 2007). Under WAC 173-340-430, an interim action is a remedial action that is technically necessary to reduce a threat to human health or the environment by eliminating or substantially reducing one or more pathways for exposure to a hazardous substance, that corrects a problem that may become substantially worse or cost substantially more to address if the remedial action is delayed, or that is needed to provide for completion of a site hazard assessment, RI/FS, or design of a cleanup action.

The purpose of the interim action work plan is to present a general description of the interim action developed to address HVOCs in ground water discharging to the Sammamish River at the Riverside property. Any additional cleanup action that may be required will be addressed as an additional interim action and/or as a final cleanup action after this interim action is completed. The interim action work plan was developed using information obtained during Site investigations that began in 1990 and are ongoing. The contaminated media at the site are described in detail in the draft RI/FS submitted by the City (Parametrix, 2009). This interim action work plan includes the following:

- Applicable state and federal laws for the cleanup action.
- Cleanup standards for each hazardous substance and for each medium of concern.
- A description of the proposed interim action.
- A schedule for implementation of the interim action.

This interim action work plan also includes the Quality Assurance Project Plan (Appendix A), which will be used during completion of interim action at the Site, and includes required elements of a compliance monitoring plan and sampling and analysis plan. The health and safety plan (submitted under separate cover) guidelines will also be followed.

1.2 SITE LOCATION AND DESCRIPTION

The Riverside property is located on the south side of SR 522, between downtown Bothell and the Sammamish River, and is approximately two acres in area. The property is currently undeveloped and used for parking. A portion of the property will accommodate the realignment of State Route (SR) 522, scheduled for construction in 2012-2013. Remnant portions of the property will be redeveloped as part of the City's overall Downtown Revitalization Plan. Figure 1 shows the site vicinity; Figures 2 and 3 show site features and the locations of previous explorations at and near the Riverside property.

2.0 SITE CONDITIONS

This section summarizes the Site conditions and the human health and environmental concerns with respect to the HVOCs in ground water. The site history, contaminated media, soil and ground water conditions at the Riverside Site are described in detail in the draft RI/FS submitted by the City (Parametrix, 2009).

2.1 Physical conditions / Topography

The Riverside property is predominantly a flat gravel-covered area with landscaped strips along the northern and southern property boundaries. A portion of the western boundary consists of vegetated ground sloping down to Horse Creek. The gravel area is used by the City as a parking lot for the adjacent park. The Sammamish River is between 50 and 100 feet south of the property line and is separated from the property by NE 180th Street.

2.2 Geology / Hydrogeology

Based on observations during investigations, soil at the Site typically consists of approximately four to nine feet of silty sand to sandy silt fill with occasional debris over alluvial soil consisting of interbedded silt, sandy silt, peat, and silty sand to a depth of up to 50 feet below ground surface (bgs). A buried soil (paleosol) horizon was observed at some locations at the fill-alluvium contact. Much of the fill material is likely dredged spoils placed on the property from realignment of the Sammamish River in the 1960s (HWA, 2008). Below the fill is predominantly medium dense to dense sand with variable gravel, silty sand, silt and peat to a depth of up to 50 feet bgs. Peat or silt beds with high organic content up to 2 feet thick are present within the alluvial soil, generally at depths greater than 10 feet bgs. These organic-rich beds appear to underlie most of the property but may not represent a contiguous layer.

Beneath these alluvial deposits is a stiff to hard clay or silt with a thickness of at least 14 feet. This unit is inferred to be a drift deposit of glacial-lacustrine origin.

2.3 Aquifer and Soil Properties

Ground water typically occurs in soil borings at depths of approximately 8 to 16 feet bgs. During summer 2009 field activities, depth to water during monitoring well installation ranged from approximately 12.5 to 25 feet bgs. Per results from Parametrix's 2009 RI/FS, the measured ground water gradient at the Site ranged from approximately 0.032 to 0.042 feet/feet, with ground water flow to the southeast.

The horizontal hydraulic conductivity for the Site was estimated using slug test data collected during the 2009 RI/FS. Based on the results of the slug test data analyses, the estimated hydraulic conductivity for the water-bearing zone ranged from 4.8 x 10^{-3} to 1.8 x 10^{-2} feet per minute (7 to 26 feet/day); the mean hydraulic conductivity determined from the slug test data is 13.1 feet/day.

HWA estimated the travel time of shallow ground water at the site. Ground water particle velocity is described by the following relationship:

V = K i / P, where: V= particle velocity
K= hydraulic conductivity
i = hydraulic gradient
P = effective porosity

Based on estimates of horizontal hydraulic conductivity of around 7 to 26 feet/day, an assumed effective porosity of 0.25 (typical of sands), and measured gradients of 0.032 to 0.042 foot/foot, estimated horizontal ground water particle flow velocity may range from approximately 1 to 4 feet per day in the shallow aquifer.

Other physical characteristics of the water-bearing material include an estimated porosity (based on ex-situ analysis) ranging from 0.25 to 0.32, wet density ranging from 123.2 to 139.5 pounds per cubic foot, and dry density ranging from 107.2 to 127.4 pounds per cubic foot (Parametrix, 2009).

2.4 Surface Water Hydrology

Horse Creek daylights from beneath the adjacent Bothell Landing Site at the midway point of the western Riverside property boundary and runs south along the boundary. The Sammamish River is located approximately 100 feet south of the Riverside property and is separated from the property by NE 180th Street. Horse Creek discharges directly into the Sammamish River in this area, although a new Horse Creek Channel is under construction which will divert much of this flow to a new creek and outfall to the Sammamish River some 600 feet to the west.

3.0 NATURE AND EXTENT OF CONTAMINATION

This section summarizes the nature and extent of HVOC impacts to ground water and surface water; petroleum and other impacts to soil are described in the RI (Parametrix, 2009). Petroleum impacts (which are not collocated with HVOC impacts) were remediated during a previous interim action.

3.1 CHEMICALS OF CONCERN (COCS)

Chemicals of concern for this interim action include the HVOCs tetrachloroethene (a.k.a., perchloroethene or PCE), and associated degradation compounds trichloroethene (TCE), cis-1,2-dichloroethene (DCE), and vinyl chloride.

3.1.1 Soil

Soil samples were analyzed for HVOCs during both the 2008 Phase II Environmental Site Assessment (ESA) (HWA, 2008) and the 2009 RI/FS (Parametrix, 2009). While some HVOC compounds were present in the ground water, none were detected at concentrations greater than the MTCA Method A cleanup level in soil.

During HWA's 2008 Phase II ESA, PCE and TCE were detected in the soil sample from boring BC-3 at 17.5 feet bgs at 5.9 micrograms per kilogram (µg/kg). PCE was detected in the soil sample from boring R-4 at 8 feet bgs at 9 µg/kg. Both of these samples were collected from within the water-bearing zone. For the 2009 RI/FS, minimal HVOC concentrations were detected in collected soil samples. In RMW-6 cis-1,2-dichloroethene (DCE) was detected at 4.5 µg/kg at 15 feet bgs. During the 2009 CDM Phase II ESA (CDM, 2009), three borings (B14 through B16) were advanced just north of the Site. PCE was detected in B15 (27 µg/kg) at 10 feet bgs and B16 (4.1 µg/kg) at 13 feet bgs. These concentrations did not exceed MTCA Method A PCE soil cleanup level of 50 µg/kg.

It is likely that the low HVOC concentrations identified in soil samples are associated with ground water contamination and not an onsite source. The locations and concentrations of the soil contamination are consistent with the areas that had the highest concentrations of HVOCs in ground water.

3.1.2 Ground Water

PCE and breakdown (daughter) products (e.g., TCE, cis-1,2-DCE, and vinyl chloride) were detected in ground water collected from borings R-2, R-3, R-4, R-5, and R-10 during HWA's 2008 Phase II ESA. These borings were completed between 12 and 20 feet bgs. Concentrations of PCE ranged from 3.9 µg/L in R-10 to 320 µg/L in R-4. TCE was detected at several locations with a maximum concentration of 140 µg/L at R-4. This concentration exceeded the MTCA Method A cleanup level of 5 µg/L for TCE. Vinyl chloride exceeding the MTCA Method A cleanup level of 0.2 µg/L was detected in R-5.

Monitoring wells BC-3 and BC-5 were also sampled during the 2008 Phase II ESA. PCE (110 µg/L) and TCE (120 µg/L) were detected in BC-3 at concentration exceeding their respective MTCA Method A cleanup levels for ground water. No HVOCs were detected above laboratory reporting limits in the sample collected from BC-5.

During Parametrix's 2009 RI/FS, eight new monitoring wells were installed to better assess the nature and extent of the HVOC contamination previously identified at the Site. The wells were installed at depths ranging from approximately 22 to 42 feet bgs. Monitoring wells RMW-7, RMW-8, and RMW-9 were installed to better assess migration of the HVOC plume in shallow ground water. Monitoring well RMW-7 is located southeast of the Site on the north bank of the Sammamish River. PCE (50 µg/L) and TCE (120 µg/L) were detected in RMW-7 at concentrations exceeding their respective MTCA Method A cleanup levels. Vinyl chloride was also detected in RMW-7 at 22 µg/L, which exceeded the MTCA Method A cleanup level. In RMW-7 cis-1,2-DCE was also detected at a concentration of 190 µg/L. RMW-8 is located east of the Riverside property. PCE, TCE, and DCE were detected in RMW-8, but at concentrations below their MTCA Method A cleanup levels. No HVOCs were detected in RMW-9, located north of the Riverside property.

RMW-10 was completed to approximately 42 feet bgs and was completed in the lower portion of the water-bearing zone. Only PCE was detected in RMW-10 (0.24 µg/L), but was below the MTCA Method A cleanup level. All other HVOCs were below laboratory reporting limits. The absence of elevated HVOC concentrations in RMW-10, located in between other shallow wells with much higher HVOC concentrations, indicates the HVOCs are mostly in shallow ground water, at depths of 10 to 25 feet.

Existing well BC-3 was also sampled during the 2009 RI/FS. This well is located roughly 25 feet east of RMW-10. PCE (130 µg/L), TCE (120 µg/L), and cis-1,2-DCE (49 µg/L) were detected in the sample collected from BC-3. PCE and TCE exceeded their respective MTCA Method A cleanup levels. The HVOC concentration at BC-3 and RMW-10 varied significantly, possibly indicating that these wells were completed in different water-bearing zones or that the HVOCs detected in BC-3 have not migrated vertically to reach the screened interval in RMW-10. As mentioned in Section 3.1.1, during the 2009 CDM Phase II ESA, three borings (B14 through B16) were installed just north of the Site. PCE was detected in ground water from B14 (5.9 µg/L) at concentrations exceeding MTCA Method A cleanup levels. PCE was also detected in

B15 (3.9 µg/L) and B16 (0.21 µg/L), but at concentrations that did not exceed MTCA Method A cleanup levels. TCE and cis-1,2-DCE were also detected in B14 and B15.

The existing data have not identified any up gradient source for the solvent plume at Riverside site. Additional exploration is planned to determine if there is any potential preferential pathway existing between the upgradient Case property solvent plume and Riverside property.

4.0 CLEANUP OBJECTIVES AND CLEANUP STANDARDS

4.1 OVERVIEW OF CONCEPTUAL SITE MODEL

The Site characteristics and environmental data summarized in Section 3 were evaluated to develop a conceptual site model for the Site. This conceptual site model relates contamination sources, affected media, and potential transport pathways between the Site and potential human health and ecological receptors.

4.1.1 Contaminant Source

Based on the results from the 2008 and 2009 Phase II ESAs and the 2009 RI/FS, it is unclear that the HVOC ground water contamination is related to an upgradient source, although additional explorations are planned to verify this. The presence of PCE daughter products indicates that natural biological degradation and attenuation of PCE are occurring in shallow ground water.

4.1.2 Potential Exposure Pathways

Potential exposure pathways for the Riverside site are described in the RI/FS (Parametrix, 2009). The main potential exposure pathway with respect to this interim action is ground water to surface water, specifically via discharge of HVOC-impacted ground water into the Sammamish River.

Soil pathways (e.g., direct contact, ingestion, soil to ground water) are not considered for this interim action because soil HVOC concentrations in this area do not exceed cleanup levels or appear to be a concern. Vapor pathways (e.g., inhalation, indoor air) are similarly not considered, due to the absence of present or planned buildings in this area.

4.1.3 Potential Receptors

Potential exposure to human and ecological receptors at the Site is described below. Human receptors include:

- **Recreational users of the Sammamish River.** The river is used for boating, kayaking, fishing, and swimming. Users may be exposed to impacted surface water via, dermal contact, ingestion of water, or ingestion of fish prior to implementation of remedial actions.

Potential ecological receptors include:

- **Aquatic species**. Aquatic biota in the Sammamish River may be exposed to impacted surface water.

4.2 CLEANUP STANDARDS

Cleanup standards consist of appropriate cleanup levels applied at a defined point of compliance that meet applicable state and federal laws (WAC 173-340-700). Due to the main concern for impacts to surface water, surface water cleanup levels were evaluated in addition to ground water values. Proposed cleanup levels are described below and shown on Table 1. The rationale for selecting cleanup levels is as follows:

- MTCA Method B surface water cleanup levels
- MTCA Method B ground water cleanup levels if there is no surface water cleanup level
- Method PQL (practical quantitation limit) if the PQL is higher than MTCA cleanup levels

Due to the proximity of the HVOC-impacted ground water to the river, surface water cleanup levels are proposed, although the preliminary point of compliance and sampling locations/methods (i.e., ground water monitoring wells) are in ground water. Direct sampling of surface water in the river is unlikely to detect any HVOCs due to the relatively low concentrations in ground water and dilution in the river.

Method B surface water cleanup levels. Standard Method B cleanup levels for surface waters shall be at least as stringent as all of the following:

- Surface water quality criteria per WAC 173-201A, including referenced Clean Water Act and EPA standards.

- Drinking water standards per WAC 173-340-720, for surface waters classified as suitable for domestic water supplies

Table 1 provides the basis for surface water cleanup levels**,** including MTCA Method B cleanup levels, and available federal and state Applicable or Relevant and Appropriate Requirements (ARARs), including Department of Ecology Surface Water Quality Standards WAC 173-201A and referenced Clean Water Act and EPA standards.

4.3 Point of Compliance

The point of compliance is the specific location(s) at which a particular cleanup level must be met in order to demonstrate compliance of a cleanup action. MTCA defines standard and conditional points of compliance. Proposed preliminary points of compliance are described below.

4.3.1 Ground Water

The standard ground water point of compliance under MTCA (WAC 173-340-720(8)(b)) is in ground water throughout the Site from the uppermost level of the saturated zone to the lowest depth which could potentially be affected (as determined during the RI). For properties near or adjoining surface water bodies, a conditional point of compliance off the property may be approved, as close as practicable to the source and not to exceed the point or points where the ground water flows into the surface water (typically at the ground water to surface water discharge area).

For this interim action, a preliminary conditional point of compliance is proposed as near as practicable to the river, i.e., at RMW-7 located on the north bank of the river, and at four new ground water extraction wells near the river. Final point(s) of compliance will be established in the RI/FS.

4.4 Remedial Action Objectives

Remedial action objectives (RAOs) are cleanup goals established for environmental media (soil or ground water) designed to protect human health and the environment under a specified land use. The RAOs take into account potential exposure pathways, receptors, and provide acceptable concentrations for COCs that are protective of all potential exposure pathways. The primary objective of site remediation will be to minimize all applicable exposure pathways, including:

- Ground water to surface water
- Human health, direct contact
- Human health, ingestion

- Aquatic species

RAOs are based on the findings of the remedial investigation, and guide the development and evaluation of cleanup alternatives. Potential risks used to establish RAOs include:

- Ground water – Potential risks include migration of impacted ground water to adjacent surface water
- Surface water – Potential risks associated with surface water include those from direct contact with or ingestion of water, by human and ecological receptors, and ingestion of aquatic species by humans

5.0 PROPOSED INTERIM ACTION

The proposed interim action consists of pumping ground water from a line of wells placed to intercept the HVOC plume before it reaches the river, and treating the extracted ground water via discharge to sanitary sewer system.

5.1 OTHER CLEANUP METHODS EVAUATED

Alternatives evaluated for the interim action are described in the HWA Focused Feasibility Study (HWA, 2012), and included:

- Source Control
- In situ ground water treatment
  - Chemical oxidation
  - Chemical reduction
  - Bioremediation
  - Air sparging with soil vapor extraction
- Ground water gradient control
  - Pump, treat, and discharge
    - Carbon adsorption
    - Air stripping
    - Discharge to sanitary sewer
  - Pump, treat (using one of the above-listed methods), and recirculate
- Permeable reactive barriers
  - Zero valent iron
  - Funnel and gate with zero valent iron
- Monitored Natural attenuation

Soil cleanup methods at the Riverside property were not considered, because 1) soil does not appear to be impacted by HVOCs on the Riverside property, and 2) the source is very far from the river (approximately 900 feet north), at the Case property / Ultra Custom Care Cleaners site.

The cleanup method selected for this interim action was gradient control via pumping, with treatment via discharge to sanitary sewer. In situ and reactive barrier methods were ruled out due to the high potential for adversely impacting the nearby river. Gradient control via a series of pumping wells was determined to be the preferred option for capturing the HVOC plume before it reaches the river. Discharge of the pumped ground water to sanitary sewer, for treatment at an off site wastewater treatment plant was the preferred treatment option due to its simplicity, reliability, and straightforward permitting requirements.

5.2 GENERAL TECHNOLOGY DESCRIPTION

Achieving hydraulic control of the ground water involves a sufficient number, location, and spacing of wells, with pumping rates sufficient to modify the gradient such that impacted ground water flows into the wells, and not into the river. Well spacing and pumping rates were determined via a capture zone analysis using numerical ground water modeling (HWA, 2012), with input parameters derived from previous remedial investigation work (e.g., gradient mapping, aquifer testing (Parametrix, 2009)). Actual pumping rates will be determined after additional pumping / interference tests at the site, and would be adjusted during operation of the system based on measured water levels. The optimal pumping rate would be that which captures HVOC impacted water headed for the river, but does not pump too much river water into the wells.

Pumped ground water will be discharged to sanitary sewer for treatment at the King County wastewater treatment plant. HVOC contaminants at the concentrations detected are acceptable by King County Industrial Waste Division (KCIWD) for discharge and treatment. The KCIWD discharge criteria for HVOCs are as follows:

Compound	**Discharge Limit (µg/L)**
PCE	240
TCE	500
1,1, DCA	1700
1,2 DCA	170
1,1, DCE	3
1,2, DCE	2000
Vinyl chloride	12

The HVOCs will likely be treated by the standard primary and secondary wastewater treatment processes (e.g., activated sludge, facultative lagoons, etc.), or will volatilize prior to reaching the treatment areas, in the sewer lines, manholes, treatment plant headworks, solids removal, and aeration basins.

5.3 TREATMENT SYSTEM DESCRIPTION

Elements of the treatment system include the following:

- **Permitting** – Anticipated permitting requirements include the following:
  - Notice of intent to construct resource protection wells under Chapter 173-160 WAC, Minimum Standards for Construction and Maintenance Of Wells

  - Obtaining a discharge authorization from KCIWD. This may include limitations of discharge volumes allowed per day, and specified discharge points

- **Extraction Wells** – Based on the capture area analysis performed, four wells are planned at roughly 40 foot spacing. Figure 2 shows the extraction well locations. The wells will be constructed of four-inch diameter PVC, with 20 feet of mill-slotted well screen set at a depths of 15 to 35 feet below grade.

- **Well Development** - After well installation, each well will be developed by surging and pumping to remove fines from around the well screen.

- **Well sampling**– After development, each well will be sampled for HVOCs and field parameters

- **Well testing** – After sampling, a short pumping test will be conducted at each well to measure its specific capacity and maximum predicted pumping rate. This will be accomplished by pumping the wells at successively higher discharge rates and measuring the resulting drawdown in the pumping and adjacent wells.

- **Pump controls** will include a down-well float switch that shuts off each pump if water level goes below the pump intake. Controls will be housed in a NEMA weather-proof enclosure, in either a locked container or within a locked chain link fenced enclosure.

- **Pump sizing** – Based on the well testing results, downhole electric submersible pumps will be specified, purchased and installed in each well. Pumping / discharge rates will be made adjustable by adjusting the pumping level (float switch level), using valves in the discharge lines, timers, variable frequency drive motors and controllers, or some combination of these methods.

- **Piping and wiring** to and from the wells will be underground, and installed per City of Bothell code for underground utilities.

- **Well discharge lines** from each well will contain a sampling port to collect individual well water samples.

- **Discharge to sanitary sewer** will be via a nearby sanitary sewer manhole, per City of Bothell and King County Industrial Waste Division requirements, and will include a totalizing water meter and sample collection port. Discharge to the sanitary sewer will be under permit to King County Industrial Waste Division, who will impose a limitation on allowable daily discharge volumes based on system capacity.

- **Operation and maintenance (O&M)** will include periodic inspection of the system. The only mechanical components are the down-hole submersible pumps, which require no regular maintenance. The treatment system will be inspected for proper operation, leaks, etc., and repairs conducted as needed.

5.3 COMPLIANCE MONITORING

This section describes protection, performance, and confirmation monitoring to be performed during the interim action.

5.3.1 Protection Monitoring

Protection monitoring will be conducted to confirm that human health and the environment are adequately protected during construction and operation of the interim action. This includes any sampling or testing performed for health and a safety purposes during the interim action, and is detailed in the site specific Health and Safety Plan. The only element of the interim action anticipated to require protection monitoring is the drilling and installation of the ground water extraction wells. Air monitoring of the work space will be conducted during drilling and installation per the site specific Health and Safety Plan.

Construction of the above-ground components of the treatment system is not anticipated to require any protection monitoring, although construction-related health and safety procedures will be followed (e.g., construction, electrical and mechanical safety issues).

5.3.2 Performance Monitoring

Performance monitoring is required to confirm that the interim action has attained cleanup standards. Performance monitoring will include collection of ground water samples from the extraction wells and selected monitoring wells, as follows:

Performance Monitoring

Sample type	Sampling location	Sampling Frequency / Rationale
Preliminary Point of Compliance	Extraction well 1 Extraction well 2 Extraction well 3 Extraction well 4 RMW-7	Quarterly for one year, then modify based on results and consultation with Ecology (e.g., move to semiannual if concentrations stabilize)
Combined discharge	Combined discharge at sewer manhole or manifold	As required by KCIWD permit
Nearby wells	BC-3 RMW-4 RMW-5 RMW-6 RMW-8 RMW-9 RMW-10	Semiannual for one year, then modify based on results and consultation with Ecology to check for water quality impacts due to pumping

Performance monitoring samples will be analyzed for HVOCs and field parameters, as detailed in Appendix A. Other elements of performance monitoring include:

- Meter readings recording volumes of water discharged to sewer
- Ground water levels in all pumping and nearby monitoring wells
- Preparation of ground water gradient maps to confirm plume capture

5.3.3 Confirmation Monitoring

Confirmation monitoring is required to confirm the long-term effectiveness of the interim action once cleanup standards have been attained. Confirmation monitoring will include similar sampling to performance monitoring, after cleanup levels have been reached.

Confirmation Monitoring

Sampling location	Sampling Frequency
RMW-7 RMW-6 BC-3 Extraction well 1 Extraction well 2 Extraction well 3 Extraction well 4 Note: due to the seven wells in a row at close spacings, only selected wells will be sampled after initial monitoring, based on ongoing results	Semiannual one year, rest period of one year, then one sampling event. Cease interim action if cleanup levels have been met after this sampling event. If cleanup levels have not been met, then repeat cycle - begin semiannual sampling for another year followed by one year rest period. Cease interim action one month after Ecology's concurrence that the cleanup levels have been met, or if HVOC concentrations stabilize long term.

Confirmation samples will be analyzed for HVOCs and field parameters, as detailed in Appendix A.

6.0 SCHEDULE

The proposed interim action is planned to be implemented in 2013, per the following preliminary schedule.

Month	0	1	2	3	4	5	6
Approval of work plan	x	.	.	.	.	.	.
Design system	xxxxxx		.	.	.	.	.
Bidding	.	xxxxxx		.	.	.	.
Construction/install wells	.	.	xxxxxx		.	.	.
Develop, sample & test wells	.	.	.	xxxx	.	.	.
Spec/order pumps	.	.	.	.	xxxxxxxx		.
Install pumps	.	.	.	.	.	xx	.
System startup	.	.	.	.	.	.	x

7.0 REFERENCES

CDM, 2009, *Phase II Environmental Site Assessment City of Bothell Crossroads Redevelopment Project Bothell, Washington*, May 2009.

HWA GeoSciences, 2008, *Phase II Environmental Site Assessment Riverside Property Bothell, Washington*, July 2008.

HWA GeoSciences, 2012, *Focused Feasibility Study Bothell Riverside Site Bothell, Washington,* September 5, 2012.

Parametrix, 2009, *Bothell Riverside Remedial Investigation/Feasibility Study*, Revision No. 0, Prepared by Parametrix, Bellevue, Washington, November 2009.

Washington State Department of Ecology, 2007, *Model Toxics Control Act Cleanup Regulation, Chapter 173-340 WAC*, Publication No. 94-06, dated October 12.

Table 1
Site Cleanup Level Summary (µg/L)

	PCE	TCE	1,2-DCE (mixed isomers)	cis-1,2-DCE	trans-1,2-DCE	VC
Ground Water Standards						
Ground Water ARAR - State Primary Maximum Contaminant Level (MCL)	5	5	NR	70	**100**	2
Ground Water, Method A, Table Value	5	5	RND	RND	RND	0.2
Ground Water, Method B, Carcinogen, Standard Formula Value	5*	4*	NR	NR	NR	**
Ground Water, Method B, Non-carcinogen, Standard Formula Value	80	**	**72**	**16**	160	24
Surface Water Standards						
Surface Water, Method B, Carcinogen, Standard Formula Value	**	6.7	NR	NR	NR	0.025
Surface Water, Method B, Non-Carcinogen, Standard Formula Value	840	**	NR	NR	33000	6.60E+03
Surface Water ARAR - Aquatic Life - Fresh/Acute - Ch. 173-201A WAC	NR	NR	NR	NR	NR	NR
Surface Water ARAR - Aquatic Life - Fresh/Chronic - Ch. 173-201A WAC	NR	NR	NR	NR	NR	NR
Surface Water ARAR - Aquatic Life - Fresh/Chronic - Clean Water Act §304	NR	NR	NR	NR	NR	NR
Surface Water ARAR - Human Health - Fresh Water - Clean Water Act §304 (	**0.69**	**2.50**	NR	NR	140000	0.03
Surface Water ARAR - Aquatic Life - Fresh/Acute - Clean Water Act §304	NR	NR	NR	NR	NR	NR
Surface Water ARAR - Human Health - Fresh Water - National Toxics Rule, 40 CFR 131	0.80	2.70	NR	NR	RND	2.00
Surface Water ARAR - Aquatic Life - Fresh/Acute - National Toxics Rule - 40 CFR 131	NR	NR	NR	NR	NR	NR
Surface Water ARAR - Aquatic Life - Fresh/Chronic - National Toxics Rule, 40 CFR 131	NR	NR	NR	NR	NR	NR
PQL / RL achievable by local accredited labs	0.2	0.2	0.2	0.2	0.2	**0.2**

NR – Not researched

RND – Researched-No Data

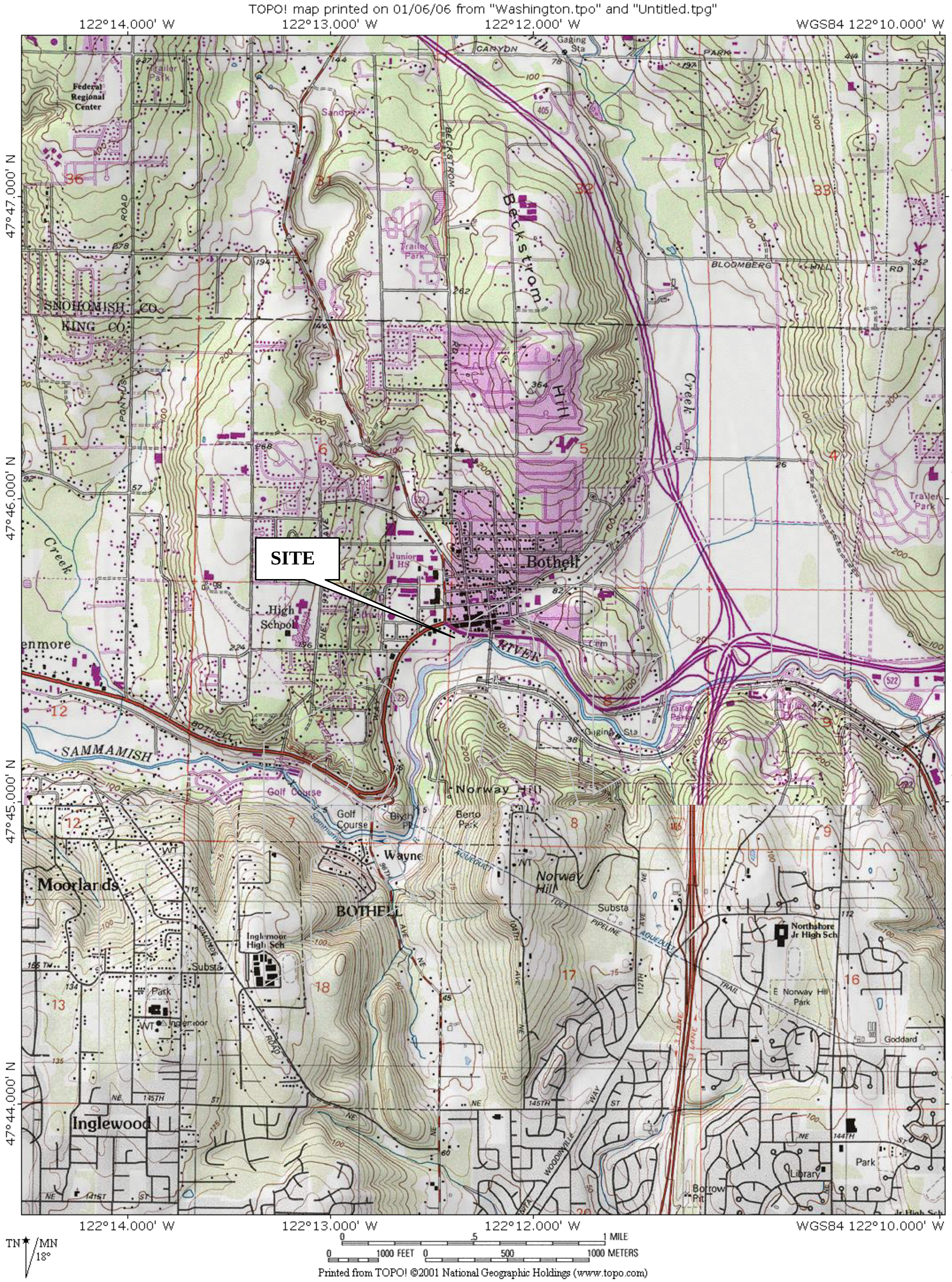
* Per Sunny Becker at Ecology

** See additional information per CLARC

Highlighted – lowest value

Bold Highlighted – selected value

PQL – practical quantitation limit



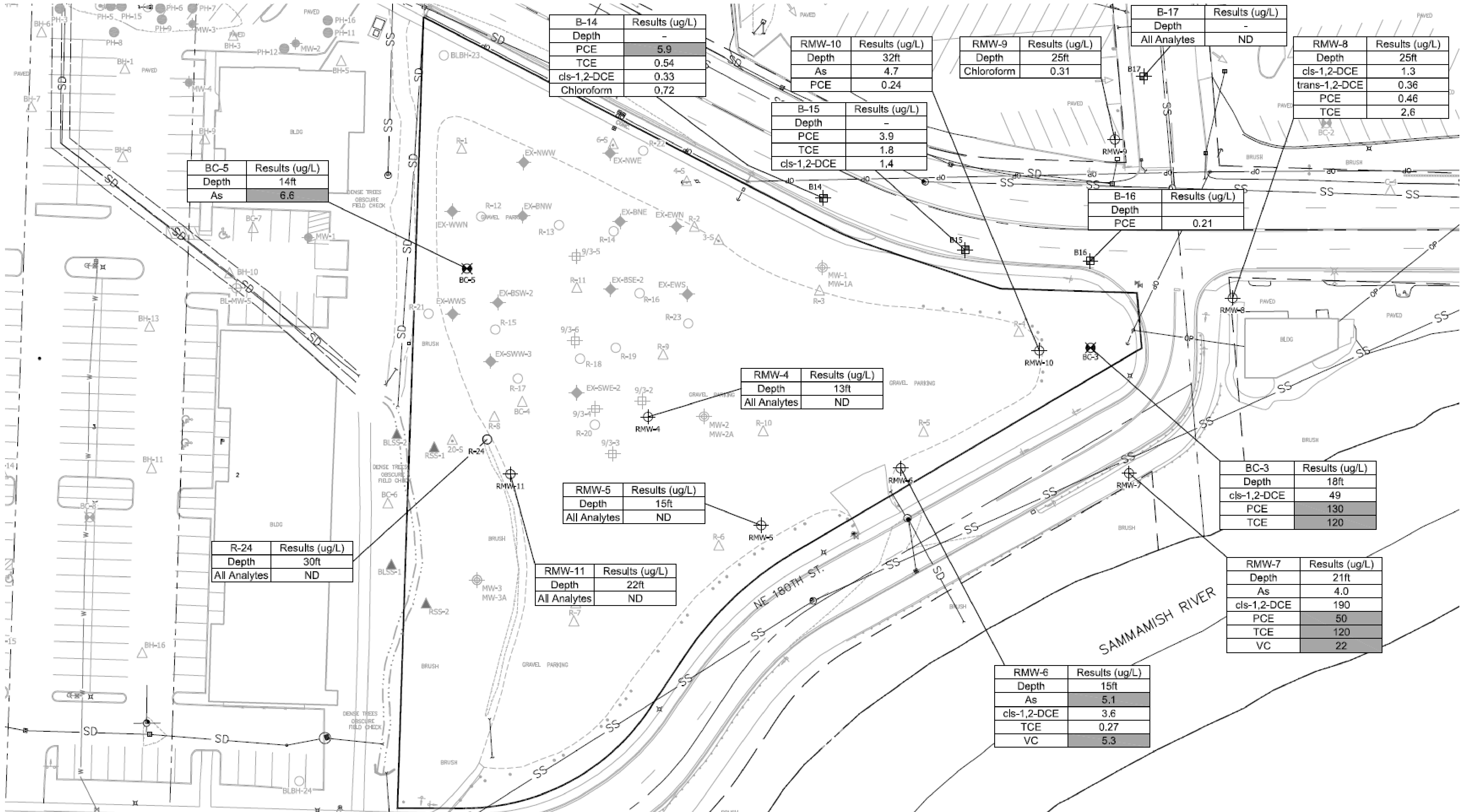
HWA GeoSciences Inc.

SITE VICINITY

BOTHELL RIVERSIDE SITE
INTERIM ACTION WORK PLAN
BOTHELL, WASHINGTON

FIGURE NO.
1

PROJECT NO.
2007-098



B-14	Results (ug/L)
Depth	-
PCE	5.9
TCE	0.54
cis-1,2-DCE	0.33
Chloroform	0.72

RMW-10	Results (ug/L)
Depth	32ft
As	4.7
PCE	0.24

RMW-9	Results (ug/L)
Depth	25ft
Chloroform	0.31

B-17	Results (ug/L)
Depth	-
All Analytes	ND

RMW-8	Results (ug/L)
Depth	25ft
cis-1,2-DCE	1.3
trans-1,2-DCE	0.36
PCE	0.46
TCE	2.6

B-15	Results (ug/L)
Depth	-
PCE	3.9
TCE	1.8
cis-1,2-DCE	1.4

BC-5	Results (ug/L)
Depth	14ft
As	6.6

B-16	Results (ug/L)
Depth	
PCE	0.21

RMW-4	Results (ug/L)
Depth	13ft
All Analytes	ND

RMW-5	Results (ug/L)
Depth	15ft
All Analytes	ND

BC-3	Results (ug/L)
Depth	18ft
cis-1,2-DCE	49
PCE	130
TCE	120

R-24	Results (ug/L)
Depth	30ft
All Analytes	ND

RMW-11	Results (ug/L)
Depth	22ft
All Analytes	ND

RMW-7	Results (ug/L)
Depth	21ft
As	4.0
cis-1,2-DCE	190
PCE	50
TCE	120
VC	22

RMW-6	Results (ug/L)
Depth	15ft
As	5.1
cis-1,2-DCE	3.6
TCE	0.27
VC	5.3

LEGEND

- PSI 1998 CLOSURE SAMPLE LOCATIONS
- KLEINFELDER 1999 BORING LOCATIONS
- KLEINFELDER 1999 WELL LOCATIONS
- HWA 2007 PHASE II ESA BORINGS
- HWA 2007 WELL LOCATIONS
- PMX 2009 RI/FS BORING LOCATIONS
- PMX 2009 RI/FS WELL LOCATIONS
- PMX 2009 RI/FS SURFACE SOIL LOCATIONS
- CDM 2009 ROW BORING LOCATIONS
- SEACOR 1990 & 1991 TEST PIT LOCATIONS
- RZA AGRA 1991 EXCAVATION CONFIRMATION SAMPLE LOCATIONS
- GROUNDWATER TECHNOLOGY 1992 EXCAVATION CONFIRMATION SAMPLE LOCATIONS
- SITE BOUNDARY
- EXCEEDS MTCA METHOD A CLEAN UP LEVEL

N

0 50
SCALE IN FEET

Figure Source: Parametrix, 2009

HWA GEOSCIENCES INC.

GROUND WATER RESULTS

BOTHELL RIVERSIDE SITE
INTERIM ACTION WORK PLAN
BOTHELL. WASHINGTON

PROJECT NO. 2007-098

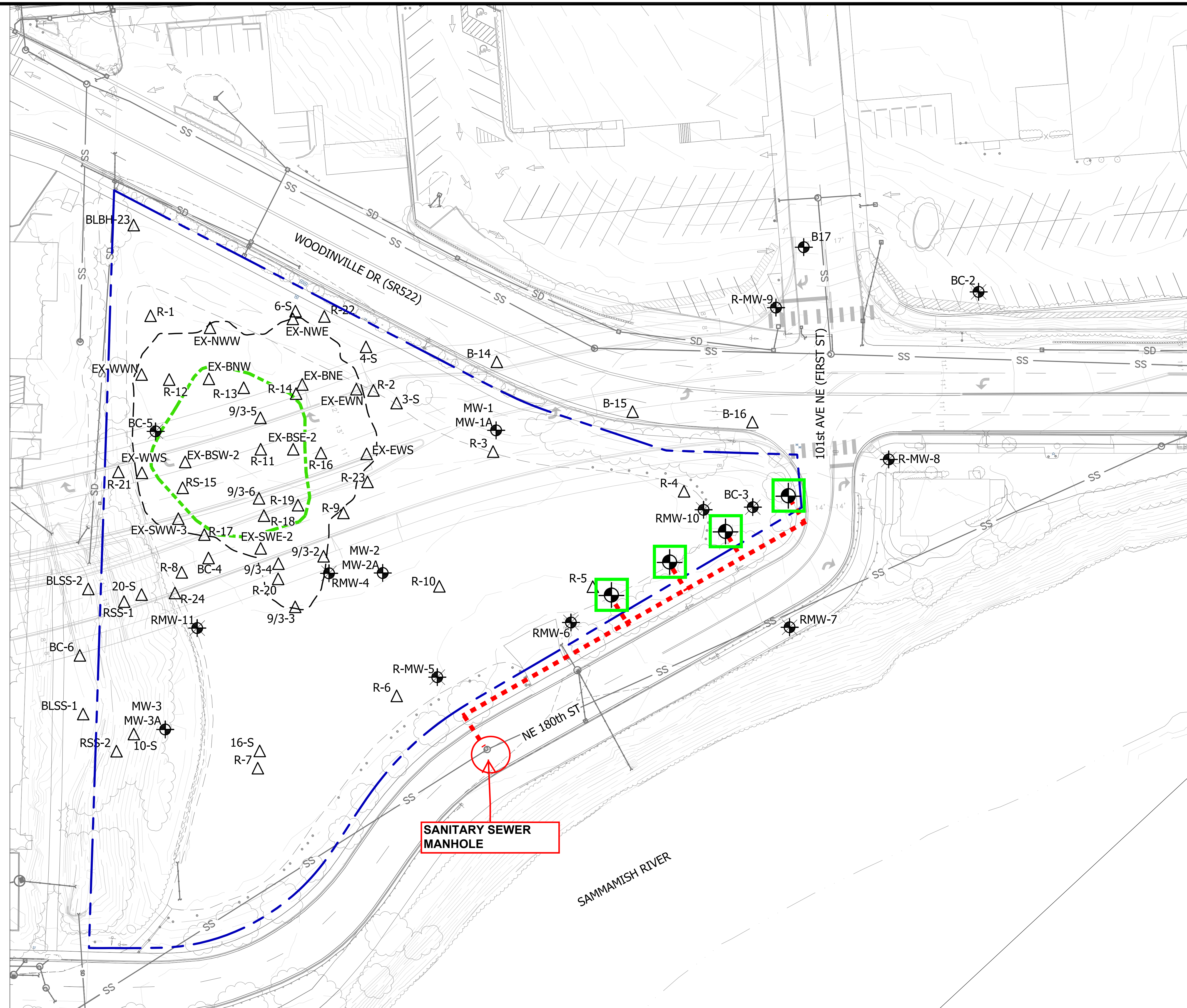
FIGURE NO. 2

N

0' 30' 60' 120'
SCALE: 1"=60'

EXPLANATION OF SYMBOLS

- APPROXIMATE EXTENT OF 2010 CLEANUP EXCAVATION
- APPROXIMATE EXTENT OF 1990'S CLEANUP
- APPROXIMATE PROPERTY BOUNDARY
- R-8 SOIL BORING OR TEST PIT LOCATIONS
- R-MW-10 MONITORING WELL LOCATIONS
- **PLANNED EXTRACTION WELL**
- **DISCHARGE LINES**



BASE MAP PROVIDED BY PARAMETRIX

HWA GEOSCIENCES INC.	BOTHELL RIVERSIDE SITE INTERIM ACTION BOTHELL, WASHINGTON	SITE PLAN	DRAWN BY EFK CHECK BY AS DATE 09.13.12	FIGURE NO. 3 PROJECT NO. 2007-098 T978

S:\2007 PROJECTS\2007-098-22 BOTHELL CROSSROADS\CAD\HWA 2007-098-21 T978.DWG <RIVERSIDE fig 2 T1944> Plotted: 12/4/2012 9:45 AM

APPENDIX A

QUALITY ASSURANCE PROJECT PLAN

INTERIM ACTION
QUALITY ASSURANCE PROJECT PLAN
BOTHELL RIVERSIDE SITE
BOTHELL, WASHINGTON

HWA Project No. 2009-098

January 7, 2013

Prepared for:
City of Bothell

HWA GEOSCIENCES INC.

TABLE OF CONTENTS

LIST OF TABLES

INTERIM ACTION
QUALITY ASSURANCE PROJECT PLAN
BOTHELL RIVERSIDE SITE
BOTHELL, WASHINGTON

1.0 INTRODUCTION

This interim action work plan has been prepared for the Bothell Riverside site (Site) in Bothell, Washington (Figure 1). The interim action is being conducted under Agreed Order DE 6295, as amended in April 2010 between the City of Bothell (City) and the Washington State Department of Ecology (Ecology). The purpose of this interim action is to reduce/eliminate the discharge of a chlorinated solvent plume that is migrating into the Sammamish River. The purpose of the Agreed Order is to conduct a remedial investigation/feasibility study (RI/FS), submit a cleanup plan to address known soil contamination related to historical releases of hazardous substances at the Site, and implement interim remedial action(s).

The City currently owns the Riverside property, a portion of which will accommodate the realignment of State Route (SR) 522, which is currently under construction. Remnant portions of the property will be redeveloped as part of the City's overall Downtown Revitalization Plan. Final delineation of the Riverside Site has not been defined, and will be established during the RI process.

This Quality Assurance Project Plan (QAPP) is incorporated within the Interim Action Work Plan (IAWP) for the property, and has been prepared to fulfill the requirements of the Agreed Order per Washington Administrative Code (WAC) 173-340-410(1)(b). This QAPP describes the sample collection procedures, analysis, and defines the Data Quality Objectives (DQOs) and criteria for the project. HWA GeoSciences Inc. prepared this QAPP in accordance with the U.S. Environmental Protection Agency (EPA) and Ecology requirements contained in the following:

- EPA QA/R-5, EPA Requirements for Quality Assurance Project Plans, Final, March 2001
- EPA QA/G-5, EPA Guidance for Quality Assurance Project Plans, December 2002
- EPA QA/G-4, EPA Guidance on Systematic Planning Using the Data Quality Objectives Process, February 2006
- Ecology Model Toxics Control Act (Ecology 2007)

2.0 PROJECT ORGANIZATION AND MANAGEMENT

2.1 PROJECT ORGANIZATION

Specific project roles and responsibilities for oversight and sampling are described in Table 2-1.

Table 2-1
Project Roles and Responsibilities

Personnel	Responsibilities
City of Bothell (Owner) Project Manager	Provides project and construction oversight and performs contract administration.
Contractor	Implements cleanup/remedial actions and coordinates with environmental consultant for confirmational sampling during construction.
Owner's Representative (Environmental Consultant)	Coordinates with Contractor to obtain confirmational sampling during interim action; coordinates analytical laboratory testing of samples; prepares interim action reports.

2.2 PROBLEM DEFINITION/BACKGROUND

The Riverside property is located on the south side of SR 522, between downtown Bothell and the Sammamish River, and is approximately two acres in area. The property is currently undeveloped and used for parking. A portion of the property will accommodate the realignment of State Route (SR) 522, which is currently under construction through 2013. Remnant portions of the property will be redeveloped as part of the City's overall Downtown Revitalization Plan. Figure 1 shows the site vicinity; Figure 2 shows site features and the locations of previous explorations at and near the Riverside property.

Chemicals of concern (COCs) for this interim action include the HVOCs tetrachloroethene (a.k.a., perchloroethene or PCE), and associated degradation compounds trichloroethene (TCE), cis-1,2-dichloroethene (DCE), and vinyl chloride.

The Interim Action is designed to remediate COCs which are present in ground water and discharging to the Sammamish River

This QAPP describes sample collection procedures and quality assurance and control methods to ensure representative data is collected during the interim action.

2.3 TASK DESCRIPTION

Based on the results of the environmental investigations and a focused feasibility study, the recommended alternative for ground water cleanup is gradient control via pumping, and treatment via discharge to sanitary sewer.

2.4 QUALITY OBJECTIVES AND CRITERIA

2.4.1 Data Quality Objectives

DQOs were developed according to EPA's DQOs Process (EPA 2006), to provide data of known and appropriate quality. The DQO process is a seven-step planning approach to develop sampling designs for data collection activities that support decision-making. It provides a systematic procedure for defining the criteria that a data collection design should satisfy. The DQOs for the project are shown in Table 2-2.

Table 2-2
Design Characterization Sampling DQOs

DQO	Description
State the Problem	Is contaminated ground water reaching the River?
Identify the Goal of the Study	Reduce contaminant concentrations reaching the river Is the collected chemical data adequate to identify and determine if contamination still exists?
Identify Information Inputs	Analytical results (what are the detected concentrations? are they above cleanup levels? was QA/QC criteria met?). Actual sample locations (correct location and depth?).
Define the Study Boundaries	The selected locations.
Develop the Analytic Approach	Sampling and analysis strategies will be developed to support the decision making process. Analytical results will be used to determine the presence or absence of contamination. Results will be compared to site specific cleanup levels established in the interim action work plan
Specify Performance or Acceptance Criteria	The tolerable limits of uncertainty regarding the cleanup of contamination at the site will be based on exceedance or non-exceedance of cleanup levels. Tolerable limits on analytical results are determined by the Quality Assurance/Quality Control (QA/QC) criteria defined in this QAPP.
Develop the Plan to Obtain Data	Presented in this QAPP.

2.4.2 Data Quality Indicators

Data quality and usability are evaluated in terms of performance criteria. Performance and acceptance criteria are expressed in terms of data quality indicators (DQIs). The principal indicators of data quality are precision, accuracy, bias, sensitivity, completeness, comparability, and representativeness. Table 2-3 provides a description of project DQIs.

Table 2-3
General Description of DQIs

DQI	Description
Precision:	A measure of agreement among repeated measurements of the same property under identical conditions. Usually assessed as a relative percent difference (RPD) between duplicate measurements. RPD guidelines for laboratory duplicate analyses are contained in the standard operating procedures (SOPs) for each analytical method and will be obtained from the laboratory for validation purposes.
Accuracy:	A measure of the overall agreement of a measurement to a known value. Analytical accuracy is assessed as percent recovery from matrix spike or reference material measurements. Percent recovery guidelines are contained in laboratory SOPs for each analytical method.
Bias:	The systematic or persistent distortion of a measurement process that causes error in one direction. Usually assessed with reference material or matrix spike measurements. Bias as reported by the laboratory will be used to assess data validity.
Sensitivity:	The capability of a method or instrument to meet prescribed reporting limits. Assessed by comparison with risk-based reporting limits, method reporting limits, instrument reporting limits, or laboratory quantitation limits, as appropriate. In general, reporting limits for the analytical methods used will be at or below applicable criteria.
Completeness:	A measurement of the amount of valid data needed to be obtained for a task. Assessed by comparing the amount of valid results to the total results set. Project requirements for completeness are 90%.
Comparability:	A qualitative term that expresses the measure of confidence that one data set can be compared to another. Assessed by comparing sample collection and handling methods, sample preparation and analytical procedures, holding times, reporting units, and other QA protocols. To ensure comparability of data collected for the Bus Barn to previous data, standard collection and measurement techniques will be used.
Representativeness:	A qualitative term that expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variation at a sample point, or environmental condition. To ensure representativeness, the sampling design will incorporate sufficient samples so that contamination is detected, if present. Additionally, all sampling procedures detailed in this QAPP will be followed.

2.5 SPECIAL TRAINING AND CERTIFICATION

All personnel conducting sampling activities on the project site must be 40-hour Hazardous Waste Operation (HAZWOPER) trained per 29 Code of Federal Regulations (CFR) 1910.120 and be current with their annual 8-hour refresher course.

All personnel working at the project site will be briefed on potential site hazards, health and safety procedures, and sampling procedures. Following completion of this training, all personnel will be required to sign an acknowledgement form verifying that they have completed the task-specific training.

A Health and Safety Plan (HSP) will also been prepared for this site, as required by WAC 296-62-3010. The Contractor and Owner's Representative will prepare their own HSPs to be consistent with the HSP.

2.6 SAMPLING DOCUMENTATION AND RECORDS

Sampling documentation will be accomplished according to the procedures provided in Table 2-4.

Table 2-4
Sampling and Sample Handling Records

Record	Use	Responsibility/Requirements
Field Notebook	Record significant events and observations.	Maintained by field sampler/geologist; must be bound; all entries must be factual, detailed, objective; entries must be signed and dated.
Sampling Field Data Sheet	Provide a record of each sample collected (Appendix A).	Completed, dated, and signed by sampler; maintained in project file.
Sample Label	Accompanies sample; contains specific sample identification information.	Completed and attached to sample container by sampler.
Chain-of-Custody Form	Documents chain-of-custody for sample handing (Appendix A).	Documented by sample number. Original accompanies sample. A copy is retained by QA Manager.
Chain-of-Custody Seal	Seals sample shipment container (e.g., cooler) to prevent tampering or sample transference. Individual samples do not require custody seals, unless they are to be archived, before going to the lab for possible analysis at a later date.	Completed, signed, and applied by sampler at time samples are transported.
Sampling and Analysis Request	Provides a record of each sample number, date of collection/transport, sample matrix, analytical parameters for which samples are to be analyzed.	Completed by sampler at time of sampling/transport; copies distributed to laboratory project file.

2.6.1 Field Logs and Forms

A bound field notebook will be maintained to provide daily records of significant events and observations that occur during field investigations. All entries are to be made in waterproof ink, signed, and dated. Pages of the field notebook are not to be removed, destroyed, or thrown away. Corrections will be made by drawing a single line through the original entry (so that the original entry can still be read) and writing the corrected entry alongside. The correction will be initialed and dated. Most corrected errors will require a footnote explaining the correction.

If an error made on a document is assigned to one person, that individual may make corrections simply by crossing out the error and entering the correct information. The erroneous information should not be obliterated. Any error discovered on a document should be corrected by the person who made the entry.

All field logs and forms will be retained in the project files.

2.6.2 Photographs

All photographs taken of field activities will be documented with the following information noted in the field notebook:

- Date, time, and location of photograph taken
- Description of photograph taken
- Reasons photograph was taken
- Viewing direction

Digital photographs will be reviewed in the field to assess quality and need to re-shoot the photograph.

2.7 REPORTING

Following completion of the confirmation sampling and analysis, the results will be included in an interim remedial action report. Reporting will include the following:

- Summary of field activities completed.
- Figures showing sampling locations.
- Summary of laboratory analytical results and a comparison to relevant regulatory criteria.
- Field log forms and sampling forms.
- Laboratory data sheets and the results of data review/validation.
- Recommendations for further sampling, if needed.

Preliminary results will be communicated verbally as they become available.

3.0 SAMPLING PROCESS DESIGN

3.1 SAMPLING APPROACH

A site-specific sampling approach has been developed to provide performance and confirmational sampling in support of the interim action. The interim action will target the area of ground water near the Sammamish River identified during the RI (Figure 3 of the IAWP). The approach used for the interim action is pumping and treatment of ground water in this area.

A summary of the sampling approach for the interim action is provided in Table 3-1.

Table 3-1
Sampling Approach

Sample type	Sampling location	Sampling Frequency / Rationale	Analytes
Performance Monitoring			
Preliminary Point of Compliance	Extraction well 1 Extraction well 2 Extraction well 3 Extraction well 4 RMW-7	Quarterly for one year, then modify based on results and consultation with Ecology (e.g., move to semiannual if concentrations stabilize)	HVOCs Field parameters Water level Discharge (gallons)
Combined discharge	Combined discharge at sewer manhole or discharge manifold	As required by KCIWD permit	HVOCs Settleable solids pH Discharge (gallons)
Nearby wells	BC-3 RMW-4 RMW-5 RMW-6 RMW-8 RMW-9 RMW-10	Semiannual for one year, then modify based on results and consultation with Ecology, to check for water quality impacts due to pumping	HVOCs Field parameters Water level
Confirmation Monitoring			
Preliminary Point of compliance and selected nearby wells	Extraction well 1 Extraction well 2 Extraction well 3 Extraction well 4 RMW-7 RMW-6 BC-3 Note: due to the seven wells in a row at close spacings, only selected wells will be sampled after initial monitoring, based on ongoing results	Semiannual one year, rest period of one year, then one sampling event. Cease interim action if cleanup levels have been met after this sampling event. If cleanup levels have not been met, then repeat cycle - begin semiannual sampling for another year followed by one year rest period. Cease interim action one month after Ecology's concurrence that the cleanup levels have been met, or if HVOC concentrations stabilize long term.	HVOCs Field parameters Water level

The objective of the sampling is to confirm that all COCs have met cleanup levels in ground water. Cleanup levels are provided in the IAWP.

Descriptions of the specific sampling methods for the above activities are presented in Sections 3.2. In addition, all sampling will be conducted in accordance with standard operating procedures.

3.2 SAMPLING METHODS AND PROCEDURES

Descriptions of the specific sampling and laboratory methods for the project are presented in this section.

3.2.1 Ground Water Sampling Procedures

Monitoring wells will be purged before sample collection to obtain ground water samples that are representative of the formation water rather than stagnant water from the well casing. Ground water that has occupied the well casing is often under oxidizing conditions, and thus may be chemically different from true formation water.

Monitoring wells will be purged and sampled using low-flow purging methods (Barcelona et al. 1994). Sampling staff will measure ground water levels to the nearest 0.01-foot using a decontaminated electronic well probe prior to collection of samples. Prior to collection of ground water samples, the wells will be purged by pumping a small volume of water to ensure sampled water represents aquifer conditions. The volume pumped will be determined in the field based on stabilization of field parameters: specific conductance, dissolved oxygen, and pH. Wells will be purged by very slowly lowering semi-rigid polyethylene tubing to a depth corresponding to roughly the midpoint of the 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 (0.132 gallons/minute). At a minimum, two pump and tubing volumes will be purged (1/2" I.D. tubing = 0.010 gallon/lineal foot). Samples from all wells will be collected once the parameter values have stabilized over the course of three sets of measurements as follows:

specific conductance	10 uS
dissolved oxygen	2 mg/L
pH	0.1

If a well can be 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 well. New tubing will be used for each well. All purge water will be collected and discharged to the sanitary sewer.

After collection, all samples will be labeled, chilled in a cooler to 4oC, and shipped to the testing laboratory for analysis. Full chain-of-custody and field documentation procedures will be employed, as described in Section 2.6. The laboratory will analyze the water samples for the constituents listed on Table 2.

3.2.2 Sample Collection

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

- Sample bottles will be filled directly from dedicated pump tubing or sampling ports with minimal air contact.
- 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.
- 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.
- Tubing or hoses from the sampling systems must not touch or be placed in the sample bottles.
- 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.
- Sample bottles, caps, or septums that fall on the ground before filling will be discarded.

WATER LEVEL MONITORING

Samplers will measure ground water levels at each of the monitoring wells at the start of each sampling round in order to monitor changes in seasonal or long-term water elevations and ground water flow directions.

3.2.3 Sample Containers, Preservation, and Holding Times

Table 3-2 provides a summary of sample analyses and specifications for containers, preservation, and holding times. The analytical laboratory will provide the sample containers and necessary preservation.

Table 3-2
Sample Containers, Preservation, and Holding Times

Analysis	Method	Matrix	Container	Preservation	Holding Time
HVOCs	EPA 8260	Water	2 –40 mL VOA vials w/ Teflon-lined silicon septum cap	HCL to pH 2 Cool to 4°C	14 days

3.2.4 Field Screening

During excavation, periodic screening of the excavation sidewalls and will be conducted using a PID and visual/olfactory methods. Each periodic sample will be placed in a re-sealable plastic bag for headspace screening using the PID. The headspace sample will be allowed to heat in the sun for approximately 10 minutes and will then be shaken vigorously. A headspace vapor measurement will be then be collected and recorded on the field sampling form. During sampling, observations will also be made for signs of contamination such as odors, staining, or sheen on saturated samples from below the water table. Such observations will also be recorded on the field sampling form. Field screening information will be used to aid in the determination of the excavation limits.

3.2.5 Decontamination Procedures

Decontamination of all non-disposable tools and equipment will be conducted prior to each sampling event and between each sampling location in accordance with the standard operating procedures. The following steps will be taken during decontamination of sampling equipment used during field investigations:

- Scrub with non-phosphate detergent (i.e., Alconox or similar)
- Rinse with tap water
- Rinse thoroughly with deionized water
- Allow to air dry and place in a new plastic bag for storage

For decontamination of larger tools and equipment, such as push-probe rods, a high-pressure, hot water washer or similar device will be used. Loose soil materials will be removed from equipment using a “dry” decontamination technique consisting of the removal of loose soil using a shovel or brush.

3.2.6 Investigation-Derived Waste

Soil - Soil cuttings from the extraction wells will be containerized onsite in 55-gallon drums and staged onsite. Two composite samples of drummed soil will be collected for waste characterization. Disposal options for the soil IDW will be based on the analytical results of the samples. Disposal shall be managed by the Owner's representative using a licensed waste disposal contractor.

Water - Drilling decontamination water will be containerized onsite in 55-gallon drums and staged onsite. Once the treatment system is operations, it will be discharged to the sanitary sewer under permit. Sampling purge water will also be discharged to the sanitary sewer.

Drums - All drums will be labeled indicating date filled, content, location, company, and a unique identification number. All drums and containers will be tracked on a waste-tracking log.

Solid waste - All disposable sampling materials and personal protective equipment, such as disposable coveralls, gloves, and paper towels used in sample processing will be placed inside polyethylene bags or other appropriate containers. Disposable materials will be placed in a normal refuse container and disposed of as normal solid waste in accordance with standard operating procedures for IDW.

3.3 SAMPLE HANDLING AND CUSTODY

The following sections describe sample handling and custody procedures.

3.3.1 Sample Identification and Labeling

Prior to the field investigation, each sample location will be assigned a unique code. Each sample collected at that location will be pre-assigned an identification code using the sampling site followed by other specific information describing the sample. The sample numbering protocol is shown in Table 3-3.

Table 3-3
Sample Numbering Protocol

Sample designations	R = Riverside Site MW= Monitoring well EX = Extraction well DISCH = Total discharge DUP= blind duplicate sample TB = trip blank
Examples	RMW-7-030513: Monitoring well MW-7, collected on 05/09/2013 REXW-2-030513: Extraction well 2, collected on 05/09/2013 RDISCH-030513: Total system discharge sample collected on 05/09/2013 Dupe 1-030513: Blind duplicate collected on 05/09/2013

3.3.2 Sample Storage, Packaging, and Transportation

Samples will be placed in a cooler following collection and chilled to approximately 4ºC. Following completion of each days sampling, all samples will be transported and/or shipped to the analytical laboratory, as appropriate. Samples which are routinely delivered to the laboratory on the same day as collection may not have sufficient time to chill to 4ºC.

3.3.3 Sample Custody

The chain-of-custody procedures used for this project provide an accurate written or computerized record that can be used to trace the possession of each sample from the time each is collected until the completion of all required analyses. A sample is in custody if it is in any of the following places:

- In someone's physical possession
- In someone's view
- In a secured container
- In a designated secure area

The following information will be provided on the chain-of-custody form:

- Sample identification numbers
- Matrix type for each sample
- Analytical methods to be performed for each sample

- Number of containers for each sample
- Sampling date and time for each sample
- Names of all sampling personnel
- Signature and dates indicating the transfer of sample custody

All samples will be maintained in custody until formally transferred to the laboratory under a written chain-of-custody. Samples will be kept in sight of the sampling crew or in a secure, locked vehicle at all times. Samples that leave the custody of field personnel will be sealed by placing a signed and dated Custody Seal across the seam of the shipping container.

3.4 ANALYTICAL METHODS

All samples will be submitted to a commercial analytical laboratory certified by Ecology to perform the required analyses. Analytical methods are listed in Table 3-4. Laboratory reporting limits will be verified prior to analyses to ensure that, at a minimum, reporting limits for each analyte are equal to or lower than MTCA Method A cleanup levels for soil and ground water. Matrix interferences may make it impossible to achieve the desired reporting limits and associated quality control (QC) criteria. In such instances, the laboratory shall report the reason for noncompliance with QC criteria or elevated detection limits.

3.5 QUALITY ASSURANCE/QUALITY CONTROL

Quality assurance (QA)/QC checks consist of measurements performed in the field and laboratory. The analytical methods referenced in Section 3.4 specify routine methods required to evaluate data precision and accuracy, and determine whether the data are within acceptable limits.

3.5.1 Field Methods

Guidelines for minimum samples for field QA/QC sampling are summarized in Table 3-4.

Table 3-4
Guidelines for Minimum QA/QC Samples for Field Sampling

Media	Field Duplicate	Trip Blank	Equipment Blank
Water	1 per batch (Max 20 samples)	1 per cooler containing water VOCs	None – no reusable equipment

Field Duplicates

A minimum of one blind field duplicate will be analyzed per 20 samples. Field duplicates will be collected following field samples. Duplicate samples will be coded so the laboratory cannot discern which samples are field duplicates.

Trip Blanks

A trip blank shall accompany each cooler containing ground water samples for HVOC analysis. The trip blank shall be obtained from the laboratory or will be made by filling the appropriate sample containers with certified analyte-free deionized water. Trip blanks will be analyzed for HVOCs with the field samples.

3.5.2 Equipment/Rinsate Blanks

No equipment blanks will be collected because no non-disposable sampling equipment will be used.

3.5.3 Laboratory Methods and Quality Control

Specific procedures and frequencies for laboratory QA procedures and QC analyses are detailed in the laboratory's QA Plan and SOPs for each method. QC analyses will be performed by the laboratory according to their Ecology-approved SOPs.

Accuracy and precision are determined through QC parameters such as surrogate recoveries, matrix spikes, QC check samples, and blind field duplicates. A blind field duplicate sample will be analyzed as a QC sample for verification of precision and accuracy. If results of the blind field duplicate are outside the control limits, corrective action and/or data qualification will be determined after review by the Data QA Manager or his/her designee. Blind field duplication can be of poor quality because of sample heterogeneity. Therefore, the Data QA Manager will determine corrective action. QC sample requirements are listed in Table 3-2.

All analyses performed for this project must reference QC results to enable reviewers to validate (or determine the quality of) the data. Sample analysis data, when reported by the laboratory, will include QC results. All data will be checked for internal consistency, transmittal errors, laboratory protocols, and for complete adherence to the QC elements.

3.5.4 Laboratory Instruments

All instruments and equipment used during analysis will be operated, calibrated, and maintained according to manufacturer's guidelines and recommendations, and in accordance with procedures in the analytical method cited, as documented in the laboratory QA plan. Properly trained personnel will operate, calibrate, and maintain laboratory instruments. Calibration blanks and check standards will be analyzed daily for each parameter to verify instrument performance and calibration before beginning sample analysis.

Where applicable, all calibration procedures will meet or exceed regulatory guidelines. The Data QA Manager must approve any variations from these procedures before beginning sample analysis.

After the instruments are calibrated and standardized within acceptable limits, precision and accuracy will be evaluated by analyzing a QC check sample for each analysis performed that day. Acceptable performance of the QC check sample verifies the instrument performance on a daily basis. Analysis of a QC check standard is also required. QC check samples containing all analytes of interest will be either purchased commercially or prepared from pure standard materials independently from calibration standards. The QC check samples will be analyzed and evaluated according to the EPA method criteria.

Instrument performance check standards and calibration blank results will be recorded in a laboratory instrument logbook that will also contain evaluation parameters, benchmark criteria, and maintenance information. If the instrument logbook does not provide maintenance information, a separate maintenance logbook will be maintained for the instrument.

3.6 FIELD INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

The types of field instruments and equipment that are anticipated to be used during sampling include, but are not limited to:

- PIDs
- Personal air monitors, as needed
- GPS

Equipment maintenance will be performed according to manufacturers' specifications. The frequency of inspection, testing, and maintenance will be established, based on operation procedures and manufacturers' specifications. Field personnel will be responsible for inspection, testing, and maintenance of field equipment. A hard copy of procedures and manufacturer's specifications will be provided to all field personnel working with the equipment. All equipment will be inspected and tested prior to use.

The results of inspection and testing, as well as any problems encountered and corrective actions, will be documented in the activity field notebook. The equipment serial number and date of activity will be included in notebooks so that a complete record is maintained. If problems are encountered, they will be reported to the Manager. .

3.7 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Field supplies such as sample containers and trip/rinsate blank water shall be obtained from reputable suppliers and shall be certified analyte-free. Records of certification shall be kept by the laboratory (for laboratory-supplied supplies) or by the Owner's Representative in the project file. Sampling spoons and bowls shall be food-grade and shall be purchased new.

3.8 NON-DIRECT MEASUREMENTS

The need for non-direct measurements is not anticipated for the Site Investigation. However, if the need does arise during task execution, the previously collected data will be evaluated to assess consistency with project DQOs and DQIs. Data from non-direct sources will be evaluated by the Data QA Manager prior to the data being used in analyses or in data reports.

3.9 DATA MANAGEMENT

The objectives of data management are to assure that large volumes of information and data are technically complete, accessible, and efficiently handled.

3.9.1 Field Data

The original hard (paper) copies of all field notes and laboratory reports will be stored in the project file. Photocopies of these documents should be prepared for working copies as needed.

Field data should be recorded in bound notebooks or individual sampling sheets. The field team members should review the field data for completeness prior to placing it in the files.

3.9.2 Laboratory Data

The laboratory data reports will be archived in the project files. The electronic data will be incorporated into Excel spreadsheets and archived on electronic media and placed in the project file.

4.0 ASSESSMENT AND OVERSIGHT

This section describes activities to be conducted to assess the effectiveness of project implementation and associated QA/QC activities. The purpose of the assessment is to ensure the QAPP is properly implemented.

4.1 ASSESSMENTS AND RESPONSE ACTIONS

A performance and system audit may be conducted at any time. Audits will consist of direct observation of work being performed and inspection of field and laboratory equipment. The performance and system audits will also review the sample custody procedures in the field and laboratory.

If implemented, internal audits of both the field and laboratory activities will be conducted by the Data QA Manager. Audits will be unannounced to assure a true representation of the technical and QA procedures employed.

Checklists for both field and laboratory audits will be based on National Enforcement Investigation Center (EPA 1984) Audit Checklists. The audits will be performed by persons having no direct responsibilities for the activities being performed.

The auditor or designee will prepare an audit report that includes findings, non-conformances, observations, and recommended corrective action, and a schedule for completion of such action.

For each identified nonconformance, a corrective action report will be issued as part of the audit report to notify the individual responsible for implementing the recommended corrective action and its schedule for completion. If a field corrective action is required, the Manager will be notified. If a laboratory corrective action is required, the Data QA Manager will be notified.

The audit will be distributed to the Manager.

Corrective actions may be needed for two categories of nonconformance:

- Deviations from the methods or QA requirements established in the QAPP.
- Equipment or analytical malfunctions.

During field operations and sampling procedures, the Field Sampler will be responsible for taking and reporting required corrective action. A description of any such action taken will be entered in the field notebook. If field conditions are such that conformance with the QAPP is not possible, the Manager will be consulted immediately. Any corrective action or field condition resulting in a major revision of the QAPP will be communicated to the Manager for review and concurrence.

During laboratory analysis, the Laboratory QA Manager will be responsible for taking required corrective actions in response to equipment malfunctions. If an analysis does not meet data quality goals outlined in the QAPP, corrective action will follow the guidelines in SW-846 (EPA 1986). If analytical conditions do not conform to this QAPP, the Data QA Manager will be notified as soon as possible so that additional corrective actions can be taken.

Corrective Action Reports will document response to any reported non-conformances. These reports may be generated from internal or external audits or from informal reviews of project activities. Corrective Action Reports will be reviewed for appropriateness of recommendations and actions by the Data QA Manager for QA matters, and the Task Manager for matters of technical approach.

4.2 REPORTS TO MANAGEMENT

The Data QA Manager will be responsible for data quality assessments and associated QA Reports. All reports will be submitted to the Manager for review. Final task or investigative reports will contain a separate QA section summarizing data quality information.

5.0 DATA VERIFICATION AND VALIDATION

Data verification is confirmation by examination and provision of objective evidence that specified requirements have been fulfilled. Validation is confirmation by examination and provision of objective evidence that the particular requirement for a specific intended use have been fulfilled. Techniques for data verification and validation will be in accordance with the Guidance on Environmental Data Validation and Verification (EPA 2001b).

5.1 DATA REVIEW, VERIFICATION AND VALIDATION

All data packages provided by the laboratory must provide a summary of quality control results adequate to enable reviewers to validate or determine the quality of the data. The Data QA Manager is responsible for conducting checks for internal consistency, transmittal errors, and for adherence to the quality control elements specified in the QAPP.

Field measurements (pH, specific conductance, temperature) will be verified and checked through review of instrument calibration, measurement, and recording procedures.

A verification level validation will be performed on all field documentation and analytical data reports. The data validation process will be used to verify the data quality. The following QC elements will be reviewed, as appropriate:

- Trip blank and rinsate blank results.
- Analytical holding times.
- Preparation blank contamination.
- Check standard precision.
- Analytical accuracy (blank and matrix spike recoveries and laboratory control sample recoveries).
- Analytical precision (comparison of replicate sample results, expressed as relative percent difference [RPD]).
- Each data package will be assessed to determine whether the required documentation is of known and verifiable quality. This includes the following items:
  - Field chain-of-custody record is present, complete and signed.
  - Certified analytical report.
  - QA/QC sample results.

Data will be qualified using guidance provided in the Contract Laboratory Program (CLP) functional guidelines for assessing data (EPA 1994a, 1994b).

The Data QA Manager will prepare a quality assurance memorandum for each site describing the results of the data validation and describing any qualifiers that are added to the data.

5.2 VERIFICATION AND VALIDATION METHODS

The Data QA Manager will review the following:

- Chain-of-custody documentation
- Holding times
- Equipment/trip blank results
- Field Duplicate results
- Method blank results

A limited review (minimum 10 percent) of the following laboratory QC data results will be conducted:

- Laboratory matrix spike/matrix spike duplicate (MS/MSD) and/or matrix duplicate results
- Laboratory surrogate recoveries
- Laboratory check samples

If, based on this limited review the QC data results indicate potential data quality problems, further evaluations will be conducted.

5.2.1 Precision

Precision measures the mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. QA/QC sample types that measure precision include field duplicates, MSD, and matrix duplicates. The estimate of precision of duplicate measurements is expressed as a RPD (Relative Percent Difference), which is calculated:

$$RPD = \frac{D_1 - D_2}{(D_1 + D_2) \div 2} \; x \; 100$$

Where D1 = First sample value
D2 = Second sample value.

The RPDs will be routinely calculated and compared with DQOs.

5.2.2 Accuracy

Accuracy is assessed using the results of standard reference material, linear check samples, and MS analyses. It is normally expressed as a percent recovery, which is calculated:

$$\text{Percent Recovery} = \frac{(\text{Total Analyte Found - Analyte Originally Present}) \times 100}{\text{Analyte Added}}$$

The percent recovery will be routinely calculated and checked against DQOs.

5.2.3 Bias

Bias is the systematic or persistent distortion of a measurement process that causes errors in one direction. Bias will be assessed with field duplicate and laboratory matrix spike samples, similar to that described for accuracy. Bias measurements are usually carried out with a minimum frequency of 1 in 20, or one per batch of samples analyzed, under the same sampling episode.

5.2.4 Sensitivity

Sensitivity expresses the capability of a method or instrument for meeting prescribed measurement reporting limits. Sensitivity will be assessed by comparing data reporting limits with applicable cleanup criteria and analytical or instrument method reporting limits.

5.2.5 Completeness

The amount of valid data produced will be compared with the total analyses performed to assess the percent of completeness. Completeness will be routinely calculated and compared with the DQOs.

5.2.6 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. Sample data will be comparable with other measurement data for similar samples and sample conditions. Comparability of the data will be maintained by using consistent methods and units.

5.2.7 Representativeness

Sample locations and sampling procedures will have been chosen to maximize representativeness. A qualitative assessment (based on professional experience and judgment) will be made of sample data representativeness based on review of sampling records and QA audit of field activities.

5.3 Reconciliation and User Requirements

The Data QA Manager will prepare a technical memorandum for each data package describing the results of the data review and describing any qualifiers that were added to the data. The technical memorandum will also summarize the laboratory's QC criteria and will include recommendations on whether additional actions such as re-sampling are necessary. Technical memoranda will be submitted with the final report.

5.4 DATA REPORTING

All laboratory data packages will contain the following information:

- Cover letter
- Chain-of-custody forms
- Summary of sample results
- Summary of QC results
- Ecology Environmental Information Management (EIM) electronic data deliverable (EDD)

The minimum information to be presented for each sample for each parameter or parameters group:

Client sample number and laboratory sample number

- Sample matrix
- Date of analysis
- Dilution factors (as reflected by practical quantitation limits (PQL)
- Analytical method
- Detection/quantitation limits
- Definitions of any data qualifiers used

Additionally, sample weights/volumes used in sample preparation/analysis and identification of analytical instrument will not be reported but will be kept in laboratory records for future reference.

The minimum QC summary information to be presented for each sample for each parameters or parameter group will include:

- Surrogate standard recovery results
- Matrix QC results (matrix spike/matrix spike duplicate, duplicate)
- Method blank results

EIM EDDs will be in accordance with the most recent version of the results spreadsheet submittal capable of being quickly uploaded into the Ecology EIM database.

6.0 REFERENCES

Ecology. 1995. Guidance for Remediation of Petroleum Contaminated Soils. November 1995.

Ecology. 2007. Model Toxics Control Act Cleanup Regulations. Washington Administrative Code (WAC) 173-340. November 2007.

EPA. 1983. Methods for chemical analysis of water and wastes.

EPA. 1984. NEIC procedures manual for the evidence audit of enforcement investigations by contractor evidence audit teams. Technical Report EPA-330/9-81-003-R. U.S. Environmental Protection Agency, Washington, D.C.

EPA. 1986. Test methods for evaluating solid waste, 3rd edition. U.S. Environmental Protection Agency, Washington, D.C. November 1986, as updated.

EPA. 1994a. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. Office of Emergency and Remedial Response. USEPA, Washington, D.C.

EPA. 1994b. USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review. Office of Emergency and Remedial Response. USEPA, Washington, D.C.

EPA. 2001a. EPA Requirements for Quality Assurance Project Plans. EPA QA/R-5, EPA/240/B-01/003, March 2001.

EPA. 2001b. Guidance on Environmental Data Validation and Verification. EPA QA/G-8.

EPA. 2002. Guidance for Quality Assurance Project Plans. EPA QA/G-5. EPA/240/R-02/009, December 2002.

EPA. 2004. Contract Laboratory Program (CLP) Guidance for Field Samplers. Appendix B. EPA/540/R-00003. August 2004.

EPA. 2006. Guidance on Systematic Planning Using the Data Quality Objectives Process. EPA QA/G-4. February 2006.

HWA, 2008a Phase I Site Assessment, Hertz Rentals Property, Bothell, WA.. Prepared by HWA Geosciences, Inc. October 8, 2008

HWA, 2008b. Phase II Site Assessment, Hertz Rentals Property, Bothell, WA.. Prepared by HWA Geosciences, Inc. October 10, 2008

APPENDIX A

OF QUALITY ASSURANCE PROJECT PLAN

Chain of Custody Form

Field Sampling Data Sheet

HWA GEOSCIENCES INC.

21312 30th Drive SE, Suite 110, Bothell, Washington 98021-7010
Tel 425.774.0106 Fax 425.774.2714 www.hwageo.com

Chain of Custody and Laboratory Anaylsis Request

DATE: ______

PAGE: ___ of ___

PROJECT NAME: ______ #: ______
SAMPLERS NAME: ______ PHONE: ______
SAMPLERS SIGNATURE: ______ DATE: ______
HWA CONTACT: ______ PHONE: ______

TURNAROUND TIME
☐ DAYS
☐ STANDARD

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

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

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

HWA GEOSCIENCES INC.
21312 30th Drive SE, Suite 110, Bothell, WA 98021
Tel: 425-774-0106 / Fax: 425-774-2714

FIELD SAMPLING DATA SHEET

Project Name: ______________________________ Well Number: ______________________________

Project Number: ______________________________ Sample Number: ______________________________

Project Location: ______________________________ Weather: ______________________________

Client/Contact: ______________________________ 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 Volume	pH	Conductivity	Temperature	Dissolved Oxygen		

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:______________________________